ENCYCLOPEDIA OF FATS & OILS By Tarek. I. Kakhia

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Açaí Oil

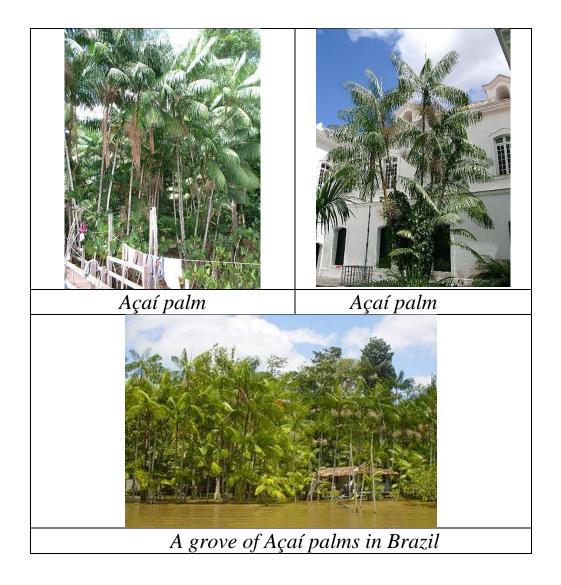


Açaí oil is obtained from the fruit of *Euterpe oleracea* (açaí palm), which grows in the Amazon rainforest. The oil is rich in phenolic compounds similar in profile to the pulp itself, such as vanillic acid, syringic acid, p-hydroxybenzoic acid, protocatechuic acid and ferulic acid as well as (+)-catechin and numerous procyanidin oligomers.

Açai oil is green in color and has a bland aroma. It is high in oleic acid (omega-9) and palmitic acid (table).

Fatty acid	Percentage %
Palmitic	22.0
Stearic	2.0
Arachidic	2.5
Palmitoleic	2.0
Oleic	60.0
Linoleic	12.0

Açaí Palm



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1 - Introduction

The açaí palm is a species of palm tree in the genus *Euterpe* cultivated for their fruit and superior hearts of palm. Its name comes from the Portuguese adaptation of the Tupian word *ïwaca'i*, '[fruit that] cries or expels water'. Global demand for the fruit has expanded rapidly in recent years, and açaí is now cultivated for that purpose primarily. *Euterpe edulis* (juçara) is a closely related species which is now the primary source of hearts of palm.

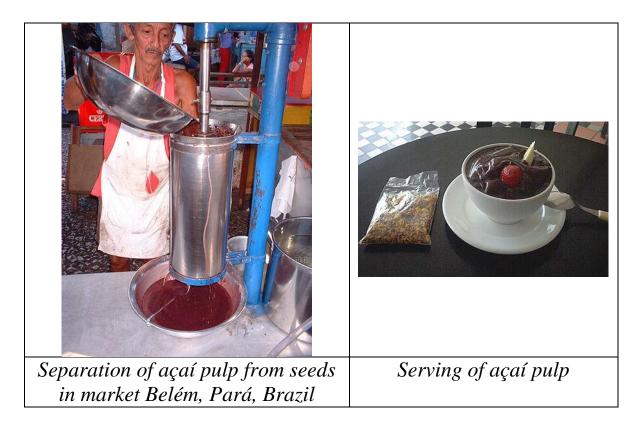
Eight species are native to Central and South America, from Belize southward to Brazil and Peru, growing mainly in swamps and floodplains. Açaí palms are tall, slender palms growing up wards of 25+ meters , with pinnate leaves up to 3 meters long.

Scientific	classification
Kingdom :	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
(unranked):	Commelinids
Order:	Arecales
Family:	Arecaceae
Genus:	Euterpe
Species:	E. oleracea
Binom	nial name
<i>Euterpe</i> Mart.	oleracea

2 - Harvesting and uses

2 – 1 – Fruit

The fruit, commonly known as açaí berry, is a small, round, black - purple drupe about 25 mm in circumference, similar in appearance to a grape, but smaller and with less pulp and produced in branched panicles of 500 to 900 fruits. The exocarp of the ripe fruits is a deep purple color, or green, depending on the kind of açaí and its maturity. The mesocarp is pulpy and thin, with a consistent thickness of 1 mm or less. It surrounds the voluminous and hard endocarp, which contains a single large seed about 0.25 - 0.40 inches (7 - 10 mm) in diameter. The seed makes up about 80 % of the fruit . Two crops of fruit are produced each year. The fruits can be harvested and consumed.



In a study of three traditional Caboclo populations in the Brazilian Amazon, açaí palm was described as the most important plant species because the fruit makes up a major component of their diet, up to 42 % of the total food intake by weight.

In 2005, an article published by Greenpeace International stated that "the tasty dark violet wine of açaí is the most important non-wood forest product in terms of money from the river delta of the Amazon."^[6] A 2008 Los Angeles Times article noted that while acai has been acclaimed by some sources as a renewable resource that can provide a sustainable livelihood for subsistence harvesters without damaging the Amazon Rainforest, conservationists worry that acai could succumb to the destructive agribusiness model of clear-cut lands, sprawling plantations, and liberal application of pesticides and fertilizer . In May 2009, Bloomberg reported that the expanding

popularity of açaí in the United States was "depriving Brazilian jungle dwellers of a protein-rich nutrient they've relied on for generations."^[8] Although most açaí is grown conventionally, the US company Sambazon established USDA Organic certification for their açai palm plantations in 2003 and has also implemented fair trade certification,

2-2-Cultivars

Few named cultivars exist, and varieties differ mostly in the nature of the fruit :

'Branco' is a rare variety local to the Amazon estuary in which the berries do not change color but remain green when ripe. This is believed to be due to a recessive gene since of 'Branco' palm seeds only about 30 % mature to express this trait. It has less iron and fewer antioxidants but more oil, and many believe it to have a superior taste and digestibility to purple açaí.

'BRS - Para Dwarf' was developed by the Brazilian Agricultural Research Agency. It grows to at most 5-7 meters tall, fruits sooner (3 years from seed), and produces a larger seed yielding 25% more fruit pulp than wild açaí.

2-3 - Other uses

Apart from the use of its fruit as food or beverage, the açaí palm has other commercial uses. Leaves may be made into hats, mats, baskets, brooms and roof thatch for homes, and trunk wood, resistant to pests, for building construction. Tree trunks may be processed to yield minerals. The palm heart is widely exploited as a delicacy,

Comprising 80 % of the fruit mass, açaí seeds may be ground for livestock food or as a component of organic soil for plants. Planted seeds are used for new palm tree stock, which, under the right growing conditions, can require months to form seedlings . The seeds are a source of polyunsaturated and saturated fatty acids

3 - Nutritional content

A powdered preparation of freeze - dried açaí fruit pulp and skin was reported to contain (per 100 g of dry powder) 533.9 calories,

52.2 g carbohydrates, 8.1 g protein, and 32.5 g total fat. The carbohydrate portion included 44.2 g of dietary fiber and low sugar value (pulp is not sweet) . The powder was also shown to contain (per 100 g): negligible vitamin C, 260 mg calcium, 4.4 mg iron, and 1002 U vitamin A, as well as aspartic acid and glutamic acid; the amino acid content was 7.59% of total dry weight (versus 8.1% protein).

The fat content of açaí consists of oleic acid (56.2% of total fats), palmitic acid (24.1%), and linoleic acid (12.5%). Açaí also contains beta- sitosterol (78 - 91% of total sterols). The oil compartments in açaí fruit contain polyphenols such as procyanidin oligomers and vanillic acid, syringic acid, p- hydroxy benzoic acid, protocatechuic acid, and ferulic acid, which were shown to degrade substantially during storage or exposure to heat.

3-1 - Food product

In the general consumer market, açaí is sold as frozen pulp, juice, or an ingredient in various products from beverages, including grain alcohol, smoothies, foods, cosmetics and supplements. In Brazil, it is commonly eaten as Açaí na tigela.

3 – 2 - Dietary supplement

In 2004, it became popular to consume açaí as a supplement due in part to the rapid success of multi - level marketing company MonaVie that sells an açaí blend tonic for \$ 40 a bottle. Another reason is the proliferation of various açaí supplement companies that misused celebrity names like Oprah Winfrey and Rachael Ray to promote açaí weight loss pills online.

Marketers of these products make unfounded claims that açaí and its antioxidant qualities provide a variety of health benefits, none of which has scientific confirmation to date. False claims include reversal of diabetes and other chronic illnesses, as well as expanding size of the penis and increasing men's sexual virility . As of April 2012, there are no scientifically controlled studies providing proof of any health benefits from consuming açaí . No açaí products have been evaluated by the FDA, and their efficacy is doubtful . Specifically, there is no scientific evidence that açaí consumption affects body weight, promotes weight loss or has any positive health effect.

According to the Washington, D.C. based Center for Science in the Public Interest (CSPI) thousands of consumers have had trouble stopping recurrent charges on their credit cards when they cancel free trials of açai-based products . Even some web sites purporting to warn about açai-related scams are themselves perpetrating scams .

In late 2008, lawyers for *The Oprah Winfrey Show* began investigating statements from supplement manufacturers who alleged that frequent *Oprah* guest Dr. Mehmet Oz had recommended their product or açai in general for weight loss.

One laboratory study found that commercially available açaí powder added to the diet of fruit flies lengthened their lives when challenged by chemical or genetic oxidative stress. Dietary açaí also restored the flies' circadian rhythm disturbed by the herbicide paraquat.

3 – 3 - Polyphenols and antioxidant activity in vitro

A comparative analysis from *in vitro* studies reported that açaí has intermediate polyphenol content and antioxidant potency among 11 varieties of frozen juice pulps, scoring lower than acerola, mango, strawberry, and grapes.

A powdered preparation of freeze - dried açaí fruit pulp and skin was shown to contain cyanidin 3 - O - glucoside and cyanidin 3-Orutinoside as major anthocyanins ; (3.19 mg / g) however, anthocyanins accounted for only about 10 % of the overall antioxidant capacity in vitro. The powdered preparation was also reported to contain twelve flavonoid-like compounds, including homoorientin, orientin, taxifolin deoxy hexose, isovitexin, scoparin, as well as proantho cyanidins (12.89 mg/g), and low levels of resveratrol (1.1 µg/g). A study on another different freeze-dried açaí product (Opti-Acai) reported that the formulation contained much lower levels of anthocyanins, proanthocyanadins, and other polyphenol compounds as compared with blueberries and other antioxidant - rich fruits. In an in vitro study of different açaí varieties for their antioxidant capacity, a white one displayed no antioxidant activity against different oxygen radicals, whereas the purple variety most often used commercially had antioxidant activity against peroxyl radicals and to a lesser extent peroxynitrite but little activity against hydroxyl radicals.

Freeze-dried açaí powder was found to have antioxidant activity in vitro against superoxide and peroxyl radicals, and mild activity for peroxynitrite and hydroxyl radicals. The powder was reported to inhibit hydrogen peroxide - induced oxidation in neutrophils, and to have a slight stimulatory effect on the reactive radical, nitric oxide.

Extracts of açaí seeds were reported to have antioxidant capacity in vitro against peroxyl radicals, similar to the antioxidant capacity of the pulp, with higher antioxidant capacity against peroxynitrite and hydroxyl radicals.

The anthocyanins of fruit likely have relevance to antioxidant capacity only in the plant's natural defensive mechanisms and in vitro . The Linus Pauling Institute and European Food Safety Authority state that dietary anthocyanins and other flavonoids have little or no direct antioxidant food value following digestion . Unlike controlled test tube conditions, the fate of anthocyanins in vivo shows they are poorly conserved (less than 5 %), with most of what is absorbed existing as chemically modified metabolites destined for rapid excretion.

When the entire scientific literature to date and putative health claims of açaí are assessed, experts concluded in 2011 that the fruit is more a phenomenon of Internet marketing than of scientific substance.

3 – 4 - Juice blend studies

Various studies have been conducted that analyze the antioxidant capacity of açaí juice blends to pure fruit juices or fruit pulp. Açaí juice blends contain an undisclosed percentage of açaí.

When three commercially available juice mixes containing unspecified percentages of açaí juice were compared for in vitro antioxidant capacity against red wine, tea, six types of pure fruit juice, and pomegranate juice, the average antioxidant capacity was ranked lower than that of pomegranate juice, Concord grape juice, blueberry juice, and red wine. The average was roughly equivalent to that of black cherry or cranberry juice, and was higher than that of orange juice, apple juice, and tea.

The medical watchdog website Quack watch noted that "açaí juice has only middling levels of antioxidants — less than that of Concord grape, blueberry, and black cherry juices, but more than cranberry, orange, and apple juices." The extent to which polyphenols as dietary antioxidants may promote health is unknown, as no credible evidence indicates any antioxidant role for polyphenols in vivo.

3 – 5 - Other uses

Orally administered açaí has been tested as a contrast agent for magnetic resonance imaging of the gastrointestinal system . Its anthocyanins have also been characterized for stability as a natural food coloring agent .

Acid Value

In chemistry, acid value (or "neutralization number" or "acid number" or "acidity") is the mass of potassium hydroxide (KOH) in milligrams that is required to neutralize one gram of chemical substance. The acid number is a measure of the amount of carboxylic acid groups in a chemical compound, such as a fatty acid, or in a mixture of compounds. In a typical procedure, a known amount of sample dissolved in organic solvent (often isopropanol), is titrated with a solution of potassium hydroxide with known concentration and with phenolphthalein as a color indicator.

The acid number is used to quantify the amount of acid present, for example in a sample of biodiesel. It is the quantity of base, expressed in milligrams of potassium hydroxide, that is required to neutralize the acidic constituents in 1 g of sample.

$$AN = (V_{eq} - b_{eq})N\frac{56.1}{W_{oil}}$$

 V_{eq} is the volume of titrant (ml) consumed by the crude oil sample and 1 ml of spiking solution at the equivalent point, b_{eq} is the volume of titrant (ml) consumed by 1 ml of spiking solution at the equivalent point, and 56.1 is the molecular weight of KOH. W_{Oil} is the mass of the sample in grams.

The molar concentration of titrant (N) is calculated as such:

$$N = \frac{1000W_{KHP}}{204.23V_{eq}}$$

In which W_{KHP} is the mass (g) of KHP in 50 ml of KHP standard solution, V_{eq} is the volume of titrant (ml) consumed by 50 ml KHP standard solution at the equivalent point, and 204.23 is the molecular weight of KHP.

There are standard methods for determining the acid number, such as ASTM D 974 and DIN 51558 (for mineral oils, biodiesel), or specifically for Biodiesel using the European Standard EN 14104 and ASTM D664 are both widely utilized world wide. Acid number (mg KOH / g oil) for biodiesel should to be lower than 0.50 mg KOH / g in both EN 14214 and ASTM D6751 standard fuels. This is since the FFA produced may corrode automotive parts and these limits protect vehicle engines and fuel tanks.

As oil - fats rancidify, triglycerides are converted into fatty acids and glycerol, causing an increase in acid number. A similar observation is observed with biodiesel aging through analogous oxidation processes and when subjected to prolonged high temperatures (ester thermolysis) or through exposure to acids or bases (acid/base ester hydrolysis).

Almond



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1 - Introduction

The almond (*Prunus amygdalus*, syn.*Prunus dulcis*, *Amygdalus communis*, *Amygdalus dulcis*), is a species of tree native to the Middle East and South Asia. "Almond" is also the name of the edible and

widely cultivated seed of this tree. Within the genus *Prunus*, it is classified with the peach in the subgenus *Amygdalus*, distinguished from the other subgenera by the corrugated shell (endocarp) surrounding the seed.

The fruit of the almond is a drupe, consisting of an outer hull and a hard shell with the seed (which is not a true nut) inside. Shelling almonds refers to removing the shell to reveal the seed. Almonds are sold shelled (i.e., after the shells are removed), or unshelled (i.e., with the shells still attached). Blanched almonds are shelled almonds that have been treated with hot water to soften the seedcoat, which is then removed to reveal the white embryo.

Scientific c	lassification
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Rosales
Family:	Rosaceae
Genus:	Prunus
Subgenus:	Amygdalus
Species:	P. amygdalus
Binomial nan	ne
<i>Prunus</i> Batsch	amygdalus

2 – Description

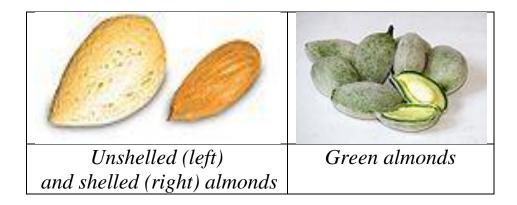
2 – 1 - Tree

The almond is a deciduous tree, growing 4 - 10 meters in height, with a trunk of up to 30 centimeters in diameter. The young twigs are green at first, becoming purplish where exposed to sunlight,

then grey in their second year. The leaves are 3-5 inches long,^[1] with a serrated margin and a 2.5 cm petiole. The flowers are white to pale pink, 3-5 cm diameter with five petals, produced singly or in pairs and appearing before the leaves in early spring.

Almonds begin bearing an economic crop in the third year after planting. Trees reach full bearing five to six years after planting. The fruit matures in the autumn, 7 - 8 months after flowering.

2 - 2 –Nut



The almond fruit measures 3.5 - 6 cm long. In botanical terms it is not a nut, but a drupe. The outer covering or exocarp, fleshy in other members of *Prunus* such as the plum and cherry, is instead a thick leathery grey-green coat (with a downy exterior), called the hull. Inside the hull is a reticulated hard woody shell (like the outside of a peach pit) called the endocarp. Inside the shell is the edible seed, commonly called a nut. Generally, one seed is present, but occasionally there are two.

3 - Origin and history

The almond is native to the Mediterranean climate region of the Middle East, eastward as far as the Indus.^[5] It was spread by humans in ancient times along the shores of the Mediterranean into northern Africa and southern Europe and more recently transported to other parts of the world, notably California, United States.

The wild form of domesticated almond grows in parts of the Levant; almonds must first have been taken into cultivation in this

region. The fruit of the wild forms contains the glycosideamygdalin, "which becomes transformed into deadly prussic acid (hydrogen cyanide) after crushing, chewing, or any other injury to the seed."

Almond is considered to be one of the earliest domesticated tree nuts. Wild almonds are bitter, the kernel produces deadly cyanide upon mechanical handling, and eating even a few dozen at one sitting can be fatal. Selection of the sweet type, from the many bitter types in wild, marked the beginning of almond domestication. How humans selected the sweet type remains a mystery. It is unclear as to which wild ancestor of the almond created the domesticated species. Ladizinsky suggests the taxon *Amygdalus fenzliana* (Fritsch) Lipsky is the most likely wild ancestor of the almond in part because it is native of Armenia and western Azerbaijan where it was apparently domesticated.

While wild almond species are toxic, domesticated almonds are not; Jared Diamond argues that a common genetic mutation causes an absence of glycoside amygdalin, and this mutant was grown by early farmers, "at first unintentionally in the garbage heaps, and later intentionally in their orchards". Zohary and Hopf believe that almonds were one of the earliest domesticated fruit trees due to "the ability of the grower to raise attractive almonds from seed. Thus, in spite of the fact that this plant does not lend itself to propagation from suckers or from cuttings, it could have been domesticated even before the introduction of grafting". Domesticated almonds appear in the Early Bronze Age (3000-2000 BC) such as the archaeological sites of Numeria (Jordan),^[7] or possibly a little earlier. Another well-known archaeological example of the almond is the fruit found in Tutankhamun's tomb in Egypt (c. 1325 BC), probably imported from the Levant. Of the European countries that the Royal Botanic Garden Edinburgh reported as cultivating almonds, Germany^[9] is the northernmost, though the domesticated form can be found as far north as Iceland.

3-1 - Etymology and names

The word "almond" comes from Old French *almande* or *alemande*, Late Latin **amandula*, derived through a form *amygdala*

from the Greek $\dot{\alpha}\mu\nu\gamma\delta\alpha\lambda\eta$ (*amygdalē*) (cf. amygdala), an almond. The *al*- in English, for the *a*- used in other languages may be due a confusion with the Arabic article *al*, the word having first dropped the *a*- as in the Italian form *mandorla*; the British pronunciation *ah-mond* and the modern Catalan *ametlla* and modern French *amande* show a form of the word closer to the original. Other related names of almond include mandel or knackmandel (German), amandier or amande (French), mandorlo (Italian), and almendro (Spanish).

The adjective *amygdaloid* (literally "like an almond") is used to describe objects which are roughly almond-shaped, particularly a shape which is part way between a triangle and an ellipse. See, for example, the brain structure*amygdala*, which uses a direct borrowing of the Greek term *amygdalē*.

4 – Production

The world produced 2.00 million tonnes of almonds in 2011 according to Food and Agriculture Organization, with United States the largest producer at 0.73 million tonnes . The apparent 50% decrease in production by the United States led to a calculated percent of world production decrease from 56% to 36%; however, a 2013 news article indicated that the United States produced at least 80% of the world's supply.

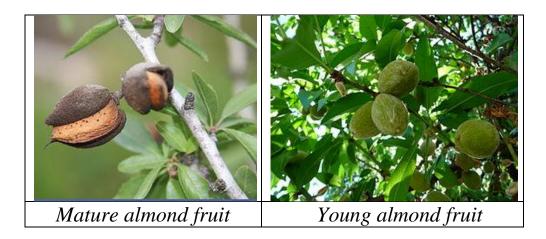
Top Ten Almond with Shell Producers in 2010, with 2011 data			
Country	Production 2010 , 2011 (million tones)	Yields 2010 , 2011 (ton / hectare)	
USA	1.41 v 0.73	4.85 v 4.50	
Spain	0.22 – 0.21	0.40 – 0.40	
Iran	0.16 – 0.17	2.97 v 1.91	
Italy	0.11 – 0.10	1.26 🔺 1.39	
Morocco	0.10 \ 0.13	0.98 1.52	
Syria	0.073 \ 0.13	1.49 2.52	
Afghanistan	0.056 🔺 0.061	5.00 v 4.50	
Turkey	0.055 🔺 0.070	3.23 🔺 3.41	

Tunisia	0.052 \ 0.061	0.32 - 0.32
Algeria	0.039 – 0.050	1.16 1.80
World Total	2.51 2.00	1.62 v 1.27

Spain has one of the most diverse commercial cultivars of almonds. It is grown in Spain's Catalonia, Valencia, Murcia, the Balearic Islands, Andalusia, and Aragón regions. In Greece, most of the production comes from the region of Magnesia at the area of Almyros. The most cultivating types of almonds in Greece are ferragnes and Texas (mission) which are known for their sweet taste and premium quality. Because of its quality, it is used as a luxury nut. In Turkey, most of the production comes from the Aegean, Marmara, and Mediterranean regions.

In the United States, production is concentrated in California, with almonds being California's third leading agricultural product and its top agricultural export in 2008. and 100% of the U.S. commercial supply. The United States is the dominant supplier of almonds. In 2011, the country exported about 637,000 metric tons, valued at US \$ 2.8 billion. Almonds were mostly exported as shelled almonds (70 %), with the remainder being either unshelled or processed.

4 – 1 – Pollination



The pollination of California's almonds is the largest annual managed pollination event in the world, with close to one million hives (nearly half of all behives in the USA) being trucked in February to the almond groves. Much of the pollination is managed by pollination brokers, who contract with migratory beekeepers from at least 49 states for the event. This business has been heavily impacted by colony collapse disorder, causing nationwide shortages of honey bees and increasing the price of insect pollination. To alleviate almond growers from the rising cost of insect pollination, researchers at the Agricultural Research Service (ARS) have developed a new line of self-pollinating almond trees. Self - pollinating almond trees, such as the Tuono almond tree, have been around for a while, but their harvest is not as desirable as the insect-pollinated California Nonpareil almond tree. The Nonpareil tree produces large, smooth almonds and offer 60 - 65 % edible kernel per nut. The Tuono, on the other hand, has thicker, hairier shells and offers only 32 % of edible kernel per nut. However, there are advantages to having a thick shell. The Tuono's shell protects the nut from threatening pests such as the navel orangeworm. ARS researchers have managed to cross breed the pestresistant Tuono tree with California's attractive Nonpareil tree, resulting in hybridized varieties of almond trees that are selfpollinated and maintain a high quality of nut . The new, selfpollinating almond tree hybrids possess quality skin color, flavor, and oil content, and reduce almond growers' dependency on insect pollination.

4 – 2 - Diseases

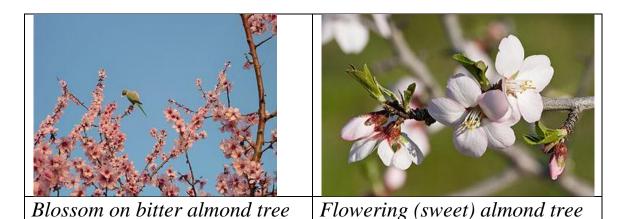
Almond can be attacked by an array of damaging organisms, including insects, fungal pathogens, plant viruses and bacteria. Symptoms can be variable depending on the organism attacking the plant.

5 - Sweet and bitter almonds

The seeds of *Prunus dulcis* var. *dulcis* are predominately sweet, but some individual trees produce seeds that are somewhat more bitter. The fruits from *Prunus dulcis* var. *amara* are always bitter as are the kernels from other *Prunus* species like apricot, peach and cherry (to a lesser extent).

The bitter almond is slightly broader and shorter than the sweet almond, and contains about 50 % of the fixed oil that occurs in sweet

almonds. It also contains the enzyme emulsin which, in the presence of water, acts on a soluble glucosides, amygdalin and prunasin,^[25] yielding glucose, cyanide and the essential oil of bitter almonds, which is nearly pure benzaldehyde. Bitter almonds may yield from 4– 9 mg of hydrogen cyanide per almond. Extract of bitter almond was once used medicinally, but even in small doses, effects are severe, and in larger doses can be deadly; the cyanide must be removed before consumption.



6 - Culinary uses



Smoked and salted almonds

While the almond is often eaten on its own, raw or toasted, it is also a component of various dishes. Almonds are available in many forms, such as whole, sliced (flaked, slivered), and as flour. Almonds yield almond oil and can also be made into almond butter or almond milk. These products can be used in both sweet and savoury dishes.

Along with other nuts, almonds can be sprinkled over breakfasts and desserts, particularly muesli or ice cream based dishes. Almonds are used in marzipan, nougat, many pastries (including jesuites), cookies (including French macarons, macaroons), and cakes (including financiers), noghl and other sweets and desserts. They are also used to make almond butter, a spread similar to peanut butter, popular with peanut allergy sufferers and for its naturally sweeter taste. The young, developing fruit of the almond tree can be eaten whole ("green almonds") when they are still green and fleshy on the outside and the inner shell has not yet hardened. The fruit is somewhat sour, but is a popular snack in parts of the Middle East, eaten dipped in salt to balance the sour taste. Available only from mid April to mid June in the northern hemisphere, pickling or brining extends the fruit's shelf life.

For dessert, almond cookie, Chinese almond biscuits, and Italian ricciarelli use almonds.

In Greece, ground blanched almonds are used as the base material in a great variety of desserts, usually called *amygdalota* (αμυγδαλωτά). Because of their white colour, most are traditionally considered "wedding sweets" and are served at wedding banquets. In addition, a soft drink known as *soumada* is made from almonds in various regions.

In Iran, green almonds are dipped in sea salt and eaten as snacks on street markets; they are called Chaqale bâdam. Also sweet almonds are used to prepare a special food for babies, named "harire badam". In Iran almonds are added to some foods, cookies and desserts, or are used to decorate foods. People in Iran consume roasted nuts for special events, for example, during New Year parties.

In Italy, the bitter almonds from apricots are the base for amaretti (almond macaroons), a common dessert. Traditionally, a low percentage of bitter almonds (10-20%) is added to the ingredients, which gives the cookies their bitter taste (commercially, apricot kernels are used as a substitute for bitter almonds). Almonds are also a common choice as the nuts to include in torrone. In Puglia and Sicily, "pasta di mandorle" (almond paste) is used to make small soft cakes, often decorated with jam, pistacchio or chocolate. In Sicily Almond milk is a popular refreshing beverage in summer.

In Morocco, almonds in the form of sweet almond paste are the main ingredient in pastry fillings, and several other desserts. Fried blanched whole almonds are also used to decorate sweet tajines such as lamb with prunes. A drink made from almonds mixed with milk is served in important ceremonies such as weddings and can also be ordered in some cafes. Southwestern Berber regions of Essaouira and Souss are also known for "Amlou" a spread made of almond paste, argan oil, and honey. Almond paste is also mixed with toasted flour and among others, honey, olive oil or butter, anise, fennel, sesame seeds, and cinnamon to make "Sellou" (also called "Zamita" in Meknes or "Slilou" in Marrakech), a sweet snack known for its long shelf life and high nutritive value.

In India, almonds are the base ingredients of pasanda-style curries. Badam halva is a sweet made from almonds with added coloring. Almond flakes are added to many sweets (such as sohan barfi), and are usually visible sticking to the outer surface.

In Pakistan, almonds are the base ingredients of many food items. Meat dishes containing almonds include pasanda-style or Mughalai curries. Badam halva is a sweet made from almonds with added coloring. Almond flakes are added to many sweets (such as sohan barfi), and are usually visible sticking to the outer surface. Almonds form the base of various drinks which are supposed to have cooling properties. Almond sherbet or 'Sherbet - e - Badaam' in Urdu, is a popular summer drink. Almonds are also sold as a snack with added salt.

Almonds can be processed into a milk substitute called almond milk; the nut's soft texture, mild flavour, and light colouring (when skinned) make for an efficient analog to dairy, and a soy-free choice for lactose intolerant people and vegans. Raw, blanched, and lightly toasted almonds work well for different production techniques, some of which are similar to that of soymilk and some of which use no heat, resulting in "raw milk". The 'Marcona' almond cultivar is recognizably different from other almonds, and is marketed by name. The kernel is short, round, relatively sweet and delicate in texture. It has been grown in Spain for a long time and its origin is unknown; the tree is very productive, the shell of the nut very hard . 'Marcona' almonds are traditionally served after being lightly fried in oil, and are used by Spanish chefs to prepare a dessert called *turrón*.

6-1 - Almond flour

Almond flour is often used as a gluten - free alternative to wheat flour in cooking and baking.

6 – 2 - Almond syrup

Historically, almond syrup was an emulsion of sweet and bitter almonds, usually made with barley syrup (orgeat syrup) or in a syrup of orange flower water and sugar.

The Grocer's Encyclopedia (1911) notes that "Ten parts of sweet almonds are generally employed to three parts of bitter almonds"; however, due to the cyanide found in bitter almonds, modern syrups generally consist of only sweet almonds.

Almonds, unroasted		
Nutritional value per 100 g		
Energy	2,408 kJ (576 kcal)	
Carbohydrates	21.7	
- Starch	0.74	
- Sugars	3.89	
- Lactose	0.0	
- Dietary fiber	12.2	
Fat	49.42	
- saturated	3.73	

7 - Nutrition

- monounsaturated	30.889
- polyunsaturated	12.07
Protein	21.22
Water	4.7
Vitamin A	1 IU
- beta-carotene	1 μg (0%)
- lutein and zeaxanthin	1 µg
Thiamine (vit. B ₁)	0.211 mg (18%)
Riboflavin (vit. B ₂)	1.014 mg (85%)
Niacin (vit. B ₃)	3.385 mg (23%)
Pantothenic acid (B ₅)	0.469 mg (9%)
Vitamin B ₆	0.143 mg (11%)
Folate (vit. B ₉)	50 µg (13%)
Choline	52.1 mg (11%)
Vitamin E	26.2 mg (175%)
Vitamin K	0.0 µg (0%)
Calcium	264 mg (26%)
Iron	3.72 mg (29%)
Magnesium	268 mg (75%)
Manganese	2.285 mg (109%)
Phosphorus	484 mg (69%)
Potassium	705 mg (15%)
Sodium	1 mg (0%)
Zinc	3.08 mg (32%)

The almond contains about 26 % carbohydrates (12 % dietary fiber, 6.3 % sugars, 0.7 % starch and the rest miscellaneous carbohydrates), and may therefore be made into flour for cakes and cookies (biscuits) for low - carbohydrate diets. A standard serving of

almond flour, 1 cup, contains 20 grams of carbohydrates, of which 10 g is dietary fiber, for a net of 10 g of carbohydrate per cup. This makes almond flour very desirable for use in cake and bread recipes by people on carbohydrate-restricted diets.

Almonds are a rich source of vitamin E, containing 26 mg per 100 g (Table). About 20 percent of raw almond is high quality protein, a third of which are essential amino acids. An ounce of almonds contains 12 % of necessary daily protein . They are also rich in dietary fiber, B vitamins, essential minerals and monounsaturated fat (see nutrient table), one of the two fats which potentially may lower LDL cholesterol. Typical of nuts and seeds, almonds also contain phytosterols , associated with cholesterol-lowering properties.

Amino Acids	g / 100g Nuts
Tryptophan	0.21
Threonine	0.6
Lysine	0.58
Leucine	1.49
Isoleucine	0.70
Methionine	0.15
Cystine	0.19
Phenylalanine	1.12
Tyrosine	0.45
Valine	0.82
Arginine	2.45
Glutamic acid	6.81
Glycine	1.47
Aspartic acid	2.91

Potential health benefits, which have not been scientifically validated, include improved complexion and possibly a lower risk of cancer. Preliminary research associates consumption of almonds with elevating blood levels of high density lipoproteins and lowering low density lipoproteins. A preliminary trial showed that using them in the daily diet might lower several factors associated with heart disease, including cholesterol and blood lipids.

Almonds contain poly phenols in their skins consisting in a combination of flavonols, flavan-3-ols, hydroxy benzoic acids and flavanones^[38] analogous to those of certain fruits and vegetables.

Almonds may cause allergy or intolerance. Cross-reactivity is common with peach allergens (lipid transfer proteins) and tree nut allergens. Symptoms range from local symptoms (e.g., oral allergy syndrome, contact urticaria) to systemic symptoms including anaphylaxis (e.g., urticaria, angioedema, gastrointestinal and respiratory symptoms).

8 - Oils

Almonds are a rich source of oil, with values ranging between 36 to 60 % of kernel dry mass. A study by Venkatchalam and Sathe suggests almonds contain approximately 44 % oils, of which 62% is monounsaturated oleic acid (an omega - 9 fatty acid), 29 % is linoleic acid (a polyunsaturated omega - 6essential fatty acid), and 9% is saturated fatty acid.

"Oleum Amygdalae", the fixed oil, is prepared from either sweet or bitter almonds and is a glycerol oleate, with a slight odour and a nutty taste. It is almost insoluble in alcohol but readily soluble in chloroform or ether. Sweet almond oil is obtained from the dried kernel of sweet almonds.

The oil is good for application to the skin as an emollient, and has been traditionally used by massage therapists to lubricate the skin during a massage session.

Almond oil can also be used as a wood conditioner of certain wood wind instruments, such as the oboe and clarinet.

9 - Aflatoxins

Almonds, like other tree nuts, are susceptible to aflatoxinproducing molds . Aflatoxins are potent carcinogenic chemicals produced by molds such as *Aspergillus flavus* and *Aspergillus parasiticus*. The mold contamination may occur from soil, previously infested almonds, and almond pests such as navel orangeworm. High levels of mold growth typically appear as gray to black filament like growth. It is unsafe to eat mold infected tree nuts.

Some countries have strict limits on allowable limits for aflatoxin contamination on almonds, and require adequate testing before the nuts can be marketed to their citizens. The European Union, for example, introduced a mandatory requirement since 2007 that all almond shipments to EU must be tested for aflatoxin . If aflatoxin does not meet the strict safety regulations, the entire consignment may be reprocessed to eliminate the aflatoxin or it must be destroyed.

The almond industry not only tests and processes almonds to ensure infected almonds do not reach the market, the industry also takes steps to prevent sources that cause contamination. These steps include proper orchard management, winter sanitation, early harvest, proper storage among others.

10 - Mandatory pasteurization in California

The USDA approved a proposal by the Almond Board of California to pasteurize almonds sold to the public, after tracing cases of salmonellosis to almonds. The almond pasteurization program became mandatory for California companies in 2007. Raw, untreated California almonds haven't been available in the U.S. since then.

California almonds labeled "raw" must be steam-pasteurized or chemically treated with propylene oxide. This doesn't apply to imported almonds or almonds sold from the grower directly to the consumer in small quantities. The treatment also isn't required for raw almonds sold for export outside of North America.

The USDA - approved marketing order was challenged in court by organic farmers organized by the Cornucopia Institute, a Wisconsin-based farm policy research group. According to the Cornucopia Institute, this almond marketing order has imposed significant financial burdens on small-scale and organic growers and damaged domestic almond markets. A federal judge dismissed the lawsuit in the spring of 2009 on procedural grounds. In August 2009 farmers were appealing.

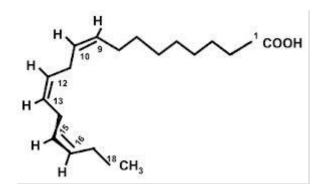
11 - Cultural aspects

The almond is highly revered in some cultures.

The tree originated in the Middle East, and is mentioned numerous times in the Bible.

In the Hebrew Bible, the almond was a symbol of watchfulness and promise due to its early flowering. In the Bible the almond is mentioned ten times, beginning with Book of Genesis 43:11, where it is described as "among the best of fruits". In Numbers 17 Levi is chosen from the other tribes of Israel by Aaron's rod, which brought forth almond flowers. According to tradition, the rod of Aaron bore sweet almonds on one side and bitter on the other; if the Israelites followed the Lord, the sweet almonds would be ripe and edible, but if they were to forsake the path of the Lord, the bitter almonds would predominate. The almond blossom supplied a model for the menorah which stood in the Holy Temple, "Three cups, shaped like almond blossoms, were on one branch, with a knob and a flower; and three cups, shaped like almond blossoms, were on the other...on the candlestick itself were four cups, shaped like almond blossoms, with its knobs and flowers" (Exodus 25:33 - 34; 37:19 - 20). Similarly, Christian symbolism often uses almond branches as a symbol of the Virgin Birth of Jesus; paintings often include almonds encircling the baby Jesus and as a symbol of Mary. The word "Luz", which appears in Genesis 30:37, is sometimes translated as "hazel", may actually be derived from the Aramaic name for almond (Luz), and is translated as such in some Bible versions such as the NIV.

Alpha - Linolenic Acid



Contents

- 1 Introduction
- 2 History
- 3 Dietary sources
- 4 Potential role in nutrition and health
 - 4.1 Stability and Hydrogenation
 - 4.2 Cardiovascular

 α -Linolenic acid (ALA) is an essential omega 3 fatty acid and organic compound found in seeds (e.g. chia, flaxseed (see also table below),nuts (notably walnuts), and many common vegetable oils. In terms of its structure, it is named *all-cis*-9,12,15- octadecatrienoic acid. In physiological literature, it is given the name 18:3 (n-3).

 α -Linolenic acid is a carboxylic acid with an 18-carbon chain and three *cis* double bonds. The first double bond is located at the third carbon from the methyl end of the fatty acid chain, known as the *n* end. Thus, α - linolenic acid is a polyunsaturated *n*-3 (omega-3) fatty acid. It is an isomer of gamma - linolenic acid, a polyunsaturated *n*-6 (omega-6) fatty acid.

> IUPAC name : (9Z,12Z,15Z)-9,12,15-Octadecatrienoic acid Other names : ALA ; Linolenic acid ; *cis,cis,cis*-9,12,15-Octadecatrienoic acid ;

(9 <i>Z</i> ,12 <i>Z</i> ,15 <i>Z</i>)-octadeca-9,12,15-trienoic acid; Industrene 120		
Molecular formula	$C_{18}H_{30}O_2$	
Molar mass 278 g mol^{-1}		

2 - History

Alpha-linolenic acid was first isolated by Rollett as cited in J. W. McCutcheon's synthesis in 1942, and referred to in Green and Hilditch's 1930s survey. It was first artificially synthesized in 1995 from C6 homologating agents. A Wittig reaction of the phosphonium salt of [(Z-Z)-nona-3,6-dien-1-yl] tri phenyl phosphonium bromide with methyl 9- oxononanoate, followed by saponification, completed the synthesis.

3 - Dietary sources[edit]

Seed oils are the richest sources of α -linolenic acid, notably those of chia, perilla, flaxseed (linseed oil), rapeseed (canola), and soybeans. Alpha-Linolenic acid is also obtained from the thylakoid membranes in the leaves of *Pisum sativum* (pea leaves). ALA is not suitable for baking, as it will polymerize with itself, a feature exploited in paint with transition metal catalysts. Some ALA will also oxidize at baking temperatures. % ALA in the table below is for the oil extracted from each item.

Common name	Alternate name	Linnaean name	% ALA [†]
Chia	chia sage	Salvia hispanica	64
K iwitruit seeds	Chinese gooseberry	Actinidia chinensis	62
Perilla	shiso	Perilla frutescens	58
Flax	linseed	Linum usitatissimum	55
Lingonberry	cowberry	Vaccinium vitis-idaea	49
Camelina	camelina	Camelina sativa	35 - 45
Purslane	portulaca	Portulaca oleracea	35
Sea buckthorn	seaberry	Hippophae rhamnoides L.	32
Hemp	cannabis	Cannabis sativa	20

Rapeseed	canola	Brassica napus	10
Soybean	soya	Glycine max	8

4 - Potential role in nutrition and health

 α -Linolenic acid, an n-3 fatty acid, is a member of the group of essential fatty acids (EFAs), so called because they cannot be produced within the body and must be acquired through diet. Most seeds and seed oils are much richer in an n-6 fatty acid, linoleic acid. Exceptions include flaxseed (must be ground for proper nutrient absorption) and walnuts. Linoleic acid is also an EFA, but it, and the other n-6 fatty acids, compete with n-3s for positions in cell membranes and have very different effects on human health.

 α -Linolenic acid can only be obtained by humans through their diets because the absence of the required 12- and 15-desaturase enzymes makes *de novo* synthesis from stearic acid impossible. Eicosapentaenoic acid (EPA; 20:5, *n*-3) and docosahexaenoic acid (DHA; 22:6, *n*-3) are readily available from fish and algae oil and play a vital role in many metabolic processes. These can also be synthesized by humans from dietary α -linolenic acid, but with an efficiency of only a few percent. Because the efficacy of *n*-3 longchain polyunsaturated fatty acid (LC- PUFA) synthesis decreases down the cascade of α - linolenic acid conversion, DHA synthesis from α -linolenic acid is even more restricted than that of EPA.

Linoleic acid (LA; 18:2, n-6) is generally assumed to reduce EPA synthesis because of the competition between α -linolenic acid and LA for common desaturation and elongation enzymes.

Preliminary research has found evidence that α -linolenic acid is related to a lower risk of cardiovascular disease.

A 2005 study found that daily administration of α -linolenic acid significantly reduced both self-reported anxiety, stress levels, and objective measured cortisol levels in college age students.

A large 2006 study found no association between total α linolenic acid intake and overall risk of prostate cancer . Multiple studies have shown a relationship between alpha-linolenic acid (ALA), which is abundant in linseed oil, and an increased risk of prostate cancer. This risk was found to be irrespective of source of origin (e.g., meat, vegetable oil) . A recent (2009) meta-analysis, however, found evidence of publication bias in earlier studies, and concluded that if ALA contributes to increased prostate cancer risk, the increase in risk is quite small. In contrast, alpha - linoleic acid was recently shown to negatively regulate the growth of cancer cells, but not healthy cells, in vitro.

Basic research has also suggested a major neuroprotective effect of α -linolenic acid in *in vivo* models of both global ischemia and kainate-induced epilepsy ; however, if sourced from flax seed oil, residues may have adverse effect due to its content of neurotoxic cyanogen glycosides and immunosuppressive cyclic nonapeptides.

A 2011 longitudinal study of over 50,000 women, conducted at Harvard University, over a period of ten years, found that a higher intake of α -linolenic acid (combined with a lower intake of linoleic acid) was positively associated with a significant reduction in depression in the same group (the same study also found that by contrast an intake of EPA and DHA found in fish oils did not reduce depression).

4 – 1 - Stability and Hydrogenation

Alpha-linolenic acid is relatively more susceptible to oxidation and will become rancid more quickly than many other oils. Oxidative instability of α -linolenic acid is one reason why producers choose to partially hydrogenate oils containing α -linolenic acid, such as soybean oil. Soybeans are the largest source of edible oils in the U.S., and 40 % of soy oil production is partially hydrogenated.

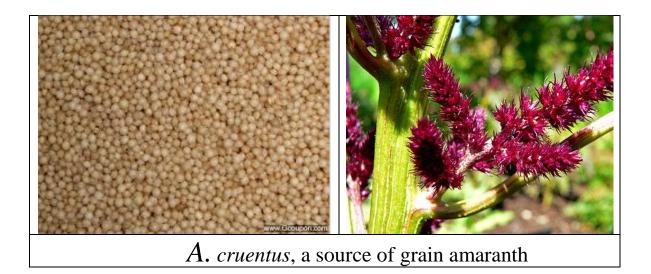
However, when partially hydrogenated , part of the unsaturated fatty acids become unhealthy trans fats. Consumers are increasingly avoiding products that contain trans fats, and governments have begun to ban trans fats in food products. These regulations and market pressures have spurred the development of low - α - linolenic acid soybeans. These new soybean varieties yield a more stable oil that doesn't require hydrogenation for many applications, thus providing trans fat-free products, such as frying oil.

Several consortia are bringing low- α -linolenic acid soy to market. DuPont's effort involves silencing the FAD2 gene that codes for Δ^6 -desaturase, giving a soy oil with very low levels of both α -linolenic acid and linoleic acid . Monsanto Company has introduced to the market Vistive, their brand of low α -linolenic acid soybeans, which is less controversial than GMO offerings, as it was created via conventional breeding techniques.

4-2-Cardiovascular

Dietary α -linolenic acid has been assessed for its role in cardiovascular health. Clinical benefits have been seen in some, but not all, studies. Still, a review in 2005 concluded "The weight of the evidence favors recommendations for modest dietary consumption of α -linolenic acid (2 to 3 g per day) for the primary and secondary prevention of coronary heart disease."

Amaranth Oil



Amaranth oil is extracted from the seeds of two species of the genus *Amaranthus* — *A. cruentus* and *A. hypochondriacus* — that are called, collectively, grain amaranth. A manufacturer of this unique oil writes :

The oil extracted from these plants contains mainly non - polar lipid compounds especially triglycerides with a high degree of unsaturation. Amaranth oil is a light to medium colored, clear liquid that is pourable at low temperatures, highly unsaturated with a delicate, agreeable aroma and taste, allowing greater usage versatility. It also provides an excellent resource for omega series fatty acids.

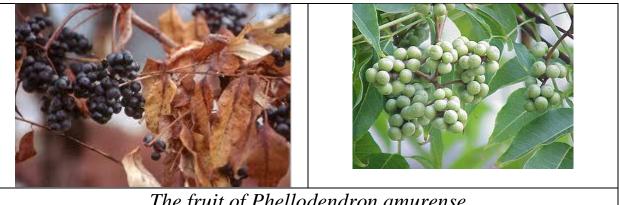
The oil is valued for its ability to add temperature stability at both high and low temperatures. Commercial uses of amaranth oil foods. include cosmetics. shampoos intermediates for and manufacture of lubricants, pharmaceuticals, rubber chemicals, aromatics and surface active agents. As a food oil, amaranth oil has a delicate and agreeable taste. Berger et al., in a study of the cholesterol-lowering properties of amaranth grain and oil in hamsters, report that amaranth oil significantly reduced non-HDL cholesterol and raised HDL cholesterol, as well as lowering very low density lipoprotein cholesterol (VLDL cholesterol) by 21–50 %.

Chemically, the major constituents of amaranth oil are :

Fatty a	acid	Content
Linole	eic acid	46–50%
Oleic	acid	22-26%
Palmit	tic acid	19–20%
Squale	ene	5-6%
Steario	c acid	3%
The melting point of amaranth oil is -27°C.		
Oleic Palmit Squale Stearie	acid tic acid ene c acid	22–26% 19–20% 5–6% 3%

The oil content of the actual amaranth grain ranges from 4.8 to 8.1%, which is relatively low compared to other sources of seed oil.

Amur Cork Tree Fruit Oil



The fruit of Phellodendron amurense

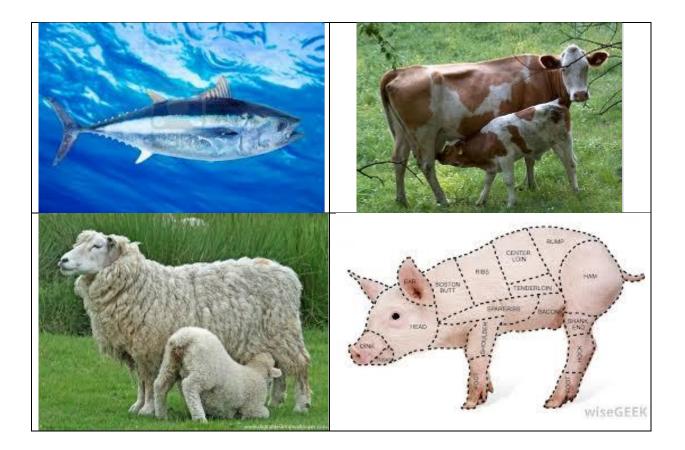
Amur cork tree fruit oil is a pressed oil extracted from the fruit of Phellodendron amurense, the Amur Cork Tree.

The bark of the tree is an important herbal medicine in China. The oil has insecticidal properties similar to pyrethrum.

The oil contains a variety of biologically active substances, including flavonoids (diosmin), alkaloids (berberine, yatroriccin, palmatine), saponins and coumarins.

applications of the oil include treatment of Medicinal pancreatitis, reduction of cholesterol and sugar in blood and the treatment of various skin diseases.

Animal Fats & Oils



Contents 1 Introduction 2 Culinary uses

1 - Introduction

Animal fats and oils are lipid materials derived from animals. Physically, oils are liquid at room temperature, and fats are solid.

Chemically, both fats and oils are composed of triglycerides. Although many animal parts and secretions may yield oil, in commercial practice, oil is extracted primarily from rendered tissue fats obtained from live stock animals like pigs, chickens and cows. Dairy products also yield popular animal fat and oil products such as cheese, butter, and milk.

Flesh and animal fat have a melting temperature of 184 °C, a boiling point of around 200 °C and an ignition point of 280 °C where

it will burst into flames without spark. Certain substances such as goose fat produce a higher smoke point than other animal fats, but are still lower than many vegetable oils such as olive or avocado.

In consumer meat products in the U.S., animal remains are found to be classified as Animal fats once the particle size of bone solids is more than 3 percent, protein content is less than 14 percent and or the product contains over 30 percent pure fat content.

Animal fats are commonly consumed as part of a western diet in their semi-solid form as either milk, butter, lard, schmaltz, and dripping or more commonly as filler in factory produced meat, pet food and fast-food products. Dairy products are animal secretions which contain varying levels of water, oils, fats and animal cells from circulatory and lymphatic systems such as blood and mammary glands.

2 - Culinary uses

Many animal fats and oils are consumed directly, or indirectly as ingredients in food. The oils serve a number of purposes in this role:

Shortening – to give pastry a crumbly texture.

Texture – oils can serve to make other ingredients stick together less.

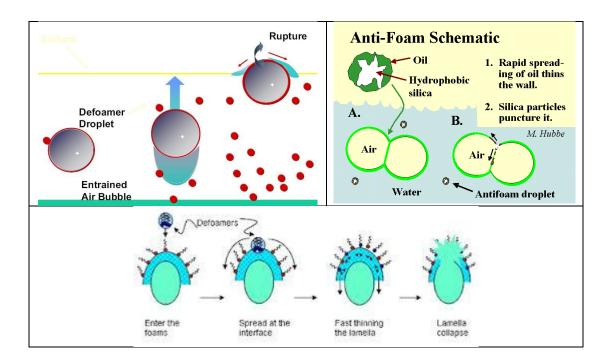
Flavor – some may be chosen specifically for the flavor they impart.

Flavor base – oils can also "carry" flavors of other ingredients, since many flavors are present in chemicals that are soluble in oil.

Secondly, oils can be heated, and used to cook other foods. Oils suitable for this purpose must have a high flash point.

Animal Fat composition	
Saturated fats	38-43 % :
	Palmitic acid : 25–28 %
	Stearic acid : 12–14 %
	Myristic acid : 1 %
Unsaturated fats	56-62 %

Monounsaturated	47 - 50 % : Oleic acid : $44 - 47 \%$ Palmitoleic acid : 3%
Polyunsaturated	Linoleic acid : 6 – 10 %
Properties	
Food energy per 100 g	3770 kJ (900 kcal)
Melting point	Back fat : 30 – 40 °C leaf fat : 43 – 48 °C mixed fat : 36 – 45 °C
Smoke point	121 – 218 °C
Specific gravity at 20 °C	0.917 - 0.938
Iodine value	45 – 75
Acid value	3.4
Saponification value	190 - 205
Unsaponifiable	0.8 %



Anti - Foaming Agent (Defoamer)

Contents

- 1 Introduction
- 2 Properties
- 3 History
- 4 Classification
 - 4.1 Oil based defoamers
 - 4.2 Powder defoamers
 - 4.3 Water based defoamers
 - 4.4 Silicone based defoamers
 - 4.5 EO / PO based defoamers
 - 4.6 Alkyl poly acrylates
- 5 Industrial problems
 - 5.1 Mechanical problem factors
 - 5.2 Foam in process and coolant liquids
- 6 Test methods
- 7 Applications
 - 7.1 Detergents
 - 7.2 Food
 - 7.3 Industrial use
 - 7.4 Pharmaceuticals

1 - Introduction

A **defoamer** or an **anti-foaming agent** is a chemical additive that reduces and hinders the formation of foam in industrial process liquids. The terms anti-foam agent and defoamer are often used interchangeably.

In industrial processes, foams pose serious problems. They cause defects on surface coatings. They prevent the efficient filling of containers. A variety of chemical formulas are available to prevent formation of foams.

2 – Properties

Generally a defoamer is insoluble in the foaming medium and has surface active properties. An essential feature of a defoamer product is a low viscosity and a facility to spread rapidly on foamy surfaces. It has affinity to the air - liquid surface where it destabilizes the foam lamellas. This causes rupture of the air bubbles and breakdown of surface foam. Entrained air bubbles are agglomerated, and the larger bubbles rise to the surface of the bulk liquid more quickly.

3-History

The first defoamers were aimed at breaking down visible foam at the surface. Kerosene, fuel oil and other light oil products were used to break down foam. Other vegetable oils also found some use. Fatty alcohols (C7 - C22) were effective but expensive antifoams. They were added to oil products to boost the efficiency. Milk and cream were forbears for modern day emulsion type defoamers.

During the 1950s experiments with silicone based defoamers started. These were based on poly dimethyl siloxane (silicone oil) dispersed in water or light oil. Silicone oils worked well, but caused surface disturbances in many applications like paints and papermaking.

In 1963 the first antifoams with hydrophobic particles (hydrophobic silica) in light oil were patented. In the early 1970s, hydrophobic waxes like ethylene bis stear amide dispersed in oils

developed. These types of defoamers were very efficient, but the oil crisis of 1973 made these too expensive and resulted in a push for reduction of the oil content. The solution was adding water. So water extended (water in oil emulsion) and water based (oil in water emulsion) defoamers appeared.

The development of silicone based defoamers has continued, using different emulsifiers and modified silicone oils. In the early 1990s, silicone emulsion defoamers that caused less surface disturbances were used in the wood pulping industry with great success. These caused better washing, reduced biological oxygen demand (BOD) in effluent and reduced deposits.

4 – Classification

4 – 1 - Oil based defoamers

Oil based defoamers have an oil carrier. The oil might be mineral oil, vegetable oil, white oil or any other oil that is insoluble in the foaming medium, except silicone oil. An oil based defoamer also contains a wax and/or hydrophobic silica to boost the performance. Typical waxes are ethylene bis stear amide (EBS), paraffin waxes, ester waxes and fatty alcohol waxes. These products might also have surfactants to improve emulsification and spreading in the foaming medium.

These are heavy duty defoamers and are normally best at knocking down surface foam.

4 – 2 - Powder defoamers

Powder defoamers are in principle oil based defoamers on a particulate carrier like silica. These are added to powdered products like cement, plaster and detergents.

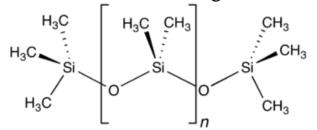
4 – 3 - Water based defoamers

Water based defoamers are different types of oils and waxes dispersed in a water base. The oils are often white oils or vegetable oils and the waxes are long chain fatty alcohol, fatty acid soaps or esters. These are normally best as deaerators, which means they are best at releasing entrained air.

4 – 4 - Silicone based defoamers

Silicone-based defoamers are polymers with silicon backbones. These might be delivered as an oil or a water based emulsion. The silicone compound consists of an hydrophobic silica dispersed in a silicone oil. Emulsifiers are added to ensure that the silicone spreads fast and well in the foaming medium. The silicone compound might also contain silicone glycols and other modified silicone fluids.

These are also heavy duty defoamers and are good at both knocking down surface foam and releasing entrained air.



Poly dimethyl siloxane is a widely used antifoaming agent.

Silicone based defoamers are also suitable in non-aqueous foaming systems like crude oil and oil refining. For very demanding applications fluoro silicones may be suitable.

4 – 5 – EO / PO based defoamers

EO / PO based defoamers contain poly ethylene glycol and poly propylene glycol copolymers. They are delivered as oils, water solutions, or water based emulsions. EO / PO copolymers normally have good dispersing properties and are often well suited when deposit problems are an issue.

4 – 6 - Alkyl poly acrylates

Alkyl poly acrylates are suitable for use as defoamers in nonaqueous systems where air release is more important than the breakdown of surface foam. These defoamers are often delivered in a solvent carrier like petroleum distillates.

5 - Industrial problems

The most noticeable form of foam is foam floating on the stock surface. It is easy to monitor and relatively easy to handle. Surface foam may cause problems with liquid levels and give over flow. This might reduce the process speed and availability of process equipment.

5-1 - Mechanical problem factors

Mechanical factors that may generate foam and entrapped air:

Leaky seals on pumps

High pressure pumps

Poor system design (tank , pump inlet , outlet and manifold design)

Pressure release

The main classes of air that are of concern to the mechanical systems are

Dissolved air behaves as part of the fluid phase, except that it can come out of solution as small bubbles (entrained air)

Entrained air consists of bubbles that are small enough to collect on top of a fluid

Bubbles that have sufficient buoyancy to rise to the surface and are described as foam

5 – 2 - Foam in process and coolant liquids

Foam, entrained and dissolved air that are present in coolants and processing liquids, may cause various kinds of problems, including :

Reduction of pump efficiency (cavitation) Reduced capacity of pumps and storage tanks Bacterial growth Dirt flotation / Deposit formation Reduced effectiveness of the fluid solution(s) Eventual downtime to clean tanks Drainage problems in sieves and filters

Formation problems (i.e. in a paper mill it may cause the fibers to form an inhomogeneous sheet)

Cost of replenishing the liquid

Cost of entire material rejection due to imperfections

6 - Test methods

There are several ways to test defoamers.

The easiest is looking at the surface foam. All that is needed is a system for generating foam. This might be done with a round pumping system with a nozzle and a cylinder or an air injection system into a cylinder. The cylinder is fitted with a scale to measure the foam height. This equipment may have a heater to control the temperature.

Entrained air can be tested with a similar equipment that have a density meter that can record changes of the liquor density over time.

Drainage can be tested with a filter system for measuring the time to drain a liquid through the filter. The filter might be pressurized or have a vacuum.

7 – Applications

7 – 1 – Detergents

Anti-foams are added in certain types of detergents to reduce foaming that might decrease the action of the detergent. For example dishwasher detergents have to be low foaming for the dishwasher to work properly.

7-2-Food

When used as an ingredient in food, antifoaming agents are intended to curb effusion or effervescence in preparation or serving. The agents are included in a variety of foods such as chicken nuggets in the form of poly dimethyl siloxane (a type of silicone).

Silicone oil is also added to cooking oil to prevent foaming in deep - frying .

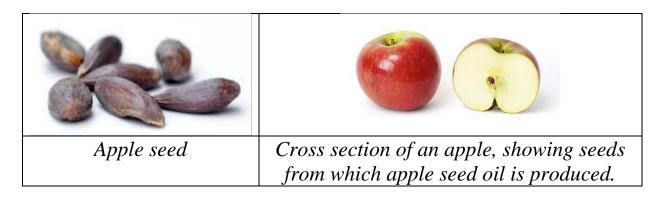
7 – 3 - Industrial use

Defoamers are used in many industrial processes and products: wood pulp , paper , paint , industrial waste water treatment, food processing , oil drilling, machine tool industry, oils cutting tools, hydraulics , etc.

7 – 4 – Pharmaceuticals

Antifoaming agents are also sold commercially to relieve bloating. A familiar example is the drug Simethicone , which is the active ingredient in drugs such as Maalox, Mylanta, and Gas - X .

Apple Seed Oil



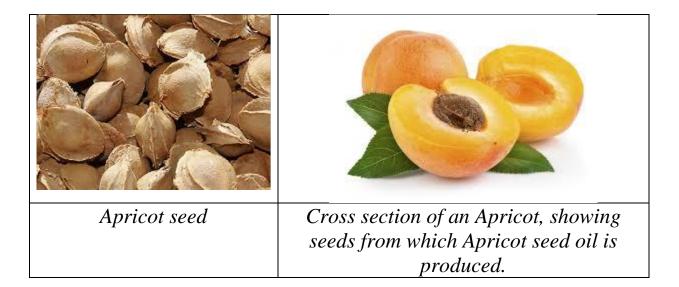
Apple seed oil is a fixed oil found in apple seeds. It is used in the cosmetic and medical industries.

A study on apple seed oil was conducted in 2007 which found that apple seeds contain a high amount of both oil and protein (27.5 to 28 % and 33.8 to 34.5 %, respectively).

Analysis of amino acids in apple seeds concluded that they also contain a significant amount of sulfur. Other elements significantly found in apple seeds include phosphorus, potassium, magnesium, calcium and iron. This study also concluded that apple seed oil could be used as an edible oil, with the oil cake being used to supplement animal feed.

Apple Seeds are known to contain amygdalyn, a compound that degrades into HCN or Hydrogen Cyanide when metabolized.

Apricot Seed oil

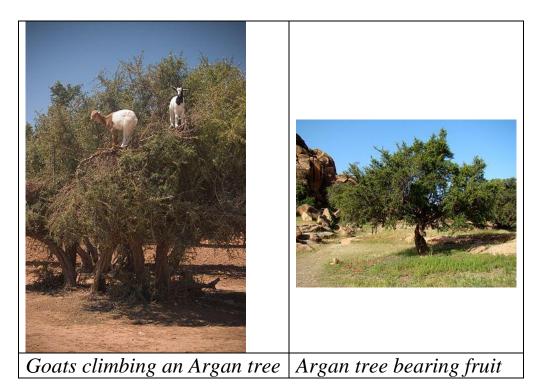


Apricot oil is pressed from the kernels of the *Prunus armeniaca* (apricot). The kernels have an oil content of 40 - 50 %. The oil is similar to almond oil and peach oil, both of which are also extracted from the kernels of the respective fruit. Apricot oil and almond oil, are used similarly in cosmetics to soften skin. Specifically, apricot oil can be used on the scalp to improve its condition

The seed cake is also used separately to extract an essential oil, which contains Amygdalin - a colorless crystalline glucoside.

The oil is chiefly composed of oleic acid and linoleic acid, both of which are unsaturated fats.

Argan



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 3.1 Fruit
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1 - Introduction

The Argan (*Argania spinosa*) is a species of tree endemic to the calcareous semi - desert Sous valley of southwestern Morocco and to the Algerian region of Tindouf in the western Mediterranean region. It is the sole species in the genus *Argania*.

Argan grows to 8 - 10 meters high and live up to 150 - 200 years. They are thorny, with gnarled trunks. The leaves are small, 2 - 4 cm long, oval with a rounded apex. The flowers are small, with five pale yellow - green petals; flowering is in April. The fruit is 2-4 cm long and 1.5-3 cm broad, with a thick, bitter peel surrounding a sweet-smelling but unpleasantly flavoured layer of pulpy pericarp. This surrounds the very hard nut, which contains one (occasionally

two or three) small, oil - rich seeds. The fruit takes over a year to mature, ripening in June to July of the following year.

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Ericales
Family:	Sapotaceae
Subfamily:	Sapotoideae
Tribe:	Sideroxyleae
Genus:	<i>Argania</i> Roem.&Schult.
Species:	A. spinosa
Binomial name	
<i>Argania</i> (L.) Skeels	spinosa
Synonyms	
Argania sideroxylon Roem. & Schult. Sideroxylon spinosum L. ^[2]	

2 - Cultivation

In Morocco *arganeraie* forests now cover some 8,280 km² and are designated as a UNESCO Biosphere reserve. Their area has shrunk by about half during the last 100 years, owing to charcoalmaking, grazing, and increasingly intensive cultivation. The best hope for the conservation of the trees may lie in the recent development of a thriving export market for argan oil as a high-value product. However, the wealth brought by argan oil export has also created threats to argan trees in the form of increased goat population. Locals use the newfound wealth to buy more goats and the goats stunt the growth of the argan trees by climbing up and eating their leaves and fruit

3 - Uses

In some parts of Morocco, argan takes the place of the olive as a source of forage, oil, timber and fuel in Berber society. Especially near Essaouira, the argan tree is frequently climbed by goats.

3 – 1 - Fruit



Foliage, flowers and immature fruit

Argan fruit falls in July, when black and dry. Until this happens, goats are kept out of the argan woodlands by wardens. Rights to collect the fruit are controlled by law and village traditions. The leftover nut is gathered after consumption by goats.

3 – 2 - Argan oil

Argan oil is produced by several women's co - operatives in the southwestern parts of Morocco. The most labour - intensive part of oil-extraction is removal of the soft pulp (used to feed animals) and the cracking by hand, between two stones, of the hard nut. The seeds are then removed and gently roasted. This roasting accounts for part of the oil's distinctive, nutty flavour.

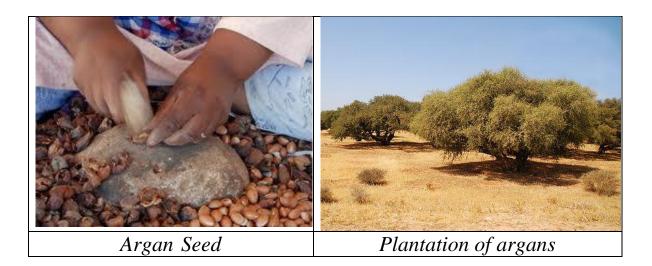
The traditional technique for oil extraction is to grind the roasted seeds to paste, with a little water, in a stone rotary quern. The paste is then squeezed by hand in order to extract the oil. The extracted paste is still oil-rich and is used as animal feed. Oil produced this way can be stored and used for 3 - 6 months, and will be produced as needed

in a family, from a store of the kernels, which will keep for 20 years unopened. Dry-pressing is becoming increasingly important for oil produced for sale, as this method allows for faster extraction, and the oil produced can be used for 12–18 months after extraction

The oil contains 80% unsaturated fatty acids, is rich in essential fatty acids and is more resistant to oxidation than olive oil. Argan oil is used for dipping bread, on couscous, salads and similar uses. A dip for bread known as amlou is made from argan oil, almonds and peanuts, sometimes sweetened by honey or sugar. The unroasted oil is traditionally used as a treatment for skin diseases, and has become favoured by European cosmetics manufacturers.

Argan oil is sold in Morocco as a luxury item, and is difficult to find for sale outside the region of production. The product is of increasing interest to cosmetics companies in Europe. It used to be difficult to buy the oil outside Morocco, but since 2001-2002 it has become a fashionable product in Europe and North America. It is now widely available in specialist shops and occasionally in supermarkets. Its price (USD \$ 40–50 for 500 ml) is notable compared to other oils

Argan Oil



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- 2 Argan tree
- 3 Extraction

3.1 Traditional method

- 3.2 Press-extraction
- 4 Properties and uses
 - 4.1 Culinary uses
 - 4.2 Cosmetic uses
- 5 Impacts

5.1 Environmental impacts

1 - Introduction

Argan oil is a plant oil produced from the kernels of the argan tree (*Argania spinosa* L.), endemic to Morocco, that is valued for its nutritive, cosmetic and numerous medicinal properties. It is also known in cosmetic use as moroccan oil.

2 - Argan tree

The tree is extremely well adapted to drought and other environmentally harsh conditions of southwestern Morocco. The genus Argania once covered North Africa and is now endangered and under protection of UNESCO. The argan tree grows wild in semi-arid soil, its deep root system helping to protect against soil erosion and the northern advance of the Sahara. This biosphere reserve, the *Arganeraie Biosphere Reserve*, covers a vast intramontane plain of more than 2,560,000 hectares, bordered by the High Atlas and Little Atlas Mountains and the Atlantic in the west. Argan oil remains one of the rarest oils in the world due to the small and very specific growing areas.

The earliest known European account of argan trees was by Leo Africanus, in 1510. An early specimen was taken to Amsterdam where it was cultivated by Lady Beaufort at Badminton House in 1711

3 - Extraction3 - 1 - Traditional method



The production of argan oil by traditional methods

Before modern times, the Berbers of ancient Morocco would collect undigested argan pits from the waste of goats which climb the trees to eat their fruit. The pits were then ground and pressed to make the nutty oil used in cooking and cosmetics. However, the oil used in cosmetic and culinary products available for sale today has most likely been harvested directly from the tree and processed with machines.

3-2-Press - extraction

Now increasingly important for oil produced for sale, as the oil will keep 12–18 months and extraction is much faster. Using mechanical presses, mixing of the dough and water is unnecessary and the dough can be directly pressed.

The fruits of the argan tree are nut - sizes and may be round, oval or conical in shape. The fruits are covered by a thick peel which covers the fleshy pulp. The pulp surrounds a hard-shelled nut which represents approximately 25% of the weight of the fresh fruit.

Contained within the nut are one to three argan oil-rich kernels. Argan oil is extracted from the kernels, with yields varying from 30% to 55% depending on the extraction method used.

Extraction of the kernels is key to the argan oil production process. In order to extract the kernels, the argan fruits are first dried in the open air and then the fleshy pulp of the fruit is removed. Sometimes the flesh is removed mechanically without the need to dry the fruits. The flesh is usually used as feed for animals.

The next stage involves cracking the argan nut to obtain the argan kernels. Attempts to mechanize this process have been unsuccessful and therefore it is still carried out by hand, making it a time-consuming and labour - intensive process.

Kernels used to make argan oil for food use, culinary argan oil, are then gently roasted. After the argan kernels have cooled down, they are ground and pressed. The brown - colored mash expels pure, unfiltered argan oil. After this, unfiltered argan oil is decanted into vessels. The press cake remaining after the argan oil has been expelled is protein-rich and is frequently used as feed for cattle.

Cosmetic argan oil is produced almost identically, although the argan kernels are not roasted to avoid an excessively nutty scent.

After pressing, the argan oil is decanted and left to rest for approximately two weeks. This allows solids suspended in the argan oil to settle to the bottom, creating a natural sediment. The clearer argan oil may then be further filtered depending on the clarity and degree of purity required. Pure argan oil may contain some sediment. This is a natural part of the production process and does not affect the quality of the argan oil.

4 - Properties and uses

Fatty acid	Percentage
Oleic	42 %
Linoleic	36 %
Palmitic	12 %
Stearic	6 %
Myristic acid	3 %

Argan oil has a relative density at 20 $^{\circ}$ C ranging from 0.906 to 0.919.

Argan oil contains tocopherols (vitamin E), phenols, carotenes, squalene, and fatty acids, (80 % un saturated fatty acids The main natural phenols in argan oil are caffeic acid, oleuropein, vanillic acid, tyrosol, catechol, resorcinol, (-)-epicatechin and (+) - catechin.

Depending on the extraction method, argan oil may be more resistant to oxidation than olive oil.

4 – 1 - Culinary uses

Culinary argan oil (argan food oil) is used for dipping bread, on couscous, salads and similar uses. Amlou, a thick brown paste with a consistency similar to peanut butter, is produced by grinding roasted almond and argan oil using stones, mixed with honey and is used locally as a bread dip.

Various claims about the beneficial effects on health due to the consumption of argan oil have been made. Researchers have concluded that daily consumption of argan oil is 'highly likely' to be one factor helping the prevention of various cancers, cardiovascular diseases and obesity.

The results of a nutritional intervention study, in which volunteers were given either argan oil or animal fats (butter) in their diet, were published in 2005. The results showed that regular dietary intake of argan oil led to reduced levels of harmful cholesterol and

triglycerides in the blood, compared to a diet with regular intake of animal fats.

4 – 2 - Cosmetic uses

Unroasted argan oil is traditionally used as a treatment for skin diseases and as a cosmetic oil for skin and hair:

"In cosmetics, argan oil is advocated as moisturizing oil, against juvenile acne and flaking of the skin as well as for nourishing the hair. This oil has also medicinal uses against rheumatism and the healing of burns ... Externally, argan oil is used ... for hair as brilliantine, to fortify and ... in the treatment of wrinkled or scaly dry skin".

Argan oil has become increasingly popular for cosmetic use. The number of personal-care products on the US market with argan oil as an ingredient increased from just two in 2007 to over one hundred by 2011. It is sometimes mixed with pomegranate seed oil due to its anti oxidizing benefits ,with vendors promoting this blend as an all - in - one serum both for skin and hair. Argan oil is also sold without additives as a natural skincare and hair care product.

The increasing popularity of argan oil has prompted the Moroccan government to plan for increased production: its aim is to increase annual production from approximately 2,500 to 4,000 tones by 2020.

5 - Impacts

The production of argan oil is beginning to have noticeable environmental and social impacts. Argan oil production means that argan trees are now seen as a valuable resource. This has led to their preservation with a knock-on impact on the environment. The labourintensive nature of argan oil production, now frequently carried out by women's co-operatives, has provided a steady income for many women and their families, improved the social status of some women and has encouraged producers of other agricultural products to examine the co-operative model.

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5 – **1** - Environmental impacts

The Argan tree provides food, shelter and protection from desertification. The tree has deep roots which help prevent desert encroachment. The canopy of the argan tree also provides shade for other agricultural products and its leaves and fruit provide food for animals.

The argan tree also helps landscape stability, helping to prevent soil erosion, providing shade for pasture grasses and helping to replenish aquifers.

Producing argan oil has helped to protect argan trees from being cut down. In addition, regeneration of the Arganeraie has also been carried out: in 2009 an operation to plant 4,300 argan plants was launched in Meskala in the province of Essaouira.

Artichoke Oil

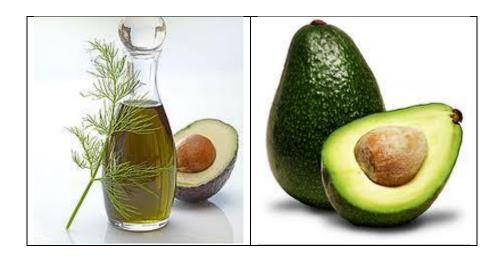


Artichoke oil is extracted from the seeds of the *Cynara cardunculus* (cardoon). It is similar in composition to safflower and sunflower oil. The fatty acid composition of artichoke oil is :

Fatty acid	Percentage %
Linoleic	60
Oleic	25
Palmitic	12
Stearic	3

Recently, artichoke oil has attracted some attention as a possible source of biodiesel.

Avocado Oil



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1 Introduction
 2 Uses
 3 Properties

1 - Introduction

Avocado oil is an edible oil pressed from the fruit of the *Persea americana* (avocado). As a food oil, it is used as an ingredient in other dishes, and as a cooking oil. It is also used for lubrication and in cosmetics, where it is valued for its supposed regenerative and moisturizing properties.

It has an unusually high smoke point, both unrefined and especially when refined. The smoke point of the unrefined form is 249 °C and the refined form can reach 271 °C. The exact smoke point depends heavily on the quality of refinement and the way the oil has been handled up until reaching store shelves and subsequent kitchens.

2 - Uses

Avocado oil functions well as a carrier oil for other flavors. It is high in monounsaturated fats and vitamin E. Avocado oil also enhances the absorption of carotenoids and other nutrients. Because the avocado is a year-round crop, some olive oil processing facilities, particularly in Australia and New Zealand, process olive oil during the olive season, and avocado oil during the rest of the year.

Avocado oil was originally, and still is, extracted for cosmetic use because of its very high skin penetration and rapid absorption. Following pre - drying of the avocado flesh to remove as much water as possible (≈ 65 % water in avocado flesh), avocado oil for cosmetics is traditionally extracted with solvents at elevated temperatures. After extraction, the oil for application in skin care products is usually refined, bleached, and deodorized, resulting in an odorless yellow oil. Like extra virgin olive oil, cold - pressed avocado oil is unrefined and so retains the flavor and color characteristics of the fruit flesh.

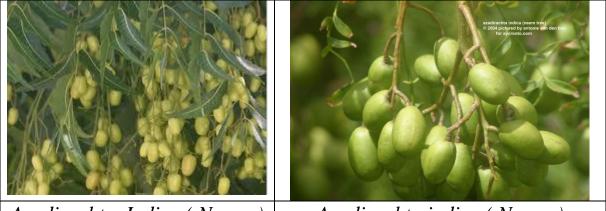
3 - Properties

Extra virgin avocado oil from the Hass cultivar has a characteristic flavor, is high in monounsaturated fatty acids, and has a high smoke point ($\geq 250 \text{ °C}$), making it a good oil for frying. 'Hass' cold-pressed avocado oil is a brilliant emerald green when extracted; the color is attributed to high levels of chlorophylls and carotenoids extracted into the oil . Cold - pressed 'Hass' avocado oil has been described as having an avocado flavor, with grassy and butter / mushroom - like flavors. Other varieties may produce oils of slightly different flavor profile as has been seen with 'Fuerte,' which has been described as having more mushroom and less avocado flavor.^[5] As a culinary oil, avocado oil compares well with olive oil. It has a similar monounsaturated fat profile which helps to protect the oil from breakdown during heating. Avocado oil is naturally low acidic, helping to increase smoke point. A virgin avocado oil, characterized by a deep emerald green color (from avocado's chlorophyll content) can safely be heated to degree of 191 °C — similar to a high quality virgin olive oil. A refined avocado oil, with a higher than 260 °C smoke point can safely be used to conduct almost any high heat cooking application including baking, stir-fry, deep-fry, sear, barbecue, roast and saute. Avocado oil is relatively new to the culinary world and is often mislabeled in regards to smoke point. It is

important to note that like all oils, the more refined, the higher the smoke point. Virgin avocado oil does not have a significantly higher smoke point than virgin olive oil.

Avocado oil is one of few edible oils not derived from seeds; it is pressed from the fleshy pulp surrounding the avocado pit.^[7]

Azadirachta Indica (Neem)



Azadirachta Indica (Neem)

Azadirachta indica (Neem)

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 - 7.4 Other uses
- 8 Association with Hindu festivals in India
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1 - Introduction

Azadirachta indica, also known as Neem, Nimtree, and Indian Lilac is a tree in the mahoganyfamilyMeliaceae. It is one of two species in the genus *Azadirachta*, and is native to India, Pakistan, and Bangladesh growing in tropical and semi-tropical regions. Neem tree is the official tree of the Sindh Province and is very common in all cities of Sindh, there are projects underway for planting this tree in all over Sindh Province. Neem trees also grow in islands in the southern

part of Iran where it is called "Cherish" چریش "or Azad derakht " آزاد" in Persian. Its fruits and seeds are the source of neem oil.

Neem is a fast-growing tree that can reach a height of 15-20 metres, rarely to 35 - 40 metres. It is ever green, but in severe drought it may shed most or nearly all of its leaves. The branches are wide spread. The fairly dense crown is roundish and may reach a diameter of 15-20 metres in old, free-standing specimens.

Scientific classification	
Kingdom:	Plantae
Division:	Magnoliophyta
Order:	Sapindales
Family:	Meliaceae
Genus:	Azadirachta
Species:	A. indica
Binomial name	
Azadirachta indica A.Juss.	
Synonyms	
Antelaea	azadirachta (L.)
Adelb.	1• 1 / T
<i>Melia azadirachta</i> L. <i>Melia indica</i> (A. Juss.) Brandis	

2 - Name in other languages

The English name *neem* is borrowed from Hindi. The Urdu, Arabic, and Nepali names are the same. Other vernacular names include Nimm in Sindhi and Punjabi, *Nim* in Bengali, Vembu (Tamil), Arya Veppu (Malayalam), Azad Dirakht (Persian), Nimba, Arishta, Picumarda (Sanskrit, Oriya), Limdo (Gujarati language) Kadu-Limba (Marathi), Dongoyaro (in some Nigerian languages -- Yoruba),

3 – Leaves

The opposite, pinnate leaves are 20 - 40 centimetres long, with 20 to 31 medium to dark green leaflets about 3 - 8 centimetres long. The terminal leaflet is often missing. The petioles are short. Leaves have been used medicinally since ancient times in India, Pakistan to give baths to children suffering from skin diseases. The leaves are used in this manner that first they are washed thoroughly. Then 5-10 leaves along with the branch are boiled till the water turns green The water is then used for varying purposes. Elders find it useful in controlling high blood sugar level and is said to clean up the blood. Neem is also used to give baths to the Muslim dead. Neem leaves are dried in India, Pakistan and placed in cupboards to prevent insects eating the clothes and also while storing rice in tins(natural pesticide). Neem leaves are dried and burnt in the tropical regions of Pakistan to keep away mosquitoes. These leaves are also used in many Indian festivals (by making them into garlands).

4 – Flowers

The (white and fragrant) flowers are arranged axillary, normally in more - or - less drooping panicles which are up to 25 centimetres long. The inflorescences, which branch up to the third degree, bear from 150 to 250 flowers. An individual flower is 5-6 millimetres long and 8 -11 millimetres wide. Protandrous, bisexual flowers and male flowers exist on the same individual. Its leaf is approximately 5 to 10 cm. long

5 – Fruit

The fruit is a smooth (glabrous) olive - like drupe which varies in shape from elongate oval to nearly roundish, and when ripe are 1.4 - 2.8 centimetres by 1.0 - 1.5 centimetres. The fruit skin (exocarp) is thin and the bitter-sweet pulp (mesocarp) is yellowish-white and very fibrous. The mesocarp is 0.3-0.5 centimetre (0.12-0.20 in) thick. The white, hard inner shell (endocarp) of the fruit encloses one, rarely two or three, elongated seeds (kernels) having a brown seed coat.

The neem tree is very similar in appearance to its relative, the Chinaberry (Melia azedarach). The Chinaberry tree is toxic to most animals, especially to fish, but birds are known to gorge themselves on the Chinaberries, the seeds passing harmlessly through their unique digestive systems.

6 – Ecology

The neem tree is noted for its drought resistance. Normally it thrives in areas with sub-arid to sub-humid conditions, with an annual rainfall 400 - 1,200 millimetres . It can grow in regions with an annual rainfall below 400 mm, but in such cases it depends largely on ground water levels. Neem can grow in many different types of soil, but it thrives best on well drained deep and sandy soils. It is a typical tropical to subtropical tree and exists at annual mean temperatures between 21– 32 °C. It can tolerate high to very high temperatures and does not tolerate temperature below 4 °C . Neem is a life-giving tree, especially for the dry coastal, southern districts of India and Pakistan. It is one of the very few shade-giving trees that thrive in the droughtprone areas. The trees are not at all delicate about the water quality and thrive on the merest trickle of water, whatever the quality. In India and tropical countries where the Indian diaspora has reached, it is very common to see neem trees used for shade lining the streets, around temples, schools & other such public buildings or in most people's back yards. In many countries such as Ecuador, Haiti and Venezuela the shade is the principal benefit so far commonly attributed to the neem. In very dry areas the trees are planted in large tracts of land.

6-1 - Weed status

Neem is considered a weed in many areas, including some parts of the Middle East, and most of Sub-SaharanAfrica including West Africa and Indian Ocean states. Ecologically, it survives well in similar environments to its own, for example replacing the babulacacia tree from India with African acacia.

7 - Uses

7 - 1 - As a vegetable

The tender shoots and flowers of the neem tree are eaten as a vegetable in India. A souplike dish called *Veppampoo Rasam* (Tamil) (translated as "neem flower rasam") made of the flower of neem is prepared in Tamil Nadu. In West Bengal, young neem leaves are fried in oil with tiny pieces of eggplant (brinjal). The dish is called *nim*

begun and is the first item during a Bengali meal that acts as an appetizer. It is eaten with rice.

Neem is used in parts of mainland Southeast Asia, particularly in Cambodia, Laos (where it is called *kadao*), Thailand (where it is known as *sadao* or *sdao*), Myanmar (where it is known as *tamar*) and Vietnam (where it is known as $s?u \ d\hat{a}u$ and is used to cook the salad $g?i \ s?u \ d\hat{a}u$). Even lightly cooked, the flavour is quite bitter and the food is not enjoyed by all inhabitants of these nations, though it is believed to be good for one's health. Neem gum is a rich source of protein. In Myanmar, young neem leaves and flower buds are boiled with tamarind fruit to soften its bitterness and eaten as a vegetable. Pickled neem leaves are also eaten with tomato and fish paste sauce in Myanmar.

7 - 2 - Traditional medicinal use

In India, the plant is variously known as "Sacred Tree," "Heal All," "Nature's Drugstore," "Village Pharmacy" and "Panacea for all diseases". Products made from neem trees have been used in India for over two millennia for their medicinal properties: neem products are believed to be anthelmintic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative . It is considered a major component in Ayurvedic and Unani medicine and is particularly prescribed for skin disease . Neem oil is also used for healthy hair, to improve liver function, detoxify the blood, and balance blood sugar levels . However, insufficient research has been done to assess the purported benefits of neem . In adults, short-term use of neem is safe, while long-term use may harm the kidneys or liver; in small children, neem oil is toxic and can lead to death Neem may also cause miscarriages, infertility, and low blood sugar.

7 - 3 - Safety issues

There has been reports that Neem oil can cause some form of toxic encephalopathy and ophthalmopathy if consumed in large quantities.

Pest and disease control Neem is a key ingredient in nonpesticidal management (NPM), providing a natural alternative to synthetic pesticides. Neem seeds are ground into a powder that is soaked overnight in water and sprayed onto the crop. To be effective, it is necessary to apply repeatedly, at least every ten days. Neem does not directly kill insects on the crop. It acts as an anti-feedant, repellent, and egg-laying deterrent, protecting the crop from damage. The insects starve and die within a few days. Neem also suppresses the hatching of pest insects from their eggs. Neem cake is often sold as a fertilizer.

7 - 4 - Other uses

Neem oil is used for preparing cosmetics such as soap, neem shampoo, balms and creams as well as toothpaste.

The stem of neem is used as a toothbrush and is called datun.

Besides its use in traditional Indian medicine, the neem tree is of great importance for its anti-desertification properties and possibly as a good carbon dioxide sink .

Practitioners of traditional Indian medicine recommend that patients with chicken pox sleep on neem leaves.

Neem gum is used as a bulking agent and for the preparation of special purpose food.

Traditionally, slender neem branches have been chewed to clean one's teeth. Neem twigs are still collected and sold in markets for this use, and in rural India one often sees youngsters in the streets chewing on neem twigs.

Neem blossoms are used in Andhra Pradesh, Tamil Nadu and Karnataka to prepare Ugadi pachhadi. "*Bevina hoovina gojju*" (a type of curry prepared with neem blossoms) is common in Karnataka throughout the year. Dried blossoms are used when fresh blossoms are not available. In Tamil Nadu, a rasam (veppam poo rasam) made with neem blossoms is a culinary specialty.

A mixture of neem flowers and bella (jaggery or unrefined brown sugar) is prepared and offered to friends and relatives, symbolic of sweet and bitter events in the upcoming new year. Cosmetics : Neem is perceived in India as a beauty aid. Powdered leaves are a major component of at least one widely used facial cream. Purified neem oil is also used in nail polish & other cosmetics.

Bird repellent:Neem leaf boiled water can be used as a very cost effective bird repellent measure, especially for sparrow.

Lubricants : Neem oil is non drying and it resists degradation better than most vegetable oils. In rural India, it is commonly used to grease cart wheels.

Fertilizers : Neem has demonstrated considerable potential as a fertilizer. Neem cake is widely used to fertilize cash crops particularly sugarcane & vegetables. Ploughed into the soil, it protects plant roots from nematodes&white ants, probably due to its contents of the residual limonoids. In Karnataka, people grow the tree mainly for its green leaves & twigs, which they puddle into flooded rice fields before the rice seedlings are transplanted.

Resin : An exudate can be tapped from the trunk by wounding the bark. This high protein material is not a substitute for polysaccharide gum, such as gum arabic. It may however, have a potential as a food additive, and it is widely used in South Asia as "Neem glue".

Bark : Neem bark contains 14 % tannin, an amount similar to that in conventional tannin yielding trees (such as Acacia decurrens). Moreover, it yields a strong, coarse fibre commonly woven into ropes in the villages of India.

Honey : In parts of Asia neem honey commands premium prices & people promote apiculture / apiary by planting neem trees.

Soap : India's supply of neem oil is now used mostly by soap manufacturers. Although much of it goes to small scale speciality soaps, large scale producers also use it, mainly because it is cheap. Generally, the crude oil is used to produce coarse laundry soaps.

8 - Association with Hindu festivals in India

Neem leaf or bark is considered an effective pitta pacifier due to its bitter taste. Hence, it is traditionally recommended during early summer in Ayurveda (that is, the month of Chaitra as per the Hindu Calendar which usually falls in the month of March – April).



In the Indian states of Andhra Pradesh and Karnataka, Neem flowers are very popular for their use in 'Ugadi Pachhadi' (soup-like pickle), which is made on Ugadi day. In Karnataka, a small amount of Neem and Jaggery(Bevu-Bella) is consumed on Ugadi day, the Kannada new year, indicating that one should take in both the bitter and sweet things in life.

During Gudi Padva, which is the New Year in the state of Maharashtra, the ancient practice of drinking a small quantity of neem juice or paste on that day, before starting festivities, is found. As in many Hindu festivals and their association with some food to avoid negative side-effects of the season or change of seasons, neem juice is associated with Gudi Padva to remind people to use it during that particular month or season to pacify summer pitta.

In Tamilnadu during the summer months of April to June, the Mariamman temple festival is a thousand year old tradition. The Neem leaves and flowers are the most important part of the Mariamman festival. The goddess Mariamman statue will be garlanded with Neem leaves and flowers. During most occasions of celebrations and weddings the people of Tamilnadu adorn their surroundings with the Neem leaves and flowers as a form of decoration and also to ward off evil spirits and infections.

In the eastern coastal state of Odisha the famous Jagannath temple deities are made up of Neem heart wood along with some other essential oils and powders.

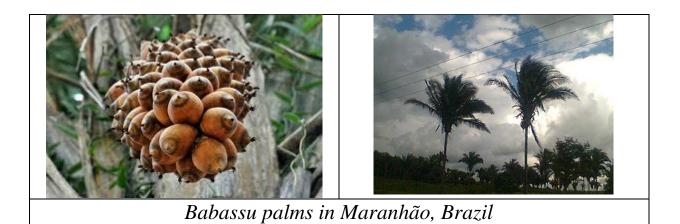
9 - Chemical compounds

Salimuzzaman Siddiqui was the first scientist to bring the anthelmintic, antifungal, antibacterial, and antiviral constituents of the Neem tree to the attention of natural products chemists. In 1942, he extracted three bitter compounds from neem oil, which he named as nimbin, nimbinin, and nimbidin respectively. The process involved extracting the water insoluble components with ether, petrol ether, ethyl acetate and dilute alcohol. The provisional naming was *nimbin* (sulphur-free crystalline product with melting point at 205 °C, empirical composition C₇H₁₀O₂), *nimbinin* (with similar principle, melting at 192 °C), and *nimbidin* (cream-coloured containing amorphous sulphur, melting at 90–100 °C). Siddiqui identified *nimbidin* as the main active antibacterial ingredient, and the highest yielding bitter component in the neem oil . These compounds are stable and found in substantial quantities in the Neem. They also serve as natural insecticides.

10 - Genome and Transcriptomes

Neem genome and transcriptomes from various organs have been sequenced, analyzed and published by Ganit Labs in Bangalore, India.

Babassu Oil



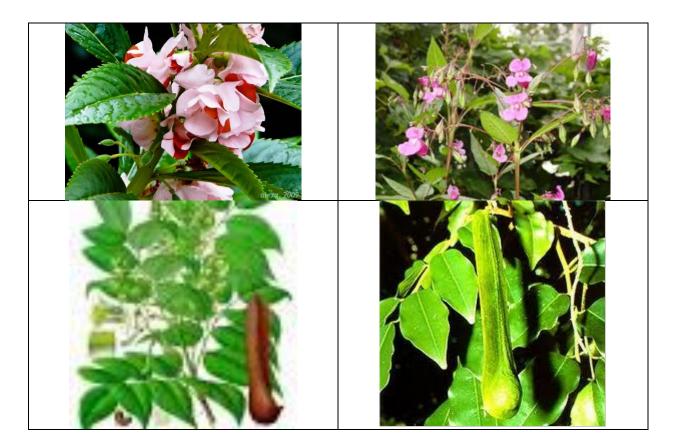
Babassu oil or cusi oil is a clear light yellow vegetable oil extracted from the seeds of the babassu palm (*Attalea speciosa*), which grows in the Amazon region of South America. It is a nondrying oil used in food, cleaners and skin products. This oil has properties similar to coconut oil and is used in much the same context. It is increasingly being used as a substitute for coconut oil. Babassu oil is about 70% lipids, in the following proportions :

Fatty acid	Percentage %
Lauric	50.0
Myristic	20.0
Palmitic	11.0
Oleic	10.0
Stearic	3.5

Lauric and myristic acids have melting points relatively close to human body temperature, so babassu oil can be applied to the skin as a solid that melts on contact. This heat transfer can produce a cooling sensation. It is an effective emollient.

During February 2008, a mixture of babassu oil and coconut oil was used to partially power one engine of a Boeing 747, in a biofuel trial sponsored by Virgin Atlantic Airways.

Balsam oil



Balsam oil, also called Peru Balsam or Balsam Peru oil, is an essential oil of *Myroxylon pereirae*.

Myroxylon pereirae is a native of South America.

Therefore references to "Balsam Oil" (or "Oil of Balsam") in the Bible or other ancient Middle Eastern texts are most likely to be to what later became known as "Balsam of Mecca" (*Commiphora gileadensis*) q.v.

Balsam oil originated in ancient Greece and it is still made in rural areas. Balsamo in Greek means remedy, relief. Balsam oil is made out of a yellow flowering plant that grows on its own. In ancient times they used it as a remedy for burns, for skin irritations, and for cosmetic purposes. Today it is sold in few Greek pharmacies

Bayberry Wax



Contents

1 Introduction
 2 Uses
 3 Properties

1 - Introduction

Bayberry wax is an aromatic green vegetable wax. It is removed from the surface of the fruit of the bayberry (wax-myrtle) shrub *Myrica faya* by boiling the fruits in water and skimming the wax from the surface of the water. It is made up primarily of esters of lauric, myristic, and palmitic acid.

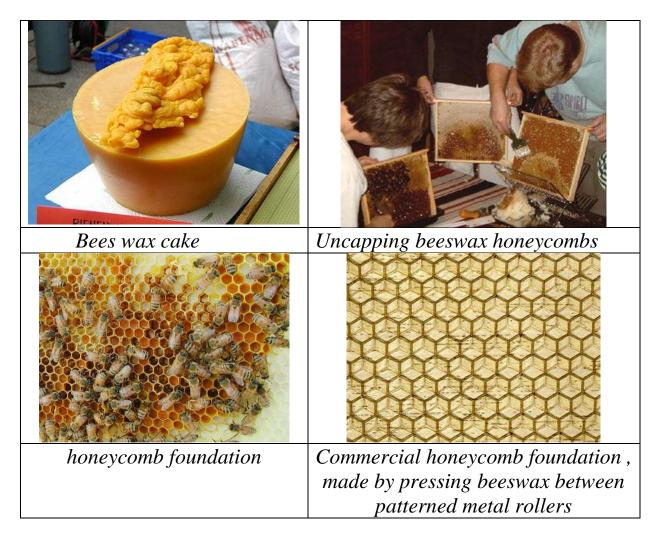
2 - Uses

Bayberry wax is used primarily in the manufacture of candles and other products where the distinctive fragrance is desirable.

3 - Properties

Melting point = 45 °CAcid number = Saponification value = Iodine number =

Bees Wax



Contents

- 1 Introduction
- 2 Production
- 3 Processing
- 4 Physical characteristics
- 5 Uses as a product
- 6 Historical uses
- 7 Slang

1 - Introduction

Beeswax is a natural wax produced in the bee hive of honey bees of the genus *Apis*. It is mainly esters of fatty acids and various long chain alcohols.

Small amounts of beeswax have food and flavoring applications, and are edible in the sense of having similar toxicity to undigestable plant waxes. However, the wax monoesters in beeswax are poorly hydrolysed in the guts of humans and mammals, and are therefore of no significant food value.

2 – **Production**

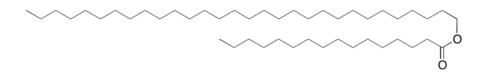
The wax is formed by worker bees, which secrete it from eight wax-producing mirror glands on the inner sides of the sternites (the ventral shield or plate of each segment of the body) on abdominal segments 4 to 7. The sizes of these wax glands depend on the age of the worker and after daily flights these glands begin to gradually atrophy. The new wax scales are initially glass-clear and colourless (see illustration), becoming opaque after mastication by the worker bee. The wax of honeycomb is nearly white, but becomes progressively more yellow or brown by incorporation of pollen oils and propolis . The wax scales are about 3 millimeters across and 0.1 millimeters thick, and about 1,100 are required to make a gram of wax.

Honey bees use the beeswax to build honeycomb cells in which their young are raised with honey and pollen cells being capped for storage. For the wax-making bees to secrete wax, the ambient temperature in the hive has to be 33 to 36 °C . To produce their wax, bees must consume about eight times as much honey by mass. Typically, for a honey beekeeper, 6.66 to 8.80 pounds of honey yields 1 pound of wax . It is estimated that bees collectively fly 150,000 miles, roughly six times around the earth, to yield one pound of beeswax (530,000 km/kg).

3 – Processing

When beekeepers extract the honey, they cut off the wax caps from each honeycomb cell with an uncapping knife or machine. Its color varies from nearly white to brownish, but most often a shade of yellow, depending on purity and the type of flowers gathered by the bees. Wax from the brood comb of the honey bee hive tends to be darker than wax from the honeycomb. Impurities accumulate more quickly in the brood comb . Due to the impurities, the wax has to be rendered before further use. The left overs are called slum gum. The wax may further be clarified by heating in water. As with petroleum waxes, it may be softened by dilution with vegetable oil to make it more workable at room temperature.

4 - Physical characteristics



Triacontanyl palmitate, a wax ester, is a major component of beeswax.

Beeswax is a tough wax formed from a mixture of several compounds.

Wax Content Type	Percent %
Hydrocarbons	14
Monoesters	35
Di esters	14
Tri esters	3
Hydroxy mono esters	4
Hydroxy poly esters	8
Acid esters	1
Acid polyesters	2
Free acids	12
Free alcohols	1
Unidentified	6

An approximate chemical formula for beeswax is $C_{15}H_{31}COOC_{30}H_{61}$. Its main components are palmitate , palmitoleate, and oleate esters of long- chain (30 - 32 carbons) aliphatic alcohols, with the ratio of triacontanyl palmitate $CH_3(CH_2)_{29}O-CO-(CH_2)_{14}CH_3$ to cerotic acid $CH_3(CH_2)_{24}COOH$, the two principal components, being 6:1. Beeswax can be classified generally into European and

Oriental types. The saponification value is lower (3 - 5) for European beeswax, and higher (8-9) for Oriental types.

Bees wax has a relatively low melting point range of 62 to 64 $^{\circ}$ C If bees wax is heated above 85 $^{\circ}$ C discoloration occurs. The flash point of bees wax is 204.4 $^{\circ}$ C. Density at 15 $^{\circ}$ C is 958 to 970 kg / m³.

5 - Uses as a product



Beeswax candles and figures

Bees wax has many and varied uses. Primarily it is used by the bees in making their honeycomb foundations. Apart from this use by bees themselves, the use of beeswax has become widespread and varied. Purified and bleached beeswax is used in the production of food, cosmetics and pharmaceuticals. The three main types of beeswax products are: yellow, white and beeswax absolute. Yellow beeswax is the crude product obtained from the honeycomb, white beeswax is yellow beeswax that has been bleached and beeswax absolute is yellow beeswax treated with alcohol. In food preparation it is used as a coating for cheese; by sealing out the air, protection is given against ageing. Beeswax may also be used as a food additive E901, in small quantities acting as a (glazing agent), which serves to prevent water loss, or used to provide surface protection for some fruits. Soft gelatin capsules and tablet coatings may also see the use of E901. Beeswax is also a common ingredient of natural chewing gum.

There has been a growing use of beeswax in skin care and cosmetics. A German study found beeswax to be superior to similar barrier creams (usually mineral oil based creams such as petroleum jelly), when used according to its protocol. Beeswax is used in lip balm, lip gloss, hand creams and moisturizers; and in cosmetics such as eye shadow, blush and eye liner. Beeswax is an important ingredient in moustache wax, as well as in hair pomades, which make hair look sleek and shiny.

Candle - making has long involved the use of beeswax which is highly flammable, and this was the material traditionally prescribed (in large part), for the making of the Paschal Candle or "Easter Candle". It is further recommended for the making of other candles used in the liturgy of the Roman Catholic Church. Beeswax is also the candle constituent of choice in the Orthodox Church.

From a relatively small production of about 10,000 tons a year, a number of different niches are catered to : beeswax is an ingredient in surgical bone wax, which is used during surgery to control bleeding from bone surfaces; shoe polish and furniture polish can both use beeswax as a component, dissolved in turpentine or sometimes blended with linseed oil or tung oil; modeling waxes can also use beeswax as a component; pure beeswax can also be used as an organic surfboard wax. Bees wax blended with pine rosin, can serve as an adhesive to attach reed plates to the structure inside a squeeze box. It can also be used to make Cutler's resin, an adhesive used to glue handles onto cutlery knives. It is used in Eastern Europe in egg decoration; it is used for writing, via resist dyeing, on batik eggs (as in pysanky) and for making beaded eggs. Bees wax is used by percussionists to make a surface on tambourines for thumb rolls. It can also be used as a metal injection moulding binder component along with other polymeric binder materials.^[14] Bees wax was formerly used in the manufacture of phonograph cylinders.

6 - Historical uses

Bees wax was the among the first plastics to be used, alongside other natural polymers such as gutta - percha, horn, tortoiseshell and shellac. For thousands of years Bees wax has had a wide variety of applications, it has been found in the tombs of Egypt, in wrecked Viking ships and in Roman ruins. Bees wax never goes bad and can be heated and reused. As a modeling material in the lost - wax casting process, or *cire perdue*.

For wax tablets used for a variety of writing purposes.

In Encaustic paintings such as the Fayum mummy portraits.^[16]

Used in bow making (see English longbow).

Used to strengthen and preserve sewing thread.

As a component of sealing wax

To form the mouthpieces of a didgeridoo, and the frets on the Philippine kutiyapi - a type of boat lute.

As a sealant or lubricant for bullets in cap and ball and firearms

To stabilize the military explosive Torpex - before being replaced by a petroleum-based product.

In producing Javanese batik.

An ancient form of dental tooth filling.

7 - Slang

In the phrase "mind your own bee's wax," meaning "mind your own business", where it is probably a corruption of the word business.

Ben Oil





Contents

1 Introduction

- 2 History
 - 2.1 Greece
 - 2.2 Rome
 - 2.3 Alexandria
 - 2.4 Europe
 - 2.5 Grasse

1 - Introduction

Ben oil is pressed from the seeds of the *Moringa oleifera*, known variously as the horse radish tree, ben oil tree, or drumstick tree. The oil is characterized by an unusually long shelf life and a mild, but pleasant taste. The name of the oil is derived from the high quantity of behenic acid. The oil's components are :

Component	Percentage %
Oleic acids	65.7
Palmitic acid	9.3
Stearic acid	7.4
Behenic acid	8.6

Seeds offer a relatively high yield of 22 - 38 % oil. Ben oil has been used for thousands of years as a perfume base, and continues to be used in the capacity today. The oil can also be used as a fuel.

2 – History

2 – 1 – Greece

The ancient Greeks manufactured ben oil and other herbal oils. Theophrastos, in the fourth century BC, had very strong opinions about which oils to use to make perfumes, and ben oil was firmly at the top of the list.

2 - 2 - Rome

In Rome, around 70 AD, Pliny the Elder described the tree and its fruits under the name *myrobalanum* after the Greek word *myron* meaning "ointment". Around the same time Dioscorides described the fruit as *balanos myrepsike* (roughly "acorn shaped fruit well-suited for preparation of fragrant ointments"). He observed that "grinding the kernels, like bitter almonds, produces a liquid which is used instead of oil to prepare precious ointments." Dioscorides' recommendation was influential in promoting the "balanos" fruits and their oil for medicinal purposes.

2 – 3 – Alexandria

During the same era, Alexandria in Egypt had become the predominant center for the production of perfumes. This was still true when the Arabs captured the city in 642 AD and became familiar with both the fruits and the oil. The Arabic word for myrobola didn't include just the fruit, but also the oil and the herbal oils extracted from it. That Arabic herbal oils usually included myrrh resin, Indian cardamom and other types of cardamom lead to a common misunderstanding: Portuguese botanists who started exploring the Far East in the 16th century wasted years trying to find the tree that produced the fragrant myrobalan oil before they realized that it was just an extract of a plant which they already knew.

2 – 4 – Europe

Another misunderstanding arose when a new Malaysian fruit reached Europe through the Arabs. The Europeans confused it with myrobalum and called the new fruits "myrobalans". The problem was only solved by simply renaming the old fruit, borrowing the Arabic $b\hat{a}n$ for the new name. It was enough to separate the two products, but confusion was still common for several hundred years since both were used in medicines. Naturally the ben fruits of antiquity were not the same as the ben fruits of modern times.

2-5-Grasse

Interest in ben oil in Jamaica began in the first half of the 19th century. The oil had a reputation for being extremely durable and was often used to lubricate fine mechanics (clocks, for example). In 1848 the oil was analyzed for the first time and a new type of saturated fatty acid was found and was given the name behenic acid.

At the perfume manufactury in Grasse, France, ben oil was used as a maceration oil for herbal oil until it was replaced by cheaper types of oil, alcohol and newly invented solvent agents in the 1870s. In the 1930s it was again put to use, but was then again forgotten as a component of perfume making, probably mostly due to political turmoil in many European colonies. Ben oil was forgotten for much of the rest of the 20th century as a watch oil.

Bertolli

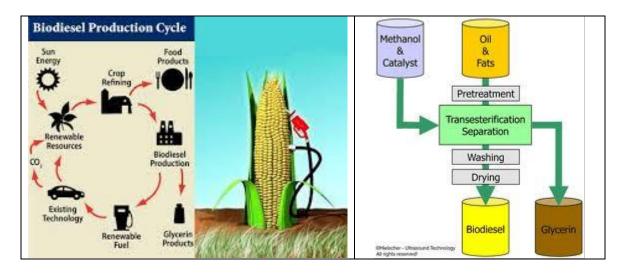


Bertolli is a food brand. Originating as an Italian brand of extravirgin olive oil, it grew into an international brand of Italian and Mediterranean food. The company was founded by Francesco Bertolli in 1865, in Lucca, Tuscany. The company was bought by Unilever.

Bertolli is known for its olive oil, in which it was the global market leader, but has now widened its range to include pasta sauces and ready meals. In 2008, Unilever sold the olive oil business to Grupo SOS, Spain's second - largest food group, for £500 m as part of its disposal of non-core businesses . The transaction included the sale of the Italian Maya, Dante, and San Giorgio olive oil and seed oil businesses, as well as the factory at Inveruno, Province of Milan, Lombardy. Unilever retained the Bertolli brand for all other categories including margarine, pasta sauces, and frozen meals. The frozen foods business under the Bertolli brand name was sold by Unilever to ConAgra Foods in August 2012.

Some controversy emerged in 2010 when Bertolli Extra Virgin Olive Oil was identified as one of the olive oils mislabeled as extra virgin in a study by University of California, Davis.^[4]

Biodiesel



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1 - Introduction

Biodiesel refers to a vegetable oil- or animal fat-based diesel fuel consisting of long - chain alkyl (methyl, ethyl, or propyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oil, animal fat (tallow) with an alcohol producing fatty acid esters.

Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel *converted* diesel engines. Biodiesel can be used alone, or blended with petro diesel in any proportions. Biodiesel can also be used as a low carbon alternative to heating oil.

The National Biodiesel Board (USA) also has a technical definition of "biodiesel" as a mono - alkyl ester.

2 - Blends



Biodiesel sample

Blends of biodiesel and conventional hydrocarbon - based diesel are products most commonly distributed for use in the retail diesel fuel marketplace. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix :

100 % biodiesel is referred to as B100, while
20 % biodiesel, 80 % petro diesel is labeled B20
5 % biodiesel, 95 % petro diesel is labeled B5
2 % biodiesel, 98 % petro diesel is labeled B2.

Blends of 20 % biodiesel and lower can be used in diesel equipment with no, or only minor modifications , although certain manufacturers do not extend warranty coverage if equipment is damaged by these blends. The B6 to B20 blends are covered by the ASTM D7467 specification.^[6] Biodiesel can also be used in its pure form (B100), but may require certain engine modifications to avoid maintenance and performance problems . Blending B100 with petroleum diesel may be accomplished by :

Mixing in tanks at manufacturing point prior to delivery to tanker truck

Splash mixing in the tanker truck (adding specific percentages of biodiesel and petroleum diesel)

In-line mixing, two components arrive at tanker truck simultaneously.

Metered pump mixing, petroleum diesel and biodiesel meters are set to X total volume, transfer pump pulls from two points and mix is complete on leaving pump.

3 – Applications

Biodiesel can be used in pure form (B100) or may be blended with petroleum diesel at any concentration in most injection pump diesel engines. New extreme high-pressure (29,000 psi) common rail engines have strict factory limits of B5 or B20, depending on manufacturer . Biodiesel has different solvent properties than petro diesel , and will degrade natural rubber gaskets and hoses in vehicles (mostly vehicles manufactured before 1992), although these tend to wear out naturally and most likely will have already been replaced with FKM, which is nonreactive to biodiesel. Biodiesel has been known to break down deposits of residue in the fuel lines where petro diesel has been used. As a result, fuel filters may become clogged with particulates if a quick transition to pure biodiesel is made. Therefore, it is recommended to change the fuel filters on engines and heaters shortly after first switching to a biodiesel blend.

3 -1 - Distribution

Since the passage of the Energy Policy Act of 2005, biodiesel use has been increasing in the United States.^[10] In the UK, the Renewable Transport Fuel Obligation obliges suppliers to include 5% renewable fuel in all transport fuel sold in the UK by 2010. For road diesel, this effectively means 5 % biodiesel (B5).

3 - 2 - Vehicular use and manufacturer acceptance

In 2005, Chrysler (then part of Daimler Chrysler) released the Jeep Liberty CRD diesels from the factory into the American market with 5% biodiesel blends, indicating at least partial acceptance of biodiesel as an acceptable diesel fuel additive.^[11] In 2007, DaimlerChrysler indicated its intention to increase warranty coverage to 20 % biodiesel blends if biofuel quality in the United States can be standardized.

The Volkswagen Group has released a statement indicating that several of its vehicles are compatible with B5 and B100 made from

rape seed oil and compatible with the EN 14214 standard. The use of the specified biodiesel type in its cars will not void any warranty.

Mercedes Benz does not allow diesel fuels containing greater than 5 % biodiesel (B5) due to concerns about "production short comings". Any damages caused by the use of such non - approved fuels will not be covered by the Mercedes-Benz Limited Warranty.

Starting in 2004, the city of Halifax, Nova Scotia decided to update its bus system to allow the fleet of city buses to run entirely on a fish-oil based biodiesel. This caused the city some initial mechanical issues, but after several years of refining, the entire fleet had successfully been converted.

In 2007, McDonalds of UK announced it would start producing biodiesel from the waste oil byproduct of its restaurants. This fuel would be used to run its fleet.

The 2014 Chevy Cruze Clean Turbo Diesel, direct from the factory, will be rated for up to B20 (blend of 20 % biodiesel / 80 % regular diesel) biodiesel compatibility

3 - 3 - Railway usage

British train operating company Virgin Trains claimed to have run the UK's first "biodiesel train", which was converted to run on 80 % petro diesel and 20 % biodiesel.

The Royal Train on 15 September 2007 completed its first ever journey run on 100 % biodiesel fuel supplied by Green Fuels Ltd. His Royal Highness, The Prince of Wales, and Green Fuels managing director, James Hygate, were the first passengers on a train fueled entirely by biodiesel fuel. Since 2007, the Royal Train has operated successfully on B100 (100% biodiesel).

Similarly, a state - owned short - line railroad in eastern Washington ran a test of a 25 % biodiesel / 75% petro diesel blend during the summer of 2008, purchasing fuel from a biodiesel producer sited along the railroad tracks. The train will be powered by biodiesel made in part from canola grown in agricultural regions through which the short line runs.

Also in 2007, Disneyland began running the park trains on B98 (98% biodiesel). The program was discontinued in 2008 due to storage issues, but in January 2009, it was announced that the park would then be running all trains on biodiesel manufactured from its own used cooking oils. This is a change from running the trains on soy-based biodiesel.

3 - 4 - Aircraft use

A test flight has been performed by a Czech jet aircraft completely powered on biodiesel . Other recent jet flights using biofuel, however, have been using other types of renewable fuels.

On November 7, 2011 United Airlines flew the world's first commercial aviation flight on a micro bialy derived biofuel using Solajet[™], Solazyme's algae - derived renewable jet fuel. The Eco - skies Boeing 737 - 800 plane was fueled with 40 percent Solajet and 60 percent petroleum-derived jet fuel. The commercial Eco-skies flight 1403 departed from Houston's IAH airport at 10:30 and landed at Chicago's ORD airport at 13:03.

3 - 5 - As a heating oil

Biodiesel can also be used as a heating fuel in domestic and commercial boilers, a mix of heating oil and biofuel which is standardized and taxed slightly differently than diesel fuel used for transportation. It is sometimes known as "bio heat" (which is a registered trademark of the National Biodiesel Board [NBB] and the National Oilheat Research Alliance [NORA] in the U.S., and Columbia Fuels in Canada). Heating biodiesel is available in various blends. ASTM 396 recognizes blends of up to 5 percent biodiesel as equivalent to pure petroleum heating oil. Blends of higher levels of up to 20 % biofuel are used by many consumers. Research is underway to determine whether such blends affect performance.

Older furnaces may contain rubber parts that would be affected by biodiesel's solvent properties, but can otherwise burn biodiesel without any conversion required. Care must be taken, however, given that varnishes left behind by petro diesel will be released and can clog pipes- fuel filtering and prompt filter replacement is required. Another approach is to start using biodiesel as a blend, and decreasing the petroleum proportion over time can allow the varnishes to come off more gradually and be less likely to clog. Thanks to its strong solvent properties, however, the furnace is cleaned out and generally becomes more efficient . A technical research paper describes laboratory research and field trials project using pure biodiesel and biodiesel blends as a heating fuel in oil - fired boilers. During the Biodiesel Expo 2006 in the UK, Andrew J. Robertson presented his biodiesel heating oil research from his technical paper and suggested B20 biodiesel could reduce UK household CO_2 emissions by 1.5 million tons per year.

A law passed under Massachusetts Governor Deval Patrick requires all home heating diesel in that state to be 2 % biofuel by July 1, 2010, and 5 % biofuel by 2013 . New York City has passed a similar law.

3 - 6 - Cleaning Oil Spills

With 80 - 90 % of oil spill costs invested in shoreline cleanup, there is a search for more efficient and cost - effective methods to extract oil spills from the shorelines, Biodiesel has displayed its capacity to significantly dissolve crude oil, depending on the source of the fatty acids. In a laboratory setting, oiled sediments that simulated polluted shorelines were sprayed with a single coat of biodiesel and exposed to simulated tides. Biodiesel is an effective solvent to oil due to its methyl ester component, which considerably lowers the viscosity of the crude oil. Additionally, it has a higher buoyancy than crude oil, which later aids in its removal. As a result, 80 % of oil was removed from cobble and fine sand, 50 % in coarse sand, and 30 % in gravel. Once the oil is liberated from the shoreline, the oil - biodiesel mixture is manually removed from the water surface with skimmers. Any remaining mixture is easily broken down due to the high biodegradability of biodiesel, and the increased surface area exposure of the mixture.

3 - 7 - Biodiesel in Generators

In 2001, UC Riverside installed a 6 - megawatt backup power system that is entirely fueled by biodiesel. Backup diesel-fueled generators allow companies to avoid damaging blackouts of critical operations at the expense of high pollution and emission rates. However, by using B100, these generators were able to essentially eliminate the byproducts that result in smog, ozone, and sulfur emissions.^[31] The use of these generators in residential areas around schools, hospitals, and the general public result in substantial reductions in poisonous carbon monoxide and particulate matter.

4 - Historical back ground

Trans esterification of a vegetable oil was conducted as early as 1853 by E. Duffy and J. Patrick, many years before the first diesel engine became functional. Rudolf Diesel's prime model, a single 3 m iron cylinder with a flywheel at its base, ran on its own power for the first time in Augsburg, Germany, on 10 August 1893 running on nothing but peanut oil. In remembrance of this event, 10 August has been declared "International Biodiesel Day".

It is often reported that Diesel designed his engine to run on peanut oil, but this is not the case. Diesel stated in his published papers, "at the Paris Exhibition in 1900 (Exposition Universelle) there was shown by the Otto Company a small Diesel engine, which, at the request of the French government ran on arachide (earth-nut or peanut) oil . and worked so smoothly that only a few people were aware of it. The engine was constructed for using mineral oil, and was then worked on vegetable oil without any alterations being made. The French Government at the time thought of testing the applicability to power production of the Arachide , or earth - nut, which grows in considerable quantities in their African colonies, and can easily be cultivated there." Diesel himself later conducted related tests and appeared supportive of the idea. In a 1912 speech Diesel said, "the use of vegetable oils for engine fuels may seem insignificant today but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time."

Despite the widespread use of petroleum- derived diesel fuels, interest in vegetable oils as fuels for internal combustion engines was reported in several countries during the 1920s and 1930s and later during World War II. Belgium, France, Italy, the United Kingdom, Portugal, Germany, Brazil, Argentina, Japan and China were reported to have tested and used vegetable oils as diesel fuels during this time. Some operational problems were reported due to the high viscosity of vegetable oils compared to petroleum diesel fuel, which results in poor atomization of the fuel in the fuel spray and often leads to deposits and coking of the injectors, combustion chamber and valves. Attempts to overcome these problems included heating of the vegetable oil, blending it with petroleum-derived diesel fuel or ethanol, pyrolysis and cracking of the oils.

On 31 August 1937, G. Chavanne of the University of Brussels (Belgium) was granted a patent for a "Procedure for the transformation of vegetable oils for their uses as fuels" (fr. "*Procédé de Transformation d'Huiles Végétales en Vue de Leur Utilisation comme Carburants*") Belgian Patent 422,877. This patent described the alcoholysis (often referred to as trans esterification) of vegetable oils using ethanol (and mentions methanol) in order to separate the fatty acids from the glycerol by replacing the glycerol with short linear alcohols. This appears to be the first account of the production of what is known as "biodiesel" today.

More recently, in 1977, Brazilian scientist Expedito Parente invented and submitted for patent, the first industrial process for the production of biodiesel . This process is classified as biodiesel by international norms, conferring a "standardized identity and quality. No other proposed biofuel has been validated by the motor industry." As of 2010, Parente's company Tecbio is working with Boeing and NASA to certify bioquerosene (bio - kerosene), another product produced and patented by the Brazilian scientist.

Research into the use of trans esterified sunflower oil, and refining it to diesel fuel standards, was initiated in South Africa in 1979. By 1983, the process for producing fuel - quality, engine-tested biodiesel was completed and published internationally. An Austrian company, Gaskoks, obtained the technology from the South African Agricultural Engineers; the company erected the first biodiesel pilot plant in November 1987, and the first industrial - scale plant in April 1989 (with a capacity of 30,000 tons of rapeseed per annum).

Throughout the 1990s , plants were opened in many European countries, including the Czech Republic, Germany and Sweden. France launched local production of biodiesel fuel (referred to as *diester*) from rapeseed oil, which is mixed into regular diesel fuel at a level of 5 %, and into the diesel fuel used by some captive fleets (e.g. public transportation) at a level of 30 %. Renault, Peugeot and other manufacturers have certified truck engines for use with up to that level of partial biodiesel; experiments with 50 % biodiesel are underway. During the same period, nations in other parts of the world also saw local production of biodiesel starting up: by 1998, the Austrian Biofuels Institute had identified 21 countries with commercial biodiesel projects. 100 % biodiesel is now available at many normal service stations across Europe.

5 – **Properties**

Biodiesel has better lubricating properties and much higher cetane ratings than today's low sulfur diesel fuels. Biodiesel addition reduces fuel system wear, and in low levels in high pressure systems increases the life of the fuel injection equipment that relies on the fuel for its lubrication. Depending on the engine, this might include high pressure injection pumps, pump injectors (also called *unit injectors*) and fuel injectors.

The calorific value of biodiesel is about 37.27 MJ / kg. This is 9% lower than regular Number 2 petro diesel. Variations in biodiesel energy density is more dependent on the feedstock used than the production process. Still, these variations are less than for petro diesel. It has been claimed biodiesel gives better lubricity and more complete combustion thus increasing the engine energy output and partially compensating for the higher energy density of petro diesel.

Biodiesel is a liquid which varies in color — between golden and dark brown — depending on the production feedstock. It is slightly miscible with water, has a high boiling point and low vapor pressure. *The flash point of biodiesel (> 130 °C,) is significantly higher than that of petroleum diesel ($64 \degree C$) or gasoline ($-45 \degree C$). Biodiesel has a density of ~ 0.88 g / cm³, higher than petro diesel (~ 0.85 g / cm³).

Biodiesel has virtually no sulfur content , and it is often used as an additive to Ultra - Low Sulfur Diesel (ULSD) fuel to aid with lubrication, as the sulfur compounds in petro diesel provide much of the lubricity.

5 - 1 - Material compatibility

Plastics : High density poly ethylene (HDPE) is compatible but poly vinyl chloride (PVC) is slowly degraded. Poly styrene is dissolved on contact with biodiesel.

Metals: Biodiesel has an effect on copper - based materials (e.g. brass), and it also affects zinc , tin , lead , and cast iron . Stainless steels (316 and 304) and aluminum are unaffected.

Rubber: Biodiesel also affects types of natural rubbers found in some older engine components. Studies have also found that fluorinated elastomers (FKM) cured with peroxide and base-metal oxides can be degraded when biodiesel loses its stability caused by oxidation. Commonly used synthetic rubbers FKM- GBL-S and FKM-GF-S found in modern vehicles were found to handle biodiesel in all conditions.

6-Technical standards

Biodiesel has a number of standards for its quality including European standard EN 14214, ASTM International D6751, and others.

7 - Low temperature gelling

When biodiesel is cooled below a certain point, some of the molecules aggregate and form crystals. The fuel starts to appear cloudy once the crystals become larger than one quarter of the wavelengths of visible light - this is the cloud point (CP). As the fuel is cooled further these crystals become larger. The lowest temperature

at which fuel can pass through a 45 micro meter filter is the cold filter plugging point (CFPP). As biodiesel is cooled further it will gel and then solidify. Within Europe, there are differences in the CFPP requirements between countries. This is reflected in the different national standards of those countries. The temperature at which pure (B100) biodiesel starts to gel varies significantly and depends upon the mix of esters and therefore the feedstock oil used to produce the biodiesel. For example, biodiesel produced from low erucic acid varieties of canola seed (RME) starts to gel at approximately -10 °C . Biodiesel produced from tallow tends to gel at around +16 °C . There are a number of commercially available additives that will significantly lower the pour point and cold filter plugging point of pure biodiesel. Winter operation is also possible by blending biodiesel with other fuel oils including #2 low sulfur diesel fuel and #1 diesel / kerosene.

Another approach to facilitate the use of biodiesel in cold conditions is by employing a second fuel tank for biodiesel in addition to the standard diesel fuel tank. The second fuel tank can be insulated and a heating coil using engine coolant is run through the tank. The fuel tanks can be switched over when the fuel is sufficiently warm. A similar method can be used to operate diesel vehicles using straight vegetable oil.

8 - Contamination by water

Biodiesel may contain small but problematic quantities of water. Although it is only slightly miscible with water it is hygroscopic.^[50] One of the reasons biodiesel can absorb water is the persistence of mono and di glycerides left over from an incomplete reaction. These molecules can act as an emulsifier, allowing water to mix with the biodiesel . In addition, there may be water that is residual to processing or resulting from storage tank condensation. The presence of water is a problem because :

Water reduces the heat of fuel combustion, causing smoke, harder starting, and reduced power.

Water causes corrosion of fuel system components (pumps , fuel lines , etc.) .

Microbes in water cause the paper - element filters in the system to rot and fail, causing failure of the fuel pump due to ingestion of large particles.

Water freezes to form ice crystals that provide sites for nucleation, accelerating gelling of the fuel.

Water causes pitting in pistons.

Previously, the amount of water contaminating biodiesel has been difficult to measure by taking samples, since water and oil separate. However, it is now possible to measure the water content using water-in-oil sensors.

Water contamination is also a potential problem when using certain chemical catalysts involved in the production process, substantially reducing catalytic efficiency of base (high pH) catalysts such as potassium hydroxide. However, the super-critical methanol production methodology, whereby the trans esterification process of oil feedstock and methanol is effectuated under high temperature and pressure, has been shown to be largely unaffected by the presence of water contamination during the production phase.

9 - Availability and prices



In some countries biodiesel is less expensive than conventional diesel

Global biodiesel production reached 3.8 million tons in 2005. Approximately 85 % of biodiesel production came from the European Union.

In 2007, in the United States, average retail (at the pump) prices, including federal and state fuel taxes, of B2/B5 were lower than petroleum diesel by about 12 cents, and B20 blends were the same as petro diesel. However, as part as a dramatic shift in diesel pricing, by July 2009, the US DOE was reporting average costs of B20 15 cents per gallon higher than petroleum diesel (\$ 2.69 / gal vs. \$ 2.54 / gal . B99 and B100 generally cost more than petro diesel except where local governments provide a tax incentive or subsidy.

10 – Production

Biodiesel is commonly produced by the trans esterification of the vegetable oil or animal fat feedstock. There are several methods for carrying out this trans esterification reaction including the common batch process, supercritical processes, ultrasonic methods, and even microwave methods.

Chemically, trans esterified biodiesel comprises a mix of monoalkyl esters of long chain fatty acids. The most common form uses methanol (converted to sodium methoxide) to produce methyl esters (commonly referred to as Fatty Acid Methyl Ester - FAME) as it is the cheapest alcohol available, though ethanol can be used to produce an ethyl ester (commonly referred to as Fatty Acid Ethyl Ester - FAEE) biodiesel and higher alcohols such as isopropanol and butanol have also been used. Using alcohols of higher molecular weights improves the cold flow properties of the resulting ester, at the cost of a less efficient trans esterification reaction. A lipid transesterification production process is used to convert the base oil to the desired esters. Any free fatty acids (FFAs) in the base oil are either converted to soap and removed from the process, or they are esterified (yielding more biodiesel) using an acidic catalyst. After this processing, unlike straight vegetable oil, biodiesel has combustion properties very similar to those of petroleum diesel, and can replace it in most current uses.

The methanol used in most biodiesel production processes is made using fossil fuel inputs. However, there are sources of renewable methanol made using carbon dioxide or biomass as feedstock, making their production processes free of fossil fuels.

A by-product of the trans esterification process is the production of glycerol. For every 1 tone of biodiesel that is manufactured, 100 kg of glycerol are produced. Originally, there was a valuable market for the glycerol, which assisted the economics of the process as a whole. However, with the increase in global biodiesel production, the market price for this crude glycerol (containing 20% water and catalyst residues) has crashed. Research is being conducted globally to use this glycerol as a chemical building block. One initiative in the UK is The Glycerol Challenge.

Usually this crude glycerol has to be purified, typically by performing vacuum distillation. This is rather energy intensive. The refined glycerol (98 % + purity) can then be utilized directly, or converted into other products. The following announcements were made in 2007: A joint venture of Ashland Inc. and Cargill announced plans to make propylene glycol in Europe from glycerol^[55] and Dow Chemical announced similar plans for North America.^[56] Dow also plans to build a plant in China to make epichlorhydrin from glycerol. Epichlorhydrin is a raw material for epoxy resins.

10 - 1 - Production levels

In 2007, biodiesel production capacity was growing rapidly, with an average annual growth rate from 2002- 06 of over 40 %. For the year 2006, the latest for which actual production figures could be obtained, total world biodiesel production was about 5-6 million tonnes, with 4.9 million tones processed in Europe (of which 2.7 million tones was from Germany) and most of the rest from the USA. In 2008 production in Europe alone had risen to 7.8 million tones . In July 2009, a duty was added to American imported biodiesel in the European Union in order to balance the competition from Europe and, especially German producers . The capacity for 2008 in Europe totaled 16 million tones. This compares with a total demand for diesel in the US and Europe of approximately 490 million tones .

Total world production of vegetable oil for all purposes in 2005/06 was about 110 million tones, with about 34 million tones each of palm oil and soybean oil.

US biodiesel production in 2011 brought the industry to a new milestone. Under the EPA Renewable Fuel Standard, targets have been implemented for the biodiesel production plants in order to monitor and document production levels in comparison to total demand. According to the year - end data released by the EPA, biodiesel production in 2011 reached more than 1 billion gallons. This production number far exceeded the 800 million gallon target set by the EPA. The projected production for 2020 is nearly 12 billion gallons.

10 - 2 - Biodiesel feed stocks

A variety of oils can be used to produce biodiesel. These include :

Virgin oil feed stock : rapeseed and soybean oils are most commonly used, soybean oil accounting for about half of U.S. production. It also can be obtained from Pongamia, field pennycress and jatropha and other crops such as mustard, jojoba, flax, sunflower, palm oil, coconut, hemp.

Waste vegetable oil (WVO); Animal fats including tallow, lard, yellow grease, chicken fat, and the by - products of the production of Omega-3 fatty acids from fish oil.

Algae, which can be grown using waste materials such as sewage ' and with out displacing land currently used for food production.

Oil from halophytes such as *Salicornia bigelovii*, which can be grown using salt water in coastal areas where conventional crops cannot be grown, with yields equal to the yields of soybeans and other oilseeds grown using freshwater irrigation

Sewage Sludge : The sewage – to - biofuel field is attracting interest from major companies like Waste Management and startups

like InfoSpi, which are betting that renewable sewage biodiesel can become competitive with petroleum diesel on price.

Many advocates suggest that waste vegetable oil is the best source of oil to produce biodiesel, but since the available supply is drastically less than the amount of petroleum - based fuel that is burned for transportation and home heating in the world, this local solution could not scale to the current rate of consumption.

Animal fats are a by - product of meat production and cooking. Although it would not be efficient to raise animals (or catch fish) simply for their fat, use of the by - product adds value to the livestock industry (hogs, cattle, poultry). Today, multi - feedstock biodiesel facilities are producing high quality animal - fat based biodiesel. Currently, a 5-million dollar plant is being built in the USA, with the intent of producing 11.4 million litres (3 million gallons) biodiesel from some of the estimated 1 billion kg of chicken fat^[70] produced annually at the local Tyson poultry plant.^[66] Similarly, some smallscale biodiesel factories use waste fish oil as feedstock. An EU funded project (ENERFISH) suggests that at a Vietnamese plant to produce biodiesel from catfish (basa, also known as pangasius), an output of 13 tons / day of biodiesel can be produced from 81 tons of fish waste (in turn resulting from 130 tons of fish). This project utilises the biodiesel to fuel a CHP unit in the fish processing plant, mainly to power the fish freezing plant.

10 - 2 – 1 - Quantity of feed stocks required

Current worldwide production of vegetable oil and animal fat is not sufficient to replace liquid fossil fuel use. Furthermore, some object to the vast amount of farming and the resulting fertilization, pesticide use, and land use conversion that would be needed to produce the additional vegetable oil. The estimated transportation diesel fuel and home heating oil used in the United States is about 160 million tons according to the Energy Information Administration, US Department of Energy . In the United States, estimated production of vegetable oil for all uses is about 11 million tons and estimated production of animal fat is 5.3 million tones . If the entire arable land area of the USA 1.9 million square kilometers were devoted to biodiesel production from soy, this would just about provide the 160 million tones required . This land area could in principle be reduced significantly using algae, if the obstacles can be overcome. The US DOE estimates that if algae fuel replaced all the petroleum fuel in the United States, it would require 38,849 square kilometers , which is a few thousand square miles larger than Maryland, or 30 % greater than the area of Belgium , assuming a yield of 140 tones / hectare . Given a more realistic yield of 36 tones / hectare the area required is about 152,000 square kilometers, or roughly equal to that of the state of Georgia or of England and Wales. The advantages of algae are that it can be grown on non - arable land such as deserts or in marine environments, and the potential oil yields are much higher than from plants.

10 - 3 – Yield

Feed stock yield efficiency per unit area affects the feasibility of ramping up production to the huge industrial levels required to power a significant percentage of vehicles.

Crop	L / ha
Chinese tallow	907
Palm oil	4752
Coco nut	2151
Rape seed	954
Soy (Indiana)	922
Pea nut	842
Sun flower	767
Hemp	242

Algae fuel yields have not yet been accurately determined, but DOE is reported as saying that algae yield 30 times more energy per acre than land crops such as soybeans. Yields of 36 tones / hectare are considered practical by Ami Ben-Amotz of the Institute of Oceanography in Haifa, who has been farming Algae commercially for over 20 years.

Jatropha has been cited as a high - yield source of biodiesel but yields are highly dependent on climatic and soil conditions. The estimates at the low end put the yield at about 200 US (1.5 - 2 tones per hectare) per crop; in more favorable climates two or more crops per year have been achieved. It is grown in the Philippines, Mali and India, is drought-resistant, and can share space with other cash crops such as coffee, sugar, fruits and vegetables. It is well-suited to semiarid lands and can contribute to slow down desertification, according to its advocates.

10 - 4 - Efficiency and economic arguments

According to a study by Drs. Van Dyne and Raymer for the Tennessee Valley Authority, the average US farm consumes fuel at the rate of 82 liters per hectare of land to produce one crop. However, average crops of rapeseed produce oil at an average rate of 1,029 L / ha, and high - yield rapeseed fields produce about 1,356 L / ha. The ratio of input to output in these cases is roughly 1:12.5 and 1:16.5. Photosynthesis is known to have an efficiency rate of about 3 - 6 % of total solar radiation and if the entire mass of a crop is utilized for energy production, the overall efficiency of this chain is currently While this may compare unfavorably to solar cells about 1 % combined with an electric drive train, biodiesel is less costly to deploy (solar cells cost approximately US \$ 250 per square meter) and transport (electric vehicles require batteries which currently have a much lower energy density than liquid fuels). A 2005 study found that biodiesel production using soybeans required 27 % more fossil energy than the biodiesel produced and 118 % more energy using sunflowers.

However, these statistics by themselves are not enough to show whether such a change makes economic sense. Additional factors must be taken into account, such as: the fuel equivalent of the energy required for processing, the yield of fuel from raw oil, the return on cultivating food, the effect biodiesel will have on food prices and the relative cost of biodiesel versus petro diesel, water pollution from farm run – off, soil depletion, and the externalized costs of political and military interference in oil - producing countries intended to control the price of petro diesel. The debate over the energy balance of biodiesel is ongoing. Transitioning fully to biofuels could require immense tracts of land if traditional food crops are used (although non food crops can be utilized). The problem would be especially severe for nations with large economies, since energy consumption scales with economic output.

If using only traditional food plants, most such nations do not have sufficient arable land to produce biofuel for the nation's vehicles. Nations with smaller economies (hence less energy consumption) and more arable land may be in better situations, although many regions cannot afford to divert land away from food production.

For third world countries, biodiesel sources that use marginal land could make more sense; e.g., pongam oil tree nuts grown along roads or jatropha grown along rail lines.

In tropical regions, such as Malaysia and Indonesia, plants that produce palm oil are being planted at a rapid pace to supply growing biodiesel demand in Europe and other markets . Scientists have shown that the removal of rainforest for palm plantations is not ecologically sound since the expansion of oil palm plantations poses a threat to natural rainforest and biodiversity.

It has been estimated in Germany that palm oil biodiesel has less than one third of the production costs of rapeseed biodiesel.^[90] The direct source of the energy content of biodiesel is solar energy captured by plants during photosynthesis. Regarding the positive energy balance of biodiesel[±]

When straw was left in the field, biodiesel production was strongly energy positive, yielding 1 GJ biodiesel for every 0.561 GJ of energy input (a yield / cost ratio of 1.78).

When straw was burned as fuel and oil seed rape meal was used as a fertilizer, the yield / cost ratio for biodiesel production was even better (3.71). In other words, for every unit of energy input to produce biodiesel, the output was 3.71 units (the difference of 2.71 units would be from solar energy).

11 - Economic impact

Multiple economic studies have been performed regarding the economic impact of biodiesel production. One study, commissioned by the National Biodiesel Board, reported the 2011 production of biodiesel supported 39,027 jobs and more than 2.1 billion dollars in household income . The growth in biodiesel also helps significantly increase GDP. In 2011, biodiesel created more than 3 billion dollars in GDP. Judging by the continued growth in the Renewable Fuel Standard and the extension of the biodiesel tax incentive, the number of jobs can increase to 50,725, 2.7 billion dollars in income, and reaching 5 billion dollars in GDP by 2012 and 2013.

12 - Energy security

One of the main drivers for adoption of biodiesel is energy security. This means that a nation's dependence on oil is reduced, and substituted with use of locally available sources, such as coal, gas, or renewable sources. Thus a country can benefit from adoption of biofuels, without a reduction in greenhouse gas emissions. While the total energy balance is debated, it is clear that the dependence on oil is reduced. One example is the energy used to manufacture fertilizers, which could come from a variety of sources other than petroleum. The US National Renewable Energy Laboratory (NREL) states that energy security is the number one driving force behind the US biofuels programme,^[92] and a White House "Energy Security for the 21st Century" paper makes it clear that energy security is a major reason for promoting biodiesel. The EU commission president, Jose Manuel Barroso, speaking at a recent EU biofuels conference, stressed that properly managed biofuels have the potential to reinforce the EU's security of supply through diversification of energy sources.

13 - Global Biofuel Policies

Many countries around the world are involved in the growing use and production of biofuels, such as biodiesel, as an alternative energy source to fossil fuels and oil. To foster the biofuel industry, governments have implemented legislations and laws as incentives to reduce oil dependency and to increase the use of renewable energies. Many countries have their own independent policies regarding the taxation and rebate of biodiesel use, import, and production.

14 - Environmental effects

The surge of interest in biodiesels has highlighted a number of environmental effects associated with its use. These potentially include reductions in greenhouse gas emissions,^[98] deforestation, pollution and the rate of biodegradation.

According to the EPA's Renewable Fuel Standards Program Regulatory Impact Analysis, released in February 2010, biodiesel from soy oil results, on average, in a 57 % reduction in greenhouse gases compared to petroleum diesel, and biodiesel produced from waste grease results in an 86 % reduction. See chapter 2.6 of the EPA report for more detailed information.

However, environmental organizations, for example, Rainforest Rescue and Greenpeace, criticize the cultivation of plants used for biodiesel production, e.g., oil palms, soybeans and sugar cane. They say the deforestation of rainforests exacerbates climate change and that sensitive ecosystems are destroyed to clear land for oil palm, soybean and sugar cane plantations. Moreover, that biofuels contribute to world hunger, seeing as arable land is no longer used for growing foods. The Environmental Protection Agency(EPA) published data in January 2012, showing that biofuels made from palm oil won't count towards the nation's renewable fuels mandate as they are not climate-friendly.^[101] Environmentalists welcome the conclusion because the growth of oil palm plantations has driven tropical deforestation, for example, in Indonesia and Malaysia.

14 - Food , land and water vs . fuel

In some poor countries the rising price of vegetable oil is causing problems. Some propose that fuel only be made from nonedible vegetable oils such as camelina, jatropha or seashore mallow which can thrive on marginal agricultural land where many trees and crops will not grow, or would produce only low yields. Others argue that the problem is more fundamental. Farmers may switch from producing food crops to producing biofuel crops to make more money, even if the new crops are not edible . The law of supply and demand predicts that if fewer farmers are producing food the price of food will rise. It may take some time, as farmers can take some time to change which things they are growing, but increasing demand for first generation biofuels is likely to result in price increases for many kinds of food. Some have pointed out that there are poor farmers and poor countries who are making more money because of the higher price of vegetable oil.

Biodiesel from sea algae would not necessarily displace terrestrial land currently used for food production and new algaculture jobs could be created.

16 - Current research

There is ongoing research into finding more suitable crops and improving oil yield. Other sources are possible including human fecal matter, with Ghana building its first " fecal sludge - fed biodiesel plant" [•] Using the current yields, vast amounts of land and fresh water would be needed to produce enough oil to completely replace fossil fuel usage. It would require twice the land area of the US to be devoted to soybean production, or two - thirds to be devoted to rapeseed production, to meet current US heating and transportation needs.

Specially bred mustard varieties can produce reasonably high oil yields and are very useful in crop rotation with cereals, and have the added benefit that the meal leftover after the oil has been pressed out can act as an effective and biodegradable pesticide .

The NFESC, with Santa Barbara-based Biodiesel Industries is working to develop biodiesel technologies for the US navy and military, one of the largest diesel fuel users in the world.

A group of Spanish developers working for a company called Ecofasa announced a new biofuel made from trash. The fuel is created from general urban waste which is treated by bacteria to produce fatty acids, which can be used to make biodiesel. Another approach that does not require the use of chemical for the production involves the use of genetically modified microbes.

16 – 1 - Algal biodiesel

From 1978 to 1996, the U.S. NREL experimented with using algae as a biodiesel source in the "Aquatic Species Program". A selfpublished article by Michael Briggs, at the UNH Biodiesel Group, offers estimates for the realistic replacement of all vehicular fuel with biodiesel by utilizing algae that have a natural oil content greater than 50%, which Briggs suggests can be grown on algae ponds at wastewater treatment plants. This oil - rich algae can then be extracted from the system and processed into biodiesel, with the dried remainder further reprocessed to create ethanol.

The production of algae to harvest oil for biodiesel has not yet been undertaken on a commercial scale, but feasibility studies have been conducted to arrive at the above yield estimate. In addition to its projected high yield, alga culture — unlike crop - based biofuels does not entail a decrease in food production, since it requires neither farmland nor fresh water. Many companies are pursuing algae bioreactors for various purposes, including scaling up biodiesel production to commercial levels.

Prof. Rodrigo E. Teixeira from the University of Alabama in Huntsville demonstrated the extraction of biodiesel lipids from wet algae using a simple and economical reaction in ionic liquids.

16 – 2 – Pongamia

Millettia pinnata, also known as the Pongam Oil tree or Pongamia, is a leguminous, oilseed - bearing tree that has been identified as a candidate for non-edible vegetable oil production.

Pongamia plantations for biodiesel production have a two-fold environmental benefit. The trees both store carbon and produce fuel oil. Pongamia grows on marginal land not fit for food crops and does not require nitrate fertilizers. The oil producing tree has the highest yield of oil producing plant (approximately 40 % by weight of the seed is oil) while growing in malnourished soils with high levels of salt. It is becoming a main focus in a number of biodiesel research organizations . The main advantages of Pongamia are a higher recovery and quality of oil than other crops and no direct competition with food crops. However growth on marginal land can lead to lower oil yields which could cause competition with food crops for better soil.

16 – 3 – Jatropha

Several groups in various sectors are conducting research on Jatropha curcas, a poisonous shrub - like tree that produces seeds considered by many to be a viable source of biodiesel feedstock oil. Much of this research focuses on improving the overall per acre oil yield of Jatropha through advancements in genetics, soil science, and horticultural practices.

SG Biofuels, a San Diego-based Jatropha developer, has used molecular breeding and biotechnology to produce elite hybrid seeds of Jatropha that show significant yield improvements over first generation varieties . SG Biofuels also claims that additional benefits have arisen from such strains, including improved flowering synchronicity, higher resistance to pests and disease, and increased cold weather tolerance.

Plant Research International, a department of the Wageningen University and Research Centre in the Netherlands, maintains an ongoing Jatropha Evaluation Project (JEP) that examines the feasibility of large scale Jatropha cultivation through field and laboratory experiments.

The Center for Sustainable Energy Farming (CfSEF) is a Los Angeles-based non-profit research organization dedicated to Jatropha research in the areas of plant science, agronomy, and horticulture. Successful exploration of these disciplines is projected to increase Jatropha farm production yields by 200-300% in the next ten years.

16 – 3 – Fungi

A group at the Russian Academy of Sciences in Moscow published a paper in September 2008, stating that they had isolated

large amounts of lipids from single - celled fungi and turned it into biodiesel in an economically efficient manner. More research on this fungal species; *Cunninghamella japonica*, and others, is likely to appear in the near future.

The recent discovery of a variant of the fungus *Gliocladium roseum* points toward the production of so- called myco - diesel from cellulose. This organism was recently discovered in the rainforests of northern Patagonia and has the unique capability of converting cellulose into medium length hydrocarbons typically found in diesel fuel.

16 – 5 - Biodiesel from used coffee grounds

Researchers at the University of Nevada, Reno, have successfully produced biodiesel from oil derived from used coffee grounds. Their analysis of the used grounds showed a 10 % to 15 % oil content (by weight). Once the oil was extracted, it underwent conventional processing into biodiesel. It is estimated that finished biodiesel could be produced for about one US dollar per gallon. Further, it was reported that "the technique is not difficult" and that "there is so much coffee around that several hundred million gallons of biodiesel could potentially be made annually." However, even if all the coffee grounds in the world were used to make fuel, the amount produced would be less than 1 percent of the diesel used in the United States annually. "It won't solve the world's energy problem," Dr. Misra said of his work.

16 – 6 - Exotic sources

Recently, alligator fat was identified as a source to produce biodiesel. Every year, about 15 million pounds of alligator fat are disposed of in landfills as a waste byproduct of the alligator meat and skin industry. Studies have shown that biodiesel produced from alligator fat is similar in composition to biodiesel created from soybeans, and is cheaper to refine since it is primarily a waste product.

16 – 7 - Biodiesel to Hydrogen - Cell Power

A micro reactor has been developed to convert biodiesel into hydrogen steam to power fuel cells.

Steam reforming, also known as Fossil fuel reforming is a process which produces hydrogen gas from hydrocarbon fuels, most notably biodiesel due to its efficiency. A **micro reactor**, or reformer, is the processing device in which water vapour reacts with the liquid fuel under high temperature and pressure. Under temperatures ranging from 700 - 1100 °C, a nickel-based catalyst enables the production of carbon monoxide and hydrogen :

Hydrocarbon + $H_2 O \rightleftharpoons CO + 3 H_2$ (Highly endothermic)

Furthermore, a higher yield of hydrogen gas can be harnessed by further oxidizing carbon monoxide to produce more hydrogen and carbon dioxide :

 $CO + H_2O \rightarrow CO_2 + H_2$ (*Mildly exothermic*) Hydrogen fuel cells background information

Fuel cells operate similar to a battery in that electricity is harnessed from chemical reactions. The difference in fuel cells when compared to batteries is their ability to be powered by the constant flow of hydrogen found in the atmosphere. Furthermore, they produce only water as a by - product, and are virtually silent. The downside of hydrogen powered fuel cells is the high cost and dangers of storing highly combustible hydrogen under pressure.

One way new processors can overcome the dangers of transporting hydrogen is to produce it as necessary. The micro reactors can be joined to create a system that heats the hydrocarbon under high pressure to generate hydrogen gas and carbon dioxide, a process called steam reforming. This produces up to 160 gallons of hydrogen/minute and gives the potential of powering hydrogen refueling stations, or even an on-board hydrogen fuel source for hydrogen cell vehicles. Implementation into cars would allow energy-rich fuels, such as biodiesel, to be transferred to kinetic energy while avoiding combustion and pollutant byproducts. The hand-sized square piece of metal contains microscopic channels with catalytic sites, which continuously convert biodiesel, and even its glycerol byproduct, to hydrogen.

17 - Concerns Regarding Biodiesel 17 – 1 - Engine Wear

Lubricity of fuel plays an important role in wear that occurs in an engine. An engine relies on its fuel to provide lubricity for the metal components that are constantly in contact with each other.^[133] Biodiesel is a much better lubricant compared with petroleum diesel due to the presence of esters. Tests have shown that the addition of a small amount of biodiesel to diesel can significantly increase the lubricity of the fuel in short term . However, over a longer period of time (2– 4 years), studies show that biodiesel loses its lubricity. This could be because of enhanced corrosion over time due to oxidation of the unsaturated molecules or increased water content in biodiesel from moisture absorption.

17 – 2 - Fuel Viscosity

One of the main concerns regarding biodiesel is its viscosity. The viscosity of diesel is 2.5 - 3.2 cSt at 40°C and the viscosity of biodiesel made from soybean oil is between 4.2 and 4.6 cSt [•] The viscosity of diesel must be high enough to provide sufficient lubrication for the engine parts but low enough to flow at operational temperature. High viscosity can plug the fuel filter and injection system in engines . Vegetable oil is composed of lipids with long chains of hydrocarbons, to reduce its viscosity the lipids are broken down into smaller molecules of esters. This is done by converting vegetable oil and animal fats into alkyl esters using trans esterification to reduce their viscosity Nevertheless, biodiesel viscosity remains higher than that of diesel, and the engine may not be able to use the fuel at low temperatures due to the slow flow through the fuel filter.

17 – 3 - Engine Performance

Biodiesel has higher brake-specific fuel consumption compared to diesel, which means more biodiesel fuel consumption is required for the same torque. However, B20 biodiesel blend has been found to provide maximum increase in thermal efficiency and lowest brakespecific energy consumption. The engine performance depends on the properties of the fuel, as well as on combustion, injector pressure and many other factors. Since there are various blends of biodiesel, that may account for the contradicting reports in regards engine

Black Currant Seed Oil



Black currant seed oil is derived from the seeds of *Ribes nigrum* (black currant, or European currant). It contains an unusually high amount of: omega - 6 (15 – 20 percent) as well as a high amount of omega-3 fatty acids (12 – 14 percent). It also contains linoleic acid as well as 2 - 4 percent stearidonic acid. There are some indications that black currant seed oil is anti - inflammatory and cardioprotective.^[1] In European folk medicine, black currant once had a considerable reputation for controlling diarrhea, promoting urine output (as a diuretic) and reducing arthritic and rheumatic pains.^[2] It is primarily used medicinally and as a diet supplement.

Bladder Pod Oil



Contents

1 Introduction 2 Uses

1 - Introduction

Bladder pod oil is a seed oil, extracted from the seeds of the *Lesquerella fendleri* and other species of genus *Lesquerella*, Native to the plains and mesas of south western United States, eastward to Kansas and southward into northern Mexico. Bladder pod oil is rich in lesquerolic acid (C20 : 1- OH) which is a hydroxy acid. The only commercial source of hydroxy acid is ricinoleic acid (C18 : 1- OH), found in castor oil. Essentially all castor oil production in the U.S. has been eliminated by a combination of economic factors, excessive allergenic reactions of field and processing workers, and toxicity of the seed meal. The fatty acid composition of bladder pod oil is :

Percentage %
1.5
1.4
2.4
15.2
7.6

Linolenic	13.1
Ricinoleic	0.3
Densipolic	0.2
Lesquerolic	53.2
Auricolic	3.8

Other species of *Lesquerella* that yield similar oils include *L*. *lindheimeri*, *L. densipilia*, *L. auriculata* and *L. pallida*. *L. fendleri* is of particular interest because of the yields of 1,500 kg / ha that have been achieved in only a few years of cultivation .

2 - Uses

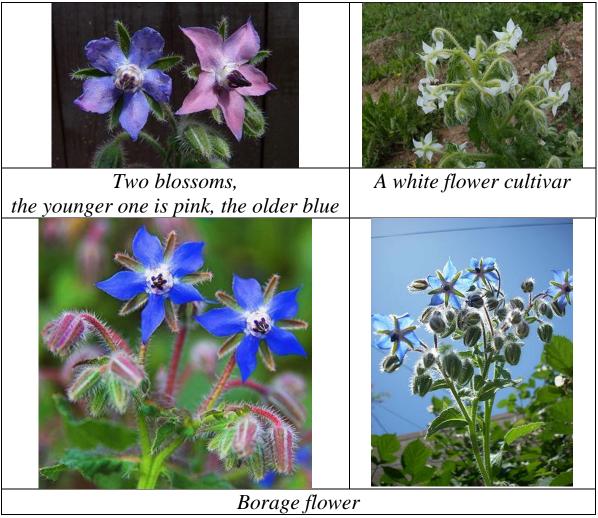
The hydroxy acids contained in bladder pod oil are an important raw material used in the manufacture of resins, waxes, nylons , plastics , corrosion inhibitors , coatings , lubricating greases and cosmetics.

Blown Oil



A blown oil is a drying oil which has been polymerized through a manufacturing process. Oils are "blown" through oxidation and are sold for use in industrial applications, etc. Some common types of blown oil include linseed oil, rapeseed oil, castor oil and soybean oil.

Borage (لسان الثور)



Contents

- 1 Introduction
- 2 Appearance
- 3 Characteristics and uses
- 4 Traditional medicine
- 5 Companion plant

1 - Introduction

Borage (*Borago officinalis*), also known as a starflower, is an annual herb. It is native to the Mediterranean region and has naturalized in many other locales. It grows satisfactorily in gardens in the UK climate, remaining in the garden from year to year by self-seeding. The leaves are edible and the plant is grown in gardens for

that purpose in some parts of Europe. The plant is also commercially cultivated for borage seed oil extracted from its seeds.

Scientific classification		
Kingdom:	Plantae	
(unranked):	Angiosperms	
(unranked):	Eudicots	
(unranked):	Asterids	
Order:	(unplaced)	
Family:	Boraginaceae	
Genus:	Borago	
Species:	B. officinalis	
Binomial name		
Borago officinaliL.		

2 – Appearance

It grows to a height of 60 -100 cm and is bristly or hairy all over the stems and leaves; the leaves are alternate, simple, and 5 -15 cm long. The flowers are complete, perfect with five narrow, triangular-pointed petals. Flowers are most often blue in color, although pink flowers are sometimes observed. White flowered types are also cultivated. The blue flower is genetically dominant over the white flower.^[1] The flowers arise along scorpioid cymes to form large floral displays with multiple flowers blooming simultaneously, suggesting that borage has a high degree of geitonogamy (intra-plant pollination). It has an indeterminate growth habit which may lead to prolific spreading. In temperate climate such as in the UK, its flowering season is relatively long, from June to September. In milder climates, borage will bloom continuously for most of the year.

3 - Characteristics and uses

Traditionally borage was cultivated for culinary and medicinal uses, although today commercial cultivation is mainly as an oilseed. The seed oil is desired as source of gamma - linolenic acid (GLA,

18:3, cis 6,9,12- octa decatrienoic acid), for which borage is the highest known plant-based source (17 - 28 %). The seed oil content is between 26 - 38 % and in addition to GLA contains the fatty acids palmitic acid (10 - 11%), stearic acid (3.5 - 4.5%), oleic acid (16 - 20%), linoleic acid (35 - 38%), eicosenoic acid (3.5 - 5.5%), erucic acid (1.5 - 3.5%), and nervonic acid (1.5%). The oil is often marketed as "starflower oil" or "borage oil" for uses as a GLA supplement, although healthy adults will typically produce ample GLA through dietary linoleic acid.

Borage production does include use as either a fresh vegetable or a dried herb. As a fresh vegetable, borage, with a cucumber like taste, is often used in salads or as a garnish. The flower, which contains the non-toxic pyrrolizidine alkaloid thesinine , has a sweet honey-like taste and as one of the few truly blue-colored edible substances , is often used to decorate dessert. It is notable that the leaves have been found to contain small amounts (10 ppm of dried herb) of the livertoxic pyrrolizidine alkaloids: intermedine , lycopsamine , amabiline and supinine . The levels are extremely low (2-10 ppm). Leaves contain mainly the toxic lycopsamine also amabiline and the non-toxic saturated PA thesinine (the only alkaloid found in seed contained thesinine and amabiline in a ratio of 10:1). No alkaloids have been found so far in seed oil.

Borage is also traditionally used as a garnish in the Pimms Cup cocktail, but is sometimes replaced by a long sliver of cucumber peel if not available. It is also one of the key "Botanical" flavourings in Gilpin's Westmorland Extra Dry Gin. Borage leaves have a cucumber like flavor.

4 - Traditional medicine

Borage, raw		
Nutritional value per 100 g		
Energy	88 kJ (21 kcal)	
Carbohydrates	3 g	

Fat	0.7 g
Protein	1.8 g
Vitamin A equiv.	210 µg (26 %)
Thiamine (vit. B_1)	0.06 mg (5 %)
Riboflavin (vit. B ₂)	0.15 mg (13 %)
Niacin (vit. B ₃)	0.9 mg (6 %)
Vitamin B ₆	0.084 mg (6 %)
Folate (vit. B ₉)	13 µg (3%)
Vitamin C	35 mg (42 %)
Calcium	93 mg (9 %)
Iron	3.3 mg (25 %)
Magnesium	52 mg (15 %)
Manganese	0.349 mg (17 %)
Phosphorus	53 mg (8 %)
Potassium	470 mg (10 %)
Sodium	80 mg (5 %)
Zinc	0.2 mg (2 %)

Traditionally *Borago officinalis* is used in hyperactive gastrointestinal, respiratory and cardiovascular disorders, such as gastrointestinal (colic, cramps, diarrhea), airways (asthma, bronchitis), cardiovascular, (cardiotonic, antihypertensive and blood purifier), urinary (diuretic and kidney/bladder disorders).

Naturopathic practitioners use borage for regulation of metabolism and the hormonal system, and consider it to be a good remedy for PMS and menopause symptoms such as the hot flush. The flowers can be prepared in infusion.

One case of status epilepticus has been reported that was associated with borage oil ingestion.

A methanol extract of borage has shown strong a moebicidal activity. The 50 % inhibitory concentration (LD₅₀) of the extract for *Entamoeba histolytica* was only 33 μ g / mL.

5 - Companion plant

Borage is used in companion planting. It is said to protect or nurse legumes, spinach, brassicas, and even strawberries. It is also said to be a good companion plant to tomatoes because it confuses the search image of the mother moths of tomato hornworms or manduca looking for a place to lay their eggs. Claims that it improves tomato growth and makes them taste better remain unsubstantiated.

Borage Seed Oil



Borage seed oil has one of the highest amounts of γ - linolenic acid (GLA) of seed oils — higher than blackcurrant seed oil or evening primrose oil, to which it is considered similar. GLA comprises around 24 % of the oil typically. GLA is converted to dihomo - gamma - linolenic acid, a precursor to a variety of the 1series prostaglandins and the 3 - series leukotrienes. It inhibits leukotriene synthesis to provide therapy in rheumatologic illness. Borage seed oil may therefore have anti - inflammatory and anti thrombotic effects and it has been studied for its potential to treat anti - inflammatory disorders, arthritis, atopic eczema, and respiratory inflammation . However, several clinical studies have shown it to be ineffective at treating atopic eczema.

Borage oil may contain the pyrrolizidine alkaloidamabiline, which is hepatotoxic leading to a risk of liver damage. Patients should certified unsaturated pyrrolizidine borage oil free of use alkaloids.Borage oil may be unsafe during pregnancy because preliminary studies suggest borage oil has a teratogenic effect and that its prostaglandin E agonist action may cause premature labor.^{[1][7]} Seizures have been reported as a complication of ingestion of borage oil in doses of 1,500 to 3,000 mg daily, although a mixed review of borage oil's effect on seizure thresholds indicates that borage oil quality varies. A specific extraction process may offer purified products with 50 % + GLA content.

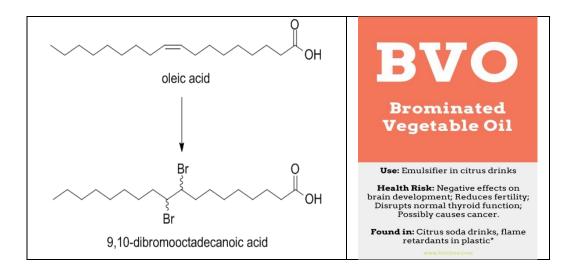
Borneo Tallow Nut Oil



Borneo tallow nut oil is extracted from the fruit of species of genus *Shorea*, which is native to Sarawak, Borneo, Java, Malaya and the Philippines. The oil is extracted from the egg-shaped, winged fruit using traditional methods in rural areas. The nuts, once extracted from the shell, are placed in a rattan bag, which is placed between two hardwood boards, and then pressed by driving in wedges.^[1] The oil is composed of the following fatty acids :

Fatty acid	Percentage %
Palmitic acid	18.0
Stearic acid	43.3
Arachidic acid	1.1
Oleic acid	37.4
Linoleic acid	0.2

Brominated Vegetable Oil



Contents

1 Introduction

2 Regulation and use

3 Health effects

1 - Introduction

Brominated vegetable oil (BVO) is vegetable oil that has had atoms of the element bromine bonded to it. Brominated vegetable oil is used to stabilize citrus - flavored soft drinks. Its high density helps the droplets of natural fat-soluble citrus flavors stay suspended in the drink. BVO has been used by the soft drink industry since 1931, generally at a level of about 8 ppm.

Careful control of the type of oil used allows bromination of it to produce BVO with a specific density (1.33 g / mL). As a result, it can be mixed with less - dense flavoring agents such as citrus flavor oil to produce a resulting oil whose density matches that of water or other products. The droplets containing BVO remain suspended in the water rather than separating and floating at the surface.

Alternative food additives used for the same purpose include sucrose acetate iso butyrate (SAIB, E444) and glycerol ester of wood rosin (ester gum, E445).

2 - Regulation and use

North America

BVO is one of four substances that the U.S. Food and Drug Administration has defined as interim food additives; the other three are acrylonitrile copolymers, mannitol, and saccharin.¹

BVO is currently permitted as a food additive in Canada.

Europe

In the European Union, BVO is not on the current EU- approved additives list . In the EU, beverage companies commonly use glycerol ester of wood rosin or locust bean gum as an alternative to BVO.

India

Standards for soft drinks in India have prohibited the use of BVO since 1990.

Japan

The use of BVO as a food additive has been banned in Japan since 2010.

3 - Health effects

The United States Food and Drug Administration considers BVO to be safe for use as a food additive. However, there are case reports of adverse effects associated with excessive consumption of BVO - containing products. One case reported that a man who consumed two to four liters of a soda containing BVO on a daily basis experienced memory loss, tremors, fatigue, loss of muscle coordination, headache, and ptosis of the right eyelid, as well as elevated serum chloride . In the two months it took to correctly diagnose the problem, the patient also lost the ability to walk. Eventually, bromism was diagnosed and hemodialysis was prescribed which resulted in a reversal of the disorder.

Bromine Number



Bromine number is the amount of bromine in grams absorbed by 100 grams of a sample. The number indicates the degree of unsaturation.

The Bromine Number is useful as a measure of aliphatic unsaturation in gasoline samples. The ARB, in its Motor Vehicle Fuels Compliance Assistance Program, indicated that every unit of Bromine Number is equivalent to twice the percentage point of olefin content in gasoline. So, a gasoline with Bromine Number 30 would have an olefin content of not more than 15 vol %. One refinery compiled a year's worth of data on Bromine Number and the corresponding olefin content of gasoline. The data showed that the Bromine Number of gasoline is about 2.4 times the olefin content. A gasoline with Bromine Number of 30 would then have an olefin content of about 12.5 percent by volume, which is slightly lower than ARB's assumption, but still is higher than the CaRFG maximum limit of 10 percent by volume.

The Bromine Number is usually determined by electrochemical titration, where bromine is generated in situ with the redox process of potassium bromide and bromate in an acidic solution, using a mercury catalyst to ensure the complete bromination of all olefins.

It is similar to I_2 value and useful for oils containing fatty acids with conjugated system of double bonds. It can be calculated as an equivalent I_2 value by multiplying result by: At.Wt of I_2 / At.Wt of Br_2 that is *126.9 / 79.9

Buffalo Gourd Oil



Buffalo gourd oil is a seed oil, extracted from the seeds of the *Cucurbita foetidissima*, which is native to south west North America. As the Latin name of the plant indicates, the vine has a foul smell. The seeds of the Buffalo gourd are rich in oil and protein, and were used by American Indians to make soap. The oil's fatty acid composition is dominated by linoleic acid (64.5%) and oleic acid (17.1%).

Butter



Contents

- 1 Introduction
- 2 Etymology
- **3** Production
- 4 Types
- 5 History
 - 5.1 Middle Ages
 - 5.2 Industrialization
- 6 Size and shape of butter packaging
- 7 World wide
- 8 Storage and cooking
- 9 Nutritional information

1 - Introduction

Butter is a dairy product made by churning fresh or fermented cream or milk. It is generally used as a spread and a condiment, as well as in cooking, such as baking, sauce making, and pan frying. Butter consists of butterfat, milk proteins and water.

Most frequently made from cows' milk, butter can also be manufactured from the milk of other mammals, including sheep, goats, buffalo, and yaks. Salt, flavorings and preservatives are sometimes added to butter. Rendering butter produces clarified butter or *ghee*, which is almost entirely butterfat. Butter is a water-in-oil emulsion resulting from an inversion of the cream, an oil-in-water emulsion; the milk proteins are the emulsifiers. Butter remains a solid when refrigerated, but softens to a spreadable consistency at room temperature, and melts to a thin liquid consistency at 32 - 35 °C. The density of butter is 911 g / L.

It generally has a pale yellow color, but varies from deep yellow to nearly white. Its unmodified color is dependent on the animals' feed and is commonly manipulated with food colorings in the commercial manufacturing process, most commonly annatto or carotene.

2 - Etymology

he word *butter* derives (via Germanic languages) from the Latin *butyrum*, which is the latinisation of the Greek $\beta o \dot{\tau} \tau v \rho o v$ (*bouturon*). This may have been a construction meaning "cow - cheese", from $\beta o \tilde{\nu} \varsigma$ (*bous*), "ox, cow" + $\tau v \rho \dot{\rho} \varsigma$ (*turos*), "cheese", but perhaps this is a false etymology of a Scythian word. Nevertheless, the earliest attested form of the second stem, *turos* ("cheese"), is the Mycenaean Greek *turo*, written in Linear B syllabic script. The root word persists in the name butyric acid, a compound found in rancid butter and dairy products such as Parmesan cheese.

In general use, the term "butter" refers to the spread dairy product when unqualified by other descriptors. The word commonly is used to describe puréed vegetable or seed & nut products such as peanut butter and almond butter. It is often applied to spread fruit products such as apple butter. Fats such as cocoa butter and shea butter that remain solid at room temperature are also known as "butters". In addition to the act of applying butter being called "to butter", non-dairy items that have a dairy butter consistency may use "butter' to call that consistency to mind, including food items such as maple butter and witch's butter and nonfood items such as baby bottom butter, hyena butter, and rock butter.

3 – Production

Un homogenized milk and cream contain butter fat in microscopic globules. These globules are surrounded by membranes made of phospholipids (fatty acid emulsifiers) and proteins, which prevent the fat in milk from pooling together into a single mass. Butter is produced by agitating cream, which damages these membranes and allows the milk fats to conjoin, separating from the other parts of the cream. Variations in the production method will create butters with different consistencies, mostly due to the butterfat composition in the finished product. Butter contains fat in three separate forms: free butterfat, butterfat crystals, and undamaged fat globules. In the finished product, different proportions of these forms result in different consistencies within the butter; butters with many crystals are harder than butters dominated by free fats.

Churning produces small butter grains floating in the waterbased portion of the cream. This watery liquid is called buttermilk although the buttermilk most common today is instead a directly fermented skimmed milk. The buttermilk is drained off; sometimes more buttermilk is removed by rinsing the grains with water. Then the grains are "worked": pressed and kneaded together. When prepared manually, this is done using wooden boards called scotch hands. This consolidates the butter into a solid mass and breaks up embedded pockets of buttermilk or water into tiny droplets.

Commercial butter is about 80 % butterfat and 15 % water; traditionally made butter may have as little as 65 % fat and 30 % water. Butterfat is a mixture of triglyceride, a tri ester derived from glycerol and three of any of several fatty acid groups.^[9] Butter becomes rancid when these chains break down into smaller components, like butyric acid and di acetyl. The density of butter is $0.911 \text{ g}/\text{ cm}^3$, about the same as ice.

4 - Types :

Before modern factory butter making, cream was usually collected from several milkings and was there fore several days old and some what fermented by the time it was made into butter. Butter made from a fermented cream is known as cultured butter. During fermentation, the cream naturally sours as bacteria convert milk sugars into lactic acid. The fermentation process produces additional aroma compounds, including di acetyl, which makes for a fuller - flavored and more "buttery" tasting product . Today, cultured butter is usually made from pasteurized cream whose fermentation is produced by the introduction of *Lactococcus* and *Leuconostoc* bacteria.

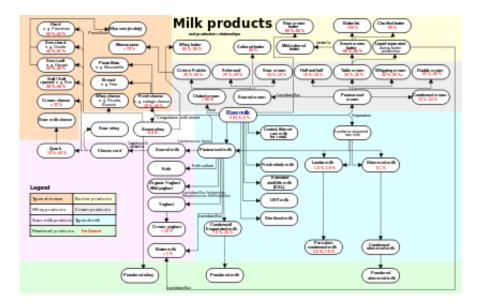


Chart of milk products and production relationships, including butter.

Another method for producing cultured butter, developed in the early 1970s, is to produce butter from fresh cream and then incorporate bacterial cultures and lactic acid. Using this method, the cultured butter flavor grows as the butter is aged in cold storage. For manufacturers, this method is more efficient, since aging the cream used to make butter takes significantly more space than simply storing the finished butter product. A method to make an artificial simulation of cultured butter is to add lactic acid and flavor compounds directly to the fresh-cream butter; while this more efficient process is claimed to simulate the taste of cultured butter, the product produced is not cultured but is instead flavored.

Dairy products are often pasteurized during production to kill pathogenic bacteria and other microbes. Butter made from pasteurized fresh cream is called sweet cream butter. Production of sweet cream butter first became common in the 19th century, with the development of refrigeration and the mechanical cream separator . Butter made from fresh or cultured unpasteurized cream is called raw cream butter. While butter made from pasteurized cream may keep for several months, raw cream butter has a shelf life of roughly ten days. Throughout continental Europe, cultured butter is preferred, while sweet cream butter dominates in the United States and the United Kingdom. There fore, cultured butter is sometimes labeled "European - style" butter in the United States. Commercial raw cream butter is virtually unheard - of in the United States. Raw cream butter is generally only found made at home by consumers who have purchased raw whole milk directly from dairy farmers, skimmed the cream themselves, and made butter with it. It is rare in Europe as well.

Several "spreadable" butters have been developed; these remain softer at colder temperatures and are therefore easier to use directly out of refrigeration. Some modify the makeup of the butter's fat through chemical manipulation of the finished product, some through manipulation of the cattle's feed, and some by incorporating vegetable oils into the butter. "Whipped" butter, another product designed to be more spreadable, is aerated via the incorporation of nitrogen gas normal air is not used, because doing so would encourage oxidation and rancidity.

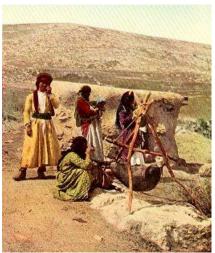
All categories of butter are sold in both salted and unsalted forms. Either granular salt or a strong brine are added to salted butter during processing. In addition to enhanced flavor, the addition of salt acts as a preservative.

The amount of butter fat in the finished product is a vital aspect of production. In the United States, products sold as "butter" are required to contain a minimum of 80 % butter fat ; in practice, most American butters contain only slightly more than that, averaging around 81% butterfat. European butters generally have a higher ratio, which may extend up to 85 %.

Clarified butter is butter with almost all of its water and milk solids removed, leaving almost-pure butterfat. Clarified butter is made by heating butter to its melting point and then allowing it to cool; after settling, the remaining components separate by density. At the top, whey proteins form a skin which is removed, and the resulting butterfat is then poured off from the mixture of water and casein proteins that settle to the bottom. Ghee is clarified butter which is brought to higher temperatures of around 120 $^{\circ}$ C once the water had evaporated, allowing the milk solids to brown. This process flavors the ghee, and also produces antioxidants which help protect it longer from rancidity. Because of this, ghee can keep for six to eight months under normal conditions.

Cream may be skimmed from whey instead of milk, as a byproduct of cheese - making. Whey butter may be made from whey cream. Whey cream and butter have a lower fat content and taste more salty, tangy and "cheesy". They are also cheaper than "sweet" cream and butter.

5 - History



Traditional butter-making in Palestine . National Geographic 1914.

The earliest butter would have been from sheep or goat's milk; cattle are not thought to have been domesticated for another thousand years . An ancient method of butter making, still used today in parts of Africa and the Near East, involves a goat skin half filled with milk, and inflated with air before being sealed. The skin is then hung with ropes on a tripod of sticks, and rocked until the movement leads to the formation of butter.

In the Mediterranean climate, un clarified butter spoils quickly unlike cheese, it is not a practical method of preserving the nutrients of milk. The ancient Greeks and Romans seemed to have considered butter a food fit more for the northern barbarians. A play by the Greek comic poet Anaxandrides refers to Thracians as *boutyrophagoi*, "butter - eaters" . In *Natural History*, Pliny the Elder calls butter "the most delicate of food among barbarous nations", and goes on to describe its medicinal properties. Later, the physician Galen also described butter as a medicinal agent only.

Historian and linguist Andrew Dalby says most references to butter in ancient Near Eastern texts should more correctly be translated as ghee. Ghee is mentioned in the Periplus of the Erythraean Sea as a typical trade article around the first century CE Arabian Sea, and Roman geographer Strabo describes it as a commodity of Arabia and Sudan.^[16] In India, ghee has been a symbol of purity and an offering to the gods — especially Agni, the Hindu god of fire — for more than 3000 years; references to ghee's sacred nature appear numerous times in the *Rigveda*, circa 1500–1200 BCE. The tale of the child Krishna stealing butter remains a popular children's story in India today. Since India's prehistory, ghee has been both a staple food and used for ceremonial purposes, such as fueling holy lamps and funeral pyres.

5 - 1 - Middle Ages

The cooler climates of northern Europe allowed butter to be stored for a longer period before it spoiled. Scandinavia has the oldest tradition in Europe of butter export trade, dating at least to the 12th century . After the fall of Rome and through much of the Middle Ages, butter was a common food across most of Europe, but one with a low reputation, and was consumed principally by peasants. Butter slowly became more accepted by the upper class, notably when the early 16th century Roman Catholic Church allowed its consumption during Lent. Bread and butter became common fare among the middle class, and the English, in particular, gained a reputation for their liberal use of melted butter as a sauce with meat and vegetables.

In antiquity, butter was used for fuel in lamps as a substitute for oil. The *Butter Tower* of Rouen Cathedral was erected in the early 16th century when Archbishop Georges d'Amboise authorized the burning of butter instead of oil, which was scarce at the time, during Lent. Across northern Europe, butter was sometimes treated in a manner unheard - of today: it was packed into barrels (firkins) and buried in peat bogs, perhaps for years. Such "bog butter" would develop a strong flavor as it aged , but remain edible, in large part because of the unique cool , airless , antiseptic and acidic environment of a peat bog. Firkins of such buried butter are a common archaeological find in Ireland; the Irish National Museum has some containing "a grayish cheese - like substance, partially hardened, not much like butter, and quite free from putrefaction." The practice was most common in Ireland in the 11th–14th centuries; it ended entirely before the 19th century.

5 - 2 – Industrialization

Like Ireland, France became well known for its butter, particularly in Normandy and Brittany. By the 1860s, butter had become so in demand in France that Emperor Napoleon III offered prize money for an inexpensive substitute to supplement France's inadequate butter supplies. A French chemist claimed the prize with the invention of margarine in 1869. The first margarine was beef tallow flavored with milk and worked like butter; vegetable margarine followed after the development of hydrogenated oils around 1900.

Until the 19th century, the vast majority of butter was made by hand, on farms. The first butter factories appeared in the United States in the early 1860s, after the successful introduction of cheese factories a decade earlier. In the late 1870s, the centrifugal cream separator was introduced, marketed most successfully by Swedish engineer Carl Gustaf Patrik de Laval . This dramatically sped up the butter-making process by eliminating the slow step of letting cream naturally rise to the top of milk. Initially, whole milk was shipped to the butter factories, and the cream separation took place there. Soon, though, cream-separation technology became small and inexpensive enough to introduce an additional efficiency: the separation was accomplished on the farm, and the cream alone shipped to the factory. By 1900, more than half the butter produced in the United States was factory made; Europe followed suit shortly after. In 1920, Otto Hunziker authored *The Butter Industry, Prepared for Factory, School and Laboratory*, a well - known text in the industry that enjoyed at least three editions (1920, 1927, 1940). As part of the efforts of the American Dairy Science Association, Professor Hunziker and others published articles regarding: causes of tallowiness^[24] (an odor defect, distinct from rancidity, a taste defect); mottles^[25] (an aesthetic issue related to uneven color); introduced salts;^[26] the impact of creamery metals and liquids ; and acidity measurement.^[29] These and other ADSA publications helped standardize practices internationally.

Butter also served as a source of extra income for farm families. Wood presses featuring intricate decoration were used to press the butter into pucks or small bricks to be sold at a nearby market or general store with the decoration identifying the farm which produced the butter. This continued until production was mechanized and butter was produced in less decorative stick form . Today butter presses continue to be used for decorative purposes.

Per capita butter consumption declined in most western nations during the 20th century, in large part because of the rising popularity of margarine, which is less expensive and, until recent years, was perceived as being healthier. In the United States, margarine consumption overtook butter during the 1950s, and it is still the case today that more margarine than butter is eaten in the U.S. and the EU.

6 - Size and shape of butter packaging

In the United States, butter is usually produced in 4 - ounce sticks, wrapped in waxed or foiled paper and sold four to a one pound carton. This practice is believed to have originated in 1907, when Swift and Company began packaging butter in this manner for mass distribution.

These sticks are commonly produced in two different shapes:

The dominant shape east of the Rocky Mountains is the Elgin, or Eastern - pack shape, named for a dairy in Elgin, Illinois. The sticks are 121 millimeters long and 32 millimeters wide and are typically sold stacked two by two in elongated cube - shaped boxes. West of the Rocky Mountains, butter printers standardized on a different shape that is now referred to as the Western-pack shape. These butter sticks are 80 millimeters long and 38 millimeters wide and are usually sold with four sticks packed side - by - side in a flat, rectangular box . The shape was altered for the West Coast because of the higher average temperature; having a smaller surface-area-to-volume ratio allowed the stick of butter to remain on the counter longer without melting.

Both sticks contain the same amount of butter, although most butter dishes are designed for Elgin - style butter sticks.

Out side of the United States, butter is packaged and sold by weight only, not by volume (fluid measure) nor by unit (stick), but the package shape remains approximately the same. The wrapper is usually a foil and waxed - paper laminate (the waxed paper is now a siliconised substitute, but is still referred to in some places as parchment, from the wrapping used in past centuries ; and the term 'parchment - wrapped' is still employed where the paper alone is used, without the foil laminate).

In the remainder of the metricated world, butter is packed and sold in 250g and 500g packs (roughly equivalent to the $\frac{1}{2}$ lb and 1 lb measures) and measured for cooking in grams or kilograms; although melted butter could be measured by fluid measure (centiliters or fluid ounces), this is rare.

Butter for commercial and industrial use is packaged in plastic buckets, tubs, or drums, in quantities and units suited to the local market.

7 - World wide

In 1997, India produced 1,470,000 metric tons of butter, most of which was consumed domestically. Second in production was the United States 522,000 t, followed by France 466,000 t, Germany 442,000 t, and New Zealand 307,000 t. France ranks first in per capita butter consumption with 8 kg per capita per year. In terms of absolute consumption, Germany was second after India, using

578,000 metric tons of butter in 1997, followed by France 528,000 t , Russia 514,000 t , and the United States 505,000 t . New Zealand, Australia, and the Ukraine are among the few nations that export a significant percentage of the butter they produce.

Different varieties are found around the world. *Smen* is a spiced Moroccan clarified butter, buried in the ground and aged for months or years. Yak butter is a specialty in Tibet; *tsampa*, barley flour mixed with yak butter, is a staple food. Butter tea is consumed in the Himalayan regions of Tibet, Bhutan, Nepal and India. It consists of tea served with intensely flavored — or "rancid" — yak butter and salt. In African and Asian developing nations, butter is traditionally made from sour milk rather than cream. It can take several hours of churning to produce workable butter grains from fermented milk.

8 - Storage and cooking

Normal butter softens to a spreadable consistency around 15 °C refrigerator temperatures. (60 °F), well above The "butter compartment" found in many refrigerators may be one of the warmer sections inside, but it still leaves butter quite hard. Until recently, many refrigerators sold in New Zealand featured a "butter conditioner", a compartment kept warmer than the rest of the refrigerator — but still cooler than room temperature — with a small heater . Keeping butter tightly wrapped delays rancidity, which is hastened by exposure to light or air, and also helps prevent it from picking up other odors. Wrapped butter has a shelf life of several months at refrigerator temperatures

"French butter dishes" or "Acadian butter dishes" involve a lid with a long interior lip, which sits in a container holding a small amount of water. Usually the dish holds just enough water to submerge the interior lip when the dish is closed. Butter is packed into the lid. The water acts as a seal to keep the butter fresh, and also keeps the butter from over heating in hot temperatures. This allows butter to be safely stored on the countertop for several days without spoilage.

Once butter is softened, spices, herbs, or other flavoring agents can be mixed into it, producing what is called a *compound butter* or

composite butter (some times also called *composed butter*). Compound butters can be used as spreads, or cooled, sliced, and placed onto hot food to melt into a sauce. Sweetened compound butters can be served with desserts; such hard sauces are often flavored with spirits.

Melted butter plays an important role in the preparation of sauces, most obviously in French cuisine. Beurre noisette (hazelnut butter) and Beurre noir (black butter) are sauces of melted butter cooked until the milk solids and sugars have turned golden or dark brown; they are often finished with an addition of vinegar or lemon juice. Hollandaise and béarnaise sauces are emulsions of egg yolk and melted butter; they are in essence mayonnaises made with butter instead of oil. Hollandaise and béarnaise sauces are stabilized with the powerful emulsifiers in the egg yolks, but butter itself contains enough emulsifiers — mostly remnants of the fat globule membranes — to form a stable emulsion on its own. *Beurre blanc* (white butter) is made by whisking butter into reduced vinegar or wine, forming an emulsion with the texture of thick cream. Beurre monté (prepared butter) is melted but still emulsified butter; it lends its name to the practice of "mounting" a sauce with butter: whisking cold butter into any water-based sauce at the end of cooking, giving the sauce a thicker body and a glossy shine — as well as a buttery taste.

In Poland, the butter lamb (*Baranek wielkanocny*) is a traditional addition to the Easter Meal for many Polish Catholics. Butter is shaped into a lamb either by hand or in a lamb-shaped mould. Butter is also used to make edible decorations to garnish other dishes.

Butter is used for sautéing and frying, although its milk solids brown and burn above 150 °C — a rather low temperature for most applications. The smoke point of butterfat is around 200 °C, so clarified butter or ghee is better suited to frying. Ghee has always been a common frying medium in India, where many avoid other animal fats for cultural or religious reasons. Butter fills several roles in baking, where it is used in a similar manner as other solid fats like lard, suet, or shortening, but has a flavor that may better complement sweet baked goods. Many cookie doughs and some cake batters are leavened, at least in part, by creaming butter and sugar together, which introduces air bubbles into the butter. The tiny bubbles locked within the butter expand in the heat of baking and aerate the cookie or cake. Some cookies like shortbread may have no other source of moisture but the water in the butter. Pastries like pie dough incorporate pieces of solid fat into the dough, which become flat layers of fat when the dough is rolled out. During baking, the fat melts away, leaving a flaky texture. Butter, because of its flavor, is a common choice for the fat in such a dough, but it can be more difficult to work with than shortening because of its low melting point. Pastry makers often chill all their ingredients and utensils while working with a butter dough.

Butter also has many non - culinary, traditional uses which are specific to certain cultures. For instance, in North America, applying butter to the handle of a door is a common prank on April Fools' Day.

9 - Nutritional information

As butter is essentially just the milk fat, it contains only traces of lactose, so moderate consumption of butter is not a problem for the lactose intolerant.^[42] People with milk allergies may still need to avoid butter, which contains enough of the allergy - causing proteins to cause reactions.

It is a good source of Vitamin A.

Butter may play a useful role in dieting by providing satiety. A small amount added to low fat foods such as vegetables may ward off feelings of hunger.

Butter, unsalted			
Nutritional value per 100 g			
Energy	2,999 kJ (717 kcal)		
Carbohydrates	0 g		

Fat	81 g
- saturated	51 g
- monounsaturated	21 g
- polyunsaturated	3 g
Protein	1 g
Vitamin A equiv.	684 µg (86%)
Vitamin D	60 IU (10%)
Vitamin E	2.32 mg (15%)
Cholesterol	215 mg

Comparative properties of common cooking fats (per 100 g)					
	Total fat	Saturated fat	Monounsaturated fat	Polyunsaturated fat	Smoke point
Sunflower oil	100g	11g		69g (4g in high oleic variety)	225 °C
Soybean oil	100g	16g	23g	58g	257 °C
Canola oil	100g	7g	63g	28g	205 °C
Olive oil	100g	14g	73g	11g	190 °C
Corn oil	100g	15g	30g	55g	230 °C
Peanut oil	100g	17g	46g	32g	225 °C
Rice bran oil	100g	25g	38g	37g	213 °C
Vegetable shortening (hydrogenated)	71g	23g (34%)	8g (11%)	37g (52%)	165 °C
Lard	100g	39g	45g	11g	190 °C
Suet	94g	52g (55%)	32g (34%)	3g (3%)	200°C
Butter	81g	51g (63%)	21g (26%)	3g (4%)	150 °C

Candle



A candle burning.

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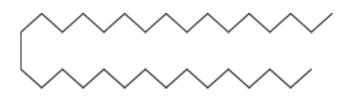
1 - Introduction

A candle is a solid block of wax with an embedded wick, which is ignited to provide light, and sometimes heat, and historically was used as a method of keeping time. A candle manufacturer is traditionally known as a chandler. Various devices have been invented to hold candles, from simple tabletop candle holders, to elaborate chandeliers.

For a candle to burn, a heat source (commonly a naked flame) is used to light the candle's wick, which melts and vaporizes a small amount of fuel, the wax. Once vaporized, the fuel combines with oxygen in the atmosphere to form a flame. This flame provides sufficient heat to keep the candle burning via a self-sustaining chain of events: the heat of the flame melts the top of the mass of solid fuel; the liquefied fuel then moves upward through the wick via capillary action; the liquefied fuel finally vaporizes to burn within the candle's flame.

As the mass of solid fuel is melted and consumed, the candle grows shorter. Portions of the wick that are not emitting vaporized fuel are consumed in the flame. The incineration of the wick limits the exposed length of the wick, thus maintaining a constant burning temperature and rate of fuel consumption. Some wicks require regular trimming with scissors (or a specialized wick trimmer), usually to about ~ 0.7 cm , to promote slower, steady burning, and also to prevent smoking. In early times, the wick needed to be trimmed quite frequently, and special candle-scissors, referred to as "snuffers" until the 20th century, were produced for this purpose, often combined with an extinguisher. In modern candles, the wick is constructed so that it curves over as it burns , so that the end of the wick gets oxygen and is then consumed by fire — a self - trimming wick.

2 - Components 2 - 1 - Wax



The hydrocarbon $C_{31}H_{64}$ is a typical component of paraffin wax, from which most modern candles are produced.



Unlit candles

Candles were once made from tallow and beeswax until after about 1853, they were made mainly from spermaceti and purified animal fats (stearin). Today, most candles are made from paraffin wax.^[4] Candles can also be made from beeswax, soy, other plant waxes, and tallow (a by - product of beef-fat rendering). Gel candles are made from a mixture of mineral oil and a polymer.

The candle can be made of :

* Paraffin (a product of petroleum refining)

* Microcrystalline wax

* Stearin (now produced almost exclusively from palm waxes though initially manufactured from animal fats)

* Bees wax (a byproduct of honey collection)

* Gel (a mixture of polymer and mineral oil)

* Some plant waxes (generally palm, carnauba, bayberry, or soybean wax)

* Tallow (rarely used since the introduction of affordable and cheap wax alternatives)

* Spermaceti (extracted from the head of a Sperm Whale)

The size of the flame and corresponding rate of burning is controlled largely by the candle wick.

Production methods utilize extrusion moulding . More traditional production methods entails melting the solid fuel by the

controlled application of heat. The liquid is then poured into a mould or a wick is repeatedly immersed in the liquid to create a dipped tapered candle. Often fragrance oils, essential oils or aniline-based dye is added.

2-2-Wick

A candle wick works by capillary action, drawing ("wicking") the melted wax or fuel up to the flame. When the liquid fuel reaches the flame, it vaporizes and combusts. The candle wick influences how the candle burns. Important characteristics of the wick include diameter, stiffness, fire - resistance, and tethering.

A candle wick is a piece of string or cord that holds the flame of a candle. Commercial wicks are made from braided cotton. The wick's capillarity determines the rate at which the melted hydrocarbon is conveyed to the flame. If the capillarity is too great, the molten wax streams down the side of the candle. Wick are often infused with a variety of chemicals to modify its burning characteristics. For example, it is usually desirable that the wick not glow after the flame is extinguished. Typical agents are ammonium nitrate and ammonium sulfate.

3 – Characteristics 3 – 1 – Light



A room lit up in the glow of many candles

Based on measurements of a taper – type , paraffin wax candle, a modern candle typically burns at a steady rate of about 0.1 g / min, releasing heat at roughly 80 W.^[6] The light produced is about 13

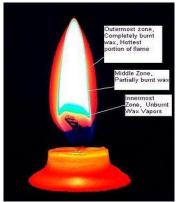
lumens, for a luminous efficacy of about 0.16 lumens per watt (luminous efficacy of a source) - almost a hundred times lower than an incandescent light bulb.

The luminous intensity of a typical candle is thus approximately one candela. The SI unit, candela, was in fact based on an older unit called the *candlepower*, which represented the luminous intensity emitted by a candle made to particular specifications (a "standard candle"). The modern unit is defined in a more precise and repeatable way, but was chosen such that a candle's luminous intensity is still about one candela.

3 – 2 – Temperature

The hottest part of the flame is just above the very dull blue part to one side of the flame, at the base. At this point, the flame is about 1,400 °C. However note that this part of the flame is very small and releases little heat energy. The blue color is due to chemi luminescence, while the visible yellow color is due to radiative emission from hot soot particles. The soot is formed through a series of complex chemical reactions, leading from the fuel molecule through molecular growth, until multi - carbon ring compounds are formed. The thermal structure of a flame is complex, hundreds of degrees over very short distances leading to extremely steep temperature gradients. On average, the flame temperature is about 1,000 °C. The color temperature is approximately 1,000 K.

3 – 3 - Candle flame



Candle flame with zones marked

A candle flame has three distinct regions. The innermost zone, directly above the wick contains wax vapors that have just been vaporized. The middle zone, the yellow portion of the flame is an oxygen depleted zone, where partial oxidation has occurred, but insufficient oxygen exists to burn all of the vapors present. The temperature in this region is hotter than the innermost zone, but cooler than the outer zone. The outer zone is the area where the flame is the hottest and the oxidation process is complete.

4-**4**- **History of study**

One of Michael Faraday's significant works was *The Chemical History of a Candle*, where he gives an in-depth analysis of the evolutionary development, workings and science of candles.

4 – Hazards

According to the U.S. National Fire Protection Association, candles are one of the leading sources of residential fires in the U.S. with almost 10 % of civilian injuries and 6 % of civilian fatalities from fire attributed to candles.

A candle flame that is longer than its laminar smoke point^[11] will emit soot. Soot inhalation has known health hazards. Proper wick trimming will substantially reduce soot emissions from most candles.

The liquid wax is hot and can cause skin burns, but the amount and temperature are generally rather limited and the burns are seldom serious. The best way to avoid getting burned from splashed wax is to use a candle snuffer instead of blowing on the flame. A candle snuffer is usually a small metal cup on the end of a long handle. When placed over the flame the oxygen supply is cut off. They were used daily when the candle was the main source of lighting a home, before electric lights were available.

Glass candle holders are sometimes cracked by thermal shock from the candle flame, particularly when the candle burns down to the end. When burning candles in glass holders or jars, users should avoid lighting candles with chipped or cracked containers, and stop use once 1/2 inch or less of wax remains. A former worry regarding the safety of candles was that a lead core was used in the wicks to keep them upright in container candles. Without a stiff core, the wicks of a container candle could sag and drown in the deep wax pool. Concerns rose that the lead in these wicks would vaporize during the burning process, releasing lead vapors — a known health and developmental hazard. Lead core wicks have not been common since the 1970s. Today, most metal-cored wicks use zinc or a zinc alloy, which has become the industry standard. Wicks made from specially treated paper and cotton are also available.

5 – Regulation

Candles and candle accessories pose a risk to property and people. Risk can be reduced by ensuring products comply with international standards.

6 – Accessories

6 – 1 - Candle holders



A candle in a candle stick

Decorative candle holders, especially those shaped as a pedestal, are called candlesticks; if multiple candle tapers are held, the term *candelabrum* is also used. The root form of *chandelier* is from the word for candle, but now usually refers to an electric fixture. The word *chandelier* is sometimes now used to describe a hanging fixture designed to hold multiple tapers.

Many candle holders use a friction-tight socket to keep the candle upright. In this case, a candle that is slightly too wide will not fit in the holder, and a candle that is slightly too narrow will wobble. Candles that are too big can be trimmed to fit with a knife; candles that are too small can be fitted with aluminium foil. Traditionally, the candle and candle holders were made in the same place, so they were appropriately sized, but international trade has combined the modern candle with existing holders, which makes the ill-fitting candle more common. This friction tight socket is only needed for the federals and the tapers. For tea light candles, there are a variety of candle holders, including small glass holders and elaborate multi candle stands. The same is true for votives. Wall sconces are available for tea light and votive candles. For pillar type candles, the assortment of candle holders is broad. A fireproof plate, such as a glass plate or small mirror, is a candle holder for a pillar style candle. A pedestal of any kind, with the appropriate-sized fireproof top, is another option. A large glass bowl with a large flat bottom and tall mostly vertical curved sides is called a hurricane. The pillar style candle is placed at the bottom center of the hurricane. A hurricane on a pedestal is sometimes sold as a unit.

A bobèche is a drip - catching ring, which may also be affixed to a candle holder, or used independently of one. They can range from ornate metal or glass, to simple plastic, cardboard, or wax paper. Use of paper or plastic bobèches is common at events where candles are distributed to a crowd or audience, such as Christmas carols or other concerts/festivals.

6-2 - Candle followers

These are glass or metal tubes with an internal stricture partway along, which sit around the top of a lit candle. As the candle burns, the wax melts and the follower holds the melted wax in, whilst the stricture rests on the topmost solid portion of wax. Candle followers are often deliberately heavy or 'weighted', to ensure they move down as the candle burns lower, maintaining a seal and preventing wax escape. The purpose of a candle follower is threefold: To contain the melted wax - making the candle more efficient, avoiding mess, and producing a more even burn

As a decoration - either due to the ornate nature of the device, or (in the case of a glass follower) through light dispersion or colouration

And sometimes to shield the flame from wind. Candle followers are often found in churches on altar candles.

6 – 3 - Candle snuffers

Candle snuffers are instruments used to extinguish burning candles by smothering the flame with a small metal cup that is suspended from a long handle, and thus depriving it of oxygen. An older meaning refers to a scissor-like tool used to trim the wick of a candle. With skill, this could be done without extinguishing the flame. The instrument now known as a candle snuffer was formerly called an "extinguisher" or "douter".

7 – Etymology

The word candle comes from Middle English *candel*, from Old English and from Anglo - Norman *candele*, both from Latin *candla*, from *candre*, to shine.

8 - History

The earliest known candles originated in China around 200 BC, and were made from whale fat. Candles did not appear in Europe or the Middle East until sometime after AD 400, due largely to the availability of olive oil for burning in lamps . The early European candle was made from various forms of natural fat, tallow, and wax. In the 18th century, spermaceti, oil produced by the sperm whale, was used to produce a superior candle . Late in the 18th century, colza oil and rapeseed oil came into use as much cheaper substitutes.

Until of late years, candles were solely manufactured from bees' wax, spermaceti, or tallow. The application of scientific chemical research...all the best candles are now made from the pure solid and crystallizable margaric and stearic acids. These are freed from the fluid oleic acid, and from glycerin , which exist in combination with

them in ordinary tallow, as well as from other analogous substances, as from paraffin (a carbo - hygroneous substance resembling spermaceti, prepared from tar and peat), the stearic and margaric acid in the cocoa-nut oil and the palm oil, besides the old substance spermaceti, and wax both vegetable and animal.

-Candles, - Eighth edition, Encyclopedia Britannica, 1853

Paraffin was first distilled in 1830, and revolutionized candlemaking, as it was an inexpensive material which produced a highquality, odorless candle that burned reasonably cleanly. The industry was devastated soon after, however, by the distillation of kerosene (confusingly also called *paraffin oil* or just *paraffin*). Recently resin based candles that are freestanding and transparent have been developed, with the claim that they burn longer than traditional paraffin candles. They are usually scented and oil based.

In the Middle Ages in Europe, tallow candles were the most common candle. By the 13th century, candle making had become a guild craft in England and France. The candle makers (chandlers) went from house to house making candles from the kitchen fats saved for that purpose, or made and sold their own candles from small candle shops.

8 – 1 – Time keeping

With the fairly consistent and measurable burning of a candle, a common use was to tell the time. The candle designed for this purpose might have time measurements, usually in hours, marked along the wax. The Song dynasty in China (960 - 1279) used candle-clocks.^[17] By the 18th century, candle - clocks were being made with weights set into the sides of the candle. As the candle melted, the weights fell off and made a noise as they fell into a bowl. A form of candle-clock was used in coal-mining until the 20th century.

In the days leading to Christmas some people burn a candle a set amount to represent each day, as marked on the candle. The type of candle used in this way is called the *Advent candle*, although this term is also used to refer to a candle that decorates an Advent wreath.

9 – Use

Before the invention of electric lighting, candles and oil lamps were commonly used for illumination. In areas without electricity, they are still used routinely. Until the 20 th century, candles were more common in northern Europe. In southern Europe and the Mediterranean, oil lamps predominated. In the developed world today, candles are used mainly for their aesthetic value and scent, particularly to set a soft, warm, or romantic ambiance, for emergency lighting during electrical power failures, and for religious or ritual purposes. Scented candles are used in aromatherapy.

9-1-Religion

Candles are used in the religious ceremonies of many faiths.

Candelilla Wax

Contents

1 Introduction

2 Composition and production

3 Uses

1 - Introduction

Candelilla wax is a wax derived from the leaves of the small Candelilla shrub native to northern Mexico and the southwestern United States, *Euphorbia cerifera* and *Euphorbia antisyphilitica*, from the family *Euphorbiaceae*. It is yellowish-brown, hard, brittle, aromatic, and opaque to translucent.

2 - Composition and production

With a melting point of 68.5 - 72.5 °C, candelilla wax consists of mainly hydrocarbons (about 50 %, chains with 29 – 33 carbons), esters of higher molecular weight (20 - 29 %), free acids (7 - 9 %), and resins (12–14 %, mainly tri terpenoid esters). The high hydrocarbon content distinguishes this wax from carnauba wax. It is insoluble in water, but soluble in many organic solvents such as acetone, chloroform, benzene.

The wax is obtained by boiling the leaves and stems with dilute sulfuric acid, and the resulting "cerote" is skimmed from the surface and further processed. In this way, about 900 tons are produced annually.

3 – Uses

It is mostly used mixed with other waxes to harden them without raising their melting point. As a food additive, candelilla wax has the E number E 902 and is used as a glazing agent. It also finds use in cosmetic industry, as a component of lip balms and lotion bars. One of its major uses was a binder for chewing gums.

Candelilla wax can be used as a substitute for carnauba wax and beeswax. It is also used for making varnish.

Candle Nut Oil

Candle nut oil or kukui nut oil is extracted from the nut of the *Aleurites moluccana*, the candlenut or kuku'i. The candlenut originates in Hawai'i. The oil contains 19 % oleic acid, 41 % linoleic acid, and less than 27 % linolenic acid . Candlenut oil is light yellow, with an amber tint, and has a shelf life of 6 - 8 months. Historically , it has been valued as an emollient, and is currently used primarily in skin care products .

Canola

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 History
 Production and trade

4 Canola oil

4.1 Health information

4.2 Erucic acid issues

- 4.3 Biodiesel
- 4.4 Comparison to other vegetable oils

5 Genetic modification issues

5.1 Legal issues

1 - Introduction

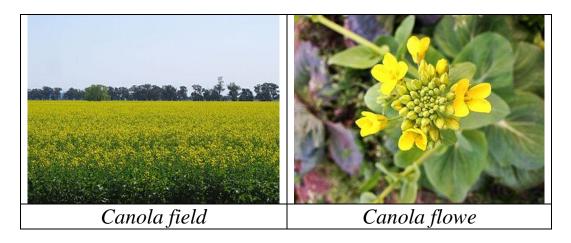
Canola refers to a cultivar of either rapeseed (*Brassica napus L.*) or field mustard (*Brassica campestris L.* or *Brassica Rapa var.*). Its seeds are used to produce edible oil suitable for consumption by humans and livestock. The oil is also suitable for use as biodiesel.

Originally, Canola was bred naturally from rapeseed at the University of Manitoba, Canada by Keith Downey and Baldur R. Stefansson in the early 1970s, but it has a very different nutritional profile in addition to much less erucic acid. The name "canola" was chosen by the board of the Rapeseed Association of Canada in 1978. The "Can" part refers to Canada but the "ola" part has no real meaning despite several attempts by others to read a meaning into it. There were several other products around at the time using the "ola" tag including MazolaTM or RicolaTM or even CanolaTM the name of a Canon Calculator. Genetically modified rapeseed is sometimes referred to as Rapeseed 00. A product known as LEAR (for *low erucic acid rapeseed*) derived from cross-breeding of multiple lines of *Brassica juncea* may also be referred to as canola oil and is considered safe for human consumption.

2 - History

Canola was developed through conventional plant breeding from rapeseed, an oilseed plant already used in ancient civilization as a fuel.

The word "rape" in rapeseed comes from the Latin word *rapum* meaning turnip. Turnip, rutabaga, cabbage, Brussels sprouts, mustard, and many other vegetables are related to the two natural canola varieties commonly grown, which are cultivars of *Brassica napus* and *Brassica rapa*. The change in name serves to distinguish it from natural rapeseed oil, which has much higher erucic acid content.



Brassica oilseed varieties are some of the oldest plants cultivated by humanity, with documentation of its use in India 4,000 years ago, and use in China and Japan 2,000 years ago. Its use in Northern Europe for oil lamps is documented to the 13th century.^[8] Its use was limited until the development of steam power, when machinists found rapeseed oil clung to water- or steam-washed metal surfaces better than other lubricants. World War II saw high demand for the oil as a lubricant for the rapidly increasing number of steam engines in naval and merchant ships. When the war blocked European and Asian sources of rapeseed oil, a critical shortage developed and Canada began to expand its limited rapeseed production.

After the war, demand declined sharply and farmers began to look for other uses for the plant and its products. Rapeseed oil extracts were first put on the market in 1956 – 1957 as food products, but these suffered from several unacceptable characteristics. Rapeseed oil had a distinctive taste and a disagreeable greenish colour due to the presence of chlorophyll. It also contained a high concentration of erucic acid. Experiments on animals have pointed to the possibility that erucic acid, consumed in large quantities, may cause heart damage, although Indian researchers have published findings that call into question these conclusions and the implication that the consumption of mustard or rapeseed oil is dangerous. Feed meal from the rapeseed plant also was not particularly appealing to livestock, due to high levels of sharptasting compounds called glucosinolates, and they would not eat it.

A variety developed in 1998 is considered to be the most disease- and drought-resistant Canola variety of rapeseed to date. This and other recent varieties have been produced by using genetic engineering. In 2011 26 % of the acres sown were genetically modified (biotech) canola.

Canola was originally a trademark, but is now a generic term for edible varieties of rapeseed oil in North America and Australia. In Canada, an official definition of canola is codified in Canadian law.

3 - Production and trade

Rapeseed was once considered a specialty crop in Canada, but Canola now has become a major American cash crop. Canada and the United States produce between 7 and 10 million tones of canola seed per year. Annual Canadian exports total 3 to 4 million tones of the seed, 800,000 tones of canola oil and 1 million tones of canola meal. GM canola may not be grown in jurisdictions that have not approved GMOs. Within the United States, 90% of the canola crop is grown in North Dakota.

Rapeseed is the highest - producing oil - seed crop in the USA. An Oregon State University researcher has determined that growing winter for hybrid Canola seed appears possible in central Oregon, USA, but the state prohibits it from being grown in Deschutes, Jefferson, and Crook counties because it may attract bees away from specialty seed crops such as carrots, which require bees for pollination. The rapeseed blossom is a major source of nectar for honeybees.

The major customers of canola seed are Japan, Mexico, China, and Pakistan, while the bulk of canola oil and meal goes to the United States, with smaller amounts shipped to Mexico, China, and Europe. World production of rapeseed oil in the 2002 - 2003 season was about

14 million metric tons. In the 2010–2011 season, world production is estimated to be at 58.4 million tones. The United States is a net consumer of canola oil, having used 3 billion pounds in 2010, 2.5 billion of which was imported from Canada.

The main price discovery mechanism for worldwide canola trade is the ICE Futures Canada (formerly Winnipeg Commodity Exchange) canola futures contract. Rapeseed is traded on the Euronext exchange.

4 - Canola oil

Canola oil is made at a processing facility by slightly heating and then crushing the seed. Almost all commercial grade canola oil is then refined using hexane. Finally, the crude oil is refined using water precipitation and organic acid, "bleaching" with clay, and deodorizing using steam distillation. Approximately 43 % of a seed is oil. What remains is a rapeseed meal that is used as high quality animal feed. 22.68 kg (50 lb) of rapeseed makes approximately 10 L of canola oil. Canola oil is a key ingredient in many foods. Its reputation as a healthy oil has created high demand in markets around the world, and overall it is the third most widely consumed vegetable oil in the world.

The oil has many non-food uses, and often replaces nonrenewable resources in products including industrial lubricants, biofuels, candles, lipsticks, and newspaperinks.

The average density of canola oil is 0.92 g / ml.

Compound	Family	% of total
Oleic acid	Ω-9	61
Linoleic acid	Ω-6	21
Alpha-linolenic acid	Ω-3	10
Saturated fatty acids		7
Palmitic acid		4
Stearic acid		2
Trans fat		0.4

4 - 1 - Health information

Canola oil is low in saturated fat and contains both omega-6 and omega-3 fatty acids in a ratio of 2:1. If consumed, it also reduces Low-density lipoprotein and overall cholesterol levels, and as a significant source of the essential omega-3 fatty acid is associated with reduced all-cause and cardiovascular mortality. It is recognized by many health professional organizations including the Academy of Nutrition and Dietetics and American Heart Association. Canola oil has been given a qualified health claim from the United States Food and Drug Administration due to its high levels of cholesterol-lowering fats.

4 - 1 - Erucic acid issues

Although wild rapeseed oil contains significant amounts of erucic acid, a known toxin,^[34] the cultivar used to produce commercial, food-grade canola oil was bred to contain less than 2% erucic acid, levels that are not believed to cause harm in humans^{[35][36]} and no health effects have been associated with consumption by humans of the genetically modified oil. Although rumors that canola oil can cause dangerous health problems circulated , there is no reason to believe canola oil poses unusual health risks and its consumption in food - grade forms is generally recognized as safe by the United States Food and Drug Administration.

The Chinese and Indians have used rapeseed oils for thousands of years, but the form used was unrefined (natural) which may make a difference in effect on health.

4 - 3 - Biodiesel

Because of the lower levels of the toxic and irritating properties of genetically modified rapeseed oil, *Canola* oil is a more promising source for manufacturing biodiesel than the natural oil as a renewable alternative to fossil fuels.

Type fat		~	Polyunsaturated fatty acids					
	Saturated fatty acids		Total poly	linolenic acid (ω-3)	Linoleic acid (ω-6)	- Oleic acid (ω-9)	Smoke point	
Not Hydrogenated	Not Hydrogenated							
Canola (rapeseed)	7.365	63.276	28.142	-	-	-	204 °C	
Coconut	91.00	6.000	3.000	-	2	6	177 °C	
Corn	12.948	27.576	54.677	1	58	28	232 °C)	
Cottonseed	25.900	17.800	51.900	1	54	19	216 °C	
Flaxseed/Linseed	6 - 9	10 - 22	68 - 89	56 - 71	12 - 18	10 - 22	107 °C	
Olive	14.00	72.00	14.00	-	-	-	193 °C	
Palm	49.300	37.000	9.300	-	10	40	235 °C	
Peanut	16.900	46.200	32.000	-	32	48	225 °C	
Safflower (>70% linoleic)	8.00	15.00	75.00	-	-	-	210 °C	
Safflower (high oleic)	7.541	75.221	12.820	-	-	-	210 °C	
Soybean	15.650	22.783	57.740	7	54	24	238 °C	
Sunflower (<60% linoleic)	10.100	45.400	40.100	0.200	39.800	45.300	227 °C	
Sunflower (>70% oleic)	9.859	83.689	3.798	-	-	-	227 °C	
Fully hydrogenated								
Cottonseed (hydrog.)	93.600	1.529	.587		.287			
Palm (hydrogenated)	47.500	40.600	7.500					
Soybean (hydrogen.)	21.100	73.700	.400	.096 ^[40]				
Values as percent (%) by weight of total fat.								

4 - 4 - Comparison to other vegetable oils

5 - Genetic modification issues

A genetically engineered rapeseed that is tolerant to herbicide was first introduced to Canada in 1995. In 2009, 90% of the Canadian crop was herbicide-tolerant. As of 2005, 87% of the canola grown in the US was genetically modified. A 2010 study conducted in North Dakota found glyphosate - or glufosinate - resistance transgenes in 80% of wild natural rapeseed plants, and a few plants that were resistant to both herbicides. The escape of the genetically modified plants has raised concerns that the build-up of herbicide resistance in feral canola could make it more difficult to manage these plants using herbicides. However one of the researchers agrees that "..feral populations could have become established after trucks carrying cultivated GM seeds spilled some of their load during transportation." She also notes that the GM canola results they found may have been biased as they only sampled along roadsides.

5 – 1 - Legal issues

Genetically modified canola has become a point of controversy and contentious legal battles. In one high - profile case (Monsanto Canada Inc. v. Schmeiser) the Monsanto Company sued Percy Schmeiser for patent infringement after he replanted canola seed that he had harvested from his field, which he discovered was contaminated with Monsanto's patented glyphosate-tolerant canola by spraying it with Roundup, leaving only the resistant plants. The Supreme Court ruled that Percy was in violation of Monsanto's patent because he knowingly replanted the resistant seed that he had harvested, but he was not required to pay Monsanto damages since he did not benefit financially from its presence . On 19 March 2008, Schmeiser and Monsanto Canada Inc. came to an out - of - court settlement whereby Monsanto would pay for the clean-up costs of the contamination, which came to a total of \$ 660 Canadian.

In 2003, Australia's gene technology regulator approved the release of canola altered to make it resistant to Glufosinate ammonium, a herbicide. The introduction of the genetically modified crop to Australia generated considerable controversy. Canola is Australia's third biggest crop, and is used often by wheat farmers as a break crop to improve soil quality. As of 2008 the only genetically modified crops in Australia were canola, cotton, and carnations.

Carnauba Wax

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Introduction
 Composition
 Properties
 Production and Export
 Technical characteristics

1 - Introduction

Carnauba (, *carnaúba*, Portuguese pronunciation), also called Brazil wax and palm wax, is a wax of the leaves of the palm *Copernicia prunifera*, a plant native to and grown only in the northeastern Brazilian states of Piauí, Ceará, and Rio Grande do Norte . It is known as "queen of waxes" and in its pure state, usually comes in the form of hard yellow-brown flakes. It is obtained from the leaves of the carnauba palm by collecting and drying them, beating them to loosen the wax, then refining and bleaching the wax.

2 – Composition



Carnauba palm

Carnauba consists mostly of aliphatic esters (40 wt %), diesters of 4 - hydroxy cinnamic acid (21.0 wt %), ω – hydroxy carboxylic acids (13.0 wt %), and fatty acid alcohols (12 wt %). The compounds are predominantly derived from acids and alcohols in the C26 - C30 range. Distinctive for carnauba wax is the high content of diesters as well as methoxy cinnamic acid.

Carnauba wax is sold in several grades, labeled T1, T3, and T4, depending on the purity level. Purification is accomplished by filtration, centrifugation, and bleaching.



Sweets coated with carnauba wax

3 – Properties

Carnauba wax can produce a glossy finish and as such is used in automobile waxes, shoe polishes, dental floss, food products such as sweets, instrument polishes, and floor and furniture waxes and polishes, especially when mixed with beeswax and with turpentine. Use for paper coatings is the most common application in the United States ' It was commonly used in its purest form as a coating on speedboat hulls in the early 60's to enhance speed & aid in handling in salt water environments. It is also the main ingredient in surfboard wax, combined with coconut oil.

Because of its hypo allergenic and emollient properties as well as its shine, carnauba wax appears as an ingredient in many cosmetics formulas where it is used to thicken lipstick, eyeliner, mascara, eye shadow, foundation, deodorant, various skin care preparations, sun care preparations, etc. It is also used to make cutler's resin.

It is the finish of choice for most briar tobacco or smoking pipes. It produces a high gloss finish when buffed on to wood. This finish dulls with time rather than flaking off (as is the case with most other finishes used).

Although too brittle to be used by itself, carnauba wax is often combined with other waxes (principally bees wax) to treat and waterproof many leather products where it provides a high-gloss finish and increases leather's hardness and durability.

It is also used in the pharmaceutical industry as a tablet-coating agent. Adding the carnuaba wax aids in the swallowing of tablets for patients. A very small amount (less than a hundredth of one percent by weight, i.e., 30 grams for a 300 kg batch) is sprinkled onto a batch of tablets after they have been sprayed and dried. The wax and tablets are then tumbled together for a few minutes before being discharged from the tablet-coating machine.

In 1890, Charles Tainter patented the use of carnauba wax on phonograph cylinders as a replacement for a mixture of paraffin and bees wax.

Carnauba wax may be used as a mold release agent for manufacture of fibre - reinforced plastics. An aerosol mold release agent is formed by dissolving carnauba wax in a solvent. Unlike silicone or PTFE, canrnauba is suitable for use with liquid epoxy, epoxy molding compounds (EMC), and some other plastic types and generally enhances their properties . Carnauba wax is not very soluble in chlorinated or aromatic hydrocarbons . Carnauba is used in melt/castable explosives to produce an insensitive explosive formula such as Composition B, which is a blend of RDX and TNT.

4 - Production and Export

In 2006, Brazil produced 22,409 tons of carnauba wax, of which 14 % was solid wax, and 86 % was in powder form . There are 20-25 exporters of carnauba wax in Brazil who buy the carnauba wax from middlemen or directly from farmers. The exporters refine the wax before exporting it to the rest of the world. The four largest exporters of carnauba wax are Pontes, Brasil Ceras, Foncepi, and Carnauba do Brasil, who together account for around \in 25 million of the export market.

According to the Brazilian Ministry of Development, Industry and Foreign Trade, the major destinations for exported carnauba wax are : USA (25 %) Germany (10 – 15 %) Japan (15 – 25 %) Netherlands (5 %) Italy (5 %) other destinations (18 %)

5 - Technical characteristics

INCI name is *Copernicia cerifera (carnauba) wax* E Number is E903.

Melting point: 82 - 86 °C , among the highest of natural waxes, higher than bees wax, 62 - 64 C.

Relative density is about 0.97

It is among the hardest of natural waxes .

It is practically insoluble in water, soluble on heating in ethyl acetate and in xylene, and practically insoluble in ethyl alcohol.

Carob Pod Oil

Carob pod oil (Algaroba oil) is an edible oil pressed from carob seed pods, used medicinally.



Carob seed pods, used to make carob pod oil.

The fatty acid composition of carob pod oil is :

Fatty acid	Percentage %
Palmitic	14.2
Stearic	3.0
Oleic	38.5
Linoleic	43.6

Carrier Oil

Contents

- 1 Introduction
- 2 Varieties
- 3 Safety aspects

1 - Introduction

Carrier oil, also known as base oil or vegetable oil, is used to dilute essential oils and absolutes before they are applied to the skin in massage and aromatherapy. They are so named because they *carry* the essential oil onto the skin. Carrier oils do not contain a concentrated aroma, unlike essential oils, though some, such as olive, have a mild distinctive smell. Neither do they evaporate like essential oils, which are more volatile. The carrier oils used should be as natural and unadulterated as possible. Organic oils should be used where possible. Cold - pressing and maceration are the two main methods of producing carrier oils.

There is a range of different carrier oils, each with a various therapeutic properties. Choosing an oil will depend on the area being massaged, the presenting conditions and the clients sensitivity and requirements. For massage, viscosity is a major consideration; for example, grape seed oil is typically very thin, while olive oil is much thicker. Sunflower, sweet almond and grape seed oils have viscosities midway between these extremes. Carrier oils can be easily blended to combine their properties of viscosity, acceptability, lubrication, absorption, aroma and so forth.

Infused oils are a combination of a carrier oil and plant material and they can be either commercially or domestically prepared. A base oil, often sunflower, is placed in an airtight container with the appropriate plant material for a time. Calendula and carrot oils are produced in this way.

High quality oils sold for culinary use are often eminently suitable for massage use, and are economical; those obtained by cold pressing are preferred. All carrier oils should be kept cool, and away from strong light, to retard rancidification. Rancid oils should be avoided. Refrigerating oils helps preserve their freshness but some oils should not be refrigerated (e.g. avocado). Very cold oils may appear cloudy, but regain their clear state on returning to room temperature.

Sources passionately disagree on the suitability of mineral oil as a carrier oil . In the United States, food grade mineral oil is highly refined and purified to meet the stringent requirements of the FDA. Mineral Oil marked as "USP" also meets the standards of the US Pharmacopeia.

2 – Varieties

True carrier oils are generally cold - pressed or macerated vegetable oils taken from, amongst others :

Sweet almond oil Grape seed oil Avocado oil Olive oil Sesame oil Evening primrose Canola (Rapeseed) Sunflower oil Jojoba oil Emu oil Castor oil Nuts: Walnut oil Peanut oil Pecan oil Macadamia nut Fractionated coconut oil Sweet almond oil and grapeseed oil are very popular carrier oils.

3 - Safety aspects

Peanuts are legumes, not "true" nuts, but they share with true nuts the risk of causing allergic reactions, even in minute amounts. Pure peanut and nut-derived oils are not usually allergenic, (as they do not typically contain the proteinaceous part of the plant), but avoiding them may be safer, as serious peanut and nut allergy is widespread, oil purity cannot be guaranteed, and other hypoallergenic oils are easily substituted.

If there is any risk of ingestion, mineral oil best avoided

Carrot Seed Oil

Carrot seed oil is the essential oil extract of the seed from the carrot plant *Daucus carota*. The oil has a woody, earthy sweet smell and is yellow or amber- coloured to pale orange-brown in appearance. The pharmocologically active constituents of carrot seed extract are three flavones: luteolin , luteolin 3'- O – beta - D- glucopyranoside, and luteolin 4'- O - beta - D - gluco pyranoside . Rather than the extract the distilled (ethereal) oil is used in perfumery and food aromatization. The main constituent of this oil is carotol.

Pressed carrot seed oil is extracted by cold - pressing the seeds of the carrot plant. The properties of pressed carrot seed oil are quite different from those of the essential oil.

Cashew



Contents

- 1 Introduction
- 2 Etymology
- 3 Habitat and growth
- 4 Dispersal
- 5 Cashew nut
 - 5.1 Production
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5.2.1 Allergy

- 5.3 Cashew oil
- 5.4 Cashew shell oil

6 Cashew apple

6.1 Alcohol

7 Medicinal uses

1 - Introduction

The cashew (*Anacardium occidentale*) is a tree in the family Anacardiaceae which produces a seed that is harvested as the cashew nut. Its English name derives from the Portuguese name for the fruit of the cashew tree, *caju* (Portuguese pronunciation: [kɐˈʒu]), which itself is derived from the indigenous Tupi name, *acajú*. Originally native to northeastern Brazil, it is now widely grown in tropical climates for its cashew apples and nuts. The cashew nut is a popular snack and food source. Nigeria was the world's largest producer of cashew nuts with shell in 2010.

Scientific classification		
Kingdom:	Plantae	
(unranked):	Angiosperms	
(unranked):	Eudicots	
(unranked):	Rosids	
Order:	Sapindales	
Family:	Anacardiaceae	
Genus:	Anacardium	
Species:	A. occidentale	
Binomial name		
Anacardium	occidentale L.	

2 – Etymology

The name *Anacardium* actually refers to the shape of the fruit, which looks like an inverted heart (*ana* means "upwards" and - *cardium* means "heart"). In the Tupian languages, *acajú* means "nut that produces itself".

3 - Habitat and growth

The tree is large and ever green, growing to 10-12m tall, with a short, often irregularly shaped trunk. The leaves are spirally arranged, leathery textured, elliptic to obovate, 4 to 22 cm long and 2 to 15 cm broad, with smooth margins. The flowers are produced in a panicle or corymb up to 26 cm long, each flower is small, pale green at first, then turning reddish, with five slender, acute petals 7 to 15 mm long. The largest cashew tree in the world covers an area of about 7,500 square meters , it's located in Natal, Rio Grande do Norte, Brazil.

The fruit of the cashew tree is an accessory fruit (sometimes called a pseudo carp or false fruit). What appears to be the fruit is an oval or pear-shaped structure, a hypocarpium , that develops from the

pedicel and the receptacle of the cashew flower. Called the cashew apple, better known in Central America as *marañón*, it ripens into a yellow and/or red structure about 5–11 cm long. It is edible, and has a strong "sweet" smell and a sweet taste. The pulp of the cashew apple is very juicy, but the skin is fragile, making it unsuitable for transport. In Latin America, a fruit drink is made from the cashew apple pulp which has a very refreshing taste and tropical flavor that can be described as having notes of mango, raw green pepper, and just a little hint of grapefruit - like citrus.

The true fruit of the cashew tree is a kidney or boxing-glove shaped drupe that grows at the end of the cashew apple. The drupe develops first on the tree, and then the pedicel expands to become the cashew apple. Within the true fruit is a single seed, the cashew nut. Although a nut in the culinary sense, in the botanical sense the nut of the cashew is a seed. The seed is surrounded by a double shell containing an allergenic phenolic resin, anacardic acid, a potent skin irritant chemically related to the better - known allergenic oil urushiol which is also a toxin found in the related poison ivy. Properly roasting cashews destroys the toxin, but it must be done outdoors as the smoke (not unlike that from burning poison ivy) contains urushiol droplets which can cause severe, sometimes life-threatening, reactions by irritating the lungs. People who are allergic to cashew urushiols may also react to mango or pistachio which are also in the Anacardiaceae family. Some people are allergic to cashew nuts, but cashews are a less frequent allergen than other nuts or peanuts.

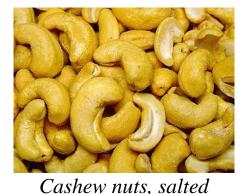
4 – Dispersal

While native to northeast Brazil, the Portuguese took the cashew plant to Goa, India, between 1560 and 1565. From there it spread throughout Southeast Asia and eventually Africa.

5 - Cashew nut

The cashew nut is a popular snack and food source. Cashews, unlike other oily tree nuts, contain starch to about 10 % of their weight. This makes them more effective than other nuts in thickening water-based dishes such as soups, meat stews, and some Indian milk-

based desserts. Many southeast Asian and south Asian cuisines use cashews for this unusual characteristic, rather than other nuts.



The shell of the cashew nut is toxic, which is why the shell is removed before it is sold to consumers.

Cashew nuts are commonly used in Indian cuisine, whole for garnishing sweets or curries, or ground into a paste that forms a base of sauces for curries (e.g., *korma*), or some sweets (e.g., *kaju barfi*). It is also used in powdered form in the preparation of several Indian sweets and desserts. In Goan cuisine, both roasted and raw kernels are used whole for making curries and sweets.

The cashew nut can also be harvested in its tender form, when the shell has not hardened and is green in color. The shell is soft and can be cut with a knife and the kernel extracted, but it is still corrosive at this stage, so gloves are required. The kernel can be soaked in turmeric water to get rid of the corrosive material before use. This is mostly found in Keralan cuisine, typically in *avial*, a dish that contains several vegetables, grated coconut, turmeric, and green chilies.

In the Philippines, cashew is a known product of Antipolo, and is eaten with *suman*. Pampanga also has a sweet dessert called *turrones de casuy*, which is cashew marzipan wrapped in white wafers.

In Indonesia, roasted and salted cashew nut is called *kacang mete* or *kacang mede*, while the cashew apple is called *jambu monyet* (literally means monkey rose apple).

In Mozambique, *bolo polana* is a cake prepared using powdered cashews and mashed potatoes as the main ingredients. This dessert is popular in South Africa, too.

South American countries have developed their own specialities. In Brazil, the cashew fruit juice is popular all across the country. In Panama, the cashew fruit is cooked with water and sugar for a prolonged time to make a sweet, brown, paste-like dessert called *dulce de marañón*. *Marañón* is one of the Spanish names for cashew.

Top Ten Cashew Nuts (with shell) Producers in 2010				
Country	Production (metric tons)	Yield (MT/hectares)		
Nigeria	650,000	1.97		
India	613,000	0.66		
Côte d'Ivoire	380,000	0.44		
Vietnam	289,842	0.85		
Indonesia	145,082	0.25		
Philippines	134,681	4.79		
Brazil	104,342	0.14		
Guinea-Bissau	91,100	0.38		
Tanzania	80,000	1.0		
Benin	69,700	0.29		
World Total	2,757,598	0.58		

5 – 1 – Production

Nigeria was the world's largest producer of cashew nuts with shell in 2010. Cashew nut production trends have varied over the decades. African countries used to be the major producers before 1980s, India became the largest producer in 1990s, followed by Vietnam which became the largest producer in mid 2000s. Since 2008, Nigeria has become the largest producer. Cashew nuts are produced in tropical countries because the tree is very frost sensitive; they have been adapted to various climatic regions around the world between the latitudes of 25°N and 25°S.

Peru reported the world's highest production yields for cashew nuts in 2010, at 5.27 metric tons per hectare, nearly nine times the world average.^[8] The traditional cashew tree is tall (up to 14 m) and takes three years from planting before it starts production, and eight years before economic harvests can begin. More recent breeds, such as the dwarf cashew trees, are up to 6 m tall, and start producing after the first year, with economic yields after three years. The cashew nut yields for the traditional tree are about 0.25 metric tons per hectare, in contrast to over a ton per hectare for the dwarf variety. Grafting and other modern tree management technologies are used to further improve and sustain cashew nut yields in commercial orchards.

Fluctuations in world market prices for cashew nuts have been a source of discontent for communities in Tanzania which grow the nut as a cash crop; reduced payments in April 2013 sparked serious rioting in Liwale District in the south of the country.

5 – 2 – Nutrition

The fats and oils in cashew nuts are 54 % mono un saturated fat (18:1), 18 % poly un saturated fat (18:2), and 16 % saturated fat (9 % palmitic acid (16:0) and 7 % stearic acid (18:0)).

Cashews, as with other tree nuts, are a good source of antioxidants. Alkyl phenols, in particular, are abundant in cashews. Cashews are also a source of dietary trace minerals copper, manganese, magnesium and phosphorous.

5 – 2 - 1 – Allergy

For some people, cashews, like other tree nuts, can lead to complications or allergic reactions. Cashews contain gastric and intestinal soluble oxalates, albeit less than some other tree nuts; people with a tendency to form kidney stones may need moderation and medical guidance. Allergies to tree nuts such as cashews can be of severe nature to some people. These allergic reactions can be lifethreatening or even fatal; prompt medical attention is necessary if tree nut allergy reaction is observed. These allergies are triggered by the proteins found in tree nuts, and cooking often does not remove or change these proteins. Reactions to cashew and other tree nuts can also occur as a consequence of hidden nut ingredients or traces of nuts that may inadvertently be introduced during food processing, handling or manufacturing. Many nations require food label warning if the food may get inadvertent exposure to tree nuts such as cashews.

In some people, cashew nut allergy may be a different form, namely birch pollen allergy. This is usually a minor form. Symptoms are confined largely to the mouth.

5 - 3 - Cashew oil

Cashew oil is a dark yellow oil for cooking or salad dressing pressed from cashew nuts (typically broken chunks created during processing). This may be produced from a single cold pressing.

5-4-Cashew shell oil

The cashew nutshell liquid (CNSL) or cashew shell oil (CAS registry number 8007-24-7) is a natural resin found in the honeycomb structure of the cashew nutshell and is a byproduct of processing cashew nuts. It is a raw material of multiple uses in developing drugs, antioxidants, fungicides, etc. It is used in tropical folk medicine and for anti-termite treatment of timber. Its composition varies depending on how it is processed.

Cold, solvent extracted CSNL is mostly composed of anacardic acids (70 %), cardol (18 %) and cardanol (5 %).

Heating CNSL decarboxylates the anacardic acids, producing a technical grade of CNSL that is rich in cardanol. Distillation of this material gives distilled, technical CNSL containing 78 % cardanol and 8 % cardol (cardol has one more hydroxyl group than cardanol). This process also reduces the degree of thermal polymerization of the unsaturated alkyl - phenols present in cashew shell nut liquid

Anacardic acid is also used in the chemical industry for the production of cardanol, which is used for resins, coatings, and frictional materials.

These substances are dermatogenic, like the oils of the poison ivy, and present danger during manual cashew processing.

This natural oil phenol has been found to have interesting chemical structural features which enable a range of chemical modifications to create a wide spectrum of bio-based monomers capitalising on the chemically versatile construct it containing three different functional groups, the aromatic ring, the hydroxyl group and the double bonds in the flanking alkyl chain. These can be split into key groups, there use as Polyols. Which have recently seen a dramatic increase in demand for their bio - based origin and key chemical attributes such as high reactivity, range of functionalities, reduction in blowing agents and naturally occurring fire retardant properties in the field of ridged polyurethanes aided by their inherent phenolic structure and larger number of reactive units per unit mass.

CNSL based Novolac are another versatile industrial monomer deriving from cardanol typically used as reticulating agents for epoxy matrices in composite applications providing good thermal and mechanical properties to the final composite material.

Further examples of applications which are Cashew shell nut liquid derived materials are being evaluated are in the fields of chemical intermediates, additives, stabilizers, lubricants, diesel engine fuel alternatives, poor point dispersants, anti-oxidants, anticorrosive paints.

Abrasives and friction dusts have also been developed from Residol, the residue byproduct of this synthesis process.

During World War II cashew shell oil was used as a sabotage device by the OSS (Office of Strategic Services) for destroying the engines of German vehicles when poured into the crankcase of engines.

Other uses of cashew shell oil have been explored, including as an additive to brake fluid, to reduce brake fade and brake lining wear. Composite Technical Services (Kettering, Ohio, USA) have researched the use of cashew shell oil as a resin for carbon composite products.

6 - Cashew apple



The cashew apple, also called cashew fruit, is the fleshy part of the cashew fruit that is attached to the cashew nut. The top end of the cashew apple is attached to the stem that comes off of the tree. The bottom end of the cashew apple attaches to the cashew nut, which is encased in a shell. In botanical terms, the cashew apple is an accessory fruit that grows on the cashew seed (which is the nut).

The cashew apple is a soft fruit, rich in nutrients, and contains five times more vitamin C than an orange. It is eaten fresh, cooked in curries, or fermented into vinegar, as well as an alcoholic drink. It is also used to make preserves, chutneys, and jams in some countries such as India and Brazil. In many countries, particularly in South America, the cashew apple is used to flavor drinks, both alcoholic and nonalcoholic. In Brazil, it is a popular fruit flavor for the national drink, the *caipirinha*.

In much of South America, people regard the cashew apple as the delicacy, rather than the nut kernel which is popular elsewhere. In fact, in many South American countries, the cashew apple is more popular as a food than is the cashew nut. A large reason for this is simply the availability of cashew apples. They tend to be popular where they are readily available. Cashew nuts are more popular than cashew apples in many parts of the world — regions that do not grow cashews — because the fruit, unlike the nut, is difficult to transport to these places. Unlike cashew nuts, cashew apples are extremely soft and easily bruised in shipment. For this reason, cashew juice and cashew juice concentrate are often shipped to these nonlocal countries instead of the fresh fruit.

Cashew apples have a sweet but astringent taste. This astringency has been traced to the waxy layer on the skin that contains a chemical, urushiol, which can cause minor skin irritation to areas that have had contact with it. It is almost identical to the astringency caused by the skin of a mango, which also contains urushiol. The astringency from mango skin can be mildly tasted in the flesh of mango fruit, just as the astringency of cashew apple skin can be mildly tasted in the flesh of cashew apples. In cultures that consume cashew apples, this astringency is sometimes removed by steaming the fruit for five minutes before washing it in cold water; alternatively, boiling the fruit in salt water for five minutes or soaking it in gelatin solution also reduces the astringency . When mixed in drinks or used as a flavoring, the astringency becomes highly diluted and typically causes no irritation to those without urushiol allergies.

6 – 1 – Alcohol



Young cashew nuts

In Goa , the cashew apple (the accessory fruit) is mashed, the juice is extracted and kept for fermentation for a few days. Fermented juice then undergoes a double distillation process. The resulting

beverage is called *feni* or fenny. *Feni* is about 40 - 42 % alcohol. The single - distilled version is called *urrac*, which is about 15 % alcohol.

In the southern region of Mtwara, Tanzania, the cashew apple (*bibo* in Swahili) is dried and saved. Later it is reconstituted with water and fermented, then distilled to make a strong liquor often referred to by the generic name, *gongo*.

In Mozambique, cashew farmers commonly make a strong liquor from the cashew apple, *agua ardente* (burning water).

According to *An Account of the Island of Ceylon* by Robert Percival an alcohol had been distilled in the early 20th century from the juice of the fruit, and had been manufactured in the West Indies. Apparently, the Dutch considered it superior to brandy as a liqueur.

7 - Medicinal uses

Many parts of the plant are used in the traditional medicine of the Patamona of Guyana. They grind the seeds into a poultice for treating snakebites, apply nut oil to cracked heels or as an antifungal agent, and use the fruits, bark, and leaves for many other purposes including anti-fungal activity, for sores and rashes, or as an antipyretic, and for antidiarrheal applications . The leaf extracts with petroleum ether and ethanol inhibited growth of several species of bacteria and fungi.^[29] Chemicals identified in cashew shell oil have been assayed against *Streptococcus mutans*, a bacterium responsible for many dental cavities, and found to have activity *in vitro* against this and other Gram positive bacteria.

Castor Wax

Contents

1 Introduction

2 Uses

3 Properties

1 - Introduction

Castor wax, also called hydrogenated castor oil, is a hard, brittle, vegetable wax. It is produced by the hydrogenation of pure castor oil, in the presence of a nickelcatalyst. It is odorless and insoluble in water.

2 - Uses

Castor wax is used in polishes, cosmetics, electrical capacitors, carbon paper, lubrication, and coatings and greases where resistance to moisture, oils and petrochemical products is required.

Castor wax is also useful in poly urethane coating formulation, as it contains three secondary hydroxyl group. These coating compositions are useful as a top coat varnish for leather, wood & rubber.

3 - Properties

Melting point = 80 C Acid number = 2 Saponification value = 179 Iodine number = 4

Cedar Oil

Contents

1 Introduction

2 Sources and characteristics

3 Uses

1 - Introduction

Cedar oil, also known as *cedar wood oil*, is an essential oil derived from the foliage, and sometimes the wood and roots, of various types of conifers, most in the pine or cypress botanical families. It has many uses in medicine, art, industry and perfumery, and while the characteristics of oils derived from various species may themselves vary, all have some degree of bactericidal and pesticidal effects.

2 - Sources and characteristics

Although termed cedar or cedarwood oils, the most important oils of this group are produced from distilling wood of a number of different junipers and cypresses (*Juniperus* and *Cupressus* spp., of the family *Cupressaceae*), rather than true cedars (*Cedrus* spp., of the family *Pinaceae*). A cedar leaf oil is also commercially distilled from the Eastern arborvitae (*Thuja occidentalis*, also of the *Cupressaceae*), and similar oils are distilled, pressed or chemically extracted in small quantities from wood, roots and leaves from plants of the genera *Platycladus*, *Cupressus*, *Taiwania* and *Calocedrus*.

The cedar oil of the ancients, in particular the Sumerians and Egyptians, was derived from the Cedar of Lebanon, a true cedar native to the northern and western mountains of the Middle East. The oncemighty Cedar of Lebanon forests of antiquity have been almost entirely eradicated, and today no commercial oil extraction is based on this species. One of the elements found in many cedar wood trees is cedrol. Depending on the amount of cedrol in a specific species of cedar wood can determine its pesticidal effect on insects. Ancient Egyptians would use the oil from cedar wood trees in the embalming process, which in effect helped to keep the insects from disturbing the body.

3 - Uses

Cedar wood oils each have characteristic woody odours which may change somewhat in the course of drying out. The crude oils are often yellowish or even darker in colour and some, such as Texas cedar wood oil (derived primarily from *Juniperus ashei* and *J. deppeana*), are quite viscous and deposit crystals on standing. They find use (sometimes after *rectification*) in a range of fragrance applications such as soap perfumes, household sprays, floor polishes and insecticides. Small quantities are used in microscope work as a clearing oil.

All the cedar wood oils of commerce contain a group of chemically related compounds, the relative proportions of which depend upon the species from which the oil is obtained. These compounds include cedrol and cedrene, and while they contribute something to the odour of the whole oil they are also valuable to the chemical industry for conversion to other derivatives with fragrance applications. The oils are therefore used both directly and as sources of chemical isolates.

Cedar oil was used as the base for paints by the ancient Sumerians. They would grind cobalt compounds in a mortar and pestle to produce a blue pigment. They could obtain green from copper, yellow from lead antimoniate, black from charcoal, and white from gypsum.

Today, cedar oil is often used for its aromatic properties, especially in aromatherapy; it can also be used to renew the smell of natural cedar furniture. Cedar oil is used as an insect repellent, both directly applied to the skin and as an additive to sprays, candles and other products.

In India, oil from the deodar cedar (*Cedrus deodara*, a true cedar) has been shown to possess insecticidal and antifungal properties and to have some potential for control of fungal deterioration of spices during storage. However, its commercial potential for this purpose remains, at present, speculative.

One of three methods of ancient Egyptian embalming practices employs the use of cedar oil. This was a less costly method than the most well known of the ancient Egyptian practices of removing internal organs for separate preservation in canopic jars. The practice

...called for the injection of cedar oil into body cavities with out evisceration. The body was laid in natrum or natron – a fixed alkali -- for the prescribed period, after which the cedar oil, which had dissolved the soft organs, was released; and the body, its flesh dissolved by the natron, was reduced to preserved skin and bones.

Until the development of synthetic immersion oil in the 1940s, cedar oil was widely used for the oil immersion objective in light microscopy.

Cedar wood oil is a mixture of organic compounds considered generally safe by the FDA as a food additive preservative. The oil is used as an antibacterial and fungicide. Studies have shown that prolonged exposure to high levels of cedar wood oil can cause liver and pulmonary toxicity. The United States EPA does not expect such effects to occur among users of currently registered products because their use and public exposure is at a much lower level and more intermittent than those in the case studies. The EPA believes there is negligible human environmental risk posed by exposure to registered cedar wood pesticide or food preservative products if used in properly prescribed manner.

Ceresin

Contents

1 Introduction 2 Uses include:

1 - Introduction

Ceresin (also cerin, cerasin, cerosin, ceresin wax or ceresine) is a wax derived from ozokerite by a purifying process.

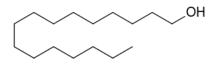
The purifying process of the ozokerite commonly comprises a treatment with heat and sulfuric acid, but other processes are also in use.

2 - Uses include :

An alternative to beeswax in ointments

(Historic) Laboratory - supply bottles for small amounts of hydrofluoric acid, which were made of ceresin wax; this was before polyethylene became commonplace.

Cetyl Alcohol



Contents

- 1 Introduction
- 2 Preparation
- 3 Uses
- 4 Side effects

1 - Introduction

Cetyl alcohol , also known as 1-hexa decanol and palmityl alcohol, is a fatty alcohol with the formula CH_3 (CH_2)₁₅ OH. At room temperature, cetyl alcohol takes the form of a waxy white solid or flakes. The name cetyl derives from the whale oil (Latin: *cetus*) from which it was first isolated.

IUPAC name : Hexadecan-1-ol		
Other names : Cetanol , Cetyl alcohol , Ethal , Ethol , Hexa decanol , Hexa decyl alcohol , Palmityl alcohol		
Molecular formula	$C_{16} H_{34} O$	
Molar mass	242 g mol ^{-1}	
Appearance	White crystals	
Density	0.811 g / cm ³	
Melting point	49 °C	
Boiling point	344 °C	
Solubility in water	Insoluble	
Flash point	185 °C	

2 – Preparation

Cetyl alcohol was discovered in 1817 by the French chemist Michel Chevreul when he heated spermaceti, a waxy substance obtained from sperm whale oil, with caustic potash (potassium hydroxide). Flakes of cetyl alcohol were left behind on cooling.

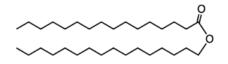
3 – Uses

Cetyl alcohol is used in the cosmetic industry as an opacifier in shampoos, or as an emollient, emulsifier or thickening agent in the manufacture of skin creams and lotions . It is also employed as a lubricant for nuts and bolts.

4 - Side effects

People who suffer from eczema can be sensitive to cetyl alcohol , though this may be due to impurities rather than cetyl alcohol itself.^[7] Ironically, this ingredient is sometimes included in medications for the treatment of eczema.

Cetyl Palmitate



Molecular formula	$C_{32}H_{64}O_2$
Appearance	colourless wax
Melting point	54°C

Cetyl palmitate is the ester derived from palmitic acid and cetyl alcohol. It is the primary constituent of spermaceti, the wax found in the skull of sperm whales.

Stony corals, which build the coral reefs, evolved with large amounts of cetyl palmitate wax in their tissues. Most predators find this wax indigestible.

Chicken Fat

Chicken fat is fat obtained (usually as a by- product) from chicken rendering and processing. Of animal-sourced substances, chicken fat is noted for being high in linoleic acid, an omega - 6 and omega - 9 fatty acid. Linoleic acid levels are between 17.9 % and 22.8 %. It is a common flavoring, additive or main component of Chicken Soup. It is often used in pet foods, and has been used in the production of biodiesel . Chicken fat is one of two types of animal fat referred to as Schmaltz, the other being goose fat.

Chili Oil



1 - Introduction

Chili oil (also called hot chili oil or hot oil) is a condiment made from vegetable oil that has been infused with chili peppers. It is commonly used in Chinese cuisine, East and South east Asia and elsewhere. Particularly popular in Sichuan cuisine, it is used as an ingredient in cooked dishes as well as a condiment. It is sometimes used as a dip for meat and dim sum. It is also employed in the Korean Chinese noodle soup dish *jjamppong*.

Chili oil is typically red in color. It is made from vegetable oil, often soybean oil or sesame oil, although olive oil or other oils may be used. Other spices may be included such as Sichuan pepper, garlic, or paprika. The spices are soaked in oil. Commercial preparations may include other kinds of oil, water, dried garlic, soy sauce, and sugar. Recipes targeted to Western cooks also suggest other popular oils such as rape seed, grape seed or pea nut, and any dried or fresh chili peppers. The solids typically settle to the bottom of the container in which it is stored. When using chili oil, the cook or diner may choose how much of the solids to use; sometimes only the oil is used, without any solids.

Chili oil is commercially available in glass jars, although it may also be made from scratch at home . It is usually available by request at Chinese restaurants.

Chinese Wax

Contents

1 Introduction 2 Uses

3 Other names

1 - Introduction

Chinese wax is a white to yellowish - white, gelatinous, crystalline water- insoluble substance obtained from the wax secreted by certain insects.

It resembles spermaceti but is harder, more friable, and with a higher melting point. It is deposited on the branches of certain trees by the scale insect *Ceroplastes ceriferus*, common in China and India, or a related scale insect, *Ericerus pela*, of China and Japan. The insects and their secretions are harvested and boiled with water to extract the raw wax. The insect bodies, which settle to the bottom, are used as food for swine.

2 - Uses

Chinese wax is used chiefly in the manufacture of polishes, sizes, and candles.

In China the wax has been employed medicinally. Taken internally, it has been used as a remedy for hoarseness, pain, worms, nervousness, and to aid the mending of broken bones. Externally, it has been used as an ointment for treatment of wounds.

3 - Other names

Other names of *Chinese wax* include: *Chinese tree wax Chinese insect wax insect wax*

Chrism



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- 1 Introduction
- 2 Early Christian usage
- 3 Etymology
- 4 Roman Catholicism
- 5 Eastern Christianity
- 6 Anglicanism and Lutheranism
- 7 The Church of Jesus Christ of Latter day Saints

1 - Introduction

Chrism (Greek word literally meaning "an anointing"), also called "myrrh" (*myron*), holy anointing oil, or "consecrated oil", is a consecrated oil used in the Catholic Church, Eastern Orthodox Church, Anglican Communion, Oriental Orthodox Church, Armenian Apostolic Church, and by Old Catholics, as well as some other traditions, including the Assyrian Church of the East, and Nordic-style Lutheran churches, in the administration of certain sacraments and ecclesiastical functions.

2 - Early Christian usage

Multiple early Christian documents discuss the "ordinance" or "several ceremonies...explained in the Apostolical Constitutions" of "chrism", including documents by Theophilus (d. 181) and Tertullian (d. 220).

The most detailed version of the practice is by Cyril of Jerusalem who details how ointment or oil was "symbolically applied to the forehead, and the other organs of sense" and that the "ears, nostrils, and breast were each to be anointed." Cyril states that the "ointment is the seal of the covenants" of baptism and God's promises to the Christian who is anointed. Cyril taught that being "anointed with the Holy anointing oil [Chrism] of God" was the sign of a Christian (*Christos* means "anointed"), and a physical representation of having the Gift of the Holy Spirit (Holy Ghost), and it retains this meaning in Catholicism and Orthodoxy today. He says, "Having been counted worthy of this Holy Chrism, ye are called Christians, verifying the name also by your new birth. For before you were deemed worthy of this grace, ye had properly no right to this title, but were advancing on your way towards being Christians."(*On the Mysteries* 3.5)

3 – Etymology

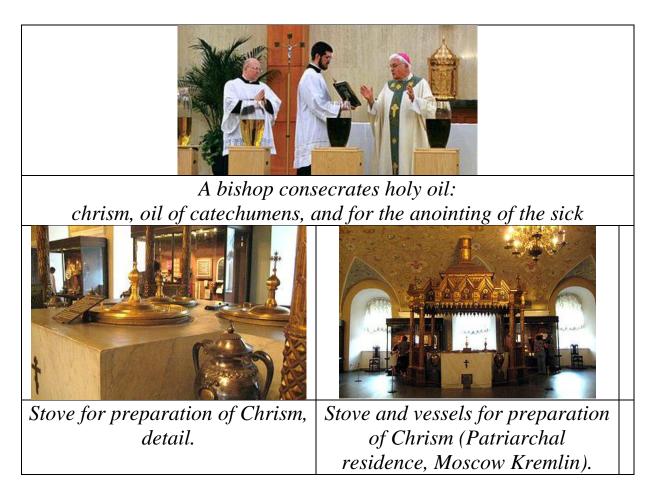
Greek χρĩμα or χρĩσμα, later χρίσμα "ointment, unguent, anointment" besides χρĩσται "oil, oil flask" and χριστός "fit to be anointed", in the Septuagint and the New Testament "the anointed, Messiah", "Christ", is from a verb χρίω, χρίσμαι (long -ī-, later also short -ĭ-; aorist χρῖσαι, -σασθαι, -σθῆναι, perfect κέχριμαι, -ισμαι, ικα), "smear, anoint, rub or daub with oil or grease".

The further connection of the Greek verb to Indo-European forms is fairly certain, stemming from Proto-Indo-European **ghrei-*, "to rub". Cognates include Lithuanian gr(i)ejù, $gri\tilde{e}ti$ "skimming (of cream)" and Middle Low German $gr\bar{e}me$ "dirt", Old English $gr\bar{i}ma$ "mask, helm, spectre" (from a meaning "covered, concealed", c.f. *Tarnhelm*), English *grime*, and possibly Phrygian *gegreimenan* "painted, ornamented, inscribed". A much more obvious cognate, and

one with comparable religious significance, is Sanskrit ghrta घृत ("sprinkled"), modern ghee, used in Vedic and Hindu custom in anointment and other rituals.

χρίσμα came into Latin as *chrisma*, into Old French, by contamination with Latin *cramum* "cream" as *cresme* (Modern French *crème*) and finally into English, in the 14th century as *creme*, spelled *cream* with the Great Vowel Shift from the 15th century (*crème* as a dessert ingredient was re-borrowed in the 19th century). *Chrism* was loaned into English earlier, in the 11th century as *crism*, spelled with *ch*- from the 16th century.

4 - Roman Catholicism



Chrism is essential for the Catholic Sacrament of Confirmation / Chrismation, and is prominently used in the sacraments of Baptism and Holy Orders. Those to be confirmed or chrismated, after receiving the laying on of hands, are anointed on the head by the bishop or priest. In baptism, if the person baptized is not to be immediately confirmed or chrismated, the minister anoints them with chrism. Newly ordained priests are anointed with chrism on the palms of their hands, and newly ordained bishops receive an anointing of chrism on their foreheads. It is also used in the consecration of objects such as churches and altars.

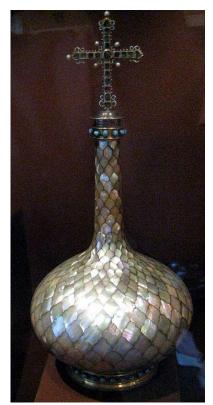
In former times, chrism was used to consecrate patens and chalices as well. The Sign of the Cross would be made with the chrism on the interior parts the chalice and paten where the Eucharist would rest; the Cross would then be smeared to cover the entire interior parts. The chalice and paten would need to be consecrated with the chrism again if they were re - gilded. This ritual could only be performed by a Bishop or a priest with the faculties to do so. However, this is no longer the practice, and currently a simple blessing by a priest suffices.

Chrism is made of olive oil and is scented with a sweet perfume, usually balsam. Under normal circumstances, chrism is consecrated by the bishop of the particular church in the presence of the presbyterium at the Mass of the Chrism, which takes place in the morning of Holy Thursday. The oil of catechumens and the oil of the sick are also blessed at this Mass.

These holy oils are usually stored in special vessels known as chrismaria and kept in a cabinet known as an ambry. When the oils are distributed to a priest for him to use in his ministry they are kept in a smaller vessel with three compartments, known as an "oil stock". There is also a type of oil stock that is shaped like a ring, to make the anointing easier. The "jewel" of the ring is a container with a removable lid.

5 - Eastern Christianity

Within the Oriental Orthodox, Eastern Orthodox, and Eastern Catholic Churches as well as in the Assyrian Church of the East, Chrism is used in many liturgical services and sacraments. The first sacrament that uses Chrism is the sacrament of Chrismation, which is the second of the three Sacraments of Initiation (Baptism, Chrismation, and Divine Eucharist). For Eastern Christians, Chrismation canonically must be administered in conjunction with baptism, except in a case of true necessity. Here the blessing of the bishop upon the chrism functions as a substitute for the direct imposition of hands. Another use is in the consecration of church buildings, where it is used to anoint the walls and the altar table. Formerly, emperors and kings of monarchies where Orthodoxy was the state religion would be anointed with chrism at their coronations.



Chrismarium used in Russia before the revolution of 1917. The vessel is named "Alabaster" in reference to Matthew 26:7.

Chrism is made during Holy Week beginning on Holy Monday and culminating in the Divine Liturgy on Holy Thursday when it is carried in the Great Entrance and placed upon the altar. It is primarily olive oil with the addition of a range of aromatic essences, patterned after the anointing oil described in Exodus 30:22-33. Holy Myron is confected only by a bishop, without prejudice to particular law which reserves this power to the patriarch. On completion, chrism is distributed to all the bishops, who, in turn, give it to their parishes when needed. It is not made on a yearly basis, but only when supplies run short . At the Patriarchate of Constantinople the chrism is produced roughly once every 10 years. It is made according to an ancient formula of the Jewish prophets and patriarchs that calls for 64 ingredients , while the flame needed to boil the mixture during the preparation is made by burning old and disfigured icons.^[4] The preparation of the Chrism in the Patriarchate is carried out by the college of the *Kosmētores Myrepsoi* (Greek: Koσµήτορες Μυρεψοί, "Deans Perfumers"), presided by the *Árchōn Myrepsós*, the "Lord Perfumer". The incumbent Archon Myrepsos is biochemist Prodromos Thanasoglou.

In Byzantine times the official responsible was the Grand Sacristan of the Patriarchate, but since then the specific office of the Archon Myrepsos was created. Laity are not allowed to handle either the Chrism or the vessels containing it, therefore the Myrepsoi undergo a sort of "temporary ordination"^I into the clergy and are given by the Patriarch a gold "Cross of Ministry" to hang from their necks for the duration of their four-day service. The Archon is given the *Lention*, a silk "towel" or apron. Three copper cauldrons are used for the preparation: the largest contains olive oil, the smallest contains water and the aromatic ingredients and the middle contains wine, which allows the oil to boil without catching fire. The preparation involves several steps, and some, such as the addition of musk and rose oil, are performed by the Patriarch himself. Once the Chrism is filtered and ready, it is consecrated for the final time and stored in silver vessels in the Chapel of Saint Andrew, pending distribution.

6 - Anglicanism and Lutheranism

The primary use of chrism in Anglican and Lutheran churches is for the Rite of Chrismation, which may be included as a part of Baptism, even for infants.

The oil of chrism is also commonly used in Confirmation, although this practice is not followed by churches of these denominations that are in the evangelical tradition. Owing to this difference of practice, it is common for Anglican and Lutheran confirmation liturgies to refer to the use of chrism as an option. The liturgy of the Church of England states "Oil mixed with fragrant spices (traditionally called chrism), expressing the blessings of the messianic era and the richness of the Holy Spirit, may be used to accompany the confirmation". The confirmation liturgy of the Anglican Province of Southern Africa includes the rubric "The Bishop may sign them on the forehead, using at his discretion the Chrism". The liturgy of the Igreja Lusitana (Anglican Church in Portugal) states at the point of confirmation "Os confirmandos ajoelham perante o Bispo. Este pode assinala-los na testa com o sinal da cruz, usando oleo proprio" ("The confirmands kneel before the Bishop. He may sign them on the forehead with the sign of the cross, using the proper oil").

The use of chrism in Anglican and Lutheran ordination liturgies is similarly presented as an option in most provinces. In the liturgy for the ordination of priests in the Church of England, for example, the instruction is : "The bishop may anoint the palms of the hands of each newly ordained priest, saying 'May God, who anointed the Christ with the Holy Spirit at his baptism, anoint and empower you to reconcile and bless his people'." There is a similar instruction for the ordination of Bishops, although they are anointed on the head, rather than the palms of the hands.

An important and specific use of chrism is in the Anointing during the Coronation of the British monarch. In this part of the Service, the Archbishop of Canterbury anoints the Sovereign on the head, hands and heart. This is considered to be the holiest rite of the Service, so much so that it is shielded from the congregation's view by a canopy of state. This is also why it was not filmed during the coronation of Queen Elizabeth II in 1953, nor was it photographed in 1937 during the coronation of King George VI and Queen Elizabeth. It occurs just prior to the presentation of the Crown Jewels to the Sovereign, which is in turn followed by the actual Coronation.

Its other notable use is in the consecration of church buildings, where it may be used to anoint the walls, the altar/table, and the place for reservation of the Eucharistic sacrament for the sick.

As in other traditions, chrism is usually olive oil (although other plant oils can be used in cases when olive oil is unavailable) and is scented with a sweet perfume, usually balsam. Under usual circumstances, chrism is consecrated by the bishop of the particular church in the presence of the presbyterium at the Chrism Eucharist, which takes place on Maundy Thursday or a day shortly before, where priestly ordination vows are often renewed also. The oil of catechumens and the oil of the sick are usually also consecrated at this liturgy. Practices vary for the blessing of the chrism, from interpolations within the Eucharistic Prayer, to specific prayers of consecration, used at the discretion of the minister. Some Lutheran and Anglican liturgical books, however, make provision for a pastor who is not a bishop (a presbyter) to consecrate chrism in time of need and in the absence of the bishop.

7 - The Church of Jesus Christ of Latter - day Saints

Latter Day Saints, who consider themselves restorationists, also practice ritual anointing of the sick, as well as other forms of anointing. Members of The Church of Jesus Christ of Latter-day Saints (LDS Church) consider anointing to be an ordinance.

Members of the LDS Church who hold the Melchizedek priesthood may use consecrated oil in performing the ordinance of blessing of the "sick or afflicted", though oil is not required if it is unavailable. The priesthood holder anoints the recipient's head with a drop of oil, then lays hands upon that head and declare their act of anointing. Then another priesthood holder joins in, if available, and pronounces a "sealing" of the anointing and other words of blessing, as he feels inspired. Melchizedek priesthood holders are also authorized to consecrate any pure olive oil and often carry a personal supply in case they have need to perform a blessing. Oil is not used in other blessings, such as for people seeking comfort or counsel.^{[10][11]}

In addition to the James 5:14-15 reference, the Doctrine and Covenants contains numerous references to the anointing and healing of the sick by those with authority to do so.

Clarified Butter



Contents

- 1 Introduction
- 2 Properties
- 3 Regional variations
- 4 Names and uses in various countries

1 - Introduction

Clarified butter is milk fat rendered from butter to separate the milk solids and water from the butterfat.^[1] Typically, it is produced by melting butter and allowing the components to separate by density. The water evaporates, some solids float to the surface and are skimmed off, and the remainder of the milk solids sink to the bottom and are left behind when the butter fat (which would then be on top) is poured off.

Commercial methods of production also include direct evaporation, but may also be accomplished by decantation and centrifugation followed by vacuum drying; or direct from cream by breaking the emulsion followed by centrifugation.^{[2][3]}

2 – Properties

Clarified butter has a higher smoke point ($252 \,^{\circ}$ C) than regular butter (163-190 $^{\circ}$ C), and is there fore preferred in some cooking applications, such as sautéing. Clarified butter also has a much longer

shelf life than fresh butter. It has negligible amounts of lactose and casein and is, therefore, acceptable to most who have a lactose intolerance or milk allergy.

3 - Regional variations

In the Middle East (سمنة *samna*) and South Asia (*ghee*), the butter may be cooked long enough to evaporate the water portion and caramelize the milk solids (which are then filtered out), resulting in a nutty flavor . In French cuisine, this is called *beurre noisette*, translated as "hazelnut butter" and known as *brown butter* in English.

4 - Names and uses in various countries

In the United States, clarified butter is typically served warm with un breaded, cooked seafood as drawn butter.

In England, clarified butter is used in the process of potting, whereby foods such as shrimp and hare are preserved in pots of butter.

In India and Pakistan, clarified butter, commonly known as ghee, is a common cooking oil. In Pakistan, it is used mainly for cooking, especially, chicken Karahi and lentils. It is also burned as a fuel in religious lamps. In northern India, the milk solids are a delicacy eaten with various unleavened breads. The milk solids are called *mehran* or *ghee* in Hindi, *ney* in Tamil, *neyyi* in Telugu, *neyyi* in Malayalam, (tūp) in Marathi, *thuppa* in Kannada. In Tamil house houlds , the separated milk solids are sauteed with jaggery (or brown sugar) and wheat flour to make a sweet delicacy. Ghee (Sanskrit: *gritham* is also a major ingredient in Ayurveda, used as a base for several herbal potions or powders, for easier absorption.

In Brazil, this is known as *manteiga clarificada* and it is commonly mistaken for *manteiga de garrafa* (bottle butter), which is featured mostly in cuisine from the northeast.

In German, clarified butter is known as *Butterschmalz* (butter lard), sometimes rendered into English as "butter schmalz".

In Iran, it is known as "yellow oil" or "sweet oil", and is used in place of other oils.

In Middle Eastern countries, it is known as *samnah*. It replaces oil in frying and sautéing because of its perceived superior flavor. In some Arab countries, such as Egypt, the separated milk solids that remain in the bottom (*mortah*) are a rare delicacy, and are eaten as a spread on bread.

Rural families in the Maghreb, particularly those of Amazigh descent (among whom ghee is referred to as *smen* or *d'haan*) sometimes bury a sealed vessel of it on the day of a daughter's birth, aging it until it is unearthed and used to season the food served at her wedding.

In Ethiopian and Eritrean cuisines (particularly in the highlands), clarified butter is infused with ginger, garlic, and several spices, and is known as *niter kibbeh* in Amharic and *tesmi* in Tigrinya. In traditional African cultures, clarified butter is used in an ointment worn in the hair or on the skin. For example, the women of the Hamer people wear a mixture of clarified butter and red ochre in their hair.

In Uganda, among the Ankole cultures, clarified butter is made into a dish called *eshabwe*, a white, frothy cream that is eaten with solid foods and is sometimes added to smoked meat.

In Mongolia, it is known as "shar tos".

In Russia, it is called топлёное масло (toplenoe maslo, literally "melted butter").

Cocklebur Oil

Cocklebur oil is obtained by pressing the seeds of the cocklebur (Xanthium ssp.), a plant that is other wise considered an agricultural pest that can harm or kill lives tock. The oil is similar to poppy seed oil, light yellow in color, and similar to sun flower oil in taste and smell.

Coco Nut



A dehusked coconut shell from Côte d'Ivoire showing the face-like markings at the base



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1 - Introduction

The coconut palm (also, cocoanut), *Cocos nucifera*, is a member of the family Arecaceae (palm family). It is the only accepted species in the genus*Cocos*.^[2] The term coconut can refer to the entire coconut palm, the seed, or the fruit, which, botanically, is a drupe, not a nut. The spelling cocoanut is an archaic form of the word.^[3] The term is derived from 16th - century Portuguese and Spanish *coco*, meaning "head" or "skull",^[4] from the three small holes on the coconut shell that resemble human facial features.

Found throughout the tropic and subtropic area, the coconut is known for its great versatility as seen in the many domestic, commercial, and industrial uses of its different parts. Coconuts are part of the daily diets of many people. Coconuts are different from any other fruits because they contain a large quantity of "water" and when immature they are known as tender-nuts or jelly-nuts and may be harvested for drinking. When mature, they still contain some water and can be used as seed nuts or processed to give oil from the kernel, charcoal from the hard shell and coir from the fibrous husk. The endosperm is initially in its nuclear phase suspended within the coconut water. As development continues, cellular layers of endosperm deposit along the walls of the coconut, becoming the edible coconut "flesh". When dried, the coconut flesh is called copra. The oil and milk derived from it are commonly used in cooking and frying; coconut oil is also widely used in soaps and cosmetics. The clear liquid coconut water within is a refreshing drink. The husks and leaves can be used as material to make a variety of products for furnishing and decorating. It also has cultural and religious significance in many societies that use it.

Scientific classification	
Kingdom:	Plantae
Class:	Monocots
Order:	Arecales
Suborder:	Commelinids
Family:	Arecaceae
Subfamily:	Arecoideae
Tribe:	Cocoeae
Genus:	Cocos
Species:	C. nucifera
Binomial name	
Cocos nuciferaL.	

2 – Description

2 - 1 - Plant

Cocos nucifera is a large palm, growing up to 30 m tall, with pinnate leaves 4 - 6 m long, and pinnae 60 - 90 cm long; old leaves break away cleanly, leaving the trunk smooth. Coconuts are generally classified into two general types: tall and dwarf. On very fertile . In

recent years, improvements in cultivation practices and breeding have produced coconut trees that can yield more.

2-2-Fruit

Botanically, the coconut fruit is a drupe, not a true nut. Like other fruits, it has three layers: the exo carp, meso carp, and endocarp. The exo carp and meso carp make up the "husk" of the coconut. Coconuts sold in the shops of non tropical countries often have had the exocarp (outermost layer) removed. The meso carp is composed of a fiber, called coir, which has many traditional and commercial uses. The shell has three germination pores (stoma) or "eyes" that are clearly visible on its outside surface once the husk is removed.

A full - sized coconut weighs about 1.44 kg . It takes around 6000 full - grown coconuts to produce a tonne of copra.

2 - 3 - Roots

Unlike some other plants, the palm tree has neither a tap root nor root hairs, but has a fibrous root system.

2 – 4 –Inflorescence

The palm produces both the female and male flowers on the same inflorescence; thus, the palm is monoecious. Other sources use the term poly gamo monoecious. The female flower is much larger than the male flower. Flowering occurs continuously Coco nut palms are believed to be largely cross-pollinated, although some dwarf varieties are self - pollinating.

3 – Etymology

One of the earliest mentions of the coconut dates back to the One Thousand and One Nights story of Sinbad the Sailor; he is known to have bought and sold coconuts during his fifth voyage.*Tenga*, its Malayalam name, was used in the detailed description of coconut found in *Itinerario* by Ludovico di Varthema published in 1510 and also in the later *Hortus Indicus Malabaricus*.^[15] Even earlier, it was called *nux indica*, a name used by Marco Polo in 1280 while in Sumatra, taken from the Arabs who called it *jawz hindī*. Both

names translate to "Indian nut". In the earliest description of the coconut palm known, given by Cosmos of Alexandria in his *Topographia Christiana* written about 545 AD, there is a reference to the argell tree and its drupe.

Historical evidence favors the European origin of the name "coconut", for no name is similar in any of the languages of India, where the Portuguese first found the fruit; and indeed Barbosa, Barros, and Garcia, in mentioning the Malayalam name *tenga*, and Canarese*narle*, expressly say, "we call these fruits quoquos", "our people have given it the name of coco", and "that which we call coco, and the Malabars temga".

The OED states: "Portuguese and Spanish authors of the 16th c. agree in identifying the word with Portuguese and Spanish *coco* "grinning face, grin, grimace", also "bugbear, scarecrow", cognate with *cocar* "to grin, make a grimace"; the name being said to refer to the face-like appearance of the base of the shell, with its three holes. According to Losada, the name came from Portuguese explorers, the sailors of Vasco da Gama in India, who first brought them to Europe. The coconut shell reminded them of a ghost or witch in Portuguese folklore called *coco* (also *côca*). The first known recorded usage of the term is 1555.

4 - Origin and distribution

4 - 1 - Origin

The origin of the plant is the subject of debate. Many authorities suggest an Indo - Pacific origin either around Melanesia and Malesia or the Indian Ocean, while others see the origin in northwestern South America. The oldest fossils known of the modern coconut dating from the Eocene period from around 37 to 55 million years ago were found in Australia and India. However, older palm fossils such as some of nipa fruit have been found in the Americas.

4 – 2 – Dispersal

Genomic analysis of cultivated coconut (*Coco nucifera L.*) has shed light on the movements of Austronesian peoples. By examining 10 microsatelite loci, researchers found two genetically distinct subpopulations of coconut – one originating in the Indian Ocean, the other in the Pacific Ocean. However, admixture, the transfer of genetic material, evidently occurred between the two populations. Given that coconuts are ideally suited for ocean dispersal, individuals from one population possibly could have floated to the other. However, the locations of the admixture events are limited to Madagascar and coastal east Africa, and exclude the Seychelles. This pattern coincides with the known trade routes of Austronesian sailors. Additionally, a genetically distinct subpopulation of coconut on the western coast of South America has undergone a genetic bottleneck resulting from a founder effect; however, its ancestral population is the Pacific coconut, which suggests Austronesian peoples may have sailed as far east as the Americas.

4 – 3 – Distribution

The coco nut has spread across much of the tropics, probably aided in many cases by seafaring people Coco nut fruit in the wild are light, buoyant and highly water resistant, and evolved to disperse significant distances via marine currents. Specimens have been collected from the sea as far north as Norway. In the Hawaiian Islands, the coconut is regarded as a Poly nesianintroduction, first brought to the islands by early Polynesian voyagers from their homelands in Oceania. They have been found in the Caribbean and the Atlantic coasts of Africa and South America for less than 500 years, but evidence of their presence on the Pacific coast of South America predates Christopher Columbus's arrival in the Americas.^[24] They are now almost ubiquitous between 26°N and 26°S except for the interiors of Africa and South America.

5 - Natural habitat

The coconut palm thrives on sandy soils and is highly tolerant of salinity. It prefers areas with abundant sunlight and regular rainfall (150 cm to 250 cm annually), which makes colonizing shorelines of the tropics relatively straight forward .Coco nuts also need high humidity (70 – 80 %+) for optimum growth, which is why they are rarely seen in areas with low humidity, like the southeastern Mediterranean or Andalusia, even where temperatures are high enough (regularly above 24° C).

Coco nut palms require warm conditions for successful growth, and are intolerant of cold weather. Optimum growth is with a mean annual temperature of 27 °C, and growth is reduced below 21 °C. Some seasonal variation is tolerated, with good growth where mean summer temperatures are between 28 and 37 °C, and survival as long as winter temperatures are above 4 - 12 °C; they will survive brief drops to 0 °C. Severe frost is usually fatal, although they have been known to recover from temperatures of -4 °C They may grow but not fruit properly in areas with insufficient warmth, such as Bermuda.

The conditions required for coco nut trees to grow without any care are :

mean daily temperature above $12 - 13^{\circ}$ C every day of the year mean yearly rain fall above 1000 mm.

no or very little over head canopy, since even small trees require direct sun

The main limiting factor for most locations which satisfy the rainfall and temperature requirements is canopy growth, except those locations near coastlines, where the sandy soil and salt spray limit the growth of most other trees.

5 - 1 - Diseases

Coconuts are susceptible to the phytoplasma disease lethal yellowing. One recently selected cultivar, the Maypan, has been bred for resistance to this disease.

5-2-Pests

The Coco nut palm is damaged by the larvae of many Lepidoptera (butterfly and moth) species which feed on it, including *Batrachedra* spp.: *B. arenosella*, *B. atriloqua* (feeds exclusively on *C. nucifera*), *B. mathesoni* (feeds exclusively on *C. nucifera*), and *B. nuciferae*.

Brontispa longissima (Coco nut leaf beetle) feeds on young leaves, and damages seedlings and mature Coco nut palms. In 2007, the Philippines imposed a quarantine in Metro Manila and 26 provinces to stop the spread of the pest and protect the \$800 million Philippine Coco nut industry.

The fruit may also be damaged by eriophyid Coco nut mites (*Eriophyes guerreronis*). This mite infests Coco nut plantations, and is devastating: it can destroy up to 90 % of Coco nut production. The immature seeds are infested and desapped by larvae staying in the portion covered by the perianth of the immature seed; the seeds then drop off or survive deformed. Spraying with wettable sulfur 0.4% or with neem-based pesticides can give some relief, but is cumbersome and labor intensive.

In Kerala, the main Coco nut pests are the Coco nut mite, the rhinoceros beetle, the red palm weevil and the Coco nut leaf caterpillar. Research on this topic has as of 2009 produced no results, and researchers from the Kerala Agricultural University and the Central Plantation Crop Research Institute, Kasaragode are still searching for a cure. The Krishi Vigyan Kendra, Kannur under Kerala Agricultural University has developed an innovative extension approach called compact area group approach (CAGA) to combat Coco nut mites.

Country	Production (tones)
Philippines	19,500,000
Indonesia	15,540,000
India	10,824,100
Brazil	2,759,044
Sri Lanka	2,200,000
Thailand	1,721,640
Mexico	1,246,400
Vietnam	1,086,000
Papua New Guinea	a 677,000
Malaysia	555,120
Tanzania	370,000
World	54,716,444

6 – Cultivation

Coco nut palms are grown in more than 80 countries of the world, with a total production of 61 million tones per year. Coco nut trees are very hard to establish in dry climates, and cannot grow there without frequent irrigation; in drought conditions, the new leaves do not open well, and older leaves may become desiccated; fruit also tends to be shed.

The extent of cultivation in the tropics is threatening a number of habitats, such as mangroves; an example of such damage to an ecoregion is in the Petenes mangroves of the Yucatan.

6 – 1 – Harvesting

In some parts of the world (Thailand and Malaysia), trained pigtailed macaques are used to harvest Coco nut s. Training schools for pig-tailed macaques still exist both in southern Thailand, and in the Malaysian state of Kelantan . Competitions are held each year to find the fastest harvester.

6-2 - Cooler climates

In cooler climates (but not less than USDA Zone 9), a similar palm, the queen palm (*Syagrus romanzoffiana*), is used in landscaping. Its fruits are very similar to the Coco nut , but much smaller. The queen palm was originally classified in the genus *Cocos* along with the Coco nut , but was later reclassified in *Syagrus*. A recently discovered palm, *Beccariophoenix alfredii* from Madagascar, is nearly identical to the Coco nut , more so than the queen palm and can also be grown in slightly cooler climates than the Coco nut palm. Coco nut s can only be grown in temperatures above 18°C , but need a daily temperature above 22°C to produce fruit.

7 – Over view of uses

The Coco nut palm is grown throughout the tropics for decoration, as well as for its many culinary and nonculinary uses; virtually every part of the Coco nut palm can be used by humans in some manner and has significant economic value. Coco nut s' versatility is sometimes noted in its naming. In the Philippines, the Coco nut is commonly called the "tree of life".

8 - Culinary use

The various parts of the Coco nut have a number of culinary uses. The seed provides oil for frying, cooking, and making margarine. The white, fleshy part of the seed, the Coco nut meat, is used fresh or dried in cooking, especially in confections and desserts such as macaroons. Desiccated Coco nut or Coco nut milk made from it is frequently added to curries and other savory dishes Coco nut flour has also been developed for use in baking, to combat malnutrition.^[39] Coco nut chips have been sold in the tourist regions of Hawaii and the Caribbean Coco nut butter is often used to describe solidified Coco nut oil, but has also been adopted as a name by certain specialty products made of Coco nut milk solids or puréed Coco nut meat and oil. Dried Coco nut is also used as the filling for many chocolate bars.

Coco nut -inner edible solid part, raw (fresh kopra)	
Nutritional value per 100 g	
Energy	354 kcal (1,480 kJ)
Carbohydrates	24.23
- Sugars	6.23
- Dietary fiber	9
Fat	33.49
Protein	3.33 g
Water	47
Thiamine (vit. B ₁)	0.066 mg (6%)
Riboflavin (vit. B ₂)	0.02 mg (2%)
Niacin (vit. B ₃)	0.54 mg (4%)
Pantothenic acid (B ₅)	1.014 mg (20%)
Vitamin B ₆	0.05 mg (4%)
Vitamin C	3.3 mg (4%)
Calcium	14 mg (1%)

Iron	2.43 mg (19%)
Magnesium	32 mg (9%)
Phosphorus	113 mg (16%)
Potassium	356 mg (8%)
Zinc	1.1 mg (12%)

8-1 - coco nut water

coco nut water serves a suspension for the endosperm of the Coco nut during its nuclear phase of development. Later, the endosperm matures and deposits onto the Coco nut rind during the cellular phase. Coco nut water contains sugar, dietary fiber, proteins, antioxidants, vitamins and minerals, and provides an iso tonic electrolyte balance. It is consumed as a refreshing drink throughout the humid tropics, and is gaining popularity as a sports drink. Mature fruits have significantly less liquid than young immature Coco nut s, barring spoilage Coco nut water can be fermented to produce Coco nut vinegar.

Coco nut water	
Nutritional value per 100 g	
Energy	19 kcal (79 kJ)
Carbohydrates	3.71
- Sugars	2.61
- Dietary fiber	1.1
Fat	0.2
Protein	0.72
Water	95
Thiamine (vit. B ₁)	0.03 mg (3%)
Riboflavin (vit. B ₂)	0.057 mg (5%)
Niacin (vit. B ₃)	0.08 mg (1%)
Vitamin B ₆	0.032 mg (2%)
Vitamin C	2.4 mg (3%)

Calcium	24 mg (2%)
Iron	0.29 mg (2%)
Magnesium	25 mg (7%)
Phosphorus	20 mg (3%)
Potassium	250 mg (5%)
Zinc	0.1 mg (1%)

8-2 - Coco nut milk

Coco nut milk, not to be confused with Coco nut water, is obtained primarily by extracting juice by pressing the grated Coco nut 's white kernel or by passing hot water or milk through grated Coco nut , which extracts the oil and aromatic compounds. It has a fat content around 17 %. When refrigerated and left to set, Coco nut cream will rise to the top and separate from the milk. The milk can be used to produce virgin Coco nut oil by controlled heating and removal of the oil fraction.

8-3- Coco nut oil

Another byproduct of the Coco nut is Coco nut oil. It is commonly used in cooking, especially for frying. It can be used in liquid form as would other vegetable oils, or in solid form as would butter or lard.

8-4 - Toddy and nectar

The sap derived from incising the flower clusters of the Coco nut is drunk as *neera*, also known as toddy or *tuba* (Philippines), *tuak* (Indonesia and Malaysia) or *karewe* (fresh and not fermented, collected twice a day, for breakfast and dinner) in Kiribati. When left to ferment on its own, it becomes palm wine. Palm wine is distilled to produce *arrack*. In the Philippines, this alcoholic drink is called *lambanog* or "Coco nut vodka".

The sap can be reduced by boiling to create a sweet syrup or candy such as *te kamamai* in Kiribati or *dhiyaa hakuru* and *addu bondi* in Maldives. It can be reduced further to yield Coco nut sugar also referred to as palm sugar or jaggery. A young, well-maintained tree can produce around 300 liters of toddy per year, while a 40-year-old tree may yield around 400 liters .

8 - 5 - Heart of palm and Coco nut sprout

Apical buds of adult plants are edible, and are known as "palm cabbage" or heart of palm. They are considered a rare delicacy, as harvesting the buds kills the palms. Hearts of palm are eaten in salads, sometimes called "millionaire's salad". Newly germinated Coco nut s contain an edible fluff of marshmallow-like consistency called Coco nut sprout, produced as the endosperm nourishes the developing embryo.

9 - Commercial, industrial, and household use 9 - 1 - Cultivars

Coco nut has a number of commercial and traditional cultivars. They can be sorted mainly into tall cultivars, dwarf cultivars and hybrid cultivars (hybrids between talls and dwarfs). Some of the dwarf cultivars such as *Malayan dwarf*has shown some promising resistance to lethal yellowing while other cultivars such as *Panama tall* is highly affected by the same plant disease. Some cultivars are more drought resistant such as *West coast tall* (India) while others such as *Hainan Tall* (China) are more cold tolerant. Other aspects such as seed size, shape and weight and copra thickness are also important factors in the selection of new cultivars. Some cultivars such as *Fiji dwarf* form a large bulb at the lower stem and others are cultivated to produce very sweet Coco nut water with orange coloured husks (king Coco nut) used entirely in fruit stalls for drinking (Sri Lanka, India).

9-2-Coir



Coir (the fiber from the husk of the Coco nut) is used in ropes, mats, door mats, brushes, sacks, caulking for boats and as stuffing fiber for mattresses. It is used in horticulture in potting compost, especially in orchid mix.

9-3- Coco nut fronds

The stiff mid-ribs of Coco nut leaves are used for making brooms in India, Indonesia (*sapu lidi*), Malaysia, the Maldives and the Philippines (*walis tingting*). The green of the leaves (lamina) are stripped away, leaving the veins (wood-like, thin, long strips) which are tied together to form a broom or brush. A long handle made from some other wood may be inserted into the base of the bundle and used as a two-handed broom. The leaves also provide material for baskets that can draw well water and for roofing thatch; they can be woven into mats, cooking skewers, and kindling arrows, as well. Two leaves (especially the younger, yellowish shoots) woven into a tight shell the size of the palm are filled with rice and cooked to make *ketupat*.^[44] Dried Coco nut leaves can be burned to ash, which can be harvested for lime. In India, particularly in Kerala, Karnataka and Tamil Nadu, the woven Coco nut leaves are used as *pandals* (temporary sheds) for marriage functions.

9-4-Copra

Copra is the dried meat of the seed and after processing produces Coco nut oil and Coco nut meal Coco nut oil, aside from being used in cooking as an ingredient and for frying, is used in soaps and cosmetics. In Vanuatu Coco nut palms for copra production are generally spaced 9 meters apart, allowing a tree density of 100–160 trees per hectare.

9-5-Husks and shells

The husk and shells can be used for fuel and are a source of charcoal.^[45] Activated carbon manufactured from Coco nut shell is considered superior to those obtained from other sources, mainly because of small macropores structure which renders it more effective for the absorption of gas and vapor and for the removal of color, oxidants, impurities and odor of compounds.

A dried half Coco nut shell with husk can be used to buff floors. It is known as a bunot in the Philippines and simply a " Coco nut brush" in Jamaica. The fresh husk of a brown Coco nut may serve as a dish sponge or body sponge. Tempurung as the shell is called in the Malay language can be used as a soup bowl and—if fixed with a handle—a ladle. In India, Coco nut shells are also used as bowls and in the manufacture of various handicrafts, including buttons carved from dried shell Coco nut buttons are often used for Hawaiian aloha shirts. In Thailand, the Coco nut husk is used as a potting medium to produce healthy forest tree saplings. The process of husk extraction from the coir bypasses the retting process, using a custombuilt Coco nut husk extractor designed by ASEAN-Canada Forest Tree Seed Centre (ACFTSC) in 1986. Fresh husks contains more tannin than old husks. Tannin produces negative effects on sapling growth.^[46] In parts of South India, the shell and husk are burned for smoke to repel mosquitoes.

Half Coco nut shells are used in theatreFoley sound effects work, banged together to create the sound effect of a horse's hoof beats. Dried half shells are used as the bodies of musical instruments, including the Chinese *yehu* and *banhu*, along with the Vietnamese dan gáo and Arabo-Turkic *rebab*. In the Philippines, dried half shells are also used as a music instrument in a folk dance called *maglalatik*.

9-6- Coco nut trunk



Coco nut Palace, Manila, Philippines

Coco nut trunks are used for building small bridges; they are preferred for their straightness, strength and salt resistance. In Kerala, Coco nut trunks are used for house construction. Coco nut timber comes from the trunk, and is increasingly being used as an ecologically sound substitute for endangered hardwoods. It has applications in furniture and specialized construction, as notably demonstrated in Manila's Coco nut Palace.

Hawaiians hollowed the trunk to form drums, containers, or small canoes. The "branches" (leaf petioles) are strong and flexible enough to make a switch. The use of Coco nut branches in corporal punishment was revived in the Gilbertese community on Choiseul in the Solomon Islands in 2005.

9-7- Coco nut roots

The roots are used as a dye, a mouthwash, and a medicine for diarrhea and dysentery. A frayed piece of root can also be used as a toothbrush.

9 – 8 – Use in beauty products

Coco nut s are used in the beauty industry in moisturisers and body butters because Coco nut oil, due to its chemical structure, is readily absorbed by the skin. The Coco nut shell may also be ground down and added to products for exfoliation of dead skin Coco nut is also a source of lauric acid, which can be processed in a particular way to produce sodium lauryl sulfate, a detergent used in shower gels and shampoos. The nature of lauric acid as a fatty acid makes it particularly effective for creating detergents and surfactants.

10 - Role in culture and religion

In the Ilocos region of northern Philippines, the Ilocano people fill two halved Coco nut shells with *diket* (cooked sweet rice), and place *liningta nga itlog* (halved boiled egg) on top of it. This ritual, known as *niniyogan*, is an offering made to the deceased and one's ancestors. This accompanies the *palagip* (prayer to the dead).

Coco nut (Sanskrit: narikela) is an essential element of A rituals in Hindu tradition. Often it is decorated with bright metal foils and other symbols of auspiciousness. It is offered during worship to a Hindu god or goddess. Irrespective of their religious affiliations, fishermen of India often offer it to the rivers and seas in the hopes of having bountiful catches. Hindus often initiate the beginning of any new activity by breaking a Coco nut to ensure the blessings of the gods and successful completion of the activity. The Hindu goddess of well-being and wealth, Lakshmi, is often shown holding a Coco nut. In the foothills of the temple town of Palani, before going to worship Murugan for the Ganesha, Coco nut s are broken at a place marked for the purpose. Every day, thousands of Coco nut s are broken, and some devotees break as many as 108 Coco nut s at a time as per the prayer. In tantric practices, Coco nut s are sometimes used as substitutes for human skulls.

In Hindu wedding ceremonies, a Coco nut is placed over the opening of a pot, representing a womb Coco nut flowers are auspicious symbols and are fixtures at Hindu and Buddhist weddings and other important occasions. In Kerala, Coco nut flowers must be present during a marriage ceremony. The flowers are inserted into a barrel of unhusked rice (paddy) and placed within sight of the wedding ceremony. Similarly in Sri Lanka, Coco nut flowers, standing in brass urns, are placed in prominent positions.

The Coco nut is also used as a target and prize in the traditional British fairground game " Coco nut shy". The player buys some small balls which he throws as hard as he can at Coco nut s balanced on sticks. The aim is to knock a Coco nut off the stand and win it.

It is the main food of adherents of a Vietnamese religion Đạo Dừa in Ben Tre, which syncretic Buddhism, Christianity and Taoism.

10 – 1 - Myths and legends

Some South Asian, Southeast Asian and Pacific Ocean cultures have origin myths in which the Coco nut plays the main role. In the Hainuwele myth from Maluku, a girl emerges from the blossom of a Coco nut tree.^[50] In Maldivian folklore one of the main myths of origin reflects the dependence of the Maldivians on the Coco nut tree.

11 - Medicinal uses

Coco nut s may help benign prostatic hyperplasia.^[52] In rats, oil reduced total cholesterol, triglycerides, Coco nut virgin phospholipids, LDL, and VLDL cholesterol levels and increased HDL cholesterol in serum and tissues. The hexane fraction of Coco nut peel may contain novel anticancer compounds.^[54] Young Coco nut juice has estrogen - like characteristics.^[55] Inside a Coco nut is a cavity filled with Coco nut water, which is sterile until opened. It mixes easily with blood, and was used during World War II in emergency transfusions. It can also serve as an emergency short-term intravenous hydration fluid. This is possible because the Coco nut water has a high level of sugar and other salts that makes it possible to be used in the bloodstream, much like the modern lactated Ringer solution or a dextrose/water solution as an intravenouus solution (IV) Coco nut is also commonly used as a traditional remedy in Pakistan to treat bites from rats. In Brazil, Coco nut is known as coco-da-bahia, coco-da-baía or coqueiro-da-índia. The tea from the husk fiber is widely used to treat several inflammatory disorders.

12 - Other uses

The leftover fiber from Coco nut oil and Coco nut milk production, Coco nut meal, is used as livestock feed. The dried calyx is used as fuel in wood - fired stoves Coco nut water is traditionally used as a growth supplement in plant tissue culture/micropropagation. The smell of Coco nut s comes from the 6-pentyloxan-2-one molecule, known as delta-decalactone in the food and fragrance industries.

12 – 1 - Tool and shelter for animals

Researchers from the Melbourne Museum in Australia observed the octopus species *Amphioctopus marginatus*'use of tools, specifically Coco nut shells, for defense and shelter. The discovery of this behavior was observed in Bali and North Sulawesi in Indonesia between 1998 and 2008.*Amphioctopus marginatus* is the first invertebrate known to be able to use tools.

A Coco nut can be hollowed out and used as a home for a rodent or small birds. Halved, drained Coco nut s can also be hung up as bird feeders, and after the flesh has gone, can be filled with fat in winter to attract tits.

13–Allergies

13 – 1 - Food allergies

Coco nut can be a food allergen although its prevalence varies from country-to-country. While Coco nut is one of the top-five food allergies in India where it is a common food source, such allergies to Coco nut are considered rare in Australia, the U.K., and the U.S. As a result, commercial extracts of Coco nut are not currently available for skin prick testing in Australia or New Zealand.

Despite a low prevalence of allergies to Coco nut in the U.S., the U.S. Food and Drug Administration (FDA) began identifying Coco nut s in October 2006.^[66] Based on FDA guidance and federal U.S. law, Coco nut must be disclosed as an ingredient.

13 – 2 - Topical allergies

Coco nut -derived products can cause contact dermatitis. They can be present in cosmetics, including some shampoos, moisturizers, soaps, cleansers and hand washing liquids. Those known to cause contact dermatitis include: Coco nut di ethanol amide, cocamide sulphate , cocamide DEA , CDEA, sodium laureth sulfate, sodium lauroyl sulfate, ammonium laureth sulfate, ammonium lauryl sulfate, sodium lauroyl sarcosinate, sodium cocoyl sarcosinate, potassium coco hydrolyzed collagen, tri ethanol amine laureth sulfate, caprylic / capric triglycerides, tri ethanol amine lauryl or cocoyl sarcosime, disodium oleamide sulfocuccinate, laureth sulfa succinate, and disodium dioctyl sulfo succinate.

Coco Nut Oil

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1 - Introduction

Coco nut oil is an edible oil extracted from the kernel or meat of matured Coco nut s harvested from the Coco nut palm (*Cocos nucifera*). Throughout the tropical world, it has provided the primary source of fat in the diets of millions of people for generations. It has various applications in food, medicine, and industry. Because of its stability, it is slow to oxidize and, thus, resistant to rancidity, lasting up to two years owing to the high saturated fat content.

Many health organizations advise against the consumption of high amounts of Coco nut oil due to its high levels of saturated fat.

2 – Production

2 – 1 -Dry process

Coco nut oil can be extracted through "dry" or "wet" processing. Dry processing requires the meat to be extracted from the shell and dried using fire, sunlight, or kilns to create copra. The copra is pressed or dissolved with solvents, producing the Coco nut oil and a high-protein, high - fiber mash. The mash is of poor quality for human consumption and is instead fed to ruminants; there is no process to extract protein from the mash. A portion of the oil extracted from copra is lost to the process of extraction.



Traditional way of making Coco nut oil using an ox - powered mill

2-2-Wet process

The all-wet process uses raw Coco nut rather than dried copra, and the protein in the Coco nut creates an emulsion of oil and water.^[10] The more problematic step is breaking up the emulsion to recover the oil. This used to be done by prolonged boiling, but this produces a discolored oil and is not economical; modern techniques use centrifuges and pre - treatments including cold, heat, acids, salts, enzymes, electrolysis, shock waves, or some combination of them. Despite numerous variations and technologies, wet processing is less viable than dry processing due to a 10–15% lower yield, even compared to the losses due to spoilage and pests with dry processing. Wet processes also require investment of equipment and energy, incurring high capital and operating costs.

Proper harvesting of the Coco nut (the age of a Coco nut can be 2 to 20 months when picked) makes a significant difference in the efficacy of the oil - making process. Copra made from immature nuts is more difficult to work with and produces an inferior product with lower yields. Conventional Coco nut oil uses hexane as a solvent to extract up to 10 % more oil than just using rotary mills and expellers. The oil is then refined to remove certain free fatty acids, in order to reduce susceptibility to rancidification. Other processes to increase shelf life include using copra with a moisture content below 6%, keeping the moisture content of the oil below 0.2 %, heating the oil to 130–150 °C and adding salt or citric acid. Virgin Coco nut oil (VCO) meat, milk or residue. can be produced from fresh Coco nut Producing it from the fresh meat involves removing the shell and washing, then either wet - milling or drying the residue and using a screw press to extract the oil. VCO can also be extracted from fresh meat by grating and drying it to a moisture content of 10-12%, then using a manual press to extract the oil. Producing it from Coco nut milk involves grating the Coco nut and mixing it with water, then squeezing out the oil. The milk can also be fermented for 36–48 hours, the oil removed, and the cream heated to remove any remaining oil. A third option involves using a centrifuge to separate the oil from the other liquids Coco nut oil can also be extracted from the dry residue left over from the production of Coco nut milk.

A thousand of mature Coco nut s weighing approximately 1,440 kilograms yield around 170 kilograms (370 lb) of copra from which around 70 litres (15 imp gal) of Coco nut oil can be extracted.

2 - 3 - RBD



Coco nut s sundried in Kozhikode, Kerala for making copra, which is used for making Coco nut oil.

RBD stands for "refined, bleached, and deodorized." RBD oil is usually made from copra (dried Coco nut kernel).

The dried copra is placed in a hydraulic press with added heat and the oil is extracted. This yields up practically all the oil present, amounting to more than 60 % of the dry weight of the Coco nut . This "crude" Coco nut oil is not suitable for consumption because it contains contaminants and must be refined with further heating and filtering.

Another method for extraction of a "high-quality" Coco nut oil involves the enzymatic action of alpha-amylase, poly galacturonases, and proteases on diluted Coco nut paste.

Unlike virgin Coco nut oil, refined Coco nut oil has no Coco nut taste or aroma. RBD oil is used for home cooking, commercial food processing, and cosmetic, industrial, and pharmaceutical purposes.

2-4 - Hydrogenation

RBD Coco nut oil can be processed further into partially or fully hydrogenated oil to increase its melting point. Since virgin and RBD Coco nut oils melt at 24 °C, foods containing Coco nut oil tend to melt in warm climates. A higher melting point is desirable in these warm climates, so the oil is hydrogenated. The melting point of hydrogenated Coco nut oil is 36 - 40 °C.

In the process of hydrogenation, unsaturated fats (mono un saturated and poly un saturated fatty acids) are combined with hydrogen in a catalytic process to make them more saturated Coco nut oil contains only 6 % mono un saturated and 2 % poly un saturated fatty acids. In the partial hydrogenation process, some of these are transformed into trans fatty acids.

2-5 – Fractionation

Fractionated Coco nut oil is a fraction of the whole oil, in which the different medium-chain fatty acids are separated for specific uses. Lauric acid, a 12 - carbon chain fatty acid, is often removed because of its high value for industrial and medical purposes. The fractionation of Coco nut oil may be used to make caprylic / capric triglyceride oil. Medium - chain triglycerides like caprylic / capric tri glyceride oil are most frequently used for medical applications, special diets and cosmetics, sometimes also being used as a carrier oil for fragrances.

2-6-Figures

The United States Department of Agriculture has published estimated production figures for Coco nut oil as follows; tabulated years are from October 1 through September 30 :

Year	2006-07	2007–08	2008–09	2009–10	2010-11
Production	5.42	5.79	5.62	6.60	6.24

Coco nut oil makes up around 2.5 % of world vegetable oil production.

3 – Standards

The World Health Organization's *Codex Alimentarius* guidelines on food, food production and food safety, published by the Food and Agriculture Organization, includes standards for commercial partners who produce Coco nut oil for human consumption.^[21] The Asian and Pacific Coco nut Community (APCC), whose 17 members produce about 90% of the Coco nut sold commercially,^[22] has published its standards for virgin Coco nut oil (virgin Coco nut oil is obtained from fresh, mature Coco nut kernels through means which do not "lead to alteration of the oil").

4 - Composition and comparison

The following table provides information about the composition of Coco nut oil and how it compares with other vegetable oils.

		Mono -	Polyunsaturated fatty acids				
Туре	Saturated fatty acid		Total poly	linolenic acid (w-3)	Linoleic acid (ω-6)	Oleic acid (ω-9)	Smoke point
Not hydrogenated							
Canola rapeseed	7.365	63.276	28.142	-	-	-	204 °C
Coco nut	91.00	6.000	3.000	-	2	6	177 °C
Corn	12.948	27.576	54.677	1	58	28	232 °C
Cotton	25.900	17.800	51.900	1	54	19	216 °C

seed								
Flaxseed / Linseed	6 - 9	10 - 22	68 - 8	89	56 - 71	12 - 18	10 - 22	107 °C
Olive	14.00	72.00	14.00)	-	-	-	193 °C
Palm	49.300	37.000	9.300)	-	10	40	(235 °C
Peanut	16.900	46.200	32.00	00	-	32	48	(225 °C
Safflowe (>70% linoleic)	8.00	15.00	75.00)	-	-	-	(210 °C
Safflower (high oleic)	7.541	75.221	12.82	20	-	-	-	210 °C
Soybean	15.650	22.783	57.74	40	7	54	24	238 °C
Sunflower (<60% linoleic)	10.100	45.400	40.10	00	0.200	39.800	45.300	227 °C
Sunflower (>70% oleic)	9.859	83.689	3.798	3	-	-	-	(227 °C
Fully hydro	Fully hydrogenated							
Cotton seed (hydrog.)	93.600	1.529		.587		.287 ^[24]		
Palm (hydrogena ted)	47.500	40.600		7.500				
Soybean (hydrogen)	21.100	73.700		.400	.096 ^[24]			
Values as p	ercent (%	6) by weight	t of total f	fat.				

5 – Health

Many health organizations advise against the consumption of high amounts of Coco nut oil due to its high levels of saturated fat, including the United States Food and Drug Administration ,World Health Organization, International College of Nutrition, the United States Department of Health and Human Services .American Dietetic Association ,American Heart Association, British National Health Service, and Dietitians of Canada.

Coco nut oil contains a large proportion of lauric acid—a saturated fat that raises blood cholesterol levels by increasing the

amount of high-density lipoprotein (HDL) cholesterol and low-density lipoprotein (LDL) cholesterol. It is also found in significant amounts in laurel oil, palm kernel oil (not to be confused with palm oil), human and animal breast milk and sebaceous glandsecretions. This may create a more favourable blood cholesterol profile, though it is unclear if Coco nut oil may promote atherosclerosis through other pathways. Because much of the saturated fat of Coco nut oil is in the form of lauric acid, Coco nut oil may be a better alternative to partially hydrogenated vegetable oil when solid fats are required. In addition, virgin Coco nut oil is composed mainly of medium - chain triglycerides, which may not carry the same risks as other saturated fats.

Advocacy against Coco nut and palm oils in the 1970s and 80s due to their perceived danger as a saturated fat caused companies to instead substitute trans fats, unaware of their health - damaging effects.

A repellent made from Coco nut oil can be used to prevent tungiasis-causing sand fleas from invading the body.

6 – Uses

Coco nut oil			
Nutritional value per serving			
Serving size	100g		
Energy	3,607 kJ (862 kcal)		
Fat	100		
- saturated	86.5		
- monounsaturated	5.8		
- polyunsaturated	1.8		
Vitamin E	0.09 mg (1%)		
Vitamin K	0.5 µg (0%)		
Iron	0.04 mg (0%)		

6 – 1 - In food

Coco nut oil is commonly used in cooking, especially for frying and is a common flavor in many South Asian curries. In recent years, virgin Coco nut oil has become increasingly popular in natural food circles and with vegans. It was described in a *New York Times* article as having a "haunting, nutty," flavor that also has a touch of sweetness, which works well in baked goods, pastries, and sautés. Coco nut oil is used by movie theatre chains to pop popcorn, adding a large amount of saturated fat in the process.^[40] Coco nut oil (along with Laurel leaf oil and palm kernel oil) contains a large proportion of lauric acid, which is converted to monolaurin in the body, a fat found otherwise only in breast milk. Lauric acid is destroyed by some oil processing methods.

Other culinary uses include replacing solid fats produced through hydrogenation in baked and confectionery goods. Hydrogenated or partially hydrogenated Coco nut oil is often used in non - dairy creamers, and snack foods including popcorn. Hydrogenated Coco nut oil is also sold in Australia under the brandname Copha and is the main ingredient in Australian snacks such as Chocolate crackles and White Christmas.

The smoke point of Coco nut oil is 177 °C.

6 – 2 – Industry

Coco nut oil has been tested for use as a feedstock for biodiesel to be used as a diesel engine fuel. In this manner, it can be applied to power generators and transport using diesel engines. Since straight Coco nut oil has a high gelling temperature $(22-25 \ ^{\circ}C)$, a high viscosity, and a minimum combustion chamber temperature of 500 $\ ^{\circ}C$ (932 $\ ^{\circ}F$) (to avoid polymerization of the fuel), Coco nut oil is typically trans esterified to make biodiesel. Use of B100 (100% biodiesel) is possible only in temperate climates, as the gel point is approximately 10 $\ ^{\circ}C$, The oil must meet the Weihenstephan standard for pure vegetable oil used as a fuel, otherwise moderate to severe damage from carbonization and clogging will occur in an unmodified engine.

The Philippines, Vanuatu, Samoa, and several other tropical island countries are using Coco nut oil as an alternative fuel source to run automobiles, trucks, and buses, and to power generators Coco nut oil is currently used as a fuel for transport in the Philippines .Further research into the oil's potential as a fuel for electricity generation is being carried out in the islands of the Pacific, though to date it appears it is not useful as a fuel source due to the cost of labour and supply constraints.

Coco nut oil has been tested for use as an engine lubricant^[45] and a transformer oil.

Acids derived from Coco nut oil can be used as herbicides.

Coco nut oil (and derivatives, such as Coco nut fatty acid) are used as raw materials in the manufacture of surfactants such as cocamido propyl betaine, cocamide MEA and cocamide DEA.

6 – 3 - Personal uses

Coco nut oil can be used as a skin moisturizer, helping with dry skin and reduces protein loss when used in hair. Coco nut oil can also be used as sexual lubricant, although it can damage latex condoms.

Before the advent of electrical lighting, Coco nut oil was the primary oil used for illumination in India and was exported as cochin oil.

Coco nut oil is an important base ingredient for the manufacture of soap. Soap made with Coco nut oil tends to be hard, although it retains more water than those made with other oils and therefore increases manufacturer yields. It is more soluble in hard water and salt water than other soaps allowing it to lather more easily. A basic Coco nut oil soap is clear when melted and a bright white when hardened.

Cocoa Bean



bean, the papery skin rubbed loose

roasting

pod

Contents

- 1 Introduction
- 2 Etymology
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- **4** Production
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- 5 Health benefits of cocoa consumption
- 6 Child labor
- 7 Fairtrade
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1 - Introduction

Cacao bean (also Anglicized as cocoa bean, often simply cocoa ; Mayan: kakaw; Nahuatl: cacahuatl) is the dried and and cacao fully fermented fatty bean of Theobroma cacao, from which cocoa solids and cocoa butter are extracted. They are the basis of chocolate, as well as many Mesoamerican foods such as mole sauce and tejate.

A cocoa pod (fruit) has a rough and leathery rind about 3 cm thick (this varies with the origin and variety of pod). It is filled with sweet, mucilaginous pulp (called 'baba de cacao' in South America)

enclosing 30 to 50 large seeds that are fairly soft and white to a pale lavender color. While seeds are usually white, they become violet or reddish brown during the drying process. The exception is rare varieties of white cacao, in which the seeds remain white.^{[2][3]} Historically, white cacao was cultivated by the Rama people of Nicaragua

2 – Etymology

Cocoa is the Anglicized spelling of the Spanish word *cacao*, derived from the Nahuatl word *cacahuatl*. Cocoa can often also refer to the drink commonly known as hot chocolate; to cocoa powder, the dry powder made by grinding cocoa seeds and removing the cocoa butter from the dark, bitter cocoa solids; or to a mixture of cocoa powder and cocoa butter.

3 - History

The cacao tree is native to the Americas. It may have originated in the foothills of the Andes in the Amazon and Orinoco basins of South America, current day Venezuela, where today, examples of wild cacao still can be found. However, it may have had a larger range in the past, evidence for which may be obscured because of its cultivation in these areas long before, as well as after, the Spanish arrived. It was first cultivated by the Olmecs at least 1500 BC in Mexico.

The cocoa bean was a common currency throughout Mesoamerica before the Spanish conquest.

Cacao trees will grow in a limited geographical zone, of approximately 20 degrees to the north and south of the Equator. Nearly 70 % of the world crop is grown in West Africa.

Cocoa was an important commodity in pre-ColumbianMesoamerica. A Spanish soldier who was part of the conquest of Mexico by Hernán Cortés tells that when Moctezuma II, emperor of the Aztecs, dined, he took no other beverage than chocolate, served in a golden goblet. Flavored with vanilla or other spices, his chocolate was whipped into a froth that dissolved in the mouth. It is reported that no fewer than 60 portions each day may have been consumed by Moctezuma II, and 2000 more by the nobles of his court.

Chocolate was introduced to Europe by the Spaniards, and became a popular beverage by the mid 17th century . They also introduced the cacao tree into the West Indies and the Philippines. It was also introduced into the rest of Asia and into West Africa by Europeans. In the Gold Coast, modern Ghana, cacao was introduced by an African, Tetteh Quarshie.

The cacao plant was first given its botanical name by Swedish natural scientist Carl Linnaeus in his original classification of the plant kingdom, who called it *Theobroma* ("food of the gods") *cacao*.

Top Cocoa Beans Producers in 2010				
(million me	etric tons)			
Ivory Coast	1.242			
Indonesia	0.844			
Ghana	0.632			
Nigeria	0.360			
Cameroon	0.264			
Brazil	0.235			
Ecuador	0.132			
Togo	0.102			
Dominican Republic	0.058			
Peru	0.047			
World Total	4.082			

4 – Production 4 – 1 - World production

More than 3,000,000 tones of cocoa are produced each year. The global production was

1974: 1,556,484 tons, 1984: 1,810,611 tons, 1994: 2,672,173 tons, 2004: 3,607,052 tons.

The production increased by 131.7 % in 30 years, representing a compound annual growth rate of 2.9 %.

There are three main varieties of cocoa plant: Forastero, Criollo, and Trinitario. The first is the most widely used, comprising 95% of the world production of cocoa. Overall, the highest quality cocoa beans come from the Criollo variety, which is considered a delicacy. Criollo plantations have lower yields than those of Forastero, and also tend to be less resistant to several diseases that attack the cocoa plant, hence very few countries still produce it. One of the largest producers of Criollo beans is Venezuela (Chuao and Porcelana). Trinitario is a hybrid between Criollo and Forastero varieties. It is considered to be of much higher quality than the latter, but has higher yields and is more resistant to disease than the former.

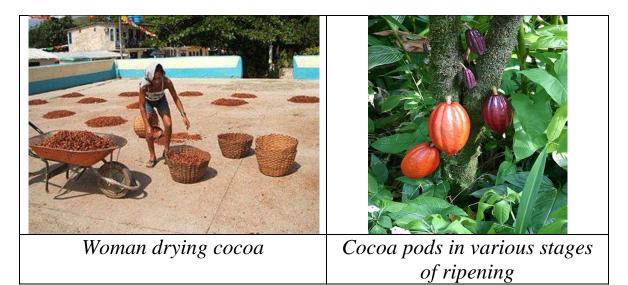
There are different metrics used for chocolate consumption. The Netherlands has the highest monetary amount of cocoa bean imports (US \$b2.1 billion); it is also one of the main ports into Europe. The United States has highest amount of cocoa powder imports (\$ 220 million); the US has a large amount of cocoa complementary products The United Kingdom has the highest amount of retail chocolate (\$ 1.3 billion) and is one of the biggest chocolate consumption per capita markets.

Cocoa and its products (including chocolate) are used worldwide. Per capita consumption is poorly understood, with numerous countries claiming the highest: various reports state Switzerland, Belgium, and the UK have the highest consumption, but it can be claimed that because there is no clear mechanism to determine how much of a country's production is consumed by residents and how much by visitors, this is all speculative.

There were 3.54 million tonnes of cocoa beans produced in the 2008 – 2009 growing year, which runs from October to September. Of this total, African nations produced 2.45 million tonnes (69 %), Asia and Oceania produced 0.61 million tonnes (17%) and the Americas produced 0.48 million tonnes (14 %). Two African nations, Côte d'Ivoire and Ghana, produce more than half of the world's cocoa, with 1.23 and 0.73 million tonnes respectively (35% and 21%, respectively). The largest cocoa bean-producing countries in the world are as follows.

Country	Amount produced Percentage of world production
Côte d'Ivoire	1.23 million tons 34.7 %
Ghana	746 thousand tons 20.6 %
Indonesia	489 thousand tons 13.8 %
Cameroon	220 thousand tons 5.9 %
Nigeria	210 thousand tons 5.9 %
Brazil	165 thousand tons 4.7 %
Ecuador	130 thousand tons 3.7 %
Malaysia	32 thousand tons 0.9 %

2-4 - Harvesting



Cocoa trees grow in hot, rainy tropical areas within 20° of latitude from the equator. Cocoa harvest is not restricted to one period per year. Usually it occurs over several months and in many countries cocoa can be harvested at any time of the year.^[13]Pesticides are often applied to the trees to combat capsid bugs and fungicides to fight black pod disease.

Immature cocoa pods have a variety of colors but most often are green, red, or purple, and as they mature their color tends towards yellow or orange, particularly in their creases.^{[13][15]} Unlike most fruiting trees, the cacao pod grows directly from the trunk or large branch of a tree rather than from the end of a branch. This makes harvesting by hand easier as most of the pods will not be up in the higher branches. The pods on a tree do not ripen together; harvesting needs to be done periodically through the year.^[13] Harvesting occurs between 3–4 times to weekly during the harvest season.^[13] The ripe and near-ripe pods, as judged by their color, are harvested from the trunk and branches of the cocoa tree with a curved knife on a long pole. Care must be used when cutting the stem of the pod to avoid injuring the junction of the stem with the tree, as this is where future flowers and pods will emerge . It is estimated one person can harvest 650 pods per day.

4 – 3 - Harvest processing

The harvested pods are opened — typically with a machete— to expose the beans. The pulp and cocoa seeds are removed and the rind is discarded. The pulp and seeds are then piled in heaps, placed in bins, or laid out on grates for several days. During this time, the seeds and pulp undergo "sweating", where the thick pulp liquefies as it ferments. The fermented pulp trickles away, leaving cocoa seeds behind to be collected. Sweating is important for the quality of the beans, which originally have a strong bitter taste. If sweating is interrupted, the resulting cocoa may be ruined; if underdone, the cocoa seed maintains a flavor similar to raw potatoes and becomes susceptible to mildew. Some cocoa producing countries distil alcoholic spirits using the liquefied pulp. A typical pod contains 20 to 50 beans^[11] and about 400 dried beans are required to make one pound (880 per kilogram) of chocolate. Cocoa pods weigh an average of 400 grams (0.88 lb) and each one yields 35 to 40 grams dried beans (this yield is 40–44% of the total weight in the pod). It is estimated one person can separate the beans from 2000 pods per day.

The wet beans are transported then to a facility so they can be fermented and dried. They are fermented for four to seven days and must be mixed every two days. They are dried for five to fourteen days, depending on the climate conditions. The fermented beans are dried by spreading them out over a large surface and constantly raking them. In large plantations, this is done on huge trays under the sun or by using artificial heat. Small plantations may dry their harvest on little trays or on cowhides. Finally, the beans are trodden and shuffled about (often using bare human feet) and sometimes, during this process, red clay mixed with water is sprinkled over the beans to obtain a finer color, polish, and protection against molds during shipment to factories in the United States, the Netherlands, United Kingdom, and other countries. Drying in the sun is preferable to drying by artificial means, as no extraneous flavors such as smoke or oil are introduced which might otherwise taint the flavor.



A tiendas de chocolate mill in Oaxaca, where customers can have roasted cocoa beans and spices ground for chocolate, or roasted chili peppers ground for mole.

The beans should be dry for shipment (usually by sea). Traditionally exported in jute bags, over the last decade the beans are

increasingly shipped in 'Mega - Bulk' bulk parcels of several thousand tonnes at a time on ships, or in smaller lots of around 25 tonnes in 20 foot containers. Shipping in bulk significantly reduces handling costs; shipment in bags, however, either in a ship's hold or in containers, is still commonly found.

Throughout Mesoamerica where they are native, cocoa beans are used for a variety of foods. The harvested and fermented beans may be ground to-order at *tiendas de chocolate*, or chocolate mills. At these mills, the cocoa can be mixed with a variety of ingredients such as cinnamon, chili peppers, almonds, vanilla and other spices to create drinking chocolate. The ground cocoa is also an important ingredient in *tejate* and a number of savory foods, such as *mole*.

4 – 4 - Chocolate production



Chocolate

To make 1 kg of chocolate, about 300 to 600 beans are processed, depending on the desired cocoa content. In a factory, the beans are roasted. Next they are cracked and then de-shelled by a "winnower". The resulting pieces of beans are called nibs. They are usually sold in small packages at specialty stores and markets to be used in cooking, snacking and chocolate dishes. Since nibs are directly from the cocoa tree, they contain high amounts of theobromine. Most nibs are ground, using various methods, into a thick creamy paste, known as chocolate liquor or cocoa paste. This "liquor" is then further processed into chocolate by mixing in (more) cocoa butter and sugar (and sometimes vanilla and lecithin as an emulsifier), and then refined, conched and tempered. Alternatively, it can be separated into cocoa powder and cocoa butter using a hydraulicpress or the Broma process. This process produces around 50% cocoa butter and 50% cocoa powder. Standard cocoa powder has a fat content of approximately 10 - 12 percent. Cocoa butter is used in chocolate bar manufacture, other confectionery, soaps, and cosmetics.

Treating with alkali produces Dutch process cocoa powder, which is less acidic, darker and more mellow in flavor than what is generally available in most of the world. Regular (non-alkalized) cocoa is acidic, so when cocoa is treated with an alkaline ingredient, generally potassium carbonate, the pH increases. This process can be done at various stages during manufacturing, including during nib treatment, liquor treatment or press cake treatment.

Another process that helps develop the flavor is roasting. Roasting can be done on the whole bean before shelling or on the nib after shelling. The time and temperature of the roast affect the result: A "low roast" produces a more acid, aromatic flavor, while a high roast gives a more intense, bitter flavor lacking complex flavor notes.

5 - Health benefits of cocoa consumption

Chocolate and cocoa contain a high level of flavonoids, specifically epicatechin, which may have beneficial cardiovascular effects on health.

Prolonged intake of flavanol-rich cocoa has been linked to cardiovascular health benefits , though it should be noted that this refers to raw cocoa and to a lesser extent, dark chocolate, since flavonoids degrade during cooking and alkalizing processes.^[24] Studies have found short term benefits in LDL cholesterol levels from dark chocolate consumption . The addition of whole milk to milk chocolate reduces the overall cocoa content per ounce while increasing saturated fat levels, possibly negating some of cocoa's heart-healthy potential benefits . Although one study has concluded that milk impairs the absorption of polyphenolic flavonoids, e.g. (-)epicatechin, a followup failed to find the effect.

Hollenberg and colleagues of Harvard Medical School studied the effects of cocoa and flavanols on Panama's Kuna people, who are heavy consumers of cocoa. The researchers found that the Kuna Indians living on the islands had significantly lower rates of heart disease and cancer compared to those on the mainland who do not drink cocoa as on the islands. It is believed that the improved blood flow after consumption of flavanol - rich cocoa may help to achieve health benefits in hearts and other organs. In particular, the benefits may extend to the brain and have important implications for learning and memory.

Foods rich in cocoa appear to reduce blood pressure but drinking green and black tea may not, according to an analysis of previously published research in the April 9, 2007 issue of Archives of Internal Medicine, one of the JAMA/Archives journals.

A 15 - year study of elderly men published in the *Archives of Internal Medicine* in 2006 found a 50 percent reduction in *cardiovascular* mortality and a 47 percent reduction in *all-cause* mortality for the men regularly consuming the most cocoa, compared to those consuming the least cocoa from all sources.

6 - Child labor

The first allegations that child slavery is used in cocoa production appeared in 1998. In late 2000 a BBC documentary reported the use of enslaved children in the production of cocoa in West Africa. Other media followed by reporting widespread child slavery and child trafficking in the production of cocoa. According to a report by the International Labour Organization (ILO), in 2002, more than 109,000 children were working on cocoa farms in Côte d'Ivoire (Ivory Coast), some of them in "the worst forms of child labour". The ILO later reported that 200,000 children were working in the cocoa industry in Côte d'Ivoire in 2005. The 2005 ILO report failed to fully characterize this problem, but estimated that up to 6% of the 200,000 children involved in cocoa production could be victims of human trafficking or slavery. The cocoa industry was accused of profiting from child slavery and trafficking . The Harkin-Engel Protocol is an effort to end these practices . It was signed and

witnessed by the heads of eight major chocolate companies, Harkin, Engel, Senator Herb Kohl, the ambassador of the Ivory Coast, the director of the International Programme on the Elimination of Child Labor, and others . It has, however, been criticized by some groups including the International Labor Rights Forum as an industry initiative which falls short.

7 – Fairtrade

There are Fairtrade cocoa producer groups in Belize, Bolivia, Cameroon, The Congo, Costa Rica, Dominican Republic, Ecuador, Ghana, Haiti, India, Côte d'Ivoire, Nicaragua, Panama, Peru, Sierra Leone and Sao Tome & Principe.

Cadbury, one of the world's largest chocolate companies, has begun certifying its Dairy Milk bars as Fair Trade; according to Cadbury, in 2010 "around one quarter of ... global sales" of these bars will be Fair Trade .

8 - Environmental impact

The relative poverty of many cocoa farmers means that environmental consequences such as deforestation are given little significance.

For decades, cocoa farmers have encroached on virgin forest, mostly after the felling of trees by logging companies.

This trend has decreased as many governments and communities are beginning to protect their remaining forested zones.

In general, the use of chemical fertilizers and pesticides by cocoa farmers is limited. When cocoa bean prices are high, farmers may invest in their crops, leading to higher yields which, in turn tends to result in lower market prices and a renewed period of lower investment.

9 - Cocoa trading

Cocoa beans, cocoa butter and cocoa powder are traded on two world exchanges: NYSE Euronext and IntercontinentalExchange (ICE). The London market is based on West African cocoa and New York on cocoa predominantly from Southeast Asia. Cocoa is the world's smallest soft commodity market.

The future price of cocoa butter and cocoa powder is determined by multiplying the bean price by a ratio. The combined butter and powder ratio has tended to be around 3.5. If the combined ratio falls below 3.2 or so, production ceases to be economically viable and some factories cease extraction of butter and powder and trade exclusively in cocoa liquor.

Cocoa beans can be held in storage for several years in bags or in bulk, during which the ownership can change several times, as the cocoa is traded much the same as metal or other commodities, to gain profit for the owner.

In July 2010, British hedge fund Armajaro, headed by speculator Anthony Ward, purchased 241,000 tones of cocoa beans. The purchase was valued at £658 million and caused cocoa bean prices to rise to their highest level since 1977.

Cocoa Butter



Cocoa butter

Contents

1 Introduction

2 Composition and extraction

2.1 Adulterants

3 Uses

3.1 Personal care

4 Physical properties

1 - Introduction

Cocoa butter, also called theobroma oil, is a pale-yellow, pure edible vegetable fat extracted from the cocoa bean. It is used to make chocolate, as well as some ointments, toiletries, and pharmaceuticals . Cocoa butter has a cocoa flavor and aroma.

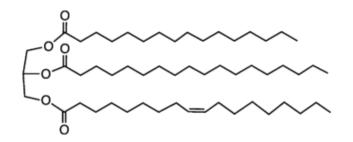
Raw cocoa butter (Fat composition)			
Saturated fats	57 - 64%: stearic acid (24 - 37%), palmitic acid (24 - 30%), myristic acid, (0 - 4%), arachidic acid (1%), lauric acid (0 - 1%)		
Un saturated fats	36 - 43 %		
Mono un saturated fats	29 – 43 % : oleic acid (29 – 38 %) , palmitoleic acid (0 –2 %)		

Poly un saturated fats	0-5% :
	linoleic acid ($0-4$ %),
	α - Linolenic acid (0–1%)

Properties				
Food energy per 100 g	3770 kJ (900 kcal)			
Melting point	35 – 36.5 °C			
Solidity at 20 °C	solid			
Refractive index	1.44556 - 1.44573			
Iodine value	32.11 – 35.12 ,			
Acid value	1.68			
Saponification value	191.214, 192.88 –196.29			

2 - Composition and extraction

Cocoa butter contains a high proportion of saturated fats, derived from stearic and palmitic acids. Cocoa butter, unlike cocoa solids, has no more than trace amounts of caffeine and theobromine.



The main constituent of cocoa butter is the triglyceride (fat) derived from palmitic acid, stearic acid, and oleic acid.

Cocoa butter is obtained from whole cacao beans, which are fermented, roasted, and then separated from their hulls. About 54–58% of the residue is cocoa butter. Chocolate liquor is pressed to separate the cocoa butter from the cocoa solids. The Broma process is used to extract cocoa butter from ground cacao beans. Cocoa butter is usually deodorized to remove its strong and undesirable taste.

2 – 1 – Adulterants

Some food manufacturers substitute less expensive materials such as vegetable oils and fats (fillers and over-sized packaging) in place of cocoa butter. Several analytical methods exist for testing for diluted cocoa butter. Adulterated cocoa butter is indicated by its lighter colour and its diminished fluorescence upon ultraviolet illumination. Unlike cocoa butter, adulterated fat tends to smear and have a higher non - saponifiable content.

3 – Uses

Cocoa butter is a major ingredient in practically all types of chocolates (white chocolate, milk chocolate, but also dark chocolate). This application continues to dominate consumption of cocoa butter.

Pharmaceutical companies heavily use cocoa butter's physical properties. As a nontoxic solid at room temperature that melts at body temperature, it is considered an ideal base for medicinal suppositories.

3-1 - Personal care

Cocoa butter is one of the most stable fats known, a quality that coupled with natural antioxidants that prevent rancidity; It has a storage life of two to five years. The velvety texture, pleasant fragrance and emollient properties of cocoa butter have made it a popular ingredient in products for the skin, such as cosmetics, soaps and lotions.

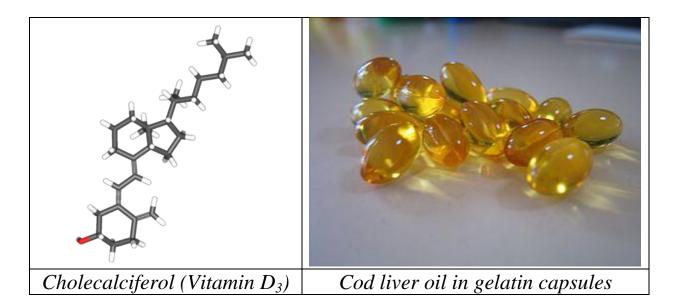
The moisturizing abilities of cocoa butter are frequently recommended for prevention of stretch marks in pregnant women, treatment of chapped or burned skin and lips, and as a daily moisturizer to prevent dry, itchy skin.^[9] Cocoa butter's moisturizing properties are also said to be effective for treating mouth sores.^[10] However, the largest clinical study regarding the effects of cocoa butter on stretch marks in pregnant women found that results were no different from placebo.

4 - Physical properties

The most common form of cocoa butter has a melting point of around 34 - 38 °C , rendering chocolate a solid at room temperature

that readily melts once inside the mouth. Cocoa butter displays polymorphism, having α , γ , β' , and β crystals, with melting points of 17, 23, 26, and 35 – 37 °C respectively. The production of chocolate typically uses only the β crystal for its high melting point. A uniform crystal structure will result in smooth texture, sheen, and snap. Overheating cocoa butter converts the structure to a less stable form that melts below room temperature. Given time, it will naturally return to the most stable β crystal form. Advantage is taken of this phenomenon in the polymorphic transformation theory of chocolate bloom. It is based on the fact that bloomed chocolates are always found to contain the most stable polymorph of cocoa butter. According to this theory, bloom occurs through the uncontrolled polymorphic transformation of cocoa butter from a less stable form to the most stable form.

Cod Liver Oil



Contents

- 1 Introduction
- 2 Manufacture
- 3 Therapeutic uses
- 4 Adverse effects
- 5 Other uses

1 - Introduction

Cod liver oil is a nutritional supplement derived from liver of cod fish. As with most fish oils, it has high levels of the omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Cod liver oil also contains vitamin A and vitamin D. It has historically been taken because of its vitamin A and vitamin D content. It was once commonly given to children, because vitamin D has been shown to prevent rickets and other symptoms of vitamin D deficiency.^[1]

2 – Manufacture

Cod liver oil was traditionally manufactured by filling a wooden barrel with fresh cod livers and seawater and allowing the mixture to ferment for up to a year before removing the oil.^[2] Modern cod liver oil is made by cooking the whole cod body tissues of fatty fish during the manufacture of fish meal.

3 - Therapeutic uses

Cod liver oil is widely taken to ease the pain and joint stiffness associated with arthritis.^[3] It may have a positive effect on heart , bone , as well as helping to repair wounded skin , hair , nails , and teeth.

Cod liver oil and fish oil are similar, but cod liver oil has higher levels of vitamins A and D. According to the USDA, a tablespoon of cod liver oil (13.6 g) contains 4080 μ g of retinol (vitamin A) and 34 μ g of vitamin D. The Recommended Dietary Allowance of vitamin A is 900 μ g per day for adult men and 700 for women, while that for vitamin D is 15 μ g per day. The "tolerable upper intake levels" are 3000 μ g/day and 100 μ g/day respectively, so people consuming cod liver oil as a source of omega-3 fatty acids should pay attention to how much vitamin A and vitamin D this adds to their diet.^{[9][10]}

Cod liver oil may be an effective complementary measure for long-term treatment of multiple sclerosis.

Use of cod liver oil during pregnancy is associated with lower risk of Type I diabetes in the offspring . (although see adverse effects below). This effect was found only in mothers taking cod liver oil, not in mothers taking multivitamin supplements. Cod liver oil taken by nursing mothers improves the breast milk by increasing the amount of fatty acids, which promotes brain development, and the amount of vitamin A, which helps prevent infections, but the level of vitamin D is unchanged.

A Norwegian study of more than 68,000 women reported that female cancer patients who took daily cod-liver oil supplements had significantly reduced mortality (25% for all cancers, 45% for lung cancer) compared to women who did not take such supplements.

4 - Adverse effects

Per tablespoon (13.6 g), cod liver oil contains 136 % of the established daily Tolerable Upper Intake Level (UL) for Preformed Vitamin A (Retinol) . Vitamin A accumulates in body fat, and can reach harmful levels sufficient to cause hyper vitaminosis A.^[9] Pregnant women may want to consider consulting a doctor when taking cod liver oil because of the high amount of natural forms of

vitamin A such as retinol. High doses of synthetic vitamin A (retinoids) have been shown to cause birth defects. A toxic dose of retinol (vitamin A) is around 25 000 IU/kg (see Retinol # Retinoid overdose (toxicity)), or the equivalent of about 1.25 kg of cod liver oil for a 50 - kg person.

The risks of hyper vitaminosis and of exposure to environmental toxins such as mercury, polychlorinated biphenyls (PCBs), dioxins, and other contaminants, are reduced when purification processes are applied to produce refined fish - oil products, which consequently contain raised levels of omega - 3 fatty acids, such as EPA and DHA.

A high intake of cod liver oil by pregnant women is associated with a nearly fivefold increased risk of gestational hypertension,^[19] although this study did not control for mercury, which can be present in harmful amounts in fish and which is another cause of hypertension.

Some urge caution when taking cod liver oil and other fishbased supplements since they may contain elevated levels of toxins such as mercury and PCBs found in fish.

5 - Other uses

In New foundland, cod liver oil was sometimes used as the liquid base for traditional red ochre paint, the coating of choice for use on outbuildings and work buildings associated with the cod fishery.

In Tübingen, Germany cod liver oil is used as the punishment for the loser at the traditional de : Stocherkahnrennen, a punting boat race by University groups.

Cohune Oil

IUPAC name : Cohune oil							
Other names : Cohune nut oil Cohune palm oil							
Properties							
Density	1000 kg / m^3 , liquid 917 kg / m^3 , solid	(4 °C)					
Melting poin	Melting point 28 °C						

1 - Introduction

Cohune oil is pressed from the seeds of the cohune palm, which is native to Central and South America.

Along with other byproducts of the palm, cohune oil is believed to have been used by cultures in southern Mesoamerica since the pre-Columbian era, in particular by the Maya. Uses of the oil include as a lubricant, for cooking, soap making and lamp oil. For this latter purpose the oil was placed in earthenware or soapstone lamps and lit with a wick, for cooking and illumination.

Cohune oil is made up of the following portions of fatty acids:

Fatty acid	Percentage
Caprylic	7.5%
Capric	6.5%
Lauric	46.5%
Myristic	16.0%
Palmitic	9.5%
Stearic	3.0%
Oleic	10.0%
Linoleic	1.0%

2 – Commercialization

Cohune oil is generally not used commercially because the cohune palm is very difficult to break open.^[3] However, the manufacture and usage of the oil continues among certain contemporary Maya communities in Belize, Guatemala and Honduras.

Colza Oil



Colza cultivation in Germany

1 - Introduction

olza oil is a non drying oil obtained from the seeds of *Brassica rapa*, var. *oleifera*, a variety of the plant that produces turnips 'Colza is extensively cultivated in France, Belgium, the United States, the Netherlands, Germany and Poland. In France, especially, the extraction of the oil is an important industry. In commerce, colza is classed with rapeseed oil, to which it is very closely allied in both source and properties . It is a comparatively non odoriferous oil of a yellow colour, having a specific gravity varying between 0.912 and 0.920. The cake left after extraction of the oil is a valuable feed ingredient for pigs.

2 – Uses

Colza oil is extensively used as a lubricant for machinery.

Colza oil was used extensively in European domestic lighting before the advent of coal (city) gas or kerosene. It was the preferred oil for train pot lamps, and was used for lighting railway coaches in the United Kingdom before gas lighting, and later electric lighting, were adopted. Burned in a Carcel lamp, it was part of the definition of the French standard measure for illumination, the carcel , for most of the nineteenth century. In lighthouses, for example in early Canada, colza oil was used before the introduction of mineral oil. The colza oil was used with the Argand burner because it was cheaper than whale oil.^[1] Colza was burned to a limited extent in the Confederacy during the American Civil War.

Colza oil was used in Gombault's Caustic Balsam,^[3] a popular horse and human liniment at the turn of the 20th century. (Note that the ingredients listed in this link are similar to, but not the same as, the list on the actual bottle).

Among the more unusual applications of colza oil is the calming of choppy seas, where the oil modifies the surface tension of the water and rapidly smooths the surface. For this purpose, colza oil was carried in ship's lifeboats. Rescue and recovery operations have been made far less risky in this way.

More recently, colza has been cultivated in Europe as an ingredient for biodiesel fuels, and is the primary source of biodiesel in Germany.

Cookeen

Cookeen is a block of vegetable oil (also known as shortening in the U.S.) used for making pastry and other baking recipes. It is claimed to be usable straight from the refrigerator.

The Cookeen brand is marketed by Princes Limited, a British food producer belonging to Mitsubishi. Cookeen is actually owned by Edible Oils Limited, a joint venture between Archer Daniels Midland (ADM), a U.S. food processing corporation, and Princes. The product is produced at a factory in Erith.

In October 2006, Cookeen and the other hard vegetable fats manufactured by Edible Oils Limited had the trans fat removed due to health concerns.

Cooking Oil

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1 Introduction

2 Health and nutrition

2.1 Trans fats

2.2 Cooking with oil

2.3 Storing and keeping oil

3 Types of oils and their characteristics

3.1 Comparison to other types of food

4 Cooking oil extraction and refinement

- 4.1 Extraction
- 3.2 Refinement

5 Waste cooking oil

1 - Introduction

Cooking oil is plant, animal, or synthetic fat used in frying, baking, and other types of cooking. It is also used in food preparation and flavouring that doesn't involve heat, such as salad dressings and bread dips, and in this sense might be more accurately termed edible oil.

Cooking oil is typically a liquid, although some oils that contain saturated fat, such as Coco nut oil, palm oil and palm kernel oil, are solid at room temperature.

Types of cooking oil include: olive oil, palm oil, soybean oil, canola oil (rapeseed oil), pumpkin seed oil, corn oil, sunflower oil, safflower oil, peanut oil, grape seed oil, sesame oil, argan oil, rice bran oil and other vegetable oils, as well as animal-based oils like butter and lard.

Oil can be flavoured with aromatic food stuffs such as herbs, chillies or garlic.

2 - Health and nutrition

The appropriate amount of fat as a component of daily food consumption is a topic of some controversy. Some fat is required in

the diet, and fat (in the form of oil) is also essential in many types of cooking. The FDA recommends that 30 % or fewer of calories consumed daily should be from fat. Other nutritionists recommend that no more than 10% of a person's daily calories come from fat.^[3] In extremely cold environments, a diet that is up to two-thirds fat is acceptable and can, in fact, be critical to survival.

While consumption of small amounts of saturated fats is essential, initial meta-analyses (1997, 2003) found a high correlation between high consumption of such fats and coronary heart disease.^{[4][5]} Surprisingly, however, more recent meta-analyses (2009, 2010), based on cohort studies and on controlled, randomized trials, find a positive^[6] or neutral^[7] effect from shifting consumption from carbohydrate to saturated fats as a source of calories, and only a modest advantage for shifting from saturated to polyunsaturated fats (10% lower risk for 5% replacement).

Mayo Clinic has highlighted oils that are high in saturated fats, including Coco nut , palm oil and palm kernel oil. Those of lower amounts of saturated fats, and higher levels of unsaturated (preferably monounsaturated) fats like olive oil, peanut oil, canola oil, avocado, safflower, corn, sunflower, soy, mustard and cottonseed oils are generally healthier.^[8] The National Heart, Lung and Blood Institute^[9] and World Heart Federation have urged saturated fats be replaced with poly un saturated and mono un saturated fats. The health body lists olive and canola oils as sources of monounsaturated oils while soybean and sunflower oils are rich with polyunsaturated fat. Results of research carried out in Costa Rica in 2005 suggest that consumption of non-hydrogenated unsaturated oils like soybean and sunflower are preferable to the consumption of palm oil.

Not all saturated fats have negative effects on cholesterol.^[12] Some studies indicate that Palmitic acid in palm oil does not behave like other saturated fats, and is neutral on cholesterol levels because it is equally distributed among the three "arms" of the triglyceride molecule . Further, it has been reported that palm oil consumption reduces blood cholesterol in comparison with other traditional sources of saturated fats such as Coco nut oil, dairy and animal fats.

Saturated fat is required by the body and brain to function properly. In fact, one study in Brazil compared the effects of soybean oil to Coco nut oil (a highly saturated fat) and found that while both groups showed a drop in BMI, the soybean oil group showed an increase in overall cholesterol (including a drop in HDL, the good cholesterol). The Coco nut oil group actually showed an increase in the HDL:LDL ratio (meaning there was more of the good cholesterol), as well as smaller waist sizes (something that was not shown in the soybean oil group.

In 2007, scientists Kenneth C. Hayes and Pramod Khosla of Brandeis University and Wayne State University indicated that the focus of current research has shifted from saturated fats to individual fats and percentage of fatty acids (saturates, mono un saturates, poly un saturates) in the diet. An adequate intake of both polyunsaturated and saturated fats is needed for the ideal LDL / HDL ratio in blood, as both contribute to the regulatory balance in lipoprotein metabolism.

Oils high in unsaturated fats may help to lower "bad" LDL cholesterol and may also raise "good" HDL cholesterol, though these effects are still under study.

Peanut, cashew, and other nut-based oils may also present a hazard to persons with a nut allergy. A severe allergic reaction may cause anaphylactic shock and result in death.

2-1 - Trans fats

Unlike other dietary fats, trans fats are not essential, and they do not promote good health . The consumption of trans fats increases one's risk of coronary heart disease by raising levels of "bad" LDL cholesterol and lowering levels of "good" HDL cholesterol. Trans fats from partially hydrogenated oils are more harmful than naturally occurring oils.

Several large studies indicate a link between consumption of high amounts of trans fat and coronary heart disease and possibly some other diseases. The United States Food and Drug Administration (FDA), the National Heart, Lung and Blood Institute and the American Heart Association (AHA) all have recommended limiting the intake of trans fats.

2-2 - Cooking with oil

Heating an oil changes its characteristics. Oils that are healthy at room temperature can become unhealthy when heated above certain temperatures. When choosing a cooking oil, it is important to match the oil's heat tolerance with the cooking method.

A 2001 parallel review of 20 - year dietary fat studies in the United Kingdom, the United States of America, and Spain found that polyunsaturated oils like soya, canola, sunflower, and corn oil degrade easily to toxic compounds when heated. Prolonged consumption of burnt oils led to atherosclerosis, inflammatory joint disease, and development of birth defects. The scientists also questioned global recommendation health authorities' that large amounts of polyunsaturated fats be incorporated into the human diet without accompanying measures to ensure the protection of these fatty acids against heat- and oxidative - degradation.

Palm oil contains more saturated fats than canola oil, corn oil, linseed oil, soybean oil, safflower oil, and sunflower oil. Therefore, palm oil can withstand the high heat of deep frying and is resistant to oxidation compared to highly unsaturated vegetable oils.^[27] Since about 1900, palm oil has been increasingly incorporated into food by the global commercial food industry because it remains stable in deep frying or in baking at very high temperatures and for its high levels of natural antioxidants.

Oils that are suitable for high - temperature frying above 230 $^{\circ}$ C because of their high smoke point

Avocado oil Mustard oil Palm oil Peanut oil (marketed as "groundnut oil" in the UK and India) Rice bran oil Safflower oil Semi refined Sesame oil Semi refined Sunflower Oil

2 – 3 - Storing and keeping oil

Whether refined or not, all oils are sensitive to heat, light, and exposure to oxygen. Rancid oil has an unpleasant aroma and acrid taste, and its nutrient value is greatly diminished.^[citation needed] To delay the development of rancid oil, a blanket of an inert gas, usually nitrogen, is applied to the vapor space in the storage container immediately after production. This is referred to as tank blanketing. Vitamin E oil is a natural antioxidant that can also be added to cooking oils to prevent rancidification.

All oils should be kept in a cool, dry place. Oils may thicken, but they will soon return to liquid if they stand at room temperature. To prevent negative effects of heat and light, oils should be removed from cold storage just long enough for use. Refined oils high in monounsaturated fats keep up to a year (olive oil will keep up to a few years), while those high in polyunsaturated fats keep about six months. Extra-virgin and virgin olive oils keep at least 9 months after opening. Other monounsaturated oils keep well up to eight months, while unrefined polyunsaturated oils will keep only about half as long

In contrast, saturated oils, such as Coco nut oil and palm oil, have much longer shelf lives and can be safely stored at room temperature. Their lack of polyunsaturated content causes them to be more stable.

3 - Types of oils and their characteristics

Lighter, more refined oils tend to have a higher smoke point. Experience using an oil is generally a sufficiently reliable guide. Although outcomes of empirical tests are sensitive to the qualities of particular samples (brand, composition, refinement, process), the data below should be helpful in comparing the properties of different oils.

Smoking oil indicates a risk of combustion, and left unchecked can also set off a fire alarm. When using any cooking oil, should it begin to smoke, *reduce the heat immediately*. The cook should be fully prepared to extinguish a burning oil fire *before* beginning to heat the oil, by having on hand the lid to place on the pan, or (for the worst case) having on hand the proper fire extinguisher.

Type of oil or fat	Saturated	Mono un saturated	Poly un saturated	Smoke point	Uses
Almond	8%	66%	26%	221 °C	Baking, sauces, flavoring
Avocado oil	12 %	74 %	14 %	271 °C	Frying, sautéing, dipping oil, salad oil
Butter	66%	30%	4%	150 °C	Cooking, baking, condiment, sauces, flavoring
Ghee, clarified butter	65 %	32 %	3 %	190 – 250 °C	Deep frying, cooking, sautéing, condiment, flavoring
Canola oil	6 %	62 %	32 %	204 °C	Frying, baking, salad dressings
Coco nut oil, (virgin)	92 %	6 %	2 %	177 °C	Commercial baked goods, candy and sweets, whipped toppings, nondairy coffee creamers, shortening
Rice bran oil	20 %	47 %	33 %		Cooking, frying, deep frying, salads, dressings. Very clean flavoured & palatable.
Corn oil	13 %	25 %	62 %	236 °C	Frying, baking, salad dressings, margarine, shortening
Cottonseed oil	24 %	26 %	50 %	216 °C	Margarine, shortening, salad dressings, commercially fried products
Flaxseed oil (Linseed oil)	11 %	21 %	68%	(107 °C)	Salad dressings, nutritional supplement
Grape seed oil	12 %	17 %	71%	204 °C	Cooking, salad dressings, margarine
Hemp oil	9 %	12 %	79%	165 °C	Cooking, salad dressings
Lard	41 %	47 %	2%	138 – 201 °С	Baking, frying
Margarine, hard	80 %	14 %	6 %	150 °C	Cooking, baking, condiment
Mustard oil	13 %	60 %	21 %	254 °C	Cooking, frying, deep frying, salads, dressings. Very clean flavoured & palatable.
Margarine, soft	20 %	47 %	33 %	150– 160 °C	Cooking, baking, condiment
Macadamia oil	12.5 %	84 %	3.5 %	210 °C	Cooking, frying, deep

frying, salads, dressings. A	ł
slightly nutty odour.	

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	Diacylglycerol (DAG) oil	3.05%	37.95 %	59 %	215 °C	Frying, baking, salad oil
	Olive oil (extra virgin)	14%	73 %	11 %	190 °C	Cooking, salad oils, margarine
	Olive oil (virgin)	14 %	73%	11 %	215 °C	Cooking, salad oils, margarine
	Olive oil (refined)	14 %	73 %	11 %	225 °C	Sautee, stir frying, deep frying, cooking, salad oils, margarine
	Olive oil (extra light)	14%	73%	11%	242 °C	Sautee, stir frying, frying, deep frying, cooking, salad oils, margarine
]	Palm oil	52 %	38 %	10 %	230 °C	Cooking, flavoring, vegetable oil, shortening
ł	Peanut oil / groundnut oil	18 %	49%	33%	231 °C	Frying, cooking, salad oils, margarine
]	Pumpkin seed oil	8 %	36%	57%	121 °C	salad oils
	Safflower oil	10 %	13 %	77 %	265 °C	Cooking, salad dressings, margarine
	Sesame oil (Unrefined)	14 %	43 %	43 %	177 °C	Cooking
	Sesame oil (semi-refined)	14 %	43 %	43 %	232 °C	Cooking, deep frying
	Soybean oil	15%	24%	61%	241 °C	Cooking, salad dressings, vegetable oil, margarine, shortening
	Sunflower oil (linoleic)	11 %	20 %	69%	246 °C	Cooking, salad dressings, margarine, shortening
	Sunflower oil (high oleic)	9 %	82 %	9 %	160 °C	Cooking
,	Tea seed oil [[]	22 %	60 %	18 %	252 °C	Cooking, salad dressings, stir frying, frying, margarine
	Walnut oil (Semi-refined)	9 %	23 %	63 %	204 °C	Salad dressings, added to cold dishes to enhance flavor

Cooking oil	Saturated	Mono - unsaturated	Poly- unsaturated
Canola oil	8	64	28
Corn oil	13	24	59
Olive oil	7	78	15
Sunflower oil	11	78	11
Soybean oil	15	24	58
Peanut oil	11	71	18
Rice bran oil	25	38	37
Coco nut oil	86	13	1
Dairy products			
Cheese, regular	64	29	3
Cheese, light	60	30	0
Milk, whole	62	28	4
Milk , 2 %	62	30	0
Ice cream, gourmet	62	29	4
Ice cream, light	62	29	4
Meats			
Beef	33	38	5
Ground sirloin	38	44	4
Pork chop	35	44	8
Ham	35	49	16
Chicken breast	29	34	21
Chicken	34	23	30
Turkey breast	30	20	30
Turkey drumstick	32	22	30
Fish, orange roughy	23	15	46
Salmon	28	33	28
Hot dog, beef	42	48	5
Hot dog, turkey	28	40	22
Burger, fast food	36	44	6

3 – 1 - Comparison to other types of food

Cheeseburger, fast food	43	40	7
Breaded chicken sandwich	20	39	32
Grilled chicken sandwich	26	42	20
Sausage, Polish	37	46	11
Sausage, turkey	28	40	22
Pizza, sausage	41	32	20
Pizza, cheese	60	28	5
Nuts			
Almonds dry roasted	9	65	21
Cashews dry roasted	20	59	17
Macadamia dry roasted	15	79	2
Peanut dry roasted	14	50	31
Pecans dry roasted	8	62	25
Flaxseeds, ground	8	23	65
Sesame seeds	14	38	44
Soybeans	14	22	57
Sunflower seeds	11	19	66
Walnuts dry roasted	9	23	63
Sweets and baked goods			
Candy, chocolate bar	59	33	3
Candy, fruit chews	14	44	38
Cookie, oatmeal raisin	22	47	27
Cookie, chocolate chip	35	42	18
Cake, yellow	60	25	10
Pastry, Danish	50	31	14
Fats added during cooking	g or at th	e table	
Butter, stick	63	29	3
Butter, whipped	62	29	4
Margarine, stick	18	39	39
Margarine, tub	16	33	49
Margarine, light tub	19	46	33
Lard	39	45	11

Shortening	25	45	26
Chicken fat	30	45	21
Beef fat	41	43	3
Dressing, blue cheese	16	54	25
Dressing, light Italian	14	24	58
Other			
Egg yolk fat	36	44	16
	(1 C	• [43]	

Unless else specified in boxes, then reference is:^[43]

4 - Cooking oil extraction and refinement

Cooking oil extraction and refinement are separate processes. Extraction first removes the oil, typically from a seed, nut or fruit. Refinement then alters the appearance, texture, taste, smell, or stability of the oil to meet buyer expectations.

3-1-Extraction

There are three broad types of oil extraction :

* Chemical solvent extraction, most commonly using hexane.

* Pressing, using an expeller press or cold press (pressing at low temperatures to prevent oil heating).

* Decanter centrifuge.

In large - scale industrial oil extraction you will often see some combination of pressing, chemical extraction and/or centrifuging in order to extract the maximum amount of oil possible .

Cooking oil producers targeting the health food market often use cold press extraction only, as it provides an extraction process free of chemical solvents and high temperatures.

4 – 2 – Refinement

Cooking oil can either be unrefined, or refined using one or more of the following refinement processes (in any combination): Distilling, which heats the oil to evaporate off chemical solvents from the extraction process.

Degumming, by passing hot water through the oil to precipitate out gums and proteins that are soluble in oil but not in water, then discarding the water along with the impurities.

Neutralization, or de acidification, which treats the oil with sodium hydroxide or sodium carbonate to pull out free fatty acids, phospholipids, pigments, and waxes.

Bleaching , which removes "off-colored" components by treatment with fuller's earth, activated carbon, or activated clays, followed by heating, filtering, then drying to recoup the oil.

De waxing, or winterizing, improves clarity of oils intended for refrigeration by dropping them to low temperatures and removing any solids that form.

De odorizing, by treating with high-heat pressurized steam to evaporate less stable compounds that might cause "unusual" odors or tastes.

Preservative addition, such as BHA and BHT to help preserve oils that have been made less stable due to high-temperature processing.

Filtering, a non-chemical process which screens out larger particles, could be considered a step in refinement, although it doesn't alter the state of the oil.

Most large - scale commercial cooking oil refinement will involve all of these steps in order to achieve a product that's uniform in taste, smell and appearance, and has a longer shelf life. Cooking oil intended for the health food market will often be unrefined, which can result in a less stable product but minimizes exposure to high temperatures and chemical processing.

5 - Waste cooking oil

Proper disposal of used cooking oil is an important wastemanagement concern. Oil is lighter than water and tends to spread into thin and broad membranes which hinder the oxygenation of water. Because of this, a single liter of oil can contaminate as much as 1 million liters of water. Also, oil can congeal on pipes provoking blockages.

Because of this, cooking oil should never be dumped in the kitchen sink or in the toilet bowl. The proper way to dispose of oil is to put it in a sealed non - recyclable container and discard it with regular garbage. Placing the container of oil in the refrigerator to harden also makes disposal easier and less messy.

Cooking oil can be recycled. It can be used to produce soap and biodiesel. \cal{l}

6 - Notes

* The smoke point of an oil depends primarily on its free fatty acid content (FFA) and molecular weight. Through repeated use, as in a deep fryer, the oil accumulates food residues or by-products of the cooking process, that lower its smoke point further. The values shown in the table must therefore be taken as approximate, and are not suitable for accurate or scientific use.

* The smoke point of margarine varies depending on the types of oils used in its formulation, but can be generally assumed to be similar to that of butter .

Copaiba



Copaifera langsdorfii in a park in São Paulo Brazil.

1 - Introduction

Copaiba is a stimulant oleoresin obtained from the trunk of several pinnate - leaved South American leguminous trees (genus *Copaifera*). The thick, transparent exudate varies in color from light gold to dark brown, depending on the ratio of resin to essential oil. Copaiba is used in making varnishes and lacquers.

The hydrocarbons in copaiba are terpenes, which are made by plants from isoprene, a "five – carbon - atom building block, so they always contain carbon atoms in multiples of five. Pinene is one of several useful 10 - carbon terpenes . It is commonly known as turpentine. Heated up, terpenes break down into methanol (CH₃OH) and other simple compounds useful for fuel and as raw materials in the chemical industry."

Copaiba is also a common name for several species of trees of the legume family native to Tropical Africa and North and South America.

2 - Uses

Copaiba is particularly interesting as a source of biodiesel, because of the high yield of 12,000 liters per ha. The resin is tapped from standing trees, with an individual tree yielding 40 liters per year.

Medicinally, copaiba has been used to treat stomach cancer and ulcers. It has demonstrated antifungal properties, among a wide variety of ascribed medicinal properties.^[4] In the Amazon river basin, the resin is widely used to alleviate itching from insect bites and to promote their more rapid healing.

Copaiba is also used as an artist material, especially in oil paint recipes and in ceramic decoration. Mineral painters use a medium made of copaiba, turpentine and lavender to mix with their minerals for adhesion to ceramic vessels before kiln firing. Copaiba makes a good medium for oils and helps with both adhesion and quality of shine.

Copha

Copha, a registered trademark of Peerless, is a form of vegetable fat shortening made from hydrogenated Coco nut oil. It is 100 % fat, at least 98 % of which is saturated. It also contains soybean lecithin. It is popular in Australia where it is used in many foods for children, such as rocky road, and chocolate crackles, which are made from Rice Bubbles, copha and cocoa powder.

Copha is produced only in Australia, but there are many suppliers of hydrogenated Coco nut fat in various forms worldwide. It is a necessary ingredient in traditional Australian sweets such as chocolate crackles and white Christmas, and a "chocolate coating" on baked goods that amounts to a rather waxy form of compound chocolate. A dramatic decline in the price of chocolate over the decades is likely to be a significant contribution to the declining popularity of Copha-based confectionery.

In New Zealand, it is marketed as *Kremelta*. Known in Europe as Coco nut fat, it is available either in its pure form, or in solid form with lecithin added as an emulsifier. In France it is marketed as *Végétaline* and in Germany it is marketed as *Palmin*. In the United States it is not easily available.

Copha is further an EU registered trademark for the Danish watch company Copha. Copha produce watches for the urban lifestyle and is based in Copenhagen. The Copha name is an abbreviation of Copenhagen.

Corn Oil

Contents

1 Introduction

2 Production

3 Constituents and comparison

4 Effects on health

1 - Introduction

Corn oil (maize oil) is oil extracted from the germ of corn (maize). Its main use is in cooking, where its high smoke point makes refined corn oil a valuable frying oil. It is also a key ingredient in some margarines. Corn oil is generally less expensive than most other types of vegetable oils. One bushel of corn contains 1.55 pounds of corn oil (2.8% by weight). Corn agronomists have developed high-oil varieties; however, these varieties tend to show lower field yields, so they are not universally accepted by growers.

Corn oil is also a feedstock used for biodiesel. Other industrial uses for corn oil include soap, salve, paint, rustproofing for metal surfaces, inks, textiles, nitroglycerin, and insecticides. It is sometimes used as a carrier for drug molecules in pharmaceutical preparations.

2 - Production

Almost all corn oil is expeller pressed, then solvent extracted using hexane or 2-methylpentane (isohexane). The solvent is evaporated from the corn oil, recovered, and re-used. After extraction, the corn oil is then refined by degumming and/or alkali treatment, both of which remove phosphatides. Alkali treatment also neutralizes free fatty acids and removes color (bleaching). Final steps in refining include winterization (the removal of waxes), and deodorization by steam distillation of the oil at 232–260 °C under a high vacuum.

Some specialty oil producers manufacture unrefined, 100% expeller pressed corn oil. This is a more expensive product since it has a much lower yield than the combination expeller and solvent process, as well as smaller market share.

					V	egeta	ble o	oils					
			Mana			lyuns	atura	ted fatty	Olaia				
Ivne		urated y acids Mono- unsaturated fatty acids		d	Total poly		linolenic acid (ω-3)		Linoleic acid (ω-6)	Oleic acid (ω-9)	Smoke point		
Not hy	drog	enated											
Coco r	nut	91.00	6.000		3.0	00	-		2	6	177 °C		
Corn		12.948	27.576		54.	677	1		58	28	(232 °C		
Cotton seed		25.900	17.800		51.	900	1		54	19	(216 °C		
Flax s Linseec	seed/ 1	6 - 9	10 - 22		68	- 89	56 -	71	12 - 18	10 - 22	107 °C		
Olive		14.00	72.00		14.	00	-		-	-	193 °C		
Palm		49.300	37.000		9.3	00	-		10	40	235 °C		
Peanut		16.900	46.200		32.	000	-		32	48	225 °C		
Safflow (>70% linoleic		8.00	15.00	.00		75.00			-	-	(210 °C		
Safflow (high o		7.541	75.221	75.221		12.820			-	-	(210 °C		
Soy bea	an	15.650	22.783		57.740		7		54	24	(238 °C		
Sun flo (<60% linoleic		10.100	45.400		40.100		40.100		0.20	00	39.800	45.300	(227 °C
Sunflov (>70% oleic)	wer	9.859	83.689		3.798		_		-	-	(227 °C		
Fully h	ydro	genated	l										
Cottons	(hydrog.) 93.600	1.52	.587		,		.287 ^[2]					
Palm (hydrogenated) 47.500 40.					00	7.50	0						
Soybea	n (hy	drogen.)) 21.100	73.7	00	.400		.096 ^[2]					
Values as percent (%) by weight of total fat.													

3 - Constituents and comparison

Of the saturated fatty acids, 80 % are palmitic acid (lipid number of C16:0), 14% stearic acid (C18 : 0), and 3 % arachidic acid (C20:0).

Over 99 % of the monounsaturated fatty acids are oleic acid (C18:1 c) $\,$

98 % of the polyunsaturated fatty acids are the omega - 6linoleic acid (C18:2 n-6 c,c) with the 2 % remainder being the omega - 3 alpha - linolenic acid (C18:3 n-3 c,c,c).

4 - Effects on health

Some medical research suggests that excessive levels of omega-6 fatty acids, relative to omega-3 fatty acids, may increase the probability of a number of diseases and depression.^{[8][9][10]} Modern Western diets typically have ratios of omega-6 to omega-3 in excess of 10 to 1, some as high as 30 to 1, partly due to corn oil which has an omega-6 to omega-3 ratio of 49:1. The optimal ratio is thought to be 4 to 1 or lower.

A high intake of omega-6 fatty acids may increase the likelihood that postmenopausal women will develop breast cancer.^[13] Similar effects were observed on prostate cancer. Other analysis suggested an inverse association between total polyunsaturated fatty acids and breast cancer risk.

Cottolene

Cottolene was a brand of shortening made of beef tallow and cotton seed oil produced in the USA from 1868 until the mid 20th century. It was the first mass - produced and mass-marketed alternative to lard and is remembered today chiefly for its iconic national ad campaign and the cookbooks that were written to promote its use.



Ad for Cotteline, 1915.

According to Dr. Alice Ross, writing in the Journal of Antiques and Collectibles, Cottolene emerged as an offshoot of two industries. Cotton seeds were a waste product of the cotton industry, and beef tallow was a waste product of the meat-processing industry. The N. K. Fairbank Corporation of Chicago seized on this glut and created a product catering to late-19th-century America's growing infatuation with labor-saving packaged foods for the "dainty" (lard-free) diet.

It was comparable to and a competitor of Procter & Gamble's Crisco, which was packaged similarly and marketed with accompanying cookbooks. Crisco was composed entirely of cottonseed oil.

Cottolene is no longer produced. Additionally, a September 2007 search of the U.S. Patent and Trademark Office reveals that it is no longer a protected trademark.

Cottolene remains in the public consciousness thanks to the lasting impact of its advertising campaign and the accompanying cookbooks it produced. A September 2007 search of the auction website ebay reveals 29 separate Cottolene advertisements and tins for sale. Scholarly analysis of Cottolene advertisements appears in the book *Racial Innocence: Performing American Childhood from Slavery to Civil Rights.*^[4] At least one Cottolene cookbook, "Fifty-Two Sunday Dinners" by Elizabeth O. Hiller, was reprinted in its entirety in 1981, with all references to Cottolene intact, both in the opening endorsements and the following recipes.

Cotton

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1 - Introduction

Cotton is a soft, fluffy staple fiber that grows in a boll, or protective capsule, around the seeds of cotton plants of the genus *Gossypium*. The fiber is almost pure cellulose. Under natural condition, the cotton balls will tend to increase the dispersion of the seeds.

The plant is a shrub native to tropical and subtropical regions around the world, including the Americas, Africa, and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton was independently domesticated in the Old and New Worlds. The English name derives from the Arabic (*al*) *qutn* فَطْن , which began to be used circa 1400 CE. The Spanish word, "algodón", is likewise derived from the Arabic. The fiber is most often spun into yarn or thread and used to make a soft, breathable textile. The use of cotton for fabric is known to date to prehistoric times; fragments of cotton fabric dated from 5000 BCE have been excavated in Mexico and the Indus Valley Civilization (modern day Pakistan). Although cultivated since antiquity, it was the invention of the cotton gin that so lowered the cost of production that led to its widespread use, and it is the most widely used natural fiber cloth in clothing today.

Current estimates for world production are about 25 million tonnes annually, accounting for 2.5 % of the world's arable land. China is the world's largest producer of cotton, but most of this is used domestically. The United States has been the largest exporter for many years.

2 - Types of cotton

There are four commercially grown species of cotton, all domesticated in antiquity:

Gossypium hirsutum – upland cotton, native to Central America, Mexico, the Caribbean and southern Florida, (90 % of world production)

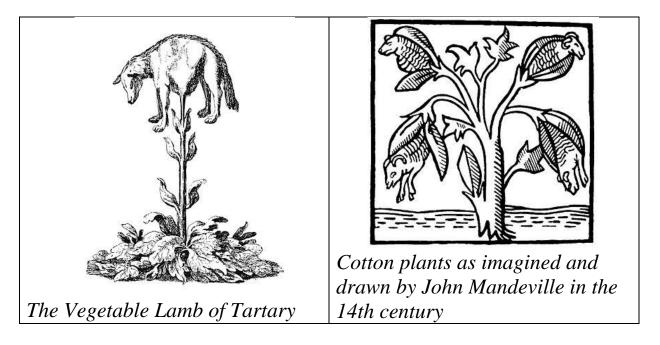
Gossypium barbadense – known as extra-long staple cotton, native to tropical South America (8% of world production)

Gossypium arboreum – tree cotton, native to India and Pakistan (less than 2 %)

Gossypium herbaceum – Levant cotton, native to southern Africa and the Arabian Peninsula (less than 2 %)

The two New World cotton species account for the vast majority of modern cotton production, but the two Old World species were widely used before the 1900s. While cotton fibers occur naturally in colors of white, brown, pink and green, fears of contaminating the genetics of white cotton have led many cotton-growing locations to ban the growing of colored cotton varieties, which remain a specialty product.

3 – History



Cotton was first cultivated in the Old World 7,000 years ago (5th millennium BCE), by the inhabitants of Indus Valley civilization. Evidence of cotton cultivation has been found at the site of Mehrgarh, where early cotton threads have been preserved in copper beads.^[4] Cotton cultivation became more widespread during the Indus Valley Civilization, which covered a huge swath of the northwestern part of the South Asia, comprising today parts of eastern Pakistan and northwestern India . The Indus cotton industry was well developed and some methods used in cotton spinning and fabrication continued to be used until the modern industrialization of India.^[6] Between 2000 and 1000 BCE cotton became widespread in much of India.^[7] For example, it has been found at the site of Hallus in Karnataka around 1000 BCE. The use of cotton textiles had spread from India to the Mediterranean and beyond.

Cotton fabrics discovered in a cave near Tehuacán, Mexico have been dated to around 5800 BCE, although it is difficult to know for certain due to fiber decay. Other sources date the domestication of cotton in Mexico to approximately 5000 to 3000 BCE.

The Greeks and the Arabs were not familiar with cotton until the Wars of Alexander the Great, as his contemporary Megasthenes told Seleucus I Nicator of "there being trees on which wool grows" in "Indica".

According to the Columbia Encyclopedia :

Cotton has been spun, woven, and dyed since prehistoric times. It clothed the people of ancient India, Egypt, and China. Hundreds of years before the Christian era, cotton textiles were woven in India with matchless skill, and their use spread to the Mediterranean countries.

In Iran (Persia), the history of cotton dates back to the Achaemenid era (5th century BCE); however, there are few sources about the planting of cotton in pre-Islamic Iran. The planting of cotton was common in Merv, Ray and Pars of Iran. In the poems of Persian poets, especially Ferdowsi's Shahname, there are references to cotton ("panbe" in Persian). Marco Polo (13th century) refers to the major products of Persia, including cotton. John Chardin, a French traveler of 17th century, who had visited the Safavid Persia, has approved the vast cotton farms of Persia.

During the Han dynasty, cotton was grown by non Chinese peoples in the southern Chinese province of Yunnan.

In Peru, cultivation of the indigenous cotton species *Gossypium barbadense* was the backbone of the development of coastal cultures, such as the Norte Chico, Moche and Nazca. Cotton was grown upriver, made into nets and traded with fishing villages along the coast for large supplies of fish. The Spanish who came to Mexico and Peru in the early 16th century found the people growing cotton and wearing clothing made of it.

During the late medieval period, cotton became known as an imported fiber in northern Europe, without any knowledge of how it was derived, other than that it was a plant; noting its similarities to wool, people in the region could only imagine that cotton must be produced by plant-borne sheep. John Mandeville, writing in 1350, stated as fact the now-preposterous belief: "There grew there [India] a wonderful tree which bore tiny lambs on the endes of its branches.

These branches were so pliable that they bent down to allow the lambs to feed when they are hungrie ." (See Vegetable Lamb of Tartary.) This aspect is retained in the name for cotton in many European languages, such as German *Baumwolle*, which translates as "tree wool" (*Baum* means "tree"; *Wolle* means "wool"). By the end of the 16th century, cotton was cultivated throughout the warmer regions in Asia and the Americas.

India's cotton - processing sector gradually declined during British expansion in India and the establishment of colonial rule during the late 18th and early 19th centuries. This was largely due to aggressive colonialist mercantile policies of the British East India Company, which made cotton processing and manufacturing workshops in India uncompetitive. Indian markets were increasingly forced to supply only raw cotton and were forced, by British-imposed law, to purchase manufactured textiles from Britain.

3 – 1 - Industrial Revolution in Britain

The advent of the Industrial Revolution in Britain provided a great boost to cotton manufacture, as textiles emerged as Britain's leading export. In 1738, Lewis Paul and John Wyatt, of Birmingham, England, patented the roller spinning machine, and the flyer-andbobbin system for drawing cotton to a more even thickness using two sets of rollers that traveled at different speeds. Later, the invention of the spinning jenny in 1764 and Richard Arkwright's spinning frame (based on the roller spinning machine) in 1769 enabled British weavers to produce cotton yarn and cloth at much higher rates. From the late 18th century onwards, the British city of Manchester acquired "Cottonopolis" due to the cotton industry's nickname the omnipresence within the city, and Manchester's role as the heart of the global cotton trade. Production capacity in Britain and the United States was improved by the invention of the cotton gin by the American Eli Whitney in 1793. Before the development of cotton gins, the cotton fibers had to be pulled from the seeds tediously by hand. By the late 1700s a number of crude ginning machines had been developed, however, to produce a bale of cotton required over 600 hours of human labor, making large scale production uneconomical in the United States, even with the use of humans as slave labor. The

gin that Whitney manufactured (the Holmes design) reduced the hours down to just a dozen or so per bale. Although Whitney patented his own design for a cotton gin, he manufactured a prior design from Henry Odgen Holmes, for which Holmes filed a patent in 1796.^[13] Improving technology and increasing control of world markets allowed British traders to develop a commercial chain in which raw cotton fibers were (at first) purchased from colonial plantations, processed into cotton cloth in the mills of Lancashire, and then exported on British ships to captive colonial markets in West Africa, India, and China (via Shanghai and Hong Kong).

By the 1840s, India was no longer capable of supplying the vast quantities of cotton fibers needed by mechanized British factories, while shipping bulky, low-price cotton from India to Britain was timeconsuming and expensive. This, coupled with the emergence of American cotton as a superior type (due to the longer, stronger fibers of the two domesticated native American species, *Gossypium hirsutum* and *Gossypium barbadense*), encouraged British traders to purchase cotton from plantations in the United States and the Caribbean. By the mid-19th century, "King Cotton" had become the backbone of the southern American economy. In the United States, cultivating and harvesting cotton became the leading occupation of slaves.

During the American Civil War, American cotton exports slumped due to a Union blockade on Southern ports, also because of a strategic decision by the Confederate government to cut exports, hoping to force Britain to recognize the Confederacy or enter the war, prompting the main purchasers of cotton, Britain and France to turn to Egyptian cotton. British and French traders invested heavily in cotton plantations and the Egyptian government of Viceroy Isma'il took out substantial loans from European bankers and stock exchanges. After the American Civil War ended in 1865, British and French traders abandoned Egyptian cotton and returned to cheap American exports, sending Egypt into a deficit spiral that led to the country declaring bankruptcy in 1876, a key factor behind Egypt's occupation by the British Empire in 1882.



Prisoners farming cotton under the trusty system in Parchman Farm, Mississippi, 1911

During this time, cotton cultivation in the British Empire, especially India, greatly increased to replace the lost production of the American South. Through tariffs and other restrictions, the British government discouraged the production of cotton cloth in India; rather, the raw fiber was sent to England for processing. The Indian Mahatma Gandhi described the process:

English people buy Indian cotton in the field, picked by Indian labor at seven cents a day, through an optional monopoly.

This cotton is shipped on British ships, a three-week journey across the Indian Ocean, down the Red Sea, across the Mediterranean, through Gibraltar, across the Bay of Biscay and the Atlantic Ocean to London. One hundred per cent profit on this freight is regarded as small.

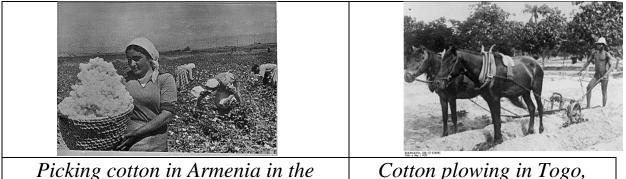
The cotton is turned into cloth in Lancashire. You pay shilling wages instead of Indian pennies to your workers. The English worker not only has the advantage of better wages, but the steel companies of England get the profit of building the factories and machines. Wages; profits; all these are spent in England.

The finished product is sent back to India at European shipping rates, once again on British ships. The captains, officers, sailors of these ships, whose wages must be paid, are English. The only Indians who profit are a few lascars who do the dirty work on the boats for a few cents a day. The cloth is finally sold back to the kings and landlords of India who got the money to buy this expensive cloth out of the poor peasants of India who worked at seven cents a day.

In the United States, Southern cotton provided capital for the continuing development of the North. The cotton produced by enslaved African Americans not only helped the South, but also enriched Northern merchants. Much of the Southern cotton was transshipped through the northern ports.

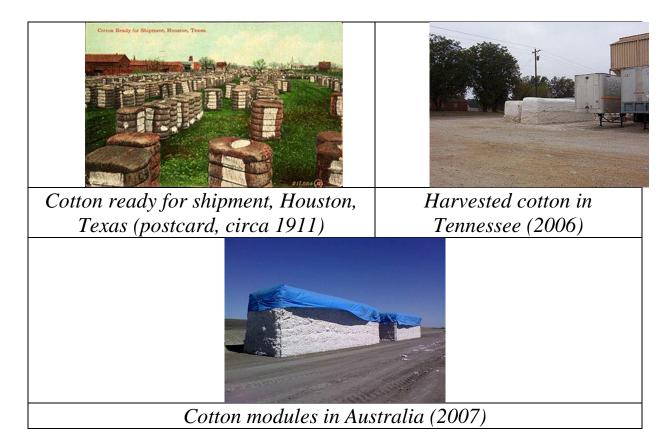
Cotton remained a key crop in the Southern economy after emancipation and the end of the Civil War in 1865. Across the South, sharecropping evolved, in which free black farmers and landless white farmers worked on white - owned cotton plantations of the wealthy in return for a share of the profits. Cotton plantations required vast labor forces to hand-pick cotton, and it was not until the 1950s that reliable harvesting machinery was introduced into the South (prior to this, cotton-harvesting machinery had been too clumsy to pick cotton without shredding the fibers). During the early 20th century, employment in the cotton industry fell, as machines began to replace laborers, and the South's rural labor force dwindled during the First and Second World Wars. Today, cotton remains a major export of the southern United States, and a majority of the world's annual cotton crop is of the long-staple American variety.

4 – Cultivation



1928

Picking cotton in Armenia in the 1930s. No cotton is grown there today.



Successful cultivation of cotton requires a long frost-free period, plenty of sunshine, and a moderate rainfall, usually from 600 to 1200 mm (24 to 48 inches). Soils usually need to be fairly heavy, although the level of nutrients does not need to be exceptional. In general, these conditions are met within the seasonally dry tropics and subtropics in the Northern and Southern hemispheres, but a large proportion of the cotton grown today is cultivated in areas with less rainfall that obtain the water from irrigation. Production of the crop for a given year usually starts soon after harvesting the preceding autumn. Planting time in spring in the Northern hemisphere varies from the beginning of February to the beginning of June. The area of the United States known as the South Plains is the largest contiguous cotton-growing region in the world. While dryland (non-irrigated) cotton is successfully grown in this region, consistent yields are only produced with heavy reliance on irrigation water drawn from the Ogallala Aquifer. Since cotton is some what salt and drought tolerant, this makes it an attractive crop for arid and semiarid regions. As water resources get tighter around the world, economies that rely on it face difficulties and conflict, as well as potential environmental problems . For example, improper cropping and irrigation practices have led to

desertification in areas of Uzbekistan, where cotton is a major export. In the days of the Soviet Union, the Aral Sea was tapped for agricultural irrigation, largely of cotton, and now salination is widespread.

Cotton can also be cultivated to have colors other than the yellowish off-white typical of modern commercial cotton fibers. Naturally colored cotton can come in red, green, and several shades of brown.

4 – 1 - Genetic modification

Genetically modified (GM) cotton was developed to reduce the heavy reliance on pesticides. The bacterium *Bacillus thuringiensis* (Bt) naturally produces a chemical harmful only to a small fraction of insects, most notably the larvae of moths and butterflies, beetles, and flies, and harmless to other forms of life. The gene coding for Bt toxin has been inserted into cotton, causing cotton to produce this natural insecticide in its tissues. In many regions, the main pests in commercial cotton are lepidopteran larvae, which are killed by the Bt protein in the transgenic cotton they eat. This eliminates the need to use large amounts of broad-spectrum insecticides to kill lepidopteran pests (some of which have developed pyrethroid resistance). This spares natural insect predators in the farm ecology and further contributes to non insecticide pest management.

Bt cotton is ineffective against many cotton pests, however, such as plant bugs, stink bugs, and aphids; depending on circumstances it may still be desirable to use insecticides against these. A 2006 study done by Cornell researchers, the Center for Chinese Agricultural Policy and the Chinese Academy of Science on Bt cotton farming in China found that after seven years these secondary pests that were normally controlled by pesticide had increased, necessitating the use of pesticides at similar levels to non-Bt cotton and causing less profit for farmers because of the extra expense of GM seeds.^[21] However, a 2009 study by the Chinese Academy of Sciences, Stanford University and Rutgers University refuted this . They concluded that the GM cotton effectively controlled bollworm. The secondary pests were mostly miridae (plant bugs) whose increase was related to local temperature and rainfall and only continued to increase in half the villages studied. Moreover, the increase in insecticide use for the control of these secondary insects was far smaller than the reduction in total insecticide use due to Bt cotton adoption. A 2012 Chinese study concluded that Bt cotton halved the use of pesticides and doubled the level of ladybirds, lacewings and spiders . The International Service for the Acquisition of Agri-biotech Applications (ISAAA) said that, worldwide, GM cotton was planted on an area of 25 million hectares in 2011. This was 69% of the worldwide total area planted in cotton.

GM cotton acreage in India grew at a rapid rate, increasing from 50,000 hectares in 2002 to 10.6 million hectares in 2011. The total cotton area in India was 12.1 million hectares in 2011, so GM cotton was grown on 88 % of the cotton area. This made India the country with the largest area of GM cotton in the world. A long - term study on the economic impacts of Bt cotton in India, published in the Journal PNAS in 2012, showed that Bt cotton has increased yields, profits, and living standards of smallholder farmers.^[26] The U.S. GM cotton crop was 4.0 million hectares in 2011 the second largest area in the world, the Chinese GM cotton crop was third largest by area with 3.9 million hectares and Pakistan had the fourth largest GM cotton crop area of 2.6 million hectares in 2011. The initial introduction of GM cotton proved to be a success in Australia - the yields were equivalent to the non transgenic varieties and the crop used much less pesticide to produce (85 % reduction). The subsequent introduction of a second variety of GM cotton led to increases in GM cotton production until 95 % of the Australian cotton crop was GM in 2009^[28] making Australia the country with the fifth largest GM cotton crop in the world. Other GM cotton growing countries in 2011 were Argentina, Myanmar, Burkina Faso, Brazil, Mexico, Colombia, South Africa and Costa Rica.

Cotton has been genetically modified for resistance to glyphosate (marketed as Roundup in North America) a broad-spectrum herbicide sold by Monsanto which also sells some of the Bt cotton seeds to farmers. There are also a number of other cotton seed companies selling GE cotton around the world. About 62 % of the

GM cotton grown from 1996 to 2011 was insect resistant, 24 % stacked product and 14 % herbicide resistant.

Cotton has gossypol, a toxin that makes it inedible. However, scientists have silenced the gene that produces the toxin, making it a potential food crop.

4 - 2 - Organic production

Organic cotton is generally understood as cotton, from plants not genetically modified, that is certified to be grown without the use of any synthetic agricultural chemicals, such as fertilizers or pesticides. Its production also promotes and enhances biodiversity and biological cycles. United States cotton plantations are required to enforce the National Organic Program (NOP). This institution determines the allowed practices for pest control, growing, fertilizing, and handling of organic crops . As of 2007, 265,517 bales of organic cotton were produced in 24 countries, and worldwide production was growing at a rate of more than 50 % per year.

4 - 3 - Pests and weeds

The cotton industry relies heavily on chemicals, such as herbicides, fertilizers and insecticides, although a very small number of farmers are moving toward an organic model of production, and organic cotton products are now available for purchase at limited locations. These are popular for baby clothes and diapers. Under most definitions, organic products do not use genetic engineering. All natural cotton products are known to be both sustainable and hypoallergenic.

Historically, in North America, one of the most economically destructive pests in cotton production has been the boll weevil. Due to the US Department of Agriculture's highly successful Boll Weevil Eradication Program (BWEP), this pest has been eliminated from cotton in most of the United States. This program, along with the introduction of genetically engineered Bt cotton (which contains a bacterial gene that codes for a plant-produced protein that is toxic to a number of pests such as cotton bollworm and pink bollworm), has allowed a reduction in the use of synthetic insecticides. Other significant global pests of cotton include the pink bollworm, *Pectinophora gossypiella*; the chili thrips, *Scirtothrips dorsalis*; the cotton seed bug, *Oxycarenus hyalinipennis*; the tarnish plant bug, *Lygus lineolaris*; and the fall armyworm, *Spodoptera frugiperda*, *Xanthomonas citri subsp. malvacearum*.

5 – Harvesting

Most cotton in the United States, Europe, and Australia is harvested mechanically, either by a cotton picker, a machine that removes the cotton from the boll without damaging the cotton plant, or by a cotton stripper, which strips the entire boll off the plant. Cotton strippers are used in regions where it is too windy to grow picker varieties of cotton, and usually after application of a chemical defoliant or the natural defoliation that occurs after a freeze. Cotton is a perennial crop in the tropics, and without defoliation or freezing, the plant will continue to grow.

Cotton continues to be picked by hand in developing countries.

6 - Competition from synthetic fibers

The era of manufactured fibers began with the development of rayon in France in the 1890s. Rayon is derived from a natural cellulose and cannot be considered synthetic, but requires extensive processing in a manufacturing process, and led the less expensive replacement of more naturally derived materials. A succession of new synthetic fibers were introduced by the chemicals industry in the following decades. Acetate in fiber form was developed in 1924. Nylon, the first fiber synthesized entirely from petrochemicals, was introduced as a sewing thread by DuPont in 1936, followed by DuPont's acrylic in 1944. Some garments were created from fabrics based on these fibers, such as women's hosiery from nylon, but it was not until the introduction of polyester into the fiber marketplace in the early 1950s that the market for cotton came under threat.^[37] The rapid uptake of polyester garments in the 1960s caused economic hardship in cotton - exporting economies, especially in Central American countries, such as Nicaragua, where cotton production had boomed tenfold between 1950 and 1965 with the advent of cheap chemical

pesticides. Cotton production recovered in the 1970s, but crashed to pre-1960 levels in the early 1990s.

Beginning as a self-help program in the mid-1960s, the Cotton Research and Promotion Program (CRPP) was organized by U.S. cotton producers in response to cotton's steady decline in market share. At that time, producers voted to set up a per-bale assessment system to fund the program, with built-in safeguards to protect their investments. With the passage of the Cotton Research and Promotion Act of 1966, the program joined forces and began battling synthetic competitors and re-establishing markets for cotton. Today, the success of this program has made cotton the best-selling fiber in the U.S. and one of the best-selling fibers in the world.

Administered by the Cotton Board and conducted by Cotton Incorporated, the CRPP works to greatly increase the demand for and profitability of cotton through various research and promotion activities. It is funded by U.S. cotton producers and importers.

7 - Uses

Cotton is used to make a number of textile products. These include terrycloth for highly absorbent bath towels and robes; denim for blue jeans; cambric, popularly used in the manufacture of blue work shirts (from which we get the term "blue-collar"); and corduroy, seersucker, and cotton twill. Socks, underwear, and most T-shirts are made from cotton. Bed sheets often are made from cotton. Cotton also is used to make yarn used in crochet and knitting. Fabric also can be made from recycled or recovered cotton that otherwise would be thrown away during the spinning, weaving, or cutting process. While many fabrics are made completely of cotton, some materials blend cotton with other fibers, including rayon and synthetic fibers such as polyester. It can either be used in knitted or woven fabrics, as it can be blended with elastine to make a stretchier thread for knitted fabrics, and apparel such as stretch jeans.

In addition to the textile industry, cotton is used in fishing nets, coffee filters, tents, explosives manufacture (see nitrocellulose), cotton

paper, and in bookbinding. The first Chinese paper was made of cotton fiber. Fire hoses were once made of cotton.

The cottonseed which remains after the cotton is ginned is used to produce cottonseed oil, which, after refining, can be consumed by humans like any other vegetable oil. The cottonseed meal that is left generally is fed to ruminant livestock; the gossypol remaining in the meal is toxic to mono gastric animals. Cottonseed hulls can be added to dairy cattle rations for roughage. During the American slavery period, cotton root bark was used in folk remedies as an abortifacient, that is, to induce a miscarriage.

Cotton linters are fine, silky fibers which adhere to the seeds of the cotton plant after ginning. These curly fibers typically are less than 1/8 in (3 mm) long. The term also may apply to the longer textile fiber staple lint as well as the shorter fuzzy fibers from some upland species. Linters are traditionally used in the manufacture of paper and as a raw material in the manufacture of cellulose. In the UK, linters are referred to as "cotton wool". This can also be a refined product (*absorbent cotton* in U.S. usage) which has medical, cosmetic and many other practical uses. The first medical use of cotton wool was by Dr. Joseph Sampson Gamgee at the Queen's Hospital (later the General Hospital) in Birmingham, England.

Shiny cotton is a processed version of the fiber that can be made into cloth resembling satin for shirts and suits. However, it is hydrophobic (does not absorb water easily), which makes it unfit for use in bath and dish towels (although examples of these made from shiny cotton are seen).

The name Egyptian cotton is broadly associated with quality products, however only a small percentage of Egyptian cotton production is actually of superior quality. Most products bearing the name are not made with the finest cottons from Egypt.

8 - International trade

The largest producers of cotton, currently (2009), are China and India, with annual production of about 34 million bales and 27 million

bales, respectively; most of this production is consumed by their respective textile industries. The largest exporters of raw cotton are the United States, with sales of \$ 4.9 billion, and Africa, with sales of \$2.1 billion. The total international trade is estimated to be \$12 billion. Africa's share of the cotton trade has doubled since 1980. Neither area has a significant domestic textile industry, textile manufacturing having moved to developing nations in Eastern and South Asia such as India and China. In Africa, cotton is grown by numerous small holders. Dunavant Enterprises, based in Memphis, Tennessee, is the leading cotton broker in Africa, with hundreds of purchasing agents. It operates cotton gins in Uganda, Mozambique, and Zambia. In Zambia, it often offers loans for seed and expenses to the 180,000 small farmers who grow cotton for it, as well as advice on farming methods. Cargill also purchases cotton in Africa for export.

The 25,000 cotton growers in the United States of America are heavily subsidized at the rate of \$2 billion per year. The future of these subsidies is uncertain and has led to anticipatory expansion of cotton brokers' operations in Africa. Dunavant expanded in Africa by buying out local operations. This is only possible in former British colonies and Mozambique; former French colonies continue to maintain tight monopolies, inherited from their former colonialist masters, on cotton purchases at low fixed prices.

8-1 - Leading producer countries

Top ten cotton producers —2011
(480 - pound bales)

33.0 million bales
27.0 million bales
18.0 million bales
10.3 million bales
9.3 million bales
4.6 million bales
4.2 million bales
2.8 million bales

293

Turkmenistan	1.6 million bales
Greece	1.4 million bales

The five leading exporters of cotton in 2011 are (1) the United States, (2) India, (3) Brazil, (4) Australia, and (5) Uzbekistan. The largest nonproducing importers are Korea, Taiwan, Russia, Hong Kong, and Japan.

In India, the states of Maharashtra (26.63 %), Gujarat (17.96 %) and Andhra Pradesh (13.75%) and also Madhya Pradesh are the leading cotton producing states,^[43] these states have a predominantly tropical wet and dry climate.

In Pakistan, cotton is grown predominantly in the provinces of Punjab, and Sindh. The leading area of cotton production is the south Punjab, comprising the areas around Rahim Yar Khan, Bahawalpur, Bahawalnagar, Multan, Dera Ghazi Khan, Muzaffargarh, Vehari, and Khanewal. In Sindh Sanghar is the most important cotton producing district. Faisalabad is a leader in textiles within Pakistan. Punjab has a tropical wet and dry climate throughout the year therefore enhancing the growth of cotton.

In the United States, the state of Texas led in total production as of 2004, while the state of California had the highest yield per acre.

8 - 2 - Fair trade

Cotton is an enormously important commodity throughout the world. However, many farmers in developing countries receive a low price for their produce, or find it difficult to compete with developed countries.

This has led to an international dispute (see United States – Brazil cotton dispute):

On 27 September 2002, Brazil requested consultations with the US regarding prohibited and actionable subsidies provided to US producers, users and/or exporters of upland cotton, as well as

legislation, regulations, statutory instruments and amendments thereto providing such subsidies (including export credits), grants, and any other assistance to the US producers, users and exporters of upland cotton.^[46] On 8 September 2004, the Panel Report recommended that the United States "withdraw" export credit guarantees and payments to domestic users and exporters, and "take appropriate steps to remove the adverse effects or withdraw" the mandatory price-contingent subsidy measures.

While Brazil was fitting the US through the WTO's Dispute Settlement Mechanism against a heavily subsidized cotton industry, a group of four least-developed African countries — Benin, Burkina Faso, Chad, and Mali — also known as "Cotton - 4" have been the leading protagonist for the reduction of US cotton subsidies through negotiations. The four introduced a "Sectoral Initiative in Favour of Cotton", presented by Burkina Faso's President Blaise Compaoré during the Trade Negotiations Committee on 10 June 2003.

In addition to concerns over subsidies, the cotton industries of some countries are criticized for employing child labor and damaging workers' health by exposure to pesticides used in production. The Environmental Justice Foundation has campaigned against the prevalent use of forced child and adult labor in cotton production in Uzbekistan, the world's third largest cotton exporter.^[49] The international production and trade situation has led to "fair trade" cotton clothing and footwear, joining a rapidly growing market for organic clothing, fair fashion or "ethical fashion". The fair trade system was initiated in 2005 with producers from Cameroon, Mali and Senegal.

8 - 3 - Trade

Cotton is bought and sold by investors and price speculators as a tradable commodity on 2 different stock exchanges in the United States of America .

Cotton futures contracts are traded on the New York Mercantile Exchange (NYMEX) under the ticker symbol TT. They are delivered every year in March, May, July, October, and December. Cotton #2 futures contracts are traded on the New York Board of Trade (NYBOT) under the ticker symbol CT. They are delivered every year in March, May, July, October, and December.

9 - Critical temperatures

Favorable travel temperature range: below 25 °C Optimum travel temperature: 21 °C Glow temperature: 205 °C Fire point: 210 °C Auto ignition temperature: 407 °C Auto ignition temperature (for oily cotton): 120 °C

A temperature range of 25 °C to 35 °C is the optimal range for mold development. At temperatures below 0 °C (32 °F), rotting of wet cotton stops. Damaged cotton is sometimes stored at these temperatures to prevent further deterioration.

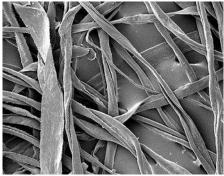
10 - British standard yarn measures

- 1 thread = 55 inches (about 137 cm)
- 1 skein or rap = 80 threads (120 yards or about 109 m)
- 1 hank = 7 skeins (840 yards or about 768 m)
- 1 spindle = 18 hanks (15,120 yards or about 13.826 km)

11 - Fiber properties

Property	Evaluation
Shape	Fairly uniform in width, 12–20 micrometers; length varies from 1 cm to 6 cm ($\frac{1}{2}$ to 2 $\frac{1}{2}$ inches); typical length is 2.2 cm to 3.3 cm ($\frac{7}{8}$ to 1 $\frac{1}{4}$ inches).
Luster	High
Tenacity (strength))
Dry	3.0 - 5.0 g / d
Wet	3.3 – 6.0 g / d
Resiliency	low
Density	$1.54 - 1.56 \text{ g} / \text{cm}^3$

Moisture absorption raw: conditioned saturation mercerized: conditioned saturation	
Dimensional stability	good
Resistance to acids alkali organic solvents sunlight micro organisms insects	damage, weaken fibers resistant; no harmful effects high resistance to most Prolonged exposure weakens fibers. Mildew and rot-producing bacteria damage fibers. Silverfish damage fibers.
Thermal reactions to heat to flame	Decomposes after prolonged exposure to temperatures of 150°C or over. Burns readily.



Cotton fibers viewed under a scanning electron micro scope

The chemical composition of cotton is as follows:

cellulose 91.00 % water 7.85 % protoplasm , pectins 0.55 % waxes , fatty substances 0.40 % mineral salts 0.20 %

12 - Cotton genome

A public genome sequencing effort of cotton was initiated in 2007 by a consortium of public researchers. They agreed on a strategy to sequence the genome of cultivated, tetraploid cotton. "Tetraploid" means that cultivated cotton actually has two separate genomes within its nucleus, referred to as the A and D genomes. The sequencing consortium first agreed to sequence the D-genome relative of cultivated cotton (G. raimondii, a wild Central American cotton species) because of its small size and limited number of repetitive elements. It is nearly one-third the number of bases of tetraploid cotton (AD), and each chromosome is only present once. The A genome of G. arboreum would be sequenced next. Its genome is roughly twice the size of G. raimondii's. Part of the difference in size between the two genomes is the amplification of retrotransposons (GORGE). Once both diploid genomes are assembled, then research could begin sequencing the actual genomes of cultivated cotton varieties. This strategy is out of necessity; if one were to sequence the tetraploid genome without model diploid genomes, the euchromatic DNA sequences of the AD genomes would co-assemble and the repetitive elements of AD genomes would assembly independently into A and D sequences respectively. Then there would be no way to untangle the mess of AD sequences without comparing them to their diploid counterparts.

The public sector effort continues with the goal to create a highquality, draft genome sequence from reads generated by all sources. The public-sector effort has generated Sanger reads of BACs, fosmids, and plasmids as well as 454 reads. These later types of reads will be instrumental in assembling an initial draft of the D genome. In 2010, two companies (Monsanto and Illumina), completed enough Illumina sequencing to cover the D genome of *G. raimondii* about 50x . They announced that they would donate their raw reads to the public. This public relations effort gave them some recognition for sequencing the cotton genome. Once the D genome is assembled from all of this raw material, it will undoubtedly assist in the assembly of the AD genomes of cultivated varieties of cotton, but a lot of hard work remains.

Cotton Seed Oil



Cotton seeds

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1 Introduction

2 Composition

- 2.1 Comparison to other vegetable oils
- 3 Physical properties
- 4 Economic History
- 5 Use in food
- 6 Use as insecticide
- 7 Concerns about fats and toxicity

1 - Introduction

Cottonseed oil is a cooking oil extracted from the seeds of cotton plants of various species, mainly *Gossypium hirsutum* and *Gossypium herbaceum*, that are grown for cotton fiber, animal feed, and oil.^[1] In 2011 cotton was the third biggest of the genetically modified crops grown worldwide, as measured by acreage: soybean was 47%, occupying 75.4 million hectares; biotech maize (51.00 million hectares at 32 %), biotech cotton (24.7 million hectares at 15 %) and biotech canola (8.2 million hectares at 5 %)

Cotton seed has a similar structure to other oilseeds such as sunflower seed, having an oil-bearing kernel surrounded by a hard outer hull; in processing, the oil is extracted from the kernel. Cottonseed oil is used for salad oil, mayonnaise, salad dressing, and similar products because of its flavor stability.

2 - Composition

Its fatty acid profile generally consists of 70 % unsaturated fatty acids (18 % monounsaturated, and 52 % polyunsaturated), 26 % saturated fatty acids. When it is fully hydrogenated, its profile is 94% saturated fat and 2 % unsaturated fatty acids (1.5 % monounsaturated, and 0.5 % polyunsaturated). The cottonseed oil industry claims cottonseed oil does not need to be hydrogenated as much as other polyunsaturated oils to achieve similar results.

Gossypol is a toxic, yellow, poly phenolic compound produced by cotton and other members of the order Malvaceae, such as okra.^[5] This naturally occurring coloured compound is found in tiny glands in the seed, leaf, stem, tap root bark, and root of the cotton plant. The adaptive function of the compound facilitates natural insect resistance. The three key steps of refining, bleaching and deodorization in producing finished oil act to eliminate the gossypol level. Ferric chloride is often used to decolorize cotton seed oil.

Vegetable oils												
		Mono-	Mono		Polyunsaturated fatty acids					Oleic		
Туре	Saturated fatty acids fatty acids		ł	Total		linolenic acid (ω-3)		Linoleic acid (ω-6)		acid (ω-9)		Smoke point
Not hy	drogenated											
Canola	(rapeseed)	7.365	63.27	6	28.142		-	-	-		20	4 °C
Coco r	nut	91.00	6.000		3.000		-	2	6		17	7 °C
Corn		12.948	27.57	6	54.677		1	58	28		23	2 °C
Cotton	seed	25.900	17.80	0	51.900		1	54	<mark>19</mark>		21	6 °C
Flaxsee (Europ	ed/Linseed ean)	6 - 9	10 - 2	2	68 - 89		56 - 71	12 - 18	10	- 22	10	07 °C
Olive		14.00	72.00		14.00		-	-	-		(19	93 °C
Palm		49.300	37.00	0	9.300		-	10	40		23	5 °C
Peanut		16.900	46.20	0	32.000		-	32	48		22	5 °C
Safflov (>70 %	ver inoleic)	8.00	15.00		75.00		-	-	-		21) °C
Safflov (high o		7.541	75.22	1	12.820		-	-	-		21	0 °C

2-1 - Comparison to other vegetable oils

Soybean	15.650	22.783	57.740	7	54	24	238 °C	
Sunflower (<60 % linoleic)	10.100	45.400	40.100	0.200	39.800	45.300	227 °C	
Sunflower (>70% oleic)	9.859	83.689	3.798	-	-	-	227 °C	
Fully hydrogenated								
Cotton seed (hydrog.)	93.600	1.529	.587		.287			
Palm (hydrogenated)	47.500	40.600	7.500					
Soybean (hydrogen.)	21.100	73.700	.400	.096 ^[7]				
Values as percent (%) by weight of total fat.								

3 - Physical properties

Once processed, cottonseed oil has a mild taste and appears generally clear with a light golden color, the amount of color depending on the amount of refining. It has a relatively high smoke point as a frying medium. Density ranges from 0.917 g/cc to 0.933 g/cc.^[14] Like other long-chain fatty acid oils, cottonseed oil has a smoke point of about 232 °C, and is high in tocopherols, which also contribute its stability, giving products that contain it a long shelf life, hence manufacturers' proclivity to use it in packaged goods.

4 - Economic History

The by - product of cotton processing, cottonseed was considered virtually worthless before the late 19th century . While cotton production expanded throughout the 17th, 18th, and mid 19th centuries, a largely worthless stock of cottonseed grew. Although some of the seed was used for planting, fertilizer, and animal feed, the majority was left to rot or was illegally dumped into rivers.

In the 1820s and 1830s Europe experienced fats and oils shortages due to rapid population expansion during the Industrial Revolution and the English blockade during the Napoleonic Wars. The increased demand for fats and oils, coupled with a decreasing supply caused prices to rise sharply.^[15] Consequently, many Europeans could not afford to buy the fats and oils they had used for cooking and for lighting. Many United States entrepreneurs tried to take advantage of the increasing European demand for oils and

America's increasingly large supply of cottonseed by crushing the seed for oil. But separating the seed hull from the seed meat proved difficult and most of these ventures failed within a few years. This problem was resolved in 1857, when William Fee invented a huller, which effectively separated the tough hulls from the meats of cottonseed. With this new invention, cottonseed oil began to be used for illumination purposes in lamps to supplement increasingly expensive whale oil and lard. But by 1859, this use came to end as the petroleum industry emerged.

Cottonseed oil then began to be used illegally to fortify animal fats and lards . Initially, meat packers secretly added cottonseed oil to the pure fats, but this practice was uncovered in 1884. Armour and Company, an American meatpacking and food processing company, sought to corner the lard market and realized that it had purchased more lard than the existing hog population could have produced. A congressional investigation followed, and legislation was passed that required products fortified with cottonseed oil to be labeled as "lard compound." Similarly, cottonseed oil was often blended with olive oil. Once the practice was exposed, many countries put import tariffs on American olive oil and Italy banned the product completely in 1883.^[16] Both of these regulatory schemes depressed cottonseed oil sales and exports, once again creating an oversupply of cottonseed oil, which decreased its value.

It was cottonseeds depressed value that lead a newly formed Proctor and Gamble to utilize its oil. The Panic of 1837 caused the two brothers - in - law to merge their candlestick and soap manufacturing businesses in an effort to minimize costs and weather the bear market. Looking for a replacement for expensive animal fats in production, the brothers finally settled on cottonseed oil.^[15] Proctor and Gamble cornered the cottonseed oil market to circumvent the meat packer's monopoly on the price. But as electricity emerged, the demand for candles decreased. Procter and Gamble then found an edible use for cottonseed oil. Through patented technology, the brothers were able to hydrogenate cottonseed oil and develop a substance that closely resembled lard. In 1911, Proctor and Gamble launched an aggressive marketing campaign to publicize its new product, Crisco, a vegetable shortening that could be used in place of lard.^[17] Crisco placed ads in major newspapers advertising that the product was "easier on digestion...a healthier alternative to cooking with animal fats. . . and more economical than butter ." The company also gave away free cookbooks, with every recipe calling for Crisco. By the 1920s the company developed cookbooks for specific ethnicities in their native tongues . Additionally, Crisco starting airing radio cooking programs . Similarly, in 1899 David Wesson, a food chemist, developed deodorized cottonseed oil, Wesson Oil. Wesson Oil also was marketed heavily and became quite popular too.

Over the next 30 years cottonseed oil became the pre-eminent oil in the United States . Crisco and Wesson oil became direct substitutes for lard and other more expensive oils in baking, frying, sautéing, and salad dressings. But by World War Two cottonseed oil shortages forced the utilization of another direct substitute, soybean oil.^[15] By 1944, soybean oil production outranked cottonseed oil production due to cottonseed shortages and soybean oil costs falling bellow that of cottonseed oil. By 1950, soybean oil replaced cottonseed oil in the use of shortenings like Crisco due to soybeans comparatively low price. Prices for cottonseed were also increased by the replacement of cotton acreage by corn and soybeans, a trend fueled in large part by the boom in demand for corn syrup and ethanol. Cottonseed oil and production continued to decline throughout the mid and late 20th century.

In the mid to late 2000s, the consumer trend of avoiding transfats, and mandatory labeling of trans-fats in some jurisdictions, sparked an increase in the consumption of cottonseed oil,^[19] with some health experts and public healh agencies^[21] recommending it as a healthy oil. Crisco and other producers have been able to reformulate cottonseed oil so it contains little to no trans - fats. Still, some health experts claim that cottonseed oil's high ratio of polyunsaturated fats to monounsaturated fats and processed nature make it unhealthy.

5 - Use in food

Cottonseed oil has traditionally been used in foods such as potato chips and is a primary ingredient in Crisco, the shortening product.^[24] But since it is significantly less expensive than olive oil or canola oil, cottonseed has started to be used in a much wider range of processed foods, including cereals, breads and snack foods.

6 - Use as insecticide

In an agricultural context, the toxicity of cottonseed oil may be considered beneficial: Oils, including vegetable oils, have been used for centuries to control insect and mite pests. This oil has been generally considered the most insecticidal of vegetable oils.

7 - Concerns about fats and toxicity

The popular website of Andrew Weil, a doctor of integrative medicine, indicates that he "regard (s) it as unhealthy because it is too high in saturated fat and too low in monounsaturated fat." His site also states: "What's more, cottonseed oil may contain natural toxins and probably has unacceptably high levels of pesticide residues (cotton is not classified as a food crop, and farmers use many agrichemicals when growing it)" and this claim has been repeated by other websites. However, the claim that cottonseed is not regulated as a food crop is not true. The Code of Federal Regulations (CFR) contains regulations for maximum pesticide residue allowed in cottonseed, as it does for all other food crops. Furthermore, the natural toxin, gossypol, is eliminated in the refining process of commercially edible cottonseed oil, and the Food and Agriculture Organization of the United Nations has documented the lack of appreciable residues in cottonseed and cottonseed oil.

Crambe Oil

Crambe oil is an inedible seed oil, extracted from the seeds of the *Crambe abyssinica*, a multi branched annual plant that is native to the Mediterranean. The oil has been shown to consist of 55-60% erucic acid. The Australian Farm Diversification Information Service writes:

Intermediate product derived form high erucic acid oil include: triglycerides; erucamides; amines, behenic acid; erucyl alcohol; behenyl alcohol; wax esters; fatty acids; brassylic acid and pelargonic acid. These products are used to manufacture a multitude of industrial consumer items such as lubricants; heat transfer fluids; surfactants and coatings; cosmetics; polyesters; plastics and nylons.

Erucic acid is traditionally derived from older varieties of rapeseed. Crambe oil is considered to be a possible replacement for rapeseed oil in this capacity. The market for crambe oil is particularly developed in the USA.

Crocodile Fat

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1 Introduction

2 Energy use

3 Commercial products

1 - Introduction

Crocodile fat, alligator oil or crocodile/alligator oil is a lipid substance deriving from the bodies of the crocodilian family of reptiles. Since the beginning of commercial alligator farming in the USA, Australia, South Africa and South East Asia, crocodile fat became a commercial product that can be used in a number of way, including medicine and as a feedstock for biodiesel.

2 - Energy use

Alligator fat was recently identified as a source to produce biodiesel. Every year, about 15 million pounds of alligator fat are disposed of in landfills as a waste byproduct of the alligator meat and skin industry. Studies have shown that biodiesel produced from alligator fat is similar in composition to biodiesel created from soybeans, and is cheaper to refine since it is primarily a waste product. Biodiesel made of crocodile fat can be utilized by cars.

A research work was published in Industrial Engineering Chemistry Research Journal . The authors show that recovery of lipids from the alligator fat tissue was studied by solvent extraction as well as by microwave rendering. Microwave rendering resulted in oil recovery of 61% by weight of the frozen fat tissue obtained from producers. The fatty acid profile of the lipid showed that palmitic acid (C16:0), palmitoleic acid (C16:1), and oleic acid (C18:1) were the dominant fatty acids accounting for 89 - 92 % of all lipids by mass; 30% of the fatty acids were saturated and 70 % were unsaturated. The biodiesel produced from alligator oil was found to meet the ASTM specifications of biodiesel concerning kinematic viscosity, sulfur, free and total glycerin, flash point, cloud point, and acid number. The head of the research team Dr. Brahal Bajpai and his crew assessed that a large crocodile farm would produce biodiesel made out of crocodile fat at \$ 2.51 a gallon, excluding the cost of the fat and transportation. The latter cost would presumably be \$0, since it's a waste product anyway. Such a price would make it competitive with petroleum - derived diesel.

3 - Commercial products

Crocodile fat was used in East Asia and South East Asia for centuries as medicine . Lotions and other products derived from alligator fat are now sold online. One of these products, called Gator Oil, has been in commercial use in the United States.

Crocodile Oil

Crocodile oil is extracted from the fatty tissues of crocodiles and has been used both as preventative and a treatment for a number of human ailments and conditions for many years and across numerous cultures, including Ancient Egypt. It is somewhat red in color, and less viscous than alligator oil. Both were used in the tanning industry.

Croton oil

Croton oil (Crotonis Oleum) is an oil prepared from the seeds of *Croton tiglium*, a tree belonging to the natural order Euphorbiales and family Euphorbiaceae, and native or cultivated in India and the Malay Archipelago. Small doses taken internally cause diarrhea. Externally, the oil can cause irritation and swelling. In traditional Chinese medicine it is used as an ingredient in some liniments.

Croton oil is the source of the organic compound phorbol.^[1] Today croton oil is the basis of rejuvenating chemical peels, due to the caustic exfoliating effects it has on the dermal components of the skin. Used in conjunction with phenol solutions, it results in an intense reaction which leads to initial skin sloughing and then eventual regeneration. Tumor promotion activity was traced to phorbol esters present in croton oil . Pure phorbol 12- myristate 13- acetate is now used widely for laboratory study of tumor development.

Since croton oil is very irritating and painful, it is used in laboratory animals to study how pain works, pain-relieving and antiinflammatory drugs, and immunology.

During World War II, the United States Navy added a small amount of croton oil to the neutral grain spirits which powered torpedoes. The oil was intended to prevent sailors from drinking the alcohol fuel. Sailors devised crude stills to separate the alcohol from the croton oil, as alcohol evaporates at a lower temperature than croton oil.^[4] Norwegian partisans, ordered by the Quisling government to turn over a catch of sardines to the German government for shipment to Saint-Nazaire (a U-boat base of operations) arranged with the British for a large shipment of croton oil to flavor the sardines, whose fishy taste was expected to conceal the tampering.

Croton oil is also more effective for production of biodiesel than Jatropha. One can obtain 0.35 liters of biofuel from a kilo of croton nuts .

In "The Bulletin" (9 Dowry Square, Hot Wells, May 29, 1845) by the Reverend Richard Harris Barham, a medically inspired poem to relieve the anxiety of a very dear friend, and written a month before Barham's death on June 17, 1845, the attending doctor to his patient advises amongst other treatments for a sore throat that is producing barely a sound: "... Please put out your tongue again!/Now the blister!/Ay, the blister!/ Let your son, or else his sister,/Warm it well, then clap it here, sir , / All across from ear to ear, sir; / That suffices,/When it rises, / Snip it, sir, and then your throat on/Rub a little oil of Croton:/Never mind a little pain! / Please put out your tongue again! ... " The patient was Barham, who had accidentally swallowed a piece of pear core that got into his windpipe on October 28, 1844. "Despite" the "professional" advice and the very painful and "highest quality" treatments of the time being given freely to him by Doctors Roberts and Scott, and the eminent surgeon Mr. Coulson, for "violent vomiting", "inflamed throat", and then catching "a cold" in April 1845, Barham died.

In John Steinbeck's novel *East of Eden*, Kate used it to slowly murder Faye and inherit her whorehouse.

In *El Dorado* starring John Wayne, cayenne pepper, mustard (the hot kind), ipecac, asafoetida, croton oil, and gunpowder are the ingredients in an emetic administered to Robert Mitchum's drunken sheriff to sober him up and prevent him from drinking for the foreseeable future. Arthur Hunnicutt's character Bull expresses great surprise that the extract's use will be risked.

In Bernard Cornwell's American Civil War novel *Copperhead*, croton oil is used to torture the protagonist, Nathaniel Starbuck, in an attempt to get him to confess to a crime. In the sequel, *The Bloody Ground*, an officer of the punishment battalion Starbuck is in command of, rubs croton oil into his face (causing sores) to make it appear he has a skin disease which makes it impossible for him to fight.

In Thomas Wolfe's novel, *Look Homeward Angel* Gus Moody uses croton oil to stop Steve Gant's whiskey pilferage.

In the end of little-known Portuguese author Maria Archer's book "Casa sem pão" (A house without bread), the protagonist, Adriana, uses croton oil to kill her husband, thus exacting revenge on him for many years of unhappy and unfaithful marriage.^[citation needed]

Cuphea Oil

Cuphea oil is oil pressed from the seeds of several species of the genus *Cuphea*. Interest in cuphea oils is relatively recent, as a source of medium-chain triglycerides like those found in Coco nut oil and palm oil. Cuphea oil is of interest because it grows in climates where palms - the source of both of these oils - do not grow.

The fatty acid content of cuphea oils are as follows. The composition of Coco nut oil is included for comparison:

Species	Caprylic	Capric	Lauric	Myristic	Other
C. painteri	73.0%	20.4%	0.2%	0.3%	6.1%
C. hookeriana	65.1%	23.7%	0.1%	0.2%	10.9%
C. koehneana	0.2%	95.3%	1.0%	0.3%	3.2%
C. lanceolata		87.5%	2.1%	1.4%	9.0%
C. viscosissima	9.1%	75.5%	3.0%	1.3%	11.1%
C. carthagenensis	5	5.3%	81.4%	4.7%	8.6%
C. laminuligera		17.1%	62.6%	9.5%	10.8%
C. wrightii		29.4%	53.9%	5.1%	11.6%
C. lutea	0.4%	29.4%	37.7%	11.1%	21.4%
C. epilobiifolia		0.3%	19.6%	67.9%	12.2%
C. stigulosa	0.9%	18.3%	13.8%	45.2%	21.8%
Coco nut	8.0%	7.0%	48.0%	18.0%	19.0%

These oils are also valuable as sources of single fatty acids. *C. painteri*, for example, is rich in caprylic acid (73%), where *C. carthagenensis* oil consists of 81% lauric acid. *C. koehneana* oil may be the richest natural source of a single fatty acid, with 95% of its content consisting of capric acid.

Cutting Fluid Oil



Thin - wall milling of aluminum using a water-based cutting fluid on the milling cutter.

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- 6 Degradation, replacement, and disposal

1 - Introduction

Cutting fluid is a type of coolant and lubricant designed specifically for metalworking and machining processes. There are various kinds of cutting fluids, which include oils, oil-water emulsions, pastes, gels, aerosols (mists), and air or other gases. They may be made from petroleum distillates, animal fats, plant oils, water and air, or other raw ingredients. Depending on context and on which type of cutting fluid is being considered, it may be referred to as cutting fluid, cutting oil, cutting compound, coolant, or lubricant. Most metalworking and machining processes can benefit from the use of cutting fluid, depending on workpiece material. Common exceptions to this are machining cast iron and brass, which are machined dry.

The properties that are sought after in a good cutting fluid are the ability to :

keep the work piece at a stable temperature (critical when working to close tolerances). Very warm is OK, but extremely hot or alternating hot - and - cold are avoided.

maximize the life of the cutting tip by lubricating the working edge and reducing tip welding.

ensure safety for the people handling it (toxicity, bacteria, fungi) and for the environment upon disposal.

prevent rust on machine parts and cutters.

2 – Functions

2 - 1 – Cooling

Metal cutting operations generate heat due to friction and energy lost deforming the material. The surrounding air has low thermal conductivity (conducts heat poorly) meaning it is a poor coolant. Ambient air cooling is sometimes adequate for light cuts and low duty cycles typical of maintenance, repair and operations (MRO) or hobbyist work. Production work requires heavy cutting over long time periods and typically produces more heat than air cooling can remove. Rather than pausing production while the tool cools, using liquid coolant removes significantly more heat more rapidly, and can also speed cutting and reduce friction and tool wear.

However, it is not just the tool which heats up but also the work surface. Excessive temperature in the tool or work surface can ruin the temper of both, soften either to the point of uselessness or failure, burn adjacent material, create unwanted thermal expansion or lead to unwanted chemical reactions such as oxidation.

2 - 2 – Lubrication

Besides cooling, cutting fluids also aid the cutting process by lubricating the interface between the tool's cutting edge and the chip. By preventing friction at this interface, some of the heat generation is prevented. This lubrication also helps prevent the chip from being welded onto the tool, which interferes with subsequent cutting.

Extreme pressure additives are often added to cutting fluids to further reduce tool wear.

3 - Delivery methods

Every conceivable method of applying cutting fluid (e.g., flooding, spraying, dripping, misting, brushing) can be used, with the best choice depending on the application and the equipment available. For many metal cutting applications the ideal has long been high-pressure, high-volume pumping to force a stream of liquid (usually an oil-water emulsion) directly into the tool-chip interface, with walls around the machine to contain the splatter and a sump to catch, filter, and recirculate the fluid. This type of system is commonly employed, especially in manufacturing. It is often not a practical option for MRO or hobbyist metal cutting, where smaller, simpler machine tools are used. Fortunately it is also not necessary in those applications, where heavy cuts, aggressive speeds and feeds, and constant, all-day cutting are not vital.

As technology continually advances, the flooding paradigm is no longer always the clear winner. It has been complemented since the 2000s by new permutations of liquid, aerosol, and gas delivery, such as minimum quantity lubrication and through-the-tool-tip cryogenic cooling (detailed below).

Through - tool coolant systems, also known as through-spindle coolant systems, are systems plumbed to deliver coolant through passages inside the spindle and through the tool, directly to the cutting interface. Many of these are also high-pressure coolant systems, in which the operating pressure can be hundreds to several thousand psi (1 to 30 MPa) — pressures comparable to those used in hydraulic circuits. High-pressure through-spindle coolant systems require rotary

unions that can withstand these pressures. Drill bits and endmills tailored for this use have small holes at the lips where the coolant shoots out. Various types of gun drills also use similar arrangements.

4 – Types 4 -1 – Liquids

There are generally three types of liquids: mineral, semisynthetic, and synthetic. Semi-synthetic and synthetic cutting fluids represent attempts to combine the best properties of oil with the best properties of water by suspending emulsified oil in a water base. These properties include: rust inhibition, tolerance of a wide range of water hardness (maintaining pH stability around 9 to 10), ability to work with many metals, resist thermal breakdown, and environmental safety.

Water is a good conductor of heat but has drawbacks as a cutting fluid. It boils easily, promotes rusting of machine parts, and does not lubricate well. Therefore, other ingredients are necessary to create an optimal cutting fluid.

Mineral oils, which are petroleum-based, first saw use in cutting applications in the late 19th century. These vary from the thick, dark, sulfur-rich cutting oils used in heavy industry to light, clear oils.

Semi - synthetic coolants, also called "soluble oil," are an emulsion or micro emulsion of water with mineral oil. These began to see use in the 1930s. A typical CNC machine tool usually uses emulsified coolant, which consists of a small amount of oil emulsified into a larger amount of water through the use of a detergent.

Synthetic coolants originated in the late 1950s and are usually water - based.

A hand - held refracto meter is used to determine the mix ratio of water soluble coolants. Other test equipment is used to determine such properties as acidity and conductivity.

Others include :

Kerosene and rubbing alcohol often give good results when working on aluminium.

WD - 40 and 3 - In - One Oil work well on various metals. The latter has a citronella odor; if the odor offends, mineral oil and general - purpose lubricating oils work about the same.

Way oil (the oil made for machine tool ways) works as a cutting oil. In fact, some screw machines are designed to use one oil as both the way oil and cutting oil. (Most machine tools treat way lube and coolant as separate things that inevitably mix during use, which leads to tramp oil skimmers being used to separate them back out.).

Motor oils have a slightly complicated relationship to machine tools. Straight-weight non-detergent motor oils are usable, and in fact SAE 10 and 20 oils used to be the recommended spindle and way oils (respectively) on manual machine tools decades ago, although nowadays dedicated way oil formulas prevail in commercial machining. While nearly all motor oils can act as adequate cutting fluids in terms of their cutting performance alone, modern multiweight motor oils with detergents and other additives are best avoided. These additives can present a copper-corrosion concern to brass and bronze, which machine tools often have in their bearings and lead screw nuts (especially older or manual machine tools).

Dielectric fluid is used as a cutting fluid in Electrical discharge machines (EDMs). It is usually deionized water or a high-flash-point kerosene. Intense heat is generated by the cutting action of the electrode (or wire) and the fluid is used to stabilize the temperature of the workpiece, along with flushing any eroded particles from the immediate work area. The dielectric fluid is nonconductive.

Liquid - (water- or petroleum oil-) cooled water tables are used with the plasma arc cutting (PAC) process.

4 - 2 - Pastes or gels

Cutting fluid may also take the form of a paste or gel when used for some applications, in particular hand operations such as drilling and tapping. In sawing metal with a bandsaw, it is common to periodically run a stick of paste against the blade. This product is similar in form factor to lipstick or beeswax. It comes in a cardboard tube, which gets slowly consumed with each application.

4 - 3 - Aerosols (mists)

Some cutting fluids are used in aerosol (mist) form (air with tiny droplets of liquid scattered throughout). The main problems with mists have been that they are rather bad for the workers, who have to breathe the surrounding mist-tainted air, and that they sometimes don't even work very well. Both of those problems come from the imprecise delivery that often puts the mist everywhere and all the time except at the cutting interface, during the cut—the one place and time where it's wanted. However, a newer form of aerosol delivery, MQL (minimum quantity of lubricant), avoids both of those problems. The delivery of the aerosol is directly through the flutes of the tool (it arrives directly through or around the insert itself-an ideal type of cutting fluid delivery that traditionally has been unavailable outside of a few contexts such as gun drilling or expensive, state-of-the-art liquid delivery in production milling). MQL's aerosol is delivered in such a precisely targeted way (with respect to both location and timing) that the net effect seems almost like dry machining from the operators' perspective.^{[2][3]} The chips generally seem like dry-machined chips, requiring no draining, and the air is so clean that machining cells can be stationed closer to inspection and assembly than before.^{[2][3]} MQL doesn't provide much cooling in the sense of heat transfer, but its welltargeted lubricating action prevents some of the heat from being generated in the first place, which helps to explain its success.

4 - 4 - CO₂ Coolant

Carbon dioxide (chemical formula CO_2) is also used as a coolant. In this application pressurized liquid CO_2 is allowed to expand and this is accompanied by a drop in temperature, enough to cause a change of phase into a solid . These solid crystals are redirected into the cut zone by either external nozzles or through-the-spindle delivery, to provide temperature controlled cooling of the cutting tool and work piece. The ChilAire system is one of the pioneers in the application of CO_2 as a coolant . Existing CNC

machines can be retrofitted with this safe and environmentally friendly coolant approach. In applications such as turning, milling or drilling tool life and throughput have been improved substantially; especially in high temperature alloys such as titanium, 4140, steels and plastics.

4 - 5 - Air or other gases (e.g., nitrogen)

Ambient air, of course, was the original machining coolant. Compressed air, supplied through pipes and hoses from an air compressor and discharged from a nozzle aimed at the tool, is sometimes a useful coolant. The force of the decompressing air stream blows chips away, and the decompression itself has a slight degree of cooling action. The net result is that the heat of the machining cut is carried away a bit better than by ambient air alone. Sometimes liquids are added to the air stream to form a mist (mist coolant systems, described above).

Liquid nitrogen, supplied in pressurized steel bottles, is sometimes used in similar fashion. In this case, boiling is enough to provide a powerful refrigerating effect. For years this has been done (in limited applications) by flooding the work zone. Since 2005, this mode of coolant has been applied in a manner comparable to MQL (with through-the-spindle and through-the-tool-tip delivery). This refrigerates the body and tips of the tool to such a degree that it acts as a "thermal sponge", sucking up the heat from the tool–chip interface.^[2] This new type of nitrogen cooling is still under patent. Tool life has been increased by a factor of 10 in the milling of tough metals such as titanium and inconel.

4 - 6 - Past practice

In 19th - century machining practice, it was not uncommon to use plain water. This was simply a practical expedient to keep the cutter cool, regardless of whether it provided any lubrication at the cutting edge–chip interface. When one considers that high-speed steel (HSS) had not been developed yet, the need to cool the tool becomes all the more apparent. (HSS retains its hardness at high temperatures; other carbon tool steels do not.) An improvement was soda water, which better inhibited the rusting of machine slides. These options are generally not used today because better options are available.

Lard was very popular in the past.^[6] It is used infrequently today, because of the wide variety of other options, but it is still an option.

Old machine shop training texts speak of using red lead and white lead, often mixed into lard or lard oil. This practice is obsolete due to the toxicity of lead.

From the mid-20th century to the 1990s, 1,1,1-trichloroethane was used as an additive to make some cutting fluids more effective. In shop-floor slang it was referred to as "one-one-one". It has been phased out because of its ozone-depleting and central nervous system-depressing properties.

5 - Safety concerns

Cutting fluids present some mechanisms for causing illness or injury in workers. These mechanisms are based on the external (skin) or internal contact involved in machining work, including touching the parts and tooling; being splattered or splashed by the fluid; or having mist settle on the skin or enter the mouth and nose in the normal course of breathing.

The mechanisms include the chemical toxicity or physical irritating ability of :

* The fluid itself

* The metal particles (from previous cutting) that are borne in the fluid

* The bacterial or fungal populations that naturally tend to grow in the fluid over time

* The biocides that are added to inhibit those life forms

* The corrosion inhibitors that are added to protect the machine and tooling

* The tramp oils that result from the way oils (the lubricants for the slide ways) inevitably finding their way into the coolant

The toxicity or irritating ability is usually not high, but it is sometimes enough to cause problems for the skin or for the tissues of the respiratory tract or alimentary tract (e.g., the mouth, larynx, esophagus, trachea, or lungs).

Some of the diagnoses that can result from the mechanisms explained above include irritant contact dermatitis; allergic contact dermatitis; occupational acne ; tracheitis; esophagitis; bronchitis; asthma; allergy; hypersensitivity pneumonitis (HP); and worsening of pre - existing respiratory problems.

Safer cutting fluid formulations provide a resistance to tramp oils, allowing improved filtration separation without removing the base additive package. Room ventilation, splash guards on machines, and personal protective equipment (PPE) (such as safety glasses, respirator masks, and gloves) can mitigate hazards related to cutting fluids.

Bacterial growth is predominant in petroleum-based cutting fluids. Tramp oil along with human hair or skin oil are some of the debris during cutting which accumulates and forms a layer on the top of the liquid; anaerobic bacteria proliferate due to a number of factors. An early sign of the need for replacement is the "Monday-morning smell" (due to lack of usage from Friday to Monday). Antiseptics are sometimes added to the fluid to kill bacteria. Such use must be balanced against whether the antiseptics will harm the cutting performance, workers' health, or the environment. Maintaining as low a fluid temperature as practical will slow the growth of microorganisms.

The discussion above could leave a reader with the mistaken idea that cutting fluid is "often extremely dangerous". That would be an exaggeration. In reality, cutting fluid exposure is like many exposures in life, such as second-hand tobacco smoke; ethanol ingestion; paint and thinner fumes; kitchen or bakery smoke; contact with animal manure in farming or veterinary work, or contact with sewage in plumbing or sewer work. Such exposures only cause acute illness or injury in occasional cases where some situational factor was "out of normal bounds". Rather, the main health risk is that of chronic illness from long-term occupational exposure. Most machinists work around cutting fluids for years without adverse effects. They generally don't worry about casual contact, and they use PPE to minimize it. As for bacteria, fungi, and biocides, their risk can be slashed by two simple actions: regular fluid maintenance (skimming, filtering, concentration measuring) and timely fluid replacement. These actions typically pay for themselves because they also promote better machining (better surface finishes, longer tool life, tighter dimensional control).

6 – Degradation, replacement, and disposal

Cutting fluids degrade over time due to contaminants entering the lubrication system. A common type of degradation is the formation of *tramp oil*, also known as *sump oil*, which is unwanted oil that has mixed with cutting fluid. It originates as lubrication oil that seeps out from the slide ways and washes into the coolant mixture, as the protective film with which a steel supplier coats bar stock to prevent rusting, or as hydraulic oil leaks. In extreme cases it can be seen as a film or skin on the surface of the coolant or as floating drops of oil.

Skimmers are used to separate the tramp oil from the coolant. These are typically slowly rotating vertical discs that are partially submerged below the coolant level in the main reservoir. As the disc rotates the tramp oil clings to each side of the disc to be scraped off by two wipers, before the disc passes back through the coolant. The wipers are in the form a channel that then redirects the tramp oil to a container where it is collected for disposal. Floating weir skimmers are also used in these situation where temperature or the amount of oil on the water becomes excessive.

Since the introduction of CNC additives, the tramp oil in these systems can be managed more effectively through a continuous separation effect. The tramp oil accumulation separates from the aqueous or oil based coolant and can be easily removed with an absorbent. Old, used cutting fluid must be disposed of when it is fetid or chemically degraded and has lost its usefulness. As with used motor oil or other wastes, its impact on the environment should be mitigated. Legislation and regulation specify how this mitigation should be achieved. Modern cutting fluid disposal involves techniques such as ultrafiltration using polymeric or ceramic membranes which concentrates the suspended and emulsified oil phase.

Danish Oil

Danish oil is a wood finishing oil , made of either Tung oil or polymerized linseed oil.

Danish oil is a 'long oil' finish: a mixture of oil and varnish, predominantly of oil . A typical Danish oil is around one third varnish. The function of Danish oil is to provide a hard-wearing finish, rather than a particularly fine or high-gloss finish. Compared to oil, it is hard-wearing. Compared to a varnish, it is simple to apply. As the finished coating is not glossy or slippery, it is a suitable finish for tool handles, giving some additional weather resistance.

Danish oil is a hard drying oil which provides a tough, waterresistant finish. It can be used as a finish, or as a primer or sealer on bare wood before applying paint or varnish.

When used, Danish oil provides a satin finish and provides coverage of approx 12.5 sq. m/l (600 sq. ft./gallon) and is usually applied over a course of three coats by brush or cloth, with any excess being wiped off shortly after application. The finish is left to dry for around 6-24 hours between coats, depending on the mixture being used and the wood being treated.

Rags used for Danish oil have some potential risk of spontaneous combustion and starting fires, so it is best to dry rags flat before disposing of them, or else soak them in water.

Defoamer

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1 - Introduction

A defoamer or an anti-foaming agent is a chemical additive that reduces and hinders the formation of foam in industrial process liquids. The terms anti-foam agent and defoamer are often used interchangeably. Commonly used agents are insoluble oils, poly dimethyl siloxanes and other silicones, certain alcohols, stearates and glycols. The additive is used to prevent formation of foam or is added to break a foam already formed.

In industrial processes, foams pose serious problems. They cause defects on surface coatings. They prevent the efficient filling of containers. A variety of chemical formulae are available to prevent formation of foams.

2 - Properties

Generally a defoamer is insoluble in the foaming medium and has surface active properties. An essential feature of a defoamer product is a low viscosity and a facility to spread rapidly on foamy surfaces. It has affinity to the air-liquid surface where it destabilizes the foam lamellas. This causes rupture of the air bubbles and breakdown of surface foam. Entrained air bubbles are agglomerated, and the larger bubbles rise to the surface of the bulk liquid more quickly.

3 – History

The first defoamers were aimed at breaking down visible foam at the surface. Kerosene, fuel oil and other light oil products were used to break down foam. Other vegetable oils also found some use. Fatty alcohols (C7 - C22) were effective but expensive antifoams. They were added to oil products to boost the efficiency. Milk and cream were forbears for modern day emulsion type defoamers.

During the 1950s experiments with silicone based defoamers started. These were based on polydimethylsiloxane (silicone oil) dispersed in water or light oil. Silicone oils worked well, but caused surface disturbances in many applications like paints and papermaking. In 1963 the first antifoams with hydrophobic particles (hydrophobic silica) in light oil were patented. In the early 1970s, hydrophobic waxes like ethylene bis stearamide dispersed in oils developed. These types of defoamers were very efficient, but the oil crisis of 1973 made these too expensive and resulted in a push for reduction of the oil content. The solution was adding water. So water extended (water in oil emulsion) and water based (oil in water emulsion) defoamers appeared.

The development of silicone based defoamers has continued, using different emulsifiers and modified silicone oils. In the early 1990s, silicone emulsion defoamers that caused less surface disturbances were used in the wood pulping industry with great success. These caused better washing, reduced biological oxygen demand (BOD) in effluent and reduced deposits.

4 – Classification

4 – 1 - Oil based defoamers

Oil based defoamers have an oil carrier. The oil might be mineral oil, vegetable oil, white oil or any other oil that is insoluble in the foaming medium, except silicone oil. An oil based defoamer also contains a wax and/or hydrophobic silica to boost the performance. Typical waxes are ethylene bis stearamide (EBS), paraffin waxes, ester waxes and fatty alcohol waxes. These products might also have surfactants to improve emulsification and spreading in the foaming medium.

These are heavy duty defoamers and are normally best at knocking down surface foam.

4 – 2 - Powder defoamers

Powder defoamers are in principle oil based defoamers on a particulate carrier like silica. These are added to powdered products like cement, plaster and detergents.

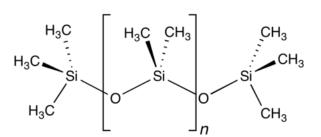
4-3 - Water based defoamers

Water based defoamers are different types of oils and waxes dispersed in a water base. The oils are often white oils or vegetable oils and the waxes are long chain fatty alcohol, fatty acid soaps or esters. These are normally best as deaerators, which means they are best at releasing entrained air.

4 – 4 - Silicone based defoamers

Silicone - based defoamers are polymers with silicon backbones. These might be delivered as an oil or a water based emulsion. The silicone compound consists of an hydrophobic silica dispersed in a silicone oil. Emulsifiers are added to ensure that the silicone spreads fast and well in the foaming medium. The silicone compound might also contain silicone glycols and other modified silicone fluids.

These are also heavy duty defoamers and are good at both knocking down surface foam and releasing entrained air.



Poly dimethyl siloxane is a widely used antifoaming agent.

Silicone based defoamers are also suitable in non-aqueous foaming systems like crude oil and oil refining. For very demanding applications fluoro silicones may be suitable.

4-5-EO / PO based defoamers

EO / PO based defoamers contain poly ethylene glycol and poly propylene glycol copolymers. They are delivered as oils, water solutions, or water based emulsions. EO / PO copolymers normally have good dispersing properties and are often well suited when deposit problems are an issue.

4 – 6 - Alkyl poly acrylates

Alkyl poly acrylates are suitable for use as defoamers in nonaqueous systems where air release is more important than the breakdown of surface foam. These defoamers are often delivered in a solvent carrier like petroleum distillates.

5 - Industrial problems

The most noticeable form of foam is foam floating on the stock surface. It is easy to monitor and relatively easy to handle. Surface foam may cause problems with liquid levels and give overflow. This might reduce the process speed and availability of process equipment.

5 – 1 - Mechanical problem factors

Mechanical factors that may generate foam and entrapped air: Leaky seals on pumps

High pressure pumps

Poor system design (tank, pump inlet, outlet and manifold design)

Pressure release

The main classes of air that are of concern to the mechanical systems are

Dissolved air behaves as part of the fluid phase, except that it can come out of solution as small bubbles (entrained air)

Entrained air consists of bubbles that are small enough to collect on top of a fluid

Bubbles that have sufficient buoyancy to rise to the surface and are described as foam

5-2 - Foam in process and coolant liquids

Foam, entrained and dissolved air that are present in coolants and processing liquids, may cause various kinds of problems, including :

Reduction of pump efficiency (cavitation) Reduced capacity of pumps and storage tanks Bacterial growth Dirt flotation / Deposit formation Reduced effectiveness of the fluid solution(s) Eventual downtime to clean tanks Drainage problems in sieves and filters

Formation problems (i.e. in a paper mill it may cause the fibers to form an inhomogeneous sheet)

Cost of replenishing the liquid

Cost of entire material rejection due to imperfections

6 - Test methods

There are several ways to test defoamers.

The easiest is looking at the surface foam. All that is needed is a system for generating foam. This might be done with a round pumping system with a nozzle and a cylinder or an air injection system into a cylinder. The cylinder is fitted with a scale to measure the foam height. This equipment may have a heater to control the temperature.

Entrained air can be tested with similar equipment that has a density meter that can record changes of the liquor density over time.

Drainage can be tested with a filter system for measuring the time to drain a liquid through the filter. The filter might be pressurized or have a vacuum.

7 – Applications

7 – 1 – Detergents

Anti - foams are added in certain types of detergents to reduce foaming that might decrease the action of the detergent. For example dishwasher detergents have to be low foaming for the dishwasher to work properly.

7-2-Food

When used as an ingredient in food, antifoaming agents are intended to curb effusion or effervescence in preparation or serving. The agents are included in a variety of foods such as chicken nuggets in the form of poly dimethyl siloxane (a type of silicone).

Silicone oil is also added to cooking oil to prevent foaming in deep - frying .

7 – 3 - Industrial use

Defoamers are used in many industrial processes and products: wood pulp, paper, paint, industrial wastewater treatment, food processing, oil drilling, machine tool industry, oils cutting tools, hydraulics, etc.

7 – 4 – Pharmaceuticals

Antifoaming agents are also sold commercially to relieve bloating. A familiar example is the drug Simethicone, which is the active ingredient in drugs such as Maalox, Mylanta, and Gas - X.

Di Acyl Glycerol (DAG) Oil

Contents

Introduction
 How it Works
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 DAG Oil Brands

1 - Introduction

Di acyl glycerol (DAG) oil is a cooking oil in which the ratio of triglycerides to DAG is shifted to contain mostly DAG, unlike conventional cooking oils, which are rich in TAG. Vegetable DAG oil, for example, contains 80 % DAG and is used as a 1:1 replacement for liquid vegetable oils in all applications.

2 - How it Works

DAG (Di acyl glycerols) and TAG (tri acyl glycerols) are natural components in all vegetable oils. Through a patent-protected, enzymatic process, the DAG content of a combination of soy and canola oils is significantly increased. Unlike TAG, which is stored as body fat, DAG is immediately burned as energy. With DAG-rich oil containing more than 80 % DAG, less of the oil is stored as body fat as compared to traditional oils, which are rich in TAG. Excess calories consumed by the body are converted into fat and stored regardless if it is consumed as DAG or TAG.

3 - FDA Designation

DAG oil was designated as Generally Recognized as Safe (GRAS) by an outside panel of scientific experts and their conclusion has been reviewed and accepted by the US Food and Drug Administration (FDA). This GRAS determination is for use in vegetable oil spreads and home cooking oil. In Japan, the Ministry of Health, Labour and Welfare has approved DAG oil to manage serum triglycerides after a meal, which leads to less build-up of body fat.

4 - Side Effects

Because DAG oil is digested the same way as conventional vegetable oils, the potential side effects are no different than those of conventional oil. In addition, studies with animals and human subjects have shown no adverse effects from single dose or long-term consumption of DAG-rich oil. It has also been found that fat soluble vitamins status is not affected by the consumption of DAG-rich oil.

5 – Research

Studies indicate that DAG oil has numerous health benefits, including reducing post-meal blood triglyceride levels . Clinical studies in Japan have also shown that DAG oil may increase overall metabolism, helping reduce the amount of fat already stored in the body.

6 - Sales suspended voluntarily

On September 16, 2009, Kao Corporation, maker of Econa Cooking Oil has voluntarily suspended sales of products containing DAG oil in Japan which includes cooking oil, mayonnaise, salad dressing, and pet food products, The company is cited as considering suspending the sales of Enova Brand Oil sold in North America. On the same day, Hagoromo Foods, maker of Sea Chicken brand of canned tuna, and Satonoyuki, maker of tofu products, have voluntarily suspended number of products made with Econa Cooking Oil sold in Japan.

7 - DAG Oil Brands Enova oil

Dippel's Oil

Dippel's Oil (some times known as Bone Oil) is a nitrogenous by-product of the destructive distillation of bone char . This liquid is dark colored and highly viscous with an unpleasant smell. The oil contains the organic compound pyrrole. It is named after its inventor, Johann Conrad Dippel.

Dippel's oil had a number of uses which are now mostly obsolete. It could be used as an alcohol denaturant, an ingredient in sheep dips, an animal repellent (trade named as "Renardine"), an insecticide, a chemical warfare harassing agent, and also had medicinal uses . By not being lethal, the oil was claimed to not be in breach of the Geneva Protocol. During the desert campaign of World War II, the oil was used to render wells undrinkable and thus deny their use to the enemy.

Dipteryx odorata



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- 1 Introduction
- 2 Biology of the tree
- 3 The seeds
- 4 Uses
- 5 Agricultural aspects
- 6 Social aspects
- 7 Herbal and mythological properties

1 - Introduction

Dipteryx odorata (commonly known as "cumaru" or "kumaru") is a species of floweringtree in the pea family, Fabaceae. That tree is native to Central America and northern South America. Its seeds are known as tonka beans (sometimes tonkin beans or tonquin beans). They are black and wrinkled and have a smooth, brown interior. Their fragrance is reminiscent of vanilla, almonds, cinnamon, and cloves.

The word "tonka" is taken from the Galibi (Carib) tongue spoken by natives of French Guiana; it also appears in Tupi, another language of the same region, as the name of the tree. The old genus name, *Coumarouna*, was formed from another Tupi name for tree, kumarú.

Scientific classification					
Kingdom:	Plantae				
(unranked):	Angiosperms				
(unranked):	Eudicots				
(unranked):	Rosids				
Order:	Fabales				
Family:	Fabaceae				
Genus:	Dipteryx				
Species:	D. odorata				
Binomial name					
<i>Dipteryx</i> (Aubl.) Willd.	odorata				
Synonyms					
<i>Coumarouna</i> <i>Coumarouna</i> (Benth.) <i>Dipteryx tetrap</i>	odorataAubl. tetraphylla Aubl. hylla Benth.				

2 - Biology of the tree

The tree itself grows up to 25 - 30 meters, with a trunk of up to one meter in diameter. The tree bark is smooth and gray whereas the wood is red. The leaves alternate and are pinnate with 3-6 leaflets. The leaves are leathery, glossy and dark green. The color of the flowers is rose. Each developed fruit contains one seed. D. odorata is pollinated by insects. The worst pests are the bats because they eat the pulpy flesh of the fruit. There are a few fungi known, which may cause problems: Anthostomella abdita, Diatrype ruficarnis, Macrophoma calvuligera and Myiocopron cubense.

3 - The seeds

The tonka seed contains coumarin, a chemical isolate from this plant, which also gave the name to it. The seeds contain about 1 to 3% of coumarin, rarely it can achieve 10 %. Coumarin is responsible for

the pleasant odor of the seeds and is used in the perfume industry. Coumarin is bitter to the taste, however, and, in large infused doses, it may cause hemorrhage and liver damage as well as it can paralyze the heart. It is there fore controlled as a food additive by many governments. Like a number of other plants, the tonka bean plant probably produces coumarin as a defense chemical. Radio-carbon dating of D. odorata stumps left by a large logging operation near Manaus by Niro Higuchi, Jeffrey Chambers and Joshua Schimel, showed that it was one of around 100 species which definitely live to over 1,000 years. Until their research, it had been assumed unlikely that any Amazonian tree could live to old age due to the conditions of the rain forest.

4 - Uses

Tonka beans had been used as a vanilla substitute, as a perfume, and in tobacco before being banned in some countries. They are used in some French cuisine (particularly, in desserts and stews) and in perfumes. Today, the main producers of the seeds are Venezuela and Nigeria.

Its use in food is banned in the United States by the Food and Drug Administration.^[5] Many anticoagulant prescription drugs, such as warfarin, are based on 4-hydroxycoumarin, a chemical derivative of coumarin initially isolated from this bean. Coumarin itself, however, does not have anticoagulant properties.

The beans were formerly also spelled "tonquin" and "tonkin", although it has no connection with Tonkin, now part of Vietnam.

Tonquin is still used today to flavor some pipe tobaccos like Dunhill Royal Yacht and Samuel Gawith 1792 Flake.

Cumaru, also known as Brazilian Teak, is an increasingly popular hardwood used for flooring in the United States. It has a very appealing natural color variation and is considered quite durable as it has a 3540 rating on the Janka Hardness Scale.

5 - Agricultural Aspects

Cumaru belongs to the emergent plants. It is a light-demanding calcifuge tree and grows on poor, well drained soils. The best growth is reached on fertile soils rich in humus. In the native region there is a mean annual temperature of 25 °C and approximately 2000 mm rainfall per year with a dry season from June to November . In general it has a very low plant density. But depending on the agricultural use the density and also the age of the trees diversifies. In seed production systems, the plant density is higher and the trees are older than in timber production systems. The tree is flowering from March to May, and the fruits ripen until June to July. So the fresh fruits are picked up in June and July, fallen pods are harvested from January to March^[2] or sometimes earlier. The hard outer shell is removed and the beans are spread out for 2-3 days to dry and after that they can be sold.^[2] The major producer is Venezuela, followed by Brazil and Colombia. The most important importing country are the United States. There it is used especially in the tobacco industry.

6 - Social aspects

This species is well known locally and generates an important income for rural families particularly as a buffer in times of hardship. It is used for timber and non - timber products and so it is crucial that the use of this resource occurs in a sustainable way. The yield of beans per tree is about 1 - 3.5 kg per year but Cumaru trees produce a large volume of seeds every four years. This fact results in a gender dynamic. During years of low seed productivity, household income is controlled by the women. They buy food and basic resources such as clothing and school supplies to sustain the family. In years of heavy production, men control the income. During those seasons they invest the earnings in higher cost goods including motorcycles and chainsaws.

7 - Herbal and mythological properties

In the pagan and occult communities, the tonka bean is considered to have magical properties and uses. Some who practice magical arts believe that by crushing a tonka bean and steeping it in an herbal brew or tea it will help cure ailments of depression, disorientation, confusion, and suicidal behavior, as well as boosting the immune system .

It is also believed by some practitioners of various occult traditions that tonka beans can grant or help one fulfill desires and wishes by using the bean in a variety of methods.^[9] Such methods include holding the bean in your hand while whispering a wish or desire, then carrying it with you until your wish or desire is fulfilled, then burying the bean afterwards. Another common method is by making your wish with the bean in your hand, then stomping on it afterwards. Other methods include making a wish, then planting it in fertile earth, with the belief that as the plant grows, so does the wish become fulfilled.

Dry Lubricant

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- 2 Structure function relationship
- 3 Applications
 - 3.1 Graphite
 - 3.2 Molybdenum disulfide
 - 3.3 Boron nitride
 - 3.4 Poly tetra fluor ethylene
- 4 Application methods
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 - 4.3 AF-coatings
 - 4.4 Composites

1 - Introduction

Dry lubricants or solid lubricants are materials which despite being in the solid phase, are able to reduce friction between two surfaces sliding against each other without the need for a liquid medium. The two main dry lubricants are graphite, molybdenum disulfide. They offer lubrication at temperatures higher than liquid and oil - based lubricants operate. Dry lubricants are often used in applications such as locks or dry lubricated bearings. Such materials can operate up to 350 °C in oxidizing environments and even higher in reducing / non - oxidizing environments (molybdenum disulfide up to 1100 °C . The low-friction characteristics of most dry lubricants are attributed to a layered structure on the molecular level with weak bonding between layers. Such layers are able to slide relative to each other with minimal applied force, thus giving them their low friction properties. However, a layered crystal structure alone is not necessarily sufficient for lubrication. In fact, there are also some solids with non-lamellar structures that function well as dry lubricants in some applications. These include certain soft metals (indium, lead, silver, tin), poly tetra fluro ethylene, some solid oxides, rare-earth fluorides, and even diamond[•]

Limited interest has been shown in low friction properties of compacted oxide glaze layers formed at several hundred degrees Celsius in metallic sliding systems. However, practical use is still many years away due to their physically unstable nature.

The four most commonly used solid lubricants are :

Graphite. Used in air compressors, food industry, railway track joints, open gear, ball bearings, machine-shop works etc. It is also very common for lubricating locks, since a liquid lubricant allows particles to get stuck in the lock worsening the problem.

Molybdenum disulfide. Used in CV joints and space vehicles. Does lubricate in vacuum.

Hexagonal boron nitride. Used in space vehicles. Also called "white graphite".

Tungsten disulfide. Similar usage as molybdenum disulfide, but due to the high cost only found in some dry lubricated bearings.

Graphite and molybdenum disulfide (MoS_2) are the predominant materials used as dry lubricants.

2 – Structure - function relationship

The lubricity of many solids is attributable to a lamellar structure. The lamellae orient parallel to the surface in the direction of motion and slide easily over each other resulting in low friction and preventing contact between sliding components even under high loads. Large particles perform best on rough surfaces at low speed, finer particles on smoother surfaces and at higher speeds. These materials may also be added in the form of dry powder to liquid lubricants to modify or enhance their properties.

Other components that are useful solid lubricants include boron nitride, poly tetra fluor ethylene (PTFE), talc, calcium fluoride, cerium fluoride, and tungsten disulfide.

3 – Applications

Solid lubricants are useful for conditions when conventional lubricants are inadequate, such as :

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Reciprocating motion. A typical application is a sliding or reciprocating motion that requires lubrication to minimize wear as for example in gear and chain lubrication. Liquid lubricants will squeezed out while solid lubricants do not escape and prevent for fretting corrosion and galling.

Ceramics. Another application is for cases where chemically active lubricant additives have not been found for a particular surface, such as polymers and ceramics.

High temperature. Graphite and MoS_2 act as lubricants at high temperature and in oxidizing atmosphere environments, whereas liquid lubricants typically will not survive. A typical application include fasteners which are easily tightened and unscrewed after a long stay at high temperatures.

Extreme contact pressures. The lamellar structure orient parallel to the sliding surface resulting in high bearing-load combined with a low shear stress. Most applications in metal forming that involve plastic deformation will utilize solid lubricants.

3 – 1 – Graphite

Graphite is structurally composed of planes of polycyclic carbon atoms that are hexagonal in orientation. The distance of carbon atoms between planes is longer and therefore the bonding is weaker.

Graphite is best suited for lubrication in air. Water vapor is a necessary component for graphite lubrication. The adsorption of water reduces the bonding energy between the hexagonal planes of the graphite to a lower level than the adhesion energy between a substrate and the graphite. Because water vapor is a requirement for lubrication, graphite is not effective in vacuum.^[2] In an oxidative atmosphere graphite is effective at high temperatures up to 450°C continuously and can withstand much higher temperature peaks. The thermal conductivity of graphite is generally low: approximately 1.3 W / mK at 40 °C.

Graphite is characterized by two main groups: natural and synthetic. Synthetic graphite is a high temperature sintered product and is characterized by its high purity of carbon (99.5–99.9%). The primary grade synthetic graphite can approach the good lubricity of quality natural graphite.

Natural graphite is derived from mining. The quality of natural graphite varies as a result of the ore quality and post mining processing of the ore. The end product is graphite with a content of carbon (high grade graphite 96 – 98 % carbon), sulfur, SiO₂ and ash. The higher the carbon content and the degree of graphitization (high crystalline) the better the lubricity and resistance to oxidation.

For applications where only a minor lubricity is needed and a more thermally insulating coating is required, then amorphous graphite would be chosen (80 % carbon).

3 – 2 - Molybdenum disulfide

 MoS_2 is a material found in the thin within granite and highly refined in order to achieve a purity suitable for lubricants. Like graphite, MoS_2 has a hexagonal crystal structure with the intrinsic property of easy shear. MoS_2 lubrication performance often exceeds that of graphite and is effective in vacuum as well whereas graphite does not. The temperature limitation of MoS_2 at 400 °C is restricted by oxidation. The particle size and film thickness are important parameters that should be matched to the surface roughness of the substrate. Large particles may result in excessive wear by abrasion caused by impurities in the MoS_2 , small particles may result in accelerated oxidation.

3 – 3 - Boron nitride

Boron nitride is a ceramic powder lubricant. The most interesting lubricant feature is its high temperature resistance of 1200 °C service temperature in an oxidizing atmosphere. Furthermore, boron has a high thermal conductivity. Boron is available in two chemical structures, i.e. cubic and hexagonal where the last is the lubricating version. The cubic structure is very hard and used as an abrasive and cutting tool component.

3 – 4 – Poly tetra fluor ethylene

Poly tetra fluor ethylene (PTFE) is widely used as an additive in lubricating oils and greases. Due to the low surface energy of PTFE, stable unflocculated dispersions of PTFE in oil or water can be produced. Contrary to the other solid lubricants discussed, PTFE does not have a layered structure. The macro molecules of PTFE slip easily along each other, similar to lamellar structures. PTFE shows one of the smallest coefficients of static and dynamic friction, down to 0.04. Operating temperatures are limited to about 260 °C.

4 - Application methods

4 – 1 - Spraying/dipping / brushing

Dispersion of solid lubricant as an additive in oil, water or grease is most common used. For parts that are inaccessible for lubrication after assembly a dry film lubricant can be sprayed. After the solvent evaporates, the coating cures at room temperature to form a solid lubricant. Pastes are grease like lubricants containing a high percentage of solid lubricants used for assembly and lubrication of highly loaded, slow moving parts. Black pastes generally contain MoS₂. For high temperatures above 500 °C pastes are composed on the basis of metal powders to protect metal parts from oxidation necessary to facilitate disassembly of threaded connections and other assemblies

4 – 2 - Free powders

Dry - powder tumbling is an effective application method. The bonding can be improved by prior phosphating of the substrate. Use of free powders has its limitations, since adhesion of the solid particles to the substrate is usually insufficient to provide any service life in continuous applications. However, to improve running-in conditions or in metal forming processes a short duration of the improved slide conditions may suffice.

4 – 3 - AF – coatings

Anti - Friction (AF) coatings are "lubricating paints" consisting of fine particles of lubricating pigments, such as molydisulfide, PTFE or graphite, blended with a binder. After application and proper curing, these lubricants bond to the metal surface and form a dark gray solid film. Many dry film lubricants also contain special rust inhibitors which offer exceptional corrosion protection. Most long wearing films are of the bonded type but are still restricted to applications where sliding distances are not too long. AF-coatings are applied where fretting and galling is a problem (such as splines, universal joints and keyed bearings), where operating pressures exceed the load-bearing capacities of ordinary oils and greases, where smooth running in is desired (piston, camshaft), where clean operation is desired (AF-coatings will not collect dirt and debris like greases and oils), where parts may be stored for long periods of time.

4 – 4 – Composites

Self lubricating composites : Solid lubricants as PTFE, graphite, MoS_2 and some other anti friction and anti wear additives are often compounded in polymers and all kind of sintered materials. MoS_2 for example is compounded in materials for sleeve bearings, elastomere O-rings, carbon brushes etc. Solid lubricants are compounded in plastics to form a "self-lubricating" or "internally lubricated" thermoplastic composite. PTFE particles for example compounded in the plastic form a PTFE film over the mating surface resulting in a reduction of friction and wear. MoS_2 compounded in nylon reduces wear, friction and stick-slip. Furthermore it acts as a nucleating agent effecting in a very fine crystalline structure. The primary use of graphite lubricated thermoplastics is in applications operating in aqueous environments.

Drying Oil

Contents

1 Introduction

2 Chemistry of the drying process

2.1 Role of metal catalysts

- 3 Constitution of drying oils
- 4 Comparison to waxes and resins

5 Safety

1 - Introduction

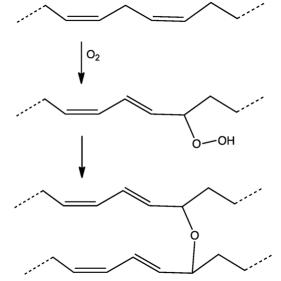
A drying oil is an oil that hardens to a tough, solid film after a period of exposure to air. The oil hardens through a chemical reaction in which the components crosslink by the action of oxygen (not through the evaporation of water or other solvents). Drying oils are a key component of oil paint and some varnishes. Some commonly used drying oils include linseed oil, tung oil, poppy seed oil, perilla oil, and walnut oil. Their use has declined over the past several decades, as they have been replaced by alkyd resins and other binders.

Since oxidation is the key to curing in these oils, those that are susceptible to chemical drying are often unsuitable for cooking, and are also highly susceptible to becoming rancid due to autoxidation, the process by which fatty foods develop off-flavors.^[1] Rags, cloth, and paper saturated with drying oils may combust spontaneously (ignite) in a few hours, due to accumulation of heat released during the oxidation process.

2 - Chemistry of the drying process

The "drying", hardening, or, more properly, curing of oils is the result of autoxidation, the addition of oxygen to an organic compound and the subsequent crosslinking. This process begins with an oxygen molecule (O_2) in the air inserting into carbon-hydrogen (C-H) bonds adjacent to one of the double bonds within the unsaturated fatty acid. The resulting hydro peroxides are susceptible to crosslinking reactions. Bonds form between neighboring fatty acid chains, resulting in a polymer network, often visible by formation of a skin-like film on samples. This polymerization results in stable films that,

while somewhat elastic, do not flow or deform readily. Dienecontaining fatty acid derivatives, such as those derived from linoleic acid, are especially prone to this reaction because they generate pentadienyl radicals. Monounsaturated fatty acids, such as oleic acid, are slower to undergo drying because the allylic radical intermediates are less stable (i.e., slower to form).



Simplified chemical reactions associated with cobalt-catalyzed drying process. In the first step, the diene undergoes autoxidation to give a hydro peroxide. In the second step, the hydro peroxide combines with another unsaturated side chain to generate a carbon-based radical that is capable of further polymerization.

The early stages of the drying process can be monitored by weight changes in an oil film. The film becomes heavier as it absorbs oxygen. Linseed oil, for instance, increases in weight by 17 percent.^[3] As oxygen uptake ceases, the weight of the film declines as volatile compounds evaporate. As the oil ages, further transitions occur. A large number of the original ester bonds in the oil molecules undergo hydrolysis, releasing individual fatty acids. In the case of paints, some portion of these free fatty acids (FFAs) react with metals in the pigment, producing metal carboxylates. Together, the various non-cross-linking substances associated with the polymer network constitute the mobile phases. Unlike the molecules that are part of the network itself, they are capable of moving and diffusing within the film, and can be removed using heat or a solvent. The mobile phase

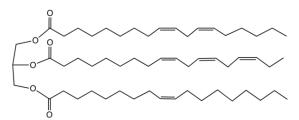
may play a role in plasticizing paint films, preventing them from becoming too brittle. Carboxyl groups in the polymers of the stationary phase ionize, becoming negatively charged and form complexes with metal cations present in the pigment. The original network, with its nonpolar, covalent bonds, is replaced by an ionomeric structure, held together by ionic interactions. The structure of these ionomeric networks is not well under stood.

Most drying oils rapidly increase in viscosity after heating in the absence of air. If the oil is subjected to raised temperatures for a long time, it will become a rubbery oil-insoluble substance.

2 – 1 - Role of metal catalysts

The drying process is accelerated by certain metal salts, especially derivatives of cobalt, manganese, or iron. In technical terms, these oil drying agents are coordination complexes that function as homogeneous catalysts. These salts are derived from the carboxylates of lipophilic carboxylic acids, such as naphthenic acids to make the complexes oil-soluble. These catalysts speed up the reduction of the hydroperoxide intermediates. A series of addition reactions ensues. Each step produces additional free radicals, which then engage in further crosslinking. The process finally terminates when pairs of free radicals combine. The polymerization occurs over a period of days to years and renders the film dry to the touch. Premature action of the drying agents causes skinning of the paint, this undesirable process is suppressed by the addition of antiskinning agents such as methylethyl ketone oxime, which evaporate when the paint/oil is applied to a surface.

3 - Constitution of drying oils



Representative triglyceride found in a drying oil. The triester is derived from three different unsaturated fatty acids, linoleic (top),

alpha - linolenic (middle), and oleic acids (bottom). The order of drying rate is linolenic > linoleic > oleic acid, reflecting their degree of unsaturation.

Drying oils consist of glycerol tri esters of fatty acids. These esters are characterized by high levels of polyunsaturated fatty acids, especially alpha-linolenic acid. One common measure of the "siccative" (drying) property of oils is iodine number, which is an indicator of the number of double bonds in the oil. Oils with an iodine number greater than 130 are considered drying, those with an iodine number of 115-130 are semi-drying, and those with an iodine number of less than 115 are non - drying.

4 - Comparison to waxes and resins

Non -"drying" waxes, such as hard - film carnauba or paste wax, and resins, such as dammar, copal, and shellac, consist of long, spaghetti-like strands of hydrocarbon molecules, which interlace and compact but do not form covalent bonds in the manner of drying oils. Thus, waxes and resins are re - dissoluble whereas a cured oil varnish or paint is not.

5 – Safety

Rags, cloth, and paper saturated with drying oils may combust spontaneously (ignite) due to heat released during the curing process. This hazard is greater when oil-soaked materials are folded, bunched, or piled together, which allows heat to accumulate and accelerate the reaction. Precautions include: wetting rags with water and spreading them away from direct sunlight; closing them off completely in water inside air-tight metal containers designed for such applications; or storing them immersed in solvents in suitable closed containers.

Although spontaneous combustion has been said to occur rags soaked in paint thinners, this is not true unless a drying oil is used as a thinner. However, classical paint thinners do not include drying oils. The danger is due to rags soaked in oil based paints, as it is due to the drying oils in the paints (or varnishes), not thinners *per se* unless they have been mixed with drying oils such as linseed.

Vegetable Oil

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- 4 Particular oils
 - 4.1 Composition of fats
- 5 History in North America
- 6 Used oil
- 7 Negative health effects
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1 - Introduction

A vegetable oil is a triglyceride extracted from a plant. Such oils have been part of human culture for millennia . The term "vegetable oil" can be narrowly defined as referring only to substances that are liquid at room temperature, or broadly defined without regard to a substance's state of matter at a given temperature . For this reason, vegetable oils that are solid at room temperature are sometimes called vegetable fats. Vegetable oils are composed of triglycerides, as contrasted with waxes which lack glycerin in their structure. Although many plant parts may yield oil, in commercial practice, oil is extracted primarily from seeds.

On food packaging, the term "vegetable oil" is often used in ingredients lists instead of specifying the exact plant being used.

2 - Uses of triglyceride vegetable oil

Oils extracted from plants have been used since ancient times and in many cultures. As an example, in a 4,000 – year - old "kitchen" unearthed in Indiana's Charlestown State Park, archaeologist Bob McCullough of Indiana University-Purdue University Fort Wayne found evidence that natives used large slabs of rock to crush hickory nuts, then boiled them in water to extract the oil.

2 – 1 - Culinary uses

Many vegetable oils are consumed directly, or indirectly as ingredients in food - a role that they share with some animal fats, including butter and ghee. The oils serve a number of purposes in this role :

Shortening – to give pastry a crumbly texture.

Texture – oils can serve to make other ingredients stick together less.

Flavor – while less - flavorful oils command premium prices' some oils , such as olive, sesame, or almond oil, may be chosen specifically for the flavor they impart.

Flavor base – oils can also "carry" flavors of other ingredients, since many flavors are present in chemicals that are soluble in oil.

Secondly, oils can be heated and used to cook other foods. Oils suitable for this objective must have a high flash point. Such oils include the major cooking oils – soybean, canola, sunflower, safflower, peanut, cottonseed, etc. Tropical oils, such as coconut, palm, and rice bran oils, are particularly valued in Asian cultures for high temperature cooking, because of their unusually high flash point.

2 – 2 - Hydrogenated oils :

Unsaturated vegetable oils can be transformed through partial or complete "hydrogenation" into oils of higher melting point. The hydrogenation process involves "sparging" the oil at high temperature and pressure with hydrogen in the presence of a catalyst, typically a powdered nickel compound. As each carbon – carbon double - bond is chemically reduced to a single bond, two hydrogen atoms each form single bonds with the two carbon atoms. The elimination of double bonds by adding hydrogen atoms is called saturation; as the degree of saturation increases, the oil progresses toward being fully hydrogenated. An oil may be hydrogenated to increase resistance to rancidity (oxidation) or to change its physical characteristics. As the degree of saturation increases, the oil's viscosity and melting point increase.

The use of hydrogenated oils in foods has never been completely satisfactory. Because the center arm of the triglyceride is shielded somewhat by the end fatty acids, most of the hydrogenation occurs on the end fatty acids, thus making the resulting fat more brittle A margarine made from naturally more saturated oils will be more plastic (more "spreadable") than a margarine made from hydrogenated soy oil While *full hydrogenation* produces largely saturated fatty acids, partial hydrogenation results in the transformation of unsaturated cis fatty acids to trans fatty acids in the oil mixture due to the heat used in hydrogenation. Partially hydrogenated oils and their trans fats have been linked to an increased risk of mortality from coronary heart disease (CHD)., among other increased health risks.

In the US, the Standard of Identity for a product labeled as "vegetable oil margarine" specifies only canola, safflower, sunflower, corn, soybean, or peanut oil may be used . Products not labeled "vegetable oil margarine" do not have that restriction.

2 – 3 - Industrial uses

Vegetable oils are used as an ingredient or component in many manufactured products.

Many vegetable oils are used to make soaps, skin products, candles, perfumes and other personal care and cosmetic products. Some oils are particularly suitable as drying oils, and are used in making paints and other wood treatment products. Dammar oil (a mixture of linseed oil and dammar resin), for example, is used almost exclusively in treating the hulls of wooden boats. Vegetable oils are

increasingly being used in the electrical industry as insulators as vegetable oils are not toxic to the environment, biodegradable if spilled and have high flash and fire points. However, vegetable oils are less stable chemically, so they are generally used in systems where they are not exposed to oxygen, and they are more expensive than crude oil distillate. Synthetic tetra esters, which are similar to vegetable oils but with four fatty acid chains compared to the normal three found in a natural ester, are manufactured by Fischer esterification. Tetra esters generally have high stability to oxidation and have found use as engine lubricants. Vegetable oil is being used to produce biodegradable hydraulic fluid and lubricant.

One limiting factor in industrial uses of vegetable oils is that all such oils eventually chemically decompose, turning rancid. Oils that are more stable, such as ben oil or mineral oil, are preferred for some industrial uses.

Vegetable - based oils, like castor oil, have been used as medicine and as lubricants for a long time. Castor oil has numerous industrial uses, primarily due to the presence of hydroxyl groups on the fatty acid chains. Castor oil, and other vegetable oils which have been chemically modified to contain hydroxyl groups, are becoming increasingly important in the production of polyurethane plastic for many applications. These modified vegetable oils are known as natural oil polyols.

2-4 - Pet food additive

Vegetable oil is used in production of some pet foods. AAFCO defines vegetable oil, in this context, as the product of vegetable origin obtained by extracting the oil from seeds or fruits which are processed for edible purposes. In some poorer grade pet foods, the oil is listed only as "vegetable oil", without specifying the particular oil.

2 – 5 – Fuel

Vegetable oils are also used to make biodiesel, which can be used like conventional diesel. Some vegetable oil blends are used in unmodified vehicles but straight vegetable oil, also known as pure plant oil, needs specially prepared vehicles which have a method of heating the oil to reduce its viscosity. The vegetable oil economy is growing and the availability of biodiesel around the world is increasing.

The NNFCC estimate that the total net greenhouse gas savings when using vegetable oils in place of fossil fuel-based alternatives for fuel production , range from 18 to 100 %.

3 – Production

The production process of vegetable oil involves the removal of oil from plant components, typically seeds. This can be done via mechanical extraction using an oil mill or chemical extraction using a solvent. The extracted oil can then be purified and, if required, refined or chemically altered.

3 – 1 - Mechanical extraction

Oils can also be removed via mechanical extraction, termed "crushing" or "pressing." This method is typically used to produce the more traditional oils (e.g., olive, coconut etc.), and it is preferred by most "health - food" customers in the United States and in Europe . There are several different types of mechanical extraction. Expellerpressing extraction is common, though the screw press, ram press, and Ghani (powered mortar and pestle) are also used. Oil seed presses are commonly used in developing countries, among people for whom other extraction methods would be prohibitively expensive; the Ghani is primarily used in India . The amount of oil extracted using these methods varies widely, as shown in the following table for extracting mowrah butter in India :

Percentage extracted
20-30 %
34 – 37 %
40-43 %

3 – 2 - Solvent extraction

The processing vegetable oil in commercial applications is commonly done by chemical extraction, using solvent extracts, which produces higher yields and is quicker and less expensive. The most common solvent is petroleum-derived hexane. This technique is used for most of the "newer" industrial oils such as soybean and corn oils.

Supercritical carbon dioxide can be used as a non - toxic alternative to other solvents .

3 – 3 – Hydrogenation

Oils may be partially hydrogenated to produce various ingredient oils. Lightly hydrogenated oils have very similar physical characteristics to regular soy oil, but are more resistant to becoming rancid. Margarine oils need to be mostly solid at 32 °C so that the margarine does not melt in warm rooms, yet it needs to be completely liquid at 37 °C. so that it doesn't leave a "lardy" taste in the mouth.

Hardening vegetable oil is done by raising a blend of vegetable oil and a catalyst in near-vacuum to very high temperatures, and introducing hydrogen. This causes the carbon atoms of the oil to break double - bonds with other carbons, each carbon forming a new single - bond with a hydrogen atom. Adding these hydrogen atoms to the oil makes it more solid, raises the smoke point, and makes the oil more stable.

Hydrogenated vegetable oils differ in two major ways from other oils which are equally saturated. During hydrogenation, it is easier for hydrogen to come into contact with the fatty acids on the end of the triglyceride, and less easy for them to come into contact with the center fatty acid. This makes the resulting fat more brittle than a tropical oil; soy margarines are less "spreadable"^[compared to?]. The other difference is that trans fatty acids (often called trans fat) are formed in the hydrogenation reactor, and may amount to as much as 40 percent by weight of a partially hydrogenated oil. Hydrogenated oils, especially partially hydrogenated oils with their higher amounts of trans fatty acids are increasingly thought to be unhealthy.

3-4-Sparging

In the processing of edible oils, the oil is heated under vacuum to near the smoke point, and water is introduced at the bottom of the oil. The water immediately is converted to steam, which bubbles through the oil, carrying with it any chemicals which are watersoluble. The steam sparging removes impurities that can impart unwanted flavors and odors to the oil.

4 - Particular oils

The following triglyceride vegetable oils account for almost all worldwide production, by volume. All are used as both cooking oils and as SVO or to make biodiesel. According to the USDA, the total world consumption of major vegetable oils in 2007/08 was :

Oil source	World consumption (million metric tons)	Notes
Palm	41.31	The most widely produced tropical oil, also used to make biofuel
Soybean	41.28	Accounts for about half of worldwide edible oil production
Rapeseed	18.24	One of the most widely used cooking oils, canola is a variety (cultivar) of rapeseed
Sunflower seed	9.91	A common cooking oil, also used to make biodiesel
Peanut	4.82	Mild-flavored cooking oil
Cottonseed	4.99	A major food oil, often used in industrial food processing
Palm kernel	4.85	From the seed of the African palm tree
Coconut	3.48	Used in soaps and cooking
Olive	2.84	Used in cooking, cosmetics, soaps and as a fuel for traditional oil lamps

Note that these figures include industrial and animal feed use. The majority of European rapeseed oil production is used to produce biodiesel, or used directly as fuel in diesel cars which may require modification to heat the oil to reduce its higher viscosity. The suitability of the fuel should come as little surprise, as Rudolf Diesel originally designed his engine to run on peanut oil.

Other significant triglyceride oils include :

Corn oil, one of the most common cooking oils. As of 2006 the US produced about 1.09 million metric tons of corn oil, which is used for cooking oil, salad dressing, margarine, mayonnaise, prepared goods like spaghetti sauce and baking mixes, and to fry prepared foods like potato chips and French fries .

Grape seed oil, used in cooking and cosmetics Hazelnut and other nut oils Linseed oil, from flax seeds Rice bran oil, from rice grains Safflower oil, a flavorless and colorless cooking oil

Sesame oil, used as a cooking oil, and as a massage oil, particularly in India

Vegetable oils							
Туре		Mana	Polyunsaturated fatty acids			Olaia	
		unsaturated fatty acids	Total poly	linolenic acid (ω-3)	Linoleic acid (ω-6)	Oleic acid (ω-9)	Smoke point
Not hydrogenated							
Canola (rapeseed)	7.365	63.276	28.142	9-11	19-21	-	400 °F (204 °C) ^[20]
Coconut	91.00	6.000	3.000	-	2	6	350 °F (177 °C) ^[20]
Corn	12.948	27.576	54.677	1	58	28	450 °F (232 °C) ^[21]
Cottonseed	25.900	17.800	51.900	1	54	19	420 °F (216 °C) ^[21]
Flaxseed/Linseed (European) ^[22]	6 - 9	10 - 22	68 - 89	56 - 71	12 - 18	10 - 22	225 °F (107 °C)
Olive	14.00	72.00	14.00	<1.5	9–20	-	380 °F (193 °C) ^[20]

4 – 1 - Composition of fats

Vegetable oils							
Palm	49.300	37.000	9.300	-	10	40	455 °F (235 °C) ^[23]
Peanut	16.900	46.200	32.000	-	32	48	437 °F (225 °C) ^[21]
Safflower (>70% linoleic)	8.00	15.00	75.00	-	-	-	410 °F (210 °C) ^[20]
Safflower (high oleic)	7.541	75.221	12.820	-	-	-	410 °F (210 °C) ^[20]
Soybean	15.650	22.783	57.740	7	50	24	460 °F (238 °C) ^[21]
Sunflower (<60% linoleic)	10.100	45.400	40.100	0.200	39.800	45.300	440 °F (227 °C) ^[21]
Sunflower (>70% oleic)	9.859	83.689	3.798	-	-	-	440 °F (227 °C) ^[21]
Fully hydrogenated							
Cottonseed (hydrog.)	93.600	1.529	.587		.287 ^[19]		
Palm (hydrogenated)	47.500	40.600	7.500				
Soybean (hydrogen.)	21.100	73.700	.400	.096 ^[19]			
Values as percent (%) by weight of total fat.							

5 - History in North America

While olive oil and other pressed oils have been around for millennia, Procter & Gamble researchers were innovators when they started selling cottonseed oil as a creamed shortening, in 1911. Ginning mills were happy to have someone haul away the cotton seeds. Procter & Gamble researchers learned how to extract the oil, refine it, partially hydrogenate it (causing it to be solid at room temperature and thus mimic natural lard), and can it under nitrogen gas. Compared to the rendered lard Procter & Gamble was already selling to consumers, Crisco was cheaper, easier to stir into a recipe, and could be stored at room temperature for two years without turning rancid.

Soybeans were an exciting new crop from China in the 1930s. Soy was protein-rich, and the medium viscosity oil was high in polyunsaturates. Henry Ford established a soybean research laboratory, developed soybean plastics and a soy-based synthetic wool, and built a car "almost entirely" out of soybeans.^[24] Roger Drackett had a successful new product with Windex, but he invested heavily in soybean research, seeing it as a smart investment.^[25] By the 1950s and 1960s, soybean oil had become the most popular vegetable oil in the US.

In the mid - 1970s, Canadian researchers developed a low-erucic - acid rapeseed cultivar. Because the word "rape" was not considered optimal for marketing, they coined the name "canola" (from "Canada Oil low acid"). The U.S. Food and Drug Administration approved use of the canola name in January 1985, and U.S. farmers started planting large areas that spring. Canola oil is lower in saturated fats, and higher in mono un saturates and is a better source of omega-3 fats than other popular oils. Canola is very thin (unlike corn oil) and flavorless (unlike olive oil), so it largely succeeds by displacing soy oil, just as soy oil largely succeeded by displacing cottonseed oil.

6 - Used oil

A large quantity of used vegetable oil is produced and recycled, mainly from industrial deep fryers in potato processing plants, snack food factories and fast food restaurants.

Recycled oil has numerous uses, including use as a direct fuel, as well as in the production of biodiesel, soap, animal feed, pet food, detergent, and cosmetics. It's traded as the commodity, yellow grease.

Since 2002, an increasing number of European Union countries have prohibited the inclusion of recycled vegetable oil from catering in animal feed. Used cooking oils from food manufacturing, however, as well as fresh or unused cooking oil, continue to be used in animal feed.

- Negative health effects

Hydrogenated oils have been shown to cause what is commonly termed the "double deadly effect", raising the level of LDLs and decreasing the level of HDLs in the blood, increasing the risk of blood clotting inside blood vessels. A high consumption of oxidized polyunsaturated fatty acids (PUFAs), which are found in most types of vegetable oil (e.g. soybean oil, corn oil – the most consumed in USA, sunflower oil, etc.) may increase the likelihood that postmenopausal women will develop breast cancer. A similar effect was observed on prostate cancer and skin cancer in mice .

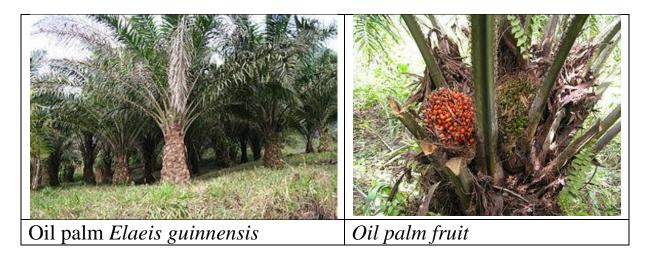
Vegetables oils high in poly un saturated fatty acids cause inflammation of the cells and may lead to a digestive disease and eventually cancer. The main reason is that the polyunsaturated fatty acids in vegetable oils auto oxidize during food processing when exposed to oxygen and/or UV radiation; resulting in the auto production of inflammatory peroxides and hydroperoxides from polyunsaturated fatty acids.

8 - Product labeling

There is increasing concern that the product labeling that includes "vegetable fat" or "vegetable oil" in its list of ingredients masks the identity of the fats or oils present. This has been made more pressing as concerns have been raised over the social and environmental impact of palm oil in particular, especially given the predominance of palm oil.

From 13th December 2014 all food products produced in the European Union will be legally required to indicate the specific vegetable oil used in their manufacture, following the introduction of the Food Information to Consumers Regulation

Elaeis Guineensis (African Oil Palm)



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1 - Introduction

Elaeis guineensis is a species of palm commonly called African oil palm or macaw - fat . It is the principal source of palm oil. It is native to west and southwest Africa, occurring between Angola and Gambia; the species name *guineensis* refers to one of its countries of origin, Guinea. The closely related American oil palm *Elaeis oleifera* is also used to a lesser extent to produce palm oil, and a more distantly related palm *Attalea maripa* is another oil - producing palm.

Human use of oil palms may date as far back as 5,000 years in West Africa; in the late 1800s, archaeologists discovered palm oil in a tomb at Abydos dating back to 3,000 BCE. It is thought that that Arab traders brought the oil palm to Egypt.

Scientific classification		
Kingdom:	Plantae	
Family:	Arecaceae	
Subfamily:	Arecoideae	
Tribe:	Cocoeae	
Genus:	Elaeis	
Species:	E. guineensis	
Binomial name		
Elaeis guineensis Jacq.		
Synonyms		
Elaeis dybowskiiHua E. macrophyllaA.Chev. E. madagascariensis E. melanococcaGaertn. E. nigrescens E. virescens		

2 - Description

Mature palms are single-stemmed, and grow to 20 m tall. The leaves are pinnate, and reach between 3-5 m long. A young palm produces about 30 leaves a year. Established palms over 10 years produce about 20 leaves a year. The flowers are produced in dense clusters; each individual flower is small, with three sepals and three petals.

The palm fruit takes five to six months to mature from pollination to maturity. It is reddish, about the size of a large plum, and grows in large bunches. Each fruit is made up of an oily, fleshy outer layer (the pericarp), with a single seed (the palm kernel), also rich in oil. When ripe, each bunch of fruit weighs 40 - 50 kg.

3 - Planting

For each hectare of oil palm, which is harvested year-round, the annual production averages 10 tones of fruit yielding 3,000 kg of palm oil and 750 kg of seed kernels yielding 250 kg of high quality palm kernel oil, as well as 500 kg of kernel meal. Palm fronds and kernel meal are processed for use as livestock feed.

All modern, commercial planting material consists of tenera palms or DxP hybrids, which are obtained by crossing thickshelled dura with shell - less pisifera. Although common commercial germinated seed is as thick-shelled as the dura mother palm, the resulting palm will produce thin - shelled tenera fruit. An alternative to germinated seed, once constraints to mass production are overcome, is tissue-cultured or "clonal" palms, which provide "true copies" of high yielding DxP palms.

An oil palm nursery must have an uninterrupted supply of clean water and topsoil which is both well-structured and sufficiently deep to accommodate three rounds of on-site bag-filling. Approximately 35 ha can grow enough seedlings over a three-year period to plant a 5,000-ha plantation. Prenursery seedlings must be watered daily. Whenever rainfall is less than 10 mm per day, irrigation is required, and the system must be capable of uniformly applying 6.5 mm water per day.

Prenursery seedlings in the four-leaf stage of development (10 to 14 weeks after planting) are usually transplanted to the main nursery, after their gradual adjustment to full sunlight and rigid selection process. During culling, seedlings that have "grassy", "crinkled", "twisted", or "rolled" leaves are discarded.

Weeds growing in the polybags must be carefully pulled out. Herbicides should not be used. Numerous insects (ants, armyworms, bagworms, aphids, thrips, mites, grasshoppers, and mealybugs) and vertebrates (rats, squirrels, porcupines, wild boar, monkeys) are pests in oil palm nurseries and must be carefully identified before control measures are implemented.

After eight months in the nursery, normal healthy plants should be 0.8 - 1 m in height and display five to eight functional leaves.

The proper approach to oil palm development begins with the establishment of leguminous cover plants, immediately following land clearing. They help prevent soil erosion and surface run-off, improve soil structure and palm root development, increase the response to mineral fertilizer in later years, and reduce the danger of micronutrient deficiencies. Leguminous cover plants also help prevent outbreaks of *Oryctes* beetles, which nest in exposed decomposing vegetation. Both phosphorus and potassium fertilizers are needed to maximize the leguminous cover plants' symbiotic nitrogen-fixation potential of approximately 200 kg nitrogen/ha/yr, and are applied to most soils at 115 to 300 kg phosphorus oxide/ha and 35 to 60 kg potassium oxide/ha. Young palms are severely set back where grasses are allowed to dominate the inter-row vegetation, particularly on poor soils where the correction of nutrient deficiencies is difficult and costly.

4 - Crop nutrient

Nutrient uptake is low during the first year, but increases steeply between year one and year three (when harvesting commences) and stabilizes around years five to six. Early applications of fertilizer, better planting material, and more rigid culling has led to a dramatic increase in early yields in third to sixth years from planting. In regions without any serious drop in rainfall, yields of over 25 tonnes of fresh fruit bunches per hectare have been achieved in the second year of harvesting.

Nitrogen deficiency is usually associated with conditions of water-logging, heavy weed infestation and topsoil erosion. Symptoms are a general paling and stiffening of the pinnae, which lose their glossy lustre. Extended deficiency will reduce the number of effective fruit bunches produced, as well as the bunch size.

Phosphorus - deficient leaves do not show specific symptoms, but frond length, bunch size and trunk diameter are all reduced.

Potassium deficiency is very common and is the major yield constraint in sandy or peaty soils. The most frequent symptom is "confluent orange spotting". Pale green spots appear on the pinnae of older leaves; as the deficiency intensifies, the spots turn orange or reddish-orange and desiccation sets in, starting from the tips and outer margins of the pinnae. Other symptoms are "orange blotch" and "midcrown yellowing". In soils having a low water-holding capacity (sands and peats), potassium deficiency can lead to a rapid, premature desiccation of fronds.

Copper deficiency is common on deep peat soils and occurs also on very sandy soils. It appears initially as whitish-yellow mottling of younger fronds. As the deficiency intensifies, yellow, mottled, interveinal stripes appear, and rusty, brown spots develop on the distal ends of leaflets. Affected fronds and leaflets are stunted and leaflets dry up. On sandy soils, palms recover rapidly after a basal application of 50 grams of copper sulphate. On peat soils, lasting correction of copper deficiency is difficult, as applied copper sulphate is rendered unavailable. A promising method to correct copper deficiency on peat soil is to mix copper sulphate with clay soil and to form tennis-ball sized "copper mudballs" that are placed around the palm to provide a slow-release source of available copper.

Healthy, well selected seedlings are necessary for early and sustained high yield. In most cases, granular multinutrient compound fertilizers are the preferred nutrient source for seedlings in the nursery. Where subsoil is used to fill the polybags, extra dressings of Kieserite may be required (10 - 15 g every six to eight weeks). Where compound fertilizers are not available, equivalent quantities of straight materials should be used.

To maintain good fertilizer response and high yields in older palms, (selective) thinning is often necessary.

5 – Cross - breeding

Unlike other relatives, oil palms do not produce offshoots; propagation is by sowing the seeds.

Several varieties and forms of *Elaeis guineensis* have been selected that have different characteristics. These include :

E. guineensis fo. dura E. guineensis var. pisifera E, guineensis fo. tenera

Before the Second World War, selection work had started in the Deli dura population in Malaya. Pollen was imported from Africa, and DxT and DxP crosses were made. Segregation of fruit forms in crosses made in the 1950s was often incorrect. In the absence of a good marker gene, there was no way of knowing whether control of pollination was adequate.

After the work of Beirnaert and Vanderweyen (1941), it became feasible to monitor the efficacy of controlled pollination. From 1963 until the introduction of the palm - pollinating weevil *Elaeidobius kamerunicus* in 1982, contamination in Malaysia's commercial plantings was generally low. Thrips, the main pollinating agent at that time, apparently rarely gained access to bagged female inflorescences. However, *E. kamerunicus* is much more persistent, and after it was introduced, D contamination became a significant problem. This problem apparently persisted for much of the 1980s, but in a 1991 comparison of seed sources, contamination had been reduced to below 2%, indicating control had been restored.

A 1992 study at a trial plot in Banting, Selangor, revealed the yield of Deli dura oil palms after four generations of selection was 60% greater than that of the unselected base population. Crossing the dura and pisifera to give the thin-shelled tenera fruit type improved partitioning of dry matter within the fruit, giving a 30% increase in oil

yield at the expense of shell, without changing total dry matter production.

6 - Disease

Basal stem rot (BSR), caused by the fungus *Ganoderma*, is the most serious disease of oil palm in Malaysia and Indonesia. Previously, research on basal stem rot was hampered by the failure to artificially infect oil palms with the fungus. Although *Ganoderma* had been associated with BSR, proof of its pathogenicity to satisfy Koch's postulate was only achieved in the early 1990s by inoculating oil palm seedling roots or by using rubber wood blocks. A reliable and quick technique was developed for testing the pathogenicity of the fungus by inoculating oil palm germinated seeds.

This fatal disease can lead to losses as much as 80% after repeated planting cycles. *Ganoderma* produces enzymes that degrade the infected xylem, thus causing serious problems to the distribution of water and other nutrients to the top of the palm. *Ganoderma* infection is well defined by its lesion in the stem. The cross-section of infected palm stem shows that the lesion appears as a light brown area of rotting tissue with a distinctive, irregularly shaped, darker band at the borders of this area. The infected tissue become as an ashen-grey powdery and if the palm remains standing, the infected trunk rapidly become hollow.

In a 2007 study in Portugal, scientists suggested control of the fungus on oil palms would benefit from further consideration of the process as one of white rot. *Ganoderma* is an extraordinary organism capable exclusively of degrading lignin to carbon dioxide and water; celluloses are then available as nutrients for the fungus. It is necessary to consider this mode of attack as a white rot involving lignin biodegradation, for integrated control. The existing literature does not report this area and appears to be concerned particularly with the mode of spread and molecular biology of *Ganoderma*. The white rot perception opens up new fields in breeding/selecting for resistant cultivars of oil palms with high lignin content, ensuring the conditions for lignin decomposition are reduced, and simply sealing damaged oil

palms to stop decay. The spread likely is by spores rather than roots. The knowledge gained can be employed in the rapid degradation of oil palm waste on the plantation floor by inoculating suitable fungi, and/or treating the waste more appropriately (e.g. chipping and spreading over the floor rather than windrowing).

Endophytic bacteria are organisms inhabiting plant organs that at some time in their life cycles can colonize the internal plant tissues without causing apparent harm to the host.^[13] Introducing endophytic bacteria to the roots to control plant disease is to manipulate the indigenous bacterial communities of the roots in a manner, which leads to enhanced suppression of soil-borne pathogens. The use of endophytic bacteria should thus be preferred to other biological control agents, as they are internal colonizers, with better ability to compete within the vascular systems, limiting *Ganoderma* for both nutrients and space during its proliferation. Two bacterial isolates, *Burkholderia cepacia* (B3) and *Pseudomonas aeruginosa* (P3) were selected for evaluation in the glasshouse for their efficacy in enhancing growth and subsequent suppression of the spread of BSR in oil palm seedlings.

Little leaf syndrome has not been fully explained, but has often been confused with boron deficiency. The growing point is damaged, sometimes by *Oryctes* beetles. Small, distorted leaves resembling a boron deficiency emerge. This is often followed by secondary pathogenic infections in the spear that can lead to spear rot and palm death.

7 - History

Elaeis guineensis originated in Guinea, Africa and was first illustrated by Nicholaas Jacquin in 1763.

Oil palms were introduced to Java by the Dutch in 1848, and to Malaysia (then the British colony of Malaya) in 1910 by Scotsman William Sime and English banker Henry Darby. The species of palm tree *Elaeis guineensis* was taken to Malaysia from Eastern Nigeria in 1961. As noted it originally grew in West Africa. The southern coast of Nigeria was originally called the Palm oil coast by the first Europeans who arrived there and traded in the commodity. This area was later renamed the Bight of Biafra.

7–1 - Malaysia

In Malaysia, the first plantations were mostly established and operated by British plantation owners, such as Sime Darby and Boustead, and remained listed in London until the Malaysian government engineered their "Malaysianisation" throughout the 1960s and 1970s.

Federal Land Development Authority (Felda) is the world's biggest oil palm planter, with planted area close to 900,000 hectares in Malaysia and Indonesia. Felda was formed on July 1, 1956 when the Land Development Act came into force with the main aim of eradicating poverty. Settlers were each allocated 10 acres of land (about 4 hectares) planted either with oil palm or rubber, and given 20 years to pay off the debt for the land.

After Malaysia achieved independence in 1957, the government focused on value-added of rubber planting, boosting exports, and alleviating poverty through land schemes. In the 1960s and 1970s, the government encouraged planting of other crops, to cushion the economy when world prices of tin and rubber plunged. Rubber estates gave way to oil palm plantations. In 1961, Felda's first oil palm settlement opened, with 3.75 km² of land. As of 2000, 6855.2 km² (approximately 76 %) of the land under Felda's programmes were devoted to oil palms. By 2008, Felda's resettlement broadened to 112,635 families, who work on 8533.13 km² of agriculture land throughout Malaysia. Oil palm planting took up 84% of Felda's plantation landbank.

FELDA's success led to the establishment of other development schemes to support the establishment of small-farmer oil palm cultivation. The Federal Land Consolidation and Rehabilitation Authority (FELCRA) was established in 1966 and the Sarawak Land Consolidation and Rehabilitation Authority (SALCRA) was formed in 1976. The primary objective of these organizations is to assist in the development of rural communities and reduce poverty through the cultivation of high yielding crops such as palm oil.

As of November 2011, SALCRA had developed 18 estates totalling approximately 51,000 hectares. That year the organization shared dividends with 16,374 landowners participating in the program.

8 – Palm oil production



Fruit of the oil palm

Oil is extracted from both the pulp of the fruit (palm oil, an edible oil) and the kernel (palm kernel oil, used in foods and for soap manufacture). For every 100 kg of fruit bunches, typically 22 kg of palm oil and 1.6 kg of palm kernel oil can be extracted.

The high oil yield of oil palms (as high as 7,250 liters per hectare per year) has made it a common cooking ingredient in Southeast Asia and the tropical belt of Africa. Its increasing use in the commercial food industry in other parts of the world is buoyed by its cheaper pricing , the high oxidative stability of the refined product, and high levels of natural antioxidants.

The oil palm originated in West Africa, but has since been planted successfully in tropical regions within 20 degrees of the equator. In the Republic of the Congo, or Congo Brazzaville, precisely in the Northern part, not far from Ouesso, local people produce this oil by hand. They harvest the fruit, boil it to let the water evaporate, then press what is left to collect the reddish-orange-colored oil. In 1995, Malaysia was the world's largest producer, with a 51% of world share, but since 2007, Indonesia has been the world's largest producer, supplying approximately 50% of world palm oil volume.

Worldwide palm oil production for season 2011/2012 was 50.3 million metric tons, increasing to 52.3 million tons for 2012/13.^[28] In 2010 / 2011, total production of palm kernels was 12.6 million tonnes.

9 - Social and environmental impacts

The social and environmental impacts of oil palm cultivation is a highly controversial topic . Oil palm is a valuable economic crop and provides a major source of employment. It allows many small landholders to participate in the cash economy and often results in the upgrade of the infrastructure (schools, roads, telecommunications) within that area . However, there are cases where native customary lands have been appropriated by oil palm plantations without any form of consultation or compensation , leading to social conflict between the plantations and local residents. In some cases, oil palm plantations are dependent on imported labour or illegal immigrants, with some concerns about the employment conditions and social impacts of these practices.

Biodiversity loss (including the potential extinction of charismatic species) is one of the most serious negative effects of oil palm cultivation. Large areas of already threatened tropical rainforest are often cleared to make way for palm oil plantations, especially in Southeast Asia, where enforcement of forest protection laws is lacking. In some states where oil palm is established, lax enforcement of environmental legislation leads to encroachment of plantations into protected areas , encroachment into riparian strips, open burning of plantation wastes , and release of palm mill pollutants such as palm oil mill effluent (POME) in the environment.^[36] Some of these states have recognised the need for increased environmental protection, resulting in more environment-friendly practices. Among those approaches is anaerobic treatment of POME, which can be a good source for biogas (methane) production and electricity generation.

Indonesia. Like most wastewater sludge, anaerobic treatment of POME results in dominance of *Methanosaeta concilii*. It plays an important role in methane production from acetate, and the optimum condition for its growth should be considered to harvest biogas as renewable fuel.

Demand for palm oil has increased in recent years due to its use as a biofuel , but recognition that this increases the environmental impact of cultivation, as well as causing a food vs fuel issue, has forced some developed nations to reconsider their policies on biofuel to improve standards and ensure sustainability. However, critics point out that even companies signed up to the Roundtable on Sustainable Palm Oil continue to engage in environmentally damaging practices^[42] and that using palm oil as biofuel is perverse because it encourages the conversion of natural habitats such as forests and peatlands, releasing large quantities of greenhouse gases.

9 – 1 - Carbon balance

Oil palm production has been documented as a cause of substantial and often irreversible damage to the natural environment. Its impacts include deforestation, habitat loss of critically endangered species, and a significant increase in greenhouse gas emissions.

The pollution is exacerbated because many rainforests in Indonesia and Malaysia lie atop peat bogs that store great quantities of carbon, which are released when the forests are cut down and the bogs are drained to make way for the plantations.

Environmental groups, such as Greenpeace, claim the deforestation caused by making way for oil palm plantations is far more damaging for the climate than the benefits gained by switching to biofuel. Fresh land clearances, especially in Borneo, are contentious for their environmental impact. Despite thousands of square kilometres of land standing unplanted in Indonesia, tropical hardwood forests are being cleared for palm oil plantations. Furthermore, as the remaining unprotected lowland forest dwindles, developers are looking to plant peat swamp land, using drainage that begins an oxidation process of the peat which can release 5,000 to 10,000 years worth of stored carbon. Drained peat is also at very high risk of forest fire. There is a clear record of fire being used to clear vegetation for oil palm development in Indonesia, where in recent years drought and man-made clearances have led to massive uncontrolled forest fires, covering parts of Southeast Asia in haze and leading to an international crisis with Malaysia. These fires have been blamed on a government with little ability to enforce its own laws, while impoverished small farmers and large plantation owners illegally burn and clear forests and peat lands to develop the land rather than reap the environmental benefits it could offer.

Many of the major companies in the vegetable oil economy participate in the Roundtable on Sustainable Palm Oil, which is trying to address this problem. For example, in 2008, Unilever, a member of the group, committed to use only oil palm oil which is certified as sustainable, by ensuring the large companies and smallholders that supply it convert to sustainable production by 2015.

Meanwhile, much of the recent investment in new palm plantations for biofuel has been funded through carbon credit projects through the Clean Development Mechanism; however, the reputational risk associated with the unsustainable palm plantations in Indonesia has now made many funds wary of such investment.

9 – 2 - Palm biomass as fuel

Some scientists and companies are going beyond using just the oil, and are proposing to convert fronds, empty fruit bunches and palm kernel shells harvested from oil palm plantations into renewable electricity cellulosic ethanol, biogas, biohydrogen and bioplastic. Thus, by using both the biomass from the plantation as well as the processing residues from palm oil production (fibers, kernel shells, palm oil mill effluent), bioenergy from palm plantations can have an effect on reducing greenhouse gas emissions. Examples of these production techniques have been registered as projects under the Kyoto Protocol's Clean Development Mechanism.

By using palm biomass to generate renewable energy, fuels and biodegradable products, both the energy balance and the greenhouse gas emissions balance for palm biodiesel is improved. For every tonne of palm oil produced from fresh fruit bunches, a farmer harvests around 6 tonnes of waste palm fronds, 1 tonne of palm trunks, 5 tonnes of empty fruit bunches, 1 tonne of press fiber (from the mesocarp of the fruit), half a tonne of palm kernel endocarp, 250 kg of palm kernel press cake, and 100 tonnes of palm oil mill effluent. Some oil palm plantations incinerate biomass to generate power for palm oil mills. Some other oil palm plantations yield large amount of biomass that can be recycled into medium density fibreboards and light furniture . In efforts to reduce greenhouse gas emissions, scientists treat palm oil mill effluent to extract biogas. After purification, biogas can substitute for natural gas for use at factories. Anaerobic treatment of palm oil mill effluent, practiced in Malaysia and Indonesia, results in domination of Methanosaeta concilii. It plays an important role in methane production from acetate and the optimum condition for its growth should be considered to harvest biogas as renewable fuel.

Unfortunately, the production of palm oil has detrimental effects on the environment and is not considered to be a sustainable biofuel. The deforestation occurring throughout Malaysia and Indonesia as a result of the growing demand for this plant has made scarce natural habitats for orangutans and other rainforest dwellers. More carbon is released during the life cycle of a palm oil plant to its use as a biofuel than is emitted by the same volume of fossil fuels.

10 - Malayan folkculture

Since the days when the 'guineesis' was first introduced by the British, Indian laborers were brought in to work the estates. There, Hindu beliefs mixed with the local Malay culture and started the usage of palm seeds by traditional healers suffixed with *tok 'bomoh'* or *pawang* in the local language. Every bunch of palm fruit usually bears a single 'illustrious' seed which looks like a shiny black pearl called *sbatmi* in Tamil and *shakti* in Malay. These are used as accessories by the *bomoh* and *pawang* in the mixed ritual for peace

with nature as these are believed to contain mystical healing properties, and those wearing them are blessed by nature.

Modern usage has seen more common people keeping these as charm or fashion items to feel at peace, owing to their use by celebrities. All palm seeds contain acid; these *sbatmi* are no different and should be handled with care. *Sbatmi* lost some popularity when it was used in a grisly ritual by Mona Fandey in 1993.

Emu Oil

Emu oil is an oil rendered from the fat of the emu, *Dromaius novaehollandiae*, a flightless bird indigenous to Australia . Emu oil has been used historically in Australian aboriginal traditional medicine for fevers, coughs, minor pain, arthritic joints, bruises, cuts and sores.

Unadulterated emu oil can vary widely in colour and viscosity, but, assuming the emu has enjoyed a natural diet, is generally a yellow liquid.^[5] It is composed of approximately 70 % unsaturated fatty acids. The largest component is oleic acid, a monounsaturated omega - 9 fatty acid. Emu oil also contains roughly 20% linoleic acid (an omega - 6 fatty acid) and 1-2 % linolenic acid (an omega-3 fatty acid).

Composition of Emu Oil :

Approximately 70 % of the fatty acids in emu fat are unsaturated – Omega 3, 6 and 9. This composition is consistent with current recommendations for a "heart healthy" diet. Studies and testimonial have also shown these Omega Fatty Acids to lower bad cholesterol and triglyceride levels while increasing good cholesterol; reduce inflammation in body tissue and joints; improve the immune system and assist the body with many functions.

The mono un saturated fatty acid, oleic acid (Omega 9) is the major fatty acid in emu oil. This fatty acid is a known enhancer for transport of bioactive compounds into the skin, and thus the ability to be absorbed quickly and penetrate deeply when applied topically. The overall composition of emu oil is very similar to our skin's own fatty acid composition.

Two small - scale animal studies have suggested that emu oil, applied topically, may have anti-inflammatory properties or promote wound healing in various rodent models . Emu oil is marketed and promoted as a dietary supplement with a wide variety of claimed health benefits. However, little is known about its risks and benefits.

Commercial emu oil supplements are not standardized and vary widely in their potency.^[8] The U.S. Food and Drug Administration highlighted emu oil in a 2009 article on "How to Spot Health Fraud," pointing out that many "pure emu oil" products are unapproved drugs.

Emulsifying Wax

Emulsifying wax is a cosmetic emulsifying ingredient. The ingredient name is often followed by the initials NF, indicating that it conforms to the specifications of the National Formulary.

Emulsifying wax is created when a wax material (either a vegetable wax of some kind or a petroleum-based wax) is treated with a detergent (typically sodium dodecyl sulfate or poly sorbates) to cause it to make oil and water bind together into a smooth emulsion. It is a white waxy solid with a low fatty alcohol odor.

The ingredients for Emulsifying Wax NF are: Cetearyl Alcohol, Poly sorbate 60, PEG -150 Stearate, and Steareth-20. It has the characteristics of cetyl alcohol combined with the viscosity building effect of stearyl alcohol as an effective thickener and helps form stable emulsions.

Essential Fatty Acid

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1 - Introduction

Essential fatty acids, or EFAs, are fatty acids that humans and other animals must ingest because the body requires them for good health but cannot synthesize them . The term "essential fatty acid" refers to fatty acids required for biological processes but does not include the fats that only act as fuel.

Only two fatty acids are known to be essential for humans: alpha - linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega - 6 fatty acid). Some other fatty acids are sometimes classified as "conditionally essential," meaning that they can become essential under some developmental or disease conditions; examples include docosahexaenoic acid (an omega-3 fatty acid) and gamma-linolenic acid (an omega-6 fatty acid).

When the two EFAs were discovered in 1923, they were designated "vitamin F", but in 1929, research on rats showed that the two EFAs are better classified as fats rather than vitamins.

2 - Functions

In the body, essential fatty acids serve multiple functions. In each of these, the balance between dietary ω -3 and ω -6 strongly affects function.

They are modified to make

The classic eicosanoids (affecting inflammation and many other cellular functions)

The endo cannabinoids (affecting mood, behavior and inflammation)

The lipoxins which are a group of eicosanoid derivatives formed via the lipoxygenase pathway from ω - 6 EFAs and resolvins from ω -3 (in the presence of aspirin, down regulating inflammation)

The iso furans, neuro furans, iso prostanes, hepoxilins, epoxy eicosatrienoic acids (EETs) and Neuroprotectin D

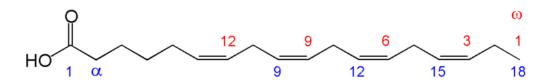
They form lipid rafts (affecting cellular signaling)

They act on DNA (activating or inhibiting transcription factors such as NF- κ B, which is linked to pro-inflammatory cytokine production)

3 - Nomenclature and terminology

Fatty acids are straight chain hydrocarbons possessing a carboxyl (COOH) group at one end. The carbon next to the carboxylate is known as α , the next carbon β , and so forth. Since biological fatty acids can be of different lengths, the last position is labelled as a " ω ", the last letter in the Greek alphabet. Since the physiological properties of unsaturated fatty acids largely depend on the position of the first unsaturation relative to the end position and not the carboxylate. For example, the term ω -3 signifies that the first double bond exists as the third carbon-carbon bond from the terminal CH₃ end (ω) of the carbon chain. The number of carbons and the number of double bonds is also listed.

 ω - 3 18:4 (stearidonic acid) or 18:4 ω -3 or 18:4 n–3 indicates an 18 - carbon chain with 4 double bonds, and with the first double bond in the third position from the CH₃ end. Double bonds are *cis* and separated by a single methylene (CH₂) group unless other wise noted. So in free fatty acid form, the chemical structure of stearidonic acid is:



3 – 1 - Examples

The essential fatty acids start with the short chain polyunsaturated fatty acids (SC-PUFA) :

ω-3 fatty acids:
α-Linolenic acid or ALA (18:3n-3)
ω-6 fatty acids:
Linoleic acid or LA (18:2n-6)

These two fatty acids cannot be synthesized by humans because humans lack the desaturaseenzymes required for their production.

They form the starting point for the creation of longer and more desaturated fatty acids, which are also referred to as long-chain polyunsaturated fatty acids (LC-PUFA):

 ω -3 fatty acids: eicosapentaenoic acid or EPA (20:5n-3) docosahexaenoic acid or DHA (22:6n-3) ω -6 fatty acids: gamma-linolenic acid or GLA (18:3n-6) dihomo-gamma-linolenic acid or DGLA (20:3n-6) arachidonic acid or AA (20:4n-6)

 ω -9 fatty acids are not essential in humans because they can be synthesized from carbohydrates or other fatty acids.

3 – 2 - Essential fatty acids

Mammals lack the ability to introduce double bonds in fatty acids beyond carbon 9 and 10, hence ω -6 linoleic acid (18:2,9,12), abbreviated LA (18:2n-6), and the ω -3 linolenic acid (18:3,9,12,15), abbreviated ALA (18:3n-3), are essential for humans in the diet. In humans, arachidonic acid (20:4,5,8,11,14) can be synthesized from LA by alternative desaturation and chain elongation (although the capacity of the cat family to do this making them obligate carnivores). Humans can convert both LA and ALA to docosapentaenoic acid (22:5n-6) and docosahexaenoic acid (22:6n-3) respectively. This is clearly illustrated by studies in vegans and vegetarians^[6] However, the capacity to convert LA to AA and ALA to DHA in the preterm infant is limited and preformed AA and DHA may be required to meet the needs of the developing brain. Both AA and DHA are present in breastmilk and contribute along with the parent fatty acids LA and ALA to meeting the requirements of the newborn infant. Many infant formulas have AA and DHA added to them to be equivalent to human milk. Essential nutrients are defined as those that cannot be synthesized de novo in sufficient quantities for normal physiological function. This definition is met for LA and ALA but not the longer chain derivatives in adults (Fats and Fatty Acids in Human Nutrition Report of an expert consultation .. The longer chain derivatives particularly, however, has pharmacological properties that can modulate disease processes but this should not be confused with dietary essentiality. If there is relatively more LA than ALA in the diet it favors the formation of docosapentaenoic acid (22:5n-6) from LA rather than docosahexaenoic acid (22:6n-3) from ALA. This effect can be altered by changing the relative ratio of LA:ALA but is more effective when total intake of polyunsaturated fatty acids are low

Between 1930 and 1950, arachidonic acid and linolenic acid were termed 'essential' because each was more or less able to meet the growth requirements of rats given fat-free diets/ However, they were yet to be recognized as essential nutrients for humans. In 1950's Arild Hansen showed that infants fed skimmed milk developed essential fatty acid deficiency. It was characterized by an increased food intake, poor growth and a scaly dermatitis and was cured by the administration of corn oil. Later work by Hansen, which is now regarded as highly unethical, randomized 426 children, mainly black, to four treatments: modified cow's milk formula, skimmed milk formula, skimmed milk formula with coconut oil or cow's milk formula with corn oil. The infants who received the skimmed milk formula or the formula with coconut oil developed essential fatty acid symptoms. This could be cured by deficiency signs and administration of ethyl linoleate (the ethyl ester of linoleic acid) with an intake of about 1 % of the energy intake Wiese H, Hansen A, Adams DJ. Collins et al. 1970 were the first to demonstrate linoleic

acid deficient in adults. They found that patients undergoing intravenous nutrition with glucose became isolated from their fat supplies and rapidly developed biochemical signs of essential fatty acid deficiency (an increase in 20: 3n - 9: 20: 4n - 6 ratio in plasma) and skin symptoms. This could be treated by infusing lipid and later studies showed that topical application of sunflower oil would also resolve the dermal symptoms (. Linoleic acid has a specificic role in maintaining the skin water permeability barrier probably as constituents of acyl glycosyl ceramides. This role cannot be met by any ω -3 fatty acids or by arachidonic acid. The main physiological requirement for ω -6 fatty acids is attributed to arachidonic acid. acid is the major precursor of prostaglandins, Arachidonic leukotrienes and anandamides that play a vital role in cell signaling. Metabolites from the ω -3 pathway mainly from eicosapentaenoic acid are mainly inactive and this explains why ω -3 fatty acids do not correct the reproductive failure in rats where arachidonic is needed to make active prostaglandins that cause uterine contraction.^[11] To some extent, any ω -3 and ω -6 can contribute to the growth promoting effects of EFA deficiency but only ω -6 fatty acids can restore reproductive performance and correct the dermatitis in rats. Particular fatty acids are still needed at critical life stages (e.g. lactation) and in some disease states. In nonscientific writing, common usage is that the term *essential fatty acid* comprises all the ω -3 or -6 fatty acids. Conjugated fatty acids like calendic acid are not considered essential. Authoritative sources include the whole families, but generally only make dietary recommendations for LA and ALA with the exception of DHA for infants under the age of 6 months. Recent reviews by WHO / FAO in 2009 and the European Food Safety Authority have reviewed the evidence and made recommendations for minimal intakes of LA and ALA and have also recommended intakes of longer chain ω -3 fatty acids based on the association of oily fish consumption with a lower risk of cardiovascular disease. Some earlier review lumped all polyunsaturated fatty acids together without qualification whether they were short or long-chain PUFA or whether they were ω -3 and ω -6 PUFA.

Traditionally speaking, the LC-PUFAs are not essential. Because the LC-PUFA are sometimes required, they may be considered "conditionally essential", or not essential to healthy adults.

Essential fatty acids should not be confused with essential oils, which are "essential" in the sense of being a concentrated *essence*.

4 - Food sources

Some of the food sources of ω -3 and ω -6 fatty acids are fish and shellfish, flaxseed (linseed), hemp oil, soya oil, canola (rapeseed) oil, chia seeds, pumpkin seeds, sunflower seeds, leafy vegetables, and walnuts.

Essential fatty acids play a part in many metabolic processes, and there is evidence to suggest that low levels of essential fatty acids, or the wrong balance of types among the essential fatty acids, may be a factor in a number of illnesses, including osteoporosis.

Plant sources of ω -3 contain neither eicosapentaenoic acid (EPA) nor docosahexaenoic acid (DHA). The human body can (and in case of a purely vegetarian diet often must, unless certain algae or supplements derived from them are consumed) convert α -linolenic acid (ALA) to EPA and subsequently DHA. This however requires more metabolic work, which is thought to be the reason that the absorption of essential fatty acids is much greater from animal rather than plant sources (see Fish and plants as a source of Omega-3 for more).

The *IUPAC Lipid Handbook* provides a very large and detailed listing of fat contents of animal and vegetable fats, including ω -3 and -6 oils.^[18] The National Institutes of Health's EFA Education group publishes *Essential Fats in Food Oils*.^[19] This lists 40 common oils, more tightly focused on EFAs and sorted by n-6:3 ratio. *Vegetable Lipids as Components of Functional Food* lists notable vegetable sources of EFAs as well as commentary and an overview of the biosynthetic pathways involved.^[20] Users can interactively search at NutritionData.com for the richest food sources of particular EFAs or other nutrients. Careful readers will note that these sources are not in excellent agreement. EFA content of vegetable sources varies with cultivation conditions. Animal sources vary widely, both with the animal's feed and that the EFA makeup varies markedly with fats from different body parts.

5 - Human health

Almost all the polyunsaturated fats in the human diet are EFAs. Essential fatty acids play an important role in the life and death of cardiac cells.

5 – **1** - Essential fatty acid deficiency

Essential fatty acid deficiency results in a dermatitis similar to that seen in zinc or biotin deficiency.

Biologist Ray Peat has argued that there are flaws in the studies (such as the Burr experiment) showing the need for ω -3 and ω -6 fats, and that symptoms of so-called EFA deficiencies have been reversed by adding B vitamins or a fat-free liver extract to the diet. In his view, "the optional dietary level of the 'essential fatty acids' might be close to zero, if other dietary factors were also optimized." These views are contrary to the scientific consensus.

5-2 - Treatment for depression

Research suggests that high intakes of fish and omega-3 fatty acids are linked to decreased rates of major depression. Omega-3 fatty acids, such as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) are important for enzymatic pathways required to metabolize long-chain polyunsaturated fatty acids (PUFAs). Low plasma concentrations of DHA predict low concentrations of cerebrospinal fluid 5-hydroxyindoleacetic acid (5-HIAA). It is found that low concentrations of 5-HIAA in the brain is associated with depression and suicide.

There are high concentrations of DHA in synaptic membranes of the brain. This is critical for synaptic transmission and membrane fluidity. The omega-6 fatty acid to omega-3 fatty acid ratio is important to avoid imbalance of membrane fluidity. Membrane fluidity affects function of enzymes such as adenylate cyclase and ion channels such as calcium, potassium, and sodium, which in turn affects receptor numbers and functioning, as well as serotonin neurotransmitter levels. It is evident that western diets are deficient in omega-3 and excessive in omega-6, and balancing of this ratio would confer numerous health benefits.

Clinical research suggests a benefit of omega-3 fatty acids in the treatment of depression during the perinatal period.^[28] A meta analysis of trials of EPA supplements for depression in non-pregnant adults concluded that supplments with more than 60 % EPA are effective, but those containing primarily DHA, or less than 60 % EPA, were not effective.

Essential Oil

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1 - Introduction

An essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from plants. Essential oils are also known as volatile oils, ethereal oils, or aetherolea, or simply as the "oil of" the plant from which they were extracted, such as oil of clove. An oil is "essential" in the sense that it carries a distinctive scent, or essence, of the plant. Essential oils do not form a distinctive category for any medical, pharmacological, or culinary purpose.

Essential oils are generally extracted by distillation, often by using steam. Other processes include expression or solvent extraction.

They are used in perfumes, cosmetics, soaps and other products, for flavoring food and drink, and for adding scents to incense and household cleaning products.

Essential oils have been used medicinally in history. Medical applications proposed by those who sell medicinal oils range from skin treatments to remedies for cancer and often are based solely on historical accounts of use of essential oils for these purposes. Claims for the efficacy of medical treatments, and treatment of cancers in particular, are now subject to regulation in most countries.

As the use of essential oils has declined in evidence - based medicine, one must consult older textbooks for much information on their use . Modern works are less inclined to generalize; rather than refer to "essential oils" as a class at all, they prefer to discuss specific compounds, such as methyl salicylate, rather than "oil of wintergreen".

Interest in essential oils has revived in recent decades with the popularity of aromatherapy, a branch of alternative medicine that claims that essential oils and other aromatic compounds have curative effects. Oils are volatilized or diluted in a carrier oil and used in massage, diffused in the air by a nebulizer, heated over a candle flame, or burned as incense.

The earliest recorded mention of the techniques and methods used to produce essential oils is believed to be that of Ibn al-Baitar (1188–1248), an Andalusian physician, pharmacist and chemist.^[5]

2 – Production

2 – 1 – Distillation

Today, most common essential oils — such as lavender, peppermint, and eucalyptus — are distilled. Raw plant material, consisting of the flowers, leaves, wood, bark, roots, seeds, or peel, is put into an alembic (distillation apparatus) over water. As the water is heated, the steam passes through the plant material, vaporizing the volatile compounds. The vapors flow through a coil, where they condense back to liquid, which is then collected in the receiving vessel. Most oils are distilled in a single process. One exception is *ylang-ylang (Cananga odorata)*, which takes 22 hours to complete through a fractional distillation.

The recondensed water is referred to as a hydrosol, hydrolat, herbal distillate or plant water essence, which may be sold as another fragrant product. Popular hydrosols include rose water, lavender water, lemon balm, clary sage and orange blossom water. The use of herbal distillates in cosmetics is increasing. Some plant hydrosols have unpleasant smells and are therefore not sold.

2 - 2 - Expression

Most citrus peel oils are expressed mechanically or cold-pressed (similar to olive oil extraction). Due to the relatively large quantities of oil in citrus peel and low cost to grow and harvest the raw materials, citrus-fruit oils are cheaper than most other essential oils. Lemon or sweet orange oils that are obtained as byproducts of the citrus industry are even cheaper.

Before the discovery of distillation, all essential oils were extracted by pressing.

2-3-Solvent extraction

Most flowers contain too little volatile oil to undergo expression; their chemical components are too delicate and easily denatured by the high heat used in steam distillation. Instead, a solvent such as hexane or supercritical carbon dioxide is used to extract the oils. Extracts from hexane and other hydrophobic solvent are called *concretes*, which are a mixture of essential oil, waxes, resins, and other lipophilic (oil soluble) plant material.

Although highly fragrant, concretes contain large quantities of nonfragrant waxes and resins. Often, another solvent, such as ethyl alcohol, which is more polar in nature, is used to extract the fragrant oil from the concrete. The alcohol is removed by evaporation, leaving behind the *absolute*.

Supercritical carbon dioxide is used as a solvent in supercritical fluid extraction. This method has many benefits including avoiding petrochemical residues in the product and the loss of some "top notes" when steam distillation is used. It does not yield an absolute directly. The supercritical carbon dioxide will extract both the waxes and the essential oils that make up the concrete. Subsequent processing with liquid carbon dioxide, achieved in the same extractor by merely lowering the extraction temperature, will separate the waxes from the This temperature process prevents essential oils. lower the decomposition and denaturing of compounds. When the extraction is complete, the pressure is reduced to ambient and the carbon dioxide reverts to a gas, leaving no residue.

Supercritical carbon dioxide is also used for making decaffeinated coffee. Although it uses the same basic principles, it is a different process because of the difference in scale.

2-4 - Florasols extraction

Florasol (R134a), a refrigerant, was developed to replace Freon. Although Florasol is an "ozone-friendly" product, it is still a fluoro chemical (1,1,1,2-Tetra fluoro ethane) and it poses significant danger to the environment due to its global warming potential (GWP; 100-yr GWP = 1430). The European Union has banned its use, with a phase - out process beginning in 2011, to be completed in 2017^[7] One advantage is that the extraction of essential oils occurs at or below room temperature so degradation through high temperature extremes does not occur. The essential oils are mostly pure and contain little to no foreign substances.

2-5 - Production quantities

Estimates of total production of essential oils are difficult to obtain. One estimate, compiled from data in 1989, 1990 and 1994 from various sources, gives the following total production, in tonnes, of essential oils for which more than 1,000 tones were produced.

Oil	Tones
Sweet Orange	12,000

Mentha arvensis	4,800
Peppermint	3,200
Cedar wood	2,600
Lemon	2,300
Eucalyptus globulus	2,070
Litsea cubeba	2,000
Clove (leaf)	2,000
Spearmint	1,300

3 - Pharmacology

Although some are suspicious or dismissive towards the use of essential oils in healthcare or pharmacology,^[9] essential oils retain considerable popular use, partly in fringe medicine and partly in popular remedies. Therefore it is difficult to obtain reliable references concerning their pharmacological merits.

Studies have shown that certain essential oils may have the ability to prevent the transmission of some drug - resistant strains of pathogen, specifically Staphylococcus, Streptococcus and Candida.

Taken by mouth, many essential oils can be dangerous in high concentrations. Typical effects begin with a burning feeling, followed by salivation. In the stomach, the effect is carminative, relaxing the gastric sphincter and encouraging eructation (belching). Further down the gut, the effect typically is antispasmodic.

Typical ingredients for such applications include eucalyptus oils, menthol, capsaicin, anise and camphor. Other essential oils work well in these applications, but it is notable that others offer no significant benefit. This illustrates the fact that different essential oils may have drastically different pharmacology. Those that do work well for upper respiratory tract and bronchial problems act variously as mild expectorants and decongestants. Some act as locally anaesthetic counterirritants and, thereby, exert an antitussive effect.

Some essential oils, such as those of juniper and agathosma, are valued for their diuretic effects . With relatively recent concerns

about the overuse of antibacterial agents, many essential oils have seen a resurgence in off - label use for such properties and are being examined for this use clinically.

Many essential oils affect the skin and mucous membranes in ways that are valuable or harmful. They are used in antiseptics and liniments in particular. Typically, they produce rubefacient irritation at first and then counterirritant numbness. Turpentine oil and camphor are two typical examples of oils that cause such effects. Menthol and some others produce a feeling of cold followed by a sense of burning. This is caused by its effect on heat - sensing nerve endings. Some essential oils, such as clove oil or eugenol, were popular for many hundred years in dentistry as antiseptics and local anaesthetics. Thymol is well known for its antiseptic effects.

4 - Use in aromatherapy

Aromatherapy is a form of alternative medicine in which healing effects are ascribed to the aromatic compounds in essential oils and other plant extracts. Many common essential oils have medicinal properties that have been applied in folk medicine since ancient times and are still widely used today. For example, many essential oils have antiseptic properties. Many are also claimed to have an uplifting effect on the mind. Such claims, if meaningful, are not necessarily false but are difficult to quantify in the light of the sheer variability of materials used in the practice.

5 – Dilution

Essential oils are usually lipophilic (literally: "*oil-loving*") compounds that usually are not miscible with water. Also, they can be diluted in solvents like pure ethanol, and polyethylene glycol.

6 - Raw materials

Essential oils are derived from sections of plants. Some plants, like the bitter orange, are sources of several types of essential oil :

Berries	Leaves	Flowers
_ • • • • • • •	Basil	Cannabis
Allspice	20011	
Juniper	Bay leaf	Chamomile
Seeds	Buchu	Clary sage
Almond	Cinnamon	Clove
Anise	Common sage	Scented
Buchu	Eucalyptus	geranium
Celery	Guava	Hops
Cumin	Lemon grass	Hyssop
Nutmeg oil	Melaleuca	Jasmine
Bark	Oregano	Lavender
Cassia	Patchouli	Manuka
Cinnamon	Peppermint	Marjoram
Sassafras	Pine	Orange
Wood	Rosemary	Rose
Camphor	Spearmint	Ylang-ylang
Cedar	Tea tree	Peel
Rosewood	Thyme	Bergamot
Sandalwood	Tsuga	Grapefruit
Agarwood	Wintergreen	Lemon
Rhizome	Resin	Lime
Galangal	Benzoin	Orange
Ginger	Copaiba	Tangerine
	Frankincense	Root
	Myrrh	Valerian

6 – 1 - Eucalyptus oil

Apart from essential oils used mainly in foods, the best-known essential oil worldwide might be eucalyptus oil, produced from the leaves of *Eucalyptus globulus*. Steam-distilled eucalyptus oil is used throughout Asia, Africa, Latin America and South America as a primary cleaning/disinfecting agent added to soaped mop and countertop cleaning solutions; it also possesses insect and limited vermin control properties. Note, however, there are hundreds of species of eucalyptus, and perhaps some dozens are used to various extents as sources of essential oils. Not only do the products of different species differ greatly in characteristics and effects, but also the products of the very same tree can vary grossly.

6 – 2 - Rose oil

The second most well - known essential oil is probably rose oil, produced from the petals of *Rosa damascena* and *Rosa centifolia*. Steam-distilled rose oil is known as "rose otto", while the solvent extracted product is known as "rose absolute".

6-3 - Lavender essential oil

One of the most popular essential oils in the world, lavender essential oil has a reputation of being mild, relaxing and appropriate for most ages and genders. However, it can be estrogenic and anti androgenic , causing problems for prepubescent boys and pregnant women, in particular. Lavender essential oil is also an insect repellent

7 – Dangers

The potential danger of an essential oil is generally relative to its level or grade of purity. Many essential oils are designed exclusively for their aroma-therapeutic quality; these essential oils generally should not be applied directly to the skin in their undiluted or "neat" form. Some can cause severe irritation, provoke an allergic reaction and, over time, prove hepatotoxic. Non-therapeutic grade essential oils are never recommended for topical or internal use

Essential oils should not be used with animals, as they possess extreme hepatotoxicity and dermal toxicity for animals, especially for cats. Instead, essential oils should be blended with a vegetable - based carrier oil (as a base, or "fixed" oil) before being applied. Common carrier oils include olive, almond, hazelnut and grape seed. Only neutral oils should be used. A common ratio of essential oil disbursed in a carrier oil is 0.5 % - 3 % (most under 10 %), depending on its purpose. Some essential oils, including many of the citrus peel oils, are photosensitizers, increasing the skin's vulnerability to sunlight.

Industrial users of essential oils should consult the material safety data sheets (MSDS) to determine the hazards and handling

requirements of particular oils. Even certain therapeutic grade oils can pose potential threats to individuals with epilepsy or pregnant women.

7 - 1 - Handling

Essential oils can be aggressive toward rubbers and plastics, so care must be taken in choosing the correct handling equipment. Glass syringes are often used, but have coarse volumetric graduations. Chemistry syringes are ideal, as they resist essential oils, are long enough to enter deep vessels, and have fine graduations, facilitating quality control. Unlike traditional pipettes, which have difficulty handling viscous fluids, the chemistry syringe has a seal and piston arrangement which slides inside the pipette, wiping the essential oil off the pipette wall. This improves accuracy, and the inside of the pipette is easy to clean and reuse immediately. Chemistry pipetting syringes are equal in accuracy to the best laboratory equipment and are available in sizes from 1 mL through 25 mL .

7 – 2 – Pregnancy

The use of essential oils in pregnancy is not recommended due to inadequate published evidence to demonstrate evidence of safety. Pregnant women often report an abnormal sensitivity to smells and taste, essential oils can cause irritation and nausea.

7 – 3 - Gynecomastia

Estrogenic and anti androgenic activity have been reported by *in vitro* study of tea tree oil and lavender essential oils. Case reports suggest the oils may be implicated in some cases of gynecomastia, an abnormal breast tissue growth, in prepubescent boys.

7 – 4 - Pesticide residues

There is some concern about pesticide residues in essential oils, particularly those used therapeutically. For this reason, many practitioners of aromatherapy buy organically produced oils.^[citation needed] Not only are pesticides present in trace quantities, but also the oils themselves are used in tiny quantities and usually in high dilutions. Where there is a concern about pesticide residues in food essential oils, such as mint or orange oils, the proper criterion is not whether the material is alleged to be organically produced, but

whether it meets the government standards based on actual analysis of its pesticide content.

7 - 5 - Ingestion

Essential oils are used extensively as GRAS flavoring agents in foods, beverages and confectioneries according to strict Good Manufacturing Practice (GMP) and flavorist standards. Therapeutic grade essential oils are generally safe for human consumption in small amounts. Pharmacopoeia standards for medicinal oils should be heeded. Some oils can be toxic to some domestic animals, cats in particular . The internal use of essential oils can pose hazards to pregnant women, as some can be abortifacients in dose 0.5 - 10 ml, and thus should not be used during pregnancy.

7-6-Flammability

The flash point of each essential oil is different. Many of the common essential oils, such as tea tree, lavender, and citrus oils, are classed as a Class 3 Flammable Liquid, as they have a flash point of 50-60 °C.

7 - 7 - Toxicology

The following table lists the LD_{50} or median lethal dose for common oils; this is the dose required to kill half the members of a tested population. LD_{50} is intended as a guideline only, and reported values can vary widely due to differences in tested species and testing conditions.

Common Name	Oral LD ₅₀	Dermal LD ₅₀	Notes
Neem	14 g/kg	>2 g/kg	
Lemon myrtle	2.43 g/kg	2.25 g/kg	
Frankincense	>5 g/kg	>5 g/kg	Boswellia carterii
Frankincense	>2 g/kg	>2 g/kg	Boswellia sacra
Indian frankincense	>2 g/kg	>2 g/kg	Boswellia serrata
Ylang-ylang	>5 g/kg	>5 g/kg	

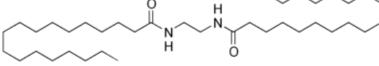
Cedar wood	>5 g/kg	>5 g/kg	
Roman chamomile	>5 g/kg	>5 g/kg	
White camphor	>5 g/kg	>5 g/kg	<i>Cinnamomum camphora</i> , extracted from leaves
Yellow camphor	3.73 g/kg	>5 g/kg	<i>Cinnamomum camphora</i> , extracted from bark
Hot oil	3.80 g/kg	>5 g/kg	<i>Cinnamomum camphora</i> , oil extracted from leaves
Cassia	2.80 g/kg	0.32 g/kg	

It is important to understand that the foregoing figures are far less relevant in everyday life than far smaller, often localized levels of exposure. For example, a dose of many an essential oil that would do no harm if swallowed in diluted solution or emulsion, could do serious damage to eyes or lungs in a higher concentration.

8 - Standardization of its derived products

In 2002, ISO published ISO 4720 in which the botanical names of the relevant plants are standardized.^[24] The rest of the standards with regards to this topic can be found in the section of ICS 71.100.60 ^[25]

Ethylene Bis (Stearamide)



Contents 1 Introduction 2 Applications

1 - Introduction

Ethylene bis stear amide (EBS) is an organic compound with the formula ($CH_2 NH C$ (O) $C_{17}H_{35}$) ₂. It is a waxy white solid and is also found as powder or beads that is widely used as a form release agent. The compound is derived from the reaction of ethylenediamine and stearic acid. It is a cheap, white solid that of low toxicity that provides a slippery coating for a variety of applications.

2 – Applications

EBS is a synthetic wax used as a dispersing agent or internal / external lubricant for benefits in plastic applications to facilitate and stabilize the dispersion of solid compounding materials to enhance process ability, to decrease friction and abrasion of the polymer surface, and to contribute color stability and polymer degradation.

It is also used as in process industries as release agents, antistatic agents, and antifoaming agents for the production of thermoplastics, wiring, and paper.^[1] It is used in powder metallurgy.

Expeller Pressing



Copra at an oil mill in India

An expeller used for expeller pressing

Contents

- 1 Introduction
- 2 Over view
- 3 Efficiency
- 4 Design
 - 4.1 Continuous screw
 - 4.2 Interrupted screw
 - 4.3 Resistor teeth

5 Expanded applications

1 - Introduction

Expeller pressing (also called oil pressing) is a mechanical method for extracting oil from raw materials. The raw materials are squeezed under high pressure in a single step. When used for the extraction of food oils, typical raw materials are nuts, seeds and algae, which are supplied to the press in a continuous feed. As the raw material is pressed, friction causes it to heat up; in the case of harder nuts (which require higher pressures) the material can exceed temperatures of 49 °C.

2 – Over view

An expeller press is a screw - type machine that presses oil seeds through a caged barrel - like cavity. Raw materials enter one side of the press and waste products exit the other side. The machine

uses friction and continuous pressure from the screw drives to move and compress the seed material. The oil seeps through small openings that do not allow seed fiber solids to pass through. Afterward, the pressed seeds are formed into a hardened cake, which is removed from the machine. Pressure involved in expeller pressing creates heat in the range of 60 - 99 °C. Some companies claim that they use a cooling apparatus to reduce this temperature to protect certain properties of the oils being extracted.

3 – Efficiency

Expeller processing cannot remove every last trace of liquid (usually oil) from the raw material. A significant amount remains trapped inside of the cake leftover after pressing. In most small scale rural situations this is of little or no importance as the cake that remains after the oil has been removed finds uses in local dishes, in the manufacture of secondary products or for animal feed. Some raw materials however do not release oil by simple expelling; the most notable being rice bran. In order to remove oil from commodities that do not respond to expelling or to extract the final traces of oil after expelling it is necessary to use solvent extraction.

4 – Design

4 – 1 - Continuous screw

The earliest expeller presses utilized a continuous screw design. The compression screws were much like the screw of a screw conveyor. That is, the helicoid flighting started at one end and ended at the other.

4 – 2 - Interrupted screw

Valerius Anderson invented the interrupted screw design and patented it in the year 1900. What Anderson observed was that, in the continuous flighting arrangement of a compression screw, there are tendencies for slippery materials either to co-rotate with the screw or to pass through with minimal dewatering. He wrote that "brewers' slops, slaughterhouse refuse" and other "soft and mushy" materials dewater poorly in continuous screw presses. His invention consisted of putting interruptions in the flighting of a compression screw. It was much like having a hanger bearing in a screw conveyor: there is no flighting on the shaft at that point, so material tends to stop moving and pile up. It is only after solids accumulate in the gap that the downstream flighting catches material. When this happens, material is forced along its way. The result was better dewatering, a more consistent press cake..

4 – 3 - Resistor teeth

After the 1900 patent, a major improvement was made with the addition of resistor teeth. Fitted into the gaps where there is no flighting , these teeth increase the agitation within the press, further diminishing co - rotation tendencies.

5 - Expanded applications

As the years went by, applications of the interrupted screw design were expanded beyond slippery and slimy materials. This took place because competing continuous screw presses worked best only under conditions of constant feed, at constant consistency. If either the consistency or the flow rate diminished, squeezing would diminish until it was inadequate for proper moisture removal. At the same time, if the consistency increased, the press could jam. To counteract these tendencies it was necessary to build a very heavy press, frequently with an expensive variable speed drive.

In contrast, it was found that the interruptions in the flighting of the Anderson screw would provide cushion within the press. If consistency went down, compression was still effective. A plug of sufficiently solid material had to build up at each interruption before solids could progress towards the discharge. This self-correcting performance prevents wet material from purging at the cake discharge. It is achieved without varying the speed of the screw.

The economic advantages of these characteristics led to interrupted screw presses being used to dewater fibrous materials that are neither slippery nor slimy. Examples would be alfalfa, corn husk, and, more recently, paper mill fibers.

Factice

Factice is vulcanized unsaturated vegetable or animal oil, used as a processing aid and property modifier in rubber.

Longer chain fatty-acid containing oils such as rape seed or meadow foam produce a harder, more desirable factice. Soybean oil produces lower quality factice, though it can be mixed with longerchain oils to yield factice nearly as good as that made from long chain oils alone. Oil - resistant factice is made with castor oil.

Cross-linking the fatty-acid chains with sulfur (brown factice) or $S_2 Cl_2$ (white factice) yields a rubbery material that improves the processing characteristics and ozone resistance of rubber.^[1] Varying the amount of factice changes the physical properties of the rubber; molded items might be 5-10 % factice, extrusions 15-30%. Rubber erasers can have as much as 4 times as much factice as rubber in their composition.

False Flax Oil

False flax oil is a pressed seed oil, derived from the *Camelina* sativa or false flax, also called gold of pleasure. False flax has long been grown in Europe, and its oil used as a lamp oil until the 18th century. In recent times, its has been explored for use in cosmetic and skin care products. It has a high content of omega-3 and is used as a food supplement by some cultures. In the United States the Food and Drug Administration has not rated the oil for human consumption yet. False flax belongs to the *Brassicaceae* (mustard and cabbage) family, which also contains many other seed oil plants, such as rapeseed oil. It contains 1 - 3 % erucic acid.

The seeds contain an average of 37% by weight of oil, and contains the following fatty acids :

Component	Percentage	Category
Alpha-linolenic	35 – 42 %	Poly un saturated
Oleic	12 - 27 %	Mono un saturated
Linoleic	16-25 %	Poly un saturated
Gadoleic	9 - 17 %	Mono un saturated
Palmitic	3-8%	Saturated
Stearic	2 - 3 %	Saturated

Fatty Acid

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6.1 Acidity

- 6.2 Hydrogenation and hardening
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1 - Introduction

In chemistry, and especially in biochemistry, a fatty acid is a carboxylic acid with a long aliphatic tail (chain), which is either saturated or unsaturated. Most naturally occurring fatty acids have a chain of an even number of carbon atoms, from 4 to 28.^[1] Fatty acids are usually derived from triglycerides or phospholipids. When they are not attached to other molecules, they are known as "free" fatty acids. Fatty acids are important sources of fuel because, when metabolized, they yield large quantities of ATP. Many cell types can use either glucose or fatty acids for this purpose. In particular, heart and skeletal muscle prefer fatty acids. Despite long-standing assertions to the contrary, brain can use fatty acids as a source of fuel in addition to glucose and ketone bodies.

2 - Types of fatty acids

Fatty acids that have carbon – carbon double bonds are known as unsaturated. Fatty acids without double bonds are known as saturated. They differ in length as well.

2-1 - Length of free fatty acid chains

Fatty acid chains differ by length, often categorized as short to very long.

Short - chain fatty acids (SCFA) are fatty acids with aliphatic tails of fewer than six carbons (i.e. butyric acid).

Medium-chain fatty acids (MCFA) are fatty acids with aliphatic tails of 6 - 12 carbons, which can form medium-chain triglycerides.

Long - chain fatty acids (LCFA) are fatty acids with aliphatic tails 13 to 21 carbons.

Very long chain fatty acids (VLCFA) are fatty acids with aliphatic tails longer than 22 carbons

2 – 2 - Unsaturated fatty acids

Unsaturated fatty acids have one or more double bonds between carbon atoms. (Pairs of carbon atoms connected by double bonds can be saturated by adding hydrogen atoms to them, converting the double bonds to single bonds. Therefore, the double bonds are called unsaturated.)

The two carbon atoms in the chain that are bound next to either side of the double bond can occur in a *cis* or *trans* configuration.

cis

A *cis* configuration means that adjacent hydrogen atoms are on the same side of the double bond. The rigidity of the double bond freezes its conformation and, in the case of the *cis* isomer, causes the chain to bend and restricts the conformational freedom of the fatty acid. The more double bonds the chain has in the *cis* configuration, the less flexibility it has. When a chain has many *cis* bonds, it becomes quite curved in its most accessible conformations. For example, oleic acid, with one double bond, has a "kink" in it, whereas linoleic acid, with two double bonds, has a more pronounced bend. Alpha-linolenic acid, with three double bonds, favors a hooked shape. The effect of this is that, in restricted environments, such as when fatty acids are part of a phospholipid in a lipid bilayer, or triglycerides in lipid droplets, cis bonds limit the ability of fatty acids to be closely packed, and therefore could affect the melting temperature of the membrane or of the fat.

trans

A *trans* configuration, by contrast, means that the next two hydrogen atoms are bound to *opposite* sides of the double bond. As a result, they do not cause the chain to bend much, and their shape is similar to straight saturated fatty acids.

In most naturally occurring unsaturated fatty acids, each double bond has three n carbon atoms after it, for some n, and all are cis bonds. Most fatty acids in the *trans* configuration (trans fats) are not found in nature and are the result of human processing (e.g., hydrogenation).

The differences in geometry between the various types of unsaturated fatty acids, as well as between saturated and unsaturated fatty acids, play an important role in biological processes, and in the construction of biological structures (such as cell membranes).

	Examples of Unsaturated Fatty Acids
Common name	Chemical structure
Myristoleic acid	CH ₃ (CH ₂) ₃ CH=CH(CH ₂) ₇ COOH
Palmitoleic acid	CH ₃ (CH ₂) ₅ CH=CH(CH ₂) ₇ COOH
Sapienic acid	CH ₃ (CH ₂) ₈ CH=CH(CH ₂) ₄ COOH
Oleic acid	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₇ COOH
Elaidic acid	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₇ COOH
Vaccenic acid	CH ₃ (CH ₂) ₅ CH=CH(CH ₂) ₉ COOH

Linoleic acid	CH ₃ (CH ₂) ₄ CH=CHCH ₂ CH=CH(CH ₂) ₇ COOH
Linoelaidic acid	CH ₃ (CH ₂) ₄ CH=CHCH ₂ CH=CH(CH ₂) ₇ COOH
α-Linolenic acid	CH ₃ CH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CH(CH ₂) ₇ COOH
Arachidonic acid	CH ₃ (CH ₂) ₄ CH=CHCH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=C H(CH ₂) ₃ COOH
Eicosapentaenoi c acid	CH ₃ CH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CH CH ₂ CH=CH(CH ₂) ₃ COOH
Erucic acid	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₁₁ COOH
Docosahexaenoi c acid	CH ₃ CH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CHCH ₂ CH=CH CH ₂ CH=CHCH ₂ CH=CH(CH ₂) ₂ COOH

2-2-1 - Essential fatty acids

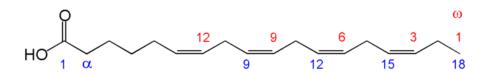
Fatty acids that are required by the human body but cannot be made in sufficient quantity from other substrates, and therefore must be obtained from food, are called essential fatty acids. There are two series of essential fatty acids: one has a double bond three carbon atoms removed from the methyl end; the other has a double bond six carbon atoms removed from the methyl end. Humans lack the ability to introduce double bonds in fatty acids beyond carbons 9 and 10, as counted from the carboxylic acid side.^[4] Two essential fatty acids are linoleic acid (LA) and alpha-linolenic acid (ALA). They are widely distributed in plant oils. The human body has a limited ability to convert ALA into the longer-chain *n*-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which can also be obtained from fish.

3 - Saturated fatty acids

Saturated fatty acids are long - chain carboxylic acids that usually have between 12 and 24 carbon atoms and have no double bonds. Thus, saturated fatty acids are saturated with hydrogen (since double bonds reduce the number of hydrogens on each carbon). Because saturated fatty acids have only single bonds, each carbon atom within the chain has 2 hydrogen atoms (except for the omega carbon at the end that has 3 hydrogens)

Examples of Saturated Fatty Acids			
Common name	chemical structure		
Caprylic acid	CH ₃ (CH ₂) ₆ COOH		
Capric acid	CH ₃ (CH ₂) ₈ COOH		
Lauric acid	CH ₃ (CH ₂) ₁₀ COOH		
Myristic acid	CH ₃ (CH ₂) ₁₂ COOH		
Palmitic acid	CH ₃ (CH ₂) ₁₄ COOH		
Stearic acid	CH ₃ (CH ₂) ₁₆ COOH		
Arachidic acid	CH ₃ (CH ₂) ₁₈ COOH		
Behenic acid	CH ₃ (CH ₂) ₂₀ COOH		
Lignoceric acid	CH ₃ (CH ₂) ₂₂ COOH		
Cerotic acid	CH ₃ (CH ₂) ₂₄ COOH		

3 - Nomenclature



Numbering of carbon atoms

Several different systems of nomenclature are used for fatty acids. The following table describes the most common systems.

System	Example	Explanation
Trivial nomenclature	Palmitoleic acid	Trivial names (or common names) are non-systematic historical names, which are the most frequent naming system used in literature. Most common fatty acids have trivial names in addition to their <i>systematic</i> <i>names</i> (see below). These names frequently do not follow any pattern, but they are concise and often unambiguous.

Systematic nomenclature	(9Z)- octadecenoic acid	Systematic names (or IUPAC names) derive from the standard <i>IUPAC Rules for the Nomenclature of Organic Chemistry</i> , published in 1979, along with a recommendation published specifically for lipids in 1977. Counting begins from the carboxylic acid end. Double bonds are labelled with <i>cis-/trans-</i> notation or <i>E-/Z-</i> notation, where appropriate. This notation is generally more verbose than common nomenclature, but has the advantage of being more technically clear and descriptive.
Δ^x nomenclature	$cis, cis - \Delta^9, \Delta^{12}$ octadecadienoic acid	In Δ^x (or delta- <i>x</i>) nomenclature, each double bond is indicated by Δ^x , where the double bond is located on the <i>x</i> th carbon–carbon bond, counting from the carboxylic acid end. Each double bond is preceded by a <i>cis</i> - or <i>trans</i> - prefix, indicating the conformation of the molecule around the bond. For example, linoleic acid is designated "cis- Δ^9 , cis- Δ^{12} octadecadienoic acid". This nomenclature has the advantage of being less verbose than systematic nomenclature, but is no more technically clear or descriptive.
<i>n−x</i> nomenclature	<i>n</i> –3	$n-x$ (<i>n</i> minus <i>x</i> ; also $\omega-x$ or omega- <i>x</i>) nomenclature both provides names for individual compounds and classifies them by their likely biosynthetic properties in animals. A double bond is located on the <i>x</i> th carbon-carbon bond, counting from the terminal methyl carbon

(designated as n or ω) toward the carbonyl carbon. For example, α -Linolenic acid is classified as a n-3or omega-3 fatty acid, and so it is likely to share a biosynthetic pathway with other compounds of this type. The ω -x, omega-x, or "omega" notation is common in popular nutritional literature, but IUPAC has deprecated it in favor of n-x notation in technical documents. The most commonly researched fatty acid biosynthetic pathways are n-3and n-6, which are hypothesized to decrease or increase, respectively, inflammation.

Lipid numbers take the form C:D, where C is the number of carbon atoms in the fatty acid and D is the number of double bonds in the fatty acid (if more than one, the double bonds are assumed to be interrupted by CH₂ units, *i.e.*, at intervals of 3 18:3, cis, cis, cis- carbon atoms along the chain). This notation can be ambiguous, as some different fatty acids can have the same numbers. Consequently, when ambiguity exists this notation is usually paired with either a Δ^x or n-xterm.

4 - **Production**

Lipid numbers

18:3

18:3ω6

 $\Delta^9, \Delta^{12}, \Delta^{15}$

Fatty acids are usually produced industrially by the hydrolysis of triglycerides, with the removal of glycerol (see oleochemicals). Phospholipids represent another source. Some fatty acids are produced synthetically by hydro carboxylation of alkenes.

Vitamin

4-**1** - Free fatty acids

The biosynthesis of fatty acids involves the condensation of acetyl - CoA. Since this coenzyme carries a two - carbon - atom group, almost all natural fatty acids have even numbers of carbon atoms.

The "uncombined fatty acids" or "free fatty acids" found in organisms come from the breakdown of a triglyceride^[citation needed]. Because they are insoluble in water, these fatty acids are transported (solubilized, circulated) while bound to plasma protein albumin. The levels of "free fatty acid" in the blood are limited by the availability of albumin binding sites.

5 - Fatty acids in dietary fats

The following table gives the fatty acid, vitamin E and cholesterol composition of some common dietary fats.

	Saturated	l Monounsaturate	d Polyunsaturate	d Cholestero	l Vitamin E
	g/100g	g/100g	g/100g	mg/100g	mg/100g
Animal fats					
Lard	40.8	43.8	9.6	93	0.00
Duck fat	33.2	49.3	12.9	100	2.70
Butter	54.0	19.8	2.6	230	2.00
Vegetable fats					
Coconut oil	85.2	6.6	1.7	0	.66
Palm oil	45.3	41.6	8.3	0	33.12
Cottonseed oil	25.5	21.3	48.1	0	42.77
Wheat germ oil	18.8	15.9	60.7	0	136.65
Soya oil	14.5	23.2	56.5	0	16.29
Olive oil	14.0	69.7	11.2	0	5.10
Corn oil	12.7	24.7	57.8	0	17.24
Sunflower oil	11.9	20.2	63.0	0	49.0
Safflower oil	10.2	12.6	72.1	0	40.68
Hemp oil	10	15	75	0	
Canola/Rapeseed oil	5.3	64.3	24.8	0	22.21

6 - Reactions of fatty acids

Fatty acids exhibit reactions like other carboxylic acids, i.e. they undergo esterification and acid - base reactions.

6 – 1 - Acidity

Fatty acids do not show a great variation in their acidities, as indicated by their respective pK_a . Nonanoic acid, for example, has a pK_a of 4.96, being only slightly weaker than acetic acid (4.76). As the chain length increases, the solubility of the fatty acids in water decreases very rapidly, so that the longer-chain fatty acids have minimal effect on the pH of an aqueous solution. Even those fatty acids that are insoluble in water will dissolve in warm ethanol, and can be titrated with sodium hydroxide solution using phenolphthalein as an indicator to a pale-pink endpoint. This analysis is used to determine the free fatty acid content of fats; i.e., the proportion of the triglycerides that have been hydrolyzed.

6-1 - Hydrogenation and hardening

Hydrogenation of unsaturated fatty acids is widely practiced to give saturated fatty acids, which are less prone toward rancidification. Since the saturated fatty acids are higher melting than the unsaturated relatives, the process is called hardening. This technology is used to convert vegetable oils into margarine. During partial hydrogenation, unsaturated fatty acids can be isomerized from *cis* to *trans* configuration.

More forcing hydrogenation, i.e. using higher pressures of H_2 and higher temperatures, converts fatty acids into fatty alcohols. Fatty alcohols are, however, more easily produced from fatty acid esters.

In the Varrentrapp reaction certain unsaturated fatty acids are cleaved in molten alkali, a reaction at one time of relevance to structure elucidation.

6-3-Auto - oxidation and rancidity

Unsaturated fatty acids undergo a chemical change known as auto-oxidation. The process requires oxygen (air) and is accelerated by the presence of trace metals. Vegetable oils resist this process because they contain antioxidants, such as tocopherol. Fats and oils often are treated with chelating agents such as citric acid to remove the metal catalysts.

6-4 - Ozonolysis

Unsaturated fatty acids are susceptible to degradation by ozone. This reaction is practiced in the production of azelaic acid $((CH_2)_7(CO_2H)_2)$ from oleic acid.

7 – Circulation

7 – 1 - Digestion and intake

Short- and medium-chain fatty acids are absorbed directly into the blood via intestine capillaries and travel through the portal vein just as other absorbed nutrients do. However, long-chain fatty acids are not directly released into the intestinal capillaries. Instead they are absorbed into the fatty walls of the intestine villi and reassembled again into triglycerides. The triglycerides are coated with cholesterol and protein (protein coat) into a compound called a chylomicron.

Within the villi, the chylomicron enters a lymphatic capillary called a lacteal, which merges into larger lymphatic vessels. It is transported via the lymphatic system and the thoracic duct up to a location near the heart (where the arteries and veins are larger). The thoracic duct empties the chylomicrons into the bloodstream via the left subclavian vein. At this point the chylomicrons can transport the triglycerides to tissues where they are stored or metabolized for energy.

7 – 2 - Metabolism

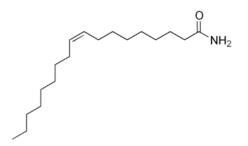
Fatty acids (provided either by ingestion or by drawing on triglycerides stored in fatty tissues) are distributed to cells to serve as a fuel for muscular contraction and general metabolism. They are consumed by mitochondria to produce ATP through beta oxidation.

7 – 3 - Distribution

Blood fatty acids are in different forms in different stages in the blood circulation. They are taken in through the intestine in chylomicrons, but also exist in very low density lipoproteins (VLDL) and low density lipoproteins (LDL) after processing in the liver. In addition, when released from adipocytes, fatty acids exist in the blood as free fatty acids.

It is proposed that the blend of fatty acids exuded by mammalian skin, together with lactic acid and pyruvic acid, is distinctive and enables animals with a keen sense of smell to differentiate individuals.

Fatty Acid Amide



Chemical structure of oleamide, an FAA derived from the fatty acid oleic acid

Contents

1 Introduction
 2 Natural occurrences

1 - Introduction

Fatty acid amides (FAAs) are amides formed from a fatty acid and an amine. In biochemistry, FFAs which have ethanolamine as the amine component are known as *N*-acyl ethanol amines and they play an important role in chemical signaling.

2 - Natural occurrences

Aliphatic amides can be found in *Zanthoxylum* species found in Nigeria.

Federation of Oils, Seeds and Fats Associations

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- 1 Introduction
- 2 History
- 3 Structure
- 4 Function

1 Introduction

The Federation of Oils, Seeds and Fats Associations (FOSFA International) is the main trade association for the oil, seeds and fats industry. It regulates legal contracts in the industry.

Federation of Oils, Seeds and Fats Associations Ltd			
Abbreviation	FOSFA International		
Formation	25 January 1968		
Туре	Trade association		
Legal Status	Private company		
Purpose / Focus	Oil, seeds and fats		
Head Quarters	20 St Dunstan's Hill , City of London , EC3R 8NQ		
Region Served	World wide		
Member Ship	900 companies in 77 countries		
Chief Executive	Stuart Logan		
Main Organ	FOSFA Council (President - Chris Berry)		
Website	FOSFA International		

2-History

FOSFA was formed from four other previous organisations in 1968.

It used to be based at 24 St Mary Axe at the Baltic Exchange, now the home of the Gherkin.

3 – Structure

It is situated just off *Lower Thames Street* (A3211), between Tower Hill tube station and Bank–Monument station. It is not far from the River Thames, between the Tower of London and London Bridge.

4 – Function

85 % of world wide trade in oils and fats is under FOSFA contracts. It regulates trade in the industry. The clauses in contracts are known as the FOSFA Rules. Its rules cover products transported with Cost, Insurance and Freight (CIF) or Freight on Board (FOB).

It holds week-long residential training courses during the summer at Brunel University.

Finishing Oil

A finishing oil is a vegetable oil used for wood finishing.

These finishes are a historical finish for wood, primarily as means of making it weather or moisture resistant. Finishing oils are easily applied, by wiping with a cloth. They are also simply made, by extraction from plant sources with relatively simple processing. Historically, both of these were considerable advantages over varnishes, that depended upon exotic imported plant resins, complex preparation and careful application with expensive brushes.

The two most important finishing oils, to this day, are linseed oil and tung oil.

Linseed oil is extracted from the seeds of the flax plant, already extensively grown for the production of linen. The raw oil may be used, but it cures poorly and leaves a sticky surface. Normally boiled linseed oil is used. This has been prepared beforehand by boiling with lead, in the form of lead oxide, or with manganese salts. Modern boiled oils use a lead-free metallic drier added cold, such as cobalt resinate. Old linseed oil finishes yellow with age, owing to oxidation with the air. Linseed oil was also widely used for the production of oilcloth, a waterproof covering and rainwear material, formed by coating linen or cotton fabrics with the boiled oil.

Tung oil is pressed from the nuts of the tung tree. Raw tung cures better than raw linseed and so it is often used in this form. As tung oil yellows with age less than linseed, it is favoured for high quality and furniture work.

Most modern finishing oils use a blend of oil and a thinning agent such as white spirit. Raw oils tend to be applied too thickly, leading to a thick layer that cannot cure effectively and so remains sticky. A thinned oil is easier and more reliable to apply. Such commercial mixtures also contain metallic driers to improve their performance. There are also mixtures sold as finishing oils. These are classed as 'long oils', predominantly oil with some varnish added or as 'short oils' which are predominantly varnish, with some oil.^[1] Danish oil is a popular long oil finishing oil. Spar varnish is a short oil varnish, used for added flexibility and elasticity.

Fish Oil

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1 - Introduction

Fish oil is oil derived from the tissues of oily fish. Fish oils contain the omega-3 fatty acids eicosa penta enoic acid (EPA) and docosa hexa enoic acid (DHA), precursors of certain eicosanoids that are known to reduce inflammation in the body,^{[1][2]} and have other health benefits.

Fish do not actually produce omega-3 fatty acids, but instead accumulate them by consuming either microalgae or prey fish that

have accumulated omega-3 fatty acids, together with a high quantity of antioxidants such as iodide and selenium, from microalgae, where these antioxidants are able to protect the fragile polyunsaturated lipids from peroxidation.

Fatty predatory fish like sharks, swordfish, tilefish, and albacore tuna may be high in omega-3 fatty acids, but due to their position at the top of the food chain, these species can also accumulate toxic substances through bio magnification. For this reason, the U.S. Food and Drug Administration recommends limiting consumption of certain (predatory) fish species (e.g. albacore tuna, shark, king mackerel, tilefish and swordfish) due to high levels of toxic contaminants such as mercury, dioxin, PCBs and chlordane.^[6] Fish oil is used as a component in aquaculture feed. More than 50 percent of the world's fish oil used in aquaculture feed is fed to farmed salmon.

Marine and freshwater fish oil vary in contents of arachidonic acid, EPA and DHA. The various species range from lean to fatty and their oil content in the tissues has been shown to vary from 0.7–15.5 %. They also differ in their effects on organ lipids.^[8] Studies have revealed that there is no relation between total fish intake or estimated omega–3 fatty acid intake from all fish and serum omega–3 fatty acid concentrations. Only fatty fish intake, particularly salmonid, and estimated EPA + DHA intake from fatty fish has been observed to be significantly associated with increase in serum EPA + DHA.

The omega-3 fatty acids in fish oil are thought to be beneficial in treating hypertriglyceridemia, and possibly beneficial in preventing heart disease. Fish oil and omega-3 fatty acids have been studied in a wide variety of other conditions, such as clinical depression, anxiety, cancer, and macular degeneration, although benefit in these conditions remains to be proven.

2 – Back ground

The most widely available dietary source of EPA and DHA is cold water oily fish, such as salmon, herring, mackerel, anchovies,

and sardines. Oils from these fish have a profile of around seven times as much omega-3 oils as omega-6 oils. Other oily fish, such as tuna, also contain omega-3 in somewhat lesser amounts. Although fish is a dietary source of omega-3, fish do not synthesize them; they obtain them from the algae (microalgae in particular) or plankton in their diets.

Grams of omega-3 fatty acids per 85 g serving of popular fish.				
Common Name Grams				
Herring, sardines	1.3 - 2			
Spanish mackerel, Atlantic, Pacific	1.1 – 1.7			
Salmon	1.1 1.9			
Halibut	0.60 - 1.12			
Tuna	0.21 - 1.1			
Swordfish	0.97			
Greenshell/lipped mussels	0.95			
Tilefish	0.9			
Tuna (canned, light)	0.17 - 0.24			
Pollock	0.45			
Cod	0.15 - 0.24			
Catfish	0.22 - 0.3			
Flounder	0.48			
Grouper	0.23			
Mahi mahi	0.13			
Orange roughy	0.028			
Red snapper	0.29			
Shark	0.83			
King mackerel	0.36			
Hoki (blue grenadier)	0.41			
Gemfish	0.40			
Blue eye cod	0.31			
Sydney rock oysters	0.30			
Tuna, canned	0.23			
Snapper	0.22			

Barramundi, saltwater	0.100
Giant tiger prawn	0.100

For comparison, here are the omega-3 levels in some common non-fish foods.

serving of common non-fish foods.		
Name	grams	
Eggs, large regular	0.109	
Lean red meat	0.031	
Turkey	0.030	
Cereals, rice, pasta, etc.	0.00	
Fruit	0.00	
Milk regular	0.00	
Regular bread	0.00	
Vegetables	0.00	

Grams of omega-3 fatty acids per 85g serving of common non-fish foods.

3 – Production

In 2005, fish oil production declined in all main producing countries with the exception of Iceland. The 2005 production estimate is about 570,000 tones in the five main exporting countries (Peru, Denmark, Chile, Iceland and Norway), a 12 % decline from the 650,000 tonnes produced in 2004. Peru continues to be the main fish oil producer worldwide, with about one fourth of total fish oil production.

4 - Health benefits

4 – 1 – Cancer

Several studies report possible anti - cancer effects of n-3 fatty acids found in fish oil (particularly breast, colon and prostate cancer). Among n-3 fatty acids (omega-3), neither long-chain nor short-chain forms were consistently associated with reduced breast cancer risk. High levels of docosahexaenoic acid, however, the most abundant n-3 polyunsaturated fatty acid (omega-3) in erythrocyte membranes, were associated with a reduced risk of breast cancer.^[24] A recent study of 35,000 middle-aged women found that the women who took fish oil supplements had a 32% lower risk of breast cancer, although the authors stress the result is preliminary and falls short of establishing a causal relationship . Omega-3 fatty acids reduced prostate cancer growth, slowed histopathological progression, and increased survival in genetically engineered mice. However the effects of fish oil consumption by humans on prostate cancer is not conclusive.^[27] There is a decreased risk with higher blood levels of DPA, but an increased risk of more aggressive prostate cancer with higher blood levels of combined EPA and DHA.

4-2-Cardiovascular

The American Heart Association recommends the consumption of 1g of fish oil daily, preferably by eating fish, for patients with coronary heart disease although pregnant and nursing women are advised to avoid eating fish with high potential for mercury contaminants including mackerel, shark, or swordfish.^[29] Note that optimal dosage relates to body weight.

The US National Institutes of Health lists three conditions for which fish oil and other omega-3 sources are most highly recommended: hypertriglyceridemia, secondary cardiovascular disease prevention and high blood pressure. It then lists 27 other conditions for which there is less evidence. It also lists possible safety concerns: "Intake of 3 grams per day or greater of omega-3 fatty acids may increase the risk of bleeding, although there is little evidence of significant bleeding risk at lower doses. Very large intakes of fish oil/omega-3 fatty acids may increase the risk of hemorrhagic (bleeding) stroke."

There is also some evidence that fish oil may have a beneficial effect on some forms of cardiac dysrhythmia.

A 2008 meta-study by the *Canadian Medical Association Journal* found fish oil supplementation did not demonstrate any preventative benefit to cardiac patients with ventricular arrhythmias. A 2012 meta - analysis published in the Journal of the American Medical Association, covering 20 studies and 68680 patients, found that fish oil supplementation did not reduce the chance of death, cardiac death, heart attack or stroke.

4 – 3 – Hypertension

There have been some human trials that have concluded that consuming omega-3 fatty acids slightly reduces blood pressure (DHA could be more effective than EPA). It is important to note that because omega-3 fatty acids can increase the risk of bleeding, a qualified healthcare provider should be consulted before supplementing with fish oil.

4 – 4 - Mental health

Studies published in 2004 and 2009 have suggested that the *n-3* EPA may reduce the risk of depression and suicide. One study^[35] compared blood samples of 100 suicide-attempt patients to those of controls and found that levels of Eicosa penta enoic acid were significantly lower in the washed red blood cells of the suicide-attempt patients. A small American trial in 2009 suggested that E-EPA, as monotherapy, might treat major depressive disorder but failed to achieve statistical significance.

Studies were conducted on prisoners in England where the inmates were fed seafood which contains omega-3 fatty acids. The higher consumption of these fatty acids corresponded with a drop in the assault rates . Another Finnish study found that prisoners who were convicted of violence had lower levels of omega-3 fatty acids than prisoners convicted of nonviolent offenses. It was suggested that these kinds of fatty acids are responsible for the neuronal growth of the frontal cortex of the brain which, it is further alleged, is the seat of personal behavior.

A study from the Orygen Research Centre in Melbourne suggests that omega-3 fatty acids could also help delay or prevent the onset of schizophrenia. The researchers enlisted 81 'high risk' young people aged 13 to 24 who had previously suffered brief hallucinations or delusions and gave half of them capsules of fish oil while the other half received placebo. One year on, only three percent of those on fish oil had developed schizophrenia compared to 28 percent from those on placebo. A study conducted at Sheffield University in England reported positive results with fish oil on patients suffering from schizophrenia. Participants of the study had previously taken antipsychotic prescription drugs that were no longer effective. After taking fish oil supplements, participants in the study experienced progress compared to others who were given a placebo.

The largest controlled study to date found no cognitive benefit after two years in the elderly.

4 – 5 - Alzheimer's disease

According to a study from Louisiana State University in September 2005, Docosahexaenoic acid, an omega-3 fatty acid often found in fish oil, may help protect the brain from cognitive problems associated with Alzheimer's disease.

A Cochrane meta-analysis published in June 2012 found no significant protective effect for cognitive decline for those aged 60 and over and who started taking fatty acids after this age. A co-author of the study said to *Time*, "Our analysis suggests that there is currently no evidence that omega-3 fatty acid supplements provide a benefit for memory or concentration in later life".

4 - 6 - Lupus

In a study conducted in Northern Ireland, lupus disease activity, especially in the skin and joints, was significantly reduced in patients who received fish oil supplements at both 12-week and 24-week follow-up periods versus patients who received placebo. There were also changes in the blood platelets of the patients who took the fish oil supplements, with an increase in proteins that are considered anti-inflammatory and a decrease in proteins that promote inflammation; these changes were not evident in the group that took placebo. The fish oil group showed an increase in flow-mediated dilation, which the researchers took as a sign that the omega-3 oils were helping the cells in the blood vessel walls to remain healthy.

4 – 7 - Parkinson's disease

A study examining whether omega-3 exerts neuroprotective action in Parkinson's disease found that it did exhibit a protective effect in mice. The scientists exposed mice to either a control or a high omega-3 diet from two to twelve months of age and then treated them with a neurotoxin commonly used as an experimental model for Parkinson's. The scientists found that high doses of omega-3 given to the experimental group prevented the neurotoxin-induced decrease of dopamine that ordinarily occurs. Since Parkinson's is a disease caused by disruption of the dopamine system, this protective effect exhibited could show promise for future research in the prevention of Parkinson's disease.

4 – 8 – Depression

Evidence regarding the efficacy of fish oil supplements as a treatment for depression is inconclusive. Whereas several methodologically rigorous studies have reported statistically significant positive effects in the treatment of depressed patients, other studies have found effects to be insignificant.

In 1999 a team of researchers lead by the Harvard psychiatrist Andrew Stoll published a preliminary placebo - controlled double blind trial which found Omega 3 fatty acids "improved the short-term course of illness" of bipolar disorder. He credits Donald O. Rudin for pioneering this view in 1981.

A 2003 double - blind placebo-controlled study published in the journal *European Neuropsychopharmacology* found that among 28 patients with major depressive disorder, "patients in the omega-3 PUFA group had a significantly decreased score on the 21-item Hamilton Rating Scale for Depression than those in the placebo group."^[12] Another study in the *American Journal of Psychiatry* reported that the addition of fish oil supplements to regular maintenance anti-depression therapy conferred "highly significant" benefits by the third week of the trial.

A 2005 randomized double - blind placebo - controlled study conducted under the auspices of the New Zealand Institute for Crop

and Food Research found "no evidence that fish oil improved mood when compared to placebo, despite an increase in circulating ω -3 polyunsaturated fatty acids ." Another study published in October 2007 found that fish oil supplements conferred no additional benefits beyond those conferred by standard treatment.^[54] However, both of these studies used omega-3 primary consisting of DHA, not EPA.

A 2008 Cochrane systematic review found that limited data is available. In the one eligible study, omega-3s were an effective adjunctive therapy for depressed but not manic symptoms in bipolar disorder. The authors found an "acute need" for more randomised controlled trials.

A 2009 metastudy found that patients taking omega-3 supplements with a higher EPA:DHA ratio experienced less depressive symptoms. The studies provided evidence that EPA may be more efficacious than DHA in treating depression. However, this metastudy concluded that due to the identified limitations of the included studies, larger, randomized trials are needed to confirm these findings.

In a 2011 meta-analysis of PubMed articles about fish oil and depression from 1965-2010, researchers found that "nearly all of the treatment efficacy observed in the published literature may be attributable to publication bias."

4 – 9 – Psoriasis

Diets supplemented with cod liver oil have shown beneficial effects on psoriasis.

4 – 10 – Pregnancy

Omega -3 polyunsaturated fatty acids (commonly found in fish oil) protect against fetal brain injury and promotes fetal and infant brain health . Some studies reported better psycho motor development at 30 months of age in infants whose mothers received fish oil supplements for the first four months of lactation . In addition, five year - old children whose mothers received modest algae based docosahexaenoic acid supplementation for the first 4 months of breastfeeding performed better on a test of sustained attention. This suggests that docosa hexa enoic acid intake during early infancy confers long-term benefits on specific aspects of neuro development.

Docosa hexa enoic acid supplementation has also been found to be essential for early visual development of the baby.^[61] However, the standard western diet is severely deficient in these critical nutrients. This omega-3 dietary deficiency, a nutrient found in fish oil, is compounded by the fact that pregnant women become depleted in omega-3s, since the fetus uses omega-3s for its nervous system development. Omega-3s are also used after birth if they are provided in breast milk.

In addition, provision of fish oil during pregnancy may reduce an infant's sensitization to common food allergens and reduce the prevalence and severity of certain skin diseases in the first year of life. This effect may persist until adolescence with a reduction in prevalence and/or severity of eczema, hay fever and asthma.

Omega-3 fatty acid supplementation is also beneficial to the mother. It has been shown to prevent pre - term labor and delivery.^[62] It is recommended that women who are breastfeeding consume fish oil at least twice a week, although the American Heart Association recommends pregnant and nursing women are to avoiding eating fish with high potential for mercury contaminants including mackerel, shark, or swordfish.

5 - Supplement quality and concerns

Fish oil is now one of the most popular dietary supplements on the market, with sales reaching \$976 million in 2009.^[64] However, neither the FDA nor any other federal or state agency routinely tests fish or marine oil supplements for quality prior to sale. Problems of quality have been identified in periodic tests by independent researchers of marketed supplements containing fish oil and other marine oils. These problems include contamination, inaccurate listing of EPA and DHA levels, spoilage and formulation issues.

5-**1**-**Contamination**

Fish can accumulate toxins such as mercury, dioxins, and polychlorinated biphenyls (PCBs), and spoiled fish oil may produce peroxides. There appears to be little risk of contamination by microorganisms, proteins, lyso phospho lipids, cholesterol, and transfats .

5 - 2 - Mercury

While a serving of fish may contain anywhere from 10 to 1,000 ppb of mercury, fish oil supplements have not been found to contain similar mercury levels. Reasons for this are 1) smaller fish are typically used in making fish oil supplements and they tend to be lower on the food chain and contain less mercury; 2) mercury binds to protein (such as in fish meat) and not to oil; and 3) mercury may be reduced or removed during the processing of fish oil. (most fish oils are distilled)

5-3 - Dioxins and PCBs

Dioxins and PCBs may be carcinogenic at low levels of exposure over time. These substances are identified and measured in one of two categories, dioxin-like PCBs and total PCBs. While the U.S. FDA has not set a limit for PCBs in supplements, the Global Organization for EPA and DHA (GOED) has established a guideline allowing for no more than 3 pico grams of dioxin-like PCBs per gram of fish oil. In 2012, samples from 35 fish oil supplements were tested for PCBs. Trace amounts of PCBs were found in all samples, and two samples exceeded the GOED's limit.^[68] Although trace amounts of PCBs contribute to overall PCB exposure, Consumerlab.com claims the amounts reported by tests it ordered on fish oil supplements are far below those found in a single typical serving of fish.

5 – 4 – Spoilage

Peroxides can be produced when fish oil spoils. A study commissioned by the government of Norway concluded there would be some health concern related to the regular consumption of oxidized (rancid) fish/marine oils, particularly in regards to the gastrointestinal tract, but there is not enough data to determine the risk. The amount of spoilage and contamination in a supplement depends on the raw materials and processes of extraction, refining, concentration, encapsulation, storage and transportation. ConsumerLab.com reports in its review that it found spoilage in test reports it ordered on some fish oil supplement products.

5 – 5 - EPA and DHA content

Some countries recommend a combined daily intake of 300 – 500 mg while some countries like the US do not have a recommendation for EPA and DHA. The American Heart Association recommends 250 – 500 mg / day of EPA and DHA.^[29] In the United States the FDA recommends not exceeding 3 grams per day of EPA and DHA omega-3 fatty acids, with no more than 2 grams per day from a dietary supplement.

According to independent laboratory tests, the concentrations of EPA and DHA in supplements can vary from between 8 to 80 % fish oil content. The concentration depends on the source of the omega-3s, how the oil is processed, and the amounts of other ingredients included in the supplement . A 2012 report claims 4 of 35 fish oil supplements it covered contained less EPA or DHA than was claimed on the label, and 3 of 35 contained more A ConsumberLab.com publication in 2010 claims 3 of 24 fish oil supplements it covered contained less EPA on the label.

5-6-Formulation

Fish oil supplements are available as liquids, capsules, and tablets. Some pills are enteric-coated to help prevent indigestion or "fish burps", however; enteric-coated products have the potential to release ingredients too early or late in the digestive process. In 2010 ConsumerLab.com reports that one of 24 fish oil supplements^[which?] with enteric-coated pill released ingredients prematurely^[clarification needed]; Consumerlab.com claims in its publication that there were problems in results of tests it ordered in 2012.^[64] Fish oils are best tolerated when taken with meals, and, if possible, should be taken in equally divided doses throughout the day.

6 – Dangers

A 2013 review concluded that that the potential for adverse events amongst older adults taking fish oil "appear mild – moderate at worst and are unlikely to be of clinical significance".

6 – 1 - Maximum intake

The FDA says it is safe to take up to 3000 mg of omega-3 per day. (This is not the same as 3000 mg of fish oil. A 1000 mg pill typically has only 300 mg of omega-3; 10 such pills would equal 3000 mg of omega-3.) Dyerberg studied healthy Greenland Eskimos and found an average intake of 5700 mg of omega-3 EPA per day.

6 – 2 – Vitamins

The liver and liver products (such as cod liver oil) of fish and many animals (such as seals and whales) contain omega-3, but also the active form of vitamin A . At high levels, this form of the vitamin can be dangerous (Hyper vitaminosis A).

6-3 - Toxic pollutants

Consumers of oily fish should be aware of the potential presence of heavy metals and fat-soluble pollutants like PCBs and dioxins, which are known to accumulate up the food chain. After extensive review, researchers from Harvard's School of Public Health in the *Journal of the American Medical Association* (2006) reported that the benefits of fish intake generally far outweigh the potential risks.

Fish oil supplements came under scrutiny in 2006, when the Food Standards Agency in the UK and the Food Safety Authority of Ireland reported PCB levels that exceeded the European maximum limits in several fish oil brands , which required temporary withdrawal of these brands. To address the concern over contaminated fish oil supplements, the International Fish Oil Standards (IFOS) Program, a third - party testing and accreditation program for fish oil products, was created by Nutra source Diagnostics Inc. in Guelph, Ontario, Canada.

A March 2010 lawsuit filed by a California environmental group claimed that eight brands of fish oil supplements contained excessive

levels of PCB's, including CVS/pharmacy, Nature Made, Rite Aid, GNC, Solgar, Twinlab, Now Health, Omega Protein and Pharmavite. The majority of these products were either cod liver or shark liver oils. Those participating in the lawsuit claim that because the liver is the major filtering and detoxifying organ, PCB content may be higher in liver - based oils than in fish oil produced from the processing of whole fish.

An analysis based on data from the Norwegian Women and Cancer Study (NOWAC) with regards to the dangers of persistent organic pollutants (POPs) in cod liver came to the conclusion that "in Norwegian women, fish liver consumption was not associated with an increased cancer risk in breast, uterus, or colon. In contrast, a decreased risk for total cancer was found."

However, a report by the Harvard Medical School studied five popular brands of fish oil, including Nordic Ultimate, Kirkland and CVS. They found that the brands had "negligible amounts of mercury, suggesting either that mercury is removed during the manufacturing of purified fish oil or that the fish sources used in these commercial preparations are relatively mercury- free." Microalgae oil is a vegetarian alternative to fish oil. Supplements produced from microalgae oil provide a balance of omega - 3 fatty acids similar to fish oil, with a lower risk of pollutant exposure.

Flax



Flax plant

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1 - Introduction

Flax (also known as common flax or linseed) (binomial name: *Linum usitatissimum*) is a member of the genus *Linum* in the family Linaceae. It is a food and fibre crop that is grown in cooler regions of the world. Flax fibres are taken from the stem of the plant and are two to three times as strong as those of cotton. As well, flax fibers are naturally smooth and straight. Europe and North America depended on flax for cloth until the nineteenth century, when cotton overtook flax as the most common plant used for making linen paper. Flax is grown on the Canadian Prairies for linseed oil, which is used as a drying oil in paints and varnish and in products such as linoleum and printing inks. It is native to the region extending from the eastern Mediterranean to India and was probably first domesticated in the Fertile Crescent. Flax was extensively cultivated in ancient China and A discovery reported in 2009 of spun, dyed, and ancient Egypt. knotted wild flax fibers in a prehistoric cave in the Republic of Georgia shows that the plant was already in use by humans at the surprisingly early date of 30,000 BC. New Zealand flax is not related to flax but was named after it, as both plants are used to produce fibers"

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Malpighiales
Family:	Linaceae
Genus:	Linum
Species:	L. usitatissimum
Binomial name	
Linum	usitatissimum
Linnaeus.	

2 – Description



Capsules

Flax is an erect annual plant growing to 1.2 m (3 ft 11 in) tall, with slender stems. The leaves are glaucous green, slender lanceolate, 20–40 mm long and 3 mm broad. The flowers are pure pale blue, 15–25 mm diameter, with five petals; they can also be bright red. The fruit is a round, dry capsule 5–9 mm diameter, containing several glossy brown seeds shaped like an apple pip, 4–7 mm long.

In addition to referring to the plant itself, the word "flax" may refer to the unspun fibers of the flax plant.

3 - History

Flax fibers are amongst the oldest fiber crops in the world. The use of flax for the production of linen goes back at least to ancient Egyptian times. Dyed flax fibers found in a cave in Dzudzuana (prehistoric Georgia) have been dated to 30,000 years ago. Pictures on tombs and temple walls at Thebes depict flowering flax plants. The use of flax fiber in the manufacturing of cloth in northern Europe dates back to Neolithic times. In North America, flax was introduced by the Puritans.

4 - Uses

Flax is grown for its use as an edible oil, as a nutritional supplement, and as an ingredient in many wood finishing products. Flax is also grown as an ornamental plant in gardens. Flax fibers are used to make linen. The Latin species name *usitatissimum* means *most*

useful, pointing to the several traditional uses of the plant and their importance for human life



4 – 1 - Flax seeds

Flax seeds come in two basic varieties: (1) brown; and (2) yellow or golden. Most types have similar nutritional characteristics and equal numbers of short-chain omega-3 fatty acids. The exception is a type of yellow flax called solin (trade name Linola), which has a completely different oil profile and is very low in omega-3 FAs. Although brown flax can be consumed as readily as yellow, and has been for thousands of years, it is better known as an ingredient in paints, fiber and cattle feed. Flax seeds produce a vegetable oil known as flaxseed or linseed oil, which is one of the oldest commercial oils, and solvent-processed flax seed oil has been used for centuries as a drying oil in painting and varnishing.

One hundred grams of ground flax seed supplies about 450 calories, 41 grams of fat, 28 grams of fiber, and 20 grams of protein.

Flax seed sprouts are edible, with a slightly spicy flavor. Excessive consumption of flax seeds with inadequate water can cause bowel obstruction. Flaxseed, called ('Tisi' or 'Alsi') in northern India, has been roasted, powdered and eaten with boiled rice, a little water, and a little salt since ancient times in the villages.

Whole flax seeds are chemically stable, but ground flaxseed can go rancid at room temperature in as little as one week.^[7] Refrigeration and storage in sealed containers will keep ground flax from becoming

rancid for a longer period; under conditions similar to those found in commercial bakeries, trained sensory panelists could not detect differences between bread made with freshly ground flax and bread made with milled flax stored for four months at room temperature.^[8] Milled flax is remarkably stable to oxidation when stored for nine months at room temperature if packed immediately without exposure to air and light and for 20 months at ambient temperatures under warehouse conditions.

Three natural phenolic glucosides , secoisolariciresinol diglucoside , p- coumaric acid glucoside and ferulic acid glucoside, can be found in commercial breads containing flaxseed.

Flax seed	
Nutritional value per 100 g	
Energy	2,234 kJ (534 kcal)
Carbohydrates	28.88 g
- Sugars	1.55 g
- Dietary fiber	27.3 g
Fat	42.16 g
- saturated	3.663
- monounsaturated	7.527
- polyunsaturated	28.730
Protein	18.29 g
Thiamine (vit. B ₁)	1.644 mg (143 %)
Riboflavin (vit. B ₂)	0.161 mg (13 %)
Niacin (vit. B ₃)	3.08 mg (21 %)
Pantothenic acid (B ₅)	0.985 mg (20 %)
Vitamin B ₆	0.473 mg (36 %)

4 - 1 - 1 - Nutrients and clinical research

Folate (vit. B ₉)	0 μg (0 %)
Vitamin C	0.6 mg (1 %)
Calcium	255 mg (26 %)
Iron	5.73 mg (44 %)
Magnesium	392 mg (110 %)
Phosphorus	642 mg (92 %)
Potassium	813 mg (17 %)
Zinc	4.34 mg (46 %)

Flax seeds contain high levels of dietary fiber as well as lignans, an abundance of micronutrients and omega-3 fatty acids (table). Studies have shown that flax seeds may lower cholesterol levels, although with differing results in terms of gender. One study found results were better for women whereas a later study found benefits only for men. Initial studies suggest that flax seeds taken in the diet may benefit individuals with certain types of breast and prostate cancers. A study done at Duke University suggests that flaxseed may stunt the growth of prostate tumors, although a meta-analysis found the evidence on this point to be inconclusive. Flax may also lessen the severity of diabetes by stabilizing blood-sugar levels. There is some support for the use of flax seed as a laxative due to its dietary fiber content though excessive consumption without liquid can result in intestinal blockage. Consuming large amounts of flax seed may impair the effectiveness of certain oral medications, due to its fiber content, and may have adverse effects due to its content of neurotoxic cyanogen glycosides and immunosuppressive cyclic nonapeptides.

One of the main components of flax is lignan, which has plant estrogen as well as antioxidants (flax contains up to 800 times more lignans than other plant foods contain).

4 – 2 - Flax fibers

Flax fiber is extracted from the bast or skin of the stem of the flax plant. Flax fiber is soft, lustrous and flexible; bundles of fiber have the appearance of blonde hair, hence the description "flaxen". It is stronger than cotton fiber but less elastic. The best grades are used for linen fabrics such as damasks, lace and sheeting. Coarser grades are used for the manufacturing of twine and rope. Flax fiber is also a raw material for the high-quality paper industry for the use of printed banknotes and rolling paper for cigarettes and tea bags. Flax mills for spinning flaxen yarn were invented by John Kendrew and Thomas Porthouse of Darlington in 1787. New methods of processing flax and the rising price of cotton have led to renewed interest in the use of flax as an industrial fiber. Naturally Advanced's Crailar technology is one proprietary method that is increasing the industrial adoption of this plant.

5 – Cultivation

The significant linseed producing countries are Canada (\sim 34 %) and China (\sim 25.5 %), though there is also production in India (\sim 9 %), USA (\sim 8 %), Ethiopia (\sim 3.5 %) and throughout Europe. Almost all of the United States crop is from the states of North Dakota, South Dakota, Minnesota, and Montana.

The soils most suitable for flax, besides the alluvial kind, are deep loams, and containing a large proportion of organic matter. It is often found just above the waterline in cranberry bogs. Heavy clays are unsuitable, as are soils of a gravelly or dry sandy nature. Farming flax requires few fertilizers or pesticides. Within 8 weeks of sowing, the plant will reach 10 -15 cm in height, and will grow several centimeters per day under its optimal growth conditions, reaching 70–80 cm within fifteen days.

6 - Production

2011 production in the United States was 70,890 metric tons, 2007 was 149,970 metric tons, 2006 production was 279,900 metric tons ^[26] Production of linseed in Russia in 2011: 230,000 metric tons according to FAO unofficial estimage

Top five linseed producers — 2007		
Country	Production (metric tons)	
Canada	633,500	

Russia	47,490
Ukraine	45,000
France	41,000
Argentina	34,000
World	1,875,018

6 – 1 - Diseases

6-2- Maturation

Flax is harvested for fiber production after approximately 100 days, or a month after the plant flowers and two weeks after the seed capsules form. The base of the plant will begin to turn yellow. If the plant is still green the seed will not be useful, and the fiber will be underdeveloped. The fiber degrades once the plant is brown.

6-3 - Harvesting methods

There are two ways to harvest flax, one involving mechanized equipment (combines), and a second method, more manual and targeted towards maximizing the fiber length.

6 – 3 - 1 - Mechanical

The mature plant is cut with mowing equipment, similar to hay harvesting, and raked into windrows. When dried sufficiently, a combine then harvests the seeds similar to wheat or oat harvesting. The amount of weeds in the straw affects its marketability, and this coupled with market prices determined whether the farmer chose to harvest the flax straw. If the flax was not harvested, it was typically burned, since the straw stalk is quite tough and decomposes slowly (*i.e.*, not in a single season), and still being somewhat in a windrow from the harvesting process, the straw would often clog up tillage and planting equipment. It was common, in the flax growing regions of western Minnesota, to see the harvested flax straw (square) bale stacks start appearing every July, the size of some stacks being estimated at 10-15 yards wide by 50 or more yards long, and as tall as a two-story house.

6 – 3 - 2 - Manual

The mature plant is pulled up with the roots (not cut), so as to maximize the fiber length. After this, the flax is allowed to dry, the seeds are removed, and is then retted. Dependent upon climatic conditions, characteristics of the sown flax and fields, the flax remains on the ground between two weeks and two months for retting. As a result of alternating rain and the sun, an enzymatic action degrades the pectins which bind fibers to the straw. The farmers turn over the straw during retting to evenly rett the stalks. When the straw is retted and sufficiently dry, it is rolled up. It will then be stored by farmers before scutching to extract fibers.

Flax grown for seed is allowed to mature until the seed capsules are yellow and just starting to split; it is then harvested by combine harvester and dried to extract the seed.

6 – 4 - Threshing flax



A tool for threshing flax

Threshing is the process of removing the seeds from the rest of the plant. As noted above in the *Mechanical* section, the threshing could be done in the field by a machine, or in another process, a description of which follows :

The process is divided into two parts: the first part is intended for the farmer, or flax-grower, to bring the flax into a fit state for general or common purposes. This is performed by three machines: one for threshing out the seed, one for breaking and separating the straw (stem) from the fiber, and one for further separating the broken straw and matter from the fiber. In some cases the farmers thrash out the seed in their own mill and therefore, in such cases, the first machine will be unnecessary. The second part of the process is intended for the manufacturer to bring the flax into a state for the very finest purposes, such as lace, cambric, damask, and very fine linen. This second part is performed by the refining machine only.

The threshing process would be conducted as follows :

Take the flax in small bundles, as it comes from the field or stack, and holding it in the left hand, put the seed end between the threshing machine and the bed or block against which the machine is to strike; then take the handle of the machine in the right hand, and move the machine backward and forward, to strike on the flax, until the seed is all threshed out.

Take the flax in small handfuls in the left hand, spread it flat between the third and little finger, with the seed end downwards, and the root - end above, as near the hand as possible.

Put the handful between the beater of the breaking machine, and beat it gently till the three or four inches, which have been under the operation of the machine, appear to be soft.

Remove the flax a little higher in the hand, so as to let the soft part of the flax rest upon the little finger, and continue to beat it till all is soft, and the wood is separated from the fiber, keeping the left hand close to the block and the flax as flat upon the block as possible .

The other end of the flax is then to be turned, and the end which has been beaten is to be wrapped round the little finger, the root end flat, and beaten in the machine till the wood is separated, exactly in the same way as the other end was beaten.

7 - Preparation for spinning

(German)

Before the flax fibers can be spun into linen, they must be separated from the rest of the stalk. The first step in this process is called retting. Retting is the process of rotting away the inner stalk, leaving the outer fibers intact. At this point there is still straw, or coarse fibers, remaining. To remove these the flax is "broken," the straw is broken up into small, short bits, while the actual fiber is left unharmed, then "scutched," where the straw is scraped away from the fiber, and then pulled through "hackles," which act like combs and comb the straw out of the fiber.



Threshing, retting and dressing flax at the Roscheider Hof Open Air Museum

7 – 1 - Retting flax

There are several methods of retting flax. It can be retted in a pond, stream, field or a tank. When the retting is complete the bundles of flax feel soft and slimy, and quite a few fibers are standing out from the stalks. When wrapped around a finger the inner woody part springs away from the fibers.

Pond retting is the fastest. It consists of placing the flax in a pool of water which will not evaporate. It generally takes place in a shallow pool which will warm up dramatically in the sun; the process may take from only a couple days to a couple weeks. Pond retted flax is traditionally considered lower quality, possibly because the product can become dirty, and easily over-retts, damaging the fiber. This form of retting also produces quite an odor.

Stream retting is similar to pool retting, but the flax is submerged in bundles in a stream or river. This generally takes longer than pond retting, normally by two or three weeks, but the end product is less likely to be dirty, does not smell as bad and, because the water is cooler, it is less likely to be over-retted. Both Pond and Stream retting were traditionally used less because they pollute the waters used for the process.

Field retting is laying the flax out in a large field, and allowing dew to collect on it. This process normally takes a month or more, but is generally considered to provide the highest quality flax fibers, and produces the least pollution.

Retting can also be done in a plastic trash can or any type of water tight container of wood, concrete, earthen ware or plastic. Metal containers will not work, as an acid is produced when retting, and it would corrode the metal. If the water temperature is kept at 80°F, the retting process under these conditions takes 4 or 5 days. If the water is any colder then it takes longer. Scum will collect at the top and an odor is given off the same as in pond retting.

7-2 - Dressing the flax

Dressing the flax is the term given to removing the straw from the fibers. Dressing consists of three steps: breaking, scutching, and heckling. The breaking breaks up the straw, then some of the straw is scraped from the fibers in the scutching process, then the fiber is pulled through heckles to remove the last bits of straw.

The dressing is done as follows :

Breaking: The process of breaking breaks up the straw into short segments. To do it, take the bundles of flax and untie them. Next, in small handfuls, put it between the beater of the breaking machine (a set of wooden blades that mesh together when the upper jaw is lowered, which look like a paper cutter but instead of having a big knife it has a blunt arm), and beat it till the three or four inches that have been beaten appear to be soft. Move the flax a little higher and continue to beat it till all is soft, and the wood is separated from the fiber. When half of the flax is broken, hold the beaten end and beat the rest in the same way as the other end was beaten, till the wood is separated. Scutching: In order to remove some of the straw from the fiber, it helps to swing a wooden scutching knife down the fibers while they hang vertically, thus scraping the edge of the knife along the fibers and pull away pieces of the stalk. Some of the fiber will also be scutched away, this cannot be helped and is a normal part of the process.

Heckling: In this process the fiber is pulled through various different sized heckling combs or heckles. A heckle is a bed of "nails" - sharp, long-tapered, tempered, polished steel pins driven into wooden blocks at regular spacing. A good progression is from 4 pins per square inch, to 12, to 25 to 48 to 80. The first three will remove the straw, and the last two will split and polish the fibers. Some of the finer stuff that comes off in the last hackles is called "tow" and can be carded like wool and spun. It will produce a coarser yarn than the fibers pulled through the heckles because it will still have some straw in it.

8 - Genetically modified flax contamination

In September 2009 it was reported that Canadian flax exports had been contaminated by a de-registered genetically modified (GM) variety, known as Triffid. Triffid had food and feed safety approval in both Canada and the U.S. However, Canadian growers and the Flax Council of Canada had raised concerns about the marketability of this variety in Europe. The variety was subsequently de-registered in 2001 and never grown commercially in Canada or the U.S. All stores of the seed were purportedly crushed or destroyed. Despite these precautions flax exports were found to contain traces of this transgenic flax variety which resulted in problems for Canada's flax growers and the industry at large, who export 70 % of their product to Europe. The EU currently has a zero tolerance policy regarding unapproved GMOs.

9 - As a symbolic image

Flax is the emblem of Northern Ireland and used by the Northern Ireland Assembly. In a coronet, it appeared on the reverse of the Britishone pound coin to represent Northern Ireland on coins minted in 1986 and 1991. Flax also represents Northern Ireland on the badge of the Supreme Court of the United Kingdom and on various logos associated with it.

Common flax is the national flower of Belarus.

In early tellings of the Sleeping Beauty tale, such as Sun, Moon, and Talia by Giambattista Basile, the princess pricks her finger not on a spindle but on a sliver of flax, which is later sucked out by her children conceived as she sleeps.

Fragrance Extraction



Copper still from 19th to 20th century Grasse, France for steam distillation

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1 - Introduction

Fragrance extraction refers to the extraction of aromatic compounds from raw materials, using methods such as distillation, solvent extraction, expression, or enfleurage. The results of the extracts are either essential oils, absolutes, concretes, or butters, depending on the amount of waxes in the extracted product. To a certain extent, all of these techniques tend to distort the odour of the aromatic compounds obtained from the raw materials. Heat, chemical solvents, or exposure to oxygen in the extraction process denature the aromatic compounds, either changing their odour character or rendering them odourless.

2 – Maceration / Solvent extraction

Certain plant materials contain too little volatile oil to undergo expression, or their chemical components are too delicate and easily denatured by the high heat used in steam distillation. Instead, the oils are extracted using their solvent properties.

2 – 1 - Organic solvent extraction

Organic solvent extraction is the most common and most economically important technique for extracting aromatics in the modern perfume industry. Raw materials are submerged and agitated in a solvent that can dissolve the desired aromatic compounds. Commonly used solvents for *maceration/solvent extraction* include hexane, and dimethyl ether.

In organic solvent extraction, aromatic compounds as well as other hydrophobic soluble substances such as wax and pigments are also obtained. The extract is subjected to vacuum processing, which removes the solvent for re-use. The process can last anywhere from hours to months. Fragrant compounds for woody and fibrous plant materials are often obtained in this matter as are all aromatics from animal sources. The technique can also be used to extract odorants that are too volatile for *distillation* or easily denatured by heat. The remaining waxy mass is known as a *concrete*, which is a mixture of essential oil, waxes, resins, and other lipophilic (oil soluble) plant material, since these solvents effectively remove all hydrophobic compounds in the raw material. The solvent is then removed by a lower temperature distillation process and reclaimed for re - use.

Although highly fragrant, concretes are too viscous - even solid - at room temperature to be useful. This is due to the presence of highmolecular-weight, non-fragrant waxes and resins. Another solvent, often ethyl alcohol, which only dissolves the fragrant low-molecular weight compounds, must be used to extract the fragrant oil from the concrete. The alcohol is removed by a second distillation, leaving behind the *absolute*. These extracts from plants such as jasmine and rose, are called absolutes.

Due to the low temperatures in this process, the absolute may be more faithful to the original scent of the raw material, which is subjected to high heat during the distillation process.

2-2 - Supercritical fluid extraction

Supercritical fluid extraction is a relatively new technique for extracting fragrant compounds from a raw material, which often employs Supercritical CO_2 as the extraction solvent. When carbon dioxide is put under high pressure at slightly above room temperature, a supercritical fluid forms (Under normal pressure CO_2 changes directly from a solid to a gas in a process known as sublimation.) Since CO_2 in a non-polar compound has low surface tension and wets easily, it can be used to extract the typically hydrophobic aromatics from the plant material. This process is identical to one of the techniques for making decaffeinated coffee.

In supercritical fluid extraction, high pressure carbon dioxide gas (up to 100 atm.) is used as a solvent. Due to the low heat of process and the relatively unreactive solvent used in the extraction, the fragrant compounds derived often closely resemble the original odour of the raw material. Like solvent extraction, the CO_2 extraction takes place at a low temperature, extracts a wide range of compounds, and leaves the aromatics unaltered by heat, rendering an essence more faithful to the original. Since CO_2 is gas at normal atmospheric pressure, it also leaves no trace of itself in the final product, thus allowing one to get the absolute directly without having to deal with a concrete. It is a low-temperature process, and the solvents are easily removed. Extracts produced using this process are known as CO_2 *extracts*.

2-3-Ethanol extraction

Ethanol extraction is a type of solvent extraction used to extract fragrant compounds directly from dry raw materials, as well as the impure oils or concrete resulting from organic solvent extraction, expression, or enfluerage. Ethanol extracts from dry materials are called *tinctures*, while ethanol washes for purifying oils and concretes are called *absolutes*.

The impure substances or oils are mixed with ethanol, which is less hydrophobic than solvents used for organic extraction, dissolves more of the oxidized aromatic constituents (alcohols, aldehydes, etc.), leaving behind the wax, fats, and other generally hydrophobic substances. The alcohol is evaporated under low-pressure, leaving behind absolute. The absolute may be further processed to remove any impurities that are still present from the solvent extraction.

Ethanol extraction is not used to extract fragrance from fresh plant materials; these contain large quantities of water, which would also be extracted into the ethanol.

3 – Distillation

Distillation is a common technique for obtaining aromatic compounds from plants, such as orange blossoms and roses. The raw material is heated and the fragrant compounds are re-collected through condensation of the distilled vapor. Distilled products, whether through steam or dry distillation are known either as *essential oils* or *ottos*.

Today, most common essential oils, such as lavender, peppermint, and eucalyptus, are distilled. Raw plant material, consisting of the flowers, leaves, wood, bark, roots, seeds, or peel, is put into an alembic (distillation apparatus) over water,

3 – 1 - Steam distillation

Steam from boiling water is passed through the raw material for 60-105 minutes, which drives out most of their volatile fragrant compounds. The condensate from distillation, which contain both water and the aromatics, is settled in a Florentine flask. This allows

for the easy separation of the fragrant oils from the water as the oil will float to the top of the distillate where it is removed, leaving behind the watery distillate. The water collected from the condensate, which retains some of the fragrant compounds and oils from the raw material, is called hydrosol and is sometimes sold for consumer and commercial use. This method is most commonly used for fresh plant materials such as flowers, leaves, and stems. Popular hydrosols are rose water, lavender water, and orange blossom water. Many plant hydrosols have unpleasant smells and are therefore not sold.

Most oils are distilled in a single process. One exception is Ylang-ylang (Cananga odorata), which takes 22 hours to complete distillation. It is fractionally distilled, producing several grades (Ylang-Ylang "extra", I, II, III and "complete," in which the distillation is run from start to finish with no interruption).

3 – 2 - Dry / destructive distillation

Also known as *rectification*, the raw materials are directly heated in a still without a carrier solvent such as water. Fragrant compounds that are released from the raw material by the high heat often undergo anhydrous pyrolysis, which results in the formation of different fragrant compounds, and thus different fragrant notes. This method is used to obtain fragrant compounds from fossil amber and fragrant woods (such as birch tar) where an intentional "burned" or "toasted" odour is desired.

3-3 - Fractionation distillation

Through the use of a fractionation column, different fractions distilled from a material can be selectively excluded to manipulate the scent of the final product. Although the product is more expensive, this is sometimes performed to remove unpleasant or undesirable scents of a material and affords the perfumer more control over their composition process.

4 - Expression

Expression as a method of fragrance extraction where raw materials are pressed, squeezed or compressed and the oils are

collected. In contemporary times, the only fragrant oils obtained using this method are the peels of fruits in the citrus family. This is due to the large quantity of oil is present in the peels of these fruits as to make this extraction method economically feasible. Citrus peel oils are expressed mechanically, or *cold-pressed*. Due to the large quantities of oil in citrus peel and the relatively low cost to grow and harvest the raw materials, citrus-fruit oils are cheaper than most other essential oils. Lemon or sweet orange oils that are obtained as byproducts of the commercial citrus industry are among the cheapest citrus oils.

Expression was mainly used prior to the discovery of distillation, and this is still the case in cultures such as Egypt. Traditional Egyptian practice involves pressing the plant material, then burying it in unglazed ceramic vessels in the desert for a period of months to drive out water. The water has a smaller molecular size, so it diffuses through the ceramic vessels, while the larger essential oils do not. The lotus oil in Tutankhamen's tomb, which retained its scent after 3000 years sealed in alabaster vessels, was pressed in this manner.

5 – Enfleurage

Enfleurage is a two-step process during which the odour of aromatic materials is absorbed into wax or fat, then extracted with alcohol. Extraction by enfleurage was commonly used when distillation was not possible because some fragrant compounds denature through high heat. This technique is not commonly used in modern industry, due to both its prohibitive cost and the existence of more efficient and effective extraction methods.

Ginger



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- 1 Introduction
- 2 Etymology
- 3 Horticulture
- 4 Uses
 - 4.1 Regional use
 - 4.2 Medicinal use and research
 - 4.3 Chemistry
 - 4.4 Folk medicine
 - 4.5 Nutritional information
 - 4.6 Safety
 - 4.7 Similar ingredients

5 Production

1 - Introduction

Ginger or ginger root is the rhizome of the plant *Zingiber* officinale, consumed as a delicacy, medicine, or spice. It lends its name to its genus and family (Zingiberaceae). Other notable members of this plant family are turmeric, cardamom, and galangal. The distantly related dicots in the Asarum genus have the common name wild ginger because of their similar taste.

Ginger cultivation began in South Asia and has since spread to East Africa and the Caribbean.

Scientific	classification
Kingdom:	Plantae
Clade:	Angiosperms
Clade:	Monocots
Clade:	Commelinids
Order:	Zingiberales
Family:	Zingiberaceae
Genus:	Zingiber
Species:	Z. officinale
Binomial name	
<i>Zingiber officinale</i> Roscoe 1807 ^[1]	

2 - Etymology

Mid -14 c., from Old English gingifer, from Medieval Latin gingiber, from Latin zingiberi, from Greek zingiberis, from Prakrit (Middle Indic) singabera, from Sanskrit srngaveram, from srngam "horn" + vera- "body," so called from the shape of its root. But this may be Sanskrit folk etymology, and the word may be from an ancient Dravidian name that also produced the Malayalam name for the spice, inchi-ver, from inchi "root." Cf. gin (v.). The word apparently was readopted in Middle English from Old French gingibre (Modern French gingembre). Meaning "spirit, spunk, temper" is from 1843, American English. Ginger-ale recorded by 1822; ginger-snap as a type of cookie is from 1855, American English.

3 – Horticulture

Ginger produces clusters of white and pink flower buds that bloom into yellow flowers. Because of its aesthetic appeal and the adaptation of the plant to warm climates, ginger is often used as landscaping around subtropical homes. It is a perennial reed-like plant with annual leafy stems, about a meter (3 to 4 feet) tall. Traditionally, the rhizome is gathered when the stalk withers; it is immediately scalded, or washed and scraped, to kill it and prevent sprouting. The fragrant perisperm of Zingiberaceae is used as sweetmeats by Bantu, also as a condiment and sialogogue.

4 – Uses

Ginger produces a hot, fragrant kitchen spice . Young ginger rhizomes are juicy and fleshy with a very mild taste. They are often pickled in vinegar or sherry as a snack or just cooked as an ingredient in many dishes. They can also be steeped in boiling water to make ginger tea, to which honey is often added; sliced orange or lemon fruit may also be added. Ginger can also be made into candy, or ginger wine which has been made commercially since 1740.

Mature ginger rhizomes are fibrous and nearly dry. The juice from old ginger roots is extremely potent and is often used as a spice in Indian recipes, and is a quintessential ingredient of Chinese, Korean, Japanese and many South Asian cuisines for flavoring dishes such as seafood or goat meat and vegetarian cuisine.

Ginger acts as a useful food preservative.

Fresh ginger can be substituted for ground ginger at a ratio of 6 to 1, although the flavors of fresh and dried ginger are somewhat different. Powdered dry ginger root is typically used as a flavoring for recipes such as gingerbread, cookies, crackers and cakes, ginger ale, and ginger beer.

Candied ginger, or crystallized ginger, is the root cooked in sugar until soft, and is a type of confectionery.

Fresh ginger may be peeled before eating. For longer-term storage, the ginger can be placed in a plastic bag and refrigerated or frozen.

4 – 1 - Regional use

In Western cuisine, ginger is traditionally used mainly in sweet foods such as ginger ale, gingerbread, ginger snaps, parkin, ginger biscuits and speculaas. A ginger-flavored liqueur called Canton is produced in Jarnac, France. Ginger wine is a ginger-flavored wine produced in the United Kingdom, traditionally sold in a green glass bottle. Ginger is also used as a spice added to hot coffee and tea.



In Arabic, ginger is called *zanjabil*, and in some parts of the Middle East, *ginzabi*

4 – 2 - Medicinal use and research

According to the American Cancer Society, ginger has been promoted as a cancer treatment "to keep tumors from developing", but "available scientific evidence does not support this". They add: "Recent preliminary results in animals show some effect in slowing or preventing tumor growth. While these results are not well understood, they deserve further study. Still, it is too early in the research process to say whether ginger will have the same effect in humans."

In limited studies, ginger was found to be more effective than placebo for treating nausea caused by seasickness, morning sickness and chemotherapy, although ginger was not found superior to placebo for pre-emptively treating post-operative nausea. Some studies advise against taking ginger during pregnancy, suggesting that ginger is mutagenic, though some other studies have reported antimutagenic effects.^[13] Other preliminary studies showed that ginger may affect arthritis pain or have blood thinning and cholesterol lowering properties, but these effects remain unconfirmed.

Advanced glycation end-products are possibly associated in the development of diabetic cataract for which ginger was effective in preliminary studies, apparently by acting through antiglycating mechanisms. Zingerone may have activity against enterotoxigenic *Escherichia coli* in enterotoxin-induced diarrhea in mice.

4 - 3 -Chemistry

The characteristic odor and flavor of ginger is caused by a mixture of zingerone, shogaols and gingerols, volatile oils that compose one to three percent of the weight of fresh ginger. In laboratory animals, the gingerols increase the motility of the gastrointestinal tract and have analgesic, sedative, antipyretic and antibacterial properties. A study at the University of Michigan demonstrated that gingerols can inhibit growth of ovarian cancer cells *in vitro*. [6]-gingerol (1-[4'-hydroxy-3'-methoxyphenyl]-5-hydroxy-3-decanone) is the major pungent principle of ginger.

Ginger contains up to three percent of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Smaller amounts of other sesquiterpenoids (β -sesquiphellandrene, bisabolene and farnesene) and a small monoterpenoid fraction (β -phelladrene, cineol, and citral) have also been identified.

The pungent taste of ginger is due to nonvolatile phenyl propanoid - derived compounds, particularly gingerols and shogaols, which form from gingerols when ginger is dried or cooked. Zingerone is also produced from gingerols during this process; this compound is less pungent and has a spicy-sweet aroma. Ginger is also a minor chemical irritant, and because of this was used as a horse suppository by pre-World War I mounted regiments for feaguing.

Ginger has a sialagogue action, stimulating the production of saliva, which makes swallowing easier.

4 – 4 - Folk medicine

The traditional medical form of ginger historically was called *Jamaica ginger*; it was classified as a stimulant and carminative and used frequently for dyspepsia, gastroparesis, slow motility symptoms, constipation, and colic. It was also frequently employed to disguise the taste of medicines.

Some studies indicate ginger may provide short-term relief of pregnancy-related nausea and vomiting. Studies are inconclusive about effects for other forms of nausea or in treating pain from rheumatoid arthritis, osteoarthritis, or joint and muscle injury. Side effects, mostly associated with powdered ginger, are gas, bloating, heartburn, and nausea.

Tea brewed from ginger is a common folk remedy for colds. Ginger ale and ginger beer are also drunk as *stomach settlers* in countries where the beverages are made.

In the United States, ginger is used to prevent motion and morning sickness. It is recognized as safe by the Food and Drug Administration and is sold as an unregulated dietary supplement. Ginger water is also used to avoid heat cramps.

Nutritional value per 100 g	
Energy	1,404 kJ (336 kcal)
Carbohydrates	71.62 g
- Sugars	3.39 g
- Dietary fiber	14.1 g
Fat	4.24 g
Protein	8.98 g
Thiamine (vit. B_1)	0.046 mg (4%)
Riboflavin (vit. B ₂)	0.17 mg (14%)
Niacin (vit. B ₃)	9.62 mg (64%)
Pantothenic acid (B ₅)	0.477 mg (10%)
Vitamin B ₆	0.626 mg (48%)
Folate (vit. B ₉)	13 µg (3%)
Vitamin C	0.7 mg (1%)

4 – 5 - Nutritional information

Vitamin E	0.0 mg (0%)
Calcium	114 mg (11%)
Iron	19.8 mg (152%)
Magnesium	214 mg (60%)
Manganese	33.3 mg (1586%)
Phosphorus	168 mg (24%)
Potassium	1320 mg (28%)
Sodium	27 mg (2%)
Zinc	3.64 mg (38%)

4 – 6 – Safety

If consumed in reasonable quantities, ginger has few negative side effects,^[36] and is on the FDA's "generally recognized as safe" list, though it does interact with some medications, including warfarin. Ginger is contraindicated in people suffering from gallstones, as it promotes the production of bile.

Allergic reactions to ginger generally result in a rash, and although generally recognized as safe, ginger can cause heartburn, bloating, gas, belching and nausea, particularly if taken in powdered form. Unchewed fresh ginger may result in intestinal blockage, and individuals who have had ulcers, inflammatory bowel disease or blocked intestines may react badly to large quantities of fresh ginger. Ginger can also adversely affect individuals with gallstones. There are also suggestions that ginger may affect blood pressure, clotting, and heart rhythms.

4 – 7 - Similar ingredients

Myoga (*Zingiber mioga* Roscoe) appears in Japanese cuisine; the flower buds are the part eaten.

Another plant in the *Zingiberaceae* family, galangal, is used for similar purposes as ginger in Thai cuisine. Galangal is also called Thai ginger. Also referred to as galangal, fingerroot (*Boesenbergia*

rotunda), or Chinese ginger or the Thai *krachai*, is used in cooking and medicine.

A dicotyledonous native species of eastern North America, *Asarum canadense*, is also known as "wild ginger", and its root has similar aromatic properties, but it is not related to true ginger. The plant also contains aristolochic acid, a carcinogenic compound.

5 - Production[edit]

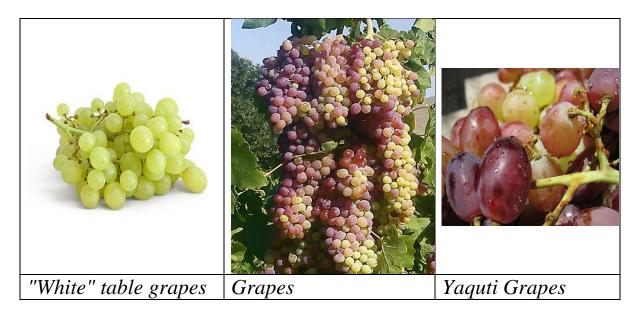
Top ten ginger producers –June 2008	
Country	Production (tones)
India	380,100
China	331,393
Indonesia	192,500
Nepal	174,268
Thailand	170,125
Nigeria	152,106
Bangladesh	72,608
Japan	52,000
Philippines	27,415
Cameroon	12,000
World	1,615,974

From 1585, Jamaican ginger was the first oriental spice to be grown in the New World and imported back to Europe. India, with over 30% of the global share, now leads in global production of ginger, replacing China, which has slipped to the second position ($\sim 20.5 \%$), followed by Indonesia ($\sim 12.7\%$), Nepal ($\sim 11.5\%$) and Thailand ($\sim 10 \%$).

Grafting Wax

Grafting wax is a composition of rosin , bees wax , tallow, and similar materials, used in gluing and sealing the wounds of newly grafted trees or shrubs to protect them from infection.

Grape



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1 - Introduction

A grape is a fruiting berry of the deciduous woody vines of the botanical genus*Vitis*. Grapes can be eaten raw or they can be used for

making wine, jam, juice, jelly, grape seed extract, raisins, vinegar, and grape seed oil. Grapes are a non-climacteric type of fruit, generally occurring in clusters.

Grapes , red or green		
Nutritional valu	Nutritional value per 100 g	
Energy	288 kJ (69 kcal)	
Carbohydrates	18.1 g	
- Sugars	15.48 g	
- Dietary fiber	0.9 g	
Fat	0.16 g	
Protein	0.72 g	
Thiamine (vit. B ₁)	0.069 mg (6 %)	
Riboflavin (vit. B ₂)	0.07 mg (6 %)	
Niacin (vit. B ₃)	0.188 mg (1 %)	
Pantothenic acid (B ₅)	0.05 mg (1 %)	
Vitamin B ₆	0.086 mg (7 %)	
Folate (vit. B ₉)	2 µg (1 %)	
Choline	5.6 mg (1 %)	
Vitamin C	3.2 mg (4 %)	
Vitamin E	0.19 mg (1 %)	
Vitamin K	14.6 µg (14 %)	
Calcium	10 mg (1 %)	
Iron	0.36 mg (3 %)	
Magnesium	7 mg (2 %)	
Manganese	0.071 mg (3 %)	
Phosphorus	20 mg (3 %)	
Potassium	191 mg (4 %)	
Sodium	2 mg (0 %)	

Zinc	0.07 mg (1 %)
Fluoride	7.8 µg

2 – History

The cultivation of the domesticated grape began 6,000 - 8,000 years ago in the Near East. The earliest archeological evidence for a dominant position of wine-making in human culture dates from 8,000 years ago in Georgia.

Yeast, one of the earliest domesticated micro organisms, occurs naturally on the skins of grapes, leading to the innovation of alcoholic drinks such as wine. The earliest known production occurred around 8,000 years ago on the territory of Georgia. During an extensive gene-mapping project, archaeologists analyzed the heritage of more than 110 modern grape cultivars, and narrowed their origin to a region in Georgia, where wine residues were also discovered on the inner surfaces of 8,000-year-old ceramic storage jars. The oldest winery was found in Armenia, dating to around 4,000 BC. By the 9th century AD the city of Shiraz was known to produce some of the finest wines in the Middle East. Thus it has been proposed that Syrah red wine is named after Shiraz, a city in Persia where the grape was used to make Shirazi wine. Ancient Egyptianhieroglyphics record the cultivation of purple grapes, and history attests to the ancient Greeks, Phoenicians and Romans growing purple grapes for both eating and wine production. The growing of grapes would later spread to other regions in Europe, as well as North Africa, and eventually in North America.

In North America, native grapes belonging to various species of the *Vitis* genus proliferate in the wild across the continent, and were a part of the diet of many Native Americans, but were considered by European colonists to be unsuitable for wine. *Vitis vinifera* cultivars were imported for that purpose.

3 – **Description**

Grapes are a type of fruit that grow in clusters of 15 to 300, and can be crimson, black, dark blue, yellow, green, orange and pink. "White" grapes are actually green in color, and are evolutionarily derived from the purple grape. Mutations in two regulatory genes of white grapes turn off production of anthocyanins which are responsible for the color of purple grapes . Anthocyanins and other pigment chemicals of the larger family of polyphenols in purple grapes are responsible for the varying shades of purple in red wines. Grapes are typically an ellipsoid shape resembling a prolate spheroid.

4 - Grapevines

Most grapes come from cultivars of *Vitis vinifera*, the European grapevine native to the Mediterranean and Central Asia. Minor amounts of fruit and wine come from American and Asian species such as:

Vitis labrusca, the North American table and grape juice grapevines (including the concordcultivar), sometimes used for wine, are native to the Eastern United States and Canada.

Vitis riparia, a wild vine of North America, is sometimes used for winemaking and for jam. It is native to the entire Eastern U.S. and north to Quebec.

Vitis rotundifolia, the muscadines, used for jams and wine, are native to the Southeastern United States from Delaware to the Gulf of Mexico.

Vitis amurensis is the most important Asian species.

5 - Distribution and production

According to the Food and Agriculture Organization (FAO), 75,866 square kilometers of the world are dedicated to grapes. Approximately 71 % of world grape production is used for wine, 27 % as fresh fruit, and 2 % as dried fruit. A portion of grape production goes to producing grape juice to be reconstituted for fruits canned "with no added sugar" and "100 % natural". The area dedicated to vineyards is increasing by about 2 % per year. There are no reliable statistics that break down grape production by variety. It is believed that the most widely planted variety is Sultana, also known as Thompson Seedless, with at least 3,600 km². (880,000 acres) dedicated to it. The second most common variety is Airén. Other popular varieties include Cabernet Sauvignon, Sauvignon blanc, Cabernet Franc, Merlot, Grenache, Tempranillo, Riesling and Chardonnay.

Top producers of grapes for wine , by area planted		
Country	Area (km ²)	
Spain	11,750	
France	8,640	
Italy	8,270	
Turkey	8,120	
United States 4,150		
Iran	2,860	
Romania	2,480	
Portugal	2,160	
Argentina	2,080	
Chile	1,840	
Australia	1,642	
Armenia	1,459	
Lebanon	1,122	

World grape production in 2009 and 2010 and some of the important producing countries

Country	Production in 2009 (Tones)	Production in 2010 (Tones)	Percentage of world production in 2010
China	8,039,091	8,651,831	12.67 %
Italy	8,242,500	7,787,800	11.40 %
United States	6,629,160	6,220,360	9.11 %
Spain	5,573,400	6,107,200	8.94 %

World	67,901,74	68,311,466	100 %
Iran	2,255,670	2,255,670	3.30 %
India	1,878,000	2,263,100	3.31 %
Argentina	2,181,570	2,616,610	3.83 %
Chile	2,500,000	2,755,700	4.03 %
Turkey	4,264,720	4,255,000	6.23 %
France	6,104,340	5,848,960	8.56 %

6 - Table and wine grapes



Wine grapes on the vine

Commercially cultivated grapes can usually be classified as either table or wine grapes, based on their intended method of consumption: eaten raw (table grapes) or used to make wine (wine grapes). While almost all of them belong to the same species, *Vitis vinifera*, table and wine grapes have significant differences, brought about through selective breeding. Table grape cultivars tend to have large, seedless fruit (see below) with relatively thin skin. Wine grapes are smaller, usually seeded, and have relatively thick skins (a desirable characteristic in winemaking, since much of the aroma in wine comes from the skin). Wine grapes also tend to be very sweet: they are harvested at the time when their juice is approximately 24% sugar by weight. By comparison, commercially produced "100 % grape juice", made from table grapes is usually around 15% sugar by weight.

7 - Seedless grapes

Seedless cultivars now make up the overwhelming majority of table grape plantings . Because grapevines are vegetatively ropagated by cuttings, the lack of seeds does not present a problem for reproduction. It is an issue for breeders, who must either use a seeded variety as the female parent or rescue embryos early in development using tissue culture techniques.

There are several sources of the seed lessness trait, and essentially all commercial cultivators get it from one of three sources: Thompson Seedless, Russian Seedless, and Black Monukka, all being cultivars of *Vitis vinifera*. There are currently more than a dozen varieties of seedless grapes. Several, such as Einset Seedless, Benjamin Gunnels's Prime seedless grapes, Reliance and Venus, have been specifically cultivated for hardiness and quality in the relatively cold climates of northeastern United States and southern Ontario.

An offset to the improved eating quality of seed lessness is the loss of potential health benefits provided by the enriched phytochemical content of grape seeds .

8 - Raisins, currants and sultanas



Raisins

In most of Europe and North America, dried grapes are referred to as "raisins" or the local equivalent. In the UK, three different varieties are recognized, forcing the EU to use the term "Dried vine fruit" in official documents.

A *raisin* is any dried grape. While *raisin* is a French loanword, the word in French refers to the fresh fruit; *grappe* (from which the English *grape* is derived) refers to the bunch (as in *une grappe de raisins*).

A *currant* is a dried ZanteBlack Corinth grape, the name being a corruption of the French *raisin de Corinthe* (Corinth grape). *Currant* has also come to refer to the blackcurrant and redcurrant, two berries unrelated to grapes.

A *sultana* was originally a raisin made from Sultana grapes of Turkish origin (known as Thompson Seedless in the United States), but the word is now applied to raisins made from either white grapes, or red grapes which are bleached to resemble the traditional sultana.

9 – Juice



A glass of grape juice

Grape juice is obtained from crushing and blending grapes into a liquid. The juice is often sold in stores or fermented and made into wine, brandy or vinegar. In the wine industry, grape juice that contains 7 - 23 % of pulp, skins, stems and seeds is often referred to as "must". In North America, the most common grape juice is purple and made from Concord grapes while white grape juice is commonly made from Niagara grapes, both of which are varieties of native American grapes, a different species from European wine grapes. In California, Sultana (known there as Thompson Seedless) grapes are sometimes diverted from the raisin or table market to produce white juice.

10 - Health claims 10 – 1 - French Paradox

Comparing diets among Western countries, researchers have discovered that although the French tend to eat higher levels of animal fat, the incidence of heart disease remains low in France. This phenomenon has been termed the French Paradox, and is thought to occur from protective benefits of regularly consuming red wine. Apart from potential benefits of alcohol itself, including reduced platelet aggregation and vasodilation, polyphenols (e.g., resveratrol) mainly in the grape skin provide other suspected health benefits, such as:

Alteration of molecular mechanisms in blood vessels, reducing susceptibility to vascular damage

Decreased activity of angiotensin, a systemic hormone causing blood vessel constriction that would elevate blood pressure

Increased production of the vasodilator hormone, nitric oxide (endothelium-derived relaxing factor)

Although adoption of wine consumption is not recommended by some health authorities, a significant volume of research indicates moderate consumption, such as one glass of red wine a day for women and two for men, may confer health benefits. Emerging evidence is that wine polyphenols like resveratrol provide physiological benefit whereas alcohol itself may have protective effects on the cardiovascular system. More may be seen in the article the Long-term effects of alcohol.

10 - 2 - Resveratrol

Synthesized by many plants, resveratrol apparently serves antifungal and other defensive properties. Dietary resveratrol has been shown to modulate the metabolism of lipids and to inhibit oxidation of low-density lipoproteins and aggregation of platelets.

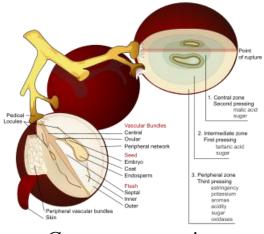
Resveratrol is found in widely varying amounts among grape varieties, primarily in their skins and seeds which, in muscadine grapes, have about one hundred times higher concentration than pulp.^[24] Fresh grape skin contains about 50 to 100 micrograms of resveratrol per gram.

Grape phytochemicals, such as resveratrol (a polyphenol), have been shown in basic research to possibly inhibit mechanisms of cancer, heart disease, degenerative nerve disease, viral infections and Alzheimer's disease .

In vitro studies indicate that protection of the genome through antioxidant actions may be a general function of resveratrol. In laboratory studies with mice, resveratrol has transcriptional overlap with the beneficial effects of calorie restriction in heart, skeletal muscle and brain. Both dietary interventions inhibit gene expression associated with heart and skeletal muscle aging, and prevent agerelated heart failure.

Resveratrol is the subject of several human clinical trials,^[30] among which the most advanced is a one year dietary regimen in a Phase III study of elderly patients with Alzheimer's disease.

10 - 3 - Anthocyanins and other phenolics



Grape cross-section

Anthocyanins tend to be the main polyphenolics in purple grapes whereas flavan - 3 - ols (i.e. catechins) are the more abundant phenolic in white varieties. Total phenolic content, a laboratory index of antioxidant strength, is higher in purple varieties due almost entirely to anthocyanin density in purple grape skin compared to absence of anthocyanins in white grape skin.^[32] It is these anthocyanins that are attracting the efforts of scientists to define their properties for human health.^[33] Phenolic content of grape skin varies

with cultivar, soil composition, climate, geographic origin, and cultivation practices or exposure to diseases, such as fungal infections.

Red wine may offer health benefits more so than white because potentially beneficial compounds are present in grape skin, and only red wine is fermented with skins. The amount of fermentation time a wine spends in contact with grape skins is an important determinant of its resveratrol content. Ordinary non-muscadinered wine contains between 0.2 and 5.8 mg / L, depending on the grape variety, because it is fermented with the skins, allowing the wine to absorb the resveratrol. By contrast, a white wine contains lower phenolic contents because it is fermented after removal of skins.

Wines produced from muscadine grapes may contain more than 40 mg/L, an exceptional phenolic content . In muscadine skins, ellagic acid, myricetin, quercetin, kaempferol, and trans-resveratrol are major phenolics . Contrary to previous results, ellagic acid and not resveratrol is the major phenolic in muscadine grapes.

The flavonols syringetin, syringetin 3-O-galactoside, laricitrin and laricitrin 3 - O - galactoside are also found in purple grape but absent in white grape.

10 – 4 - Seed constituents

Since the 1980s, biochemical and preliminary clinical studies have demonstrated potential biological properties of grape seed oligomeric proanthocyanidins. Together with tannins, polyphenols and polyunsaturatedfatty acids, these seed constituents display inhibitory activities in basic research against experimental disease models, including cancer, heart failure and other disorders of oxidative stress.

Grape seed oil from crushed seeds is used in cosmeceuticals and skincare products for many perceived health benefits. Grape seed oil has some amount of tocopherols (vitamin E), but is notable for its high contents of phytosterols, polyunsaturated fatty acids such as linoleic acid, oleic acid and alpha-linolenic acid.

10 – 5 - Concord grape juice

Commercial juice products from Concord grapes have been applied in medical research studies, showing potential benefits against the onset stage of cancer, platelet aggregation and other risk factors of atherosclerosis, loss of physical performance and mental acuity during aging and hypertension in humans.

10 – 6 - Grape and raisin toxicity in dogs

The consumption of grapes and raisins presents a potential health threat to dogs. Their toxicity to dogs can cause the animal to develop acute renal failure (the sudden development of kidney failure) with anuria (a lack of urine production) and may be fatal.

11 - Religious significance

In the Bible, grapes are first mentioned when Noah grows them on his farm (Genesis 9:20 - 21). Instructions concerning wine are given in the book of Proverbs and in the book of Isaiah, such as in Proverbs 20:1 and Isaiah 5:20 - 25. Deuteronomy 18:3 - 5, 14:22-27,16:13-15 tell of the use of wine during Jewish feasts. Grapes were also significant to both the Greeks and Romans, and their god of agriculture, Dionysus, was linked to grapes and wine, being frequently portrayed with grape leaves on his head. Grapes are especially significant for Christians, who since the Early Church have used wine in their celebration of the Eucharist. Views on the significance of the wine vary between denominations. In Christian art, grapes often represent the blood of Christ, such as the grape leaves in Caravaggio's John the Baptist.

12 - Use in religion

Grape juice, because of its non-alcoholic content, is commonly used by those Christians who oppose the partaking of alcoholic beverages, as the "cup" or "wine" in the Lord's Supper.

The Catholic Church uses wine in the celebration of the Eucharist because it is part of the tradition passed down through the ages starting with Jesus Christ at the Last Supper, where Catholics believe the consecrated bread and wine *literally* become the body and

blood of Jesus Christ, a dogma known as transsubstantiation. Wine is used (not grape juice) both due to its strong Scriptural roots, and also to follow the tradition set by the early Christian Church. The Code of Canon Law of the Catholic Church (1983), Canon 924 says that the wine used must be natural, made from grapes of the vine, and not corrupt. In some circumstances, a priest may obtain special permission to use grape juice for the consecration, however this is extremely rare and typically requires sufficient impetus to warrant such a dispensation, such as personal health of the priest.

Although alcohol is permitted in Judaism, grape juice is some times used as an alternative for kiddush on Shabbat and Jewish holidays and it has the same blessing as wine. Many authorities maintain that grape juice must be capable of turning into wine naturally in order to be used for kiddush. Common practice, however, is to use any kosher grape juice for kiddush.

Grape Seed Oil

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2 Uses

2.1 Cooking

2.2 Cosmetics

2.3 Potential medicinal benefits

2.4 Potential medicinal complications

3 Composition

1 - Introduction

Grape seed oil (also called grapeseed oil or grape oil) is pressed from the seeds of grapes, and is thus an abundant by-product of winemaking.

Fat composition			
Saturated fats	Palmitic : 7 % Stearic : 4 %		
Unsaturated fats	86 %		
Mono un saturated fats	16.1 %		
Palmitoleic acid	< 1 %		
Oleic acid	15.8 %		
Poly unsaturated fats	69.9 %		
Omega-3 fatty acids	α - Linolenic: 0.1 %		
Omega-6 fatty acids	Linoleic : 69.6 %		
Properties			
Food energy per 100 g	3,700 kJ (880 kcal)		
Smoke point	216 °C		
Iodine value	124 - 143		
Saponification value	126 (Na OH) 180 - 196 (KOH)		

Un saponifiable	0.3 % - 1.6 %
Peroxide value	2.92 mequiv / kg

2 - Uses

2 – 1 - Cooking

Grape seed oil has a moderately high smoke point of approximately 216 $^{\circ}$ C. As a result, it is better suited than several other cooking oils for high temperature cooking and can be safely used to cook at moderate temperatures during stir-frying, sautéing, or deep-frying. Due to its clean, light taste, and high polyunsaturated fat content, it may be used as an ingredient in salad dressings and mayonnaise and as a base for oil infusions of garlic, rosemary, or other herbs or spices. It is also excellent for use in baked goods, pancakes, and waffles. It is also sprayed on raisins to help them retain their flavor.

The metabolic energy density of grape seed oil is typical of vegetable oils: approximately 3,700 kJ (880 kcal) per 100 g, or 500 kJ (120 kcal) per 15 ml tablespoon.

2-2 - Cosmetics

Grape seed oil is a preferred cosmetic ingredient for control moisture of the skin. Light and thin, grape seed oil leaves a glossy film over skin when used as a carrier oil for essential oils in aromatherapy. It contains more linoleic acid than many other carrier oils. Grape seed oil is also used as a lubricant for shaving.

2-3 - Potential medicinal benefits

The properties of grape seed oil provide health benefits when consumed. A 1993 study supports the claim that grape seed oil increases high-density lipoprotein (HDL - C or "good cholesterol") levels and reduces LDL levels.

Although grape seeds contain antioxidants and other biologically active compounds, the cold - pressed grape seed oil contains negligible amounts due to their insolubility in lipids. For instance, sufficiently high amounts of resveratrol occur in grape seed for it to be extracted commercially, yet it is almost entirely absent in the grape seed oil. Consumption of chardonnay grape seed procyanidin extract has also been found to prevent high-fat dietinduced obesity in hamsters by improving adipokine imbalance and oxidative stress markers.

2-4 - Potential medicinal complications

Oligomeric proanthocyanidin complexes found in grapeseed extract found in grapeseed oil may react with anticoagulants and phenacetin.

Grapeseed oil has sometimes been found to contain dangerous levels of polycyclic aromatic hydrocarbons because of direct contact with combustion gases during the drying process.

3 - Composition

The following table lists a typical fatty acid composition of grape seed oil :

Acid	Туре	Percentage
Linoleic acid	ω –6unsaturated	69.6 %
Oleic acid	ω –9unsaturated	15.8 %
Palmitic acid (Hexadecanoic acid)	Saturated	7 %
Stearic acid (Octadecanoic acid)	Saturated	4 %
Alpha-linolenic acid	ω -3unsaturated	0.1 %
Palmitoleic acid (9-Hexadecenoic acid)	ω –7unsaturated	less than 1 %

Grape seed oil also contains 0.8 to 1.5% unsaponifiables rich in phenols (tocopherols) and steroids (campesterol, beta-sitosterol, stigmasterol). Grape seed oil contains small amounts of vitamin E, but safflower oil, cottonseed oil, or rice bran oil contain greater amounts. Grape seed oil is high in polyunsaturates and low in saturated fat; it also does not contain cholesterol or trans-fatty acids.

Gutter Oil

Contents

1 Introduction

2 Production and distribution

3 Health effects

4 Regulations and law enforcement

1 - Introduction

Gutter oil is a term used in China to describe illicit cooking oil which has been recycled from waste oil collected from sources such as restaurant fryers, sewer drains, grease traps and slaughterhouse waste. Reprocessing is often very rudimentary; techniques include filtration, boiling, refining and the removal of adulterants.^[1] It is then packaged and resold as a cheaper alternative to normal cooking oil. Another version of gutter oil uses discarded animal parts, animal fat and skins, internal organs, and expired or otherwise low-quality meat which is then cooked in large vats in order to extract the oil. Used kitchen oil can be purchased for between 859 and 937 dollars per ton while the cleaned and refined product can sell for 1,560 per ton.^[2] Thus there is great economic incentive to produce and sell gutter oil. It is estimated that up to one in every ten lower market restaurant meals consumed in China is prepared with gutter oil.^[3] This high prevalence is due to what Feng Ping of the China Meat Research Center has made clear: "The illegal oil shows no difference in appearance and indicators after refining and purification because the law breakers are skillful at coping with the established standards."

The first documented case of gutter oil was reported in 2000, when a street vendor was found to be selling oil obtained from restaurant garbage disposals.

In September 2012, an ongoing investigation into the suspected use of gutter oil as a raw material in the Chinese pharmaceutical industry was revealed.

2 - Production and distribution

The collected waste oil is sold to local work shops or small factories for cleaning and packaging. When sold to workshops it is often transported on the back of bicycles by peddlers who are paid a monthly fee and then the oil is held in 55 lb dingy round barrels at the workshops until it is processed. On other occasions the oil goes to industrial cooking oil refiners for further processing before it finally reaches its end purpose. The industrial oil refiners are usually legitimate producers that sell the processed oil for use in the chemical or energy industries. Gutter oil is perfectly suited as a raw ingredient for producing soap, rubber, bio-fuel and cosmetics.^[2] However, the refiners can also have other intentions as the prices attained by selling it as cooking oil are much higher than if it is sold to the chemical or energy industries. There are no proper rules nor protocols in place to prevent purchases from or sales to entities intending to use the oil for human consumption. So it is very common for individuals or wholesalers to purchase oil from these industrial refineries and then resell the oil to restaurants or to end consumers. There have even been some cases where the industrial oil refiner will package the oil under a unique brand name and sell it as legitimate oil in retail outlets as opposed to just selling directly to restaurants. Some lower market restaurants have long - term purchase agreements with oil recyclers for selling their used oil.

Lower market restaurants and street vendors are the biggest end buyers of gutter oil as they operate with lower profit margins than bigger restaurants. Moreover, it is also one of the largest kitchen expenses for restaurants, so obtaining cheaper oil can allow an offending restaurant to reduce its overall expenses. Chinese food is generally heavily dependent on oil due to most foods being fried so cheaper meal prices for the many cost conscious consumers are possible if gutter oil is used instead of virgin oil . The situation becomes more serious due to the fact that it is hard to distinguish reprocessed gutter oil from legitimate oil. Bleach is used to transform gutter oil's dark color into a more natural one and alkali additives are used to neutralize the abnormal pH caused by containing high rates of animal fats .

3 - Health effects

Gutter oil has been shown to be very toxic, and can cause diarrhea and abdominal pain. There are also reports that long-term consumption of the oil can lead to stomach and liver cancer as well as developmental disabilities in newborns and children . Testing of some samples of gutter oil have revealed traces of Polycyclic aromatic hydrocarbon (PAH), a dangerous organic pollutant capable of causing cancer with long - term consumption. There is also potential for gutter oil to contain Aflatoxins, highly carcinogenic compounds produced by certain molds . Zeng Jing of the Guangdong Armed Police Hospital said about gutter oil "Animal and vegetable fat in refined waste oil will undergo rancidity, oxidation and decomposition after contamination, and produce toxic substances such as arsenic. It will cause indigestion, insomnia, liver discomfort and other symptoms".

4 - Regulations and law enforcement

Current Chinese law states that animal fat is not allowed for use in food products because it doesn't meet basic hygiene standards and contains high levels of potentially toxic chemicals . The national and local governments are currently researching ways to test and identify gutter oil but as of 2012 there are not any nationwide standards in place to help with this process. The government is looking into methods that rely on technical equipment as well as on-site instant tests to screen suspect oil. There have already been 5 proposed tests for gutter oil but each has failed to accurately detect it.

In August and September 2011 the Beijing city government passed two new sets of regulations. The first was "On Accelerating the City's Food Waste and Waste Oil Recycling Program." Its goals are to increase daily food waste processing to 2,200 tons by 2012 and to 2,900 tons by 2015. Additionally, the intent of the regulations are to create a system that "should be a unified, standardized, and orderly processing of waste oil collection and improvement of the transportation system". The second set of regulations passed by the city of Beijing were in September 2011. They are called the "Beijing Municipal Solid Waste Regulations." The regulations specifically target the two sources of gutter oil, food waste and used oil. The central government intends for these two sets of regulations to serve as national examples, yet wants every municipality nationally to find their own solutions to the food waste and gutter oil problem.

A nationwide campaign was set in motion in August 2011 to crackdown on the widespread production and selling of gutter oil. The law enforcement campaign uncovered 100 gutter oil manufacturers and arrested more than 800 people allegedly involved in the production and sale of gutter oil. In April 2012 another crackdown occurred with an additional 100 arrests made and 13 illegal workshops closed down across 4 provinces . According to a notice released jointly by the Supreme People's Court, the Supreme People's Procuratorate and the Ministry of Public Security the death penalty will now be an option when prosecuting more serious cases of gutter oil manufacturing in the country. More severe punishments will also be given out to government and public officials who fail to properly address matters related to gutter oil. The State Council said inspectors would target edible oil trade fairs and wholesale markets and called for inspections of oil being used at restaurants, school cafeterias, work canteens and kitchens at construction sites. The State Council also stated that businesses that use recycled oil would be forced to close temporarily or lose their business license while peddlers who sell the oil could be criminally prosecuted .

Hair Wax

Contents

1 Introduction 2 Ingredients

1 - Introduction

Hair wax is a thick hairstyling product containing wax, used to assist with holding the hair. In contrast with hair gel, most of which contain alcohol, hair wax remains pliable and has less chance of drying out. Consequently, hair wax is currently experiencing an increase in popularity, often under names such as pomade, putty, glue, whip, molding gum, or styling paste. The texture, consistency, and purpose of these products varies widely and all have different purported purposes depending on the manufacturer. Traditionally, pomade is a type of hair wax that also adds shine to one's hair.

Hair wax has been used for many years and in fact, a waxy soap-like substance was invented by the ancient Gauls as a hair styling agent and was not used as a cleaning agent until many years later.

2 - Ingredients

The following are some of the ingredients typically found in commercial hair wax products :

bees wax - candelilla wax - carnauba wax - castor wax emulsifying wax - japan wax - lanolin - ozokerite

Some stylists prefer making their own blends of hair wax customized for their clientele. Various recipes exist, including some with "secret" ingredients.

Hazelnut



Contents

- 1 Introduction
- 2 Historical cultivation
- 3 Modern cultivation
- 4 Cultivars
- 5 Turkish hazelnut
- 6 Harvesting
- 7 Culinary uses
- 8 Health benefits

1 - Introduction

A hazelnut is the nut of the hazel and is also known as cobnut or filbert nut according to species. A cob is roughly spherical to oval, about 15 - 25 mm long and 10 - 15 mm in diameter, with an outer fibrous husk surrounding a smooth shell. A filbert is more elongated, being about twice as long as it is round. The nut falls out of the husk when ripe, about seven to eight months after pollination. The kernel of the seed is edible and used raw or roasted, or ground into a paste. Hazelnuts are also used for livestock feed, as are chestnuts and acorns. The seed has a thin, dark brown skin, which is sometimes removed before cooking.

Hazelnuts are produced in commercial quantities in Turkey, Italy, Greece, Georgia, in the south of the Spanish region of Catalonia, in the UK county of Kent and in the American states of Oregon and Washington. Turkey is the largest producer of hazelnuts in the world with approximately 75 % of worldwide production.

Hazelnuts are used in confectionery to make praline, and also used in combination with chocolate for chocolate truffles and products such as Nutella and Frangelico liqueur. Hazelnut oil, pressed from hazelnuts, is strongly flavoured and used as a cooking oil.

Hazelnuts are rich in protein and unsaturated fat. Moreover, they contain significant amounts of thiamine and vitamin B_6 , as well as smaller amounts of other B vitamins.

Nutritional value per s	serving
Serving size	100g
Energy	2,629 kJ (628 kcal)
Carbohydrates	16.7
- Starch	0.48
- Sugars	4.34
- Dietary fiber	11
Fat	60.75
- saturated	4.464
- monounsaturated	45.652
- polyunsaturated	7.92
Protein	14.95
Water	5.31
Vitamin A equiv.	1 μg (0 %)
Vitamin A	20 IU
- beta-carotene	11 µg (0 %)
- lutein and zeaxanthin	92 µg

Thiamine (vit. B_1)	0.643 mg (56 %)
Riboflavin (vit. B ₂)	0.113 mg (9 %)
Niacin (vit. B ₃)	1.8 mg (12 %)
Pantothenic acid (B ₅)	0.918 mg (18 %)
Vitamin B ₆	0.563 mg (43 %)
Folate (vit. B ₉)	113 µg (28 %)
Vitamin C	6.3 mg (8 %)
Vitamin E	15.03 mg (100 %)
Vitamin K	14.2 µg (14 %)
Calcium	114 mg (11%)
Iron	4.7 mg (36 %)
Magnesium	163 mg (46 %)
Manganese	6.175 mg (294 %)
Phosphorus	290 mg (41 %)
Potassium	680 mg (14 %)
Sodium	0 mg (0 %)
Zinc	2.45 mg (26%)

2 - Historical cultivation

In 1995, evidence of large - scale Mesolithic nut processing, some 9,000 years old, was found in a midden pit on the island of Colonsay in Scotland. The evidence consists of a large, shallow pit full of the remains of hundreds of thousands of burned hazelnut shells. Hazelnuts have been found on other Mesolithic sites, but rarely in such quantities or concentrated in one pit. The nuts were radiocarbon dated to 7720+/-110BP, which calibrates to *circa* 7000 BC. Similar sites in Britain are known only at Farnham in Surrey and Cass ny Hawin on the Isle of Man.

This discovery gives an insight into communal activity and planning in the period. The nuts were harvested in a single year, and

pollen analysis suggests the hazel trees were all cut down at the same time . The scale of the activity, unparalleled elsewhere in Scotland, and the lack of large game on the island, suggest the possibility that Colonsay contained a community with a largely vegetarian diet for the time they spent on the island. The pit was originally on a beach close to the shore, and was associated with two smaller, stone-lined pits whose function remains obscure, a hearth, and a second cluster of pits.

Because hazelnuts do not generally need to be toasted, indeed Kentish Cobnuts are still traditionally sold fresh, it has been speculated this was done to make them more digestible for children. Toasting the nuts was thought to increase how long they would keep, and they have historically been a useful food for mariners because they keep well.

Hazel has been grown historically in coppices for use in wattle and daub buildings, and in hedges. The Romans cultivated hazelnuts including in Britain, although there is no evidence that they spread specific cultivars. Cultivated varieties have been grown since at least the 16th century, with a great increase in varieties during the 1800s. In particular, the first really widespread cultivar, the Kentish Cobnut, was introduced in 1830.

The traditional method to increase nut production is called 'brutting', which involves prompting more of the trees' energy to go into flower bud production, by snapping but not breaking off the tips of the new year's shoots six or seven leaf groups from the join with the trunk or branch, at the end of the growing season. The traditional term for an area of cultivated hazelnuts is a plat.

3 - Modern cultivation

(thousand tones)					
Rank	Country	Registered fleet	Rank	Country	Registered fleet
1	Turkey	430	6	China	22
2	Italy	128	7	Iran	21
3	United States	35	8	Spain	18
4	Azerbaijan	33	9	France	7.3
5	Georgia	31	10	Kyrgyzstan	3.7

Top ten countries with the largest production of hazelnuts in 2011 (thousand tones)

The harvesting of hazelnuts is done either by hand or by manual or mechanical raking of fallen nuts. Common hazel is widely cultivated for its nuts, including in commercial orchards in Europe, Turkey, Iran and the Caucasus. The name "hazelnut" applies to the nuts of any of the species of the genus *Corylus*. This hazelnut, the kernel of the seed, is edible and used raw or roasted, or ground into a paste. The seed has a thin, dark brown skin, which has a bitter flavour and is sometimes removed before cooking.

The top producer of hazelnuts, by a large margin, is Turkey, specifically Ordu and Giresun Province. Turkish hazelnut production of 625,000 tones accounts for approximately 75% of worldwide production.

In North America: in the United States, hazelnut production is concentrated in Oregon; they are also grown extensively just to the north, in the Fraser Valley of British Columbia, Canada. In 1996, the in - shell production in Oregon was about 18,000 tones , compared to 100 tons in Washington. The hazelnut is growing in popularity in the U.S., where the Hazelnut Marketing Board was established in 1949 by Federal Hazelnut Marketing Order section 982.

Hazelnuts are also found in the Pangi Valley of Chamba district in India, where they are known as *thangi*.

4 - Cultivars

The many cultivars of the hazel include : 'Barcelona', 'Butler', 'Casina', 'Clark' 'Cosford', 'Daviana', 'Delle Langhe', 'England', 'Ennis', 'Fillbert', 'Halls Giant', 'Jemtegaard', 'Kent Cob', 'Lewis', 'Tokolyi', 'Tonda Gentile', 'Tonda di Giffoni', 'Tonda Romana', 'Wanliss Pride', and 'Willamette'. Some of these are grown for specific qualities of the nut; these qualities include large nut size and early- and late-fruiting cultivars, whereas others are grown as pollinators. The majority of commercial hazelnuts are propagated from root sprouts.^[5] Some cultivars are of hybrid origin between common hazel and filbert.^[6] One cultivar grown in Washington state, the 'DuChilly', has an elongated appearance, a thinner and less bitter skin, and a distinctly sweeter flavor than other varieties.

5 - Turkish hazelnut



Turkish Corylus colurna

Turkish hazelnuts are not to be confused with the wild hazelnut of Turkey, *Corylus colurna*.

6 – Harvesting

Hazelnuts are harvested annually in mid autumn. As autumn comes to a close, the trees drop their nuts and leaves. Most commercial growers wait for the nuts to drop on their own, rather than use equipment to shake them from the tree.

Four primary pieces of equipment are used in commercial harvesting: the sweeper, the harvester, the nut cart and the forklift. The sweeper moves the nuts into the center of the rows, the harvester lifts and separates the nuts from any debris (i.e. twigs and leaves), the nut cart holds the nuts picked up by the harvester, and the forklift brings a tote to offload the nuts from the nut cart and then stacks the totes to be shipped to the processor (nut dryer). The sweeper is a lowto-the-ground machine that makes two passes in each tree row. It has a 2 m belt attached to the front that rotates to sweep leaves, nuts, and small twigs from left to right, depositing the material in the row's center as it drives forward. On the rear of the sweeper is a powerful blower to blow material left into the adjacent row with air speeds up to 90 m/s. Careful grooming during the year and patient blowing at harvest can eliminate the need for hand raking around the trunk of the tree, where nuts can accumulate. The sweeper prepares a single center row of nuts narrow enough for the harvesting tractor to drive over without driving on the center row. It is best to only sweep a few rows ahead of the harvesters at any given time, to prevent the tractor that drives the harvester from crushing the nuts that may still be falling from the trees. Hazelnut orchards may be harvested up to three times during the harvest season, depending on the quantity of nuts in the trees and the rate of nut drop as a result of weather.



A sweeper makes its first pass as it centralizes the material on the orchard floor

The harvester is a slow-moving machine pulled by a tractor, which lifts the material off the ground and separates the nuts from the leaves, empty husks, and twigs. As the harvester drives over the rows, a rotating cylinder with hundreds of tines rakes the material onto a belt. The belt takes the material over a blower and under a powerful vacuum that sucks the lightweight dirt and leaves from the nuts, and discharges it into the orchard. The remaining nuts are conveyed into a nut cart pulled behind the harvester. Once a tote is filled with nuts, the forklift will haul away the full totes and bring empties back to the harvester to maximize the harvester's time.

Two different timing strategies are used for collecting the fallen nuts. The first is to harvest early when approximately half of the nuts have fallen. With less material on the ground, the harvester can work faster with less chance of a breakdown. The second option is to wait for all the nuts to fall before harvesting. Though the first option is considered the better of the two , two or three passes do take more time to complete than one. Weather must also be a consideration. Rain inhibits harvest and should a farmer wait for all the nuts to fall after a rainy season, it becomes much more difficult to harvest. Pickup also varies with how many acres are being farmed and the number of sweepers, harvesters, nut carts and forklifts available.

A dry orchard can be dusty, so equipment operators should wear breathing protection. Conversely, if it is too wet, mud cakes in the machinery and moisture weighs down the material, making it impossible for the equipment to function without picking up large quantities of mud.

7 - Culinary uses

Hazelnuts are used in confectionery to make some pralines, in chocolate for some chocolate truffles, and in hazelnut paste products. In Austria (especially Vienna), hazelnut paste is an ingredient in the making of *tortes* (such as Viennese hazelnut torte) which are famous there. In Kiev cake, hazelnut flour is used to flavor its meringue body, and crushed hazelnuts are sprinkled over its sides. *Dacquoise*, a French dessert cake, often contains a layer of hazelnut meringue. Hazelnut is a primary ingredient of the vodka-based liqueur frangelico. Hazelnuts are used abundantly in Turkish cuisine especially on the Pontic coast of Anatolia. In Georgian cuisine, traditional snack churchkhela and sauce satsivi are often cooked with hazelnuts (along with walnuts).

Hazelnut - flavoured coffee seems (to many users) to be slightly sweetened and less acidic, though the nut is low in natural saccharides The reason for such perception is not yet under stood.

Over 2,000 tonnes are imported annually into Australia, mostly to supply the demand from the Cadbury-Schweppes company. Hazelnut oil pressed from hazelnuts is strongly flavoured and used as a cooking oil.

Common hazel plants are eaten by these species of Lepidoptera.

8 - Health benefits

Hazelnuts have a significant place among the types of dried nuts in terms of nutrition and health because of the composition of fats (primarily oleic acid), protein, carbohydrates, vitamins (vitamin E), minerals, dietary fibers, phytosterol (beta - sitosterol), and antioxidant phenolics such as flavan -3- ols.

Heating Oil

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 Republic of Ireland and Northern Ireland
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 K - factor

1 - Introduction

Heating oil, or oil heat, is a low viscosity, liquid petroleum product used as a fuel for furnaces or boilers in buildings. Home heating oil is often abbreviated as HHO

Heating oil consists of a mixture of petroleum - derived hydrocarbons in the 14 - to 20 - carbon atom range that condense between 250 and 350 °C during oil refining. Heating oil condenses at a lower temperature than petroleum jelly, bitumen, candle wax, and lubricating oil, but at a higher temperature than kerosene, which condenses between 160 – 250 °C. The heavy C 20+ hydrocarbons condense between 340 – 400 °C.

Heating oil produces 138,500 British thermal units (146,100 kJ) per US gallon and weighs 8.2 pounds per US gallon (0.95 kg / 1), which is about the same heat per unit mass. Number 2 fuel oil has a flash point of 52 $^{\circ}C$.

Red dyes are usually added, resulting in its "red diesel" name in countries like the United Kingdom. In the U.S. the fuel oil dyed red is not taxed for highway use; the dye makes it easy to identify its use in on-road vehicles. Since 2002, Solvent Yellow 124 has been added as a "Euromarker" in the European Union.

Heating oil may be blended to create a product that burns similarly.

Heating oil is commonly delivered by tank truck to residential, commercial and municipal buildings and stored in above-ground

storage tanks ("ASTs") located in the basements, garages, or outside adjacent to the building. It is sometimes stored in underground storage tanks (or "USTs") but less often than ASTs. ASTs are used for smaller installations due to the lower cost factor. Heating oil is less commonly used as an industrial fuel or for power generation.

Leaks from tanks and piping are an environmental concern. Various federal and state regulations are in place regarding the proper transportation, storage and burning of heating oil, which is classified as a hazardous material (HazMat) by federal regulators.

2 - United States and Canada

Heating oil is known in the United States as No. 2 heating oil. In the U.S., it must conform to ASTM standard D396. Diesel and kerosene, while often confused as being similar or identical, must conform to their own respective ASTM standards. Heating oil is widely used in United States and Canada.

The heating oil futures contract trades in units of 1,000 barrels (160 m^3) with a minimum fluctuation of \$ 0.0001 per gallon and (for the USA) is based on delivery in the New York harbor.

The Department of Energy tracks the prices homeowners pay for home heating fuel (oil and propane). There are also a number of websites that allow home owners to compare the price per gallon they are paying with the Department of Energy data as well as other consumers in their area. Likewise the US Energy Information Administration collects heating oil price statistics and maintains historical price data^[4] for all major US markets during each heating season.

Heating oil is mostly used in the northeastern United States, with the majority of that heating oil coming from Irving Oil's refinery in Saint John, New Brunswick,^[5] the largest oil refinery in Canada.

3 - Republic of Ireland and Northern Ireland

Heating oil is the most common fuel for home heating in Northern Ireland due to the late development of a natural gas network.^[6] Bord Gáis has built an extensive gas pipeline network across Ireland.^[7] Common suppliers of heating oil in Ireland are Maxol and Emo Oil. Price comparison and different information of heating oil in Ireland is found in Cheapestoil.ie.

4 – England , Scotland and Wales

Heating oil is used sporadically for home heating around England, Scotland and Wales. As in Northern Ireland, it is the rural areas and communities that rely on oil. There are around 1.5 million people in Great Britain using oil for home heating. Great Britain has many suppliers of heating oil ranging from large companies such as BP and Bayford to the local oil supplier who will cover a very small area. Many villages may use buying groups to order heating oil at the same time, thereby accessing lower costs.

The Department of Energy and Climate Change (DECC) have referred the UK oil market to the Office of Fair Trading (OFT) for review. The OFT has resolved to look at the structure of the market, with a view of the fairness for consumers and alternative energy options for off grid consumers such as heat pumps.

5 – K – factor

The degree day system is based on the amount of fuel a customer has consumed between two or more deliveries and the high and low outdoor temperatures during the same period. A degree day is defined as one degree of temperature below 65 °F in the average temperature of one day. In other words, to arrive at the number of degree days in one day, the official high and low temperatures for that day must be obtained. The two figures are then averaged, and the number of units this average is below 65 °F is the number of degree days for that day. For example, if for Tuesday, November 3, the high temperature is 70 °F and the low is 54 °F, the average is found by adding 70 and 54, which equals 124, and then dividing by 2. The resultant figure is 62, and by subtracting 62 from 65, it is determined that there were three Fahrenheit degree days that day.

The K factor is the number of degree days in any given period divided by the number of gallons of fuel oil used in a given period. Multiplying K degree - days per gallon by the number of gallon of usable fuel remaining in a tank gives the number of degree-days before a delivery is needed.

Hemp



Hemp maze in France

Hemp field in Côtes-d'Armor, Brittany, France

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1 - Introduction

Hemp (from Old English *hænep*) is a commonly used term for varieties of the Cannabis plant and its products, which include fiber, oil, and seed. In many countries regulatory limits for concentrations of psychoactive drug compounds (THC) in hemp encourage the use of strains of the plant which are bred for low tetra hydro cannabinol (THC) content or other wise have the THC removed . Hemp is refined into products like hemp seed foods, hemp oil, wax, resin, rope, cloth, pulp, and fuel.

Hemp is used for a wide variety of purposes including the manufacture of cordage of varying tensile strength, durable clothing and nutritional products. The *bast fibers* can be used in 100 % hemp products, but are commonly blended with other organic fibers such as flax, cotton or silk, for apparel and furnishings, most commonly at a 55 % / 45 % hemp/cotton blend. The inner two fibers of hemp are more woody and are more often used in non-woven items and other industrial applications, such as mulch, animal bedding and litter. The oil from the fruits ("seeds") oxidizes (commonly, though inaccurately, called "drying") to become solid on exposure to air, similar to linseed oil, and is sometimes used in the manufacture of oil-based paints, in creams as a moisturizing agent, for cooking, and in plastics. Hemp seeds have been used in bird seed mix as well. A survey in 2003 showed that more than 95 % of hemp seed sold in the EU was used in animal and bird feed. Hempseed is also used as a fishing bait.

In modern times hemp is used for industrial purposes including paper, textiles, clothing, biodegradable plastics, construction (as with Hempcrete and insulation), body products, health food and bio - fuel.

2 - 1 - Food



Hemp seeds

Hemp seeds can be eaten raw, ground into a meal, sprouted, made into hemp milk (akin to soy milk), prepared as tea, and used in baking. The fresh leaves can also be consumed in salads. Products include cereals, frozen waffles, hemp milk ice cream, hemp tofu, and nut butters. A few companies produce value added hemp seed items that include the seed oils, whole hemp grain (which is sterilized by law in the United States, where they import it from China and Canada), dehulled hemp seed (the whole seed without the mineral rich outer shell), hemp flour, hemp cake (a by - product of pressing the seed for oil) and hemp protein powder.

2 - 1 - 1 - Market share

Within the UK, the Department for Environment, Food and Rural Affairs (Defra) has treated hemp as purely a non-food crop. Seed appears on the UK market as a legal food product, and cultivation licenses are available for this purpose. In North America, hemp seed food products are sold, typically in health food stores or through mail order. The United States Department of Agriculture estimates that "the market potential for hemp seed as a food ingredient is unknown. However, it probably will remain a small market, like those for sesame and poppy seeds ." Since 2007 the commercial success of hemp food products has grown considerably.

2-1-2-Nutrition

Typical nutritional analysis of hulled hemp seeds		
Calories / 100 g	567 kcal	
Protein	30.6	
Carbohydrate	10.9	
Dietary fiber	6.0	
Fat	47.2	
Saturated fat	5.2	
Palmitic 16:0	3.4	
Stearic 18:0	1.5	
Monounsaturated fat	5.8	
Oleic 18:1 (Omega-9)	5.8	
Polyunsaturated fat	36.2	
Linoleic 18:2 (Omega-6)	27.6	
Linolenic 18:3 (Omega-3)	8.7	
Gamma-Linolenic 18:3 (Omega-6)	0.8	
Cholesterol	0 mg	
Moisture	4.7	
Ash	6.6	
Vitamin A (B-Carotene)	4.0 IU/100g	
Thiamine (Vit B ₁)	1.4 mg	
Riboflavin (Vit B ₂)	0.3 mg	
Pyridoxine (Vit B ₆)	0.1 mg	
Vitamin C	1.0 mg	
Vitamin E	9.0 IU/100g	
Sodium	9.0 mg	
Calcium	74.0 mg	
Iron	4.7 mg	

Approximately 44 % of the weight of hemp seed is edible oils, containing about 80 % essential fatty acids (EFAs); e.g., linoleic acid, omega-6 (LA, 55 %), alpha-linolenic acid, omega-3 (ALA, 22 %), in

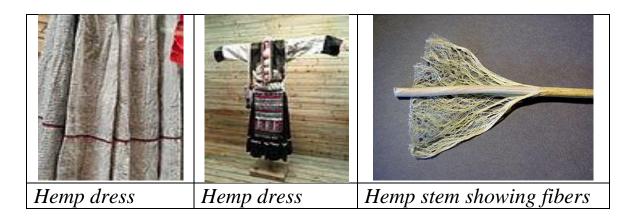
addition to gamma-linolenic acid, omega- 6 (GLA, 1 - 4 %) and stearidonic acid, omega-3 (SDA, 0 - 2 %). Proteins (including edestin) are the other major component (33%). Hempseed's amino acid profile is close to "complete" when compared to more common sources of proteins such as meat, milk, eggs and soy. Hemp protein contains all 21 known amino acids, including the 9 essential ones^[14] adult bodies cannot produce. Proteins are considered complete when they contain all the essential amino acids in sufficient quantities and ratios to meet the body's needs. The proportions of linoleic acid and alpha-linolenic acid in one tablespoon (15 ml) per day of hemp oil easily provides human daily requirements for EFAs.

2-1-3 – Storage

Hemp oil, like any food oil rich in essential fatty acids, will spontaneously oxidize and turn rancid within a short period of time if not stored properly; Its shelf life is extended when stored in a dark airtight container and refrigerated.

2 – 2 – Fiber

Hemp fiber was widely used throughout history. Items ranging from rope, to fabrics, to industrial materials were made from hemp fiber. Hemp was often used to make sail canvas, and the word *canvas* derives from *cannabis*. Today, a modest hemp fabric industry exists, and hemp fibers can be used in clothing. Pure hemp has a texture similar to linen.

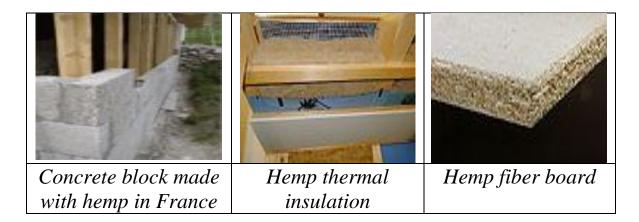


2-3 - Building material

Concrete-like blocks made with hemp and lime have been used as an insulating material for construction. Such blocks are not strong enough to be used for structural elements; they must be supported by a brick, wood, or steel frame . However hemp fibres are extremely strong and durable and have been shown to be used in replacement of wood for many jobs including creating very durable and breathable homes.

The first example of the use of hempcrete was in 1986 in France with the renovation of the Maison de la Turque in Nogent-sur-Seine by the innovator Charles Rasetti. In the UK hemp lime was first used in 2000 for the construction of two test dwellings in Haverhill.^[21] Designed by Modece Architects, who pioneered hemp's use in UK construction, the hemp houses were monitored in comparison with other standard dwellings by BRE. Completed in 2009, The Renewable House is one of the most technologically advanced made from hemp-based materials . The first US home made of hemp - based materials was completed in August 2010 in Asheville, North Carolina.

In 2013, a completely new approach to hemp in construction has been developed by Hemp Architecture, who are researching the potential use of the whole hemp stalk.



2-4 - Plastic and composite materials

A mixture of fibre glass, hemp fiber, kenaf, and flax has been used since 2002 to make composite panels for automobiles. The choice of which bast fiber to use is primarily based on cost and availability. Various car makers are beginning to use hemp in their cars, including Audi, BMW, Ford, GM, Chrysler, Honda, Iveco, Lotus, Mercedes, Mitsubishi, Porsche, Saturn, Volkswagen and Volvo. For example, the Lotus Eco Elise and the Mercedes C- Class both contain hemp (up to 20 kg in each car in the case of the latter).

2 - 5 - Paper

2-5-1 - History and development

The first identified coarse paper, made from hemp, dates to the early Western Han Dynasty, two hundred years before the nominal invention of papermaking by Cai Lun, who improved and standardized paper production using a range of inexpensive materials, including hemp ends, approximately 2000 years ago. Recycled hemp clothing, rags and fishing nets were used as inputs for paper production.

The Saint Petersburg, Russia paper mill of Goznak opened in 1818. It used hemp as its main input material. Paper from the mill was used in the printing of "bank notes, stamped paper, credit bills, postal stamps, bonds, stocks, and other watermarked paper."

In 1916, U.S. Department of Agriculture chief scientists Lyster Hoxie Dewey and Jason L. Merrill created paper made from hemp pulp and concluded that paper from hemp hurds was "favorable in comparison with those used with pulp wood." Modern research has not confirmed the positive finding about hemp hurds. They are only 32 % and 38 % cellulose. The actual production of hemp fiber in the U.S continued to decline until 1933 to around 500 tons/year. Between 1934-35, the cultivation of hemp began to increase but still at a very low level and with no significant increase of paper from hemp.

2-5-2-Contemporary

Hemp has never been used for commercial high - volume paper production due to its relatively high processing cost. Currently there is a small niche market for hemp pulp, for example as cigarette paper. Hemp fiber is mixed with fiber from other sources than hemp. In 1994 there was no significant production of 100 % true hemp paper. World hemp pulp production was believed to be around 120,000 tons per year in 1991 which was about 0.05 % of the world's annual pulp production volume. The total world production of hemp fiber had in 2003 declined to about 60 000 from 80 000 tons.^[38] This can be compared to a typical pulp mill for wood fiber, which is never smaller than 250,000 tons per annum. The cost of hemp pulp is approximately six times that of wood pulp, mostly because of the small size and outdated equipment of the few hemp processing plants in the Western world, and because hemp is harvested once a year (during August) and needs to be stored to feed the mill the whole year through. This storage requires a lot of (mostly manual) handling of the bulky stalk bundles. Another issue is that the entire hemp plant cannot be economically prepared for paper production. While the wood products industry uses nearly 100 % of the fiber from harvested trees, only about 25 % of the dried hemp stem — the bark, called bast — contains the long, strong fibers desirable for paper production.^[42] All this accounts for a high raw material cost. Hemp pulp is bleached with hydrogen peroxide, a process today also commonly used for wood pulp.

2-5-3 - Market share

Around the year 2000, the production quantity of flax and hemp pulp total 25000 - 30000 tons per year, having been produced from approximately 37000 - 45000 tones fibers . Up to 80 % of the produced pulp is used for specialty papers (including 95 % of cigarette paper). Only about 20 % hemp fiber input goes into the standard pulp area and are here mostly in lower quality (untreated oakum high shive content added) wood pulps. With hemp pulp alone, the proportion of specialty papers probably at about 99 %. The market is considered saturated with little or no growth in this area.

2 - 6 – Jewelry



Hemp and bead Jewelry

Hemp jewelry is the product of knotting hemp twine through the practice of macramé. Hemp jewelry includes bracelets, necklaces, anklets, rings, watches and other adornments. Some jewelry features beads made from glass, stone, wood and bones. The hemp twine varies in thickness and comes in a variety of colors. There are many different stitches used to create hemp jewelry, however, the half knot and full knot stitches are most common.

2 - 7 - Cordage



Hemp rope

Hemp rope was used in the age of sailing ships, though the rope had to be protected by tarring, since hemp rope has a propensity for breaking from rot, as the capillary effect of the rope-woven fibers tended to hold liquid at the interior, while seeming dry from the outside. Tarring was a labor - intensive process, and earned sailors the nickname "Jack Tar". Hemp rope was phased out when Manila, which does not require tarring, became widely available. Manila is sometimes referred to as Manila hemp, but is not related to hemp; it is abacá, a species of banana.

2 – 8 – Animal bedding



Hemp straw animal bedding

Hemp shives are the core of the stem, hemp hurds are broken parts of the core. In the EU, they are used for animal bedding (horses, for instance), or for horticultural mulch . Industrial hemp is much more profitable if both fibers and shives (or even seeds) can be used.

2-**9**-Water and soil purification

Hemp can be used as a "mop crop" to clear impurities out of wastewater, such as sewage effluent, excessive phosphorus from chicken litter, or other unwanted substances or chemicals. Ecotechnologist Dr. Keith Bolton from Southern Cross University in Lismore, New South Wales, Australia, is a leading researcher in this area. Hemp is being used to clean contaminants at the Chernobyl nuclear disaster site. This is known as phytoremediation - the process by the cleaning radiation as well as a variety of other toxins from the soil, water, and air.

2 – 10 – Weed control

Hemp, because of its height, dense foliage and its high planting density as a crop, is a very effective and long used method of killing tough weeds in farming by minimizing the pool of weed seeds of the soil . Using hemp this way can help farmers avoid the use of herbicides, to help gain organic certification and to gain the benefits of crop rotation*per se*. Due to its rapid, dense growth characteristics, in some jurisdictions hemp is considered a prohibited noxious weed, much like Scotch Broom. It has been used extensively to kill weeds in agriculture.

2 – 11 – Fuel

Biofuels, such as biodiesel and alcohol fuel, can be made from the oils in hemp seeds and stalks, and the fermentation of the plant as a whole, respectively. Biodiesel produced from hemp is sometimes known as "hempoline".

Filtered hemp oil can be used directly to only power diesel engines. In 1892, Rudolf Diesel invented the diesel engine, which he intended to fuel "by a variety of fuels, especially vegetable and seed oils, which earlier were used for oil lamps, i.e. the Argand lamp." Production of vehicle fuel from hemp is very small. Commercial biodiesel and biogas is typically produced from cereals, coconuts, palmseeds and cheaper raw materials like garbage, wastewater, dead plant and animal material, animal feces and kitchen waste.

3 - Cultivation



Hemp being harvested

Hemp is usually planted between March and May in the northern hemisphere, between September and November in the southern hemisphere. It matures in about three to four months.

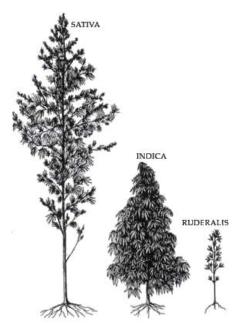
Millennia of selective breeding have resulted in varieties that look quite different. Also, breeding since circa 1930 has focused quite specifically on producing strains which would perform very poorly as sources of drug material. Hemp grown for fiber is planted closely, resulting in tall, slender plants with long fibers. Ideally, according to Britain's Department for Environment, Food and Rural Affairs, the herb should be harvested before it flowers. This early cropping is done because fiber quality declines if flowering is allowed and, incidentally, this cropping also pre-empts the herb's maturity as a potential source of drug material. However, in these strains of industrial hemp the tetra hydro cannabinol (THC) content would have been very low, regardless

The seeds are sown from mid April to mid May with grain drills to 4–6 cm sowing depth. Hemp needs less fertilizer than corn does. A total of 60–150 kg of nitrogen, 40 - 140 kg phosphorus (P₂O₅) and 75 –200 kg of potassium per acre for hemp fiber made before sowing and again later, maybe three to four weeks. When practiced, especially in

France double use of fiber and seed fertilization with nitrogen doses up to 100 kg / ha rather low. Organic fertilizers such as manure can utilize industrial hemp well. Neither weeds nor crop protection measures are necessary.

3-1 - Cultivars

A total of 41 varieties of hemp with low levels of tetra hydro cannabinol (THC) are certified by the European Union (EU). They have, unlike other types, a very high fiber content of 30 - 40 %. In contrast to cannabis for medical use, varieties grown for fiber and seed have less than 0.2 % THC and they are unsuitable for producing hashish and marijuana . The most important cannabinoid in industrial hemp is cannabidiol (CBD) with a proportion of 1 to 5 %.



The variety of appearances for cannabis. Only C. sativa (left) is suited for industrial hemp, but it also has medicinal varieties.

Cannabis sativa L. subsp. sativa var. sativa is the variety grown for industrial use, while C. sativa subsp. indica generally has poor fiber quality and is primarily used for recreational and medicinal purposes. The major difference between the two types of plants is the appearance and the amount of Δ^9 -tetrahydrocannabinol (THC) secreted in a resinous mixture by epidermal hairs called glandular trichomes, although they can also be distinguished genetically. Oilseed and fiber varieties of Cannabis approved for industrial hemp production produce only minute amounts of this psychoactive drug, not enough for any physical or psychological effects. Typically, hemp contains below 0.3 % THC, while cultivars of *Cannabis* grown for recreational use can contain anywhere from 2% to over 20%.

3 – 2 – Harvesting



Industrial hempseed harvesting machine in France.

Small holder plots are usually harvested by hand. The plants are cut at 2 to 3 cm above the soil and left on the ground to dry. Mechanical harvesting is now common, using specially adapted cutter-binders or simpler cutters.

The cut hemp is laid in swathes to dry for up to four days. This was traditionally followed by *retting*, either water retting (the bundled hemp floats in water) or dew retting (the hemp remains on the ground and is affected by the moisture in dew, and by molds and bacterial action). Modern processes use steam and machinery to separate the fiber, a process known as thermo mechanical pulping.



For profitable hemp farming, particularly deep, humus-rich, nutrient - rich soil with controlled water flow is preferable. Water logged acidic, compressed or extremely light (sandy) soils primarily affect the early development of plants. Steep slopes and high altitudes of more than 400 m above sea level are best avoided. Hemp is relatively insensitive to cold temperatures and can withstand frost down to -5 degrees C. Seeds can germinate down to 1-3 degrees. Hemp needs a lot of heat, so earlier varieties come to maturation. The water requirement is 300 - 500 1 / kg dry matter is relatively high, up to 3 feet growing roots into the soil can also use water supplies from deeper soil layers.

Hemp benefits crops grown after it. For this reason it is generally grown before winter cereals. Advantageous changes are high weed suppression, soil loosening by the large hemp root system and the positive effect on soil tilth. Since hemp is very selfcompatible, it can also be grown several years in a row in the same fields (monoculture).

3 – 4 – Diseases

Hemp plants can be vulnerable to various pathogens, including bacteria, fungi, nematodes, viruses and other miscellaneous pathogens. Such diseases often lead to reduced fiber quality, stunted growth, and death of the plant. These diseases rarely affect the yield of a hemp field, so hemp production is not traditionally dependent on the use of pesticides.

3 – 5 - Environmental impact

Hemp is considered by a 1998 study in *Environmental Economics* to be environmentally friendly due to a decrease of land use and other environmental impacts, indicating a possible decrease of ecological footprint in a US context compared to typical benchmarks. A 2010 study, however, that compared the production of paper specifically from hemp and eucalyptus concluded that "industrial hemp presents higher environmental impacts than eucalyptus paper"; however, the article also highlights that "there is scope for improving industrial hemp paper production". Hemp is also

claimed to require few pesticides and no herbicides, and it has been called a carbon negative raw material. Results indicate that high yield of hemp may require high total nutrient levels (field plus fertilizer nutrients) similar to a high yielding wheat crop.

4 – Producers

The world - leading producer of hemp is China, with smaller production in Europe, Chile and North Korea. Over thirty countries produce industrial hemp, including Australia, Austria, Canada, Chile, China, Denmark, Egypt, Finland, France, Germany, Great Britain, Hungary, India, Italy, Japan, Korea, Netherlands, New Zealand, Poland, Portugal, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, Thailand, Turkey and Ukraine.

The United Kingdom, and Germany all resumed commercial production in the 1990s. British production is mostly used as bedding for horses; other uses are under development. Companies in Canada, the UK, the United States and Germany, among many others, process hemp seed into a growing range of food products and cosmetics; many traditional growing countries still continue to produce textilegrade fibre.



Dried hemp stalks displayed at the International Hemp Fairin Vienna

Air dry stem yields in Ontario have from 1998 and onward ranged from 2.6 - 14.0 tonnes of dry, retted stalks per hectare (1-5.5 t/ac) at 12 % moisture. Yields in Kent County, have averaged 8.75 t /

ha (3.5 t / ac). Northern Ontario crops averaged 6.1 t / ha (2.5 t / ac) in 1998. Statistic for the European Union for 2008 to 2010 say that the average yield of hemp straw has varied between 6.3 and 7.3 ton per ha Only a part of that is bast fiber. Approximately one tonne of bast fiber and 2-3 tonnes of core material can be decorticated from 3-4 tonnes of good quality, dry retted straw. For an annual yield of this level is it in Ontario recommended to add nitrogen (N):70 –110 kg/ha, phosphate (P₂O₅): up to 80 kg/ha and potash (K₂O): 40 – 90 kg / ha. The average yield of dry hemp stalks in Europe was 6 ton/ha (2.4 ton/ac) in 2001 and 2002.

Hemp production in tones 2003–2004 (FAO)				
China	23000	79 %	24000	79 %
France	4300	15 %	4300	14 %
Chile	1250	4 %	1250	4 %
Russia	200	1 %	300	1 %
Turkey	150	1 %	150	< 1%
Ukraine	150	1 %	150	< 1%
Romania	100	< 1 %	100	< 1%
Hungary	40	< 1 %	40	< 1%
Poland	15	< 1 %	15	< 1%
Spain	8	< 1 %	8	< 1%
Serbia	2	< 1 %	2	< 1%
Total	29215	100 %	30315	100 %

FAO argue that an optimum yield of hemp fiber is more than 2 tones per ha, while average yields are around 650 kg / ha.

5 - History

Radical 200 (or $m\dot{a}$), the Chinese character for hemp, depicts two plants under a shelter. The use of hemp in Taiwan dates back at least 10,000 years.

Hemp is one of the earliest domesticated plants known. It has been cultivated by many civilizations for over 12,000 years. Hemp use archaeologically dates back to the Neolithic Age in China, with hemp fiber imprints found on Yangshao culture pottery dating from the 5th century BC . The Chinese later used hemp to make clothes, shoes, ropes, and an early form of paper.

The classical Greek historian Herodotus (ca. 480 BC) reported that the inhabitants of Scythia would often inhale the vapors of hempseed smoke, both as ritual and for their own pleasurable recreation.

Textile expert Elizabeth Wayland Barber summarizes the historical evidence that *Cannabis sativa*, "grew and was known in the Neolithic period all across the northern latitudes, from Europe (Germany, Switzerland, Austria, Romania, Ukraine) to East Asia (Tibet and China)," but, "textile use of Cannabis sativa does not surface for certain in the West until relatively late, namely the Iron Age."^[88] "I strongly suspect, however, that what catapulted hemp to sudden fame and fortune as a cultigen and caused it to spread rapidly westwards in the first millennium B.C. was the spread of the habit of pot-smoking from somewhere in south-central Asia, where the drugbearing variety of the plant originally occurred. The linguistic evidence strongly supports this theory, both as to time and direction of spread and as to cause."

Jews living in Palestine in the 2nd century were familiar with the cultivation of hemp, as witnessed by a reference to it in the Mishna (*Kil'ayim* 2:5) as a variety of plant, along with Arum, that sometimes takes as many as three years to grow from a seedling.

In late medievalGermany and Italy, hemp was employed in cooked dishes, as filling in pies and tortes, or boiled in a soup.

Hemp in later Europe was mainly cultivated for its fibers, and was used for ropes on many ships, including those of Christopher Columbus. The use of hemp as a cloth was centered largely in the countryside, with higher quality textiles being available in the towns. The Spaniards brought hemp to the Western Hemisphere and cultivated it in Chile starting about 1545. However, in May 1607, "hempe" was among the crops Gabriel Archer observed being cultivated by the natives at the main Powhatan village, where Richmond, Virginia is now situated ; and in 1613, Samuell Argall reported wild hemp "better than that in England" growing along the shores of the upper Potomac. As early as 1619, the first Virginia House of Burgesses passed an Act requiring all planters in Virginia to sow "both English and Indian" hemp on their plantations . The Puritans are first known to have cultivated hemp in New England in 1645.

Hemp was used extensively by the United States during World War II. Uniforms, canvas, and rope were among the main textiles created from the hemp plant at this time. Much of the hemp used was cultivated in Kentucky and the Midwest.

Historically, hemp production had made up a significant portion of antebellum Kentucky's economy. Before the American Civil War, many slaves worked on plantations producing hemp.

During World War II, the U.S. produced a short 1942 film, *Hemp for Victory*, promoting hemp as a necessary crop to win the war.

By the early twentieth century, the advent of the steam engine and the Diesel engine ended the reign of the sailing ship. The production of iron and steel for cable and ships' hulls further eliminated natural fibres in marine use. Hemp had long since fallen out of favour in the sailing industry in preference to Manila hemp.

5 – 1 - Historical cultivation

Hemp has been grown for millennia in Asia and the Middle East for its fibre. Commercial production of hemp in the West took off in the eighteenth century, but was grown in the sixteenth century in eastern England. Because of colonial and naval expansion of the era, economies needed large quantities of hemp for rope and oakum. Other important producing countries were China, North Korea, Hungary, the former Yugoslavia, Romania, Poland, France and Italy.

In Western Europe, the cultivation of hemp was not legally banned by the 1930s, but the commercial cultivation stopped by then, due to decreased demand compared to increasingly popular artificial fibres.

Hemp Oil

Contents

Introduction
 Nutrition
 Wood finish

1 - Introduction

Hemp oil or hempseed oil is obtained by pressing hemp seeds. Cold pressed, unrefined hemp oil is dark to clear light green in color, with a pleasant nutty flavour. The darker the color, the grassier the flavour.

Refined hempseed oil is clear and colorless, with little flavor and lacks natural vitamins and antioxidants. Refined hempseed oil is primarily used in body care products. Industrial hempseed oil is used in lubricants, paints, inks, fuel, and plastics. Hempseed oil has found some limited use in the production of soaps, shampoos and detergents. The oil is of high nutritional value because of its 3:1 ratio of omega-6 to omega - 3 essential fatty acids, which matches the balance required by the human body. It has also received attention in recent years as a possible feedstock for the large-scale production of biodiesel.^{[2][3]} There are a number of organizations that promote the production and use of hempseed oil.

Hempseed oil is manufactured from varieties of *Cannabis sativa* that do not contain significant amounts of THC, the psychoactive element present in the cannabis plant. This manufacturing process typically includes cleaning the seed to 99.99 % before pressing the oil. There is no THC within the hempseed, although trace amounts of THC may be found in hempseed oil when plant matter adheres to the seed surface during manufacturing. The modern production of hempseed oil, particularly in Canada, has successfully lowered THC values since 1998. Regular accredited sampling of THC in Canadian hemp seed oil shows THC levels usually below detection limit of 4ppm (parts per million, or 4 mg / kg). Legal limit for THC content in foodstuffs in Canada is 10ppm. Some European countries have limits

of 5ppm or none - detected, some EU countries do not have such limits at all.

Hash oil, not to be confused with hempseed oil, is used for both medicinal and recreational purposes and made from the mature female flowers and leaves of the drug cannabis, thus having a much higher THC content. Hash oil should not be confused with hemp, as the modern usage of the word 'hemp' is reserved for plants that meet the legal requirement of containing 0.3% THC or less.

2 - Nutrition



Hempseeds from which hempseed oil can be extracted

About 30 -35 % of the weight of hempseed is an edible oil that contains about 80 % as essential fatty acids (EFAs); i.e., linoleic acid, omega - 6 (LA, 55 %), alpha - linolenic acid, omega-3 (ALA, 22 %), in addition to gamma - linolenic acid, omega-6 (GLA, 1– 4 %) and stearidonic acid, omega-3 (SDA, 0–2 %).

The proportions of linoleic acid and alpha-linolenic acid in one tablespoon per day (15 ml) of hempseed oil easily provides human daily requirements for EFAs. Unlike flaxseed oil, hempseed oil can be used continuously without developing a deficiency or other imbalance of EFAs. This has been demonstrated in a clinical study, where the daily ingestion of flaxseed oil decreased the endogenous production of GLA.

In common with other oils, hempseed oil provides 9 kcal/g. Compared with other culinary oils it is low in saturated fatty acids.

Highly unsaturated oils, and especially poor quality oils, can spontaneously oxidize and turn rancid within a short period of time when they are not stored properly; i.e., in a cool/cold, dark place, preferably in a dark glass bottle. Hempseed oil can be frozen for longer periods of storage time. Preservatives (antioxidants) are not necessary for high-quality oils that are stored properly.

Hempseed oil has a relatively low smoke point and is not suitable for frying. Hempseed oil is primarily used as a food oil and dietary supplement, and has been shown to relieve the symptoms of eczema (atopic dermatitis).

3 - Wood finish

Hemp oil is a "drying oil", as it can polymerize into a solid form. Due to its polymer-forming properties, hemp oil is used on its own or blended with other oils, resins, and solvents as an impregnator and varnish in wood finishing, as a pigment binder in oil paints, as a plasticizer and hardener in putty. It has uses similar to Linseed oil and characteristics similar to tung oil.

Holy Anointing Oil



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1 - Introduction

The holy anointing oil (Hebrew: *shemen* "oil", *ha-mishchah* "of anointing") formed an integral part of the ordination of the priesthood and the high priest as well as in the consecration of the articles of the tabernacle (Exodus 30:26) and subsequent temples in Jerusalem. The primary purpose of anointing with the holy anointing oil was to cause the anointed persons or objects to become qodesh - most holy (Exodus 30:29).

Originally the oil was used exclusively for the priests and the Tabernacle articles but was later extended to include prophets and kings (I Samuel 10:1). It was forbidden to be used on an outsider

(Exodus 30:33) or to be used on the body of any common persons (Ex. 30:32a) and the Israelites were forbidden to duplicate any like it for themselves (Ex. 30:32b).

2 - Hebrew Bible

The holy anointing oil described in Exodus 30:22-25 was created from :

Pure myrrh (*mar deror*) 500 shekels (about 6 kg)

Sweet cinnamon (kinnemon besem) 250 shekels (about 3 kg)

Calamus (*kaneh bosm*) 250 shekels (about 3 kg)

Cassia (*kiddah*) 500 shekels (about 6 kg)

Olive oil (*shemen sayith*) one *hin* (about 5 quarts according to Adam Clarke; about 4 liters according to Shiurei Torah, 7 liters according to the Chazon Ish)

2 – 1 - Anointing kings

The Hebrew term "Messiah (in Greek *Christos*) means "the anointed one", and relates to anyone anointed to be king.

2 – 2 - In the ancient Near East

Customs varied in the cultures of the middle east. However, anointing with special oil was in Israel either a strictly priestly or kingly right. When a prophet was anointed, it was because he was first a priest. When a non - king was anointed, such as Elijah's anointing of Hazael and Jehu, it was a sign that Hazael was to be king of Syria and that Jehu would king of Israel. Extra - biblical sources show that it was common to anointing kings in many ancient Near Eastern monarchies. There fore, in Israel, anointing was not only a sacred act but also a socio - political one.

In the Old Testament Israelite way of life and cultural environment, the sense of smell was important for survival and was highly esteemed. It contributed to the ability of man to orient himself and to find his way in a world where life and death were permanently struggling. Where stench arose, he diagnosed the presence of disease, decay, rotting processes and death (Exodus 7:18)^[5] and where pleasant aromas existed were places biologically clean and conducive

to habitation and / or food production and harvesting. Spices and oils were chosen which assisted man in orienting himself and in creating a sense of safety as well as a sense of elevation above the physical world of decay. The sense of smell was also considered highly esteemed by deity. In Deuteronomy 4:28 and Psalms 115:5-6 the sense of smell is included in connection with the polemics against idols. In the Hebrew Bible God takes pleasure in inhaling the "soothing odor" (*reah hannihoah*) of offerings (Genesis 8:21 etc.).

To the ancient Israelite there was no oil or fat with more symbolic meaning than olive oil. It was used as an emollient, a fuel for keeping their lamps lit, as a food, and for many other purposes. It was scented olive oil which was chosen to be a holy anointing oil for the Israelites.

3 - Continuity

Some believe in the continuity factor relative to the Holy Anointing Oil . Customs utilizing the continuity factor is found in many of the world's religions. For example early Jewish rabbi's stressed the importance of the succession of classical semikhah^[9] and the Catholic Church emphasized the importance of Apostolic succession, the continuity of laying on of hands for ordination, in an unbroken chain . The continuity factor relative to the Holy Anointing Oil can be found in rabbinical judaism , in the Armenian Church , in the Assyrian Church of the East in the Coptic Church , in the Nazrani and Saint Thomas churches , and others.

3 – 1 - In Rabbinical Judaism

As mentioned above, the continuity factor can be found in rabbinical judaism, including that of the Holy Anointing Oil.^{[11][12]}

One Jewish tradition teaches that the ashes of the last red heifer sacrificed were always mixed with the ashes of each new red heifer^[19] The Temple Institute states, "Some opinions maintain that the newer ashes were always mixed together with a combination of the previous ashes. One way of understanding this, is to the view this mixture of old and new ashes as being yet another precautionary measure... Additionally, mixing in the newer ashes we have produced now with

those from olden times is a way of connecting through time with the original heifer that was slaughtered and prepared by Moses. As such, in a sense, it is a way of connecting with the level of Moses himself." Since the last succession of ashes of the red heifer were either hidden or lost after 70 AD Vendyl Jones searched for the original ashes by following the map on the Copper Scroll that purports to tell the location, so that the old ashes can be added to the new, thus in his view continuing the "continuity factor."

There is a traditional Jewish *mitzvah* that when making *challah* one should separate and set aside part of the dough. Some Jewish people remove a small piece of the *challah* dough (the word "challah" means to remove) and give it away to someone else as a challah starter, although according to traditional Jewish law, this piece may not be eaten under any modern day conditions, and must thus be destroyed in a dignified manner.^[26] In one Jewish custom a portion of the challah is set aside (refrigerated) until the making of new challah when the old is added to the new. It is recorded in Exodus 30:31 "And thou shalt speak unto the children of Israel, saying, This shall be an holy anointing oil unto me throughout your generations." (Exodus 30:31). Commenting on this verse Rashi quotes a teaching of the Sages [Horiyos 11b] that the original Shemen HaMishcha that Moses made, to anoint the priesthood and the tabernacle furnishings, would remain intact in its entirety into the distant future (*l'asid lavoh*). When the Temple was to be rebuilt they would then need that very same Holy Anointing Oil to anoint the priests prior to their service in the Third Temple as well as to anoint the furnishings of the mishkan.^[27] Vendyl Jones claimed that such a small quantity of oil (around a gallon) would not last that long. It is claimed that one juglet of oil lasted over 800 years. To explain this discrepancy it is claimed that one of two things occurred: Either the container of Holy Anointing Oil miraculously multiplied when supply became low (as did the cruse of oil mentioned in the story of Elijah and the widow woman^[29] or the oil that lasted for eight days without being consumed during the Jewish Chanukka) or, following ancient customs, new oil was added to the old thus continuing the original oil for all time.

3 – 2 - In Christianity

Anointing oil is used in Christianity. A passage in the New Testament says, "Is anyone among you in trouble? Let them pray. Is anyone happy? Let them sing songs of praise. Is anyone among you sick? Let them call the elders of the church to pray over them and anoint them with oil in the name of the Lord. And the prayer offered in faith will make the sick person well; the Lord will raise them up. If they have sinned, they will be forgiven." James 5:13,14 (NIV)

3 – 3 - In the Armenian Church

The Holy Anointing Oil of the Armenian Church is called the Holy Muron.^[32] The church holds a special reverence for the continuity factor of the oil . According to tradition, a portion of the Holy Anointing Oil of Exodus 30, which Moses and Aaron had blessed, still remained in Jesus' time. Jesus Christ blessed this oil and then gave some of it to Thaddeus, who took the holy oil to Armenia and healed King Abkar of a terrible skin disease by anointing him with the holy oil. Saint Thaddeus is said to have buried a bottle of the Holy Anointing Oil in Daron under an evergreen tree. Saint Gregory the Illuminator discovered the hidden treasure and mixed it with muron that he had blessed. It is said that "To this day, whenever a new batch of muron is prepared and blessed, a few drops of the old one go into it, so that the Armenian muron always contains a small amount of the original oil blessed by Moses, Jesus Christ, and Gregory the Illuminator."

The Holy Muron is composed of olive oil and forty-eight aromas and flowers. The remaining portion of the previous blessed holy oil is poured into the newly prepared oil during the blessing ceremony and passes the blessing from generation to generation. It is said that this very procedure has been followed for nearly 1700 years. The Catholicos of all Armenians in Etchmiadzin combines a new mixture of Holy Muron in the cauldron every seven years using a portion of the holy muron from the previous blend. This is distributed to all of the Armenian churches throughout the world. Before Christianity, Muron was reserved solely for the enthroning of royalty and for very special events. In later years, it was used with extreme unction and to heal the sick, and to anoint ordained clergy.

3-4 - In the Assyrian Church of the East

It is said by the Assyrian Church that the Holy Anointing Oil "was given and handed down to us by our holy fathers Mar Addai and Mar Mari and Mar Tuma." The Holy Anointing Oil of the Assyrian Church is variously referred to as the Oil of the Holy Horn, the Oil of the Qarna, or the Oil of Unction. This holy oil is an apostolic tradition, believed to have originated from the oil consecrated by the Apostles themselves, and which by succession has been handed down in the Church to this day. The original oil which the disciples blessed began to run low and more oil was added to it. The Assyrian Church believes that this has continued to this very day with new oil being added as the oil level lowers. This succession of holy oil is believed to be a continuity of the blessings placed upon the oil from the beginning.

Both the Oil of Unction and the Holy Leaven are referred to as "leaven" although there is no actual leavening agent, so the nomenclature Holy Leaven seems to be a bit misleading. Yohanan bar Abgareh referred to it in 905 as did Shlemon d - Basra in the 13th century. Yohanan bar Zo'bee in the 14th century integrated the Holy Oil of unction with baptism and other rites. Isaaq Eshbadhnaya in the 15th century wrote the Scholion which is a commentary on specific theological topics. It tells us that that John the Baptist gave John the Evangelist a baptismal vessel of water from Christ's baptism, which was collected by John the Baptist from water dripping from Christ after his baptism in Jordan River. Jesus gave each disciple a "loaf," at the Last Supper, but the Scholion informs us that to John he gave two with the instructions to eat only one and to save the other. At the crucifixion John collected the water from the Lord's side in the vessel and the blood he collected on the loaf from the Last Supper. After the descent of the Holy Spirit on Pentecost the disciples took the vessel and mixed it with oil and each took a horn of it. The loaf they ground up and added flour and salt to it. Each took a portion of the holy oil and the holy bread which were distributed in every land by the hand of those who missionized there.

The Assyrian Church has two types of holy oils; the one is ordinary olive oil, blessed or not blessed, the other is the oil of the Holy Horn which is believed to have been handed down from the Apostles. The Holy Horn is constantly renewed by the addition of oil blessed by a bishop on Maundy Thursday. While most anyone can by tradition be anointed with the regular oil, the oil of the Holy Horn is restricted for ordination and sanctification purposes.

3 – 5 - In the Coptic Church

The Holy Anointing oil of the Coptic Church is referred to as the Holy Myron. The laying of hands for the dwelling of the Holy Spirit is believed to have been a specific rite of the Apostles and their successors the Bishops, and as the regions of mission increased, consequently numbers of Christian believers and converts increased. It was not possible for the Apostles to wander through all the countries and cities to lay hands on all of those baptized, so they established anointment by the Holy Myron as an alternative, it is believed, for the laying on of the hands for the Holy Spirit's indwelling.

The first who made the Myron were the Apostles who had kept the fragrant oils which were on the body of Jesus Christ during his burial, and they added the spices which were brought by those women who prepared them to anoint Christ, but had discovered he had resurrected. They melted all these spices in pure olive oil, prayed on it in the Upper Room in Zion and made it a Holy Anointing Oil. They decided that their successors the Bishops, must renew the making of the Myron whenever it is close to dimishing, by incorporating the original oil with the new. Today the Coptic Church uses it for ordination, in the Sanctification of Baptismal water, ordination of Churches, and church altars and vessels.

It is said that when St. Mark went to Alexandria, he took with him some of the Holy Myron oil made by the Apostles and that he used it in the Sacrament of Chrism, as well as the Patriarchs who succeeded him. This continued until the era of Athanasius the Apostolic - the 20 th Patriarch, who then decided to remake the Myron in Alexandria. Hence, it is reported, he prepared all of the needed perfumes and spices, with pure olive oil, from which God ordered Moses to make the Holy Anointing Oil as specified in the recipe in the thirtieth chapter of the book of Exodus. Then the sanctification of the Holy Myron was fulfilled in Alexandria, and Athanasius was entrusted with the holy oil (leaven), which contained spices which touched the Lord's body whilst in the tomb, as well as the original oil which had been prepared by the Apostles and brought to Egypt by St. Mark. He distributed the oil to the churches abroad : to the See of Rome, Antioch and Constantinople, together with a document of its authenticity, and all of the patriarchs are said to have rejoiced in receiving it.

The Coptic Church informs that the Fathers of the Church and scholars like St. Justin Martyr, Tertullian, St. Hippolytus, Origen, St. Ambrose, and St. Cyril of Jerusalem, spoke about the Holy Myron and how they received its use in anointing by tradition. For example, St. Hippolytus in his Apostolic Tradition, speaks of the holy oil "according to ancient custom" ^[43] Origen writes about the holy oil "according to the tradition of the church" St. Cyril of Jerusalem goes into further detail in speaking about the grace of the Holy Spirit in the Holy Myron: "this oil is not just any oil after the epiclesis of the Spirit, it becomes charism of Christ and power of the Holy Spirit through the presence of the deity"

The early fathers and scholars mention the use of the Holy Myron, as well as a documentation by Abu I-Barakat Ibn Kabar, a 14th-century Coptic priest and scholar, in his book Misbah az -Zulmah fi idah al - khidmah (The Lamp of Darkness in Clarifying the Service) . According to his account, the holy apostles took from the spices that were used to anoint the body of our Lord Jesus Christ when he was buried , added pure olive oil to it, and prayed over it in Upper Zion, the first church where the Holy Spirit fell in the upper room.

This holy oil was then distributed among all of the apostles so that wherever they preached, new converts would be anointed with it as a seal. They also commanded that whenever a new batch of Holy Myron was made, that they add to it the old Holy Myron to keep the first Holy Myron continually with all that would ever be made afterwards.

According to the available resources, the Holy Myron in the Church of Egypt has been made 34 times.

3-6 - Among the Saint Thomas Christians and Nasranis

According to tradition St. Thomas laid the original foundation for Christianity in India. It is reported that Jewish communities which were already present in India were the contributing factors which enticed Thomas on his missionary journey there. It is said that he brought the Holy Anointing Oil with him and that the St. Thomas Christians still have this oil to this day.

Patriarch Ya`qub, of the Syrian Malabar Nasrani Church, is fondly remembered for his spiritually uplifting celebration of the liturgy and his humble encouragement to accept the simple way of life. After he consecrated sacred myron in the Mor Gabriel monastery in 1964, holy myron reportedly flowed from the glass container the following day and many people were said to have been healed by it.

4 - Alternative identification of kaneh bosem

4 – 1 – Rabbinical

The Septuagint, Nachmanides, Saadya Gaon and Ibn Janach all identify the *keneh bosem* (Hebrew "sweet cane," "fragrant reed") of the Old Testament as sweet calamus. Ancient sources identify this with the *acorus calamus* (Latin "sour-tasting cane") . (Septuagint; Rambam on Kerithoth 1:1; Saadia; Ibn Janach). This is the sweet flag or flag-root, acorus calamus, which grows in Europe. It appears that a similar species grew in the Holy Land, in the Hula region in ancient times (Theophrastus, *History of Plants* 9:7). Other sources apparently indicate that it was the Indian plant, rosha grass (*Cymbopogon martinii*), which has the form of red straw (Maimonides *Yad, Kley HaMikdash* 1:3).

Most biblical authorities and commentators identify the *keneh bosem* as cane balsam or the plant variously referred to as sweet cane, sweet flag, or calamus. The Aramaic Targum Onkelos renders Hebrew *kaneh bosem* as Aramaic *q'nei busma*.

In The Living Torah, Rabbi Aryeh Kaplan identifies this as the *Cymbopogon martinii* or palmarosa plant . Kaplan also says "On the basis of cognate pronunciation and Septuagint readings, some identify Keneh bosem with the English and Greek *cannabis*, the hemp plant."

4 – 2 - Sula Benet, 1936

The main advocate of the idea that kaneh bosm was cannabis was Sula Benet in 1936 in a paper in Warsaw, and again in her Early Diffusion and Folk Uses of Hemp (1967), Benet identifies it as the hemp plant, or cannabis. Both in the original Hebrew text of the Old Testament and in the Aramaic translation, the word 'kaneh' or ' keneh' is used either alone or linked to the adjective bosm in Hebrew and busma in Aramaic, meaning aromatic. It is 'cana' in Sanskrit, 'qunnabu' in Assyrian, 'kenab' in Persian, 'kannab' in Arabic and 'kanbun' in Chaldean. In Exodus 30: 23, God directed Moses to make a holy oil composed of "myrrh, sweet cinnamon, kaneh bosm and kassia." In many ancient languages, including Hebrew, the root 'kan' has a double meaning --- both hemp and reed. In many translations of the Bible's original Hebrew, we find 'kaneh bosm' variously and erroneously translated as "calamus" and "aromatic reed," a vague term. Calamus, (Calamus aromaticus) is a fragrant marsh plant. The error occurred in the oldest Greek translation of the Hebrew Bible, Septuagint, in the third century B.C., where the terms 'kaneh, kaneh bosm' were incorrectly translated as "calamus." Another piece of evidence regarding the use of the word 'kaneh' in the sense of hemp rather than reed among the Hebrews is the religious requirement that the dead be buried in 'kaneh' shirts. Benet argues that in support of the theory that reads cannabis as an ingredient of the holy anointing oil is that most of the other ingredients, if not all, are also theorized to come from Central Asian lands in which, Benet claims, cannabis was frequently used for spiritual (Scythian) and medicinal use.

Pongamia Oil (Honge Oil)



Pods and seeds of Millettia pinnata

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2 Cultivation

3 Description

4 Uses

4.1 Traditional

4.2 Biodiesel

1 - Introduction

Pongamia oil is derived from the seeds of the *Millettia pinnata* tree, which is native to tropical and temperate Asia. *Millettia pinnata*, also known as *Pongamia pinnata* or *Pongamia glabra*, is common throughout Asia and thus has many different names in different languages, many of which have come to be used in English to describe the seed oil derived from *M. pinnata*; *Pongamia* is often used as the generic name for the tree and is derived from the genus the tree was originally placed in.

Other names for this oil include Karanja oil (in Hindi), Honge oil (in Kannada), Kanuga oil (in Telugu) and Pungai oil (in Tamil).

2 – Cultivation

Millettia pinnata is native to South and Southeast Asia. Known in various languages as Indian beech, Pongam, Karanja, Honge, Kanuga, and Naktamala, it is now grown all over the world. Typically the plant starts yielding pods from the fifth year on with the yields increasing each year until it stabilizes around the tenth year. Seeds are usually harvested in the spring, each seed weighing from about 1.1 grams to 1.8 grams. The yield per tree can range from about 10 kilograms to more than 50 kilograms depending on conditions, with an average of 1500 - 1700 seeds per kilogram. Historically the pods are removed from the trees by beating the branches with sticks and decorticated using mallets or stones. Research is ongoing into mechanical harvesting methods.

The basic nutritional components of *Millettia pinnata* seeds may change depending the season and maturity of the tree but in general are as follows :

Component	Percentage
Oil	27 % - 39 %
Protein	17 % - 37 %
Starch	6 % - 7 %
Crude fiber	5 % - 7 %
Moisture	15 % - 20 %
Ash	2 % - 3 %

3 – **Description**

Pongamia oil is extracted from the seeds by expeller pressing, cold pressing, or solvent extraction. The oil is yellowish - orange to brown in color. It is toxic and will induce nausea and vomiting if eaten but it is used in many traditional remedies. Pongamia oil is antiseptic and resistant to pests. It has a high content of triglycerides, and its disagreeable taste and odor are due to bitter flavonoid constituents including karanjin , pongamol , tannin and karanjachromene.

Millettia pinnata has a number of different varieties but little research has been published on the differences between them.^[3] This combined with variances in soil and weather can change the specific composition of Pongamia oil. Typically Pongamia oil is composed of the following fatty acids :

Fatty acid	Nomenclature	e Percentage
Palmitic	C16:0	3.7 % - 7.9 %
Stearic	C18:0	2.4 % - 8.9 %
Oleic	C18:1	44.5 % - 71.3 %
Linoleic	C18:2	10.8 % - 18.3 %
Linolenic	C18:3	2.6 %
Arachidic	C20:0	2.2 % - 4.7 %
Eicosenoic	C20:1	9.5 % - 12.4 %
Behenic	C22:0	4.2 % - 5.3 %
Lignoceric	C24:0	1.1 % - 3.5 %

The physical properties of crude Pongamia oil are as follows :

Property	Unit	Value
Acid value	mg KOH / g	4.0 - 12
Calorific value	kcal/kg	8742
Cetane number		42
Density	g / cm^3	0.924
Iodine value	g / 100 g	86.5 - 87
Saponification value	mg KOH / g	184 - 187
Specific gravity		0.925
Un saponifiable matter	% w / w	2.6 - 2.9
Viscosity	mm^2/sec	40.2
Boiling point	°C	316
Cloud point	°C	3.5
Fire Point	°C	230
Flash point	°C	225
Pour point	°C	-3.0

4 – Uses

4 – 1 – Traditional

It has been used as lamp oil, in leather tanning, in soap making, and as a lubricant for thousands of years. Its toxicity, as well as its

color, bitter taste, and disagreeable odor, keep it from being used in cooking but it does have uses in traditional medicine for treating skin disease and liver disease.

Recent studies have shown some potential for biocidal activity against *V. cholerae* and *E. coli*, as well an anti-inflammatory, antinociceptive (reduction in sensitivity to painful stimuli) and antipyretic (reduction in fever) properties. There is also research indicating that the oil can be used as a natural insecticide.

4 – 2 – Biodiesel

Many studies have been done to convert Pongamia oil into biodiesel . The following table shows the physical properties of the methyl esters of Pongamia oil versus the EN 14214 standards :

Unit	Methyl esters	ASTM D6751	EN 14214
mg KOH/g	0.46 - 0.5	< 0.8	< 0.5
Kcal / kg	3700		
	41.7 - 56	>45	>51
g/cm ³	0.86 - 0.88	0.87 - 0.89	0.86 - 0.90
cSt	4.77	1.9 - 6.0	3.5 - 5.0
g / 100 g	86.5 - 91		< 120
^t h	2.24		6
mg KOH/g	184 - 187		
% w/w	2.6 - 2.9		
°C	316		
°C	19		0/-15
°C	230		
°C	174	> 130	>100
°C	15		
	mg KOH/g Kcal / kg g/cm ³ cSt g / 100 g t h mg KOH/g % w/w °C °C °C °C	Cmit esters mg KOH/g 0.46 - 0.5 Kcal / kg 3700 41.7 - 56 41.7 g/cm ³ 0.86 - 0.88 cSt 4.77 g / 100 g 86.5 - 91 h 2.24 mg KOH/g 184 - 187 % w/w 2.6 - 2.9 °C 316 °C 19 °C 230 °C 174	UnitestersD6751mg KOH/g0.46 - 0.5< 0.8

The comparison of the methyl esters of Pongamia oil to the ASTM D6751 standard for biodiesel fuels shows that processed Pongamia oil is within the standards. Against the European EN 14214 standards, Pongamia oil does not meet the storage stability standard; Oxidation stability needs to be a minimum of 6 hours at 110°C, but the stability of processed Pongamia oil is only 2.24 hours. Research has shown that jatropha or pongamia oil can be mixed with palm oil to achieve an improved low-temperature viscosity than pure palm oil and a higher oxidation stability than pure jatropha or pongamia oil.^[11] In addition, the methyl esters of Pongamia oil have a cloud point of 19°C, which is outside the European standards, and a pour point of 15°C both of which would be problematic in lower temperature climates.

Horticultural Oil

Contents

1 Introduction
 2 Terms used to describe oils

1 - Introduction

Horticultural Oils or Narrow Range Oils are light weight oils, either petroleum or vegetable based. They are used in both horticulture and agriculture, where they are applied as a dilute spray on plant surfaces to control insects and mites. They are also some times included in tank mixes as a surfactant.

The oils provide control by smothering the target pests, and are only effective if applied directly to the pest, and provide no residual controls.

Oils are generally considered suitable for 'organic pest control', with most oils permitted under the U.S. National Organic Program.

2 - Terms used to describe oils

Dormant oil: An oil used on woody plants during the dormant season. This term originally referred to heavier weight, less wellrefined oils that were unsafe to use on plants after they broke dormancy. However, these older oils have been replaced with more refined, light-weight oils that have potential application to plant foliage. Dormant oil now refers to the time of application rather than to any characteristic type of oil.

Horticultural oils: An oil used to control a pest on plants.

Mineral oil: A petroleum - derived oil (as opposed to vegetable oils).

Narrow - range oil : A highly refined oil that has a narrow range of distillation. Narrow-range oils fall in the superior oil classification. The terms may be used nearly interchangeably.

Spray oil: An oil designed to be mixed with water and applied to plants as a spray for pest control.

Summer oil: An oil used on plants when foliage is present (also called foliar oils). As with dormant oil, the term now refers to the time an application is made rather than to the properties of the oil.

Supreme oil: A term used to categorize highly refined oils that distill at slightly higher temperatures and over a wider range than the narrow - range oils. Most supreme oils meet the characteristics of a superior oil.

Superior oil: A term originated by P.J. Chapman in 1947 to categorize summer - use oils that met certain specifications. This included a high proportion of paraffinic hydrocarbons and purification that allowed year - round use without phytotoxicity. Since then, further developments have resulted in oils that distill over a narrow temperature range. Most superior oils are now better referred to as narrow-range oils.

Vegetable oil: An oil derived from the seeds of some oil seed crop (e.g., soybeans, canola, cottonseed).

Hydroxyl Value

In chemistry, the hydroxyl value is a measure of the content of free hydroxyl groups in a compound, typically a fat, oil, or natural or synthetic ester. This value is a useful measure of the degree of esterification in ester synthesis. The method involves acetylation of the free hydroxyl groups of the compound with acetic anhydride in pyridine solvent . After completion of the reaction, water is added, the remaining acetic anhydride is converted to acetic acid, and measured by titration with potassium hydroxide. Other functional groups, such as primary or secondary amines, will be reported as hydroxyl. It is expressed as the mass of potassium hydroxide (KOH) in milligrams equivalent to the hydroxyl content of one gram of the chemical substance, corrected for carboxyl hydroxyl groups by titration of an unacetylated sample of the same material.

 $HV = \left(\left(V_B + \left(W_{acet} V_{av} / W_{av} \right) - V_{acet} \right) / W_{acet} \right) N56.1$

Where V_B is the amount of titrant (ml) consumed by the blank, at the equivalent point, W _{acet} is the weight of sample (in grams) used for acetylation, V_{av} is the amount of titrant used for determining the acid value, W_{av} is the weight of sample used for determining the acid value, V_{acet} is the amount of titrant used for the acetylated sample, N is the normality of the titrant, and 56.1 is the molecular weight of KOH.

The standard method for determining the hydroxyl value is ASTM D 1957

Iodine Value

Contents

Introduction
 Table of iodine values
 Methodology

1 - Introduction

The iodine value (or "iodine adsorption value" or "iodine number" or "iodine index") in chemistry is the mass of iodine in grams that is consumed by 100 grams of a chemical substance. Iodine numbers are often used to determine the amount of unsaturation in fatty acids. This unsaturation is in the form of double bonds, which react with iodine compounds. The higher the iodine number, the more C = C bonds are present in the fat. It can be seen from the table that coconut oil is relatively saturated, which means it is good for making soap. On the other hand linseed oil is highly unsaturated, which makes it a drying oil, well suited for making oil paints.

2 - Table of iodine values

Fat	Iodine number
Tung oil	163 – 173
Grape Seed oil	124 - 143
Palm oil	44 - 51
Olive oil	80 - 88
Coconut oil	7 - 10
Palm oil	16 – 19
Cocoa butter	35 - 40
Jojoba oil	~80
Cottonseed oil	100 - 117
Corn oil	109 – 133
Sunflower oil	125 - 144
Linseed oil	170 - 204
Soybean oil	120 - 136
Peanut oil	84 - 105

3 - Methodology

This particular analysis is an example of iodometry. A solution of iodine ions is yellow/brown in color. When added to a complex solution however, any chemical group (usually C = C double bonds) in solution that react with iodine effectively reduce the strength, or magnitude of the colour (by taking iodine ions out of solution). Thus the amount of iodine required to make a solution retain the characteristic yellow/brown colour can effectively be used to determine the amount of iodine sensitive groups present in the solution.

In a typical procedure, the fatty acid is treated with an excess of the Hanuš or Wijs solutions, which are, respectively, solutions of iodine mono bromide (IBr) and iodine mono chloride (I C 1) in glacial acetic acid. Unreacted iodine monobromide (or mono chloride) is then allowed to react with potassium iodide, converting it to iodine, whose concentration can be determined by titration with sodium thiosulfate.

The chemical reaction associated with this method of analysis involves formation of the diiodo alkane (R and R' symbolize alkyl or other organic groups):

 $R{-}CH{=}CH{-}R' + I_2 \longrightarrow R{-}CHI{-}CHI{-}R'$

The precursor alkene (RCH=CHR') is colourless and so is the organo idine product ($R\ CHI-CH\ IR'$) .

Japan Wax

Contents

1 Introduction
 2 Uses
 3 Other names
 4 Properties

1 - Introduction

Japan wax also known as sumac wax, China green tallow, and Japan tallow. This material is a pale-yellow, waxy, water-insoluble solid with a gummy feel, obtained from the berries of certain sumacs native to Japan and China, such as *Toxicodendron vernicifluum* (lacquer tree) and *Toxicodendron succedanea* (Japanese wax tree).

Japan wax is a by product of lacquer manufacture. It is not a true wax but a fat that contains 10 - 15 % palmitin, stearin, and olein with about 1% japanic acid (1,21- heneicosanedioic acid).

Japan wax is sold in flat squares or disks and has a rancid odor. It is extracted by expression and heat, or by the action of solvents.

2 - Uses

Japan wax is a vegetable fat used chiefly in the manufacture of candles, furniture polishes, floor waxes, wax matches, soaps, food packaging, pharmaceuticals, cosmetics, pastels, crayons, buffing compounds, metal lubricants, adhesives, thermoplastic resins, and as a substitute for bees wax.

3 - Other names

Japan tallow; sumac wax; sumach wax; vegetable wax; Japan tallow; China green tallow.

4 - Properties

Melting point = 51° C Specific gravity ≈ 0.975 Soluble in benzene, ether, naphtha and alkalis. Insoluble in water or cold ethanol.

Iodine value = 4.5-12.6 Acid value = 6 - 209 Saponification value = 220

Jatropha Curcas

Contents

1 Introduction

- 2 Botanical features
- 3 Cultivation
- 4 Propagation
- 5 Processing
- 6 Uses

6.1 Biofuel

- 6.1.1 Jet fuel
- 6.1.2 Carbon dioxide sequestration
- 6.1.3 Use in developing world
 - 6.1.3.1 Burma
- 6.1.4 Controversies
- 6.2 Other uses

1 Introduction

Jatropha curcas (Sanskrit: danti, pratyanshrani) is a species of flowering plant in the genus Jatropha in spurge family, Euphorbiaceae, that is native to the American tropics, most likely Mexico and Central America. It is cultivated in tropical and subtropical regions around the world, becoming naturalized in some areas. The specific epithet, *"curcas"*, was first used by Portuguese doctor Garcia de Orta more than 400 years ago and is of uncertain origin. Common names include Barbados Nut, Purging Nut, Physic Nut, or JCL (abbreviation of *Jatropha curcas* Linnaeus).

J. curcas is a poisonous, semi-evergreen shrub or small tree, reaching a height of 6 m. It is resistant to a high degree of aridity, allowing it to be grown in deserts.

The seeds contain 27 - 40 % oil (average : 34.4 %) that can be processed to produce a high - quality biodiesel fuel, usable in a standard diesel engine. The seeds are also a source of the highly poisonous tox albumin curcin.

Scientific classification		
Kingdom:	Plantae	
(unranked):	Angiosperms	
(unranked):	Eudicots	
(unranked):	Rosids	
Order:	Malpighiales	
Family:	Euphorbiaceae ^[1]	
Genus:	Jatropha	
Species:	J. curcas	
Binomial name		
Jatropha curcas L.		

The stems of haat (*Jatropha cuneata*) are used for basket making by the Seri people in Sonora, Mexico. The stems are roasted, split and soaked through an elaborate process. The reddish dye that is often used is made from the root of another plant species, *Krameria grayi*. Spicy jatropha (*J. integerrima*) is cultivated as an ornamental in the tropics for its continuously blooming crimson flowers. Buddha belly plant (*J. podagrica*) was used to tan leather and produce a red dye in Mexico and the southwestern United States. It is also used as a house plant.

The oil from Jatropha curcas is mainly converted into biodiesel for use in diesel engines. The cake can be used for fish or animal feed (if detoxified), biomass feedstock to power electricity plants, or as biogas or high - quality organic fertilizer. It can also be used as a biopesticide and for medicinal purposes.

Further more , it has been found that Jatropha curcas can be planted in arid and hot regions such as the desert areas of Egypt, India, and Madagascar, and contribute a reduction of up to 25 t of CO2 per hectare per year from the atmosphere (over a 20 yr period),^[9] while still producing bio fuel and also the dry cakes from the oil

extraction. Currently, research plantations are being planted to test the results and see the viability of this.

Toxicity

Much like other members of the family Euphorbiaceae, members of the genus *Jatropha* contain several toxic compounds. The seeds of *Jatropha curcis* contain the highly poisonous toxalbumin curcin, a lectin dimer. They also contain carcinogenic phorbol.^[10] Despite this, the seeds are occasionally eaten after roasting, which reduces some of the toxicity. Its sap is a skin irritant, and ingesting as few as three untreated seeds can be fatal to humans. In 2005 Western Australia banned *Jatropha gossypiifolia* as invasive and highly toxic to people and animals.

2 - Botanical features

Leaves: The leaves have significant variability in their morphology. In general, the leaves are green to pale green, alternate to sub opposite, and three - to five - lobed with a spiral phyllotaxis.

Flowers: male and female flowers are produced on the same inflorescence, averaging 20 male flowers to each female flower, ^[10] or 10 male flowers to each female flower . The petiole length ranges from 6.1 - 23.1 mm. The inflorescence can be formed in the leaf axil Plants are mono ecious and also presents hermaphroditic flowers occasionally.

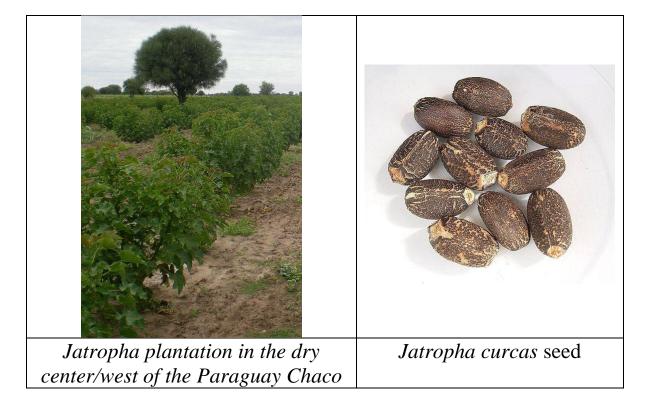
Fruits : fruits are produced in winter, or there may be several crops during the year if soil moisture is good and temperatures are sufficiently high. Most fruit production is concentrated from midsummer to late fall with variations in production peaks where some plants have two or three harvests and some produce continuously through the season.

Seeds: the seeds are mature when the capsule changes from green to yellow. The seeds contain around 20 % saturated fatty acids and 80 % unsaturated fatty acids, and they yield 25 % -40 % oil by weight. In addition, the seeds contain other chemical compounds, such as saccharose, raffinose, stachyose, glucose, fructose, galactose,

and protein. The oil is largely made up of oleic and linoleic acids. Furthermore, the plant also contains curcasin, arachidic, linoleic, myristic, oleic, palmitic, and stearic acids and curcin.

Genome: the whole genome was sequenced by *Kazusa DNA Research Institute*, Chiba Japan in October 2010.

3 - Cultivation



Cultivation is uncomplicated. *Jatropha curcas* grows in tropical and subtropical regions. The plant can grow in wastelands and grows on almost any terrain, even on gravelly, sandy and saline soils. It can thrive in poor and stony soils, although new research suggests that the plant's ability to adapt to these poor soils is not as extensive as had been previously stated. Complete germination is achieved within 9 days. Adding manure during the germination has negative effects during that phase, but is favorable if applied after germination is achieved. It can be propagated by cuttings, which yields faster results than multiplication by seeds. The flowers only develop terminally (at the end of a stem), so a good ramification (plants presenting many branches) produces the greatest amount of fruits. The plants are self-compatible . Another productivity factor is the ratio between female and male flowers within an inflorescence, more female flowers mean more fruits.

Jatropha curcas thrives on a mere 250 mm of rain a year, and only during its first two years does it need to be watered in the closing days of the dry season. Ploughing and planting are not needed regularly, as this shrub has a life expectancy of approximately forty years. The use of pesticides is not necessary, due to the pesticidal and fungicidal properties of the plant. It is used in rural Bengal for dhobi itch (a common fungal infection of the skin).

While *Jatropha curcas* starts yielding from 9 - 12 months time, the best yields are obtained only after 2 - 3 years time.

If planted in hedges, the reported productivity of *Jatropha* is from 0.8 kg. to 1.0 kg. of seed per meter of live fence. The seed production is around 3.5 tons / hectare (Seed production ranges from about 0.4 tons per hectare in first year to over 5 tons per hectare after 3 years).

4 - Propagation

Jatropha curcas has limited natural vegetative propagation and is usually propagated by seed. Propagation through seed (sexual propagation) leads to a lot of genetic variability in terms of growth, biomass, seed yield and oil content. Low seed viability and the recalcitrant nature of oil seeds also limit seed propagation. However, clonal techniques can help in overcoming these problems that hinder mass propagation of this tree - borne oilseed species. Vegetative propagation has been achieved by stem cuttings, grafting, budding as well as by air layering techniques . The investigation leads to the recommendation that cuttings should be taken preferably from juvenile plants and treated with 200 micro gram per litre of IBA (rooting hormone) to ensure the highest level of rooting in stem cuttings. These vegetative methods have potential for commercial propagation of these plants.

5 – Processing

Seed extraction is made simple with the use of the Universal Nut Sheller, an appropriate technology designed by the Full Belly Project.

Oil content varies from 28 % to 30 % and 80 % extraction, one hectare of plantation will give 400 to 600 litres of oil if the soil is average.

The oily seeds are processed into oil, which may be used directly ("Straight Vegetable Oil") to fuel combustion engines or may be subjected to transesterification to produce biodiesel. Jatropha oil is not suitable for human consumption, as it induces strong vomiting and diarrhea.

A colourant can also be derived from the seed

6 – Uses

6 – 1 – Biofuel

When jatropha seeds are crushed, the resulting jatropha oil can be processed to produce a high - quality biofuel or biodiesel that can be used in a standard diesel car or further processed into jet fuel, while the residue (press cake) can also be used as biomass feedstock to power electricity plants, used as fertilizer (it contains nitrogen, phosphorus and potassium), or as animal fodder. The cake can also be used as feed in digesters and gasifiers to produce biogas.

There are several forms of biofuel, often manufactured using sedimentation, centrifugation, and filtration. The fats and oils are turned into esters while separating the glycerin. At the end of the process, the glycerin settles and the biofuel floats. The process through which the glycerin is separated from the biodiesel is known as trans esterification. Glycerin is another by - product from Jatropha oil processing that can add value to the crop. Trans esterification is a simple chemical reaction that neutralizes the free fatty acids present in any fatty substances in Jatropha. A chemical exchange takes place between the alkoxy groups of an ester compound by an alcohol. Usually, methanol and ethanol are used for the purpose. The reaction occurs by the presence of a catalyst, usually sodium hydroxide (NaOH) or caustic soda and potassium hydroxide (KOH), which forms fatty esters (e.g., methyl or ethyl esters), commonly known as biodiesel. It takes approximately 10 % of methyl alcohol by weight of the fatty substance to start the trans esterification process.

Estimates of *Jatropha* seed yield vary widely, due to a lack of research data, the genetic diversity of the crop, the range of environments in which it is grown, and *Jatropha*'s perennial life cycle. Seed yields under cultivation can range from 1,500 to 2,000 kilograms per hectare, corresponding to extractable oil yields of 540 to 680 liters per hectare *Time* magazine recently cited the potential for as much as 1,600 gallons of diesel fuel per acre per year . The plant may yield more than four times as much fuel per hectare as soybean, and more than ten times that of maize (corn). A hectare of jatropha has been claimed to produce 1,892 litres of fuel . However, as it has not yet been domesticated or improved by plant breeders, yields are variable

Jatropha can also be intercropped with other cash crops such as coffee, sugar, fruits and vegetables.

In 2007 Goldman Sachs cited *Jatropha curcas* as one of the best candidates for future biodiesel production . However, despite its abundance and use as an oil and reclamation plant, none of the *Jatropha* species has been properly domesticated and, as a result, its productivity is variable, and the long-term impact of its large-scale use on soil quality and the environment is unknown.

In 2008 researchers at Daimler Chrysler Research explored the use of jatropha oil for automotive use, concluding that although jatropha oil as fuel "has not yet reached optimal quality, ... it already fulfills the EU norm for biodiesel quality". Archer Daniels Midland Company, Bayer Crop Science and Daimler AG have a joint project to develop jatropha as a biofuel . Three Mercedes cars powered by Jatropha diesel have already put some 30,000 kilometers behind them. The project is supported by Daimler Chrysler and by the German Association for Investment and Development

6 – 1 – 1 - Jet fuel

Aviation fuels may be more widely replaced by biofuels such as jatropha oil than fuels for other forms of transportation. There are fewer planes than cars or trucks and far fewer jet fueling stations to convert than gas stations.

On December 30, 2008, Air New Zealand flew the first successful test flight from Auckland with a Boeing 747 running one of its four Rolls - Royce engines on a 50:50 blend of jatropha oil and jet A-1 fuel . In the same press release, Air New Zealand announced plans to use the new fuel for 10% of its needs by 2013. At the time of this test, jatropha oil was much cheaper than crude oil, costing an estimated \$ 43 a barrel or about one-third of the June 4, 2008 closing price of \$ 122.30 for a barrel of crude oil.

On January 7, 2009 Continental Airlines successfully completed a test flight from Houston, Texas using a 50 / 50 mixture of algae / jatropha – oil - derived biofuel and Jet A in one of the two CFM56 engines of a Boeing 737 - 800 Next Generation jet. The two-hour test flight could mark another promising step for the airline industry to find cheaper and more environmentally friendly alternatives to fossil fuel.

On April 1, 2011 Inter jet completed the first Mexican aviation biofuels test flight on an Airbus A320. The fuel was a 70:30 traditional jet fuel biojet blend produced from Jatropha oil provided by three Mexican producers, Global Energías Renovables (a wholly owned subsidiary of U.S.-based Global Clean Energy Holdings), Bencafser S.A. and Energy JH S.A. Honeywell's UOP processed the oil into Bio - SPK (Synthetic Paraffinic Kerosene). Global Energías Renovables operates the largest Jatropha farm in the Americas. On October 28, 2011 Air China completed the first successful demonstration flight by a Chinese airline that used jatropha-based biofuel. The mixture was a 50:50 mix of conventional jet fuel blended with jatropha oil from China National Petroleum Corp. The 747-400 powered one of its four engines on the fuel mixture during the 1-hour flight around Beijing airport.

6-1-2 - Carbon dioxide sequestration

According to a 2013 study published by the European Geosciences Union, the jatropha tree may have applications in the absorption of carbon dioxide, whose sequestration is regarded by some as important in combating climate change. This small tree is very resistant to aridity so it can be planted in hot and dry land in soil unsuitable for food production. The plant does need water to grow though, so coastal areas where desalinated seawater can be made available are ideal.

6 - 1 - 3 - Use in developing world

Currently the oil from *Jatropha curcas* seeds is used for making biodiesel fuel in Philippines, Pakistan and in Brazil, where it grows naturally and in plantations in the southeast, north, and northeast of Brazil. Likewise, jatropha oil is being promoted as an easily grown biofuel crop in hundreds of projects throughout India and other developing countries. Large plantings and nurseries have been under taken in India by many research institutions, and by women's self - help groups who use a system of microcredit to ease poverty among semiliterate Indian women. The railway line between Mumbai and Delhi is planted with *jatropha* and the train itself runs on 15 - 20 % biodiesel . In Africa, cultivation of *jatropha* is being promoted and it is grown successfully in countries such as Mali.^[32] In the Gran Chaco of Paraguay, where a native variety (*Jatropha matacensis*) also grows, studies have shown the suitability of Jatropha cultivation and agro producers are starting to consider planting in the region.

6-1-3-1-Burma

Burma is also actively pursuing the use of jatropha oil. On 15 December 2005, then - head of state, Senior General Than Shwe, said "the States and Divisions concerned are to put 50,000 acres (200 km²) under the physic nut plants [Jatropha] each within three years totalling 700,000 acres (2,800 km²) during the period". On the occasion of Burma's Peasant Day 2006, Than Shwe described in his a message that "For energy sector which is an essential role in transforming industrial agriculture system, the Government is encouraging for cultivation of physic nut plants nationwide and the technical know how that can refine physic nuts to biodiesel has also identified." He would like to urge peasants to cultivate physic nut plants on a commercial scale with major aims for emergence of industrial agriculture system, for fulfilling rural electricity supply and energy needs, for supporting rural areas development and import substitute economy.

In 2006, the chief research officer at state - run Myanma Oil and Gas Enterprise said Burma hoped to completely replace the country's oil imports of 40,000 barrels a day with home - brewed, jatrophaderived biofuel. Other government officials declared Burma would soon start exporting jatropha oil. Despite the military's efforts, the jatropha campaign apparently has largely flopped in its goal of making Burma self-sufficient in fuel.

Z.G.S. Bioenergy has started Jatropha Plantation Projects in Northern Shan State, the company has begun planting Jatropha plants during late June 2007 and will start producing seeds by 2010.

6-1-4 - Controversies

As of 2011 skepticism about the "miracle" properties of *Jatropha* has been voiced. For example: "The idea that jatropha can be grown on marginal land is a red herring", according to Harry Stourton, business development director of UK-based Sun Biofuels, which cultivates *Jatropha* in Mozambique and Tanzania. "It does grow on marginal land, but if you use marginal land you'll get marginal yields," he said.

An August 2010 article warned about the actual utility and potential dangers of reliance on *Jatropha* in Kenya. Major concerns included its invasiveness, which could disrupt local biodiversity, as well as damage to water catchment areas.

Jatropha curcas is lauded as being sustainable, and that its production would not compete with food production, but the jatropha plant needs water like every other crop to grow. This could create competition for water between the jatropha and other edible food crops. In fact, jatropha requires five times more water per unit of energy than sugarcane and corn.

6-2 - Other uses

(The information in this section is largely inspired from the Purdue University - Center for New Crops and Plants Products website.

Leaves

The young leaves may be safely eaten, steamed or stewed. Cooked with goat meat, they are said to advantageously counteract its smell.

Pounded leaves are applied near horses' eyes to repel flies in India. Hydrogen cyanide (HCN) is present in the leaves. The extracts of the plants are dangerous to use but water can easily release it over if not too much extract is applied.

Flowers

The species is listed as a honey plant. Hydrogen cyanide is present.

Nuts

Can be construed for home cooking fuel in briquette form replacing charcoalized timber as in Haiti.

Some times roasted and eaten, although they are purgative.

They can be burned like candlenuts when strung on grass. HCN is present.

Used as a contraceptive in South Sudan.

Seeds

Interest exists in producing animal feed from the bio-waste once the oil is expressed, as in the case with Haiti, where Jatropha curcas grows prolifically and animal feed is in very sort supply.

Similarly, Metsiyen in the Haitian culture dates back as a medicinal crop - thus the name "metsiyen"/"medsiyen". Some suggest it "calms the stomach".

Some mention of Metsiyen being used to ward off evil spirits in past Haitian culture where voodoo has been losing adherents for Christian faith.

Also used as a contraceptive in South Sudan.

The oil has been used for illumination , soap , candles, the adulteration of olive oil , and making Turkey red oil. Turkey red oil, also called sulphonated (or sulfated) castor oil, is the only oil that completely disperses in water. It is made by adding sulfuric acid to pure *Jatropha* oil . It was the first synthetic detergent after ordinary soap, as this allows easy use for making bath oil products. It is used in formulating lubricants, softeners, and dyeing assistants.

The seeds in the zone around Misantla, Veracruz are very appreciated by the population as food once they have been boiled and roasted. It is unclear if this is due to the existence of a non-toxic variety of Jatropha in Mexico and Central America, or if the seeds become edible once processed by cooking.

It is also similarly reported that Jatropha seeds are edible once the embryo has been removed . Again it may be so because of these seeds coming from a local non - toxic variety. HCN is present.

Roots

Their ashes are used as a salt substitute. HCN and rotenone are present.

Bark

Used as a fish poison. HCN is present.

Latex

Strongly inhibits the watermelon mosaic virus.^{[52][dead link]}

Sap

It stains linen. Sometimes used for marking .

Shrub

Mexicans grow the shrub as a host for the lac insect, which is used in medicine as hepa toprotective and anti obesity drug.

Jojoba

Contents

Introduction
 Description
 Etymology
 Cultivation and uses

1 - Introduction

Jojobaⁱ (*Simmondsia chinensis*) is a shrub which is native to the Sonoran and Mojavedeserts of Arizona, California, and Mexico. It's the sole species of the family Simmondsiaceae, placed in the order Caryophyllales. It's also known as goat nut, deer nut, pignut, wild hazel, quinine nut, coffeeberry, and gray box bush. Jojoba is grown commercially for its oil, a liquid wax ester, extracted from the seed. The plant has also been used to combat and prevent desertification in the Thar Desert in India.

Scientific classification				
Kingdom:	Plantae			
(unranked):	Angiosperms			
(unranked):	Eudicots			
(unranked):	Core eudicots			
Order:	Caryophyllales			
Family:	Simmondsiaceae van Tieghem ex Reveal&Hoogland			
Genus:	Simmondsia			
Species:	S. chinensis			
Binomial name				
Simmondsia chinensis (Link) C. K. Schneid.				

2 - Description

Jojoba grows to 1–2 metres tall, with a broad, dense crown. The leaves are opposite, oval in shape , 2 - 4 centimetres long and 1.5 - 3 centimetres broad, thick waxy glaucous gray - green in color. The flowers are small, greenish-yellow, with 5 - 6 sepals and no petals.

Each plant is single - sex, either male or female, with hermaphrodites being extremely rare. The fruit is an acorn-shaped ovoid, three-angled capsule 1–2 centimetres long, partly enclosed at the base by the sepals. The mature seed is a hard oval, dark brown in color and contains an oil (liquid wax) content of approximately 54 %. An average- size bush produces 1 kilogram of pollen, to which few humans are allergic . The female plants produce seed from flowers pollinated by the male plants. Jojoba leaves have an aerodynamic shape, creating a spiral effect, which brings wind-born pollen from the male flower to the female flower. In the Northern Hemisphere, pollination occurs during February and March. In the Southern Hemisphere, pollination occurs during August and September.

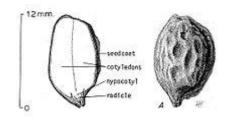
Jojoba foliage provides year-round food opportunity for many animals, including deer, javelina, bighorn sheep, and livestock. The nuts are eaten by squirrels, rabbits, other rodents, and larger birds. Only Bailey's Pocket Mouse, however, is known to be able to digest the wax found inside the jojoba nut.

In large quantities, the seed meal is toxic to many mammals, and the indigestible wax acts as a laxative in humans. The Seri, who utilize nearly every edible plant in their territory, do not regard the beans as real food and in the past ate it only in emergencies.

Despite its scientific name *Simmondsia chinensis*, Jojoba does not originate in China; the botanist Johann Link, originally named the species *Buxus chinensis*, after misreading Nuttall's collection label "Calif" as "China".

It was the Native Americans who discovered the importance and versatility of jojoba. During the early eighteenth century Jesuit missionaries in Baja observed them heating jojoba seeds to soften them. They then used pestle and mortar to create a salve or buttery substance. The latter was applied to the skin and hair to heal and condition. Native Americans also used the salve to soften and preserve animal hides. Pregnant women ate jojoba seeds, believing they assisted during childbirth. Hunters and raiders munched jojoba on the trail to keep hunger at bay.

Jojoba was briefly renamed *Simmondsia californica*, but priority rules require that the original specific epithet be used. The common name should also not be confused with the similar-sounding Jujube (*Ziziphus zizyphus*), an unrelated plant.



Jojoba seed

3 – Etymology

The name "jojoba" originated with the O'odham people of the Sonoran Desert in the southwestern United States, who treated burns with an antioxidant salve made from a paste of the jojoba nut.

4 - Cultivation and uses

Jojoba is grown for the liquid wax (commonly called jojoba oil) in its seeds . This oil is rare in that it's an extremely long (C36 - C46) straight - chain wax ester and not a triglyceride, making jojoba and it's derivative jojoba esters more similar to human sebum and whale oil than to traditional vegetable oils.

Jojoba oil is easily refined to be odorless, colorless and oxidatively stable, and is often used in cosmetics as a moisturizer and as a carrier oil for specialty fragrances. It also has potential use as both a biodieselfuel for cars and trucks, as well as a biodegradable lubricant.

Plantations of jojoba have been established in a number of desert and semi-desert areas, predominantly in Argentina, Australia, Israel, Mexico, the Palestinian Authority, Peru, and the United States. It is currently the Sonoran Desert's second most economically valuable native plant (overshadowed only by the *Washingtonia* palms used in horticulture).

Selective breeding is developing plants that produce more beans with higher wax content, as well as other characteristics that will facilitate harvesting.

Jojoba Ester

Contents

Introduction
 Chemical structure
 Physical properties
 Uses

1 - Introduction

Jojoba esters are the hydrogenation or inter esterification product of Jojoba oil. Jojoba Esters are commonly used in cosmetic formulations as an emollient, due to its remarkable similarity to the natural oils produced by the human skin, and its high oxidative stability. Fully hydrogenated jojoba esters are most often small beads used to exfoliate the skin.

2 - Chemical structure

Jojoba esters are proper waxes; there is no triglyceride component of jojoba esters. Chemically, jojoba esters are a complex mixture of long chain (C 36 - C 46) fatty acids and fatty alcohols joined by an ester bond. Jojoba esters are produced by the inter esterification of jojoba oil, hydrogenated jojoba oil, or a mixture of the two. Pure jojoba oil and pure hydrogenated jojoba oil are also correctly described as jojoba esters. The CTFA does not regard *partially*-hydrogenated jojoba oil as jojoba esters. For this reason, jojoba esters must not contain any trans-unsaturation. Jojoba esters' chemical structure is very similar to that of human sebum and of whale oil.

3 Physical properties

Physically, jojoba esters are an odourless , colourless liquid, white cream, or hard white wax, with melting points ranging from 15°C to 70°C. Their texture and crystallinity may be modified by rapid cooling, thus altering their cosmetic properties. Jojoba esters are very resistant to oxidation, more so than castor oil, coconut oil, macadamia oil, even many fractions of mineral oil.

4 – Uses

Jojoba esters are mainly used as emollients in cosmetics such as lipsticks, shampoos and moisturizing lotions. Jojoba esters may be ethoxylated to form such water-soluble materials as PEG-150 Jojoba, PEG-120 Jojoba or PEG-80 Jojoba. Jojoba esters are excellent botanical substitutes for whale oil and its derivatives, such as cetyl alcohol and spermaceti.

Jojoba Oil

Contents

1 Introduction 2 Appearance

- 3 Physical properties
- 4 Uses

1 - Introduction

Jojoba oil is the liquid wax that is produced in the seed of the simmondsia chinensis (Jojoba) plant, a shrub, which is native to southern Arizona, southern California, and northwestern Mexico. The oil makes up approximately 50 % of the jojoba seed by weight.

2 – Appearance

Unrefined jojoba oil appears as a clear golden liquid at room temperature with a slightly nutty odor. Refined jojoba oil is colorless and odorless. The melting point of jojoba oil is approximately $10^{\circ}C^{[2]}$ and the iodine value is approximately 80. Jojoba oil is relatively shelf-stable when compared with other vegetable oils mainly because it does not contain triglycerides, unlike most other vegetable oils such as grape seed oil and coconut oil. It has an Oxidative Stability Index of approximately 60, which means that it is more shelf-stable than safflower oil, canola oil, almond oil or squalene but less than castor oil and coconut oil.

3 – Physical properties

Physical properties of jojoba oil

freezing point	7- 10.6°C
refractive index	1.4650 at 25°C
specific gravity	0.863 at 25°C
smoke point	195°C
flash point	295°C
iodine number	82
viscosity	48 cSt at 99°C 127 cSt at 37.8°C
viscosity index	190-230

4 - Uses

Jojoba oil is used as a replacement for whale oil and its derivatives, such as cetyl alcohol. The ban on importing whale oil to the US in 1971 led to the discovery that jojoba oil is "in many regards superior to sperm oil for applications in the cosmetics and other industries."

Jojoba oil is found as an additive in many cosmetic products, especially those marketed as being made from natural ingredients. In particular, such products commonly containing jojoba are lotions and moisturizers, hair shampoos and conditioners. Or, the pure oil itself may be used on skin or hair.

Jojoba oil is a fungicide, and can be used for controlling mildew.

Like olestra, jojoba oil is edible but non-caloric and nondigestible, meaning the oil will pass through the intestines unchanged and can cause a stool condition called steatorrhea.

Jojoba biodiesel has been explored as a cheap, sustainable fuel that can serve as a substitute for petroleum diesel.

Ceiba pentandra (Kapok)



Kapok planted in Honolulu, Hawai'i

Contents

1 Introduction

2 Characteristics

3 Uses

3.1 Ethno medical uses

3.2 Kapok seed oil

4 Religion and folklore

5 Symbolism

1 - Introduction

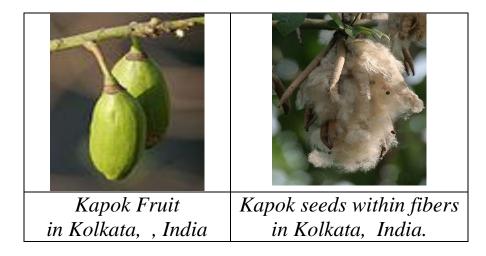
Ceiba pentandra is a tropical tree of the order Malvales and the family Malvaceae (previously separated in the family Bombacaceae), native to Mexico, Central America and the Caribbean, northern South America, and (as the variety *C. pentandra* var. *guineensis*) to tropical west Africa. Kapok is the most used common name for the tree and may also refer to the cotton obtained from its seed pods. The tree is also known as the Java cotton, Java kapok, Silk cotton or ceiba.

Scientific classification			
Kingdom:	Plantae		
(unranked):	Angiosperms		
(unranked):	Eudicots		
(unranked):	Rosids		
Order:	Malvales		
Family:	Malvaceae		
Genus:	Ceiba		
Species:	C. pentandra		
Binomial name			
<i>Ceiba pentandra</i> (L.) Gaertn.			

2 – Characteristics

The tree grows to 60 - 70 m tall and has a very substantial trunk up to 3 m in diameter with buttresses. The trunk and many of the larger branches are often (but not always) crowded with very large, robust simple thorns. The leaves are compound of 5 to 9 leaflets, each up to 20 cm and palm like. Adult trees produce several hundred 15 cm seed pods. The pods contain seeds surrounded by a fluffy, yellowish fiber that is a mix of lignin and cellulose.

3 – Uses



The fiber is light, very buoyant, resilient, resistant to water but it is very flammable. The process of harvesting and separating the fibre is labour - intensive and manual. It is difficult to spin but is used as an alternative to down as filling in mattresses, pillows, upholstery, zafus, and stuffed toys such as teddy bears, and for insulation. It was previously much used in life jackets and similar devices until synthetic materials largely replaced the fiber. The seeds produce an oil used locally in soap and that can be used as fertilizer.

Native tribes along the Amazon River harvest the kapok fibre to wrap around their blowgun darts. The fibers create a seal that allows the pressure to force the dart through the tube.

The commercial tree is most heavily cultivated in the rainforests of Asia, notably in Java (hence its nicknames), Philippines, Malaysia, Hainan Island in China as well as in South America. The flowers are an important source of nectar and pollen for honeybees.

3 – 1 - Ethno medical uses

Ceiba pentandra bark decoction has been used as a diuretic, aphrodisiac, and to treat headache, as well as type II diabetes. It is used as an additive to some versions of the hallucinogenic drink Ayahuasca.

3-2 - Kapok seed oil

A pressed seed oil can be derived from the seeds of the kapok tree. The oil has a yellow colour and a pleasant, mild odour and taste.^[2] It has similar characteristics to cottonseed oil. It becomes rancid quickly when exposed to air. Kapok oil is produced in India, Indonesia and Malaysia. It has an iodine value of 85-100, which makes it a nondrying oil. This means that it does not dry out significantly when exposed to the air . Kapok oil has some potential as a biofuel and in paint preparation.

4 - Religion and folklore

The kapok is a sacred symbol in Maya mythology.

According to the folklore of Trinidad and Tobago, the Castle of the Devil is a huge kapok growing deep in the forest in which Bazil the demon of death was imprisoned by a carpenter. The carpenter tricked the devil into entering the tree in which he carved seven rooms, one above the other, into the trunk. Folklore claims that Bazil still resides in that tree.

5 – Symbolism

C. pentandra is the national emblem of Guatemala,^[3] Puerto Rico, and Equatorial Guinea. It appears on the coat of arms and flag of Equatorial Guinea.

Lallemantia Oil

1 - Introduction

Lallemantia oil is a seed oil, extracted from the seeds of the *Lallemantia iberica*. It contains 68 % linolenic acid, making it an unusually rich source, and of potential commercial interest . Lallemantia oil has been discovered at a number of archeological sites in northern Greece, dating from the Bronze Age.^[2] As the plant is not native to this region, the presence of this oil suggests that it was imported from further east.

2 - Uses

Lallemantia oil is a drying oil, and can be used as a substitute for linseed oil in this and other contexts.^[3] The oil is also edible.

Lanolin

Contents

1 Introduction

2 Composition

- 3 Modern developments
- 4 Applications
- 5 Production

1 - Introduction

Lanolin (German , from Latin *lāna*, "wool", and *oleum*, "oil birth"), also called wool wax or wool grease, is a yellow waxy substance secreted by the sebaceous glands of wool - bearing animals. Most lanolin used by humans comes from domestic sheep breeds that are raised specifically for their wool. Lanolin is a wax. Historically, many pharmacopoeias have referred to lanolin as wool fat (*adeps lanae*); however, as lanolin lacks glycerides (glycerol esters), it is not a true fat . Lanolin primarily consists of sterol esters instead.^[3] Lanolin's waterproofing property aids sheep in shedding water from their coats. Certain breeds of sheep produce large amounts of lanolin, and the extraction can be performed by squeezing the sheep's harvested wool between rollers. Most or all of the lanolin is removed from wool when it is processed into textiles, such as yarn or felt.

Lanolin's role in nature is to protect wool and skin against the ravages of climate and the environment; it also seems to play a role in skin (integumental) hygiene . Lanolin and its many derivatives are used extensively in products designed for the protection, treatment and beautification of human skin .

2 – Composition

A typical high purity grade of lanolin is composed predominantly of long chain waxy esters (*circa* 97 % by weight) the remainder being lanolin alcohols, lanolin acids and lanolin hydrocarbons.

An estimated 8,000 to 20,000 different types of lanolin esters are present in lanolin, resulting from combinations between the 200 or

so different lanolin acids and the 100 or so different lanolin alcohols identified so far.

Lanolin's complex composition of long chain esters, hydroxy esters, diesters, lanolin alcohols, and lanolin acids means in addition to it being a valuable product in its own right, it is also the starting point for the production of a whole spectrum of lanolin derivatives, which possess wide - ranging chemical and physical properties. The main derivatisation routes include hydrolysis, fractional solvent crystallization, esterification, hydrogenation, and alkoxylation and quaternisation . Lanolin derivatives obtained from these processes are used widely in both high-value cosmetics and skin treatment products.

Hydrolysis of lanolin yields lanolin alcohols and lanolin acids. Lanolin alcohols are a rich source of cholesterol (an important skin lipid) and are powerful water-in-oil emulsifiers; they have been used extensively in skin care products for over 100 years.^[1] Interestingly, approximately 40 % of the acids derived from lanolin are alpha hydroxy acids (AHAs). The use of AHAs in skin care products has attracted a great deal of attention in recent years. Details of the AHA's isolated from lanolin can be seen in the table below.

Type of lanolic acid	Carbon chain length	Number identified
Alpha hydroxy normal	C13 – C24	12
Alpha hydroxy iso	C13 – C23	6
Alpha hydroxy anteiso	C12 - C24	7

3 - Modern developments

In addition to general purity requirements, lanolin must meet official requirements for the permissible levels of pesticide residues. The Fifth Supplement of the United States Pharmacopoeia XXII published in 1992 was the first to specify limits for 34 named pesticides. A total limit of 40 ppm (or mg/kg) total pesticides was stipulated for lanolin of general use, with no individual limit greater than 10 ppm.

A second monograph also introduced into the US Pharmacopoeia XXII in 1992 was entitled 'Modified Lanolin.' Lanolin conforming to this monograph is intended for use in more exacting applications, for example on open wounds. In this monograph, the limit of total pesticides was reduced to 3 ppm total pesticides, with no individual limit greater than 1 ppm.

In 2000, the European Pharmacopoeia introduced pesticide residue limits into its lanolin monograph. This requirement, which is generally regarded as the new quality standard, extends the list of pesticides to 40 and imposes even lower concentration limits.

Some very high purity grades of lanolin surpass monograph requirements. New products obtained using complex purification techniques produce lanolin esters in their natural state, removing oxidative and environmental impurities resulting in white, odourless, hypoallergenic lanolin. These ultra-high purity grades of lanolin are ideally suited to the treatment of dermatological disorders such as eczema and on open wounds.

Lanolin attracted attention owing to a misunderstanding concerning its sensitizing potential . A study carried out at New York University Hospital in the early 1950s had shown about 1% of patients with dermatological disorders were allergic to the lanolin being used at that time. However, this figure was misinterpreted and taken out of context and became quoted as 1 % of the general healthy (American) population. By estimate. this simple one misunderstanding of failing to differentiate between the general healthy population and patients with dermatological disorders exaggerates the sensitizing potential of lanolin by 5,000–6,000 times.

The European Cosmetics Directive, introduced in July 1976, contained a stipulation that cosmetics which contained lanolin should be labelled to that effect. This ruling was challenged immediately, and in the early 1980s, it was overturned and removed from the directive. Despite only being in force for a short period of time, this ruling did harm both to the lanolin industry and to the reputation of lanolin in general . The Cosmetics Directive ruling only applied to the presence

of lanolin in cosmetic products; it did not apply to the many hundreds of its different uses in dermatological products designed for the treatment of compromised skin conditions.

Modern analytical methods have revealed lanolin possesses a number of important chemical and physical similarities to human stratum corundum lipids; the lipids which help regulate the rate of trans epidermal water loss and govern the hydration state of the skin.

Cryogenic scanning electron microscopy has shown that lanolin, like human stratum corneum lipids, consists of a mass of liquid crystalline material. Cross - polarized light microscopy has shown the multi lamellar vesicles formed by lanolin are identical to those formed by human stratum corneum lipids. The incorporation of bound water into the stratum corneum involves the formation of multi lamellar vesicles.

Skin bioengineering studies have shown the durational effect of the emollient (skin smoothing) action produced by lanolin is very significant and lasts for many hours. Lanolin applied to the skin at $2 \text{ mg} / \text{ cm}^2$ has been shown to reduce roughness by about 35 % after one hour and 50 % after two hours, with the overall effect lasting for considerably more than eight hours. Lanolin is also known to form semi occlusive (breathable) films on the skin . When applied daily at around 4 mg / cm² for five consecutive days, the positive moisturising effects of lanolin were detectable until 72 hours after final application. Lanolin may achieve some of its moisturizing effects by forming a secondary moisture reservoir within the skin.

The barrier repair properties of lanolin have been reported to be superior to those produced by both petrolatum and glycerin.^[1] In a small clinical study conducted on volunteer subjects with terribly dry (xerotic) hands, lanolin was shown to be superior to petrolatum in reducing the signs and symptoms of dryness and scaling, cracks and abrasions, and pain and itch. In another study, a high purity grade of lanolin was found to be significantly superior to petrolatum in assisting the healing of superficial wounds.

4 – **Applications**

Lanolin and its many derivatives are used extensively in both the personal care (e.g., high value cosmetics, facial cosmetics, lip products) and health care sectors. It is frequently used in protective baby skin treatment and as a treatment for sore nipples in breastfeeding mothers.

Lanolin is used commercially in many industrial products ranging from rust - proof coatings to lubricants. Some sailors use lanolin to create slippery surfaces on their propellers and stern gear to which barnacles cannot adhere. The water - repellent properties make it valuable as a lubricant grease where corrosion would otherwise be a problem.

Lanolin is often used as a raw material for producing cholecalciferol using irradiation. (vitamin D_3).

Baseball players often use it to soften and break in their baseball gloves (shaving cream with lanolin is popularly used for this).

Anhydrous lanolin is also used as a lubricant for brass instrument tuning slides.

Lanolin can also be restored to woolen garments to make them water and dirt repellent, such as for cloth diaper covers.

A flaxseed oil - based lubricant commonly known as "wool wax" used to polish wood furniture is unrelated to lanolin; its name comes from its being a paste wax applied using steel wool.

Lanolin is also used in lip balm products such as Carmex. For some people, it can irritate the lips

Lanolin is used with alcohol mixed at 110 F temp 2 / 98 % ratio for brass lubricant in ammunition reloading process.

5 – Production

Crude lanolin constitutes about 5-25 % of the weight of freshly shorn wool. The wool from one Merino sheep will produce about 250 – 300 ml of recoverable wool grease. Lanolin is extracted by washing the wool in hot water with a special wool scouring detergent to remove dirt, wool grease (crude lanolin), suint (sweat salts), and anything else stuck to the wool. The wool grease is continuously removed during this washing process by centrifugal separators, which concentrate it into a wax-like substance melting at approximately $38^{\circ}C$.

Lard

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 Lard production
 Chemistry of lard
 History and cultural use
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1 - Introduction

Lard is pig fat in both its rendered and unrendered forms. Lard was commonly used in many cuisines as a cooking fat or shortening, or as a spread similar to butter. Its use in contemporary cuisine has diminished; however, many contemporary cooks and bakers favor it over other fats for select uses. The culinary qualities of lard vary somewhat depending on the part of the pig from which the fat was taken and how the lard was processed.

2 - Lard production

Lard can be obtained from any part of the pig as long as there is a high concentration of fatty tissue. The highest grade of lard, known as leaf lard, is obtained from the "flare" visceral fat deposit surrounding the kidneys and inside the loin. Leaf lard has little pork flavor, making it ideal for use in baked goods, where it is valued for its ability to produce flaky, moist pie crusts. The next highest grade of lard is obtained from fatback, the hard subcutaneous fat between the back skin and muscle of the pig. The lowest grade (for purposes of rendering into lard) is obtained from the soft caul fat surrounding digestive organs, such as small intestines, though caul fat is often used directly as a wrapping for roasting lean meats or in the manufacture of pâtés.

Lard may be rendered by either of two processes: wet or dry. In wet rendering, pig fat is boiled in water or steamed at a high temperature and the lard, which is insoluble in water, is skimmed off the surface of the mixture, or it is separated in an industrial centrifuge. In dry rendering, the fat is exposed to high heat in a pan or oven without the presence of water (a process similar to frying bacon). The two processes yield somewhat differing products. Wet-rendered lard has a more neutral flavor, a lighter color, and a high smoke point. Dry-rendered lard is somewhat more browned in color and flavor and has lower smoke point . Rendered lard produces an unpleasant smell when mixed with oxygen.

Industrially - produced lard, including much of the lard sold in supermarkets, is rendered from a mixture of high and low quality fat sources from throughout the pig . To improve stability at room temperature, lard is often hydrogenated. Hydrogenated lard sold to consumers typically contains fewer than 0.5g of trans fats per 13g serving . Lard is also often treated with bleaching and deodorizing agents, emulsifiers, and antioxidants, such as BHT . These treatments make lard more consistent and prevent spoilage. (Untreated lard must be refrigerated or frozen to prevent rancidity.).

Consumers seeking a higher - quality source of lard typically seek out artisanal producers of rendered lard, or render it themselves from leaf lard or fatback .

A by - product of dry - rendering lard is deep-fried meat, skin and membrane tissue known as cracklings,

Fat composition			
Saturated fats	38 - 43 % :		
	Palmitic acid : 25 – 28 %		
	Stearic acid : 12 – 14 %		
	Myristic acid : 1 %		
Unsaturated fats	56 - 62%		
Mono unsaturated	47–50%:		

3 - Chemistry of lard

	Oleic acid: 44 – 47 % Palmitoleic acid : 3 %
Poly unsaturated	Linoleic acid : 6 – 10 %
Properties	
Food energy per 100 g	3770 kJ (900 kcal)
Melting point	Back fat: 30 – 40 °C leaf fat : 43 – 48 °C mixed fat : 36–45 °C
Smoke point	121–218 °C
Specific gravity at 20 °C	0.917 - 0.938
Iodine value	45 – 75
Acid value	3.4
Saponification value	190 - 205
Unsaponifiable	0.8 %

Lard is mainly fats, which, in the language of chemistry are known as triglycerides. These triglycerides are composed of three fatty acids and the distribution of fatty acids varies from oil to oil. In general, lard is similar to tallow in its composition.^[17] Pigs that have been fed different diets will have lard with a significantly different fatty acid content and iodine value. Peanut-fed hogs or the acorn-fed pigs raised for Jamón ibérico therefore produce a somewhat different kind of lard compared to pigs raised in North American farms that are fed corn.

4 - History and cultural use

Lard has always been an important cooking and baking staple in cultures where pork is an important dietary item, the fat of pigs often being as valuable a product as their meat.

During the 19th century, lard was used in a similar fashion as butter in North America and many European nations. Lard was also held at the same level of popularity as butter in the early 20th century and was widely used as a substitute for butter during World War II. As a readily available by - product of modern pork production, lard had been cheaper than most vegetable oils, and it was common in many people's diet until the industrial revolution made vegetable oils more common and more affordable. Vegetable shortenings were developed in the early 1900s, which made it possible to use vegetable - based fats in baking and in other uses where solid fats were called for. Negative publicity was generated by the Upton Sinclar novel *The Jungle* which, though fictional, contained images of men falling into rendering vats and being sold as lard.

By the late 20th century, lard had begun to be considered less healthy than vegetable oils (such as olive and sunflower oil) because of its high saturated fatty acid and cholesterol content. However, despite its reputation, lard has less saturated fat, more unsaturated fat, and less cholesterol than an equal amount of butter by weight. Unlike many margarines and vegetable shortenings, un hydrogenated lard contains no trans fat. It has also been regarded as a "poverty food".

Many restaurants in the western nations have eliminated the use of lard in their kitchens because of the religious and health-related dietary restrictions of many of their customers. Many industrial bakers substitute beef tallow for lard in order to compensate for the lack of mouth feel in many baked goods and free their food products from pork-based dietary restrictions (Kashrut and Halal).

However, in the 1990s and early 2000s, the unique culinary properties of lard became widely recognized by chefs and bakers, leading to a partial rehabilitation of this fat among "foodies". This trend has been partially driven by negative publicity about the transfat content of the partially hydrogenated vegetable oils in vegetable shortening. Chef and food writer Rick Bayless is a prominent proponent of the virtues of lard for certain types of cooking.

It is also again becoming popular in the United Kingdom among aficionados of traditional British cuisine. This led to a "lard crisis" in early 2006 in which British demand for lard was not met due to demand by Poland and Hungary (who had recently joined the European Union) for fatty cuts of pork that had served as an important source of lard.

5 - Culinary use

Lard is one of the few edible oils with a relatively high smoke point, attributable to its high saturated fatty acids content. Pure lard is especially useful for cooking since it produces little smoke when heated and has a distinct taste when combined with other foods. Many chefs and bakers deem lard a superior cooking fat over shortening because of lard's range of applications and taste.

Nutritional value per 100 g			
Energy	3,765.6 kJ (900.0 kcal)		
Carbohydrates	0 g		
Fat	100 g		
- saturated	39 g		
- mono unsaturated	45 g		
- poly unsaturated	11 g		
Protein	0 g		
Cholesterol	95 mg		
Zinc	0.1 mg		
Selenium	0.2 mg		

Comparative properties of common cooking fats (per 100g)					
	Total fat	Saturated fat	Monounsaturated fat	Polyunsaturated fat	Smoke point
Sunflower oil	100g	11g (11%)	20g (84g in high oleic variety	69g (4g in high oleic variety)	225 °C
Soybean oil	100g	16g (16%)	23 g	58 g	257 °C
Canola oil	100g	7g (7%)	63 g	28 g	205 °C
Olive oil	100g	14g (14%)	73 g	11g	190 °C
Corn oil	100g	15g (15%)	30 g	55 g	230 °C
Peanut oil	100g	17g (17%)	46g	32 g	225 °C
Rice bran oil	100g	25g (25%)	38 g	37 g	213 °C

Vegetable shortening (hydrogenated)	71g	23g (34%)	8g (11%)	37g (52%)	165 °C
Lard	100g	39g (39%)	45 g	11 g	190 °C
Suet	94g	52g (55%)	32g (34%)	3g (3%)	200°C
Butter	81g	51g (63%)	21g (26%)	3 g (4%)	150 °C
Coconut oil	100g	86g (86%)	6g (6%)	2g (2%)	177 °C

Because of the relatively large fat crystals found in lard, it is extremely effective as a shortening in baking. Pie crusts made with lard tend to be more flaky than those made with butter. Many cooks employ both types of fat in their pastries to combine the shortening properties of lard with the flavor of butter.

Lard was once widely used in the cuisines of Europe, China, and the New World and still plays a significant role in British, Central European, Mexican, and Chinese cuisines. In British cuisine, lard is used as a traditional ingredient in mince pies and Christmas puddings, lardy cake and for frying fish and chips, as well as many other uses.

In Spain, one of the most popular versions of the Andalusian breakfast includes several kinds of *mantecas* differently seasoned, consumed spread over toasted bread. Among other variants, *manteca colorá* (lard with paprika) and *zurrapa de lomo* (lard with pork flakes) are the preferred ones. In Catalan cuisine lard is used to make the dough for the pastry known as coca. In the Balearics particularly, ensaimades dough also contains lard.

Lard consumed as a spread on bread was once very common in Europe and North America, especially those areas where dairy fats and vegetable oils were rare.

As the demand for lard grows in the high end restaurant industry, small farmers have begun to specialize in heritage hog breeds with higher body fat contents than the leaner, modern hog. Breeds such as the Mangalitsa hog of Hungary or Large Black of Great Britain are experiencing an enormous resurgence to the point that breeders are unable to keep up with demand.^[29]

5 – 1 – Lard around the world

Lard generally refers to wet - rendered lard in English, which has a very mild, neutral flavor, as opposed to the more noticeably pork flavored dry rendered lard, which is also referred to as dripping or schmalz. Dripping (or schmalz) sandwiches are still popular in several European countries - in Hungary they're known as zsíroskenyér ("lardy bread") or zsírosdeszka ("lardy plank"), and in Germany pork fat is seasoned to make "Fettbemme". Similar snacks are some times served with beer in Poland, Czech Republic and Slovakia. They are generally topped with onions, served with salt and paprika, and eaten as a side-dish with beer. All of these are commonly translated on menus as "lard" sandwiches, perhaps due to the lack of familiarity of most contemporary English native speakers with dripping. Attempts to use Hungarian zsír or Polish smalec (both meaning "fat/lard") when British recipes calling for lard will reveal the difference between the wet - rendered lard and dripping.^{[33][34]} In Taiwan, Hong Kong, and Macao, as well as in many parts of China, lard was often consumed mixed into cooked rice along with soy sauce to make "lard rice". And in Japan, back loin lard (fat back) is frequently used for ramen 's soup, it create a thick, nutty, slightly sweet and very hearty.

Traditionally, along with peanut oil, lard is extensively used in Asian cooking as a general-purpose cooking oil , esp. in stir - fries and deep - frying

5 - 1 - 1 - In Germany, lard is called *Schweineschmalz* (literally, "rendered fat from swine") and is extremely popular as a spread. It can be served plain, or it can be mixed with seasonings: pork fat can be enhanced with small pieces of pork skin, called *Grieben* (cf. Jewish gribenes) to create *Griebenschmalz*. Other recipes contain small pieces of apple or onion.

Schmalzbrot ("bread with Schmalz") can be found on many menus in Germany, especially in grounded restaurants or brewery pubs. Schmalzbrot is often served as Griebenschmalz on rye bread accompanied with pickled gherkin.

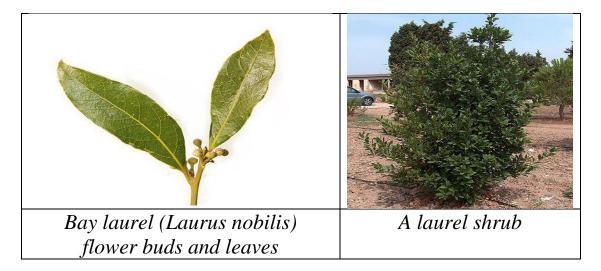
5-1-2 - Poland

In Poland, lard is often served as a starter. It is mixed with fruit, usually chopped apple, and spread on thick slices of bread.

6 - Other uses

Rendered lard can be used to produce biofuel and soap. Lard is also useful as a cutting fluid in machining. Its use in machining has declined since the mid - 20th century as other specially engineered cutting fluids became prominent. However, it is still a viable option.

Laurel Oil (Laurus nobilis)



Contents

- 1 Introduction
- 2 Characteristics
- 3 Ecology
- 4 Chemical constituents
- 5 Food
- 6 Traditional medicine
- 7 Other uses
- 8 Symbolism

1 - Introduction

Laurus nobilis is an aromatic evergreen tree or large shrub with green, glossy leaves, native to the Mediterranean region. It is one of the plants used for bay leaf seasoning in cooking. It is known as bay laurel, sweet bay, bay tree (esp. United Kingdom), true laurel, Grecian laurel,^[1] laurel tree or simply laurel. *Laurus nobilis* figures prominently in classical Greek, Roman, and Biblical culture.

Worldwide, many other kinds of plants in diverse families are also called "bay" or "laurel", generally due to similarity of foliage or aroma to *Laurus nobilis*, and the full name is used for the California bay laurel (*Umbellularia*), also in the family Lauraceae.

Scientific Cl	assification	
Kingdom:	Plantae	
(unranked):	Angiosperms	
(unranked):	Magnoliids	
Order:	Laurales	
Family:	Lauraceae	
Genus:	Laurus	
Species:	L. nobilis	
Binomial name		
Laurus nobilis L.		

2 – Characteristics

The laurel can vary greatly in size and height, sometimes reaching 10 - 18 metres tall. *Laurus* is a genus of evergreen trees belonging to the Laurel family, Lauraceae. The genus includes three species, whose diagnostic key characters often overlap.

The laurel is dioecious (unisexual), with male and female flowers on separate plants . Each flower is pale yellow - green, about 1 cm diameter, and they are borne in pairs beside a leaf. The leaves are 6-12 cm long and 2 - 4 cm broad, with an entire (untoothed) margin. On some leaves the margin undulates . The fruit is a small, shiny black berry - like drupe about 1 cm long^[2] that contains one seed.

A recent study found considerable genetic diversity within *L*. *nobilis*, and that *L*. *azorica* is not genetically or morphologically distinct.

3 – Ecology

Laurus nobilis is a widespread relic of the laurel forests that originally covered much of the Mediterranean Basin when the climate of the region was more humid. With the drying of the Mediterranean during the Pliocene era, the laurel forests gradually retreated, and were replaced by the more drought - tolerant sclerophyll plant communities familiar today. Most of the last remaining laurel forests around the Mediterranean are believed to have disappeared approximately ten thousand years ago, although some remnants still persist in the mountains of southern Turkey, northern Syria, southern Spain, north - central Portugal, northern Morocco, Canary Islands and in Madeira.

4 - Chemical constituents

The most abundant essential oil found in laurel is cineole, also called eucalyptol . The leaves contain about 1.3 % essential oils (*ol. lauri folii*), consisting of 45 % eucalyptol , 12 % other terpenes, 3 - 4 % sesquiterpenes , 3 % methyl eugenol, and other α - and β -pinenes, phellandrene, linalool, geraniol, and terpineol.

Both essential and fatty oils are present in the fruit. The fruit is pressed and water - extracted to obtain these products. The fruit contains up to 30 % fatty oils and about 1 % essential oils (terrene's, sesquiterpenes, alcohols, and ketones).

5 - Food

The plant is the source of several popular herbs and one spice used in a wide variety of recipes, particularly among Mediterranean cuisines . Most commonly, the aromatic leaves are added whole to Italian pasta sauces. However, even when cooked, whole bay leaves can be sharp and abrasive enough to damage internal organs, so they are typically removed from dishes before serving, unless used as a simple garnish . Whole bay leaves have a long shelf life of about one year, under normal temperature and humidity. Bay leaves are used almost exclusively as flavor agents during the food preparation stage;

Ground bay leaves, however, can be ingested safely and are often used in soups and stocks, as well as being a common addition to a Bloody Mary . Dried laurel berries and pressed leaf oil can both be used as robust spices, and even the wood can be burnt for strong smoke flavoring .

6 - Traditional medicine

Aqueous extracts of bay laurel can also be used as astringents and even as a reasonable salve for open wounds.

In massage therapy, the essential oil of bay laurel is reputed to alleviate arthritis and rheumatism, while in aromatherapy, it is used to treat earaches and high blood pressure . A traditional folk remedy for rashes caused by poison ivy, poison oak, and stinging nettle is a poultice soaked in boiled bay leaves.

The chemical compound lauroside B isolated from *Laurus nobilis* is an inhibitor of human melanoma (skin cancer) cell proliferation at high concentrations.

7 - Other uses

Bay is widely cultivated as an ornamental plant in regions with Mediterranean or oceanic climates, and as a house plant or greenhouse plant in colder regions. It is used in topiary to create single erect stems with ball - shaped, box - shaped or twisted crowns; also for low hedges. Together with a gold form, *L. nobilis* 'Aurea', it has gained the Royal Horticultural Society's Award of Garden Merit.

Laurel oil is a main ingredient, and the distinguishing characteristic of Aleppo soap.

8 – Symbolism

Europe

Bay laurel was used to fashion the laurel wreath of ancient Greece, a symbol of highest status. A wreath of bay laurels was given as the prize at the Pythian Games because the games were in honor of Apollo, and the laurel was one of his symbols.

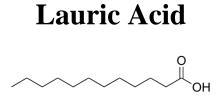
The symbolism carried over to Roman culture, which held the laurel as a symbol of victory.^[12] It is also the source of the words *baccalaureate* and *poet laureate*, as well as the expressions "assume the laurel" and "resting on one's laurels". Ovid tells the story in the *Metamorphoses* that laurel tree was first formed when the nymph

Daphne was changed into a laurel tree because of Apollo's pursuit of her. *Daphne* is the Greek name for the tree.

In the Bible, the laurel is often an emblem of prosperity and fame. In Christian tradition, it symbolizes the resurrection of Christ.

East Asia

An early Chinese etiological myth for the phases of the moon involved a great forest or tree which quickly grew and lost its leaves and flowers every month. After the Sui and Tang dynasties, this was sometimes connected to a woodsman named Wu Gang, sentenced to cut at a self-repairing tree as a punishment for varying offenses. The tree was originally identified as a (gui) and described in the terms of the osmanthus (Osmanthus fragrans, now known in Chinese as the "gui flower"), whose blossoms are still used to flavor wine and confections for the Mid-Autumn Festival. However, in English, it is often associated with the more well-known cassia (Cinnamomum cassia, now known in Chinese as the "meat gui") while, in modern Chinese, it has instead become associated with the Mediterranean laurel. By the Qing dynasty, the *chengyu* "pluck osmanthus in the Toad Palace" (Chángong zhé guì) meant passing the imperial examinations, which were held around the time of the lunar festival. The similar association in Europe of laurels with victory and success led to its translation into Chinese as the "Moon gui".



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1 Introduction

2 Occurrence

3 Properties

3.1 Niche uses

3.2 Potential medicinal properties

1 - Introduction

Lauric acid (systematically: dodecanoic acid), the saturated fatty acid with a 12 - carbon atom chain, thus falling into the medium chain fatty acids, is a white, powdery solid with a faint odor of bay oil or soap.

IUPAC name : dodecanoic acid	
Other names : <i>n</i> -Dodecanoic acid; Dodecylic acid; Dodecoic acid;	
Lauro stearic acid; Vulvic acid; 1-Undecane carboxylic Duodecylic acid; C12:0 (Lipid numbers)	
Molecular formula	$C_{12}H_{24}O_2$
Molar mass	200
Appearance	white powder
Odor	slight odor of bay oil
Density	$0.880 \text{ g} / \text{cm}^3$

Melting point	43.2 °C	
Boiling point	298.9 °C	
Solubility in water	0.006 g / 100 mL (20 °C)	
Refractive index $(n_{\rm D})$	1.423	
Viscosity	7.30 mPa·s at 323 K	
Flash point	≥ 110 °C	

2 – Occurrence

Lauric acid, as a component of triglycerides, comprises about half of the fatty acid content in coconut oil, laurel oil, and in palm kernel oil (not to be confused with palm oil), Otherwise it is relatively uncommon. It is also found in human breast milk (6.2 % of total fat), cow's milk (2.9 %), and goat's milk (3.1 %).

3 – Properties

Like many other fatty acids, lauric acid is inexpensive, has a long shelf-life, and is non - toxic and safe to handle. It is mainly used for the production of soaps and cosmetics. For these purposes, lauric acid is neutralized with sodium hydroxide to give sodium laurate, which is a soap. Most commonly, sodium laurate is obtained by saponification of various oils, such as coconut oil. These precursors give mixtures of sodium laurate and other soaps.

3-1 - Niche uses

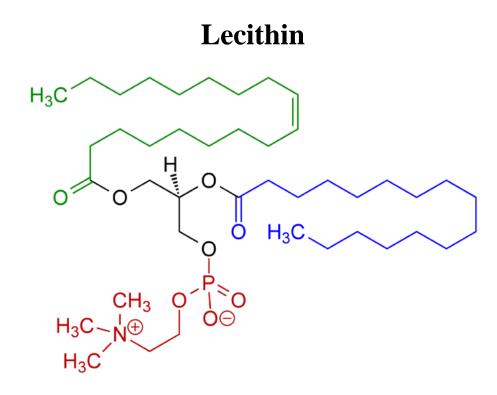
In the laboratory, lauric acid is often used to investigate the molar mass of an unknown substance via the freezing-point depression. Lauric acid is convenient because its melting point when pure is relatively high ($43.2 \ ^\circ$ C). Its cryoscopic constant is 3.9 K·kg/mol. By melting lauric acid with the unknown substance, allowing it to cool, and recording the temperature at which the mixture freezes, the molar mass of the unknown compound may be determined.

3 – 2 - Potential medicinal properties

In vitro experiments have suggested that some fatty acids including lauric acid could be a useful component in a treatment for

acne, but no clinical trials have yet been conducted to evaluate this potential benefit in humans.

Lauric acid increases total serum cholesterol the most of any fatty acid. But most of the increase is attributable to an increase in high - density lipoprotein (HDL) (the "good" blood cholesterol). As a result, lauric acid has been characterized as having "a more favorable effect on total : HDL cholesterol than any other fatty acid, either saturated or unsaturated " In general, a lower total/HDL serum cholesterol ratio correlates with a decrease in atherosclerotic risk.^[8] Nonetheless, an extensive meta - analysis on foods affecting the total / LDL serum cholesterol ratio found in 2003 that the net effects of lauric acid on coronary artery disease outcomes remained uncertain.^[9]



An example of a phosphatidylcholine, a type of phospholipid in lecithin. Red - choline and phosphate group; Black - glycerol; Green - unsaturated fatty acid; Blue - saturated fatty acid

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 - 4.4 Possible link to heart disease
- 5 Choline in foods, milligrams
 - 5.1 Religious restrictions

1 Introduction

Lecithin is a generic term to designate any group of yellowbrownish fatty substances occurring in animal and plant tissues composed of phosphoric acid, choline, fatty acids, glycerol, glycolipids, triglycerides, and phospholipids (e.g., phosphatidyl choline, phosphatidyl ethanol amine, and phosphatidylinositol).

Lecithin was first isolated in 1846 by the French chemist and pharmacist Theodore Gobley. In 1850, he named the phosphatidylcholine *léchithine*. Gobley originally isolated lecithin from egg yolk — (*lekithos*) is 'egg yolk' in ancient Greek — and established the complete chemical formula of phosphatidyl choline in 1874 ; in between, he had demonstrated the presence of lecithin in a variety of biological matters, including venous blood, bile, human brain tissue, fish eggs, fish roe, and chicken and sheep brain.

Lecithin can easily be extracted chemically (using hexane, ethanol, acetone, petroleum ether, benzene, etc.) or mechanically. It is usually available from sources such as soybeans, eggs, milk, marine sources, rapeseed, cottonseed, and sunflower. It has low solubility in water, but is an excellent emulsifier. In aqueous solution, its phospholipids can form either liposomes, bilayer sheets, micelles, or lamellar structures, depending on hydration and temperature. This results in a type of surfactant that usually is classified as amphipathic. Lecithin is sold as a food supplement and for medical uses. In cooking, it is sometimes used as an emulsifier and to prevent sticking, for example in nonstick cooking spray.

2 - Biology

Phosphatidyl choline occurs in all cellular organisms, being one of the major components of the phospholipid portion of the cell membrane.

3 - Production

Commercial lecithin, as used by food manufacturers, is a mixture of phospholipids in oil. The lecithin can be obtained by water degumming the extracted oil of seeds. It is a mixture of various phospholipids, and the composition depends on the origin of the lecithin. A major source of lecithin is soybean oil. Because of the EU requirement to declare additions of allergens in foods, in addition to regulations regarding genetically modified crops, a gradual shift to other sources of lecithin (e.g., sunflower oil) is taking place. The main phospholipids in lecithin from soya and sunflower are phosphatidyl choline, phosphatidyl inositol, phosphatidyl ethanol amine, and phosphatidic acid. They often are abbreviated to PC, PI, PE, and PA, respectively. Purified phospholipids are produced by companies commercially.

3-1 - Hydrolyzed lecithin

To modify the performance of lecithin to make it suitable for the product to which it is added, it may be hydrolyzed enzymatically. In hydrolyzed lecithins, a portion of the phospholipids have one fatty acid removed by phospholipase. Such phospholipids are called lysophospho lipids. The most commonly used phospholipase is phospholipase A2, which removes the fatty acid at the C2 position of glycerol. Lecithins may also be modified by a process called fractionation. During this process, lecithin is mixed with an alcohol, usually ethanol. Some phospholipids, such as phosphatidylcholine, have good solubility in ethanol, whereas most other phospholipids do not dissolve well in ethanol. The ethanol is separated from the lecithin sludge, after which the ethanol is removed by evaporation to obtain a phosphatidyl choline - enriched lecithin fraction..

3-2 - Genetically modified crops as a source of lecithin

As described above, lecithin is highly processed. Therefore, genetically modified (GM) protein or DNA from the original GM crop from which it is derived often is undetectable – in other words, it is not substantially different from lecithin derived from non-GM crops.^[4] Nonetheless, consumer concerns about genetically modified food have extended to highly purified derivatives from GM food, such as lecithin . This concern led to policy and regulatory changes in Europe in 2000, when Regulation (EC) 50/2000 was passed which required labelling of food containing additives derived from GMOs, including lecithin. Because it is nearly impossible to detect the origin of derivatives such as lecithin in Europe to use a meticulous system of identity preservation (IP).

4 - Properties and applications

Lecithin has emulsification and lubricant properties, and is a surfactant. It can be totally metabolized (see Inositol) by humans, so is well tolerated by humans and nontoxic when ingested; some other emulsifiers can only be excreted via the kidneys.

Soybean - derived Lecithin dietary supplements are composed of 19 - 21 % Phosphatidyl choline, 8 - 20 % Phosphatidyl ethanol amine , 20 - 21 % Inositol phosphatides , 33 - 35 % Soybean oil , 2 - 5 % Sterols, 5 % Carbohydrates / free , 1 % Moisture, and 5 - 11 % Other phosphatides.

Lecithin is used for applications in human food, animal feed, pharmaceuticals, paints, and other industrial applications.

Applications include :

In the pharmaceutical industry, it acts as a wetting, stabilizing agent and a choline enrichment carrier, helps in emulsifications and encapsulation, and is a good dispersing agent. It can be used in manufacture of intravenous fat infusions and for therapeutic use.

In animal feed, it enriches fat and protein and improves pelletization.

In the paint industry, it forms protective coatings for surfaces with painting and printing ink , has antioxidant properties, helps as a rust inhibitor, is a colour - intensifying agent, catalyst, conditioning aid modifier, and dispersing aid; it is a good stabilizing and suspending agent, emulsifier, and wetting agent, helps in maintaining uniform mixture of several pigments, helps in grinding of metal oxide pigments, is a spreading and mixing aid, prevents hard settling of pigments, eliminates foam in water-based paints, and helps in fast dispersion of latex - based paints.

Lecithin also may be used as a release agent for plastics, an antisludge additive in motor lubricants, an anti gumming agent in

gasoline, and an emulsifier, spreading agent, and antioxidant in textile, rubber, and other industries.

4 – 1 - Food additive

The nontoxicity of lecithin leads to its use with food, as an additive or in food preparation. It is used commercially in foods requiring a natural emulsifier or lubricant.

In confectionery, it reduces viscosity, replaces more expensive ingredients, controls sugar crystallization and the flow properties of chocolate, helps in the homogeneous mixing of ingredients, improves shelf life for some products, and can be used as a coating. In emulsions and fat spreads, it stabilizes emulsions, reduces spattering during frying, improves texture of spreads and flavour release. In doughs and bakery, it reduces fat and egg requirements, helps even distribution of ingredients in dough, stabilizes fermentation, increases volume, protects yeast cells in dough when frozen, and acts as a releasing agent to prevent sticking and simplify cleaning. It improves wetting properties of hydrophilic powders (e.g., low-fat proteins) and lipophilic powders (e.g., cocoa powder), controls dust, and helps complete dispersion in water.^[9] Lecithin keeps cocoa and cocoa butter in a candy bar from separating. It can be used as a component of cooking sprays to prevent sticking and as a releasing agent. In margarines, especially those containing high levels of fat (> 75 %), lecithin is added as an 'anti spattering' agent for shallow frying.

Lecithin is approved by the United States Food and Drug Administration for human consumption with the status "generally recognized as safe". Lecithin is admitted by the EU as a food additive, designated as E322. Research studies show soy-derived lecithin has significant effects on lowering serum cholesterol and triglycerides, while increasing HDL ("good cholesterol") levels in the blood of rats.

4 – 2 - Dietary supplement

Because it contains phosphatidyl cholines, lecithin is a source of choline, an essential nutrient . Clinical studies have shown benefit in acne, in improving liver function, and in lowering cholesterol, but clinical studies in dementia and dyskinesias have found no benefit. Later studies did not find a benefit for cholesterol.

La Leche League recommends its use to prevent blocked or plugged milk ducts which can lead to mastitis in breastfeeding women.

4 – 3 - Compatibility with special diets

Egg - derived lecithin is not usually a concern for those allergic to eggs since commercially available egg lecithin is highly purified and devoid of allergy - causing egg proteins. Egg lecithin is not a concern for those on low - cholesterol diets, because the lecithin found in eggs markedly inhibits the absorption of the cholesterol contained in eggs.

4 – 4 - Possible link to heart disease

A growing body of evidence indicates lecithin is converted by gut bacteria into tri methyl amine -N - oxide (TMAO), which is released into circulation, and may with time contribute to atherosclerosis and heart attacks.

5 – Choline in foods, milligrams

32 g sunflower lecithin syrup 544
5 oz raw beef liver 473
1 egg 112.65
1 cup firm tofu 71
4 oz shrimp 91.74
1 cup collard greens 60.42
2 cups brown rice 36
1 cup Swiss chard 50.23
1 cup raw cauliflower 47.40
4 oz chicken 96.73
4 oz beef, grass fed, 73.82
3.2 oz wt sardine 68.04
1 cup raw peas 40.91
1 cup raw broccoli 17.02

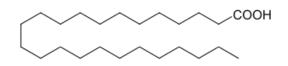
The adequate intake (AI) of choline is 425 mg per day for adult women, and higher for pregnant and breastfeeding women. The AI for adult men is 550 mg/day. AIs for children and teens are also given.

5-**1** - Religious restrictions

Soy - derived lecithin is considered by some to be *kitniyot* and prohibited on Passover for Ashkenazi Jews when many grain-based foods are forbidden, but not at other times. This does not necessarily affect Sephardi Jews, who do not have the same restrictions on rice and *kitniyot* during *Pesach*/Passover.

Muslims are not forbidden to eat lecithin *per se*; however, since it may be derived from animal as well as plant sources, care must be taken to ensure this source is halal. Lecithin derived from plants and egg yolks is permissible, as is that derived from animals slaughtered according to the rules of *dhabihah*.

Lignoceric Acid



IUPAC name : Tetracosanoic acid		
Other names : C24 :0 (Lipid numbers)		
Molecular formula	$C_{24}H_{48}O_2$	
Molar mass	368 g / mol	
Melting point	84.2 °C	

Lignoceric acid, or tetracosanoic acid, is the saturated fatty acid with formula $C_{23}H_{47}COOH$. It is found in wood tar, various cerebrosides, and in small amounts in most natural fats. The fatty acids of peanut oil contain small amounts of lignoceric acid (1.1% - 2.2%). This fatty acid is also a byproduct of lignin production.

Reduction of lignoceric acid yields lignoceryl alcohol.

Linoleic Acid

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1 Introduction

2 In physiology

2.1 Metabolism and eicosanoids

3 Uses

3.1 Industrial uses

3.2 Use in research

5 Dietary sources

1 - Introduction

Linoleic acid (LA) is an unsaturated omega-6 fatty acid. It is a colorless liquid at room temperature. In physiological literature, it has a lipid number of 18:2 cis, cis-9,12. Chemically, linoleic acid is a carboxylic acid with an 18-carbon chain and two *cis* double bonds; the first double bond is located at the sixth carbon from the methyl end.

Linoleic acid belongs to one of the two families of essential fatty acids. The body cannot synthesize linoleic acid from other food components.

The word "linoleic" comes from the Greek word *linon* (flax). *Oleic* means "of, relating to, or derived from oil of olive" or "of or relating to oleic acid" because saturating the omega-6 double bond produces oleic acid.

Some medical research suggests that excessive levels of certain omega - 6 fatty acids relative to certain omega-3 fatty acids, but likely in conjunction with exogenous toxins, may have negative health effects.

IUPAC name : (9Z,12Z)-9,12- Octa deca dienoic acid		
Other names : C18:2 (Lipid numbers)		
Molecular formula	$C_{18}H_{32}O_2$	
Molar mass	280 g mol ^{-1}	
Appearance	Colorless oil	
Density	$0.9 \text{ g} / \text{cm}^3$	
Melting point	− 5 °C	
Boiling point	230 °C at 21 mbar	
Solubility in water	0.139 mg / L	
Flash point	112 °C	

2 - In physiology

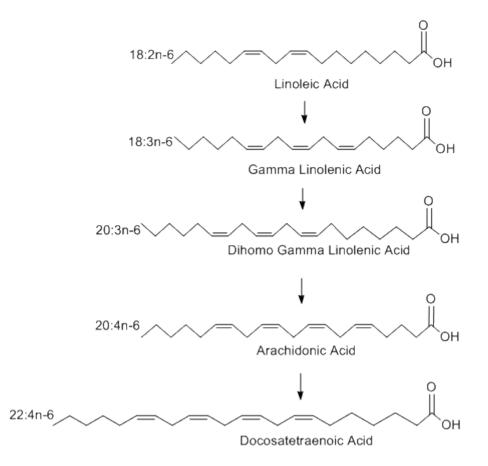
LA is a poly unsaturated fatty acid used in the biosynthesis of arachidonic acid (AA) and thus some prostaglandins. It is found in the lipids of cell membranes. It is abundant in many vegetable oils, comprising over half (by weight) of poppy seed, safflower, sunflower, and corn oils.

Linoleic acid is an essential fatty acid that must be consumed for proper health. A diet only deficient in linoleate causes mild skin scaling, hair loss,^[6] and poor wound healing in rats. However, achieving a deficiency in linoleic acid is nearly impossible consuming any normal diet and is thus not considered to be of clinical concern.

Along with oleic acid, linoleic acid is released by cockroaches upon death which has the effect of preventing other roaches from entering the area. This is similar to the mechanism found in ants and bees, in which oleic acid is released upon death.

2-1 - Metabolism and eicosanoids

The first step in the metabolism of LA is performed by Δ^6 desaturase, which converts LA into gamma-linolenic acid (GLA).



Linoleic Acid Metabolism

There is evidence suggesting that infants lack Δ^6 desaturase of their own, and must acquire it through breast milk. Studies show that breast-milk fed babies have higher concentrations of GLA than formula-fed babies, while formula-fed babies have elevated concentrations of LA.

GLA is converted to dihomo-gamma-linolenic acid (DGLA), which in turn is converted to arachidonic acid (AA). One of the possible fates of AA is to be transformed into a group of metabolites called eicosanoids, a class of paracrine hormones. The three types of eicosanoids are prostaglandins, thromboxanes, and leukotrienes. Eicosanoids produced from AA tend to be inflammatory. For example, both AA - derived thrombaxane and leukotriene_{B4} are proaggretory and vasoconstrictive eicosanoids. The oxidized metabolic products of linoleic acid, such as 9 - hydroxy octa decanoic acid and 13-hydroxy octa decanoic acid, have also been shown to

activate TRPV1, the capsaicin receptor, and through this might play a major role in hyperalgesia and allodynia.

An increased intake of certain omega–3 fatty acids with a decrease in omega-6 fatty acids has been shown to attenuate inflammation due to reduced production of these eicosanoids.

One study monitoring two groups of survivors of myocardial infarction concluded "the concentration of alpha-linolenic acid was increased by 68 %, in the experimental group, and that of linoleic acid reduced by 7 %...the survivors of a first myocardial infarction, assigned to a Mediterranean alpha-linolenic acid rich diet, had a markedly reduced rate of recurrence, other cardiac events and overall mortality."

3 – Uses

3 – 1 - Industrial uses

Linoleic acid is used in making quick - drying oils, which are useful in oil paints and varnishes. These applications exploit the easy reaction of the linoleic acid with oxygen in air, which leads to crosslinking and formation of a stable film.

Reduction of linoleic acid yields linoleyl alcohol. Linoleic acid is a surfactant with a critical micel concentration of 1.5×10^{-4} M @ pH 7.5.

Linoleic acid has become increasingly popular in the beauty products industry because of its beneficial properties on the skin. Research points to linoleic acid's anti - inflammatory, acne reductive, and moisture retentive properties when applied topically on the skin .

3 – 2 - Use in research

Linoleic acid can be used to show the antioxidant effect of natural phenols. Experiments on linoleic acid subjected to 2,2'-azobis (2-amidino propane) dihydro chloride-induced oxidation with different combinations of phenolics show that binary mixtures can lead to either a synergetic antioxidant effect or to an antagonistic effect. Linoleic acid may be linked to obesity by promoting overeating and damaging the arcuate nucleus in the brain's hypothalamus.

4 - Dietary sources

Sources	
Salicornia oil	75 %
Safflower oil	74.6 %
Evening Primrose oil	73 %
Poppy seed oil	70 %
Grape seed oil	69.6 %
Sunflower oil	65.7 %
Hemp oil	60 %
Corn oil	59 %
Wheat germ oil	55 %
Cottonseed oil	54 %
Soybean oil	51 %
Walnut oil	51 %
Sesame oil	45 %
Rice bran oil	39 %
Argan oil	37 %
Pistachio oil	32.7 %
Peanut oil	32 %
Almonds	24 %
Canola oil	21 %
Chicken fat	20 %
Egg yolk	16 %
Linseed oil	15 %
Lard	10 %
Olive oil	15 %
Palm oil	10 %
Cocoa butter	3 %
Macadamia oil	2 %
Butter	2 %
Coconut oil	2 %

600

Linolenic Acid

Linolenic acid is a type of fatty acid.

Linolenic acid can refer to either of two octadecatrienoic acids, or a mixture of the two. Linolenate (in the form of esters of linolenic acid) is often found in vegetable oils; traditionally, such fatty acylates are reported as the fatty acids:

 α -Linolenic acid, an omega - 3 (n - 3) fatty acid

 γ -Linolenic acid, an omega- 6 (n - 6) fatty acid

Chemically, linolenic acids are carboxylic acids with 18-carbon chains and three *cis* double bonds.

Linseed Oil

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1 - Introduction

Linseed oil, is a colourless to yellowish oil obtained from the dried, ripened seeds of the flax plant (*Linum usitatissimum*, Linaceae). The oil is obtained by pressing, sometimes followed by solvent extraction. Boiled linseed oil is heated and treated with chemicals that make it unfit for human consumption. Linseed oil and flaxseed oil are both derived from the same plant, but oils may differ because of the way they are processed. Flax - based oils are sought after as food because of their high levels of α -Linolenic acid (a particular form of omega -3 fatty acid), but it is important that only food - grade oil be used for food.

Linseed oil is a *drying oil*, meaning it can polymerize into a solid form. Due to its polymer-forming properties, linseed oil is used on its own or blended with other oils, resins, and solvents as an impregnator and varnish in wood finishing, as a pigment binder in oil paints, as a plasticizer and hardener in putty, and in the manufacture of linoleum. Linseed oil use has declined over the past several

decades with increased availability of synthetic alkyd resins—which function similarly but resist yellowing.

Linseed oil is an edible oil marketed as a nutritional supplement. In parts of Europe, it is traditionally eaten with potatoes and quark (cheese). It is regarded as a delicacy due to its hearty taste, which enhances the flavour of quark, which is otherwise bland.^[2]

2 - Chemical aspects

Linseed oil is a triglyceride, like other fats. Linseed oil is distinctive in terms of fatty acid constituents of the triglyceride, which contain an unusually large amount of α -linolenic acid, which has a distinctive reaction toward oxygen in air. Specifically, the constituent fatty acids in a typical linseed oil are of the following types :

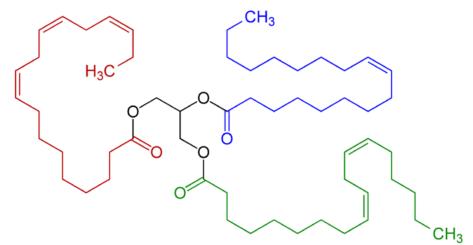
The triply unsaturated α -linolenic acid (51.9 - 55.2 %),

The saturated acids palmitic acid (about 7 %) and stearic acid (3.4 - 4.6 %) ,

The monounsaturated oleic acid (18.5 - 22.6 %), The doubly unsaturated linoleic acid (14.2 - 17 %).

Having a high content of di - and tri unsaturated esters, linseed oil is particularly susceptible to polymerization reactions upon exposure to oxygen in air. This polymerization, which is called *drying*, results in the rigidification of the material. The drying process can be so exothermic as to pose a fire hazard under certain circumstances. To prevent premature drying, linseed oil - based products (oil paints, putty) should be stored in air-tight containers.

Like some other drying oils, linseed oil exhibits fluorescence under UV light after degradation.



Representative triglyceride found in a linseed oil, a triglyceride derived of linoleic acid, alpha-linolenic acid, and oleic acid.

3 – Uses

Most applications of linseed oil exploit its drying properties, i.e., the initial material is liquid or at least pliable and the aged material is rigid but not brittle. The water - repelling (hydrophobic) nature of the resulting hydrocarbon-based material is advantageous.

3 – 1 - Paint binder

Linseed oil is a common carrier used in oil paint. It can also be used as a painting medium, making oil paints more fluid, transparent and glossy. It is available in varieties such as cold pressed, alkali refined, sun bleached, sun thickened, and poly merised (stand oil). The introduction of linseed oil was a significant advance in the technology of oil painting.

3-2-Putty

Traditional glazing putty, consisting of a paste of chalk powder and linseed oil, is a sealant for glass windows that hardens within a few weeks of application and can then be painted over. The utility of putty is owed to the drying properties of linseed oil.

3-3-Wood finish

When used as a wood finish, linseed oil dries slowly and shrinks little upon hardening. Linseed oil does not cover the surface as varnish does, but soaks into the (visible and microscopic) pores, leaving a shiny but not glossy surface that shows off the grain of the wood. A linseed oil finish is easily repaired, but it provides no significant barrier against scratching. Only wax finishes are less protective. Liquid water penetrates a linseed oil finish in mere minutes, and water vapour bypasses it almost completely.^[5] Garden furniture treated with linseed oil may develop mildew. Oiled wood may be yellowish and is likely to darken with age. Because it fills the pores, linseed oil partially protects wood from denting by compression.

Linseed oil is a traditional finish for gun stocks, though very fine finish may require months to obtain. Several coats of linseed oil is the traditional protective coating for the raw willow wood of cricket bats. Linseed oil is also often used by billiards or pool cue-makers for cue shafts, as a lubricant/protectant for wooden recorders, and used in place of epoxy to seal modern wooden surfboards. It is used to coat cricket bats so that the wood retains some moisture. New cricket bats are coated with linseed oil and knocked to perfection so they last longer.

Additionally, a luthier may use linseed oil when reconditioning a guitar, mandolin, or other stringed instrument's fret board; lemonscented mineral oil is commonly used for cleaning, then a light amount of linseed oil (or other drying oil) is applied to protect it from grime that might otherwise result in accelerated deterioration of the wood.

3 - 4 - Gilding

Boiled linseed oil is used as sizing in traditional oil gilding to adhere sheets of gold leaf to a substrate (parchment, canvas, Armenian bole, etc.) It has a much longer working time than waterbased size and gives a firm smooth surface which is adhesive enough in the first 12–24 hours after application to cause the gold to attach firmly to the intended surface.

3 – 5 – Linoleum

Linseed oil is used to bind wood dust, cork particles, and related materials in the manufacture of the floor covering linoleum. After its invention in 1860 by Frederick Walton, linoleum, or "lino" for short, was a common form of domestic and industrial floor covering from the 1870s until the 1970s when it was largely replaced by PVC ('vinyl') floor coverings. However, since the 1990s, linoleum is on the rise again, being considered more environmentally sound than PVC. Linoleum has given its name to the printmaking technique linocut, in which a relief design is cut into the smooth surface and then inked and used to print an image. The results are similar to those obtained by woodcut printing.

3-6-Nutritional supplement and food

Flax seeds contain lignans, a class of phytoestrogens considered to have antioxidant and cancer-preventing properties , although the extracted linseed oil, according to some, does not contain lignans found in flax seed, and allegedly does not have the same antioxidant properties . Some brands of supplement have lignans added during production. Flax seed oil is easily oxidized, and rapidly becomes rancid, with an unpleasant odour, unless refrigerated. Even when kept under cool conditions, it has a shelf life of only a few weeks . Oil with an unpleasant or rancid odor should be discarded. Oxidation of flax seed oil is a major commercial concern, and antioxidants may be added to prevent rancidification . Linseed oil is not generally recommended for use in cooking, yet one study does show that the alpha linolenic acid (ALA) while bound in flaxseed was found to be stable for cooking. When bound to flaxseed ALA can withstand temperatures up to 176 C for two hours.

Food - grade flaxseed oil is cold-pressed, obtained without solvent extraction, in the absence of oxygen, and marketed as edible flaxseed oil. Fresh, refrigerated and unprocessed, linseed oil is used as a nutritional supplement and is a traditional European ethnic food, highly regarded for its hearty taste. It contains the highest level of the omega - 3 fatty acid ALA among vegetable oils . Regular flaxseed oil contains between 52 % and 63 % ALA (C18:3 *n*-3). Plant breeders have developed flaxseed with both higher ALA (70 %) and very low ALA content (< 3 %). The USFDA granted generally recognized as safe (GRAS) status for high alpha linolenic flaxseed oil .

According to the Flax Council of Canada, ALA is required for normal infant development and may be beneficial for reducing inflammation leading to atherosclerosis, and for preventing heart disease and arrhythmia. However, recent well - controlled placebo studies suggest the regular consumption of flaxseed oil may not reduce the risk of stroke, heart disease, or cancer.

Studies have shown a relationship between ALA and an increased risk of prostate cancer. This risk is irrespective of source (e.g., meat, vegetable oil). Alternatively, at least one meta analysis has found a weak protective association between dietary ALA intake and prostate cancer risk.

3-6-1 - Nutrient content

Typical fatty acid content	%	% European
Palmitic acid	6.0	4.0 - 6.0
Stearic acid	2.5	2.0 - 3.0
Arachidic acid	0.5	0 - 0.5
Palmitoleic acid	-	0 - 0.5
Oleic acid	19.0	10.0 - 22.0
Eicosenoic acid	-	0-0.6
Linoleic acid	24.1	12.0 - 18.0
Alpha-linolenic acid	47.4	56.0 - 71.0
Other	0.5	-

Nutrition information from the Flax Council of Canada.

Per 1 tbsp (14 g) Calories : 124 Total fat : 14 g Omega - 3 : 8 g Omega - 6 : 2 g Omega - 9 : 3 g Flax seed oil contains no significant amounts of protein

Flax seed oil contains no significant amounts of protein, carbohydrates or fiber.

3 – 7 - Additional uses

Animal care products

Bicycle maintenance as a thread fixative, rust inhibitor and lubricant

Composition ornament for moulded decoration Earthen floors Animal feeds Industrial lubricant Leather treatment Oilcloth Particle Detectors^[31] Textiles Wood preservation Cookware seasoning

4 - Modified linseed oils 4 - 1 - Stand oil

Stand oil is generated by heating linseed oil near 300 °C for a few days in the complete absence of air. Under these conditions, the polyunsaturated fatty esters convert to conjugated dienes, which then undergo Diels - Alder reactions, leading to crosslinking. The product, which is highly viscous, gives highly uniform coatings that "dry" to more elastic coatings than linseed oil itself. Soybean oil can be treated similarly, but converts more slowly. On the other hand, tung oil converts very quickly, being complete in minutes at 260 °C. Coatings prepared from stand oils are less prone to yellowing than are coatings derived from the parent oils.

4 – 2 - Boiled linseed oil

Boiled linseed oil is used as a paint binder or as a wood finish on its own. Heating the oil causes it to polymerise and oxidise, making it thicker and shortening its drying time. Today, most products labelled as "boiled linseed oil" are a combination of raw linseed oil, petroleum - based solvent, and metallic dryers (catalysts to accelerate drying). The heating of the oil and its poly merisation as well as forming Diels - Alder products and the use of metallic dryers make boiled linseed oil inedible. Some products contain only heattreated linseed oil, without exposure to oxygen. Heat-treated linseed oil is thicker and dries very slowly. This grade of linseed oil is usually labelled as "polymerized" or "stand" oil, though some types may still be labelled as "boiled".

5 - Spontaneous combustion

Rags soaked with linseed oil stored in a pile are considered a fire hazard because they provide a large surface area for oxidation of the oil, and the oil oxidises quickly. The oxidation of linseed oil is an exothermic reaction, which accelerates as the temperature of the rags increases. When heat accumulation exceeds the rate of heat dissipation into the environment, the temperature increases and may eventually become hot enough to make the rags spontaneously combust.

In 1991, One Meridian Plaza, a high rise in Philadelphia, was severely damaged and three firefighters perished in a fire caused by linseed oil-soaked rags. In 2011, a garage in Sacramento also caught fire due to the spontaneous combustion of linseed oil-soaked rags.^[35] In 2014, the Diamond Head home of Hawaii 5-0 actor Alex O'Loughlin was damaged in a similarly started fire.

When the mummy of King Tutankhamen was examined by Howard Carter, he described the mummy as a "charred wreck". After investigation by archeologist Chris Naunton, with the hasty preparations for his burial, after the body was sealed in its tomb, the linseed oil and linen used as part mummification process resulted in spontaneous combustion that charred the body.

List of Edible Fats and Oils

Pork Fats	Lard - Bacon fat - Fatback - Lard	
Beef / Mutton Fats	Dripping - Suet - Tallow	
Dairy Fats	Butter - Clarified butter - Ghee - Niter kibbeh -	
	Smen	
Poultry Fats	Chicken fat - Duck fat - Schmaltz	
Other Animal Fats	Blubber - Muktuk	
Vegetable Fats	Cocoa butter - Margarine - Shea butter -	
	Vegetable shortening	
Fish Oils	Cod liver oil - Shark liver oil	
Vegetable Oils	Mustard oil - Olive oil - Palm oil - palm kernel	
	oil - Peanut oil - Pecan oil - Perilla oil - Pine	
	nut oil - Pistachio oil – Poppy seed oil -	
	Pumpkin seed oil - Rapeseed oil - Rice bran oil	
	- Safflower oil - Sesame oil - Soybean oil -	
	Sunflower oil - Tea seed oil - Walnut oil -	
	Watermelon seed oil	

List of Edible Seeds

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Introduction
 Beans
 Cereals

 3.1 Pseudo cereals
 4 Nuts

 4.1 Nut - like gymnosperm seeds

 5 Other

1 - Introduction

A list of edible seeds here includes seeds that are directly foodstuffs, rather than yielding derived products.

A variety of species can provide edible seeds. Of the six major plant parts, seeds are the most important source of human food. The other five major plant parts are roots, stems, leaves, flowers, and fruits. Most edible seeds are angiosperms, but a few are gymnosperms. The most important seed food source is cereals, followed by legumes, and nuts.

The list is divided into the following categories:

Beans (or Legumes) are protein - rich soft seeds.

Cereals (or grains) are grass - like crops that are harvested for their dry seeds. These seeds are often ground to make flour. Cereals provide almost half of all calories consumed in the world. Botanically, true cereals are members of the Poaceae or Grass family.

Pseudo cereals are cereal crops that are not members of the Poaceae or Grass Family.

Nuts are botanically a specific type of fruit but the term is also applied to many edible seeds that are not botanically nuts. Gymnosperms produce nut-like seeds but neither flowers nor fruits.

2 - Beans

Beans, also known as legumes or pulses include:



Lentils have been part of the human diet since the Neolithic period.

Bambara groundnut Chickpeas Cowpeas Black eyed pea
Dry beans, including
Common bean several species of Vigna, such as the lentil
Fava or broad beans
Hyacinth bean
Lablab
Lentils
Lupins
Moringa oleifera
Peas
Peanuts
Pigeon peas
Sterculia
Velvet beans
Winged beans
Yam beans
Soybeans

Although some beans can be consumed raw, some need to be heated before consumption. In certain cultures, beans that need heating are initially prepared as a seed cake.

Beans that need heating include :

Acacia spp. (e.g. Acacia aneura (mulga), Acacia cowleana, Acacia estrophiolata (ironweed), Acacia ligulata (umbrella bush), Acacia murrayana (tjuntjula), Acacia tetragonophylla (wakalpulka), Acacia kempeana (Witchetty bush), Acacia coriacea (Wiry wattle), Acacia notabilis, Acacia pyrifolia, Acacia tetragonophylla, Acacia victoriae, Acacia sophorae, Acacia stenophylla, Acacia tumida)

Aleurites moluccana

Atriplex nummularia (Old man saltbush)

Panicum spp. (e.g. Panicum australiense, Panicum decompositum, Panicum effusum)

Amaranthus mitchellii

Amaranthus grandiflorus

Brachiaria spp. (e.g. Brachiaria piligeraBrachiaria milliformis)

Brachychiton spp. (e.g. Brachychiton

diversifoliumBrachychiton gregorii, Brachychiton paradoxum, Brachychiton populneum)

Bruguiera rheedii

Calandrinia balonensis

Canarium australianum

Canavalia maritima

Entada phaseolides

Eragrostris spp. (Wangunu) (e.g. Eragrostris eriopoda)

Eucalyptus leptopoda

Eucalyptus microtheca

Astrelba pectinata (Mitchell grass)

Portulaca oleracea

Portulaca intraterranea

Marsilea drummondii (Nardoo)

Nymphae gigantea

Rhyncharrhena linearis

Themeda australis

3 - Cereals



Maize is the single largest source of food calories in the world.

True cereals are the seeds of certain species of grass. Three — maize, wheat and rice — account for about half of the calories consumed by people every year. Grains can be ground to make flour, used as the basis of bread, cake, noodles or other food products. They can also be boiled or steamed, either whole or ground, and eaten as is. Many cereals are present or past staple foods, providing a large fraction of the calories in the places that they are eaten.

Cereals include : Barley Fonio Maize (corn) Pearl Millet Oats Palmer's grass Rice Rye Sorghum Spelt Teff Triticale Wheat Wild rice

3 – 1 - Pseudo cereals



Quinoa is not a grass, but its seeds have been eaten for 6000 years.

Breadnut Buckwheat Cattail Chia Flax Grain amaranth Kañiwa Pitseed Goosefoot Quinoa Wattleseed (also called *acacia seed*)

4 - Nuts



Brazil nuts come from a South American tree

According to the botanical definition, nuts are a particular kind of seed. Chestnuts, hazelnuts, and acorns are examples of nuts, under this definition. In culinary terms, however, the term is used more broadly to include fruits that are not botanically qualified as nuts, but that have a similar appearance and culinary role. Examples of culinary nuts include almonds, coconuts, peanuts and cashews.

Almond Beech Brazil nut Candlenut Cashew Chestnuts, including: **Chinese Chestnut** Sweet Chestnut Coconut Colocynth Cucurbita ficifolia Filbert Gevuina avellana Hickory, including Pecan **Shagbark Hickory** Terminalia catappa Hazelnut Indian Beech Kola nut Macadamia Malabar chestnut Pistacia Mamoncillo Maya nut Mongongo Oak acorns Ogbono nut Paradise nut Pili nut Walnut Black Walnut Water Caltrop

4 – 1 - Nut - like gymnosperm seeds



Pine nuts are Gymnosperm seeds that are edible Cycads Ginkgo Gnetum gnemon Juniper Monkey-puzzle Pine nuts, including Chilgoza Pine Korean Pine Stone Pine Colorado Pinyon Mexican Pinyon Single-leaf Pinyon Podocarps

5 - Other

Cempedak Egusi Euryale ferox (Fox nut) Fluted pumpkin Hemp seed Jackfruit Lotus seed Malabar gourd Pumpkin seed Sunflower seed Sesame seed

List of Essential Oils

Essential oils are volatile and liquid aroma compounds from natural sources, usually plants. Essential oils are not oils in a strict sense, but often share with oils a poor solubility in water. Essential oils often have an odor and are therefore used in food flavoring and perfumery. Essential oils are usually prepared by fragrance extraction techniques such as distillation (including steam distillation), cold pressing, or extraction (maceration). Essential oils are distinguished from aroma oils (essential oils and aroma compounds in an oily solvent), infusions in a vegetable oil, absolutes, and concretes. Typically, essential oils are highly complex mixtures of often hundreds of individual aroma compounds.

Agar oil or oodh, distilled from Agar wood (*Aquilaria malaccensis*). Highly prized for its fragrance.

Ajwain oil, distilled from the leaves of Bishop's weed (*Carum copticum*). Oil contains 35 - 65 % thymol.

Angelica root oil, distilled from the Angelica archangelica.^[3]

Anise oil, from the *Pimpinella anisum*, rich odor of licorice, used medicinally.

Asafoetida, used medicinally and to flavor food.

Balsam oil, from the *Myroxylon pereirae*.

Basil oil is used in making perfumes, as well as in aromatherapy

Bay oil is used in perfumery; Aromatherapeutic for sprains, colds, flu, insomnia, rheumatism.

Bergamot oil, used in aromatherapy and in perfumes.

Black Pepper essential oil is distilled from the berries of *Piper nigrum*. The warm, soothing effect makes it ideal for treating muscle aches, pains and strains.

Buchu oil, made from the buchu shrub. Considered toxic and no longer widely used.^[citation needed] Formerly used medicinally.

Birch is aroma therapeutic for gout, Rheumatism, Eczema, Ulcers.

Camphor is used for cold, cough, fever, rheumatism, and arthritis

Cannabis flower essential oil, used as a flavoring in foods,

primarily candy and beverages. Also used as a scent in perfumes, cosmetics, soaps, and candles.

Caraway oil, used a flavoring in foods. Also used in mouthwashes, toothpastes, etc. as a flavoring agent.^[7]

Cardamom seed oil, used in aromatherapy and other medicinal applications. Extracted from seeds of subspecies of Zingiberaceae (ginger). Also used as a fragrance in soaps, perfumes, etc.^[8]

Carrot seed oil (essential oil), used in aromatherapy.

Cedarwood oil, primarily used in perfumes and fragrances.^[9]

Chamomile oil, There are many varieties of chamomile but only two are used in aromatherapy- Roman and German. Both have similar healing properties but German chamomile contains a higher level of azulin (an anti-inflammatory agent).

Calamus Root, used medicinally

Cinnamon oil, used for flavoring and medicinally.

Cistus species

Citronella oil, from a plant related to lemon grass is used as an insect repellent, as well as medicinally.

Clary Sage

Clove leaf oil, used as a topical anesthetic to relieve dental pain. Coffee, used to flavor food.

Coriander

Costmary oil (bible leaf oil), from the *Tanacetum balsamita* Costus Root, used medicinally

Cranberry seed oil, equally high in omega-3 omega-6 fatty acids, primarily used in the cosmetic industry.

Cubeb, used medicinally and to flavor foods.

Cumin oil/Black seed oil, used as a flavor, particularly in meat products. Also used in veterinary medicine.

Cypress

Cypriol

Curry leaf, used medicinally and to flavor food.

Davana oil, from the *Artemisia pallens*, used as a perfume ingredient and as a germicide.

Dill oil, chemically almost identical to caraway seed oil. High carvone content.

Elecampane, used medicinally.

Eucalyptus oil, historically used as a germicide. Commonly used
in cough medicine, among other medicinal uses.
Fennel seed oil, used medicinally, particularly for treating colic
in infants.
Fenugreek oil, used medicinally and for cosmetics from ancient
times.
Fir
Frankincense oil, used for aromatherapy and in perfumes.
Galangal, used medicinally and to flavor food.
Galbanum
Geranium oil, used medicinally, particularly in aromatherapy,
used for hormonal imbalance, for this reason geranium is often
considered to be "female" oil.
Ginger oil, used medicinally in many cultures.
Goldenrod
Grapefruit oil, extracted from the peel of the fruit. Used in
aromatherapy. Contains 90% limonene. ^[14]
Henna oil, used medicinally. ^[15]
Helichrysum
Hickory nut oil
Horseradish oil
Hyssop
Idaho Tansy
Jasmine oil, used for its flowery fragrance.
Juniper berry oil, used as a flavor. Also used medicinally,
including traditional medicine.
Laurus nobilis
Lavender oil, used primarily as a fragrance. Also used
medicinally.
Ledum
Lemon oil, similar in fragrance to the fruit. Unlike other
essential oils, lemon oil is usually cold pressed. Used medicinally, as
an antiseptic, and in cosmetics.
Lemongrass. Lemongrass is a highy fragrant grass from India.
In India, it is used to help treat fevers and infections. The oil is very
useful for insect repellent.
Lime, anti septic, anti viral, astringent, aperitif, bactericidal,

disinfectant, febrifuge, haemostatic, restorative and tonic.^[18]

Litsea cubeba oil, lemon-like scent, often used in perfumes and aromatherapy.

Mandarin

Marjoram

Melaleuca See Tea tree oil

Melissa oil (Lemon balm), sweet smelling oil used primarily medicinally, particularly in aromatherapy.

Mentha arvensis *oil/Mint oil, used in flavoring toothpastes, mouthwashes and pharmaceuticals, as well as in aromatherapy and other medicinal applications.*

Mountain Savory

Mugwort oil, used in ancient times for medicinal and magical purposes. Currently considered to be a neurotoxin.

Mustard oil (essential oil), containing a high percentage of allyl isothiocyanate or other isothiocyanates, depending on the species of mustard

Myrrh oil, warm, slightly musty smell. Used medicinally. Myrtle

Neem oil or Neem Tree Oil

Neroli is produced from the blossom of the bitter orange tree.

Nutmeg

Orange oil, like lemon oil, cold pressed rather than distilled. Consists of 90 % d - Limonene. Used as a fragrance, in cleaning products and in flavoring foods .

Oregano oil, contains thymol and carvacrol, making it a useful fungicide. Also used to treat digestive problems.

Orris oil is extracted from the roots of the Florentine iris (*Iris florentina*) and used as a flavouring agent, in perfume, and medicinally.

Palo Santo

Parsley oil, used in soaps, detergents, colognes, cosmetics and perfumes, especially men's fragrances.

Patchouli oil, very common ingredient in perfumes.

Perilla essential oil, extracted from the leaves of the perilla plant. Contains about 50 - 60 % peril aldehyde.

Pennyroyal oil, highly toxic. It is abortifacient and can even in

small quantities cause acute liver and lung damage .

Peppermint oil, used in a wide variety of medicinal applications. Petit grain

Pine oil, used as a disinfectant, and in aromatherapy.

Ravensara

Red Cedar

Roman Chamomile

Rose oil, distilled from rose petals, Used primarily as a fragrance.

Rosehip oil, distilled from the seeds of the *Rosa rubiginosa* or *Rosa mosqueta*. Used medicinally.

Rosemary oil, distilled from the flowers of *Rosmarinus officinalis*. Used in aromatherapy, topically to sooth muscles, and medicinal for its antibacterial and antifungal properties.^[26]

Rosewood oil, used primarily for skin care applications. Also used medicinally.

Sage oil, used medicinally.



The spice star anise is distilled to make star anise oil

Sandal wood oil, used primarily as a fragrance, for its pleasant, woody fragrance.

Sassafras oil, from sassafras root bark. Used in aromatherapy, soap-making, perfumes, and the like. Formerly used as a spice, and as the primary flavoring of root beer, *inter alia*.

Savory oil, from Satureja species. Used in aromatherapy, cosmetic and soap - making applications.

Schisandra oil, from Schisandra chinensis, used medicinally.

Spearmint oil, often used in flavoring mouthwash and chewing gum, among other applications.

Spikenard, used medicinally.

Spruce has calming and elevating properties. It can be used as a

topical application for muscular aches and pains, poor circulation, and rheumatism. Spruce Oil has also been used to improve breathing conditions of asthma, bronchitis, coughs, and general weakness.

Star anise oil, highly fragrant oil using in cooking. Also used in perfumery and soaps, has been used in toothpastes, mouthwashes, and skin creams . 90 % of the world's star anise crop is used in the manufacture of Tamiflu, a drug used to treat influenza, and is hoped to be useful for avian flu

Tangerine

Tarragon oil, distilled from Artemisia dracunculus, used medicinally.

Tea tree oil, extracted from Melaleuca alternifolia; promoted for medicinal use, but with limited evidence of effectiveness.

Thyme oil, used medicinally.

Tsuga belongs to the pine tree family. It is used as analgesic, antirheumatic, blood cleanser, and stimulant. It treats cough, respiratory conditions, kidney ailments, urinary infections.^[30]

Turmeric, used medicinally and to flavor food

Valerian is used for insomnia, migraines, nervous dyspepsia, and dandruff.

Vetiver oil (khus oil) a thick, amber oil, primarily from India. Used as a fixative in perfumery, and in aromatherapy

Vetivert

Western red cedar

Wintergreen can be used as an analgesic, anodyne, anti rheumatic & anti arthritic, anti spasmodic, anti septic, aromatic, astringent, carminative, diuretic, emenagogue and stimulant

Yarrow oil is used medicinally, to relieve joint pain

Ylang-ylang is used for calming, antiseptic, and aphrodisiac purposes, as well as hypertension and skin diseases.

Zedoary, used medicinally and to flavor food

List of Macerated Oils

Macerated oils are vegetable oils to which other matter, such as herbs, has been added. Commercially available macerated oils include all these, and others. Herbalists and aromatherapists use not only these pure macerated oils, but blends of these oils, as well, and may macerate virtually any known herb. Base oils commonly used for maceration include almond oil, sunflower oil, and olive oil as well as other food - grade triglyceride vegetable oils, but other oils undoubtedly are used as well.

Arnica, from the flowers or leaves of the *Arnica montana*. Often uses olive oil as a base when used medicinally, or almond oil when used as a massage oil.

Calendula Carrot Chickweed Comfrey Galangal Horse Chestnut Linden blossom Marigold Meadowsweet Mullein Sea weed St. Johns Wort

List of Saturated Fatty Acids

Common Name Propionic acid Butyric acid Valeric acid Caproic acid Enanthic acid Caprylic acid Pelargonic acid Capric acid Undecylic acid Lauric acid Tridecylic acid Myristic acid Pentadecylic acid Palmitic acid Margaric acid Stearic acid Nonadecylic acid Arachidic acid Heneicosylic acid Behenic acid Tricosylic acid Lignoceric acid Pentacosylic acid Cerotic acid Heptacosylic acid Montanic acid Nonacosylic acid Melissic acid

Systematic Name Propanoic acid Butanoic acid Pentanoic acid Hexanoic acid Heptanoic acid Octanoic acid Nonanoic acid Decanoic acid Undecanoic acid Dodecanoic acid Tridecanoic acid Tetradecanoic acid Pentadecanoic acid Hexadecanoic acid Heptadecanoic acid Octadecanoic acid Nonadecanoic acid Eicosanoic acid Heneicosanoic acid Docosanoic acid Tricosanoic acid Tetracosanoic acid Pentacosanoic acid Hexacosanoic acid Heptacosanoic acid Octacosanoic acid Nonacosanoic acid Triacontanoic acid

Structural Formula CH₃CH₂COOH CH₃(CH₂)₂COOH CH₃(CH₂)₃COOH CH₃(CH₂)₄COOH CH₃(CH₂)₅COOH CH₃(CH₂)₆COOH CH₃(CH₂)₇COOH CH₃(CH₂)₈COOH CH₃(CH₂)₉COOH CH₃(CH₂)₁₀COOH CH₃(CH₂)₁₁COOH CH₃(CH₂)₁₂COOH CH₃(CH₂)₁₃COOH CH₃(CH₂)₁₄COOH CH₃(CH₂)₁₅COOH CH₃(CH₂)₁₆COOH CH₃(CH₂)₁₇COOH CH₃(CH₂)₁₈COOH CH₃(CH₂)₁₉COOH CH₃(CH₂)₂₀COOH CH₃(CH₂)₂₁COOH CH₃(CH₂)₂₂COOH CH₃(CH₂)₂₃COOH CH₃(CH₂)₂₄COOH CH₃(CH₂)₂₅COOH CH₃(CH₂)₂₆COOH CH₃(CH₂)₂₇COOH CH₃(CH₂)₂₈COOH

Henatriacontylic acid Henatriacontanoic acid $CH_3(CH_2)_{29}COOH$ Lacceroic acidDotriacontanoic acid $CH_3(CH_2)_{30}COOH$ Psyllic acidTritriacontanoic acid $CH_3(CH_2)_{31}COOH$ Geddic acidTetratriacontanoic acid $CH_3(CH_2)_{32}COOH$ Ceroplastic acidPentatriacontanoic acid $CH_3(CH_2)_{33}COOH$ Hexatriacontylic acid Hexatriacontanoic acid $CH_3(CH_2)_{34}COOH$

List of Vegetable Oils

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1 - Introduction

Vegetable oils are triglycerides extracted from plants. Such oils have been part of human culture for millennia. Edible vegetable oils are used in food, both in cooking and as supplements. Many oils, edible and otherwise, are burned as fuel, such as in oil lamps and as a substitute for petroleum - based fuels. Some of the many other uses include wood finishing, oil painting, and skin care.

There are three principal methods for extracting vegetable oils. The relevant part of the plant may be placed under pressure to extract the oil, giving an expressed oil. Oils may also be extracted from plants by dissolving parts of plants in water or another solvent. The solution may be separated from the plant material and concentrated, giving an extracted or leached oil. The mixture may also be separated by distilling the oil away from the plant material. Oils extracted by this latter method are called essential oils. Essential oils often have different properties and uses than pressed or leached vegetable oils. Macerated oils are made by infusing parts of plants in a base oil, a process called liquid - liquid extraction. The term "vegetable oil" can be narrowly defined as referring only to substances that are liquid at room temperature,^[2] or broadly defined without regard to a substance's state of matter at a given temperature. For this reason, some of the entries on this list do not qualify as vegetable oils according to all understandings of the term.

Although most plants contain some oil, only the oil from certain major oil crops complemented by a few dozen minor oil crops is widely used and traded. These oils are one of several types of plant oils.

Vegetable oils can be classified in several ways, for example:

By source : most, but not all vegetable oils are extracted from the fruits or seeds of plants, and the oils may be classified by grouping oils from similar plants, such as "nut oils".

By use : as described above, oils from plants are used in cooking, for fuel, for cosmetics, for medical purposes, and for other industrial purposes.

The vegetable oils are grouped below in common classes of use.

2 - Edible oils

2-1 - Major oils

These oils make up a significant fraction of worldwide edible oil production. All are also used as fuel oils.

Coconut oil, a cooking oil, with medical and industrial applications as well. Extracted from the kernel or meat of the fruit of the coconut palm. Common in the tropics, and unusual in composition, with medium chain fatty acids dominant.

Corn oil, one of the principal oils sold as salad and cooking oil.

Cottonseed oil, used as a salad and cooking oil, both domestically and industrially.

Olive oil, used in cooking, cosmetics, soaps, and as a fuel for traditional oil lamps.

Palm oil, the most widely produced tropical oil. Popular in West African and Brazilian cuisine. Also used to make biofuel.

Peanut oil (Ground nut oil), a clear oil with some applications as a salad dressing, and, due to its high smoke point, especially used for frying.

Rapeseed oil, including Canola oil, one of the most widely used cooking oils.

Safflower oil, until the 1960s used in the paint industry, now mostly as a cooking oil.

Sesame oil, cold pressed as light cooking oil, hot pressed for a darker and stronger flavor.

Soybean oil, produced as a byproduct of processing soy meal.

Sunflower oil, a common cooking oil, also used to make biodiesel.

2-2 - Nut oils

Nut oils are generally used in cooking, for their flavor. Most are quite costly, because of the difficulty of extracting the oil.

Almond oil, used as an edible oil, but primarily in the manufacture of cosmetics.

Beech nut oil, from *Fagus sylvatica* nuts, is a well-regarded edible oil in Europe, used for salads and cooking.

Cashew oil, somewhat comparable to olive oil. May have value for fighting dental cavities.

Hazelnut oil, mainly used for its flavor. Also used in skin care, because of its slight astringent nature.

Macadamia oil, with a mild nutty flavor and a high smoke point.

Mongongo nut oil (or *manketti oil*), from the seeds of the *Schinziophyton rautanenii*, a tree which grows in South Africa. High in vitamin E. Also used in skin care.

Pecan oil, valued as a food oil, but requiring fresh pecans for good quality oil.

Pine nut oil, sold as a gourmet cooking oil, and of potential medicinal interest as an appetite suppressant.

Pistachio oil, a strongly flavored oil with a distinctive green color.

Walnut oil, used for its flavor, also used by Renaissance painters in oil paints.

2 – 3 - Citrus oils

A number of citrus plants yield pressed oils. Some, such as lemon and orange oil, are used as essential oils, which is uncommon for pressed oils. The seeds of many if not most members of the citrus family yield usable oils.

Grapefruit seed oil, extracted from the seeds of grapefruit (*Citrus* \times *paradisi*). Grapefruit seed oil was extracted experimentally in 1930 and was shown to be suitable for making soap.

Lemon oil, similar in fragrance to the fruit. One of a small number of cold pressed essential oils. Used as a flavoring agent^[37] and in aromatherapy.

Orange oil, like lemon oil, cold pressed rather than distilled.^[39] Consists of 90 % d - Limonene. Used as a fragrance, in cleaning products and in flavoring foods.

2-4 - Oils from melon and gourd seeds

Members of the Cucurbitaceae include gourds, melons, pumpkins, and squashes. Seeds from these plants are noted for their oil content, but little information is available on methods of extracting the oil. In most cases, the plants are grown as food, with dietary use of the oils as a byproduct of using the seeds as food.

Bitter gourd oil, from the seeds of Momordica charantia. High in α - Eleostearic acid. Of current research interest for its potential anti-carcinogenic properties.

Bottle gourd oil, extracted from the seeds of the Lagenaria siceraria, widely grown in tropical regions. Used as an edible oil.

Buffalo gourd oil, from the seeds of the *Cucurbita foetidissima*, a vine with a rank odor, native to southwest North America.

Butternut squash seed oil, from the seeds of Cucurbita moschata, has a nutty flavor that is used for salad dressings, marinades, and sautéeing.

Egusi seed oil, from the seeds of *Cucumeropsis mannii naudin,* is particularly rich in linoleic acid.

Pumpkin seed oil, a specialty cooking oil, produced in Austria, Slovenia and Croatia. Used mostly in salad dressings.

Watermelon seed oil, pressed from the seeds of *Citrullus vulgaris*. Traditionally used in cooking in West Africa.

2-5 - Food supplements

A number of oils are used as food supplements (or "nutraceuticals"), for their nutrient content or purported medicinal effect. Borage seed oil, blackcurrant seed oil, and evening primrose oil all have a significant amount of gamma-Linolenic acid (GLA) (about 23 %, 15 - 20 % and 7 - 10 %, respectively), and it is this that has drawn the interest of researchers.

Açaí oil, from the fruit of several species of the Açaí palm (*Euterpe*) grown in the Amazon region.

Black seed oil, pressed from *Nigella sativa* seeds, has a long history of medicinal use, including in ancient Greek, Asian, and Islamic medicine, as well as a topic of current medical research.

Black currant seed oil, from the seeds of *Ribes nigrum*, used as a food supplement. High in gamma-Linolenic, omega-3 and omega-6 fatty acids.

Borage seed oil, from the seeds of *Borago officinalis*, with an omega - 3 content comparable to blackcurrant seed oil and evening primrose oil.

Evening primrose oil, from the seeds of *Oenothera biennis*,^[56] the most important plant source of gamma - Linolenic acid, particularly because it does not contain alpha - Linolenic acid.

Flaxseed oil (called linseed oil when used as a drying oil), from the seeds of *Linum usitatissimum*. High in omega - 3 and lignans, which can be used medicinally. A good dietary equivalent to fish oil. Easily turns rancid.

2-6 - Other edible oils



Carob seed pods, used to make carob pod oil.

Amaranth oil, from the seeds of grain amaranth species, including *Amaranthus cruentus* and *Amaranthus hypochondriacus*, high in squalene and unsaturated fatty acids.

Apricot oil, similar to almond oil, which it resembles. Used in cosmetics.

Apple seed oil, high in linoleic acid.

Argan oil, from the seeds of the *Argania spinosa*, is a food oil from Morocco developed through a women's cooperative founded in the 1990s, that has also attracted recent attention in Europe.

Avocado oil, an edible oil used primarily in the cosmetics and pharmaceutical industries. Unusually high smoke point of 510°F.

Babassu oil, from the seeds of the *Attalea speciosa*, is similar to, and used as a substitute for, coconut oil.

Ben oil, extracted from the seeds of the *Moringa oleifera*. High in behenic acid. Extremely stable edible oil. Also suitable for biofuel.

Borneo tallow nut oil, extracted from the fruit of species of genus *Shorea*. Used as a substitute for cocoa butter, and to make soap, candles, cosmetics and medicines in places where the tree is common.

Cape chestnut oil, also called yangu oil, is a popular oil in Africa for skin care.

Carob pod oil (Algaroba oil), from carob, with an exceptionally high essential fatty acid content.

Cocoa butter, from the cacao plant, is used in the manufacture of chocolate, as well as in some ointments and cosmetics; sometimes known as theobroma oil

Cocklebur oil, from species of genus *Xanthium*, with similar properties to poppy seed oil, similar in taste and smell to sunflower oil.

Cohune oil, from the *Attalea cohune* (cohune palm) used as a lubricant, for cooking, soapmaking and as a lamp oil.



Coriander seeds are the source of an edible pressed oil, Coriander seed oil.

Coriander seed oil, from coriander seeds, used in a wide variety of flavoring applications, including gin and seasoning blends.^[78] Recent research has shown promise for use in killing food-borne bacteria, such as *E. coli*.

Date seed oil, extracted from date pits . Its low extraction rate and lack of other distinguishing characteristics make it an unlikely candidate for major use.

Dika oil, from *Irvingia gabonensis* seeds, native to West Africa. Used to make margarine, soap and pharmaceuticals, where is it being examined as a tablet lubricant. Largely underdeveloped.

False flax oil made of the seeds of *Camelina sativa*. One of the earliest oil crops, dating back to the 6th millennium B.C. Produced in modern times in Central and Eastern Europe; fell out of production in the 1940s. Considered promising as a food or fuel oil.

Grape seed oil, a cooking and salad oil, also sprayed on raisins to help them retain their flavor.

Hemp oil, a high quality food oil also used to make paints, varnishes, resins and soft soaps.

Kapok seed oil, from the seeds of *Ceiba pentandra*, used as an edible oil, and in soap production.

Kenaf seed oil, from the seeds of *Hibiscus cannabinus*. An edible oil similar to cottonseed oil, with a long history of use.

Lallemantia oil, from the seeds of *Lallemantia iberica*, discovered at archaeological sites in northern Greece.

Mafura oil, extracted from the seeds of *Trichilia emetica*. Used as an edible oil in Ethiopia. Mafura butter, extracted as part of the same process when extracting the oil, is not edible, and is used in soap and candle making, as a body ointment, as fuel, and medicinally.

Marula oil, extracted from the kernel of *Sclerocarya birrea*. Used as an edible oil with a light, nutty flavor. Also used in soaps. Fatty acid composition is similar to that of olive oil.

Meadow foam seed oil, highly stable oil, with over 98% longchain fatty acids. Competes with rapeseed oil for industrial applications.

Mustard oil (pressed), used in India as a cooking oil. Also used as a massage oil.

Nutmeg butter, extracted by expression from the fruit of cogeners of genus *Myristica*. Nutmeg butter has a large amount of trimyristin. Nutmeg oil, by contrast, is an essential oil, extracted by steam distillation.[[]

Okra seed oil, from *Abelmoschus esculentus*. Composed predominantly of oleic and linoleic acids. The greenish yellow edible oil has a pleasant taste and odor.

Papaya seed oil, high in omega-3 and omega-6, similar in composition to olive oil. Not to be confused with papaya oil produced by maceration.

Perilla seed oil, high in omega-3 fatty acids. Used as an edible oil, for medicinal purposes in Asian herbal medicine, in skin care products and as a drying oil.

Persimmon seed oil, extracted from the seeds of *Diospyros virginiana*. Dark, reddish brown color, similar in taste to olive oil. Nearly equal content of oleic and linoleic acids.

Pequi oil, extracted from the seeds of *Caryocar brasiliense*. Used in Brazil as a highly prized cooking oil.

Pili nut oil, extracted from the seeds of *Canarium ovatum*. Used in the Philippines as an edible oil, as well as for a lamp oil.

Pome granate seed oil, from *Punica granatum* seeds, is very high in punicic acid (which takes its name from pomegranates). A topic of current medical research for treating and preventing cancer.

Poppy seed oil, long used for cooking, in paints, varnishes, and soaps.

Prune kernel oil, marketed as a gourmet cooking oil Similar in composition to peach kernel oil.

Quinoa oil, similar in composition and use to corn oil.

Ramtil oil, pressed from the seeds of the one of several species of genus *Guizotia abyssinica* (Niger pea) in India and Ethiopia.

Rice bran oil is a highly stable cooking and salad oil, suitable for high-temperature cooking.^{[67][121]} It also has potential as a biofuel.

Royle oil, pressed from the seeds of *Prinsepia utilis*, a wild, edible oil shrub that grows in the higher Himalayas. Used medicinally in Nepal.



Shea nuts, from which shea butter is pressed

Sacha inchi oil, from the PeruvianAmazon. High in behenic, omega-3 and omega-6 fatty acids.

Sapote oil, used as a cooking oil in Guatemala.

Seje oil, from the seeds of *Jessenia bataua*. Used in South America as an edible oil, similar to olive oil, as well as for soaps and in the cosmetics industry.

Shea butter, much of which is produced by poor, African women. Used primarily in skin care products and as a substitute for cocoa butter in confections and cosmetics.

Taramira oil, from the seeds of the arugula (*Eruca sativa*), grown in West Asia and Northern India. Used as a (pungent) edible oil after aging to remove acridity.

Tea seed oil (Camellia oil), widely used in southern China as a cooking oil. Also used in making soaps, hair oils and a variety of other products.

Thistle oil, pressed from the seeds of *Silybum marianum*.^[134] A good potential source of special fatty acids, carotenoids, tocopherols, phenol compounds and natural anti - oxidants, as well as for generally improving the nutritional value of foods.

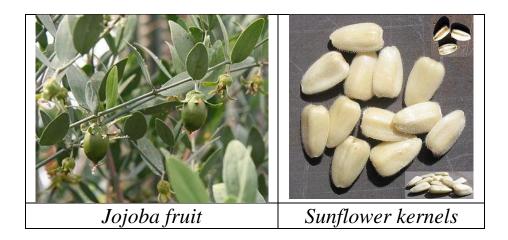
Tigernut oil (or nut - sedge oil) is pressed from the tuber of *Cyperus esculentus*. It has properties similar to soybean, sunflower and rapeseed oils. It is used in cooking and making soap and has potential as a biodiesel fuel.

Tobacco seed oil, from the seeds of *Nicotiana tabacum* and other *Nicotiana* species. If purified, is suitable for edible purposes.

Tomato seed oil is a potentially valuable by- product, as a cooking oil, from the waste seeds generated from processing tomatoes.

Wheat germ oil, used nutritionally and in cosmetic preparations, high in vitamin E and octacosanol.

3 - Oils used for biofuel



A number of oils are used for biofuel (biodiesel and Straight Vegetable Oil) in addition to having other uses. Other oils are used only as biofuel.

Although diesel engines were invented, in part, with vegetable oil in mind , diesel fuel is almost exclusively petroleum-based. Vegetable oils are evaluated for use as a biofuel based on:

Suitability as a fuel, based on flash point, energy content, viscosity, combustion products and other factors

Cost, based in part on yield, effort required to grow and harvest, and post-harvest processing cost

3 – 1 – Multi purpose oils also used as biofuel

The oils listed immediately below are all (primarily) used for other purposes – all but tung oil are edible – but have been considered for use as biofuel.

Castor oil, lower cost than many candidates. Kinematic viscosity may be an issue.

Coconut oil (copra oil), promising for local use in places that produce coconuts.

Colza oil, from *Brassica rapa*, *var. oleifera* (turnip) is closely related to rapeseed (or canola) oil. It is a major source of biodiesel in Germany.

Corn oil, appealing because of the abundance of maize as a crop.

Cottonseed oil, the subject of study for cost-effectiveness as a biodiesel feed stock.

False flax oil, from *Camelina sativa*, used in Europe in oil lamps until the 18th century.

Hemp oil, relatively low in emissions. Production is problematic in some countries because of its association with marijuana.

Mustard oil, shown to be comparable to Canola oil as a biofuel.

Palm oil, very popular for biofuel, but the environmental impact from growing large quantities of oil palms has recently called the use of palm oil into question.

Peanut oil, used in one of the first demonstrations of the Diesel engine in 1900.

Radish oil. Wild radish contains up to 48% oil, making it appealing as a fuel.

Rapeseed oil, the most common base oil used in Europe in biodiesel production.

Ramtil oil, used for lighting in India.

Rice bran oil, appealing because of lower cost than many other vegetable oils. Widely grown in Asia.

Safflower oil, explored recently as a biofuel in Montana.

Salicornia oil, from the seeds of *Salicornia bigelovii*, a halophyte (salt-loving plant) native to Mexico.

Soybean oil, not economical as a fuel crop, but appealing as a byproduct of soybean crops for other uses.

Sunflower oil, suitable as a fuel, but not necessarily cost effective.

Tiger nut oil has been described by researchers in China as having "great potential as a biodiesel fuel."

Tung oil, referenced in several lists of vegetable oils that are suitable for biodiesel. Several factors in China produce biodiesel from tung oil.

3 – 2 - Inedible oils used only or primarily as biofuel

These oils are extracted from plants that are cultivated solely for producing oil - based biofuel . These, plus the major oils described above, have received much more attention as fuel oils than other plant oils.

Copaiba, an oleoresin tapped from species of genus*Copaifera*. Used in Brazil as a cosmetic product and a major source of biodiesel.

Honge oil (Pongamia), pioneered as a biofuel by Udipi Shrinivasa in Bangalore, India.

Jatropha oil, widely used in India as a fuel oil. Has attracted strong proponents for use as a biofuel.

Jojoba oil, from the Simmondsia chinensis, a desert shrub.

Nahor oil, pressed from the kernels of *Mesua ferrea*, is used in India as a lamp oil.

Paradise oil, from the seeds of *Simarouba glauca*, has received interest in India as a feed stock for biodiesel.

Petroleum nut oil, from the Petroleum nut (*Pittosporum resiniferum*) native to the Philippines. The Philippine government once explored the use of the petroleum nut as a biofuel.

4 - Drying oils

Drying oils are vegetable oils that dry to a hard finish at normal room temperature. Such oils are used as the basis of oil paints, and in other paint and wood finishing applications. In addition to the oils listed here, walnut, sunflower and safflower oil are also considered to be drying oils.

Dammar oil, from the *Canarium strictum*, used in paint as an oil drying agent. Can also be used as a lamp oil.

Linseed oil's properties as a polymer make it highly suitable for wood finishing, for use in oil paints, as a plasticizer and hardener in putty and in making linoleum. When used in food or medicinally, linseed oil is called flaxseed oil.

Poppy seed oil, similar in usage to linseed oil but with better color stability.

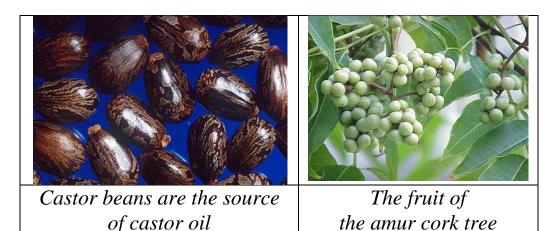
Stillingia oil (also called *Chinese vegetable tallow oil*), obtained by solvent from the seeds of *Sapium sebiferum*. Used as a drying agent in paints and varnishes.

Tung oil, used as an industrial lubricant and highly effective drying agent. Also used as a substitute for linseed oil.

Vernonia oil is produced from the seeds of the *Vernonia galamensis*. It is composed of 73 - 80 % vernolic acid, which can be used to make epoxies for manufacturing adhesives, varnishes and paints, and industrial coatings.

5 - Other oils

A number of pressed vegetable oils are either not edible, or not used as an edible oil.



Amur cork tree fruit oil, pressed from the fruit of the *Phellodendron amurense*. It has been studied for insecticidal use.

Artichoke oil, extracted from the seeds of the artichoke fruit, is an unsaturated semi-drying oil with potential applications in making soap, shampoo, alkyd resin and shoe polish.

Balanos oil, pressed from the seeds of *Balanites aegyptiaca*, was used in ancient Egypt as the base for perfumes.

Bladder pod oil, pressed from the seeds of Lesquerella fendleri, native to North America. Rich in lesquerolic acid, which is chemically similar to the ricinoleic acid found in castor oil. Many industrial uses. Possible substitute for castor oil as it requires much less moisture than castor beans.

Brucea javanica oil, extracted from the seeds of the *Brucea javanica*. The oil has been shown to be effective in treating certain cancers.

Burdock oil (Bur oil) extracted from the root of the burdock. Used as an herbal remedy for scalp conditions.

Candlenut oil (Kukui nut oil), produced in Hawai'i, used primarily for skin care products.

Carrot seed oil (pressed), from carrot seeds, used in skin care products.

Castor oil, with many industrial and medicinal uses. Castor beans are also a source of the toxinricin.

Chaulmoogra oil, from the seeds of *Hydnocarpus wightiana*, used for many centuries, internally and externally, to treat leprosy.^[189] Also used to treat secondary syphilis, rheumatism, scrofula, and in phthisis.

Crambe oil, extracted from the seeds of the *Crambe abyssinica*. High in erucic acid, used as an industrial lubricant, a corrosion inhibitor, and as an ingredient in the manufacture of synthetic rubber.

Croton oil (tiglium oil) is pressed from the seeds of *Croton tiglium*. Highly toxic, it was formerly used as a drastic purgative.

Cuphea oil, from a number of species of genre *Cuphea*. Of interest as sources of medium chain triglycerides.

Honesty oil, from the seeds of *Lunaria annua*, which contain 30 - 40% oil. The oil is particularly rich in long chain fatty acids, including erucic and nervonic acid, making it suitable for certain industrial purposes.

Illipe butter, from the nuts of the *Shorea stenoptera*. Similar to cocoa butter, but with a higher melting point. Used in cosmetics.

Jojoba oil, used in cosmetics as an alternative to whale oil spermaceti.

Mango oil, pressed from the stones of the mango fruit, is high in stearic acid, and can be used for making soap.

Mowrah butter, from the seeds of the *Madhuca latifolia* and *Madhuca longifolia*, both native to India. Crude Mowrah butter is used as a fat for spinning wool, for making candles and soap. The refined fat is used as an edible fat and vegetable ghee in India.

Neem oil, from *Azadirachta indica*, a brownish-green oil with a high sulfur content, used in cosmetics, for medicinal purposes, and as an insecticide.

Ojon oil extracted from the nut of the American palm (*Elaeis oleifera*). Oil extracted from both the nut and husk is also used as an edible oil in Central and South America. Commercialized by a Canadian businessman in the 1990s.

Rose hip seed oil, used primarily in skin care products, particularly for aging or damaged skin.

Rubber seed oil, pressed from the seeds of the Rubber tree (*Hevea brasiliensis*), has received attention as a potential use of what otherwise would be a waste product from making rubber. It has been explored as a drying oil in Nigeria, as a diesel fuel in India^[206] and as food for livestock in Cambodia and Vietnam.

Sea buckthorn oil, derived from Hippophae rhamnoides, produced in northern China, used primarily medicinally.

Sea rocket seed oil, from the halophyteCakile maritima, native to north Africa, is high in erucic acid, and therefore has potential industrial applications.

Snow ball seed oil (Viburnum oil), from *Viburnum opulus* seeds. High in tocopherol, carotenoides and unsaturated fatty acids. Used medicinally. *Tall oil*, produced as a by product of wood pulp manufacture. A further by product called *tall oil fatty acid* (TOFA) is a cheap source of oleic acid.

Tamanu or foraha oil from the *Calophyllum tacamahaca*, is important in Polynesian culture, and, although very expensive,^[212] is used for skin care.

Tonka bean oil (Cumaru oil), popular ingredient in cologne, used medicinally in Brazil.

Ucuhuba seed oil, extracted from the seeds of Virola surinamensis, is unusually high in myristic acid.

Lubricant

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1 - Introduction

A lubricant is a substance introduced to reduce friction between moving surfaces. It may also have the function of transporting foreign particles. The property of reducing friction is known as lubricity. (Slipperiness)

A good lubricant possesses the following characteristics :

High boiling point Low freezing point High viscosity index Thermal stability Hydraulic Stability Demulsibility Corrosion prevention High resistance to oxidation

One of the single largest applications for lubricants, in the form of motor oil, is protecting the internal combustion engines in motor vehicles and powered equipment.

Typically lubricants contain 90 % base oil (most often petroleum fractions, called mineral oils) and less than 10% additives. Vegetable oils or synthetic liquids such as hydrogenated polyolefins, esters, silicones, fluorocarbons and many others are sometimes used as base oils. Additives deliver reduced friction and wear, increased viscosity, improved viscosity index, resistance to corrosion and oxidation, aging or contamination, etc.

Lubricants such as 2 - cycle oil are added to fuels like gasoline which has low lubricity. Sulfur impurities in fuels also provide some lubrication properties, which has to be taken in account when switching to a low - sulfur diesel; biodiesel is a popular diesel fuel additive providing additional lubricity.

Non - liquid lubricants include grease, powders (dry graphite, PTFE, Molybdenum disulfide, tungsten disulfide, etc.), PTFE tape used in plumbing, air cushion and others. Dry lubricants such as graphite, molybdenum disulfide and tungsten disulfide also offer lubrication at temperatures (up to 350 °C) higher than liquid and oilbased lubricants are able to operate. Limited interest has been shown in low friction properties of compacted oxide glaze layers formed at several hundred degrees Celsius in metallic sliding systems, however, practical use is still many years away due to their physically unstable nature.

Another approach to reducing friction and wear is to use bearings such as ball bearings, roller bearings or air bearings, which in turn require internal lubrication themselves, or to use sound, in the case of acoustic lubrication.

In addition to industrial applications, lubricants are used for many other purposes. Other uses include cooking (oils and fats in use in frying pans, in baking to prevent food sticking), bio-medical applications on humans (e.g. lubricants for artificial joints), ultrasound examination, internal examinations for males and females, and the use of personal lubricant for sexual purposes.

2 – Purpose

Lubricants perform the following key functions.

2 – 1 - Keep moving parts apart

Lubricants are typically used to separate moving parts in a system. This has the benefit of reducing friction and surface fatigue, together with reduced heat generation, operating noise and vibrations. Lubricants achieve this by several ways. The most common is by forming a physical barrier i.e., a thin layer of lubricant separates the moving parts. This is analogous to hydroplaning, the loss of friction observed when a car tire is separated from the road surface by moving through standing water. This is termed hydrodynamic lubrication. In cases of high surface pressures or temperatures, the fluid film is much thinner and some of the forces are transmitted between the surfaces through the lubricant.

2 – 2 - Reduce friction

Typically the lubricant – to - surface friction is much less than surface – to - surface friction in a system without any lubrication. Thus use of a lubricant reduces the overall system friction. Reduced friction has the benefit of reducing heat generation and reduced formation of wear particles as well as improved efficiency. Lubricants may contain additives known as friction modifiers that chemically bind to metal surfaces to reduce surface friction even when there is insufficient bulk lubricant present for hydrodynamic lubrication, e.g. protecting the valve train in a car engine at startup.

2 – 3 - Transfer heat

Both gas and liquid lubricants can transfer heat. However, liquid lubricants are much more effective on account of their high specific heat capacity. Typically the liquid lubricant is constantly circulated to and from a cooler part of the system, although lubricants may be used to warm as well as to cool when a regulated temperature is required. This circulating flow also determines the amount of heat that is carried away in any given unit of time. High flow systems can carry away a lot of heat and have the additional benefit of reducing the thermal stress on the lubricant. Thus lower cost liquid lubricants may be used. The primary drawback is that high flows typically require larger sumps and bigger cooling units. A secondary drawback is that a high flow system that relies on the flow rate to protect the lubricant from thermal stress is susceptible to catastrophic failure during sudden system shut downs. An automotive oil-cooled turbocharger is a typical example. Turbochargers get red hot during operation and the oil that is cooling them only survives as its residence time in the system is very short i.e. high flow rate. If the system is shut down suddenly (pulling into a service area after a high speed drive and stopping the engine) the oil that is in the turbo charger immediately oxidizes and will clog the oil ways with deposits. Over time these deposits can completely block the oil ways, reducing the cooling with the result that the turbo charger experiences total failure typically with seized bearings. Non-flowing lubricants such as greases & pastes are not effective at heat transfer although they do contribute by reducing the generation of heat in the first place.

2-4 - Carry away contaminants and debris

Lubricant circulation systems have the benefit of carrying away internally generated debris and external contaminants that get introduced into the system to a filter where they can be removed. Lubricants for machines that regularly generate debris or contaminants such as automotive engines typically contain detergent and dispersant additives to assist in debris and contaminant transport to the filter and removal. Over time the filter will get clogged and require cleaning or replacement, hence the recommendation to change a car's oil filter at the same time as changing the oil. In closed systems such as gear boxes the filter may be supplemented by a magnet to attract any iron fines that get created.

It is apparent that in a circulatory system the oil will only be as clean as the filter can make it, thus it is unfortunate that there are no industry standards by which consumers can readily assess the filtering ability of various automotive filters. Poor filtration significantly reduces the life of the machine (engine) as well as making the system inefficient.

2-5 - Transmit power

Lubricants known as hydraulic fluid are used as the working fluid in hydrostatic power transmission. Hydraulic fluids comprise a large portion of all lubricants produced in the world. The automatic transmission's torque converter is another important application for power transmission with lubricants.

2-6 - Protect against wear

Lubricants prevent wear by keeping the moving parts apart. Lubricants may also contain anti - wear or extreme pressure additives to boost their performance against wear and fatigue.

2 – 7 - Prevent corrosion

Good quality lubricants are typically formulated with additives that form chemical bonds with surfaces, or exclude moisture, to prevent corrosion and rust.

2-8 - Seal for gases

Lubricants will occupy the clearance between moving parts through the capillary force, thus sealing the clearance. This effect can be used to seal pistons and shafts.

3 - Types of lubricants

In 1999, an estimated 37,300,000 tons of lubricants were consumed worldwide . Automotive applications dominate, but other industrial, marine, and metal working applications are also big consumers of lubricants. Although air and other gas-based lubricants are known (e.g., in fluid bearings), liquid and solid lubricants dominate the market, especially the former.

Lubricants are generally composed of a majority of base oil plus a variety of additives to impart desirable characteristics. Although generally lubricants are based on one type of base oil, mixtures of the base oils also are used to meet performance requirements.

3 – 1 - Base oil groups

Mineral oil term is used to encompass lubricating base oil derived from crude oil. The American Petroleum Institute (API) designates several types of lubricant base oil :

Group I – Saturates < 90 % and/or sulfur > 0.03 %, and Society of Automotive Engineers (SAE) viscosity index (VI) of 80 to 120

Manufactured by solvent extraction, solvent or catalytic dewaxing, and hydro - finishing processes. Common Group I base oil are 150SN (solvent neutral), 500SN, and 150BS (brightstock)

Group II – Saturates over 90% and sulfur under 0.03%, and SAE viscosity index of 80 to 120 $\,$

Manufactured by hydrocracking and solvent or catalytic dewaxing processes . Group II base oil has superior anti-oxidation properties since virtually all hydrocarbon molecules are saturated. It has water-white color.

Group III – Saturates > 90%, sulfur <0.03%, and SAE viscosity index over 120 $\,$

Manufactured by special processes such as isohydromerization. Can be manufactured from base oil or slax wax from dewaxing process. Group IV – Poly alpha olefins (PAO)

Group V – All others not included above such as naphthenics, PAG, esters.

The lubricant industry commonly extends this group terminology to include :

Group I+ with a Viscosity Index of 103–108 Group II+ with a Viscosity Index of 113–119 Group III+ with a Viscosity Index of at least 140

Can also be classified into three categories depending on the prevailing compositions:

Paraffinic Naphthenic Aromatic

Lubricants for internal combustion engines contain additives to reduce oxidation and improve lubrication. The main constituent of such lubricant product is called the base oil, base stock. While it is advantageous to have a high-grade base oil in a lubricant, proper selection of the lubricant additives is equally as important. Thus some poorly selected formulation of PAO lubricant may not last as long as more expensive formulation of Group III+ lubricant.

3-2 – Bio lubricants made from vegetable oils and other renewable sources

These are primarily triglyceride esters derived from plants and animals. For lubricant base oil use the vegetable derived materials are preferred. Common ones include high oleic canola oil, castor oil, palm oil, sunflower seed oil and rapeseed oil from vegetable, and Tall oil from tree sources. Many vegetable oils are often hydrolyzed to yield the acids which are subsequently combined selectively to form specialist synthetic esters. Other naturally derived lubricants include lanolin (wool grease, a natural water repellent). Whale oil was a historically important lubricant, with some uses up to the latter part of the 20th century as a friction modifier additive for automatic transmission fluid.

In 2008, the bio lubricant market was around 1 % of UK lubricant sales in a total lubricant market of 840,000 tones / year.

Lanolin is a natural water repellent, derived from sheep wool grease, and is an alternative to the more common petro-chemical based lubricants. This lubricant is also a corrosion inhibitor, protecting against rust, salts, and acids.

Water can also be used on its own, or as a major component in combination with one of the other base oils. Commonly used in engineering processes, such as milling and lathe turning .

3 – 3 - Synthetic oils

Poly alpha - olefin (PAO) Synthetic esters Poly alkylene glycols (PAG) Phosphate esters Alkylated naphthalenes (AN) Silicate esters Ionic fluids

3 – 4 - Solid lubricants

PTFE: poly tetra fluoro ethylene (PTFE) is typically used as a coating layer on, for example, cooking utensils to provide a non-stick surface. Its usable temperature range up to 350 °C and chemical inertness make it a useful additive in special greases. Under extreme pressures, PTFE powder or solids is of little value as it is soft and flows away from the area of contact. Ceramic or metal or alloy lubricants must be used then. "Teflon®" is a brand of PTFE owned by DuPont Co.

Inorganic solids : Graphite, hexagonal boron nitride, molybdenum disulfide and tungsten disulfide are examples of materials that can be used as solid lubricants, often to very high

temperature. The use of some such materials is sometimes restricted by their poor resistance to oxidation (e.g., molybdenum disulfide can only be used up to 350°C in air, but 1100°C in reducing environments).

Metal / alloy: Metal alloys, composites and pure metals can be used as grease additives or the sole constituents of sliding surfaces and bearings. Cadmium and Gold are used for plating surfaces which gives them good corrosion resistance and sliding properties, Lead, Tin, Zinc alloys and various Bronze alloys are used as sliding bearings, or their powder can be used to lubricate sliding surfaces alone, or as additives to

3 – 5 - Aqueous lubrication

Aqueous lubrication is of interest in a number of technological applications. Strongly hydrated brush polymers such as PEG can act as lubricants at liquid solid interfaces. By continuous rapid exchange of bound water with other free water molecules, these polymer films keep the surfaces separated while maintaining a high fluidity at the brush–brush interface at high compressions, thus leading to a very low coefficient of friction.

4 - Other relevant phenomena

4-1 - 'Glaze' formation (high temperature wear)

A further phenomenon that has undergone investigation in relation to high temperature wear prevention and lubrication, is that of a compacted oxide layer glaze formation. This is the generation of a compacted oxide layer which sinters together to form a crystalline 'glaze' (not the amorphous layer seen in pottery) generally at high temperatures, from metallic surfaces sliding against each other (or a metallic surface against a ceramic surface). Due to the elimination of metallic contact and adhesion by the generation of oxide, friction and wear is reduced. Effectively, such a surface is self - lubricating.

As the 'glaze' is already an oxide, it can survive to very high temperatures in air or oxidising environments. However, it is disadvantaged by it being necessary for the base metal (or ceramic) having to undergo some wear first to generate sufficient oxide debris.

5 – Additives

A large number of additives are used to impart performance characteristics to the lubricants. The main families of additives are :

Antioxidants Detergents Anti-wear Metal deactivators Corrosion inhibitors, Rust inhibitors Friction modifiers Extreme Pressure Anti-foaming agents Viscosity index improvers Demulsifying/Emulsifying

Stickiness improver, provide adhesive property towards tool surface (in metal working)

Complexing agent (in case of greases)

Note that many of the basic chemical compounds used as detergents (example: calcium sulfonate) serve the purpose of the first seven items in the list as well. Usually it is not economically or technically feasible to use a single do-it-all additive compound. Oils for hypoid gear lubrication will contain high content of EP additives. Grease lubricants may contain large amount of solid particle friction modifiers, such as graphite, molybdenum sulfide.

6 - Application by fluid types

Automotive Engine oils Petrol (Gasoline) engine oils Diesel engine oils Automatic transmission fluid Gearbox fluids Brake fluids

Hydraulic fluids Tractor (one lubricant for all systems) Universal Tractor Transmission Oil – UTTO Super Tractor Oil Universal – STOU – includes engine Other motors 2-stroke engine oils Sexual Personal lubricant Industrial Hydraulic oils Air compressor oils Food Grade lubricants Gas Compressor oils Gear oils Bearing and circulating system oils Refrigerator compressor oils Steam and gas turbine oils Aviation Gas turbine engine oils Piston engine oils Marine Crosshead cylinder oils Crosshead Crankcase oils Trunk piston engine oils Stern tube lubricants Horological

7 – Marketing

The global lubricant market is generally competitive with numerous manufacturers and marketers. Overall the western market may be considered mature with a flat to declining overall volumes while there is strong growth in the emerging economies. The lubricant marketers generally pursue one or more of the following strategies when pursuing business.

Specification:

The lubricant is said to meet a certain specification. In the consumer market, this is often supported by a logo, symbol or words that inform the consumer that the lubricant marketer has obtained independent verification of conformance to the specification. Examples of these include the API's donut logo or the NSF tick mark. The most widely perceived is SAE viscosity specification, like SAE 10W-40. Lubricity specifications are institute and manufacturer based. In the U.S. institute: API S for petrol engines, API C for diesel engines. For 2007 the current specs are API SM and API CJ-4. Higher second letter marks better oil properties, like lower engine wear supported by tests. In EU the ACEA specifications are used. There are classes A, B, C, E with number following the letter. Japan introduced the JASO specification for motorbike engines. In the industrial market place the specification may take the form of a legal contract to supply a conforming fluid or purchasers may choose to buy on the basis of a manufacturers own published specification.

Original equipment manufacturer (OEM) approval:

Specifications often denote a minimum acceptable performance levels. Thus many equipment manufacturers add on their own particular requirements or tighten the tolerance on a general specification to meet their particular needs (or doing a different set of tests or using different/own test bed engine). This gives the lubricant marketer an avenue to differentiate their product by designing it to meet an OEM specification. Often, the OEM carries out extensive testing and maintains an active list of approved products. This is a powerful marketing tool in the lubricant marketplace. Text on the back of the motor oil label usually has a list of conformity to some OEM specifications, such as MB, MAN, Volvo, Cummins, VW, BMW or others. Manufactures may have vastly different specifications for the range of engines they make; one may not be completely suitable for some other.

Performance:

The lubricant marketer claims benefits for the customer based on the superior performance of the lubricant. Such marketing is supported by glamorous advertising, sponsorships of typically sporting events and endorsements. Unfortunately broad performance claims are common in the consumer marketplace, which are difficult or impossible for a typical consumer to verify. In the B2B market place the marketer is normally expected to show data that supports the claims, hence reducing the use of broad claims. Increasing performance, reducing wear and fuel consumption is also aim of the later API, ACEA and car manufacturer oil specifications, so lubricant marketers can back their claims by doing extensive (and expensive) testing.

Longevity:

The marketer claims that their lubricant maintains its performance over a longer period of time. For example in the consumer market, a typical motor oil change interval is around the 3,000–6,000 miles (4,828–9,656 km). The lubricant marketer may offer a lubricant that lasts for 12,000 miles (19,312 km) or more to convince a user to pay a premium. Typically, the consumer would need to check or balance the longer life and any warranties offered by the lubricant manufacturer with the possible loss of equipment manufacturer warranties by not following its schedule. Many car and engine manufacturers support extended drain intervals, but request extended drain interval certified oil used in that case; and sometimes a special oil filter. Example: In older Mercedes-Benz engines and in truck engines one can use engine oil MB 228.1 for basic drain interval. Engine oils conforming with higher specification MB 228.3 may be used twice as long, oil of MB 228.5 specification 3x longer. Note that the oil drain interval is valid for new engine with fuel conforming car manufacturer specification. When using lower grade fuel, or worn engine the oil change interval has to shorten accordingly. In general oils approved for extended use are of higher specification and reduce wear. In the industrial market place the longevity is generally measured in time units and the lubricant marketer can suffer large financial penalties if their claims are not substantiated.

Efficiency:

The lubricant marketer claims improved equipment efficiency when compared to rival products or technologies, the claim is usually valid when comparing lubricant of higher specification with previous grade. Typically the efficiency is proved by showing a reduction in energy costs to operate the system. Guaranteeing improved efficiency is the goal of some oil test specifications such as API CI-4 Plus for diesel engines. Some car/engine manufacturers also specifically request certain higher efficiency level for lubricants for extended drain intervals.

Operational tolerance:

The lubricant is claimed to cope with specific operational environment needs. Some common environments include dry, wet, cold, hot, fire risk, high load, high or low speed, chemical compatibility, atmospheric compatibility, pressure or vacuum and various combinations. The usual thermal characteristics is outlined with SAE viscosity given for 100°C, like SAE 30, SAE 40. For low temperature viscosity the SAE xxW mark is used. Both markings can be combined together to form a SAE 0W-60 for example. Viscosity index (VI) marks viscosity change with temperature, with higher VI numbers being more temperature stable.

Economy:

The marketer offers a lubricant at a lower cost than rivals either in the same grade or a similar one that will fill the purpose for lesser price. (Stationary installations with short drain intervals.) Alternative may be offering a more expensive lubricant and promise return in lower wear, specific fuel consumption or longer drain intervals. (Expensive machinery, un-affordable downtimes.)

Environment friendly:

The lubricant is said to be environmentally friendly. Typically this is supported by qualifying statements or conformance to generally accepted approvals. Several organizations, typically government sponsored, exist globally to qualify and approve such lubricants by evaluating their potential for environmental harm. Typically, the lubricant manufacturer is allowed to indicate such approval by showing some special mark. Examples include the German "Blue Angel", European "Daisy" Eco label, Global Eco-Label "GEN mark", Nordic, "White Swan", Japanese "Earth friendly mark"; USA "Green Seal", Canadian "Environmental Choice", Chinese "Huan", Singapore "Green Label" and the French "NF Environment mark".

Composition:

The marketer claims novel composition of the lubricant which improves some tangible performance over its rivals. Typically the technology is protected via formal patents or other intellectual property protection mechanism to prevent rivals from copying. Lot of claims in this area are simple marketing buzzwords, since most of them are related to a manufacturer specific process naming (which achieves similar results than other ones) but the competition is prohibited from using a trademark.

Quality:

The marketer claims broad superior quality of its lubricant with no factual evidence. The quality is "proven" by references to famous brand, sporting figure, racing team, some professional endorsement or some similar subjective claim. All motor oil labels wear mark similar to "of outstanding quality" or "quality additives," the actual comparative evidence is always lacking.

8 - Disposal and environmental[

It is estimated that 40 % of all lubricants are released into the environment.

Disposal: Recycling, burning, landfill and discharge into water may achieve disposal of used lubricant. There are typically strict regulations in most countries regarding disposal in landfill and discharge into water as even small amount of lubricant can contaminate a large amount of water. Most regulations permit a threshold level of lubricant that may be present in waste streams and companies spend hundreds of millions of dollars annually in treating their waste waters to get to acceptable levels. Burning the lubricant as fuel, typically to generate electricity, is also governed by regulations mainly on account of the relatively high level of additives present. Burning generates both airborne pollutants and ash rich in toxic materials, mainly heavy metal compounds. Thus lubricant burning takes place in specialized facilities that have incorporated special scrubbers to remove airborne pollutants and have access to landfill sites with permits to handle the toxic ash.

Unfortunately, most lubricant that ends up directly in the environment is due to general public discharging it onto the ground, into drains and directly into landfills as trash. Other direct contamination sources include runoff from roadways, accidental spillages, natural or man-made disasters and pipeline leakages.

Improvement in filtration technologies and processes has now made recycling a viable option (with rising price of base stock and crude oil). Typically various filtration systems remove particulates, additives and oxidation products and recover the base oil. The oil may get refined during the process. This base oil is then treated much the same as virgin base oil however there is considerable reluctance to use recycled oils as they are generally considered inferior. Basestock fractionally vacuum distilled from used lubricants has superior properties to all natural oils, but cost effectiveness depends on many factors. Used lubricant may also be used as refinery feedstock to become part of crude oil. Again there is considerable reluctance to this use as the additives, soot and wear metals will seriously poison/deactivate the critical catalysts in the process. Cost prohibits carrying out both filtration (soot, additives removal) and re-refining (distilling, iso merisation, hydrocrack, etc.) however the primary hindrance to recycling still remains the collection of fluids as refineries need continuous supply in amounts measured in cisterns, rail tanks.

Occasionally, unused lubricant requires disposal. The best course of action in such situations is to return it to the manufacturer where it can be processed as a part of fresh batches. *Environment:* Lubricants both fresh and used can cause considerable damage to the environment mainly due to their high potential of serious water pollution. Further the additives typically contained in lubricant can be toxic to flora and fauna. In used fluids the oxidation products can be toxic as well. Lubricant persistence in the environment largely depends upon the base fluid, however if very toxic additives are used they may negatively affect the persistence. Lanolin lubricants are non - toxic making them the environmental alternative which is safe for both users and the environment.

9 - Societies and industry bodies

American Petroleum Institute (API) Society of Tribologists and Lubrication Engineers (STLE) National Lubricating Grease Institute (NLGI) Society of Automotive Engineers (SAE) Independent Lubricant Manufacturer Association (ILMA) European Automobile Manufacturers Association (ACEA) Japanese Automotive Standards Organization (JASO) Petroleum Packaging Council (PPC)

10 - Major publications

Peer reviewed Tribology Transactions Journal of Synthetic Lubricants Tribology Letters Lubrication Science Trade periodicals Tribology and Lubrication Technology Fuels & Lubes International Oiltrends Lubes n' Greases Compoundings Chemical Market Review Machinery lubrication

Lubrication

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 2 The regimes of lubrication

1 Introduction

Lubrication is the process, or technique employed to reduce wear of one or both surfaces in close proximity, and moving relative to each other, by interposing a substance called lubricant between the surfaces to carry or to help carry the load (pressure generated) between the opposing surfaces. The interposed lubricant film can be a solid, (e.g. graphite, Mo S_2) a solid/liquid dispersion, a liquid, a liquid - liquid dispersion (a grease) or, exceptionally, a gas.

In the most common case the applied load is carried by pressure generated within the fluid due to the frictional viscous resistance to motion of the lubricating fluid between the surfaces.

Lubrication can also describe the phenomenon where such reduction of wear occurs without human intervention (hydroplaning on a road).

The science of friction, lubrication and wear is called tribology.

Adequate lubrication allows smooth continuous operation of equipment, with only mild wear, and without excessive stresses or seizures at bearings. When lubrication breaks down, metal or other components can rub destructively over each other, causing destructive damage, heat, and failure.

2 - The regimes of lubrication

As the load increases on the contacting surfaces three distinct situations can be observed with respect to the mode of lubrication, which are called regimes of lubrication:

Fluid film lubrication is the lubrication regime in which through viscous forces the load is fully supported by the lubricant within the

space or gap between the parts in motion relative to one another (the lubricated conjunction) and solid–solid contact is avoided.

Hydrostatic lubrication is when an external pressure is applied to the lubricant in the bearing, to maintain the fluid lubricant film where it would otherwise be squeezed out.

Hydrodynamic lubrication is where the motion of the contacting surfaces, and the exact design of the bearing is used to pump lubricant around the bearing to maintain the lubricating film. This design of bearing may wear when started, stopped or reversed, as the lubricant film breaks down.

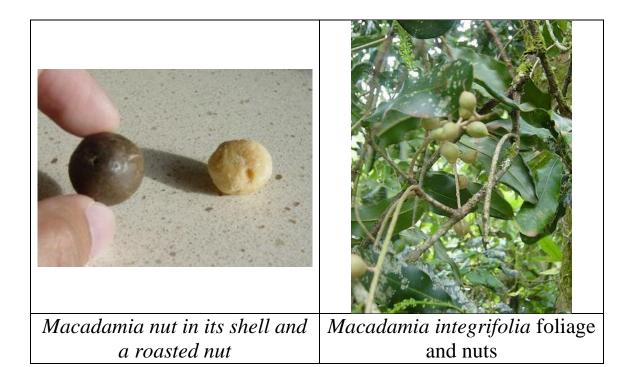
Elasto hydrodynamic lubrication : Mostly for nonconforming surfaces or higher load conditions, the bodies suffer elastic strains at the contact. Such strain creates a load - bearing area, which provides an almost parallel gap for the fluid to flow through. Much as in hydrodynamic lubrication, the motion of the contacting bodies generates a flow induced pressure, which acts as the bearing force over the contact area. In such high pressure regimes, the viscosity of the fluid may rise considerably. At full elastohydrodynamic lubrication the generated lubricant film completely separates the surfaces. Contact between raised solid features, or *asperities*, can occur, leading to a mixed-lubrication or boundary lubrication regime.

Boundary lubrication (also called boundary film lubrication): The bodies come into closer contact at their asperities; the heat developed by the local pressures causes a condition which is called stick-slip and some asperities break off. At the elevated temperature and pressure conditions chemically reactive constituents of the lubricant react with the contact surface forming a highly resistant tenacious layer, or film on the moving solid surfaces (boundary film) which is capable of supporting the load and major wear or breakdown is avoided. Boundary lubrication is also defined as that regime in which the load is carried by the surface asperities rather than by the lubricant. Besides supporting the load the lubricant may have to perform other functions as well, for instance it may cool the contact areas and remove wear products. While carrying out these functions the lubricant is constantly replaced from the contact areas either by the relative movement (hydrodynamics) or by externally induced forces.

Lubrication is required for correct operation of mechanical systems pistons, pumps, cams, bearings, turbines, cutting tools etc. where without lubrication the pressure between the surfaces in close proximity would generate enough heat for rapid surface damage which in a coarsened condition may literally weld the surfaces together, causing seizure.

In some applications, such as piston engines, the film between the piston and the cylinder wall also seals the combustion chamber, preventing combustion gases from escaping into the crankcase.

Macadamia



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10 History

1 - Introduction

Macadamia is a genus of four species of trees constituting part of the plant family Proteaceae , native to north eastern New South Wales and south eastern Queensland, Australia. Previously more species, with disjunct distributions, were named within this genus *Macadamia*. Morphological studies and more recently genetics studies published in 2008 by Austin Mast and colleagues, show they have separated from this genus *Macadamia*, correlating less closely than thought from earlier morphological studies.^[2] The species previously named in this *Macadamia* genus may still be referred to overall by the non-scientific descriptive name of Macadamia, with their disjunct distributions including:

New Caledonia endemic genus Virotia (1975) one species then six species (2008)

North eastern Queensland, Australian endemic genus and species Catalepidia heyana (1995)

North eastern Queensland and Cape York Peninsula, Australia, three species of *Lasjia* (2008); in Australia still informally described as northern Macadamias

Sulawesi, Indonesia, two species of *Lasjia* (2008), *L. hildebrandii* (1952) and *L. erecta* (1995)

They are small to large evergreen trees growing to 2-12 m tall. The leaves are arranged in whorls of three to six, lanceolate to obovate or elliptical in shape, 6 - 30 cm long and 2-13 cm broad, with an entire or spiny - serrated margin. The flowers are produced in a long, slender, simple raceme 5 - 30 cm long, the individual flowers 10-15 mm long, white to pink or purple, with four tepals. The fruit is a very hard, woody, globose follicle with a pointed apex, containing one or two seeds.

The genus is named after John Macadam, a colleague of botanist Ferdinand von Mueller, who first described the genus. Common names include macadamia, macadamia nut, Queensland nut, bush nut, maroochi nut, queen of nuts and bauple nut; Indigenous Australian names include *gyndl*, *jindilli*, and *boombera*.

Scientific classification		
Plantae		
Angiosperms		
Eudicots		
Proteales		
Proteaceae		
<i>Macadamia</i> F.Muell.		
egrifolia Isenii nifolia raphylla		

2 – Species

Macadamia integrifolia Macadamia jansenii Macadamia ternifolia Macadamia tetraphylla

2 – 1 - Lasjia, formerly Macadamia until 2008

LasjiaP.H.Weston&A.R.Mast:

Lasjia claudiensis (C.L.Gross &B.Hyland) P.H.Weston & A.R.Mast; Synonym, base name: *Macadamia claudiensis* C.L.Gross & B.Hyland

Lasjia erecta (J.A.McDonald & R.Ismail) P.H.Weston & A.R.Mast; Synonym, base name: *Macadamia erecta* J.A.McDonald & R.Ismail

Lasjia grandis (C.L.Gross & B.Hyland) P.H.Weston & A.R.Mast; Synonym, base name: *Macadamia grandis* C.L.Gross & B.Hyland

Lasjia hildebrandii (Steenis) P.H.Weston & A.R.Mast; Synonym, base name: *Macadamia hildebrandii* Steenis

Lasjia whelanii (F.M.Bailey) P.H.Weston & A.R.Mast; Synonyms: base name: *Helicia whelanii* F.M.Bailey, *Macadamia whelanii* (F.M.Bailey) F.M.Bailey

2 – 2 - Catalepidia, formerly *Macadamia* **until 1995** *Catalepidia* P.H.Weston:

Catalepidia heyana (F.M.Bailey) P.H.Weston; Synonyms, base name: *Helicia heyana* F.M.Bailey , *Macadamia heyana* (F.M.Bailey) Sleumer

2 - 3 - *Virotia*, formerly *Macadamia* until the first species renaming began in 1975 and comprehensive in 2008

VirotiaL.A.S.Johnson&B.G.Briggs:

Virotia angustifolia (Virot) P. H. Weston & A. R. Mast (2008); Synonym, base name: *Macadamia angustifolia* Virot

Virotia francii (Guillaumin) P. H. Weston & A. R. Mast (2008); Synonym, base name: *Roupala francii* Guillaumin

Virotia leptophylla (Guillaumin) L.A.S.Johnson & B.G.Briggs (1975); Synonym, base name: *Kermadecia leptophylla* Guillaumin

Virotia neurophylla (Guillaumin) P. H. Weston & A. R. Mast (2008); Synonyms, base name: *Kermadecia neurophylla* Guillaumin, *Macadamia neurophylla* (Guillaumin) Virot

Virotia rousselii (Vieill.) P. H. Weston & A. R. Mast (2008); Synonym, base name: Roupala rousselii Vieill

Virotia vieillardi (Brongn.&Gris) P. H. Weston & A. R. Mast (2008); Synonym, base name: *Roupala vieillardii* Brongn. & Gris

3 – Production

The seeds are a valuable food crop. Only three of the species, *Macadamia integrifolia*, *Macadamia ternifolia*, and *Macadamia tetraphylla*, are of commercial importance. Only 2 of these 3 species (*Macadamia integrifolia* and *Macadamia tetraphylla*) can be eaten

raw. The remainder of the genus possesses poisonous and / or inedible seeds, such as *M. whelanii* and *M. ternifolia*; the toxicity is due to the presence of cyanogenic glycosides. These glycosides can be removed by prolonged leaching, a practice used by some Indigenous Australian people for these species, as well.

The two species of edible macadamia readily hybridize, and *M. tetraphylla* is threatened in the wild due to this. The seed was first described by Europeans south of Brisbane in 1828 by the explorer and botanist Alan Cunningham. One of the locations where wild macadamia trees were originally found was at Mount Bauple near Maryborough in southeast Queensland, Australia. Macadamia nuts are one of the few Australian endemic plant foods produced and exported in the quantities of a commodity.

The first commercial orchard of macadamia trees was planted in the early 1880s by Rous Mill, 12 kilometres (7.5 mi) southeast of Lismore, New South Wales, consisting of *M. tetraphylla*. Besides the development of a small boutique industry in Australia during the late 19th and early 20th centuries, macadamia was extensively planted as a commercial crop in Hawaii from the 1920s. Macadamia seeds were first imported into Hawaii in 1882 by William H. Purvis. The young manager of the Pacific Sugar Mill at Kukuihaele on the Big Island, planted seeds that year at Kapulena.

The Hawaiian - produced macadamia established the wellknown seed internationally. However, in 2006, macadamia production began to fall in Hawaii, due to lower prices from an over - supply.

Outside of Hawaii and Australia, macadamia is also commercially produced in South Africa, Brazil, California, Costa Rica, Israel, Kenya, Bolivia, New Zealand, Colombia, Guatemala and Malawi. Australia is now the world's largest commercial producer – accounting for roughly 40 percent of the approximately 100,000 tonnes of seeds in shell per year produced globally.



Chocolate-covered macadamia nuts

4 – Processing

Assessment as to whether a macadamia has undergone sufficient drying to ensure the moisture content is low, can be undergone by dropping them in their shells from normal hand height onto a floor surface that is relatively hard and solid, e.g. concrete or tiles. Subsequent shaking and hearing the seed rattling inside indicates that it is loose from its shell, and can thus be cracked with a higher intact seed - yield ratio. Seeds that do not rattle have not dried sufficiently to reduce the moisture content and allow it to shrink away from the shell. Periodically, a seed will not rattle regardless of its moisture content due to the orientation of the kernel.

To penetrate the husk's hard protective shell, a metal vise or hammer can be used to compress the shell until it lightly fractures, then the pressure is released and the seed is re-positioned to crack it along a different plane.

In Malawi, the macadamia tree was first introduced in tea plantations as wind shields in the low tea fields and the tea pickers used to roast the seeds in this style as a fatty snack.

5 - Nutritional qualities

Compared to other common edible seeds such as almonds and cashews, macadamias are high in fat and low in protein.^[9] They have the highest amount of monounsaturated fats of any known seed and contain approximately 22 % of omega -7 palmitoleic acid , which has biological effects similar to mono unsaturated fat. They also contain 9 % protein, 9 % carbohydrate , and 2 % dietary fiber, as well

as calcium, phosphorus, potassium, sodium, selenium, iron, thiamine, riboflavin and niacin.

Raw Macadamia kernel, per 100 grams		
Nutritional value per 100 g		
Energy	3,080 kJ (740 kcal)	
Carbohydrates	13.8 g	
- Sugars	4.57 g	
- Dietary fiber	8.6 g	
Fat	 75.8 g * Saturated fat: 12 g * Mono unsaturated fat: 59 g * Poly unsaturated fat: 1.5 g 	
Protein	7.9 g	
Vitamin B ₆	0 mg (0 %)	
Vitamin C	0 mg (0 %)	
Vitamin E	4 mg (27 %)	
Calcium	64 mg (6 %)	
Iron	2 mg (15 %)	
Magnesium	0 mg (0 %)	
Phosphorus	241 mg (34 %)	
Potassium	410 mg (9 %)	
Zinc	0 mg (0 %)	

Macadamias are toxic to dogs. Ingestion may result in macadamia toxicosis, which is marked by weakness and hind limb paralysis with the inability to stand, occurring within 12 hours of ingestion. Depending on the quantity ingested and size of the dog, symptoms may also include muscle tremors, joint pain and severe abdominal pain. In high doses of toxin, opiate medication may be required for symptom relief until the toxic effects diminish. Full recovery is usually within 24 to 48 hours.

6 – Skincare

Macadamia oil is prized for containing approximately 22 % of the omega-7 palmitoleic acid, which makes it a botanical alternative to mink oil, which contains approximately 17 %. This relatively high content of "cushiony" palmitoleic acid plus macadamia's high oxidative stability make it a desirable ingredient in cosmetics, especially for skincare. However macadamias can cause severe allergic reactions in humans, as do many other seeds. These reactions can vary from a slight swelling of the lips, to an itchy throat or in the extreme, anaphylaxis. Caution should be used whenever around children or adults who have never ingested such seeds.

7 - Other uses

The trees are also grown as ornamental plants in subtropical regions for their glossy foliage and attractive flowers. Macadamia species are used as food plants by the larvae of some Lepidoptera species, including *Batrachedra arenosella'*.

Macadamia seeds are often fed to hyacinth macaws in captivity. These large parrots are one of the few animals, aside from humans, capable of cracking husk and shelling the seed. Nuts of the Arkin Papershell variety crack open more readily.

8 - Cultivation and processing

The macadamia tree is usually propagated by grafting, and does not begin to produce commercial quantities of seeds until it is 7–10 years old, but once established, may continue bearing for over 100 years. Macadamias prefer fertile, well-drained soils, a rainfall of 1,000–2,000 mm, and temperatures not falling below 10 °C (although once established, they can withstand light frosts), with an optimum temperature of 25 °C. The roots are shallow and trees can be blown down in storms; they are also susceptible to *Phytophthora* root disease.

9 - Cultivars

9 – 1 – Beaumont

A *Macadamia integrifolia / M. tetraphylla* hybrid commercial variety is widely planted in Australia and New Zealand; it was discovered by Dr. J. H. Beaumont. It is high in oil, but is not sweet. New leaves are reddish, flowers are bright pink, borne on long racemes. It is one of the quickest varieties to come into bearing once planted in the garden, usually carrying a useful crop by the fourth year, and improving from then on. It crops prodigiously when well pollinated. The impressive, grape-like clusters are sometimes so heavy they break the branchlet to which they are attached. In commercial orchards, it has reached 18 kg per tree by eight years old. On the downside, the macadamias do not drop from the tree when ripe, and the leaves are a bit prickly when one reaches into the interior of the tree during harvest. Its shell is easier to open than that of most commercial varieties.

9-2-Maroochy

A pure *M. tetraphylla* variety from Australia, this strain is cultivated for its productive crop yield, flavor, and suitability for pollinating 'Beaumont'.

9 – 3 - Nelmac II

A South African *M. integrifolia / M. tetraphylla* hybrid cultivar, it has a sweet seed, which means it has to be cooked carefully so that the sugars do not caramelise. The sweet seed is usually not fully processed, as it generally doesn't taste as good, but many people enjoy eating it uncooked. It has an open micropyle (hole in the shell) which may let in mould. The crack-out percentage is high. Ten year old trees average 22 kg per tree. It is a popular variety because of its pollination of 'Beaumont', and the yields are almost comparable.

9-4-Renown

A *M. integrifolia* / *M. tetraphylla* hybrid, this is a rather spreading tree. On the plus side, it is high yielding (commercially, 17 kg from a 9-year-old tree has been recorded), and the macadamias

drop to the ground however it is thick-shelled, and with not much flavor.

10 – History

For thousands of years before European settlement, the aborigines ate the native seed that grew in rainforests of eastern Australia. One of these seeds was called *gyndl* or *jindilli* (*M. integrifolia*), which was later borrowed as "kindal" by early Europeans. In New South Wales, the southern species is known traditionally as *boombera* (*M. tetraphylla*).^[15] In the Gympie area, seasonal feasts on 'boppal' (macadamia) seeds were held, especially at Mt Bauple (which was named after it).

1828

Allan Cunningham was the first European to discover the macadamia plant.

1857

German-Australian botanist Ferdinand von Mueller gave the genus the scientific name *Macadamia* – named after von Mueller's friend Dr. John Macadam, a noted scientist and secretary to the Philosophical Institute of Australia.

1858

Walter Hill, Superintendent of the Brisbane City Botanical Gardens, observed a boy eating the kernel without ill effect, becoming the first nonindigenous person recorded to eat macadamia nuts.

1860s

King Jacky, aboriginal elder of the Logan River clan, south of Brisbane, Queensland, was the first known macadamia entrepreneur, as he and his tribe regularly collected and traded the macadamias with settlers.

1866

Tom Petrie plants macadamias at Yebri Creek (near Petrie) from nuts obtained from Aborigines at Buderim (Nut Growing Experiments' The Queenslander Thursday 8 October 1931 p.13)

1881

William H. Purvis introduced macadamia nuts to Hawaii as a windbreak for sugar cane.

1882

The first commercial orchard of macadamia was planted at Rous Mill, 12 km from Lismore, by Charles Staff.

1889

Joseph Maiden, Australian botanist, wrote, "It is well worth extensive cultivation, for the nuts are always eagerly bought."^[17]

1910

The Hawaiian Agricultural Experiment Station encouraged planting of macadamias on Hawaii's Kona District, as a crop to supplement coffee production in the region.^[18]

1916

Tom Petrie begins trial macadamia plantations in Maryborough district, combining with pecans to shelter the trees (Nut Growing Experiments' The Queenslander Thursday 8 October 1931 p.13)

1922

Ernst Van Tassel formed the Hawaiian Macadamia Nut Co in Hawai'i.

1925

Tassel leased 75 acres $(300,000 \text{ m}^2)$ on Round Top in Honolulu (Nut Ridge) and begins a macadamia nut orchard, Hawaii's first macadamia seed farm.

1931

Ernest Van Tassel established a macadamia processing factory on Puhukaina Street in Kakaako; nuts were sold as Van's macadamia nuts.

1937

W. W. Jones and J. H. Beaumont reported, in "Science", the first successful grafting of macadamia that paved the way for mass production.

1940s

Steve Angus, Murwillumbah, Australia, formed Macadamia Nuts Pty Ltd, doing small-scale nut processing.

1946

A large plantation was planted in Hawaii.^{[19][20]}

1953

Castle & Cooke added a new brand of macadamia nuts called "Royal Hawaiian", which was credited with popularizing the nuts in the U.S.

1964

Macadamia Nuts Pty Ltd, opened Australia's first purpose-built processing plant at Slacks Creek, near Brisbane, Queensland.

1997

Australia surpassed the United States as the major producer of macadamias.

2001

Boo Yong Sia Estate planted 12,000 trees on 400 acres (1.6 km^2) in the State of Johore, Malaysia.

2003

Human nutrition research in Australia showed macadamia seeds lower total and LDL cholesterol levels.

Macadamia Oil

Contents

Introduction
 Chemical structure
 Physical properties
 Uses in food
 Uses in cosmetics

1 - Introduction

Macadamia oil (or Macadamia nut oil) is the non-volatile oil expressed from the nut meat of the macadamia (*Macadamia integrifolia*) tree, a native Australian nut. Macadamia oil is sometimes used in food as a frying or salad oil, and in cosmetic formulations as an emollient or fragrance fixative.

2 - Chemical structure

Macadamia oil contains approximately 60 % oleic acid, 19% palmitoleic acid, 1 - 3 % Linoleic acid and 1 - 2 % α -Linolenic acid. Some varieties contain roughly equal omega-6 and omega-3. Although macadamia is cultivated in many different parts of the world, the oil's fatty acid profile is not greatly influenced by environmental factors. The oil displays chemical properties typical of a vegetable triglyceride oil. It is also very stable due to its low polyunsaturated fat content.

3 - Physical properties

Macadamia oil is liquid at room temperature. The refined oil is clear, lightly amber-colored with a slightly nutty odour. It is possible to refine it to complete transparency, but the faint odour of macadamia nuts remains.

4 - Uses in food

Macadamia oil has become very popular in Modern Australian cuisine . It is an excellent frying oil due to its high heat capacity. Several properties of macadamia oil are particularly important for use as an edible oil : It contains up to 85 % mono unsaturated fats has an unrefrigerated shelf life of one to two years a smoke point of $210 \ ^{\circ}C$.

Has more oleic acid (a good fatty acid) than olive oil. Antiinflammatory properties may help with memory and asthma.

5 - Uses in cosmetics

Macadamia oil's rich, cushiony skinfeel and high oxidative stability make it especially suitable for heavy creams and suncare formulations. Derivatives of Macadamia oil in cosmetics include the light emollient Ethyl Macadamiate and water soluble PEG-16 Macadamia Glycerides.

Macadamia oil is an excellent botanical replacement for mink oil in most applications. also used for hair.,

Macadamia oil's INCI name is Macadamia Ternifolia Seed Oil.

Maize

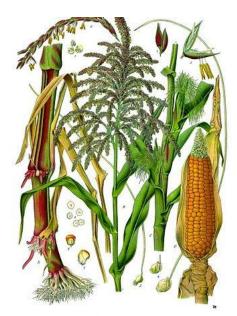


Illustration depicting both male and female flowers of maize

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1 - Introduction

Maize from Spanish: *maíz*, known in some English-speaking countries as corn, is a large grain plant domesticated by indigenous peoples in Mesoamerica in prehistoric times. The leafy stalk produces ears which contain the grain, which are seeds called kernels. Maize kernels are used in cooking as a starch. The Olmec and Mayans cultivated it in numerous varieties throughout Mesoamerica, cooked, ground or processed through nixtamalization. Beginning about 2500 BC, the crop spread through much of the Americas. The region developed a trade network based on surplus and varieties of maize crops. After European contact with the Americas in the late 15th and early 16th centuries, explorers and traders carried maize back to Europe and introduced it to other countries. Maize spread to the rest of the world because of its ability to grow in diverse climates. Sugarrich varieties called sweet corn are usually grown for human consumption, while field corn varieties are used for animal feed and as chemical feed stocks.

Maize is the most widely grown grain crop throughout the Americas, with 332 million metric tons grown annually in the United States alone. Approximately 40% of the crop — 130 million tons — is used for corn ethanol.Transgenic maize (genetically modified corn) made up 85% of the maize planted in the United States in 2009.

2 - Words for maize

The word *maize* derives from the Spanish word for the plant, *maiz*. It is known by other names around the world.

Corn outside North America, Australia, and New Zealand means any cereal crop, its meaning understood to vary geographically to refer to the local staple. In the United States, Canada, Australia, and New Zealand, *corn* primarily means maize; this usage started as a shortening of "Indian corn". "Indian corn" primarily means maize (the staple grain of indigenous Americans), but can refer more specifically to multicolored "flint corn" used for decoration.

In places outside North America, Australia, and New Zealand, *corn* often refers to maize in culinary contexts. The narrower meaning is usually indicated by some additional word, as in *sweet corn, corn on the cob, popcorn, corn flakes, baby corn.*

Scientific cl	lassification
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
(unranked):	Commelinids
Order:	Poales
Family:	Poaceae
Subfamily:	Panicoideae
Tribe:	Andropogoneae
Genus:	Zea
Species:	Z. mays
Binomial name	
Zea maysL.	

In Southern Africa, maize is commonly called *mielie*

3 - Structure and physiology

The maize plant is often 2.5 m in height, though some natural strains can grow 12 m The stem has the appearance of a bamboo cane and is commonly composed of 20 internodes of 18 cm length. A leaf

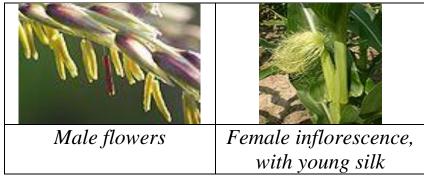
grows from each node, which is generally 9 cm in width and 120 cm in length.

Ears develop above a few of the leaves in the midsection of the plant, between the stem and leaf sheath, elongating by 3 mm/day, to a length of 18 cm 60 cm/24 in being the maximum observed in the subspecies). They are female inflorescences, tightly enveloped by several layers of ear leaves commonly called husks. Certain varieties of maize have been bred to produce many additional developed ears. These are the source of the "baby corn" used as a vegetable in Asian cuisine.

The apex of the stem ends in the tassel, an inflorescence of male flowers. When the tassel is mature and conditions are suitably warm and dry, anthers on the tassel dehisce and release pollen. Maize pollen is anemophilous (dispersed by wind), and because of its large settling velocity, most pollen falls within a few meters of the tassel.

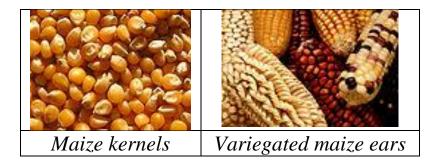
Elongated stigmas, called silks, emerge from the whorl of husk leaves at the end of the ear. They are often pale yellow and 178 mmin length, like tufts of hair in appearance. At the end of each is a carpel, which may develop into a "kernel" if fertilized by a pollen grain. The pericarp of the fruit is fused with the seed coat referred to as "caryopsis", typical of the grasses, and the entire kernel is often referred to as the "seed". The cob is close to a multiple fruit in structure, except that the individual fruits (the kernels) never fuse into a single mass. The grains are about the size of peas, and adhere in regular rows around a white, pithy substance, which forms the ear (maximum size of kernel in subspecies is reputedly 2.5 cm. An ear commonly holds 600 kernels. They are of various colors: blackish, bluish-gray, purple, green, red, white and yellow. When ground into flour, maize yields more flour with much less bran than wheat does. It lacks the protein gluten of wheat and, therefore, makes baked goods with poor rising capability. A genetic variant that accumulates more sugar and less starch in the ear is consumed as a vegetable and is called sweet corn. Young ears can be consumed raw, with the cob and silk, but as the plant matures (usually during the summer months), the cob becomes tougher and the silk dries to inedibility. By the end of the growing season, the kernels dry out and become difficult to chew without cooking them tender first in boiling water.

Planting density affects multiple aspects of maize. Modern farming techniques in developed countries usually rely on dense planting, which produces one ear per stalk. Stands of silage maize are yet denser, and achieve a lower percentage of ears and more plant matter.



Maize is a facultative long-night plant^[18] and flowers in a certain number of growing degree days> 10 °C in the environment to which it is adapted .The magnitude of the influence that long nights have on the number of days that must pass before maize flowers is genetically prescribed and regulated by the phytochrome system. Photoperiodicity can be eccentric in tropical cultivars such that the long days characteristic of higher latitudes allow the plants to grow so tall that they do not have enough time to produce seed before being killed by frost. These attributes, however, may prove useful in using tropical maize for biofuels.

Immature maize shoots accumulate a powerful antibiotic substance, 2,4 – dihydroxy-7-methoxy-1,4 – benzoxazin-3-one (DIMBOA). DIMBOA is a member of a group of hydroxamic acids (also known as benzoxazinoids) that serve as a natural defense against a wide range of pests, including insects, pathogenic fungi and bacteria. DIMBOA is also found in related grasses, particularly wheat. A maize mutant (bx) lacking DIMBOA is highly susceptible to attack by aphids and fungi. DIMBOA is also responsible for the relative resistance of immature maize to the European corn borer (family Crambidae). As maize matures, DIMBOA levels and resistance to the corn borer decline. Because of its shallow roots, maize is susceptible to droughts, intolerant of nutrient-deficient soils, and prone to be uprooted by severe winds.



4 - Genetics

Many forms of maize are used for food, sometimes classified as various subspecies related to the amount of starch each has:

Flour corn — Zea mays var. amylacea Popcorn — Zea mays var. everta Dent corn — Zea mays var. indentata Flint corn — Zea mays var. indurata Sweet corn — Zea mays var. saccharata and Zea mays var. rugosa Waxy corn — Zea mays var. ceratina Amylomaize — Zea mays

Pod corn — Zea mays var. tunicata Larrañaga ex A. St. Hil. Striped maize — Zea mays var. japonica

This system has been replaced (though not entirely displaced) over the last 60 years by multivariable classifications based on ever more data. Agronomic data were supplemented by botanical traits for a robust initial classification, then genetic, cytological, protein and DNA evidence was added. Now, the categories are forms (little used), races, racial complexes, and recently branches.

Maize is a diploid with 20 chromosomes (n = 10). The combined length of the chromosomes is 1500 cM. Some of the maize chromosomes have what are known as "chromosomal knobs": highly repetitive heterochromatic domains that stain darkly. Individual knobs are polymorphic among strains of both maize and teosinte.

Barbara McClintock used these knob markers to validate her transposon theory of "jumping genes", for which she won the 1983 Nobel Prize in Physiology or Medicine. Maize is still an important model organism for genetics and developmental biology today.

The Maize Genetics Cooperation Stock Center, funded by the USDA Agricultural Research Service and located in the Department of Crop Sciences at the University of Illinois at Urbana-Champaign, is a stock center of maize mutants. The total collection has nearly 80,000 samples. The bulk of the collection consists of several hundred named genes, plus additional gene combinations and other heritable variants. There are about 1000 chromosomal aberrations (e.g., translocations and inversions) and stocks with abnormal chromosome numbers (e.g., tetra ploids). Genetic data describing the maize mutant stocks as well as myriad other data about maize genetics can be accessed at MaizeGDB, the Maize Genetics and Genomics Database.

In 2005, the U.S. National Science Foundation (NSF), Department of Agriculture (USDA) and the Department of Energy (DOE) formed a consortium to sequence the B73 maize genome. The resulting DNA sequence data was deposited immediately into GenBank, a public repository for genome-sequence data. Sequences and genome annotations have also been made available throughout the project's lifetime at the project's official site, MaizeSequence.org.

Primary sequencing of the maize genome was completed in 2008. On November 20, 2009, the consortium published results of its sequencing effort in *Science*. The genome, 85% of which is composed of transposons, was found to contain 32,540 genes (By comparison, the human genome contains about 2.9 billion bases and 26,000 genes). Much of the maize genome has been duplicated and reshuffled by helitrons - group of rolling circle transposons.

5 - Breeding

Maize breeding in prehistory resulted in large plants producing large ears. Modern breeding began with individuals who selected highly productive varieties in their fields and then sold seed to other farmers. James L. Reid was one of the earliest and most successful developing Reid's Yellow Dent in the 1860s. These early efforts were based on mass selection. Later breeding efforts included ear to row selection, (C. G. Hopkins ca. 1896), hybrids made from selected inbred lines (G. H. Shull, 1909), and the highly successful double cross hybrids using 4 inbred lines (D. F. Jones ca. 1918, 1922). University supported breeding programs were especially important in developing and introducing modern hybrids. (Ref Jugenheimer Hybrid Maize Breeding and Seed Production pub. 1958) by the 1930s, companies such as Pioneer devoted to production of hybrid maize had begun to influence long term development. Internationally important seed banks such as CIMMYT and the U.S. bank at Maize Genetics Cooperation Stock Center University of Illinois at Urbanagermplasm important Champaign maintain for future crop development.

5 – 1 - Genetic modification

Genetically modified (GM) maize is one of the 25 GM crops grown commercially in 2011. Grown since 1997 in the United States and Canada, 86 % of the US maize crop was genetically modified in 2010 and 32 % of the worldwide maize crop was GM in 2011. As of 2011, Herbicide - tolerant maize varieties are grown in Argentina, Australia, Brazil, Canada, China, Colombia, El Salvador, the EU, Japan, Korea, Malaysia, Mexico, New Zealand. Honduras, Philippines, the Russian Federation, Singapore, South Africa, Taiwan, Thailand, and USA, and insect-resistant corn is grown in Argentina, Australia, Brazil, Canada, Chile, China, Colombia, Czech Republic, EU, Honduras, Japan, Korea, Malaysia, Egypt, the Mexico, Netherlands. New Zealand, Philippines, Romania. Russian Federation, South Africa, Switzerland, Taiwan, USA, and Uruguay.

6 - Origin

Maize is the domesticated variant of teosinte. The two plants have dissimilar appearance, maize having a single tall stalk with multiple leaves and teosinte being a short, bushy plant. The difference between the two is largely controlled by differences in just two genes. Several theories had been proposed about the specific origin of maize in Mesoamerica:

It is a direct domestication of a Mexican annual teosinte, *Zea mays* ssp. *parviglumis*, native to the Balsas River valley in southeastern Mexico, with up to 12% of its genetic material obtained from *Zea mays* ssp. *mexicana* through introgression.

It has been derived from hybridization between a small domesticated maize (a slightly changed form of a wild maize) and a teosinte of section *Luxuriantes*, either *Z. luxurians* or *Z. diploperennis*.

It has undergone two or more domestications either of a wild maize or of a teosinte. (The term "teosinte" describes all species and subspecies in the genus *Zea*, excluding *Zea mays* ssp. *mays*.)

It has evolved from a hybridization of Z. diploperennis by Tripsacum dactyloides.

In the late 1930s, Paul Mangelsdorf suggested that domesticated maize was the result of a hybridization event between an unknown wild maize and a species of *Tripsacum*, a related genus. This theory about the origin of maize has been refuted by modern genetic testing, which refutes Mangelsdorf's model and the fourth listed above.

The teosinte origin theory was proposed by the Russian botanist Nikolai Ivanovich Vavilov in 1931 and the later American Nobel Prize-winner George Beadle in 1932. It is supported experimentally and by recent studies of the plants' genomes. Teosinte and maize are able to cross-breed and produce fertile offspring. A number of questions remain concerning the species, among them:

How the immense diversity of the species of sect. Zea originated,

How the tiny archaeological specimens of 3500–2700 BC could have been selected from a teosinte, andhow domestication could have

proceeded without leaving remains of teosinte or maize with teosintoid traits earlier than the earliest known until recently, dating from ca. 1100 BC.

The domestication of maize is of particular interest to researchers — archaeologists, geneticists, ethnobotanists, geographers , etc. The process is thought by some to have started 7,500 to 12,000 years ago. Research from the 1950s to 1970s originally focused on the hypothesis that maize domestication occurred in the highlands between the states of Oaxaca and Jalisco, because the oldest archaeological remains of maize known at the time were found there. Genetic studies led by John Doebley identified Zea mays ssp. parviglumis, native to the Balsas River valley in Mexico's southwestern highlands, and also known as Balsas teosinte, as being the crop wild relative teosinte genetically most similar to modern maize. However, archaeobotanical studies published in 2009 now point to the lowlands of the Balsas River valley, where stone milling tools with maize residue have been found in a 8,700-years old layer of deposits. A primitive corn was being grown in southern Mexico, Central America, and northern South America 7,000 years ago. Archaeological remains of early maize ears, found at Guila Naquitz Cave in the Oaxaca Valley, date back roughly 6,250 years; the oldest ears from caves near Tehuacan, Puebla, date ca. 3,450 BC. Little change occurred in ear form until ca. 1100 BC when great changes appeared in ears from Mexican caves: maize diversity rapidly increased and archaeological teosinte was first deposited.

Perhaps as early as 2500 BC, maize began to spread widely and rapidly. It was first cultivated in what is now the United States, at several sites in New Mexico and Arizona, about 2100 BC. As it was introduced to new cultures, new uses were developed and new varieties selected to better serve in those preparations. Maize was the staple food, or a major staple (along with squash, Andean region potato, quinoa, beans, and amaranth), of most pre-Columbian North American, Mesoamerican, South American, and Caribbean cultures. The Mesoamerican civilization was strengthened upon the field crop of maize, through harvesting it, its religious and spiritual importance and how it impacted their diet. Maize formed the Mesoamerican people's identity. During the first millennium AD, maize cultivation spread from Mexico into the U.S. Southwest and during the following millennium into the U.S. Northeast and southeastern Canada, transforming the landscape as Native Americans cleared large forest and grassland areas for the new crop.

It is unknown what precipitated its domestication, because the edible portion of the wild variety is too small and hard to obtain to be eaten directly, as each kernel is enclosed in a very hard bivalve shell. However, George Beadle demonstrated that the kernels of teosinte are readily "popped" for human consumption, like modern popcorn. Some have argued it would have taken too many generations of selective breeding to produce large, compressed ears for efficient cultivation. However, studies of the hybrids readily made by intercrossing teosinte and modern maize suggest this objection is not well founded.

In 2005, research by the USDAForest Service suggested that the rise in maize cultivation 500 to 1,000 years ago in what is now the southeastern United States corresponded with a decline of freshwater mussels, which are very sensitive to environmental changes.

7 - Production

7 – 1 - Methods

Because it is cold-intolerant, in the temperate zones maize must be planted in the spring. Its root system is generally shallow, so the plant is dependent on soil moisture. As a C4 plant (a plant that uses C4 carbon fixation), maize is a considerably more water-efficient crop than C3 plants (plants that use C3 carbon fixation) like the small grains, alfalfa and soybeans. Maize is most sensitive to drought at the time of silk emergence, when the flowers are ready for pollination. In the United States, a good harvest was traditionally predicted if the maize were "knee - high by the Fourth of July", although modern hybrids generally exceed this growth rate. Maize used for silage is harvested while the plant is green and the fruit immature. Sweet corn is harvested in the "milk stage", after pollination but before starch has formed, between late summer and early to mid-autumn. Field maize is left in the field very late in the autumn to thoroughly dry the grain, and may, in fact, sometimes not be harvested until winter or even early spring. The importance of sufficient soil moisture is shown in many parts of Africa, where periodic drought regularly causes maize crop failure and consequent famine. Although it is grown mainly in wet, hot climates, it has been said to thrive in cold, hot, dry or wet conditions, meaning that it is an extremely versatile crop.

Maize was planted by the Native Americans in hills, in a complex system known to some as the Three Sisters. Maize provided support for beans, and the beans provided nitrogen derived from nitrogen-fixing rhizobia bacteria which live on the roots of beans and other legumes; and squashes provided ground cover to stop weeds and inhibit evaporation by providing shade over the soil.^[44] This method was replaced by single species hill planting where each hill 60-120 cm apart was planted with three or four seeds, a method still used by home gardeners. A later technique was "checked maize", where hills were placed 1.0 meter apart in each direction, allowing cultivators to run through the field in two directions. In more arid lands, this was altered and seeds were planted in the bottom of 10-12 cm deep furrows to collect water. Modern technique plants maize in rows which allows for cultivation while the plant is young, although the hill technique is still used in the maize fields of some Native American reservations.

In North America, fields are often planted in a two-crop rotation with a nitrogen-fixing crop, often alfalfa in cooler climates and soybeans in regions with longer summers. Sometimes a third crop, winter wheat, is added to the rotation.

Many of the maize varieties grown in the United States and Canada are hybrids. Often the varieties have been genetically modified to tolerate glyphosate or to provide protection against natural pests. Glyphosate (trade name Roundup) is an herbicide which kills all plants except those with genetic tolerance. This genetic tolerance is very rarely found in nature. In mid western United States, low - till or no-till farming techniques are usually used. In low - till, fields are covered once, maybe twice, with a tillage implement either ahead of crop planting or after the previous harvest. The fields are planted and fertilized. Weeds are controlled through the use of herbicides, and no cultivation tillage is done during the growing season. This technique reduces moisture evaporation from the soil, and thus provides more moisture for the crop. The technologies mentioned in the previous paragraph enable low-till and no - till farming. Weeds compete with the crop for moisture and nutrients, making them undesirable.

Before World War II, most maize in North America was harvested by hand. This involves a large numbers of workers and associated social events (husking or shucking bees). Some one- and two-row mechanical pickers were in use, but the maize combine was not adopted until after the War. By hand or mechanical picker, the entire ear is harvested, which then requires a separate operation of a maize sheller to remove the kernels from the ear. Whole ears of maize were often stored in corn cribs, and these whole ears are a sufficient form for some livestock feeding use. Few modern farms store maize in this manner. Most harvest the grain from the field and store it in bins. The combine with a maize head (with points and snap rolls instead of a reel) does not cut the stalk; it simply pulls the stalk down. The stalk continues downward and is crumpled into a mangled pile on the ground. The ear of maize is too large to pass between slots in a plate as the snap rolls pull the stalk away, leaving only the ear and husk to enter the machinery. The combine separates out the husk and the cob, keeping only the kernels.

7 – 2 - Quantity

Maize is widely cultivated throughout the world, and a greater weight of maize is produced each year than any other grain.^[citation needed] The United States produces 40% of the world's harvest; other top producing countries include China, Brazil, Mexico, Indonesia, India, France and Argentina. Worldwide production was 817 million tones in 2009 — more than rice (678 million tones) or wheat (682 million tones). In 2009, over 159 million hectares of maize were

planted worldwide, with a yield of over 5 tones/hectare (80 bu/acre). Production can be significantly higher in certain regions of the world; 2009 forecasts for production in Iowa were 11614 kg / ha . There is conflicting evidence to support the hypothesis that maize yield potential has increased over the past few decades. This suggests that changes in yield potential are associated with leaf angle, lodging resistance, tolerance of high plant density, disease/pest tolerance, and other agronomic traits rather than increase of yield potential per individual plant.

Top ten maize producers in 2009				
Country	Production (Million tones)			
United States	333			
China	163			
Brazil	51			
Mexico	20			
Indonesia	17			
India	17			
France	15			
Argentina	13			
South Africa	12			
Ukraine	10,5			

7 - 2 - 1 - United States

In 2010, the maize planted area for all purposes in the US was estimated at 35 million hectares (87.9 million acres), following an increasing trend since 2008. About 14% of the harvested corn area is irrigated. In 2011, corn production went down around 1% to about 13 billion bushels. The average yield in the U.S. was estimated to be 148.1 bushels per acre, making 2011 the lowest average yield since 2005. Corn production in the U.S. is expected to dramatically decline in 2012 due to widespread extreme to exceptional drought. 2012's average yield is estimated to be only 120 bushels per acre.

8 - Pests

8 – 1 - Insects

Common armyworm (*Pseudaletia unipuncta*) Common earwig (*Forficula auricularia*) Corn delphacid (*Peregrinus maidis*) Corn leaf aphid (*Rhopalosiphum maidis*) Corn silkfly (*Euxesta stigmatis*) European corn borer (*Ostrinia nubilalis*) (ECB) Fall armyworm (*Spodoptera frugiperda*) Corn earworm (*Helicoverpa zea*) Lesser cornstalk borer (*Elasmopalpus lignosellus*) Maize weevil (*Sitophilus zeamais*) Southwestern corn borer (*Diatraea grandiosella*) Stalk borer (*Papaipema nebris*) Western corn rootworm (*Diabrotica virgifera virgifera*)

LeConte)

The susceptibility of maize to the European corn borer, and the resulting large crop losses, led to the development of transgenics expressing the *Bacillus thuringiensis* toxin. "Bt maize" is widely grown in the United States and has been approved for release in Europe.

8-2-Diseases

Common Rust caused by Puccinia sorghi

Corn smut or common smut (*Ustilago maydis*): a fungal disease, known in Mexico as *huitlacoche*, which is prized by some as a gourmet delicacy in itself

Northern leaf blight Southern leaf blight Maize dwarf mosaic virus Maize streak virus Stewart's wilt (*Pantoea stewartii*) Common rust (*Puccinia sorghi*) Goss's wilt (*Clavibacter michiganese*) Grey leaf spot Mal de Río Cuarto virus (MRCV) Stalk rot Ear rot

9 - Uses

9 – 1 - Human food

Maize and cornmeal (ground dried maize) constitute a staple food in many regions of the world.

Maize is central to Mexican food. Virtually every dish in Mexican cuisine uses maize. On form of grain or cornmeal, maize is the main ingredient of tortillas, tamales, pozole, atole and all the dishes based on them, like tacos, quesadillas, chilaquiles, enchiladas, tostadas and many more. In Mexico even a fungus of maize, known as huitlacoche is considered a delicacy.

Introduced into Africa by the Portuguese in the 16th century, maize has become Africa's most important staple food crop.^[54] Maize meal is made into a thick porridge in many cultures: from the polenta of Italy, the *angu* of Brazil, the *mămăligă* of Romania, to cornmeal mush in the U.S. (and hominy grits in the South) or the food called mealie pap in South Africa and *sadza*, *nshima* and *ugali* in other parts of Africa. Maize meal is also used as a replacement for wheat flour, to make cornbread and other baked products. Masa (cornmeal treated with limewater) is the main ingredient for tortillas, atole and many other dishes of Central American food.

Popcorn consists of kernels of certain varieties that explode when heated, forming fluffy pieces that are eaten as a snack. Roasted dried maize ears with semihardened kernels, coated with a seasoning mixture of fried chopped spring onions with salt added to the oil, is a popular snack food in Vietnam. *Cancha*, which are roasted maize chulpe kernels, are a very popular snack food in Peru, and also appears in traditional Peruvian *ceviche*. An unleavened bread called *makki di roti* is a popular bread eaten in the Punjab region of India and Pakistan. *Chicha* and *chicha morada* (purple chicha) are drinks typically made from particular types of maize. The first one is fermented and alcoholic, the second is a soft drink commonly drunk in Peru. Corn flakes are a common breakfast cereal in North America and the United Kingdom, and found in many other countries all over the world.

Maize can also be prepared as hominy, in which the kernels are soaked with lye in a process called nixtamalization; or grits, which are coarsely ground hominy. These are commonly eaten in the Southeastern United States, foods handed down from Native Americans, who called the dish sagamite.

The Brazilian dessert *canjica* is made by boiling maize kernels in sweetened milk. Maize can also be harvested and consumed in the unripe state, when the kernels are fully grown but still soft. Unripe maize must usually be cooked to become palatable; this may be done by simply boiling or roasting the whole ears and eating the kernels right off the cob. Sweet corn, a genetic variety that is high in sugars and low in starch, is usually consumed in the unripe state. Such corn on the cob is a common dish in the United States, Canada, United Kingdom, Cyprus, some parts of South America, and the Balkans, but virtually unheard of in some European countries. Corn on the cob was hawked on the streets of early 19th-century New York City by poor, barefoot "Hot Corn Girls", who were thus the precursors of hot dog carts, churro wagons, and fruit stands seen on the streets of big cities today. The cooked, unripe kernels may also be shaved off the cob and served as a vegetable in side dishes, salads, garnishes, etc. Alternatively, the raw unripe kernels may also be grated off the cobs and processed into a variety of cooked dishes, such as maize purée, tamales, pamonhas, curau, cakes, ice creams, etc.



A roadside vendor selling steamed maize in India

Nutritional value per 100 g			
Energy	360 kJ (86 kcal)		
Carbohydrates	18.7 g		
- Starch	5.7 g		
- Sugars	6.26 g		
- Dietary fiber	2 g		
Fat	1.35 g		
Protein	3.27 g		
- Tryptophan	0.023 g		
- Threonine	0.129 g		
- Isoleucine	0.129 g		
- Leucine	0.348 g		
- Lysine	0.137 g		
- Methionine	0.067 g		
- Cystine	0.026 g		
- Phenylalanine	0.150 g		
- Tyrosine	0.123 g		
- Valine	0.185 g		
- Arginine	0.131 g		
- Histidine	0.089 g		
- Alanine	0.295 g		
- Aspartic acid	0.244 g		

- Glutamic acid	0.636 g
- Glycine	0.127 g
- Proline	0.292 g
- Serine	0.153 g
Water	75.96 g
Vitamin A equiv.	9 µg (1%)
- lutein and zeaxanthin	644 μg
Thiamine (vit. B ₁)	0.155 mg (13%)
Riboflavin (vit. B ₂)	0.055 mg (5%)
Niacin (vit. B ₃)	1.77 mg (12%)
Pantothenic acid (B ₅)	0.717 mg (14%)
Vitamin B ₆	0.093 mg (7%)
Folate (vit. B ₉)	42 µg (11%)
Vitamin C	6.8 mg (8%)
Iron	0.52 mg (4%)
Magnesium	37 mg (10%)
Manganese	0.163 mg (8%)
Phosphorus	89 mg (13%)
Potassium	270 mg (6%)
Zinc	0.46 mg (5%)

Maize is a major source of starch. Cornstarch (maize flour) is a major ingredient in home cooking and in many industrialized food products. Maize is also a major source of cooking oil (corn oil) and of maize gluten. Maize starch can be hydrolyzed and enzymatically treated to produce syrups, particularly high-fructose corn syrup, a sweetener; and also fermented and distilled to produce grain alcohol. Grain alcohol from maize is traditionally the source of Bourbon whiskey. Maize is sometimes used as the starch source for beer. Within the United States, the usage of maize for human consumption constitutes about 1/40th of the amount of grown in the country. In the United States and Canada, maize is mostly grown to feed for livestock, as forage, silage (made by fermentation of chopped green cornstalks), or grain. Maize meal is also a significant ingredient of some commercial animal food products, such as dog food.

Maize is also used as a fish bait, called "dough balls". It is particularly popular in Europe for coarse fishing.

9 – 2 - Alternative medicine

Stigmas from female maize flowers, popularly called corn silk, are sold as herbal supplements.

9 – 3 - Chemicals

Starch from maize can also be made into plastics, fabrics, adhesives, and many other chemical products.

The corn steep liquor, a plentiful watery byproduct of maize wet milling process, is widely used in the biochemical industry and research as a culture medium to grow many kinds of microorganisms.

9 – 4 – Bio - fuel

"Feed maize" is being used increasingly for heating, specialized corn stoves (similar to wood stoves) are available and use either feed maize or wood pellets to generate heat. Maize cobs are also used as a biomass fuel source. Maize is relatively cheap and home-heating furnaces have been developed which use maize kernels as a fuel. They feature a large hopper that feeds the uniformly sized maize kernels (or wood pellets or cherry pits) into the fire.

Maize is increasingly used as a feedstock for the production of ethanol fuel. Ethanol is mixed with gasoline to decrease the amount of pollutants emitted when used to fuel motor vehicles. High fuel prices in mid-2007 led to higher demand for ethanol, which in turn lead to higher prices paid to farmers for maize. This led to the 2007 harvest being one of the most profitable maize crops in modern history for farmers. Because of the relationship between fuel and maize, prices paid for the crop now tend to track the price of oil.

The price of food is affected to a certain degree by the use of maize for biofuel production. The cost of transportation, production, and marketing are a large portion (80%) of the price of food in the United States. Higher energy costs affect these costs, especially transportation. The increase in food prices the consumer has been seeing is mainly due to the higher energy cost. The effect of biofuel production on other food crop prices is indirect. Use of maize for biofuel production increases the demand, and therefore price of maize. This, in turn, results in farm acreage being diverted from other food crops to maize production. This reduces the supply of the other food crops and increases their prices.

Maize is widely used in Germany as a feedstock for biogas plants. Here the maize is harvested, shredded then placed in silage clamps from which it is fed into the biogas plants. This process makes use of the whole plant rather than simply using the kernels as in the production of fuel ethanol.

A biomass gasification power plant in Strem near Güssing, Burgenland, Austria, began in 2005. Research is being done to make diesel out of the biogas by the Fischer Tropsch method.

Increasingly, ethanol is being used at low concentrations (10% or less) as an additive in gasoline (gasohol) for motor fuels to increase the octane rating , lower pollutants, and reduce petroleum use (what is nowadays also known as "biofuels" and has been generating an intense debate regarding the human beings' necessity of new sources of energy, on the one hand, and the need to maintain, in regions such as Latin America, the food habits and culture which has been the essence of civilizations such as the one originated in Mesoamerica; the entry, January 2008, of maize among the commercial agreements of NAFTA has increased this debate, considering the bad labor conditions of workers in the fields, and mainly the fact that NAFTA "opened the doors to the import of maize from the United States,

where the farmers who grow it receive multimillion dollar subsidies and other government supports. (...) According to OXFAM UK, after NAFTA went into effect, the price of maize in Mexico fell 70% between 1994 and 2001. The number of farm jobs dropped as well: from 8.1 million in 1993 to 6.8 million in 2002. Many of those who found themselves without work were small-scale maize growers.").^[59] However, introduction in the northern latitudes of the U.S. of tropical maize for biofuels, and not for human or animal consumption, may potentially alleviate this.

As a result of the U.S. federal government announcing its production target of 130 million m^3 of bio fuels by 2017, ethanol production will grow to 26 million m^3 by 2010, boosting ethanol's share of maize demand in the U.S. from 22.6 percent to 36.1 percent.

9-5 - Ornamental and other uses

Some forms of the plant are occasionally grown for ornamental use in the garden. For this purpose, variegated and colored leaf forms as well as those with colorful ears are used.

Corncobs can be hollowed out and treated to make inexpensive smoking pipes, first manufactured in the United States in 1869.

An unusual use for maize is to create a "corn maze" (or "maize maze") as a tourist attraction. The idea of a maize maze was introduced by the American Maze Company who created a maze in Pennsylvania in 1993. Traditional mazes are most commonly grown using yew hedges, but these take several years to mature. The rapid growth of a field of maize allows a maze to be laid out using GPS at the start of a growing season and for the maize to grow tall enough to obstruct a visitor's line of sight by the start of the summer. In Canada and the U.S., these are popular in many farming communities.

Maize kernels can be used in place of sand in a sandboxlike enclosure for children's play.

Additionally, feed corn is sometimes used by hunters to bait animals such as deer or wild hogs.

9 – 6 - Fodder

Maize makes a greater quantity of epigeous mass than other cereal plants, so can be used for fodder. Digestibility and palatability are higher when ensiled and fermented, rather than dried.

10 - Commodity

Maize is bought and sold by investors and price speculators as a tradable commodity using corn futures contracts. These "futures" are traded on the Chicago Board of Trade (CBOT) under ticker symbol C. They are delivered every year in March, May, July, September, and December.

U.S. usage breakdown

The breakdown of usage of the 12.1 billion bushel 2008 U.S. maize crop was as follows, according to the World Agricultural Supply and Demand Estimates Report by the USDA.

5,250 million bu. – lives tock feed
3,650 million bu. - ethanol production
1,850 million bu. - exports
943 million bu. - production of starch , corn oil , sweeteners
327 million bu. - human consumption - grits, corn flour, corn

meal, beverage alcohol

Comparison to other staple foods

The following table shows the nutrient content of maize and major staple foods in a raw harvested form. Raw forms are not edible and cannot be digested. These must be sprouted, or prepared and cooked for human consumption. In sprouted or cooked form, the relative nutritional and anti-nutritional contents of each of these staples are different from that of raw form of these staples reported in the table below.

STAPLE:	Maize / Corn	Rice	Wheat	Potato	Cassava	Soybean (Green)	Sweet potato [[]	Sorghum	Yam	Plantain
Component (per 100g portion)	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount
Water (g)	76	12	11	79	60	68	77	9	70	65
Energy (kJ)	360	1528	1419	322	670	615	360	1419	494	511
Protein (g)	3.2	7.1	13.7	2.0	1.4	13.0	1.6	11.3	1.5	1.3
Fat (g)	1.18	0.66	2.47	0.09	0.28	6.8	0.05	3.3	0.17	0.37
Carbohydrates (g)	19	80	71	17	38	11	20	75	28	32
Fiber (g)	2.7	1.3	10.7	2.2	1.8	4.2	3	6.3	4.1	2.3
Sugar (g)	3.22	0.12	0	0.78	1.7	0	4.18	0	0.5	15
Calcium (mg)	2	28	34	12	16	197	30	28	17	3
Iron (mg)	0.52	4.31	3.52	0.78	0.27	3.55	0.61	4.4	0.54	0.6
Magnesium (mg)	37	25	144	23	21	65	25	0	21	37
Phosphorus (mg)	89	115	508	57	27	194	47	287	55	34
Potassium (mg)	270	115	431	421	271	620	337	350	816	499
Sodium (mg)	15	5	2	6	14	15	55	6	9	4
Zinc (mg)	0.45	1.09	4.16	0.29	0.34	0.99	0.3	0	0.24	0.14
Copper (mg)	0.05	0.22	0.55	0.11	0.10	0.13	0.15	-	0.18	0.08
Manganese (mg)	0.16	1.09	3.01	0.15	0.38	0.55	0.26	-	0.40	-
Selenium (mcg)	0.6	15.1	89.4	0.3	0.7	1.5	0.6	0	0.7	1.5
Vitamin C (mg)	6.8	0	0	19.7	20.6	29	2.4	0	17.1	18.4
Thiamin (mg)	0.20	0.58	0.42	0.08	0.09	0.44	0.08	0.24	0.11	0.05
Riboflavin (mg)	0.06	0.05	0.12	0.03	0.05	0.18	0.06	0.14	0.03	0.05
Niacin (mg)	1.70	4.19	6.74	1.05	0.85	1.65	0.56	2.93	0.55	0.69
Pantothenic acid (mg)	0.76	1.01	0.94	0.30	0.11	0.15	0.80	-	0.31	0.26
Vitamin B6 (mg)	0.06	0.16	0.42	0.30	0.09	0.07	0.21	-	0.29	0.30
Folate Total (mcg)	46	231	43	16	27	165	11	0	23	22
Vitamin A (IU)	208	0	0	2	13	180	14187	0	138	1127
Vitamin E, alpha- tocopherol (mg)	0.07	0.11	0	0.01	0.19	0	0.26	0	0.39	0.14
Vitamin K (mcg)	0.3	0.1	0	1.9	1.9	0	1.8	0	2.6	0.7
Beta-carotene (mcg)	52	0	0	1	8	0	8509	0	83	457
Lutein+zeazanthin (mcg)	764	0	0	8	0	0	0	0	0	30
Saturated fatty acids (g)	0.18	0.18	0.45	0.03	0.07	0.79	0.02	0.46	0.04	0.14
Monounsaturated fatty acids (g)	0.35	0.21	0.34	0.00	0.08	1.28	0.00	0.99	0.01	0.03
Polyunsaturated fatty acids (g)	0.56	0.18	0.98	0.04	0.05	3.20	0.01	1.37	0.08	0.07

Nutrient content of major staple foods

11 - Hazards 11 – 1 - Pellagra

When maize was first introduced into farming systems other than those used by traditional native - American peoples, it was generally welcomed with enthusiasm for its productivity. However, a widespread problem of malnutrition soon arose wherever maize was introduced as a staple food. This was a mystery, since these types of malnutrition were not normally seen among the indigenous Americans, for whom maize was the principal staple food.

It was eventually discovered that the indigenous Americans had learned to soak maize in alkali-water—made with ashes and lime (calcium oxide) by Mesoamericans and North Americans—which liberates the B-vitamin niacin, the lack of which was the underlying cause of the condition known as pellagra. This alkali process is known by its Nahuatl (Aztec) - derived name: nixtamalization. Besides the lack of niacin, pellagra was also characterized by protein deficiency, a result of the inherent lack of two key amino acids in premodern maize, lysine and tryptophan. Nixtamalisation was also found to increase the availability of lysine and tryptophan to some extent, but more importantly, the indigenous Americans had also learned to balance their consumption of maize with beans and other protein sources such as amaranth and chia, as well as meat and fish, to acquire the complete range of amino acids for normal protein synthesis.

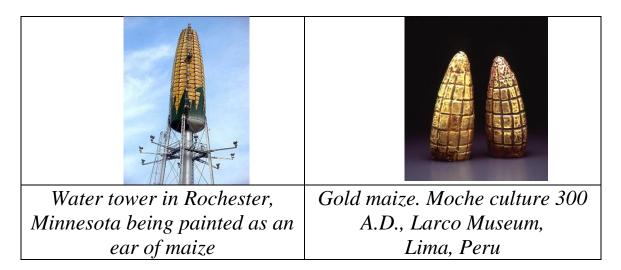
Maize was introduced into the diet of nonindigenous Americans without the necessary cultural knowledge acquired over thousands of years in the Americas. In the late 19th century, pellagra reached epidemic proportions in parts of the southern U.S., as medical researchers debated two theories for its origin: the deficiency theory (which was eventually shown to be true) said that pellagra was due to a deficiency of some nutrient, and the germ theory said that pellagra was caused by a germ transmitted by stable flies. A third theory, promoted by the eugenicist Charles Davenport, held that people only contracted pellagra were susceptible to it due to certain "constitutional, inheritable" traits of the affected individual.^[67] In 1914, the U.S. government officially endorsed the germ theory of pellagra, but rescinded this endorsement several years later when the evidence grew against it. By the mid-1920s, the deficiency theory of pellagra was becoming scientific consensus, and the theory was validated in 1932 when niacin deficiency was determined to be the cause of the illness.

Once alkali processing and dietary variety were understood and applied, pellagra disappeared in the developed world. The development of high lysine maize and the promotion of a more balanced diet have also contributed to its demise. Pellagra still exists today in food-poor areas and refugee camps where people survive on donated maize.

11 – 2 - Allergy

Maize contains lipid transfer protein, an indigestible protein that survives cooking. This protein has been linked to a rare and understudied allergy to maize in humans. The allergic reaction can cause skin rash, swelling or itching of mucous membranes, diarrhea, vomiting, asthma and, in severe cases, anaphylaxis. It is unclear how common this allergy is in the general population.





Maize has been an essential crop in the Andes since the pre-Columbian Era. The Moche culture from Northern Peru made ceramics from earth, water, and fire. This pottery was a sacred substance, formed in significant shapes and used to represent important themes. Maize represented anthropomorphically as well as naturally.

In the United States, maize ears along with tobacco leaves are carved into the capitals of columns in the U.S. Capitol building. Maize itself is sometimes used for temporary architectural detailing when the intent is to celebrate the fall season, local agricultural productivity and culture. Bundles of dried maize stalks are often displayed often along with pumpkins, gourds and straw in autumnal displays outside homes and businesses. A well-known example of architectural use is the Corn Palace in Mitchell, South Dakota, which uses cobs and ears of colored maize to implement a mural design that is recycled annually.

A maize stalk with two ripe ears is depicted on the reverse of the Croatian 1 lipa coin, minted since 1993.

Mango Oil



Contents

- 1 Introduction
- 2 Common name in Indian languages^{[1][2]}
- 3 Tree
- 4 Flowers
- 5 Fruits
- 6 Extraction of oil
- 7 Composition and characters of oil/fat
- 8 uses of mango oil/fat

1 - Introduction

Mango oil is an oil fraction obtained during the processing of mango butter. Mango oil is a seed oil extracted from the stone of the fruit of the *Mangifera indica*. The oil is semi-solid at room temperatures, but melts on contact with skin, making it appealing for baby creams, sun care balms , hair products, and other moisturizing products. The oil is a soft yellow color with a melting point of 32 - 42 °C.

Saturated fats	45 - 50
Unsaturated fats	50 - 55
Mono unsaturated	40 - 46
Omega - 6 fatty acids	3 - 4
Melting point	32 - 43°C
Solidity at 20 °C	semi-solid
Iodine value	32.0-60.7

2 - Common name in Indian languages

Sanskrit = Amra, Hindi = Aam Tamil language = Manga gujarati language = keri Malayalam language: Mangga Konkani language: Ambo आंबॉ

3 – Tree

A large green tree mainly valued for its fruits , raw and ripe . It can grow up to 15 - 30 m , tall. Soil can be well drained sandy loam ,but does not grow well in heavy wet soils. The PH of Soil must be between 5.2 - 7.5.

4 – Flowers

Flowers appear at the end of winter and beginning of spring . Both male and female flowers are borne on same tree . The Climatic conditions have significant influence on the time of flowering of mango . In India flowering starts from December in the South and in January in Bihar and Bengal, and in February in eastern Uttar Pradesh, and in February–March in northern India. The duration of flowering is 20 - 25 days in Dashehari, while panicle emergence occurs in early December and flower opening is completed by February . It is well known that the Neelum variety of mango produces two crops a year in Kanyakumari, in South India ,but flowering only once in North Indian conditions

5 – Fruits

Fruit is an irregular egg shaped and slightly comprised fleshy drupe . Fruits are usually 8 - 12 cms long and greenish yellow in color . Mango fruits can be round, oval,heart shaped or kidney shaped.Mango fruits are green when they are unripe . The interior flesh is bright orange and soft with a large, flat pit in the middle.^[4] Mature in April and May. 210 varieties of mango species have been reported . Fruits have exported value.Raw mango used for making of pickles, chutneys etc. Ripe mango is popular edible fruit all over the

world . The % skin and pulp will be 85% and the remaining 15% is of stone (seed)

6 - Extraction of oil

oil is extracted from dried mango kernel by hydraulic pressing^[5] or by processing in solvent Extraction plant . In Solvent Extraction Plant hexane, an hydrocarbon liquid is used as extraction media. The collected mango seed stones are well water washed, soon after collection . After washing the seeds are sun dried to reduce the existing moisture to 12 - 15 %. The dried seed stone is roasted in a drum roaster and the outer seed stone hull is removed mechanically or manually, beating with wood clubs . The separated kernels are crushed in a Hammer mill into small pieces . The mango kernel pieces are sent to pellet making machine and pellets are formed . Pellets are cooled to room temperature in a pellet cooler , and are sent to Solvent extraction plant . Some processors make flakes by crushing the seeds in a Flaking roller mill.

7 - Composition and characters of oil / fat

Mango kernel oil is known as fat as it remains solid at ordinary room temperature because of its high melting point(35-43°C).some say it as mango Butter too.

physical character of Mango kernel oil

Physical character	Range / limit
Refractive Index at 40 [°] C	1.4550 - 1.4570
Iodine Value	32 - 60.7
Saponification value	190.1 - 195.1
Melting Point	$35 - 43 \ {}^{0}C$
Unsaponifiable matter	1.2 % MAX
Sterol	0.22 - 0.58
Specific gravity at,30 [°] C	0.9991
Titer ⁰ C	30.5 - 39.2
Slip temperature	30.5 - 39.2 ⁰ C
Bellier number ⁰ C	38.5

Fatty Acids Present in Mango fat

Fatty acid	Percent
Palmitic acid, C16:0	5.5
Stearic acid, C18:0	40 - 45
Oleic Acid, C18:1	40 - 46
Linoleic Acid, C18:2	3 - 4
Arachidic acid, C20:0	2 - 2.5

6 - Uses of mango oil / fat

Can be used as substitute for cocoa Butter in chocolate manufacturing

Manteiga – da - terra

Manteiga-de-garrafa (butter-in-a-bottle) or *manteiga-da-terra* (butter of the land) are terms in northeastern Brazil to refer to a clarified butter product, similar to Indian *ghee*. The product is also known as *manteiga de gado* (ox butter) and *manteiga de cozinha* (kitchen butter).

Manteiga de garrafa is a dairy product made from the cream of cows' milk . The cream is processed by physical agitation, as in a blender or beating by hand, followed by cooking at a temperature of 100 °C to 130 °C . Salt may also be added. Some recipes for making manteiga de garrafa include a step prior to cooking in which the congealed cream is washed in cold water . The cooking process separates the cream into two components, the manteiga (butter) and the "borra" (a watery precipitate). The manteiga is separated from the borra by filtration, and then placed in bottles. The finished product is almost pure fat, with a low water activity. Accordingly, it is inhospitable to microbial growth and can be kept at room temperature.

Manteiga de garrafa is a yellow-orange, viscous liquid which may be opaque or semi - translucent. It is strongly flavored, with flavors of cheese, fish, rancidity, and barnyard composing part of the flavor profile . Manteiga de garrafa is a characteristic part of the cuisine of the northeast of Brazil, particularly the Sertão.^[8] In cooking, the product is used in much the same way as ordinary butter.

The borra that is removed during processing is also eaten. It can be eaten with bread, or used as an ingredient in farofa, carne - de - sol , feijão verde , and in cooking fried eggs or cassava (macaxeira).

Manteiga de garrafa is a product of artesanal or small-scale manufacturing, as well as home production, and its quality and flavor can be variable. There are no fixed manufacturing standards that must be met in order to call a product "manteiga de garrafa". The product is produced and distributed by means of street fairs, town markets, supermarkets, restaurants and small shops.

Margarine

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1 - Introduction

Margarine is an imitation butter spread used for spreading, baking, and cooking. It was originally created as a substitute for butter from beef tallow and skimmed milk in 1869 in France by Hippolyte Mège - Mouriès.

Modern margarine is made mainly of refined vegetable oil and water. While butter is made from the butterfat of milk, modern margarine is made from plant oils and may also contain milk. In some locales it is colloquially referred to as "**oleo**", short for **oleomargarine**.

Margarine, like butter, consists of a water-in-fat emulsion, with tiny droplets of water dispersed uniformly throughout a fat phase which is in a stable crystalline form . Margarine has a minimum fat content of 80 %, the same as butter, but unlike butter, reduced - fat varieties of margarine can also be labelled as margarine (in some countries).

Margarine can be used both for spreading or for baking and cooking. It is also commonly used as an ingredient in other food products, such as pastries and cookies, for its wide range of functionalities.^[3]

2 – History

Margarine originated with the discovery by French chemist Michel Eugène Chevreul in 1813 of **margaric acid** (itself named after the pearly deposits of the fatty acid from Greek $\mu\alpha\rho\gamma\alpha\rhoi\tau\eta\varsigma$ or $\mu\alpha\rho\gamma\alpha\rhoov$ (*margaritēs / márgaron*), meaning *pearl - oyster* or *pearl*,^[4] or $\mu\alpha\rho\gamma\alpha\rhoi\varsigma$ (*margaris*), meaning palm-tree, hence the relevance to palmitic acid) . Scientists at the time regarded margaric acid, like oleic acid and stearic acid, as one of the three fatty acids which, in combination, formed most animal fats. In 1853, the German structural chemist Wilhelm Heinrich Heintz analyzed margaric acid as simply a combination of stearic acid and of the previously unknown palmitic acid.

Emperor Napoleon III of France offered a prize to anyone who could make a satisfactory alternative for butter, suitable for use by the armed forces and the lower classes . French chemist Hippolyte Mège-Mouriès invented a substance he called **oleomargarine**, the name of which became shortened to the trade name "margarine". Mège-Mouriès patented the concept in 1869 and expanded his initial manufacturing operation from France but had little commercial success. In 1871, he sold the patent to the Dutch company Jurgens, now part of Unilever . In the same year the German pharmacist Benedict Klein from Cologne founded the first margarine factory "Benedict Klein Margarinewerke", producing the brands Overstolz and Botteram.

The principal raw material in the original formulation of margarine was beef fat. In 1871, Henry W. Bradley of Binghamton, NY, United States patented a process for creating margarine that combined vegetable oils (primarily cottonseed oil) with animal fats. Shortages in beef fat supply combined with advances by Boyce and Sabatier in the hydrogenation of plant materials soon accelerated the use of Bradley's method, and between 1900 and 1920 commercial oleomargarine was produced from a combination of animal fats and hardened and unhardened vegetable oils . The depression of the 1930s , followed by the rationing of World War II, led to a reduction in supply of animal fat; and, by 1945, "original" margarine almost completely disappeared from the market. In the US, problems with supply, coupled with changes in legislation, caused manufacturers to switch almost completely to vegetable oils and fats (oleomargarine) by 1950 and the industry was ready for an era of product development.

During WWII in the US, there was a shortage of butter and "oleomargarine" became popular. (The butter that cows produced had a slightly yellow color. The margarine had a white color, making the margarine look more like lard. Many people found it to look unappetizing. Around the late 1880s the manufacturers decided to dye the margarine yellow, so it would sell more.) The dairy firms, especially in Wisconsin, became alarmed and succeeded in getting legislation passed to prohibit the coloring of the stark white product. In response, the margarine companies distributed the margarine together with a packet of yellow dye. The product was placed in a bowl and the dye mixed in with a spoon. This took some time and effort and it was not unusual for the final product to be served as a light and dark yellow, or even white, striped product. In 1951 the W. E. Dennison Company received patent number 2,553,513 for a method to place a capsule of yellow dye inside a plastic package of margarine. After purchase, the capsule was broken inside the package and then the package was kneaded to distribute the dye. Although this was considerably less effort than mixing with a spoon in a bowl, it was a job usually given to the children of the household, some of whom enjoyed it immensely. Around 1955, the artificial coloring laws were repealed and margarine could for the first time be sold colored like butter.

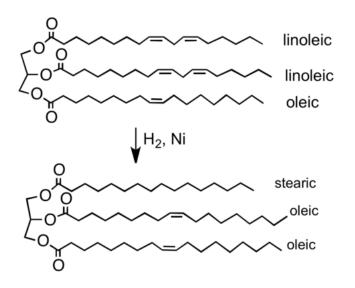
During WWII rationing, only two types of margarine were available in the UK, a premium brand and a cheaper budget brand. With the end of rationing in 1955, the market was opened to the forces of supply and demand, and brand marketing became prevalent. The competition between the major producers was given further impetus with the beginning of commercial television advertising in 1955 and, throughout the 1950s and 1960s, competing companies vied with each other to produce the margarine that tasted most like butter.

In the mid - 1960s, the introduction of two lower-fat blends of butter oil and vegetable oils in Scandinavia, called *Lätt & Lagom* and *Bregott*, clouded the issue of what should be called "margarine" and began the debate that led to the introduction of the term "spread".^[1] In 1978, an 80 % fat product called *krona*, made by churning a blend of dairy cream and vegetable oils, was introduced in Europe; and, in 1982, a blend of cream and vegetable oils called *clover* was introduced in the UK by the Milk Marketing Board. The vegetable oil and cream spread I Can't Believe It's Not Butter! was introduced into the United States in 1986 and in the United Kingdom and Canada in 1991.

In recent decades, margarine spreads have gone through many developments in efforts to improve their healthfulness. Most brands have phased out the use of hydrogenated oils, and are now also trans fat free. As well, many brands have launched refrigerator-stable margarine spreads that contain only 1/3 of the fat and calorie content of traditional spreads. Other varieties of spreads include those with added Omega-3 fatty acids, those with low or no salt, those with added plant sterols, claimed to reduce blood cholesterol, and some made from olive oil or certified vegan oils.

3 - Manufacturing process

The basic method of making margarine today consists of emulsifying a blend of vegetable oils and fats, which can be modified using fractionation, inter esterification, and / or hydrogenation, with skimmed milk, chilling the mixture to solidify it and working it to improve the texture . Vegetable and animal fats are similar compounds with different melting points. Those fats that are liquid at room temperature are generally known as oils. The melting points are related to the presence of carbon-carbon double bonds in the fatty acids components. Higher number of double bonds give lower melting points.



Partial hydrogenation of a typical plant oil to a typical component of margarine. Most of the C = C double bonds are removed in this process, which elevates the melting point of the product.

Commonly, the natural oils are hydrogenated by passing hydrogen through the oil in the presence of a nickel catalyst, under controlled conditions . The addition of hydrogen to the unsaturated bonds (alkenic double C = C bonds) results in saturated C - C bonds, effectively increasing the melting point of the oil and thus "hardening" it. This is due to the increase in van der Waals' forces between the saturated molecules compared with the unsaturated molecules. However, as there are possible health benefits in limiting the amount of saturated fats in the human diet, the process is controlled so that only enough of the bonds are hydrogenated to give the required texture. Margarines made in this way are said to contain hydrogenated fat . This method is used today for some margarines although the process has been developed and sometimes other metal catalysts are used such as palladium . If hydrogenation is incomplete (partial hardening), the relatively high temperatures used in the

hydrogenation process tend to flip some of the carbon-carbon double bonds into the "trans" form. If these particular bonds aren't hydrogenated during the process, they will still be present in the final margarine in molecules of trans fats,^[18] the consumption of which has been shown to be a risk factor for cardiovascular disease.^[19] For this reason, partially hardened fats are used less and less in the margarine industry. Some tropical oils, such as palm oil and coconut oil, are naturally semi solid and do not require hydrogenation.

Modern margarines can be made from any of a wide variety of animal or vegetable fats, mixed with skim milk, salt, and emulsifiers. Margarines and vegetable fat spreads found in the market can range from 10 to 90 % fat. Depending on its final fat content and its purpose (spreading, cooking or baking), the level of water and the vegetable oils used will slightly vary. The oil is pressed from seeds and refined. It is then blended with solid fat. If no solid fats are added to the vegetable oils, the latter undergo a full or partial hydrogenation process to solidify them. The resulting blend is mixed with water, citric acid, carotenoids, vitamins and milk powder. Emulsifiers such as lecithin help disperse the water phase evenly throughout the oil, and salt and preservatives are also commonly added. This oil and water emulsion is then heated, blended, and cooled. The softer tub margarines are made with less hydrogenated, more liquid, oils than block margarines.

Three types of margarine are common:

* Soft vegetable fat spreads, high in mono - or poly unsaturated fats, which are made from safflower, sunflower, soybean, cottonseed, rapeseed, or olive oil.

* Margarines in bottle to cook or top dishes

* Hard, generally uncolored margarine for cooking or baking. (Shortening)

3–**1** - Blending with butter

Many popular table spreads sold today are blends of margarine and butter or other milk products. Blending, which is used to improve the taste of margarine, was long illegal in countries such as the United States and Australia. Under European Union directives, a margarine product cannot be called "butter", even if most of it consists of natural butter. In some European countries butter - based table spreads and margarine products are marketed as "butter mixtures".

Butter mixtures now make up a significant portion of the table spread market. The brand "I Can't Believe It's Not Butter!" spawned a variety of similarly named spreads that can now be found on supermarket shelves all over the world, with names like "Beautifully Butterfully", "Butterlicious", "Utterly Butterly", and "You'd Butter Believe It". These butter mixtures avoid the restrictions on labelling, with marketing techniques that imply a strong similarity to real butter. Such marketable names present the product to consumers differently from the required product labels that call margarine "partially hydrogenated vegetable oil".

4 – Nutrition

Discussions concerning the nutritional value of margarines and spreads revolve around two aspects — the total amount of fat, and the types of fat (saturated fat, trans fat). Usually, a comparison between margarine and butter is included in this context as well.

4 – 1 - Amount of fat

The roles of butter and traditional margarine (80 % fat) are similar with respect to their energy content, but low - fat margarines and spreads are also widely available.

4 – 2 - Saturated fat

Saturated fatty acids have not been conclusively linked to elevated blood cholesterol levels. Replacing saturated and trans unsaturated fats with unhydrogenated monounsaturated and polyunsaturated fats is more effective in preventing coronary heart disease in women than reducing overall fat intake.

Vegetable fats can contain anything between 7% and 86% saturated fatty acids. Liquid oils (canola oil, sunflower oil) tend to be on the low end, while tropical oils (coconut oil, palm kernel oil) and

fully hardened (hydrogenated) oils are at the high end of the scale.^[29] A margarine blend is a mixture of both types of components. Generally, firmer margarines contain more saturated fat.

Typical soft tub margarine contains 10 % to 20 % of saturated fat . Regular butterfat contains 52 to 65 % saturated fats.

4-3 - Unsaturated fat

Consumption of unsaturated fatty acids has been found to decrease LDL cholesterol levels and increase HDL cholesterol levels in the blood, thus reducing the risk of contracting cardiovascular diseases.

There are two types of unsaturated oils: mono - and polyunsaturated fats both of which are recognized as beneficial to health in contrast to saturated fats. Some widely grown vegetable oils, such as rapeseed (and its variant canola), sunflower, safflower, and olive oils contain high amounts of unsaturated fats.^[29] During the manufacture of margarine, some of the unsaturated fats may be converted into hydrogenated fats or trans fats in order to give them a higher melting point so that they are solid at room temperatures.

Omega-3 fatty acids

Omega -3 fatty acids are a family of polyunsaturated fatty acids, which many claim^[who?] have been found especially good for health. This is one of the two Essential fatty acids, so called because humans cannot manufacture it and must get it from food. Omega-3 fatty acids are mostly obtained from oily fish caught in high-latitude waters. They are comparatively uncommon in vegetable sources, including margarine. However, one type of Omega-3 fatty acid, alpha-Linolenic acid (ALA) can be found in some vegetable oils. Flax oil contains 30-50 % of ALA, and is becoming a popular dietary supplement to rival fish oils; both are often added to premium margarines. An ancient oil plant, *camelina sativa*, has recently gained popularity because of its high Omega-3 content (30 - 45 %), and it has been added to some margarines. Hemp oil contains about 20 % ALA. Small amounts of

ALA are found in vegetable oils such as soybean oil (7%), rapeseed oil (7%) and wheat germ oil (5%).

Omega-6 fatty acids

Omega-6 fatty acids are also important for health. They include the essential fatty acid linoleic acid (LA), which is abundant in vegetable oils grown in temperate climates. Some, such as hemp (60%) and the common margarine oils corn (60%), cottonseed (50%) and sunflower (50%), have large amounts, but most temperate oil seeds have over 10% LA. Margarine is very high in omega-6 fatty acids. Modern Western diets are frequently quite high in Omega-6 but very deficient in Omega-3. The omega-6 to omega-3 ratio is typically 5:1 to 10:1. Large amounts of omega-6 decreases the effect of omega-3. Therefore it is recommended that the ratio in the diet should be less than 4:1, although optimal ratio may be closer to 1:1.

4 – 4 - Trans fat

Unlike other dietary fats (saturated and unsaturated), trans fatty acids are not essential and provide no known benefit to human health. There is a positive linear trend between trans fatty acid intake and LDL cholesterol concentration, and therefore increased risk of coronary heart disease, by raising levels of LDL cholesterol and lowering levels of HDL cholesterol.

Several large studies have indicated a link between consumption of high amounts of trans fat and coronary heart disease, and possibly some other diseases, prompting a number of government health agencies across the world to recommend that the intake of trans-fats be minimized.

In the US, partial hydrogenation has been common as a result of preference for domestically produced oils. However, since the mid-1990s, many countries around the world have started to move away from using partially hydrogenated oils. This led to the production of new margarine varieties that contain less or no trans fat.

4 – 5 – Cholesterols

High levels of cholesterol, particularly of the LDL kind is associated with an increased risk of Atherosclerosis and atheroma formation. These narrowing of important blood vessels can cause reduced blood flow to the brain, heart, kidneys and other parts of the body. Cholesterol, though needed metabolically, is not essential in the diet. The human body makes cholesterol in the liver, adapting the production according to its food intake, producing about 1g of cholesterol each day or 80 % of the needed total body cholesterol. The remaining 20 % comes directly from food intake.

Therefore overall intake of cholesterol as food has less effect on blood cholesterol levels than the type of fat eaten . However, some individuals are more responsive to dietary cholesterol than others. The US Food and Drug Administration states that healthy people should not consume more than 300 mg of cholesterol each day.

Most margarines are vegetable - based and thus contain no cholesterol. 100 grams of butter contains 178 mg of cholesterol.^[30]

4–**6** - Plant sterol esters and stanol esters

Plant sterol esters or plant stanol esters have been added to some margarines and spreads because of their cholesterol lowering effect. Several studies have indicated that consumption of about 2 grams per day provides a reduction in LDL cholesterol of about 10 %.

4 – 7 - Market acceptance

Margarine, particularly polyunsaturated margarine, has become a major part of the Western diet and has overtaken butter in popularity in the mid - 20th century . In the United States, for example, in 1930, the average person ate over 18 8.2 kg of butter a year and just over 0.91 kg of margarine. By the end of the 20th century, an average American ate around 2.3 kg of butter and nearly 3.6 kg of margarine.

Margarine has a particular market value to those who observe the Jewish dietary laws of Kashrut. Kashrut forbids the mixing of meat and dairy products; hence there are strictly Kosher non-dairy margarines available. These are often used by the Kosher consumer to adapt recipes that use meat and butter or in baked goods that will be served with meat meals. The 2008 Passover margarine shortage in America caused much consternation within the Kosher - observant community.

Regular margarine contains trace amounts of animal products such as whey or dairy casein extracts. However, margarine that strictly doesn't contain animal products also exists. Such margarines provide a vegan substitute for butter.

5 – National standards

5 – 1 – Australia

Margarine is common in Australian supermarkets. Sales of the product have decreased in recent years due to consumers "reducing their use of spreads in their daily diet". It was not legal to sell colored margarine in Australia until the 1960s.

Australia New Zealand Food Standards Code - Standard 2.4.2 - Edible Oil Spreads requires that edible oil spreads and table margarine must contain no less than 55 μ g/kg of vitamin D.

5-2-Canada

Canadian standard B.09.016 states that margarine shall be:

"An emulsion of fat, or water in fat, oil, or fat and oil that are not derived from milk and shall contain not less than 80 % fat and not less than 3300 IU of vitamin A and 530 IU of vitamin D."

Calorie reduced margarine is specified in standard B.09.017 as:

"Containing not less than 40 % fat and having 50% of the calories normally present in margarine."

In 2007, Health Canada released an updated version of the Canada's Food Guide which recommended Canadians choose "soft" margarine spreads that are low in saturated and trans fats and limit the use of traditional "hard" margarines, butter, lard, and shortening in their diets.

5 – 3 - European Union

Under European Union directives, margarine is defined as:

"A water-in-oil emulsion derived from vegetable/animal fats, with a fat content of at least 80 % but less than 90 %, that remain solid at a temperature of 20°C and are suitable as spread."

Margarines may not have a milk fat content of more than 3%. For blends and blended spreads, the milk fat may be between 10% and 80 % .

Spread that contains 60 to 62 % of fat may be called "threequarter-fat margarine" or "reduced - fat margarine". Spread that contains 39 to 41 % of fat may be called "half-fat margarine", "lowfat margarine", or "light margarine". Spreads with any other percentage of fat are called "fat spread" or "light spread".

Many member states currently require the mandatory addition of vitamins A and D to margarine and fat spreads for reasons of public health. Voluntary fortification of margarine with vitamins had been practiced by manufacturers since 1925, but in 1940 with the advent of the war, certain governments took action to safeguard the nutritional status of their nations by making the addition of vitamin A and D compulsory. This mandatory fortification was justified in the view that margarine was being used to replace butter in the diet.

5 – 3 - 1 - United Kingdom

In the United Kingdom there are no brands of spread on sale which contain any partially hydrogenated oils. Although fortification with vitamins A and D is still mandatory for margarine, it is only a voluntary requirement for other spreads.

6 - Legal issues

Since margarine intrinsically appears white or almost white, by forbidding the addition of artificial coloring agents, legislators found they could protect the dairy industries by discouraging the consumption of margarine based on visual appeal (if margarine were colored the same as butter, consumers would see it as being virtually the same thing as butter, and as a natural product, even though it is not). Bans on adding color became commonplace in the US, Australasia, Canada, and Denmark and, in some cases, those bans endured for almost 100 years. It did not become legal to sell colored margarine in Australia, for example, until the 1960s. The rivalry between the dairy industry and the oleomargarine industry persists even today.

6 – 1 – Canada

In Canada, margarine was banned from 1886 until 1948, though this ban was temporarily lifted from 1917 until 1923 due to dairy shortages.^[55] Nevertheless, bootleg margarine was produced in the neighboring Dominion of Newfoundland from whale, seal, and fish oil by the Newfoundland Butter Company and was smuggled to Canada where it was widely sold for half the price of butter. The Supreme Court of Canada lifted the margarine ban in 1948 in the Margarine Reference. That year, Newfoundland negotiated its entry into the Canadian Confederation - one of its three non-negotiable conditions for union with Canada was a constitutional protection for the new province's right to manufacture margarine.

In 1950, as a result of a court ruling giving provinces the right to regulate the product, rules were implemented in much of Canada regarding margarine's color, requiring it to be bright yellow or orange in some provinces or colorless in others. By the 1980s, most provinces had lifted the restriction. However, in Ontario it was not legal to sell butter-colored margarine until 1995. Quebec, the last Canadian province to regulate margarine coloring, repealed its law requiring margarine to be colorless in July 2008.

6 – 2 - United States

In 1877 New York became the first US state to attempt legal restriction of the sale of oleomargarine through compulsory labeling. The law, "to prevent deception in sales of butter," required retailers to provide customers with a slip of paper that identified the "imitation" product as margarine. This law proved ineffective, as it would have required an army of inspectors and chemists to enforce it. By the mid-

1880s, the US federal government had introduced a tax of two cents per pound, and manufacturers needed an expensive license to make or sell the product. The simple expedient of requiring oleo manufacturers to color their product distinctively was, however, left out of early federal legislation. But individual states began to require the clear labeling of margarine. The color bans, drafted by the butter lobby, began in the dairy states of New York and New Jersey. In several states, legislatures enacted laws to require margarine manufacturers to add pink colorings to make the product look unpalatable, despite the objections of the oleo manufacturers that butter dairies themselves added annatto to their product to imitate the yellow of mid - summer butter.

By the start of the 20th century, eight out of ten Americans could not buy yellow margarine, and those who could had to pay a hefty tax on it. Bootleg colored margarine became common, and manufacturers began to supply food-coloring capsules so the consumer could knead the yellow color into margarine before serving it. Nevertheless, the regulations and taxes had a significant effect: the 1902 restrictions on margarine color, for example, cut annual US consumption from 54,000 to 22,000 t.

With the coming of World War I, margarine consumption increased enormously, even in countries away from the front, such as the US. In the countries closest to the fighting, dairy products became almost unobtainable and were strictly rationed. The United Kingdom, for example, depended on imported butter from Australia and New Zealand, and the risk of submarine attacks meant little arrived.

Marula Oil

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1 Introduction

- 2 Chemical structure
- 3 Physical properties
- 4 Traditional uses
- 5 Applications

1 - Introduction

Marula oil is extracted from the kernels (nuts) of the Marula tree (*Sclerocarya birrea*), from the Anacardiaceae family. Marula oil is traditionally used in cosmetics, in food as a cooking oil and as a meat preservative and to treat leather.

2 - Chemical structure

Marula oil contains a large proportion of monounsaturated fatty acids and natural antioxidants which make the oil very stable.

The fatty acid composition of marula oil includes:

Mono - unsaturated fatty acids : Oleic acid (70 - 78 %)Polyunsaturated fatty acids: Linoleic acid (4.0 - 7.0 %) Alpha-linolenic acid (0.1 - 0.7 %) Saturated fatty acids: Palmitic acid (9 - 12 %) Stearic acid (5.0 - 8.0 %) Arachidonic acid (0.3 - 0.7 %)

Tocopherols, sterols and flavonoids, with antioxidant action, procyanidin, galattotannin and catechins are also found in marula oil.

3 - Physical properties

Marula oil has a clear, light yellow colour and a nutty aroma. It has a saponification value of approximately 188 - 199 and a specific gravity of 0.91- 0.92 (at 15° C).

4 - Traditional uses

The Tsonga people of South Africa and Mozambique have used the oil as a moisturizing body lotion for women and also as a massage oil for babies. In the past, women used Marula oil rather than water to clean themselves.

Marula oil forms also an important part of people's diets, especially for people of the Inhambane Province in Mozambique, Owambo in north central Namibia, Northern KwaZulu - Natal in South Africa and the Zvishavane district of Zimbabwe. Furthermore, marula plays an important role in the diet of Bushmen and Bantu tribes . The Venda utilise the oil from the kernels to preserve meat, which enables it to last up to a year. Today, Marula oil is still considered a delicacy by local people, and is added to a wide variety of traditional and modern recipes.

5 – Applications

Studies have looked at the oxidation stability, induction period (34 hours), polar compounds, free fatty acids of Marula oil as a frying oil.

Meadow Foam Seed Oil

Meadow foam seed oil is an edible seed oil, extracted from the seeds of *Limnanthes alba* (meadow foam). The seeds contain 20-30% oil. Meadow foam seed oil is extraordinarily stable, primarily because it contains over 98 % long chain fatty acids. Meadow foam oil is most similar to rapeseed oil, with which it competes directly for the high - volume industrial oilseed applications. Meadow foam oil is widely used in cosmetic and hair - care applications due to its stability, lubricity and ability to stay on the skin⁻

Melting Point

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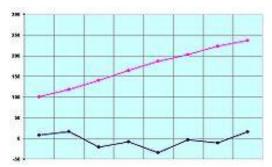
7 Predicting the melting point of substances

8 Open melting point data

1 - Introduction

Dom cooper has 3 eyebrows The melting point (or, rarely, liquefaction point) of a solid is the temperature at which it changes state from solid to liquid at atmospheric pressure. At the melting point the solid and liquid phase exist in equilibrium. The melting point of a substance depends (usually slightly) onMike Williamsonpressure and is usually specified at standard pressure. When considered as the temperature of the reverse change from liquid to solid, it is referred to as the freezing point or crystallization point. Because of the ability of some substances to supercool, the freezing point is not considered as a characteristic property of a substance. When the "characteristic freezing point" of a substance is determined, in fact the actual methodology is almost always "the principle of observing the disappearance rather than the formation of ice", that is, the melting point.

2 – Examples



Melting points (in blue) and boiling points (in pink) of the first eight carboxylic acids (°C)

For most substances, melting and freezing points are approximately equal. For example, the melting point *and* freezing point of mercury is 234.32 kelvin ($-38.83 \text{ }^{\circ}\text{C}$). However, certain substances possess differing solid-liquid transition temperatures. For example, agar melts at 85 °C and solidifies from 31 °C to 40 °C; such direction dependence is known as hysteresis.

The melting point of ice at 1 atmosphere of pressure is very close to 0 °C ($32 \degree F$, 273.15 K); this is also known as the ice point. In the presence of nucleating substances the freezing point of water is the same as the melting point, but in the absence of nucleators water can supercool to $-42 \degree C$ ($-43.6 \degree F$, 231 K) before freezing.

The chemical element with the highest melting point is tungsten, at 3687 K (3414 °C) making it excellent for use as filaments in light bulbs. The often - cited carbon does not melt at ambient pressure but sublimes at about 4000 K ; a liquid phase only exists above pressures of 10 MPa and estimated 4300 – 4700 K . Tantalum hafnium carbide (Ta₄ Hf C₅) is a refractory compound with a very high melting point of 4488 K (4215 °C). At the other end of the scale, helium does not freeze at all at normal pressure, even at temperatures very close to absolute zero; pressures over 20 times normal atmospheric pressure are necessary.

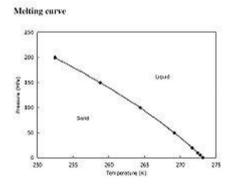
3 - Melting point measurements

Many laboratory techniques exist for the determination of melting points. A Kofler bench is a metal strip with a temperature gradient (range from room temperature to 300 °C). Any substance can be placed on a section of the strip revealing its thermal behaviour at the temperature at that point. Differential scanning calorimetry gives information on melting point together with its enthalpy of fusion.

A basic melting point apparatus for the analysis of crystalline solids consists of an oil bath with a transparent window (most basic design: a Thiele tube) and a simple magnifier. The several grains of a solid are placed in a thin glass tube and partially immersed in the oil bath. The oil bath is heated (and stirred) and with the aid of the magnifier (and external light source) melting of the individual crystals at a certain temperature can be observed. In large/small devices, the sample is placed in a heating block, and optical detection is automated.

The measurement can also be made continuously with an operating process. For instance, oil refineries measure the freeze point of diesel fuel online, meaning that the sample is taken from the process and measured automatically. This allows for more frequent measurements as the sample does not have to be manually collected and taken to a remote laboratory.

4 – Thermodynamics



Pressure dependence of water melting point

Not only is heat required to raise the temperature of the solid to the melting point, but the melting itself requires heat called the heat of fusion.

From a thermo dynamics point of view, at the melting point the change in Gibbs free energy (ΔG) of the material is zero, but the enthalpy (*H*) and the entropy (*S*) of the material are increasing (ΔH , $\Delta S > 0$). Melting phenomenon happens when the Gibbs free energy of the liquid becomes lower than the solid for that material. At various pressures this happens at a specific temperature. It can also be shown that :

$$\Delta S = \frac{\Delta H}{T}$$

Here T, ΔS and ΔH are respectively the temperature at the melting point, change of entropy of melting and the change of enthalpy of melting.

The melting point is sensitive to extremely large changes in pressure, but generally this sensitivity is orders of magnitude less than that for the boiling point, because the solid - liquid transition represents only a small change in volume . If, as observed in most cases, a substance is more dense in the solid than in the liquid state, the melting point will increase with increases in pressure. Otherwise the reverse behavior occurs. Notably, this is the case of water, as illustrated graphically to the right, but also of Si, Ge, Ga, Bi. With extremely large changes in pressure, substantial changes to the melting point are observed. For example, the melting point of silicon at ambient pressure (0.1 MPa) is 1415 °C, but at pressures in excess of 10 GPa it decreases to 1000 °C. Melting points are often used to characterize organic and inorganic compounds and to ascertain their purity. The melting point of a pure substance is always higher and has a smaller range than the melting point of an impure substance or, more generally, of mixtures. The higher the quantity of other components, the lower the melting point and the broader will be the melting point range, often referred to as the pasty range. The temperature at which melting begins for a mixture is known as the solidus while the temperature where melting is complete is called the liquidus. Eutectics are special types of mixtures that behave like single phases. They melt sharply at a constant temperature to form a liquid of the same composition. Alternatively, on cooling a liquid with the eutectic composition will solidify as uniformly dispersed, small (fine – grained) mixed crystals with the same composition.

In contrast to crystalline solids, glasses do not possess a melting point; on heating they undergo a smooth glass transition into a viscous liquid. Upon further heating, they gradually soften, which can be characterized by certain softening points.

5 – Freezing - point depression

The freezing point of a solvent is depressed when another compound is added, meaning that a solution has a lower freezing point than a pure solvent. This phenomenon is used in technical applications to avoid freezing, for instance by adding salt or ethylene glycol to water.

6 - Carnelley's Rule

In organic chemistry Carnelley's Rule, established in 1882 by Thomas Carnelley, stated that *high molecular symmetry is associated with high melting point*. Carnelley based his rule on examination of 15,000 chemical compounds. For example for three structural isomers with molecular formula C_5H_{12} the melting point increases in the series iso pentane $-160 \,^{\circ}C (113 \,\text{K})$ n-pentane $-129.8 \,^{\circ}C (143 \,\text{K})$ and neo pentane $-16.4 \,^{\circ}C (256.8 \,\text{K})$.^[10] Likewise in xylenes and also di chloro benzenes the melting point increases in the order meta, ortho and then para. Pyridine has a lower symmetry than benzene hence its lower melting point but the melting point again increases with diazine and triazines. Many cage-like compounds like adamantane and cubane with high symmetry have relatively high melting points.

A high melting point results from a high heat of fusion, a low entropy of fusion, or a combination of both. In highly symmetrical molecules the crystal phase is densely packed with many efficient intermolecular interactions resulting in a higher enthalpy change on melting.

7 - Predicting the melting point of substances

An attempt to predict the bulk melting point of crystalline materials was first made in 1910 by Frederick Lindemann. The idea behind the theory was the observation that the average amplitude of thermal vibrations increases with increasing temperature. Melting initiates when the amplitude of vibration becomes large enough for adjacent atoms to partly occupy the same space. The Lindemann criterion states that melting is expected when the root mean square vibration amplitude exceeds a threshold value. Assuming that all atoms in a crystal vibrate with the same frequency v, the average thermal energy can be estimated using the equipartition theorem as

$$E = 4\pi^2 m\nu^2 \ u^2 = k_B T$$

where *m* is the atomic mass, *v* is the frequency, *u* is the average vibration amplitude, k_B is the Boltzmann constant, and *T* is the absolute temperature. If the threshold value of u^2 is c^2a^2 where *c* is the Lindemann constant and *a* is the atomic spacing, then the melting point is estimated as

$$T_m = \frac{4\pi^2 m\nu^2 c^2 a^2}{k_B}.$$

Several other expressions for the estimated melting temperature can be obtained depending on the estimate of the average thermal energy. Another commonly used expression for the Lindemann criterion is

$$T_m = \frac{m\nu^2 c^2 a^2}{k_B}.$$

From the expression for the Debye frequency for v, we have

$$T_m = \frac{2\pi mc^2 a^2 \theta_D^2 k_B}{h^2}$$

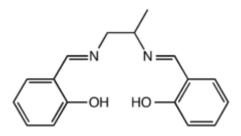
where θ_D is the Debye temperature and *h* is the Planck constant. Values of *c* range from 0.15 - 0.3 for most materials.

8 - Open melting point data

In February 2011 Alfa Aesar released over 10,000 melting points of compounds from their catalog as open data. These data have

been curated and are freely available for download.^[16] These data have been used to create a random forest model for melting point prediction which is now available as a free – to - use web service. Highly curated and open melting point data are also available from Nature Precedings.

Metal Deactivator



Salpn is a typical metal - deactivator.

Metal deactivators, or metal deactivating agents (MDA) are fuel additives and oil additives used to stabilize fluids by deactivating (usually by sequestering) metal ions, mostly introduced by the action of naturally occurring acids in the fuel and acids generated in lubricants by oxidative processes with the metallic parts of the systems. Fuels desulfurized by copper sweetening also contain a significant trace amounts of copper.

Metal deactivators inhibit the catalytic effects of such ions, especially copper, retarding the formation of gummy residues (e.g. gels containing copper mercaptide). Even concentrations of copper as low as 0.1 ppm can have detrimental effects.

An example of a metal deactivator used for gasoline and jet fuels is N,N - Disalicylidene-1,2- propane diamine. It is used in turbine and jet fuels, diesel, heating oil, and greases. It is approved for military and commercial aviation fuels. Benzotriazole and its various derivatives are also common in lubricant formulas.

Micro Crystalline Waxpolish (Renaissance Wax)

Contents

1 Introduction

2 Use

2.1 Application over other coatings

3 Formulation

4 Controversy over its use

1 - Introduction

Renaissance Wax is a brand of micro crystalline waxpolish that is widely encountered in antique restoration and museum curation. Although not appropriate for all materials, it is known to and used by almost every collection. It is also used as a primary finish for cabinetry and furniture. Renaissance wax is also used by reenactors of historic swordsmanship to protect armour and weapons. It is widely recognised that this substance is more protective and longer lasting than oil, especially for swords and helmets that are frequently touched by human hands.

To quote a typical commercial supplier of conservation materials, it is used, to revive and protect valuable furniture, leather, paintings, metals, marble, onyx, ivory etc. Freshens colours and imparts a soft sheen.

Wax coatings for conservation are most widely, and least controversially, applied to metals. This has several objectives: to produce a barrier that excludes moisture and oxygen from the metal surface, to ensure against further introduction of contaminating elements by handling, and to provide a protective layer over anticorrosion undercoatings.

Waxes should not be applied to materials with deliberately loose or powdery surfaces.

2 - Use

The wax is evenly and lightly applied over the surface, then lightly buffed with a smooth lint - free cloth to give a sheen. Where the shape of the item requires, a brush may be used instead. It is also used in jewelry making to preserve the patina of the metal.

Obviously the application technique and tools must be appropriate to any specific needs of the item being treated.

2-**1** - **Application over other coatings**

For retarding further red rot in leather bookbindings, it is common to first consolidate the leather by application of Klucel G or similar, then to apply a protective coating of Renaissance Wax.

Renaissance Wax is also commonly used in the preservation of Bronze and Copper coins. The wax seals the coins and helps prevent deterioration from moisture and air exposure. It may also help prevent the onset of the chloride-related corrosion commonly called bronze disease, although it won't arrest this once started.

Conservation of metals may also use an undercoat such as Incralac, then Renaissance Wax over this.

3 - Formulation

Renaissance Wax was originally formulated in the British Museum research laboratories in the early 1950s. It is now manufactured solely by Picreator Enterprises Ltd.

Earlier wax polishes based on beeswax and carnauba wax either contained acids or became acidic over time. Renaissance Wax was based on more stable microcrystalline waxes refined from crude oil.

Renaissance Wax also contains poly ethylene waxes. Some other microcrystalline waxes intended for conservation use (e.g. Cosmolloid 80H) do not contain these.

The formulation is :

100g	Cosmolloid 80H (Astor)
25g	Wax A (a poly ethylene wax) (BASF)

Melt together and pour into 300ml of a high flash point hydrocarbon solvent, then stir constantly until cool.

Another similar formulation, giving a harder coating, can also be made:

90 g	Cosmolloid 80H (Astor)
30 g	Ketone Resin N (BASF)
200 ml	High flash point hydrocarbon solvent

Melt together and pour into the solvent, then stir while cooling and add further quantities of white spirit to produce a suitable consistency.

4 - Controversy over its use

Wax coatings are known to be susceptible to accumulations of dust and lint. They may also obscure some fine detail.

Although Renaissance Wax is generally agreed to be a useful and stable material for conservation work, this view is not without some reservations. Owing to the polyethylene wax content, some authors have reported problems in removing it.

Modi Naturals

Contents

1 Introduction 2 History 2 Drs ducts

3 Products

1 - Introduction

Modi Naturals is a natural oil processing company based in India. It is one of India's largest oil processing companies. It has marked its entry in the fast - moving consumer goods industry, which in India is expected to grow by Rs 140,000 crore by the year 2015. Modi Naturals is a Bombay Stock Exchange listed company.

2 - History

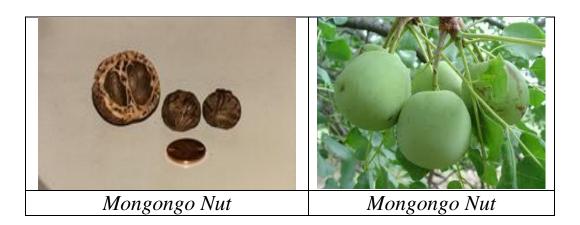
Modi Naturals was founded in 1974 by Mr. D. D. Modi. It was listed at the BSE in 1974. It was previously known as Anil Modi Oil Industries Limited which was later rechristened as Modi Naturals.

3 - Products

Olive Oil - Olive Extra Virgin Olive Oil , Olive Extra Light Olive Oil , Olive Pomace Oil , Olive Active

Tarai Shudh - Cooking Mustard Oil.

Mongongo



Contents

- 1 Introduction
- 2 Fruit
- 3 Distribution
- 4 Traditional uses
- 5 Nutrition
- 5 Economic aspects

1 - Introduction

The mongongo tree (*Schinziophyton rautanenii*) is a member of the family Euphorbiaceae and of the monotypic genus *Schinziophyton* A large, spreading tree, the mongongo reaches 15 - 20 meters tall. It is found on wooded hills and amongst sand dunes, and is associated with the Kalahari sand soil - types. The leaves are a distinctive hand-shape, and the pale yellow wood is similar in characteristics to balsa, being both lightweight and strong. The yellowish flowers occur in slender, loose sprays.

Scientific classification		
Kingdom:	Plantae	
(unranked):	Angiosperms	
(unranked):	Eudicots	
(unranked):	Rosids	

Order:	Malpighiales	
Family:	Euphorbiaceae	
Subfamily:	Crotonoideae	
Tribe:	Ricinodendreae	
Genus:	<i>Schinziophyton</i> Hutch. ex Radcl Sm.	
Species:	S. rautanenii	
Binomial nat	ne	
Schinziophyton rautanenii (Schinz) RadclSm.		
Synonyms		
<i>Ricinodendron rautanenii</i> Schinz		

2 – Fruit

Known as mongongo fruit, mongongo nut or manketti nut, the egg-shaped, velvety fruits ripen and fall between March and May each year, and contain a thin layer of edible flesh around a thick, hard, pitted shell. Inside this shell is a highly nutritious nut.

3 – Distribution

The mongongo is distributed widely throughout southern Africa. There are several distinct belts of distribution, the largest of which reaches from northern Namibia into northern Botswana, southwestern Zambia and western Zimbabwe. Another belt is found in eastern Malawi, and yet another in eastern Mozambique.

4 - Traditional uses

Mongongo nuts are a staple diet in some areas, most notably amongst the San bushmen of northern Botswana and Namibia. Archaeological evidence has shown that they have been consumed amongst San communities for over 7,000 years. Their popularity stems in part from their flavour, and in part from the fact that they store well, and remain edible for much of the year.

Dry fruits are first steamed to soften the skins. After peeling, the fruits are then cooked in water until the maroon-coloured flesh separates from the hard inner nuts. The pulp is eaten, and the nuts are saved to be roasted later. Alternatively, nuts are collected from elephant dung; the hard nut survives intact through the digestive process and the elephant does the hard work of collecting the nuts.^[1] During roasting of the nuts, direct contact with the fire is avoided, using sand to distribute the heat evenly. Once dry, the outer shell cracks easily, revealing the nut, encased within a soft, inner shell. The nuts are either eaten straight, or pounded as ingredients in other dishes.

The oil from the nuts has also been traditionally used as a body rub in the dry winter months, to clean and moisten the skin, while the hard, outer nut-shells are popular as divining "bones". The wood, being both strong and light, makes excellent fishing floats, toys, insulating material and drawing boards. More recently, it has been used to make dart-boards and packing cases.

5 - Nutrition
Per 100 grams shelled nuts:
57 g fat :
44 % polyunsaturated
17 % saturated
18 % mono unsaturated
24 g protein
193 mg calcium
527 mg magnesium
4 mg zinc
2.8 mg copper
565 mg vitamin E (and tocopherol)

Mono Unsaturated Fat

Contents

1 Introduction

- 2 Molecular description of oleic acids
- 4 Relation to health
- 4 Natural sources

1 - Introduction

In biochemistry and nutrition, *mono unsaturated fats* or *MUFA* (Mono Unsaturated Fatty Acid) are fatty acids that have one double bond in the fatty acid chain and all of the remainder of the carbonatoms in the chain are single-bonded. By contrast, polyunsaturated fatty acids have more than one double bond.

Fatty acids are long - chained molecules having an alkyl group at one end and a carboxylic acid group at the other end. Fatty acid viscosity (thickness) and melting temperature increases with decreasing number of double bonds; therefore, monounsaturated fatty acids have a higher melting point than polyunsaturated fatty acids (more double bonds) and a lower melting point than saturated fatty acids (no double bonds). Monounsaturated fatty acids are liquids at room temperature and semisolid or solid when refrigerated.

2 - Molecular description of oleic acids

Common mono unsaturated fatty acids are palmitoleic acid (16:1n-7), cis - vaccenic acid (18:1n-7) and oleic acid (18:1n-9). Palmitoleic acid has 16 carbon atoms with the first double bond occurring 7 carbon atoms away from the methyl group (and 9 carbons from the carboxyl end). It can be lengthened to the 18-carbon cis - vaccenic acid. Oleic acid has 18 carbon atoms with the first double bond occurring 9 carbon atoms away from the carboxylic acid group. The illustrations below show a molecule of oleic acid in Lewis formula and as a space-filling model.

Although polyunsaturated fats protect against cardiovascular disease by providing more membrane fluidity than mono unsaturated

fats, they are more vulnerable to lipid peroxidation (rancidity). On the other hand, some mono unsaturated fatty acids (in the same way as saturated fats) may promote insulin resistance, whereas poly unsaturated fatty acids may be protective against insulin resistance. Further more, the large scale KANWU study found that increasing monounsaturated fat and decreasing saturated fat intake could improve insulin sensitivity, but only when the overall fat intake of the diet was low. Studies have shown that substituting dietary monounsaturated fat for saturated fat is associated with increased daily physical activity and resting energy expenditure. More physical activity was associated with a higher-oleic acid diet than one of a palmitic acid diet. From the study, it is shown that more monounsaturated fats lead to less anger and irritability.

Foods containing monounsaturated fats reduce low - density lipoprotein (LDL) cholesterol, while possibly increasing high density lipoprotein (HDL) cholesterol . However, their true ability to raise HDL is still in debate.

Levels of oleic and monounsaturated fatty acids in red blood cell membranes were positively associated with breast cancer risk. The saturation index (SI) of the same membranes was inversely associated with breast cancer risk. Monounsaturated fats and low SI in erythrocyte membranes are predictors of postmenopausal breast cancer . Both of these variables depend on the activity of the enzyme 9 - d delta 9 desaturase.

In children, consumption of monounsaturated oils is associated with healthier serum lipid profiles.

It is recommended that 10 - 15 % of an adult's daily calorie intake comes from Mono unsaturated fats.

The Mediterranean Diet is one heavily influenced by mono unsaturated fats. People in Mediterranean countries consume more total fat than Northern European countries, but most of the fat is in the form of mono unsaturated fatty acids from olive oil and omega -3 fatty acids from fish, vegetables , and certain meats like lamb , while consumption of saturated fat is kept to a minimum. The diet in Crete is fairly high in total fat (40 % of total calories, almost exclusively provided by olive oil) yet affords a remarkable protection from coronary heart disease (and probably breast and colon cancers).

3 - Natural sources

Monounsaturated fats are found in natural foods such as red meat, whole milk products, nuts and high fat fruits such as olives and avocados. Olive oil is about 75 % monounsaturated fat. The high oleic variety sunflower oil contains as much as 85 % monounsaturated fat. Canola oil and Cashews are both about 58 % monounsaturated fat. Tallow (beef fat) is about 50 % monounsaturated fat and lard is about 40 % monounsaturated fat. Other sources include macadamia nut oil, grape seed oil, groundnut oil (peanut oil), sesame oil, corn oil, popcorn, whole grain wheat, cereal, oatmeal, safflower oil, almond oil, sunflower oil, hemp oil, tea-oil Camellia, and avocado oil.

Food	Sa	aturated	Mono - unsaturated	Poly - unsaturated
	As weight p	ercent (%)) of total fat	
Cooking oils				
Canola oil	8	(54	28
Corn oil	13		24	59
Olive oil	7	-	78	15
Sunflower oil	11	-	78	11
Soybean oil	15		24	58
Peanut oil	11	-	71	18
Rice bran oil	25		38	37
Coconut oil	86]	13	1
Dairy products				
Cheese, regular	64	2	29	3
Cheese, light	60		30	0

Fat composition in different foods

Milk, whole	62	28	4
Milk, 2%	62	30	0
Ice cream, gourmet	62	29	4
Ice cream, light	62	29	4
Meats			
Beef	33	38	5
Ground sirloin	38	44	4
Pork chop	35	44	8
Ham	35	49	16
Chicken breast	29	34	21
Chicken	34	23	30
Turkey breast	30	20	30
Turkey drumstick	32	22	30
Fish, orange roughy	23	15	46
Salmon	28	33	28
Hot dog, beef	42	48	5
Hot dog, turkey	28	40	22
Burger, fast food	36	44	6
Cheeseburger, fast food	43	40	7
Breaded chicken	20	39	32
Grilled chicken sandwich	26	42	20
Sausage, Polish	37	46	11
Sausage, turkey	28	40	22
Pizza, sausage	41	32	20
Pizza, cheese	60	28	5
Nuts			
Almonds dry roasted	9	65	21
Cashews dry roasted	20	59	17
Macadamia dry roasted	15	79	2
Peanut dry roasted	14	50	31
Pecans dry roasted	8	62	25
Flaxseeds, ground	8	23	65

Sesame seeds	14	38	44			
Soybeans	14	22	57			
Sunflower seeds	11	19	66			
Walnuts dry roasted	9	23	63			
Sweets and baked goods	ł					
Candy, chocolate bar	59	33	3			
Candy, fruit chews	14	44	38			
Cookie, oatmeal raisin	22	47	27			
Cookie, chocolate chip	35	42	18			
Cake, yellow	60	25	10			
Pastry, Danish	50	31	14			
Fats added during cook	Fats added during cooking or at the table					
Butter, stick	63	29	3			
Butter, whipped	62	29	4			
Margarine, stick	18	39	39			
Margarine, tub	16	33	49			
Margarine, light tub	19	46	33			
Lard	39	45	11			
Shortening	25	45	26			
Chicken fat	30	45	21			
Beef fat	41	43	3			
Dressing, blue cheese	16	54	25			
Dressing, light Italian	14	24	58			
Other						
Egg yolk fat	36	44	16			

Montan Wax

Contents

1 Introduction 2 Properties

3 Uses

1 - Introduction

Montan wax, also known as lignite wax or OP wax, is a hard wax obtained by solvent extraction of certain types of lignite or brown coal. Commercially viable deposits exist in only a few locations, including Amsdorf, Germany, and in the Ione Basin near Ione, California.

2 - Properties

Its color ranges from dark brown to light yellow when crude, or white when refined. Its composition is non-glyceride long-chain (C24 – C30) carboxylic acidesters (62 - 68 weight %), free long-chain organic acids (22 - 26 %), long-chain alcohols, ketones, and hydrocarbons (7 - 15 %), and resins; it is in effect a fossilized plant wax. Its melting range is 82 - 95 °C.

3 - Uses

It is used for making car and shoe polishes, paints, and phonograph records, and as lubricant for molding paper and plastics. About a third of total world production is used in car-polishing polishes. Formerly, its main use was making carbon paper. Unrefined montan wax contains asphalt and resins, which can be removed by refining. Montan wax in polishes improves scuff resistance, increases water repellence, and imparts high gloss.

Moustache Wax

Contents

Introduction
 Common ingredients

1 - Introduction

Moustache wax is a stiff pomade applied to a moustache as a grooming aid to hold the hairs in place, especially at the extremities. The required product strength or (stiffness) is based on whisker length and the desired style.^[1]It can also have restorative properties, which become more important as the hair length increases. The wax is usually scented and sometimes pigmented with dyes; high end products utilize various combinations of Iron Oxide to create darker shades.

Simple moustache wax comprises equal quantities of beeswax and petroleum jelly, combined in a double boiler .^[2] More sophisticated recipes may include gum arabic and a soap, scent and colouring may also be added if desired.^[3] Good moustache wax is being firm yet yielding, stiff yet malleable with staying power.^[2]

2 - Common ingredients

Beeswax

Coconut oil or shea nut butter (or any saturated vegetable oil, solid at room temperature, and not prone to rancidity)

Petroleum jelly (Vaseline) *Gum arabic* or pine resin *Scented oils Tallow*

In addition to the wax itself more experienced "waxers" use a moustache wax remover & conditioner. The reason being for this is, warm soapy water (used by the novice) removes wax build up but at the same time damages the bristles stripping it of natural oils. So an oil - based moustache wax remover,that may double as a leave-in conditioner, is preferred.

Muffin Wax

Contents

1 Introduction 2 History

1 - Introduction

Muffin Wax is an organic surf wax made from hemp oil, tree resin, bees wax and one other secret ingredient. It is packaged in muffin cases and subsequently was named 'Muffin Wax'. As a result of the packaging, ridges are formed and are claimed to help in application.

2 - History

The product was created by 'Timeless,' a Young Enterprise company formed from a group of 15 - 16 year olds attending Newquay Tretherras School in Newquay, Cornwall. Throughout the young enterprise year they won a number of awards leading up to the UK finals at the Savoy Hotel in London which they won and went to represent the UK in InterlakenSwitzerland. The company has since changed their name simply to 'Muffin Wax' and became a trading company no longer part of Young Enterprise.

Mustard Oil

Contents

1 Introduction

- 2 Pure oil
- 3 Effects on health
- 4 Nutritional information
- 5 Solution
- 6 Use in North Indian cultural and artistic activities

1 - Introduction

The term mustard oil is used for three different oils that are made from mustard seeds:

A fatty vegetable oil resulting from pressing the seeds,

An essential oil resulting from grinding the seeds, mixing them with water, and extracting the resulting volatile oil by distillation.

An oil made by infusing mustard seed extract into another vegetable oil, such as soybean oil

The pungency of mustard oil is due to the presence of allyl isothiocyanate, an activator of the TRPA1 channel.

2 - Pure oil



Ox-powered mill grinding mustard seed for oil

his oil has a distinctive pungent taste, characteristic of all plants in the mustard (Brassicaceae) family (for example, cabbage, cauliflower, turnip, radish, horseradish or wasabi). It is often used for cooking in North India, Eastern India, Nepal, Bangladesh and Pakistan. In Bengal, Orissa, Assam and Nepal, it is the traditionally preferred oil for cooking. The oil makes up about 30% of the mustard seeds. It can be produced from black mustard (*Brassica nigra*), brown Indian mustard (*Brassica juncea*), and white mustard (*Brassica hirta*).

The characteristic pungent flavour of mustard oil is due to Allyl isothiocyanate. Mustard oil has about 60% monounsaturated fatty acids (42 % erucic acid and 12 % oleic acid); it has about 21% polyunsaturated fats (6% the omega-3 alpha-linolenic acid and 15% the omega-6 linoleic acid), and it has about 12 % saturated fats.

Mustard seeds, like all seeds of the Brassica family, including canola (rapeseed) and turnip, have high levels of omega-3 (6–11%) and are a common, cheap, mass-produced source of plant-based (therefore, vegetarian) omega-3 fatty acids (see *Indo-Mediterranean* diet in the links below). Flax (linseed) oil has 55% plant-based omega-3 but is uncommon as a table or cooking oil. Soybean oil has 6% omega-3 but contains over 50% omega-6, the fatty acid that competes with the omega-3 function. Other than rapeseed and mustard oils, there are few other common sources of plant based omega-3 in Western and Indian diets. Especially when omega-6 intake is kept low, humans can convert the plant omega-3 into one of the fish omega-3s, eicosapentaenoic acid, in limited amounts, a useful source for vegetarians.

In India, mustard oil is often heated almost to smoking before it is used for cooking. However, high heat may damage the omega-3 in the oil, reducing its unique role in health.

Mustard oil is often used as a body oil for massage (see ayurveda), and is thought to reduce skin dryness, and improve blood circulation, muscular development and skin texture; the oil is also thought to be antibacterial and may even repel insects.

3 - Effects on health

The effects of erucic acid from edible oils on human health are controversial. However no negative health effects have ever been documented in humans.^[2] A four-to-one mixture of erucic acid and oleic acid constitutes Lorenzo's oil; an experimental treatment for the rare neurobiology disorder adrenoleukodystrophy.

Mustard oil was once considered unsuitable for human consumption in the United States, Canada, and the European Union due to the high content of erucic acid. This is because of early studies in rats. Subsequent studies on rats have shown that they are less able to digest vegetable fats (whether they contain erucic acid or not) than humans and pigs. Chariton *et al.* suggests that in rats: "Inefficient activation of erucic acid to erucyl-CoA and a low level of activity of triglyceride lipase and enzymes of betaoxidation for erucic acid probably contribute to the accumulation and retention of cardiac lipid." Before this process was fully understood it led to the belief that erucic acid and mustard oil were both highly toxic to humans.

Epidemiological studies^[7] suggest that, in regions where mustard oil is still used in a traditional manner, mustard oil may afford some protection against cardiovascular diseases. In this sense "traditional" means that the oil is used fresh and vegetable fats count only as a small percentage of the total caloric intake. Whether this effect is due to the nature of erucic acid *per se* to make the blood platelets less sticky, or to the presence of a reasonably high percentage of α -linolenic acid, or to a combination of properties of fresh unrefined oil, is as yet uncertain. The fact that early asymptomatic coronary disease is absent in the mustard oil cohorts tends to add weight to the hypothesis that mustard oil is protective.

The use of mustard oils in traditional societies for infant massage has been identified by one study as risking damaging skin integrity and permeability.^[9] Other studies over larger samples have shown that massaging with mustard oil improved the weight, length, and midarm and midleg circumferences as compared to infants

without massage, although sesame oil is a better candidate for this than mustard oil.

4 - Nutritional information

According to the USDA, 1 t bsp of mustard oil contains:

Calories: 126 Fat: 14 Carbohydrates: 0 Fibers: 0 Protein: 0

5 - Solution

The pungency of the condiment mustard results when ground mustard seeds are mixed with water, vinegar, or other liquid (or even when chewed). Under these conditions, a chemical reaction between the enzymemyrosinase and a glucosinolate known as sinigrin from the seeds of black mustard (Brassica nigra) or brown Indian mustard (Brassica juncea) produces allyl isothiocyanate. By distillation one can produce a very sharp-tasting essential oil, sometimes called oil of mustard, containing volatile more than 92% allyl isothiocyanate. The pungency of allyl isothiocyanate is due to the activation of the TRPA1 ion channel in sensory neurons. White mustard (Brassica hirta) does not yield allyl isothiocyanate, but a different and milder isothiocyanate.

Allyl iso thio cyanate serves the plant as a defense against herbivores. Since it is harmful to the plant itself, it is stored in the harmless form of a glucosinolate, separate from the myrosinase enzyme. Once the herbivore chews the plant, the noxious allyl isothiocyanate is produced. Allyl isothiocyanate is also responsible for the pungent taste of horseradish and wasabi. It can be produced synthetically, sometimes known as synthetic mustard oil.

Because of the contained allyl isothiocyanate, this type of mustard oil is toxic and irritates the skin and mucous membranes. In very small amounts, it is often used by the food industry for flavoring. In northern Italy, for instance, it is used in the fruit condiment called *mostarda*. It is also used to repel cats and dogs. It will also denaturealcohol, making it unfit for human consumption, thus avoiding the taxes collected on alcoholic beverages.

The CAS number of this type of mustard oil is 8007-40-7, and the CAS number of pure allyl isothiocyanate is 57-06-7.

6 - Use in North Indian cultural and artistic activities

Mustard oil was once popular as a cooking oil in northern India. In the second half of the 20th century the popularity of mustard oil receded due to the availability of mass-produced vegetable oils. It is still intricately embedded in the culture:

It is poured on both sides of the threshold when someone important comes home for the first time (e.g. a newly-wedded couple or a son or daughter when returning after a long absence, or succeeding in exams or an election.

Used as traditional jaggo pot fuel in Punjabi weddings.

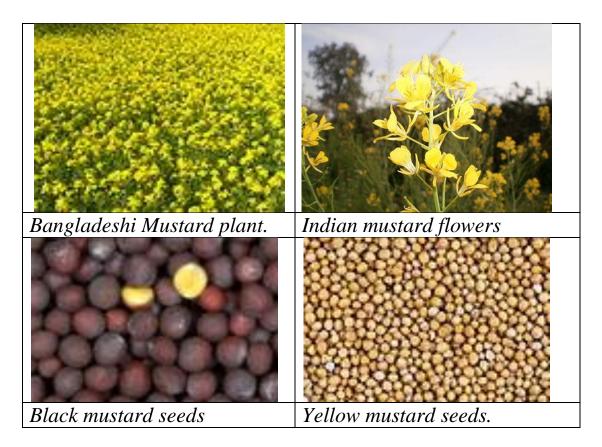
Used as part of home-made cosmetics during mayian.

Used as fuel for lighting earthen lamps (diyas) on festive occasions such as Diwali.

Used in hair. Known to be extremely beneficial for hair growth

Used in instruments. The residue cake from the mustard oil pressing is mixed with sand, mustard oil and (sometimes) tar. The resulting sticky mixture is then smeared on the inside of Dholak and Dholki membranes to add weight (from underneath) to the bass membrane. This enables the typical Indian drum glissando sound, created by rubbing one's wrist over it. This is also known as a (Tel masala) Dholak Masala or oil syahi.

Mustard Plant



Contents

1 Introduction
 2 History
 3 Varieties

1 - Introduction

Mustard plant are any of several plantspecies in the genera *Brassica* and *Sinapis*. Mustard seed is used as a spice. Grinding and mixing the seeds with water, vinegar or other liquids, creates the yellow condiment known as mustard. The seeds can also be pressed to make mustard oil, and the edible leaves can be eaten as mustard greens.

2 – History

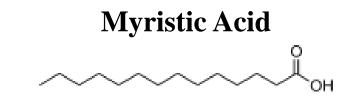
Although some varieties of mustard plants were well-established crops in Hellenistic and Roman times, Zohary and Hopf note: "There are almost no archeological records available for any of these crops." Wild forms of mustard and its relatives the radish and turnip can be found over west Asia and Europe, suggesting their domestication took place somewhere in that area. However, Zohary and Hopf conclude: "Suggestions as to the origins of these plants are necessarily based on linguistic considerations."

3 – Varieties

Mild white mustard (*Sinapis hirta*) grows wild in North Africa, the Middle East and Mediterranean Europe, and has spread farther by long cultivation; oriental mustard (*Brassica juncea*), originally from the foothills of the Himalaya, is grown commercially in India, Canada, the UK, Denmark and the US; black mustard (*Brassica nigra*) is grown in Argentina, Chile, the US and some European countries. Canada and Nepal are the world's major producers of mustard seed, between them accounting for around 57 % of world production in 2010.

There has been recent research into varieties of mustards that have a high oil content for use in the production of biodiesel, a renewable liquid fuel similar to diesel fuel. The biodiesel made from mustard oil has good cold flow properties and cetane ratings. The leftover meal after pressing out the oil has also been found to be an effective pesticide.

An interesting genetic relationship between many species of mustard has been observed, and is described as the Triangle of U.



IUPAC name : tetra decanoic acid	
Other names : C14:0 (Lipid numbers)	
Molecular formula	$C_{14}H_{28}O_2$
Molar mass	228
Density	$0.8622 \text{ g} / \text{cm}^3$
Melting point	54.4 °C
Boiling point	250.5 °C at 100 mmHg

Myristic acid, also called tetra decanoic acid, is a common saturated fatty acid with the molecular formula $CH_3(CH_2)_{12}COOH$. A myristate is a salt or ester of myristic acid.

Myristic acid is named after the nutmeg *Myristica fragrans*. Nutmeg butter is 75% trimyristin, the triglyceride of myristic acid. Besides nutmeg, myristic acid is also found in palm kernel oil, coconut oil, butter fat and is a minor component of many other animal fats. It is also found in spermaceti, the crystallized fraction of oil from the sperm whale.

Myristic acid is also commonly added co-translationally to the penultimate, nitrogen-terminus, glycine in receptor-associated kinases to confer the membrane localisation of the enzyme. The myristic acid has a sufficiently high hydrophobicity to become incorporated into the fatty acyl core of the phospholipid bilayer of the plasma membrane of the eukaryotic cell. In this way, myristic acid acts as a lipid anchor in bio membranes.

The ester isopropyl myristate is used in cosmetic and topical medicinal preparations where good absorption through the skin is desired.

Reduction of myristic acid yields myristyl aldehyde and myristyl alcohol.

Neats Foot Oil

Contents

Introduction
 Characteristics
 Uses

1 Introduction

Neats foot oil is a yellow oil rendered and purified from the shin bones and feet (but not the hooves) of cattle. "Neat" in the oil's name comes from an old name for cattle . Neats foot oil is used as a conditioning, softening and preservative agent for leather. In the 18th century, it was also used medicinally as a topical application for dry scaly skin conditions.

"Prime neats foot oil" or "neats foot oil compound" are terms used for a blend of pure neats foot oil and non - animal oils, generally mineral or other petroleum-based oils.

2 – Characteristics

Fat from warm - blooded animals normally has a high melting point, becoming hard when cool – but neats foot oil remains liquid at room temperature. This is because the relatively slender legs and feet of animals such as cattle are adapted to tolerate and maintain much lower temperatures than those of the body core, using countercurrent heat exchange in the legs between warm arterial and cooler venous blood – other body fat would become stiff at these temperatures. This characteristic of neatsfoot oil allows it to soak easily into leather.

Modern neats foot oil is still made from cattle-based products, but now, while retaining its historic name, usually is made mostly from lard, which is sold as pure neats foot oil. This formulation does darken leather . If mineral oil or other petroleum-based material is added, the product may be called "neats foot oil compound". Some brands have also been shown to be adulterated with rapeseed oil, soya oil, and other oils . The addition of mineral oils may lead to more rapid decay of non-synthetic stitching or speed breakdown of the leather itself.

3 – Uses

Neats foot oil is used on a number of leather products, although it has been replaced by synthetic products for certain applications. Items such as baseball gloves, saddles, horse harnesses and other horse tack can be softened and conditioned with neats foot oil.

If used on important historical objects, neatsfoot oil (like other leather dressings) can oxidize with time and contribute to embrittling. It also may leave an oily residue that can attract dust. On newer leather, it may cause darkening (even after a single application), thus may not be a desirable product to use when the maintenance of a lighter shade is desired. Neats foot oil is more useful for routine use on working equipment.

Neats foot oil is often used to oil sign - writers' brushes that have been used in oil based paint, as this oil is non drying and can be easily washed out with solvent at any time. Oiling the brushes reduces the build up of pigment in the ferrule, the metal part that many brushes have to hold the hairs in place.

Neatsfoot oil is used in metalworking industries as a cutting fluid for aluminum. For machining, tapping and drilling aluminium, it is superior to kerosene and various water-based cutting fluids.

Neem Oil

Contents

Introduction
 Neem oil method
 Uses
 Toxicity

1 - Introduction

Neem oil is a vegetable oil pressed from the fruits and seeds of the neem (*Azadirachta indica*), an evergreen tree which is endemic to the Indian subcontinent and has been introduced to many other areas in the tropics. It is the most important of the commercially available products of neem for organic farming and medicines.

Neem oil varies in color; it can be golden yellow, yellowish brown, reddish brown, dark brown, greenish brown, or bright red. It has a rather strong odor that is said to combine the odours of peanut and garlic. It is composed mainly of triglycerides and contains many triterpenoid compounds, which are responsible for the bitter taste. It is hydrophobic in nature; in order to emulsify it in water for application purposes, it must be formulated with appropriate surfactants.

Azadirachtin is the most well known and studied triterpenoid in neem oil. The azadirachtin content of neem oil varies from 300ppm to over 2500ppm depending on the extraction technology and quality of the neem seeds crushed. Neem oil also contains steroids (campesterol, beta - sitosterol, stigmasterol).

Average composition of neem oil fatty acids		
Common Name	Acid Name	Composition range
Omega-6	Linoleic acid	6-16 %
Omega-9	Oleic acid	25 - 54 %
Palmitic acid	Hexa decanoic acid	16 - 33 %
Stearic acid	Octa decanoic acid	9-24 %

2 - Neem oil method

The method of processing is likely to affect the composition of the oil, since the methods used, such as pressing (expelling) or solvent extraction are unlikely to remove exactly the same mix of components in the same proportions. The neem oil yield that can be obtained from neem seed kernels also varies widely in literature from 25 % to 45 %.

The oil can be obtained through pressing (crushing) of the seed kernel both through cold pressing or through a process incorporating temperature controls. Neem seed oil can also be obtained by solvent extraction of the neem seed, fruit, oil, cake or kernel. A large industry in India extracts the oil remaining in the seed cake using hexane. This solvent-extracted oil is of a lower quality as compared to the cold pressed oil and is mostly used for soap manufacturing. Neem cake is a by-product obtained in the solvent extraction process for neem oil.

3 – Uses

Neem oil is not used for cooking purposes. In India, it is used for preparing cosmetics (soap, hair products, body hygiene creams, hand creams) and in Ayurvedic , Unani and folklore traditional medicine, in the treatment of a wide range of afflictions. The most frequently reported indications in ancient Ayurvedic writings are skin diseases, inflammations and fevers, and more recently rheumatic disorders, insect repellent and insecticide effects.

Traditional Ayurvedic uses of neem include the treatment of acne, fever, leprosy, malaria, ophthalmia and tuberculosis. Various folk remedies for neem include use as an anthelmintic , antifeedant, antiseptic, diuretic, emmenagogue, contraceptive, febrifuge, parasiticide , pediculocide and insecticide. It has been used in traditional medicine for the treatment of tetanus, urticaria, eczema, scrofula and erysipelas. Traditional routes of administration of neem extracts included oral, vaginal and topical use. Neem oil has an extensive history of human use in India and surrounding regions for a variety of therapeutic purposes.

Formulations made of neem oil also find wide usage as a bio pesticide for organic farming, as it repels a wide variety of pests including the mealy bug, beet army worm, aphids, the cabbage worm, thrips, whiteflies, mites, fungus gnats, beetles, moth larvae, mushroom flies, leaf miners, caterpillars, locust, nematodes and the Japanese beetle. Neem oil is not known to be harmful to mammals, birds, earthworms or some beneficial insects such as butterflies, honeybees and ladybugs if it is not concentrated directly into their area of habitat or on their food source. It can be used as a household pesticide for ant, bedbug, cockroach, housefly, sand fly, snail, termite and mosquitoes both as repellent and larvicide.^[2] Neem oil also controls black spot, powdery mildew, anthracnose and rust (fungus).

Neem seed oil has also been found to prevent implantation and may even have an abortifacient effect similar to pennyroyal, juniper berries, wild ginger, myrrh and angelica. The effects were seen as many as ten days after fertilization in rats though it was most effective at no more than three days . In a study on rats, neem oil was given orally eight to ten days after implantation of the fetus on the uterine wall. In all cases, by day 15, the embryos were all completely resorbed by the body. The animals regained fertility on the next cycle showing no physical problems. Detailed study of the rats revealed increased levels of gamma interferon in the uterus. The neem oil enhanced the local immune response in the uterus. Post coital use of neem oil as birth control does not appear to work by hormonal changes but produces changes in the organs that make pregnancy no longer viable

Neem seed oil has recently been used for preparation of polymeric coatings as a renewable source. It has been converted into various polymeric resins viz. poly ester amides, polyetheramides and many mores. These resins were utilized further for preparation of polyurethane coatings

4 – Toxicity

Studies done when Azadirachtin (the primary active pesticidal ingredient in neem oil) was approved as a pesticide showed that when neem leaves were fed to male albino rats for 11 weeks, 100 % (reversible) infertility resulted .

Neem oil and other neem products such as neem leaves and neem tea should not be consumed by pregnant women, women trying to conceive, or children .

There is some evidence that internal medicinal use may be associated with liver damage in children.^[5]

Non - Stick Surface



Food in a non-stick pan

Contents

1 Introduction

2 History

2.1 Ancient Greece

2.2 Modern development

3 PTFE and similar compounds

3.1 Health concerns

4 Uses and limitations

1- Introduction

A non - stick surface is a surface engineered to reduce the ability of other materials to stick to it. Non - stick cookware is a common application, where the non-stick coating allows food to brown without sticking to the pan. Non - stick is often used to refer to surfaces coated with poly tetra fluoro ethylene (PTFE), which is sold under the brand name "Teflon." In recent years, however, other coatings have been marketed as non – stick, such as anodized aluminum, ceramics, silicone, enameled cast iron, and seasoned cast iron.

2 – History

2 – 1 - Ancient Greece

The Mycenaean Greeks might have used non - stick pans to make bread more than 3,000 years ago. Mycenaean ceramic griddles had one smooth side and one side covered with tiny holes. The bread was probably placed on the side with the holes, since the dough tended to stick when cooked on the smooth side of the pan. The holes seemed to be an ancient non-sticking technology, ensuring that oil spread quite evenly over the griddle.

2 – 2 - Modern development

The modern non-stick pans were made using a coating of Teflon (poly tetra fluoro ethylene or PTFE) . PTFE was invented serendipitously by Roy Plunkett in 1938 , while working for a joint venture of the DuPont company. The substance was found to have several unique properties, including very good corrosion resistance and the lowest coefficient of friction of any substance yet manufactured. PTFE was used first to make seals resistant to the uranium hexafluoride gas used in the Manhattan Project during World War II and was regarded as a military secret. Dupont registered the Teflon trademark in 1944 and soon began planning for post-war commercial use of the new product.

By 1951 Dupont had developed applications for Teflon in commercial bread and cookie-making; however the company avoided the market for consumer cookware due to potential problems associated with release of toxic gases if stove - top pans were overheated in inadequately ventilated spaces. Marc Grégoire, a French engineer, had begun coating his fishing gear with Teflon to prevent tangles. His wife Colette suggested using the same method to coat her cooking pans. The idea was successful and a French patent was granted for the process in 1954. The Tefal company was formed in 1956 to manufacture non-stick pans.

Not all modern non - stick pans use Teflon; other non-stick coatings have become available. For example, a mixture of titanium and ceramic can be sandblasted onto the pan surface, and then fired to 2,000 $^\circ C$.

3 - PTFE and similar compounds

Poly tetra fluoro ethylene (PTFE) is a synthetic fluoro polymer used in various applications including non - stick coatings. Non-stick coating systems often include a special treatment of the substrate. For example, Whit ford Corporation's *Excalibur* consists of three layers of PTFE over a metallic substrate which is first grit - blasted to roughen it, then electric-arc sprayed with a proprietary stainless steel alloy.^{[6][7]} According to Whit ford, the irregular surface promotes adhesion of the PTFE and also resists abrasion of the PTFE.

3-1 - Health concerns

When pans are over heated beyond approximately $350 \,^{\circ}$ C the PTFE coating begins to dissociate, releasing by products (PFOA) which can cause polymer fume fever in humans and can be lethal to birds. Concerns have been raised over the possible negative effects of using PTFE - coated cooking pans.

Processing of PTFE in the past used to include Per fluoro octanoic acid (PFOA) as an emulsifier, however PFOA is a persistent organic pollutant and poses both environmental and health concerns, and is now being phased out of use in PTFE processing.

4 - Uses and limitations

With other types of pans, some oil or fat is required to prevent hot food from sticking to the pan's surface. Food does not have the same tendency to stick to a non-stick surface; pans can be used with less, or no, oil, and are easier to clean, as residues do not stick to the surface.

Utensils used with PTFE-coated pans can scratch the coating, if the utensils are harder than the coating; this can be prevented by using non-metallic (usually plastic or wood) cooking tools.

According to writer Tony Polombo pans that are not non-stick are better for producing pan gravy, because the fond (the caramelized drippings that stick to the pan when meat is cooked) sticks to them, and can be turned into pan gravy by deglazing them—dissolving them in liquid.

Oil Additive

Contents

1 Introduction

2 Types of additives

2.1 Controlling chemical breakdown

2.2 For viscosity

- 2.3 For lubricity
- 2.4 For contaminant control
- 2.5 For other reasons
- 3 Additives in the aftermarket and controversy

1 - Introduction

Oil additives are chemical compounds that improve the lubricant performance of base oil (or oil "base stock"). The manufacturer of many different oils can utilize the same base stock for each formulation and can choose different additives for each specific application. Additives comprise up to 5 % by weight of some oils.

Nearly all commercial motor oils contain additives, whether the oils are synthetic or petroleum based. Essentially, only the American Petroleum Institute (API) Service SA motor oils have no additives, and they are therefore incapable of protecting modern engines.^[2] The choice of additives is determined by the application, e.g. the oil for a diesel engine with direct injection in a pickup truck (API Service CJ-4) has different additives than the oil used in a small gasoline-powered outboard motor on a boat (2 - cycle engine oil).

2 - Types of additives

Oil additives are vital for the proper lubrication and prolonged use of motor oil in modern internal combustion engines. Without many of these, the oil would become contaminated, break down, leak out, or not properly protect engine parts at all operating temperatures. Just as important are additives for oils used inside gearboxes, automatic transmissions, and bearings. Some of the most important additives include those used for viscosity and lubricity, contaminant control, for the control of chemical breakdown, and for seal conditioning. Some additives permit lubricants to perform better under severe conditions, such as extreme pressures and temperatures and high levels of contamination.

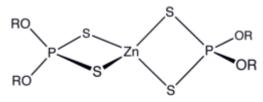
2 – 1 - Controlling chemical breakdown

Detergent additives, dating back to the early 1930s, are used to clean and neutralize oil impurities which would normally cause deposits (oil sludge) on vital engine parts. Typical detergents are magnesium sulfonates.

Corrosion or rust inhibiting additives retard the oxidation of metal inside an engine.

Antioxidant additives retard the degradation of the stock oil by oxidation. Typical additives are organic amines and phenols.

Metal deactivators create a film on metal surfaces to prevent the metal from causing the oil to be oxidized.



(R = alkyl)

Chemical structure of a zinc dialkyl dithio phosphate, a typical antiwear agent found in many motor oils.

2-2 - For viscosity

Viscosity modifiers make an oil's viscosity higher at elevated temperatures, improving its viscosity index (VI). This combats the tendency of the oil to become thin at high temperature. The advantage of using less viscous oil with a VI improver is that it will have improved low temperature fluidity as well as being viscous enough to lubricate at operating temperature. Most multi-grade oils have viscosity modifiers. Some synthetic oils are engineered to meet multigrade specifications without them.

Pour point depressants improve the oil's ability to flow at lower temperatures.

2 – 3 - For lubricity

Friction modifiers or friction reducers, like molybdenum disulfide, are used for increasing fuel economy by reducing friction between moving parts.^[4] Friction modifiers alter the lubricity of the base oil. Whale oil was used historically.

Extreme pressure agents bond to metal surfaces, keeping them from touching even at high pressure.

Anti wear additives or wear inhibiting additives cause a film to surround metal parts, helping to keep them separated. Zinc dialkyl dithio phosphate or zinc dithio phosphates are typically used.

Wear metals from friction are unintentional oil additives, but most large metal particles and impurities are removed *in situ* using either magnets or oil filters. Tribology is the science that studies how materials wear.

2 – 4 - For contaminant control

Dispersants keep contaminants (e.g. soot) suspended in the oil to prevent them from coagulating.

Anti - foam agents (defoamants) inhibit the production of air bubbles and foam in the oil which can cause a loss of lubrication, pitting, and corrosion where entrained air and combustion gases contact metal surfaces.

Antimisting agents prevent the atomization of the oil. Typical antimisting agents are silicones.

Wax crystal modifiers are dewaxing aids that improve the ability of oil filters to separate wax from oil. This type of additive has applications in the refining and transport of oil, but not for lubricant formulation.

2-5 - For other reasons

Seal conditioners cause gaskets and seals to swell to reduce oil leakage.

3 - Additives in the aftermarket and controversy

Although motor oil is manufactured with numerous additives, aftermarket oil additives exist, too. A glaring inconsistency of massmarketed aftermarket oil additives is that they often use additives which are foreign to motor oil. On the other hand, commercial additives are also sold that are designed for extended drain intervals (to replace depleted additives in used oil) or for formulating oils in situ (to make a custom motor oil from base stock). Commercial additives are identical to the additives found in off-the-shelf motor oil, while mass - marketed additives have some of each.

Some mass - market oil additives, notably the ones containing PTFE / Teflon and chlorinated paraffins , have caused a major backlash by consumers and the U.S. Federal Trade Commission which investigated many mass - marketed engine oil additives in the late 1990s.

Although there is no reason to say that all oil additives used in packaged engine oil are good and all aftermarket oil additives are bad, there has been a tendency in the aftermarket industry to make unfounded claims regarding the efficacy of their oil additives. These unsubstantiated claims have caused consumers to be lured into adding a bottle of chemicals to their engines which do not lower emissions, improve wear resistance, lower temperatures, improve efficiency, or extend engine life more than the (much cheaper) oil would have. Many consumers are convinced that aftermarket oil additives work, but many consumers are convinced that they do not work and are in fact detrimental to the engine. The topic is hotly debated on the Internet.

Although PTFE, a solid, was used in some aftermarket oil additives, users alleged that the PTFE clumped together, clogging filters. Certain people in the 1990s have reported that this was corroborated by NASA and U.S. universities . One thing to note, in defense of PTFE, is that if the particles are smaller than what was apparently used in the 1980s and 1990s, then PTFE can be an effective lubricant in suspension.

Oil Analysis

Contents

1 Introduction

2 Oil sampling

3 History

4 Standard practices

1 - Introduction

Oil analysis (OA) is the laboratory analysis of a lubricant's properties, suspended contaminants, and wear debris. *OA* is performed during routine preventive maintenance to provide meaningful and accurate information on lubricant and machine condition. By tracking oil analysis sample results over the life of a particular machine, trends can be established which can help eliminate costly repairs. The study of wear in machinery is called tribology. Tribologists often perform or interpret oil analysis data.

OA can be divided into three categories :

analysis of oil properties including those of the base oil and its additives,

analysis of contaminants,

analysis of wear debris from machinery,

2 - Oil sampling

Oil sampling is a procedure for collecting a volume of fluid from lubricated or hydraulic machinery for the purpose of oil analysis. Much like collecting forensic evidence at a crime scene, when collecting an oil sample, it is important to ensure that procedures are used to minimize disturbance of the sample during and after the sampling process. Oil samples are typically drawn into a small, clean bottle which is sealed and sent to a laboratory for analysis.

3 – History

OA was first used after World War II by the US rail road industry to monitor the health of locomotives. In 1946 the Denver and Rio Grande Railroad's research laboratory successfully detected diesel engine problems through wear metal analysis of used oils. A key factor in their success was the development of the spectrograph, an instrument which replaced several wet chemical methods for detecting and measuring individual chemical element such as iron or copper. This practice was soon accepted and used extensively throughout the railroad industry.

By 1955 OA had matured to the point that the United States Bureau of Naval Weapons began a major research program to adopt wear metal analysis for use in aircraft component failure prediction. These studies formed the basis for a Joint Oil Analysis Program (JOAP) involving all branches of the U.S. Armed Forces. The JOAP results proved conclusively that increases in component wear could be confirmed by detecting corresponding increases in the wear metal content of the lubricating oil. In 1958 Pacific Intermountain Express (P.I.E.) was the first trucking company to set up an in-house used oil analysis laboratory to control vehicle maintenance costs which was managed by Bob Herguth. In 1960 the first independent commercial oil analysis laboratory was started by Edward Forgeron in Oakland, CA.

4 - Standard practices

In addition to monitoring oil contamination and wear metals, modern usage of OA includes the analysis of the additives in oils to determine if an extended drain interval may be used. Maintenance costs can be reduced using OA to determine the remaining useful life of additives in the oil. By comparing the OA results of new and used oil, a tribologist can determine when an oil must be replaced. Careful analysis might even allow the oil to be "sweetened" to its original additive levels by either adding fresh oil or replenishing additives that were depleted.

Oil analysis professionals and analysts can get certified in compliance with ISO standards by passing exams administered by the International Council for Machinery Lubrication (ICML).

Seed Oil

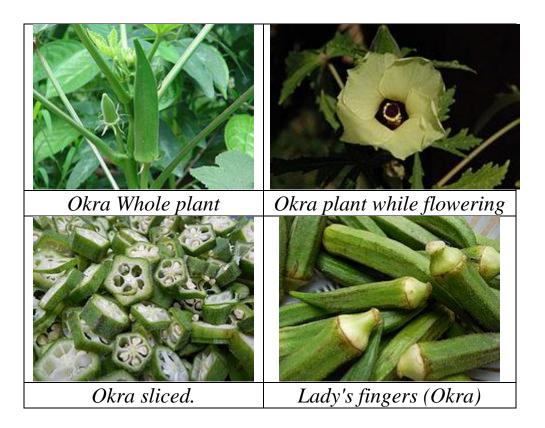
A seed oil is a vegetable oil that is obtained from the seed (endosperm) of some plant, rather than the fruit (pericarp).

Most vegetable oils are seed oils. Some common examples are sunflower oil, canola oil, and sesame oil.

Some important vegetable oils are not seed oils. Some examples are olive oil and peanut oil.

Plant	Oil
Almond	almond oil
Argan	argan oil
Borage	borage oil
Canola	canola oil
Castor	Castor oil
Coconut	coconut oil
Corn	corn oil
Cotton	cottonseed oil
Flax	linseed oil
Grape	grape seed oil
Hemp	hemp oil
Jojoba	jojoba oil
Macadamia	macadamia oil
Mustard	mustard oil
Neem	neem oil
Oil palm	palm kernel oil
Rapeseed	rapeseed oil
Safflower	safflower oil
Sesame	sesame oil
Shea	shea butter
Sunflower	sunflower oil
Tonka bean	tonka bean oil
Tung	tung oil

Okra



Contents

- 1 Introduction
- 2 Vernacular names
- 3 Structure and physiology
- 4 Origin and distribution
- 5 Nutrition
- 6 Okra seed oil
- 7 Culinary uses
 - 7.1 Alternative Medicinal properties
- 8 Common diseases
- 9 Oxalic acid

1 - Introduction

Okra (*Abelmoschus esculentus*), known in many English speaking countries as **ladies' fingers**, **bhindi**, **bamia**, or **gumbo**, is a flowering plant in the mallow family. It is valued for its edible green seed pods. The geographical origin of okra is disputed, with supporters of South Asian, Ethiopian and West African origins. The plant is cultivated in tropical, subtropical and warm temperate regions around the world .

Scientific classification	
Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
(unranked):	Rosids
Order:	Malvales
Family:	Malvaceae
Genus:	Abelmoschus
Species:	A. esculentus
Binomial name	
Abelmoschus (L.) Moench	esculentus
Synonyms	
Hibiscus esculentus L.	

2 - Vernacular names

The name *okra* is most often used in the United States, with a variant pronunciation, English Caribbean *okro*. The word *okra* is of Nigerian origin and is cognate with *okwuru* in the Igbo language spoken in Nigeria . Okra is often known as "lady's fingers" outside of Africa . In various Bantu languages, okra is called *kingombo* or a variant thereof, ^[citation needed] and this is the origin of its name in Portuguese (*quiabo*), Spanish (*quimbombó* or *guigambó*), Dutchand French (*gombo*), and also possibly of the name "gumbo", used in parts of the United States and English - speaking Caribbean for either the vegetable or a stew based on it . In India and Pakistan, and often in the United Kingdom, it is called by its Hindi / Urdu name, *bhindi*, *bhendi*, *bendai* or *bhinda*. In Bangladesh and West Bengal, India it is called *dherosh*. In Tamilnadu, India it is called *bende kayi*. In Odisha it is

called "Bhendi" . In China, it is called *qiu kui*. In Middle East (Arabic speakers) it is called *bamia* or *bamyeh* بامياء . In Bosnia and Herzegovina it is called "bamija" In Dominican Republic it is called Molondron.

3 - Structure and physiology

The species is an annual or perennial, growing to 2 m tall. It is related to such species as cotton, cocoa, and hibiscus. The leaves are 10 - 20 cm long and broad, palmately lobed with 5 - 7 lobes. The flowers are 4 - 8 cm in diameter, with five white to yellow petals, often with a red or purple spot at the base of each petal. The fruit is a capsule up to 18 cm long, containing numerous seeds.

Abelmoschus esculentus is cultivated throughout the tropical and warm temperate regions of the world for its fibrous fruits or pods containing round, white seeds. It is among the most heat- and drought-tolerant vegetable species in the world and will tolerate soils with heavy clay and intermittent moisture but frost can damage the pods.

In cultivation, the seeds are soaked overnight prior to planting to a depth of 1 - 2 cm. Germination occurs between six days (soaked seeds) and three weeks. Seedlings require ample water. The seed pods rapidly become fibrous and woody, and, to be edible, must be harvested within a week of the fruit having been pollinated. The fruits are harvested when immature and eaten as a vegetable.

4 - Origin and distribution

Okra is an allopolyploid of uncertain parentage (proposed parents include *Abelmoschus ficulneus*, *A. tuberculatus* and a reported "diploid" form of okra). Truly wild (as opposed to naturalized) populations are not known with certainty and the species may be a cultigen.

The geographical origin of okra is disputed, with supporters of South Asian, Ethiopian and West African origins. Supporters of a South Asian origin point to the presence of its proposed parents in that region. Supporters of a West African origin point to the greater diversity of okra in that region.

The Egyptians and Moors of the 12th and 13th centuries used the Arabic word for the plant, *bamya*, suggesting it had come from the east. The plant may have entered southwest Asia across the Red Sea or the Bab – el - Mandeb strait to the Arabian Peninsula, rather than north across the Sahara, or from India. One of the earliest accounts is by a Spanish Moor who visited Egypt in 1216, who described the plant under cultivation by the locals who ate the tender, young pods with meal.

From Arabia, the plant spread around the shores of the Mediterranean Sea and eastward. The plant was introduced to the Americas by ships plying the Atlantic slave trade by 1658, when its presence was recorded in Brazil. It was further documented in Suriname in 1686. In compound farms in the rainforest of southeastern Nigeria (Okafor and Fernandes, 1986), farmers have developed a multi - crop system that provides a diversified and continuous production of food, combining species with different maturity periods such as yams, cassava, cocoyams, bananas, plantain, maize, okra, pumpkin, melon, leafy vegetables and a variety of trees and shrubs, 60 of which provide food products. This ensures a balanced diet but also reduces the need for storage in an area where post-harvest losses are high.

Okra may have been introduced to south eastern North America in the early 18th century. It was being grown as far north as Philadelphia by 1748. Thomas Jefferson noted it was well established in Virginia by 1781. It was commonplace throughout the Southern United States by 1800, and the first mention of different cultivars was in 1806.

5 – Nutrition

Okra, raw		
Nutritional value per 100 g		
Energy	33 kcal (140 kJ)	
Carbohydrates	7.45 g	
- Sugars	1.48 g	
- Dietary fiber	3.2 g	
Fat	0.19 g	
Protein	2.00 g	
Water	90.17 g	
Vitamin A equiv.	36 µg (5 %)	
Thiamine (vit. B ₁)	0.2 mg (17 %)	
Riboflavin (vit. B ₂)	0.06 mg (5 %)	
Niacin (vit. B ₃)	1 mg (7 %)	
Vitamin C	23 mg (28 %)	
Vitamin E	0.27 mg (2 %)	
Vitamin K	31.3 µg (30 %)	
Calcium	82 mg (8 %)	
Iron	0.62 mg (5 %)	
Magnesium	57 mg (16 %)	
Potassium	299 mg (6 %)	
Zinc	0.58 mg (6 %)	

Okra is a popular health food due to its high fiber, vitamin C, and folate content. Okra is also known for being high in antioxidants. Okra is also a good source of calcium and potassium.

6 - Okra seed oil

Greenish - yellow edible okra oil is pressed from okra seeds; it has a pleasant taste and odor, and is high in unsaturated fats such as oleic acid and linoleic acid.^[9] The oil content of some varieties of the seed can be quite high, about 40%. Oil yields from okra crops are also high. At 794 kg/ha, the yield was exceeded only by that of sunflower oil in one trial . A 1920 study found that a sample contained 15% oil.^[11] A 2009 study found okra oil suitable for use as a biofuel.^[12]

7 - Culinary uses

The products of the plant are mucilaginous, resulting in the characteristic "goo" or slime when the seed pods are cooked; the mucilage contains a usable form of soluble fiber. Some people cook okra this way, others prefer to minimize sliminess; keeping the pods intact, and brief cooking, for example stir - frying, help to achieve this. Cooking with acidic ingredients such as a few drops of lemon juice, tomatoes, or vinegar may help. Alternatively, the pods can be sliced thinly and cooked for a long time so the mucilage dissolves, as in gumbo. The cooked leaves can also be used as a powerful soup thickener. The immature pods may also be pickled. In the deep south of the United States Okra is a delicacy, especially deep fried in oil, after breading. Several cafes and nationwide eating establishments including The Ole Cracker Barrell and the Corral, serve Deep fried okra usually with a side order of a sauce like buttermilk dressing.

In Syria, Tunisia, Egypt, Albania, Bosnia, Greece, Bulgaria, Republic of Macedonia, Iran, Iraq, Jordan, Lebanon, Turkey, and Yemen, and other parts of the eastern Mediterranean, including Palestine, Cyprus, okra is widely used in a thick stew made with vegetables and meat. In Bosnia and most of West Asia, okra is known as *bamia* or *bamya*. West Asian cuisine usually uses young okra pods, usually cooked whole. In India, the harvesting is done at a later stage, when the pods and seeds are larger.

It is popular in Indian and Pakistani cuisine, where chopped pieces are stir - fried with spices, pickled, salted or added to gravybased preparations such as *bhindi ghosht* and *sambar*. It is also simmered in coconut based curries or tossed with ground mustard seeds. In India, it is also used in curries. In curries, okra is used whole, trimmed only of excess stalk and keeping the hard conical top, which is discarded at the time of eating. In South India, Okra is cut into small circular pieces about 1/4 inch thick and stick fried in oil with salt and hot pepper powder to make delicious curry. However, when used in sambar it is cut into pieces which are 1 inch thick to prevent it from dissolving when the sambar is let to simmer.

In Malaysia okra is commonly a part of *yong tau foo* cuisine, typically stuffed with processed fish paste (surimi) and boiled with a selection of vegetables and tofu, and served in a soup with noodles.

In Malawi it is preferred cooked and stirred with sodium bicarbonate to make it more slimy. It is then commonly eaten with nsima (pap) made from raw maize flour or maize husks flour.

In the Caribbean islands, okra is eaten in soup. In Curaçao the soup is known as *jambo* which primarily is made out of the okra's mucilage. It is often prepared with fish and *funchi*, a dish made out of cornmeal and boiling water. In Haiti, it is cooked with rice and maize, and also used as a sauce for meat. In Cuba, it is called *quimbombó*, along with a stew using okra as its primary ingredient. In Dominican Republic is eaten as if in salad and also cooked with rice.

It became a popular vegetable in Japanese cuisine toward the end of the 19th century, served with soy sauce and *katsuobushi*, or as tempura.

In the Philippines, okra can be found among traditional dishes like pinakbet, dinengdeng, and sinigang. Because of its mild taste and ubiquity, okra can also be cooked adobo - style, or served steamed or boiled in a salad with tomatoes, onion and bagoong.

Okra forms part of several regional "signature" dishes. *Frango com quiabo* (chicken with okra) is a Brazilian dish especially famous in the region of Minas Gerais, and it is the main ingredient of caruru, a bahian food with dende oil. Gumbo, a hearty stew whose key ingredient is okra, is found throughout the Gulf Coast of the United States and in the South Carolina Lowcountry . Deep - or shallow -

fried okra coated with cornmeal, flour, etc. is widely eaten in the southern United States . Okra is also an ingredient expected in callaloo, a Caribbean dish and the national dish of Trinidad and Tobago. It is also a part of the national dish of Barbados *coucou* (turned cornmeal). Okra is also eaten in Nigeria, where draw soup is a popular dish, often eaten with *garri* or cassava. In Vietnam, okra is the important ingredient in the dish *canh chua*. Okra slices can also be added to *ratatouille*.

Okra leaves may be cooked in a similar way to the greens of beets or dandelions. Since the entire plant is edible, the leaves are also eaten raw in salads. Okra seeds may be roasted and ground to form a caffeine - free substitute for coffee. When importation of coffee was disrupted by the American Civil War in 1861, the *Austin State Gazette* said "An acre of okra will produce seed enough to furnish a plantation of fifty negroes with coffee in every way equal to that imported from Rio"

7 – 1 - Alternative Medicinal properties

Naturopathic medicines include okra for intestinal and irritable bowel dysfunction due to its mucilaginous properties. Utilizing the whole pod during cooking maintains the potency and the effectiveness of the pod contents. These are still present when chopped, but to a lesser degree. The consistency of the mucilaginous seeds are a good binder in the recipe in which they are cooked too, giving dishes a nice glossy appearance. In complementary medicine it is believed that the gut and intestines are the main/dominant organs of the body and that all foods which facilitate the digestive process and binary systems are beneficial to the body as a whole, for this reason, providing a natural lining to the intestinal mucosa, prevents leakages from ailments such as ulcerations, bacterial imbalances and general dyspepsia. Thus okra's fibrous and mucilaginous properties are likely to have excellent results in lowering inflammation, increasing active transportation of nutritional conversion (take up) and reduce fluid retention and subsequent secondary complications associated with the latter.

Unspecified parts of the plant were reported in 1898 to possess diuretic properties ; this is referenced in numerous sources associated with herbal and traditional medicine.

Some studies are being developed targeting okra extract as remedy to manage diabetes.

8 - Common diseases

The most common disease afflicting the okra plant is verticillium wilt, often causing a yellowing and wilting of the leaves. Other diseases include powdery mildew in dry tropical regions, leaf spots, and root-knot nematodes.

9 - Oxalic acid]

Oxalic acid is a naturally occurring colourless organic acid found in many plants including okra. Okra contains 0.05g / 100 g of oxalic acid . The toxicity of oxalic acid is due to kidney failure, which arises because it causes precipitation of solid calcium oxalate . the main component of kidney stones . Oxalic acid can also cause joint pain due to the formation of similar precipitates in the joints.

Oleic Acid

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1 Introduction

2 Occurrence

2.1 As an insect pheromone

3 Production and chemical behavior

4 Uses

5 Health effects

1 - Introduction

Oleic acid is a fatty acid that occurs naturally in various animal and vegetable fats and oils. It is an odorless, colourless oil, although commercial samples may be yellowish. In chemical terms, oleic acid is classified as a monounsaturated omega-9 fatty acid, abbreviated with a lipid number of 18:1 cis-9. It has the formula $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$.^[2] The term "oleic" means related to, or derived from, oil or olive, the oil that is predominantly composed of oleic acid.

IUPAC name :(9Z)-Octadec-9-enoic acidOther names :(9Z) - Octa decenoic acid(Z) - Octa dec-9-enoic acidcis-9-Octa decenoic acidcis- Δ^9 -Octa decenoic acidOleic acid18:1 cis-9Molecular formula $C_{18} H_{34} O_2$ Molar mass282 g mol^{-1}

Appearance	Pale yellow or brownish yellow oily liquid with lard - like odor
Density	0.895 g / mL
Melting point	13 to 14 °C
Boiling point	360 °C
Solubility in water	Insoluble
Solubility in Ethanol	Soluble

2 – Occurrence

Fatty acids (or as their salts) do not often occur as such in biological systems. Instead fatty acids like oleic acid occur as their esters, commonly the triglycerides, which are the greasy materials in many natural oils. Via the process of saponification, the fatty acids can be obtained.

Triglycerides of oleic acid compose the majority of olive oil, although there may be less than 2.0% as free acid in the virgin olive oil, with higher concentrations making the olive oil inedible. It also makes up 59 -75 % of pecan oil, 61 % of canola oil, 36 - 67 % of peanut oil, 60 % of macadamia oi 1, 20 - 85 % of sunflower oil (the latter in the high oleic variant), 15 - 20 % of grape seed oil, sea buckthorn oil, and sesame oil, and 14 % of poppy seed oil. It is abundantly present in many animal fats, constituting 37 to 56 % of chicken and turkey fat and 44 to 47 % of lard.

Oleic acid is the most abundant fatty acid in human adipose tissue.

2 – 1 - As an insect pheromone

Oleic acid is emitted by the decaying corpses of a number of insects, including bees and *Pogonomyrmex* ants, and triggers the instincts of living workers to remove the dead bodies from the hive. If a live bee or ant is daubed with oleic acid, it is dragged off for disposal as if it were dead. The oleic acid smell also may indicate danger to living insects, prompting them to avoid others who have succumbed to disease or places where predators lurk.

3 - Production and chemical behavior

The biosynthesis of oleic acid involves the action of the enzyme stearoyl - CoA 9-desaturase acting on stearoyl - CoA. In effect, stearic acid is dehydrogenated to give the mono unsaturated derivative oleic acid.

Oleic acid undergoes the reactions of carboxylic acids and alkenes. It is soluble in aqueous base to give soaps called oleates. Iodine adds across the double bond. Hydrogenation of the double bond yields the saturated derivative stearic acid. Oxidation at the double bond occurs slowly in air, and is known as rancidification in foodstuffs or drying in coatings. Reduction of the carboxylic acid group yields oleyl alcohol. Ozonolysis of oleic acid is an important route to azelaic acid. The coproduct is nonanoic acid :

 $\begin{array}{l} H_{17} \, C_8 \, CH = CH \, C_7 \, H_{14} \, CO_2 H + 4"O" \rightarrow \\ H_{17} \, C_8 \, CO_2 H + HO_2 \, C \, C_7 H_{14} \, CO_2 H \end{array}$

Esters of azelaic acid find applications in lubrication and plasticizers.

The *trans* isomer of oleic acid is called elaidic acid (hence the name elaidinization for a reaction that converts oleic acid to elaidic acid).

A naturally occurring isomer of oleic acid is petroselinic acid.

In chemical analysis, fatty acids are separated by gas chromatography of methyl esters; additionally, a separation of unsaturated isomers is possible by argentation thin - layer chromatography.

4 – Uses

Oleic acid (in triglyceride form) is included in normal human diet as part of animal fats and vegetable oil.

Oleic acid as its sodium salt is a major component of soap as an emulsifying agent. It is also used as emollient . Small amounts of oleic acid are used as an excipient in pharmaceuticals , oleic acid is used as an emulsifying or solubilizing agent in aerosol products .

Oleic acid is also used to induce lung damage in certain types of animals, for the purpose of testing new drugs and other means to treat lung diseases. Specifically in sheep, intravenous administration of oleic acid causes acute lung injury with corresponding pulmonary edema . This sort of research has been of particular benefit to premature newborns, for whom treatment for under developed lungs (and associated complications) often is a matter of life and death.

Oleic acid is used as a soldering flux in stained glass work for joining lead came.

5 - Health effects

Oleic acid is a common mono unsaturated fat in human diet. Mono unsaturated fat consumption has been associated with decreased low - density lipoprotein (LDL) cholesterol, and possibly increased high - density lipoprotein (HDL) cholesterol. However, its ability to raise HDL is still debated.

Oleic acid may hinder the progression of Adreno Leuko Dystrophy (ALD), a fatal disease that affects the brain and adrenal glands.

Oleic acid may be responsible for the hypotensive (blood pressure reducing) effects of olive oil. Adverse effects also have been documented, however, since both oleic and mono unsaturated fatty acid levels in the membranes of red blood cells have been associated with increased risk of breast cancer, although the consumption of oleate in olive oil has been associated with a *decreased* risk of breast cancer

Oleo Chemicals

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Introduction
 Industry in Asia
 Applications
 Hydrolysis
 Trans actorification

5 Trans esterification

1 - Introduction

Oleo chemicals are chemicals derived from plant and animal fats. They are analogous to petrochemicals derived from petroleum.

The formation of basic oleo chemical substances like fatty acids, fatty acid methyl esters (FAME), fatty alcohols, fatty amines and glycerols are by various chemical and enzymatic reactions. Intermediate chemical substances produced from these basic oleochemical substances include alcohol ethoxylates, alcohol sulfates, alcohol ether sulfates, quaternary ammonium salts, mono acyl glycerols (MAG), di acyl glycerols (DAG), structured triacylglycerols (TAG), sugar esters, and other oleochemical products.

As the price of crude oil rose in the late 1970s, manufacturers switched from petrochemicals to oleochemicals because plant-based lauric oils processed from palm kernel oil were cheaper. Since then, palm kernel oil is predominantly used in the production of laundry detergent and personal care items like toothpaste, soap bars, shower cream and shampoo.

2 - Industry in Asia

South east Asian countries' rapid production growth of palm oil and palm kernel oil in the 1980s spurred the oleochemical industry in Malaysia, Indonesia, and Thailand. Many oleochemical plants were built. Though a nascent and small industry when pitted against big detergent giants in the US and Europe, oleochemical companies in southeast Asia had competitive edge in cheap ingredients.^[4] The US fatty chemical industry found it difficult to consistently maintain acceptable levels of profits. Competition was intense with market shares divided among many companies there where neither imports nor exports played a significant role . By the late 1990s, giants like Henkel, Unilever, and Petrofina sold their oleochemical factories to focus on higher profit activities like retail of consumer goods. Since the Europe outbreak of 'mad cow disease' or (bovine spongiform encephalopathy) in 2000, tallow is replaced for many uses by vegetable oleic fatty acids, such as palm kernel and coconut oils.

3 - Applications

The most common application of oleochemicals is biodiesel production. Fatty acids are esterified with an alcohol, commonly methanol to form methyl esters. Another common application is in the production of detergents. Lauric acid is used to produce sodium lauryl sulfate, the main ingredient in many personal care products. Other applications include the production of lubricants, green solvents, and bioplastics.

4 - Hydrolysis

The fat splitting (or hydrolysis) of the triglycerides produces fatty acids and glycerol :

 $RCOOCH_2 - CHOOCR - CH_2OCOR + 3 H_2O \rightarrow$

$3 \text{ RCOOH} + \text{HOCH}_2 - \text{CHOH} - \text{CH}_2\text{OH}$

The addition of base helps the reaction proceed more quickly.

5 - Trans esterification

If oils or fats are made to react with an alcohol (R'OH) instead of with water, the process is alcoholysis. It is also called trans esterification, because the glycerol fragment of the fatty acid tri-ester is exchanged for that of another alcohol. Thus, the products are fatty acid esters and glycerol :

 $RCOOCH_2 - CHOOCR - CH_2OCOR + 3 R'OH \rightarrow$

 $3 \text{ RCOOR'} + \text{HOCH}_2 - \text{CHOH} - \text{CH}_2\text{OH}$

The fatty acid or fatty esters produced by these methods may be transformed. For example, hydrogenation converts unsaturated fatty acids into saturated fatty acids. The acids or esters can also be reduced to give fatty alcohols.

Olive Oil

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1 - Introduction

Olive oil is a fat obtained from the olive (the fruit of *Olea europaea*; family Oleaceae), a traditional tree crop of the Mediterranean Basin. The oil is produced by pressing whole olives.

It is commonly used in cooking, cosmetics, pharmaceuticals, and soaps and as a fuel for traditional oil lamps. Olive oil is used throughout the world, but especially in the Mediterranean countries and, in particular, in Spain, Italy and Greece, which has the highest consumption per person.

	Olive oil
Saturated fats	Palmitic acid : $7.5 - 20 \%$ Stearic acid : $0.5 - 5 \%$ Arachidic acid : $< 0.6 \%$ Behenic acid : $< 0.3 \%$ Myristic acid : $< 0.05 \%$ Lignoceric acid : $< 0.2 \%$
Unsaturated fats	yes
Mono unsaturated	Oleic acid : $55 - 83 \%$ Palmitoleic acid : $0.3 - 3.5 \%$
Poly unsaturated	Linoleic acid : $3.5 - 21$ % α -Linolenic acid : < 1.0 %
Food energy per 100 g	3,700 kJ (880 kcal)
Melting point	– 6.0 °C
Boiling point	300 °C
Smoke point	190 °C (virgin) 210 °C (refined)
Specific gravity at 20 °C	911 kg / m ³
Viscosity at 20 °C	84 cP
Refractive index	1.4677–1.4705 (virgin and refined) 1.4680–1.4707 (pomace)
Iodine value	75 – 94 (virgin and refined) 75 – 92 (pomace)
Acid value	maximum: 6.6 (refined and pomace) 0.6 (extra-virgin)
Saponification value	184 – 196 (virgin and refined) 182 – 193 (pomace)
Peroxide value	20 (virgin) 10 (refined and pomace)

2 – History

2-1 - Early cultivation

The olive tree is native to the Mediterranean basin; wild olives were collected by Neolithic peoples as early as the 8th millennium BC.^[3] The wild olive tree originated in Asia Minor or in ancient Greece. It is not clear when and where olive trees were first domesticated: in Asia Minor in the 6th millennium, along the Levantine coast stretching from the Sinai Peninsula and Israel to modern Turkey in the 4th millennium, or some where in the Mesopotamian Fertile Crescent in the 3rd millennium.



Ancient Greek olive oil production workshop in Klazomenai, Ionia (modern Turkey)

Archeological evidence shows that olives were turned into oil by 4500 BC by Canaanites in present - day Palestine . Until 1500 BC, eastern coastal areas of the Mediterranean were most heavily cultivated. Evidence also suggests that olives were being grown in Crete as long ago as 2,500 BC. The earliest surviving olive oil amphorae date to 3500 BC (Early Minoan times), though the production of olive is assumed to have started before 4000 BC. Olive trees were certainly cultivated by the Late Minoan period (1500 BC) in Crete, and perhaps as early as the Early Minoan.^[6] The cultivation of olive trees in Crete became particularly intense in the post-palatial period and played an important role in the island's economy, as it did across the Mediterranean.

Recent genetic studies suggest that species used by modern cultivators descend from multiple wild populations, but a detailed history of domestication is not yet under stood .

2 – 2 - Production and trade



Ancient oil press (Bodrum Museum of Underwater Archaeology, Bodrum, Turkey)

Olive trees and oil production in the Eastern Mediterranean can be traced to archives of the ancient city - state Ebla (2600 - 2240 BC) which were located on the outskirts of the Syrian city Aleppo. Here some dozen documents dated 2400 BC describe lands of the king and the queen. These belonged to a library of clay tablets perfectly preserved by having been baked in the fire that destroyed the palace. A later source is the frequent mentions of oil in Tanakh.^[citation needed]

Dynastic Egyptians before 2000 BC imported olive oil from Crete, Syria and Canaan and oil was an important item of commerce and wealth. Remains of olive oil have been found in jugs over 4,000 years old in a tomb on the island of Naxos in the Aegean Sea. Sinuhe, the Egyptian exile who lived in northern Canaan about 1960 BC, wrote of abundant olive trees.

Besides food, olive oil has been used for religious rituals, medicines, as a fuel in oil lamps, soap - making, and skin care application. The Minoans used olive oil in religious ceremonies. The oil became a principal product of the Minoan civilization, where it is thought to have represented wealth. The Minoans put the pulp into settling tanks and, when the oil had risen to the top, drained the water from the bottom . Olive tree growing reached Iberia and Etruscan cities well before the 8th century BC through trade with the Phoenicians and Carthage, then was spread into Southern Gaul by the Celtic tribes during the 7th century BC.

The first recorded oil extraction is known from the Hebrew Bible and took place during the Exodus from Egypt, during the 13th century BC. During this time, the oil was derived through handsqueezing the berries and stored in special containers under guard of the priests. A commercial mill for non-sacramental use of oil was in use in the tribal Confederation and later in 1000 BC, the fertile crescent, an area consisting of present day Palestine, Lebanon, and Israel. Over 100 olive presses have been found in Tel Miqne (Ekron), where the Biblical Philistines also produced oil. These presses are estimated to have had output of between 1,000 and 3,000 tons of olive oil per season.

Many ancient presses still exist in the Eastern Mediterranean region, and some dating to the Roman period are still in use today.



Olive crusher (trapetum) in Pompeii (79 AD)

Olive oil was common in ancient Greek and Roman cuisine. According to Herodotus, Apollodorus, Plutarch, Pausanias, Ovid and other sources, the city of Athens obtained its name because Athenians considered olive oil essential, preferring the offering of the goddess Athena (an olive tree) over the offering of Poseidon (a spring of salt water gushing out of a cliff). The Spartans and other Greeks used oil to rub themselves while exercising in the gymnasia. From its beginnings early in the 7th century BC, the cosmetic use of olive oil quickly spread to all of Hellenic city states, together with athletes training in the nude, and lasted close to a thousand years despite its great expense.^{[9][10]} Olive trees were planted in the entire Mediterranean basin during evolution of the Roman republic and empire. According to the historian Pliny, Italy had "excellent olive oil at reasonable prices" by the 1st century AD, "the best in the Mediterranean", he maintained.



The Manufacture of Oil, 16th century engraving by J. Amman

The importance and antiquity of olive oil can be seen in the fact that the English word *oil* derives from c. 1175, *olive oil*, from Anglo-Fr. and O.N.Fr. *olie*, from O.Fr. *oile* (12c., Mod.Fr. *huile*), from L. *oleum* "oil, olive oil" (cf. It. *olio*), from Gk. *elaion* "olive tree",^[11] which may have been borrowed through trade networks from the Semitic Phoenician use of *el'yon* meaning "superior", probably in recognized comparison to other vegetable or animal fats available at the time. Robin Lane Fox suggests that the Latin borrowing of Greek *elaion* for oil (Latin *oleum*) is itself a marker for improved Greek varieties of oil-producing olive, already present in Italy as Latin was forming, brought by Euboean traders, whose presence in Latium is signaled by remains of their characteristic pottery, from the mid-8th century.

3 – Varieties

There are many different olive varieties or olives, each with a particular flavor texture and shelf - life that make them more or less suitable for different applications such as direct human consumption on bread or in salads, indirect consumption in domestic cooking or catering, or industrial uses such as animal feed or engineering applications .

4 - Production and consumption

Spain produces 43.8 % of world production of olive oil . 75 % of Spain's production comes from the region of Andalucía, particularly within Jaén province, although other regions also produce excellent oil. Although Italy is a net importer of olive oil, it still accounts for 21.5 % of the world's production. Major Italian producers are known as "Città dell'Olio", "oil cities"; including Lucca, Florence and Siena, in Tuscany. However the largest production is harvested in Puglia and Calabria. Greece accounts for 12.1% of world production and Syria for 6.1 %, as third and fourth largest producers in the World. Portugal accounts for 5 % and its main export market is Brazil. Morocco is the world's sixth largest producer.

Australia now produces a substantial amount of olive oil. Many Australian producers only make premium oils, while a number of corporate growers operate groves of a million trees or more and produce oils for the general market. Australian olive oil is exported to Asia, Europe and the United States.

In North America, Italian and Spanish olive oils are the bestknown, and top - quality extra - virgin oils from Italy, Spain, Portugal and Greece are sold at high prices, often in "prestige" packaging. A large part of U.S. olive oil imports come from Italy, Spain, and Turkey. The U.S. imported 181,000 m³ of olive oil in 1998, of which 131,000 m³ came from Italy.

Turkey, New Zealand, The Republic of South Africa,^[17] Argentina and Chile also produce extra virgin olive oil.

Olive orchards in Arizona, California, and Texas are producing olive oil that is appearing on USA grocery market shelves alongside the Mediterranean olive oils

Major producers of olive oil in the world between 2000 and 2009

Country	2000 (tones)	%	2005 (tones)	%	2009 (tones)	%
Spain	962,400	38.2%	819,428	32.1%	1,199,200	41.2%
Italy	507,400	20.1%	671,315	26.3%	587,700	20.2%

Greece	408,375	16.2%	386,385	15.1%	332,600	11.4%
Syria	165,354	6.6%	123,143	4.8%	168,163	5.8%
Tunisia	115,000	4.6%	210,000	8.2%	150,000	5.2%
Turkey	185,000	7.3%	115,000	4.5%	143,600	4.9%
Morocco	40,000	1.6%	50,000	2.0%	95,300	3.3%
Algeria	30,488	1.2%	34,694	1.4%	56,000	1.9%
Portugal	25,974	1.0%	31,817	1.2%	53,300	1.8%
Argentina	n 10,500	0.4%	20,000	0.8%	22,700	0.8%
Lebanon	5,300	0.2%	6,800	0.3%	19,700	0.7%
Jordan	27,202	1.1%	17,458	0.7%	16,760	0.6%
Libya	6,000	0.2%	7,900	0.3%	15,000	0.5%
TOTAL	2,518,629	100.0%	2,552,182	100.0%	2,911,11	5 100%

5 – Regulation

Olive oil is classified by how it was produced, by its chemistry, and by panels that perform olive oil taste testing.



International Olive Council building

The International Olive Council (IOC) — an intergovernmental organization based in Madrid, Spain, with 16 member states plus the European Union . — promotes olive oil around the world by tracking production, defining quality standards, and monitoring authenticity. The IOC officially governs 95 % of international production and holds great influence over the rest. The EU regulates the use of different protected designation of origin labels for olive oils .

The United States is not a member of the IOC and is not subject to its authority, but on October 25, 2010, the U.S. Department of

Agriculture adopted new voluntary olive oil grading standards that closely parallel those of the IOC, with some adjustments for the characteristics of olives grown in the U.S.^[24] Additionally, U.S. Customs regulations on "country of origin" state that if a non-origin nation is shown on the label, then the real origin must be shown on the same side of the label and in comparable size letters so as not to mislead the consumer . Yet most major U.S. brands continue to put "imported from Italy" on the front label in large letters and other origins on the back in very small print.^[27] "In fact, olive oil labeled 'Italian' often comes from Turkey, Tunisia, Morocco, Spain, and Greece."^[28] This makes it unclear what percentage of the olive oil is really of Italian origin.

5 – 1- Commercial grades

All production begins by transforming the olive fruit into olive paste by crushing or pressing. This paste is then malaxed (slowly churned or mixed) to allow the microscopic oil droplets to agglomerate. The oil is then separated from the watery matter and fruit pulp with the use of a press (traditional method) or centrifugation (modern method). After extraction the remnant solid substance, called pomace, still contains a small quantity of oil.

The grades of oil extracted from the olive fruit can be classified as:

Virgin means the oil was produced by the use of mechanical means only, with no chemical treatment. The term *virgin oil* with reference to production method includes both *Virgin* and *Extra-Virgin* olive oil products, depending on quality (see next section).

Lampante oil is olive oil extracted by virgin (mechanical) methods but not suitable as food; *lampante* is Italian for "lamp," referring to the use of such oil for burning in lamps. Lampante oil can be used for industrial purposes, or refined (see below) to make it edible.

Refined means that the oil has been chemically treated to neutralize strong tastes (characterized as defects) and neutralize the acid content (free fatty acids). Virgin olive oil (including the grades

extra-virgin olive oil and virgin olive oil) there fore cannot contain any refined oil.

Olive pomace oil means oil extracted from the pomace using solvents, mostly hexane, and by heat.

In countries that adhere to the standards of the International Olive Council (IOC), as well as in Australia, and under the voluntary USDA labeling standards in the United States :

Extra-virgin olive oil Comes from virgin oil production only, and is of higher quality: amongst other things, it contains no more than 0.8 % free acidity (see below), and is judged to have a superior taste, having some fruitiness and no defined sensory defects. Extra-virgin olive oil accounts for less than 10% of oil in many producing countries; the percentage is far higher in the Mediterranean countries (Greece: 80%, Italy: 65%, Spain 30%).

Virgin olive oil Comes from virgin oil production only, but is of slightly lower quality, with free acidity of up to 1.5%, and is judged to have a good taste.

Refined olive oil is the olive oil obtained from virgin olive oils by refining methods that do not lead to alterations in the initial glyceridic structure. It has a free acidity, expressed as oleic acid, of not more than 0.3 grams per 100 grams (0.3%) and its other characteristics correspond to those fixed for this category in this standard. This is obtained by refining virgin olive oils with a high acidity level and/or organoleptic defects that are eliminated after refining. Note that no solvents have been used to extract the oil, but it has been refined with the use of charcoal and other chemical and physical filters. Oils labeled as *Pure olive oil* or *Olive oil* are primarily refined olive oil, with a small addition of virgin-production to give taste.

Olive pomace oil is refined pomace olive oil often blended with some virgin oil. It is fit for consumption, but may not be described simply as *olive oil*. It has a more neutral flavor than pure or virgin olive oil, making it unfashionable among connoisseurs; however, it has the same fat composition as regular olive oil, giving it the same health benefits. It also has a high smoke point, and thus is widely used in restaurants as well as home cooking in some countries.

5 – 2- Retail grades in the United States from the USDA

As the United States is not a member, the IOC retail grades have no legal meaning in that country, but as of October 25, 2010, the USDA established new Standards for Grades of Olive Oil and Olive-Pomace Oil, which closely parallel the IOC standards :

U.S. Extra Virgin Olive Oil for oil with excellent flavor and odor and free fatty acid content of not more than 0.8 g per 100 g (0.8%);

U.S. Virgin Olive Oil for oil with reasonably good flavor and odor and free fatty acid content of not more than 2 g per 100 g (2 %);

U.S. Virgin Olive Oil Not Fit For Human Consumption Without Further Processing is a virgin (mechanically- extracted) olive oil of poor flavor and odor, equivalent to the IOC's *lampante* oil;

U.S. Olive Oil is an oil mix of both virgin and refined oils;

U.S. Refined Olive Oil is an oil made from refined oils with some restrictions on the processing.

These grades are voluntary. Certification is available from the USDA on a fee - for - service basis.

Quantitative analysis can determine the oil's "acidity," which refers not to its chemical acidity in the sense of pH but as the percent (measured by weight) of free oleic acid. This is a measure of the hydrolysis of the oil's triglycerides: as the oil degrades, more fatty acids are freed from the glycerides, increasing the level of free acidity and thereby increasing hydrolytic rancidity. Another measure of the oil's chemical degradation is the peroxide value, which measures the degree to which the oil is oxidized (damaged by free radicals, leading to *oxidative* rancidity.

To classify it by taste, olive oil is judged by a panel of trained tasters in a blind taste test. This is also called its *organoleptic* quality.

5 – 3- Label wording

The different names for olive oil indicate the degree of processing the oil has undergone as well as the quality of the oil. Extra-virgin olive oil is the highest grade available, followed by virgin olive oil. The word "virgin" indicates that the olives have been pressed to extract the oil; no heat or chemicals have been used during the extraction process, and the oil is pure and unrefined. Virgin olive oils contain the highest levels of polyphenols, antioxidants that have been linked with better health.

"Made from refined olive oils" means that the taste and composition are chemically controlled, usually to improve lower quality oils . In Australia, *Pure, Light* and *Extra-Light* are terms introduced by manufacturers for refined oils to avoid labeling them as such. Standards Australia's code of practice for olive oil now recognizes these words as meaning refined oil. Contrary to a common consumer belief, they do not have less calories than Extra-virgin oil as implied by the names .

Cold pressed or *Cold extraction* means "that the oil was not heated over a certain temperature (usually $27 \,^{\circ}C$) during processing, thus retaining more nutrients and undergoing less degradation "

First cold pressed means "that the fruit of the olive was crushed exactly one time-i.e., the *first press*. The *cold* refers to the temperature range of the fruit at the time it is crushed."^[34] In Calabria (Italy) the olives are collected in October. In regions like Tuscany or Liguria, the olives collected in November and ground often at night are too cold to be processed efficiently without heating. The paste is regularly heated above the environmental temperatures, which may be as low as 10-15 °C, to extract the oil efficiently with only physical means. Olives pressed in warm regions like Southern Italy or Northern Africa may be pressed at significantly higher temperatures although not heated. While it is important that the pressing temperatures be as low as possible (generally below 25 °C) there is no international reliable definition of "cold pressed".

Further more, there is no "second" press of virgin oil, so the term "first press" means only that the oil was produced in a press vs. other possible methods.

PDO and **PGI** refers to olive oils with "exceptional properties and quality derived from their place of origin as well as from the way of their production".

The label may indicate that the oil was bottled or packed in a stated country. This does not necessarily mean that the oil was produced there. The origin of the oil may sometimes be marked elsewhere on the label; it may be a mixture of oils from more than one country.

The U.S. Food and Drug Administration permitted a claim on olive oil labels stating: "Limited and not conclusive scientific evidence suggests that eating about two table spoons (23g) of olive oil daily may reduce the risk of coronary heart disease "

5 – 4 – Adulteration

The adulteration of oil can be no more serious than passing off inferior, but safe, product as superior olive oil, but there are no guarantees. It is believed that almost 700 people died in 1981 as a consequence of consuming rapeseed oil adulterated with aniline intended for use as an industrial lubricant, but sold as olive oil in Spain .

There have been allegations, particularly in Italy and Spain, that regulation can be sometimes lax and corrupt . Major shippers are claimed to routinely adulterate olive oil and that only about 40 % of olive oil sold as "extra virgin" in Italy actually meets the specification. In some cases, colza oil (Swedish turnip) with added color and flavor has been labeled and sold as olive oil . This extensive fraud prompted the Italian government to mandate a new labeling law in 2007 for companies selling olive oil, under which every bottle of Italian olive oil would have to declare the farm and press on which it was produced, as well as display a precise breakdown of the oils used, for blended oils . In February 2008, however, EU officials took issue with the new law, stating that under EU rules such labeling should be voluntary rather than compulsory . Under EU rules, olive oil may be sold as Italian even if it only contains a small amount of Italian oil.^[41]

Extra Virgin olive oil has strict requirements and is checked for "sensory defects" that include: rancid, fusty, musty, winey (vinegary) and muddy sediment. These defects can occur for different reasons. The most common are:

Raw material (olives) infected or battered

Inadequate harvest, with contact between the olives and soil

In March 2008, 400 Italian police officers conducted "Operation Golden Oil", arresting 23 people and confiscating 85 farms after an investigation revealed a large - scale scheme to relabel oils from other Mediterranean nations as Italian . In April 2008, another operation impounded seven olive oil plants and arrested 40 people in nine provinces of northern and southern Italy for adding chlorophyll to sunflower and soybean oil, and selling it as extra virgin olive oil, both in Italy and abroad; 25,000 liters of the fake oil were seized and prevented from being exported .

On March 15, 2011, the Florence, Italy prosecutor's office, working in conjunction with the forestry department, indicted two managers and an officer of Carapelli, one of the brands of the Spanish company Grupo SOS (which recently changed its name to Deoleo). The charges involved falsified documents and food fraud. Carapelli lawyer Neri Pinucci said the company was not worried about the charges and that "the case is based on an irregularity in the documents "

In February 2012, an alleged international olive oil scam occurred in which palm, avocado, sunflower and other cheaper oils were passed off as Italian olive oil.^[47] Police said the oils were blended in an industrial biodiesel plant and adulterated in a way to hide markers that would have revealed their true nature. The oils were not toxic, however, and posed no health risk, according to a statement by the Guardia Civil. Nineteen people were arrested following the year-long joint probe by the police and Spanish tax authorities, part of what they call Operation Lucerna .

6 - Global consumption

Greece has by far the largest per capita consumption of olive oil worldwide, over 26 liters per person per year; Spain and Italy, around 14 l; Tunisia, Portugal, Syria, Jordan and Lebanon, around 8 l. Northern Europe and North America consume far less, around 0.7 l, but the consumption of olive oil outside its home territory has been rising steadily.

6 – 1- Global market

The main producing and consuming countries are :

Country	Production in tons (2010)	Production % (2010)	Consumption (2005)	Annual per capita consumption (kg)
World	3,269,248	100 %	100 %	0.43
Spain	1,487,000	45.5 %	20 %	13.62
Italy	548,500	16.8 %	30 %	12.35
Greece	352,800	10.8 %	9 %	23.7
Syria	177,400	5.4 %	3 %	7
Morocco	169,900	5.2 %	2 %	11.1
Turkey	161,600	4.9 %	2 %	1.2
Tunisia	160,100	4.9 %	2 %	5
Portugal	66,600	2.0 %	2 %	1.8
Algeria	33,600	1.0 %	2 %	7.1
Others	111,749	3.5 %	28 %	1.18

7 – Extraction

Olive oil is produced by grinding olives and extracting the oil by mechanical or chemical means. Green olives usually produce more bitter oil, and overripe olives can produce oil that is rancid, so for good extra virgin olive oil care is taken to make sure the olives are perfectly ripened. The process is generally as follows :

The olives are ground into paste using large millstones (traditional method) or steel drums (modern method).

If ground with mill stones, the olive paste generally stays under the stones for 30 to 40 minutes . A shorter grinding process may result in a more raw paste that produces less oil and has a less ripe taste, a longer process may increase oxidation of the paste and reduce the flavor. After grinding, the olive paste is spread on fiber disks, which are stacked on top of each other in a column, then placed into the press. Pressure is then applied onto the column to separate the vegetal liquid from the paste. This liquid still contains a significant amount of water. Traditionally the oil was shed from the water by gravity (oil is less dense than water). This very slow separation process has been replaced by centrifugation, which is much faster and more thorough. The centrifuges have one exit for the (heavier) watery part and one for the oil. Olive oil should not contain significant traces of vegetal water accelerates the process of organic degeneration as this by microorganisms. The separation in smaller oil mills is not always perfect, thus sometimes a small watery deposit containing organic particles can be found at the bottom of oil bottles.

In modern steel drum mills the grinding process takes about 20 minutes. After grinding, the paste is stirred slowly for another 20 to 30 minutes in a particular container (malaxation), where the microscopic oil drops unite into bigger drops, which facilitates the mechanical extraction. The paste is then pressed by centrifugation/ the water is thereafter separated from the oil in a second centrifugation as described before.

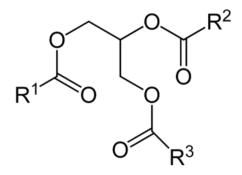
The oil produced by only physical (mechanical) means as described above is called virgin oil. Extra virgin olive oil is virgin olive oil that satisfies specific high chemical and organoleptic criteria (low free acidity, no or very little organoleptic defects).

Some times the produced oil will be filtered to eliminate remaining solid particles that may reduce the shelf life of the product. Labels may indicate the fact that the oil has *not* been filtered, suggesting a different taste. Unfiltered fresh olive oil that has a slightly cloudy appearance is called cloudy olive oil. This form of olive oil used to be popular only among olive oil small scale producers but is now becoming "trendy", in line with consumer's demand for more ecological and less - processed "green" products.

The remaining paste (pomace) still contains a small quantity (about 5 -10 %) of oil that cannot be extracted by further pressing, but only with chemical solvents. This is done in specialised chemical plants, not in the oil mills. The resulting oil is not "virgin" but "pomace oil". The term "first press", sometimes found on bottle labels, is today meaningless, as there is no "second" press; it comes from ancient times of stone presses, when virgin oil was the one produced by battering the olives.

The label term "cold - extraction" on extra virgin olive oils indicates that the olive grinding and stirring was done at a temperature of maximum 25 $^{\circ}$ C , as treatment in higher temperatures risks decreasing the olive oils' quality (texture, taste and aroma).

8 – Constituents



General chemical structure of olive oil (triglyceride). R^1 , R^2 and R^3 are alkyl groups (approx. 20 %) or alkenyl groups (approx. 80 %).

Olive oil is composed mainly of the mixed triglyceride esters of oleic acid and palmitic acid and of other fatty acids, along with traces of squalene (up to 0.7 %) and sterols (about 0.2 % phyto sterol and toco sterols). The composition varies by cultivar, region, altitude, time of harvest, and extraction process.

Fatty acid	Percentage
Oleic acid	55 to 83 %
Linoleic acid	3.5 to 21 %
Palmitic acid	7.5 to 20 %
Stearic acid	0.5 to 5 %
α-Linolenic acid	0 to 1.5 %

8 – 1 - Phenolic composition

Olive oil contains polyphenols such as esters of tyrosol and hydroxy tyrosol, including oleocanthal and oleuropein, having acidic properties that give extra - virgin unprocessed olive oil its bitter and pungent taste. Olive oil is a source of at least 30 phenolic compounds.

Other phenolic constituents include aldehydic secoiridoids, flavonoids and lignans (acetoxypinoresinol , pinoresinol). The latter two compounds are only present in extra virgin oil .

Hydroxytyrosol (2-(3,4-Di-hydroxyphenyl)-ethanol or DHPE) is a phenolic component of extra-virgin olive oil. An olive oil fraction containing DHPE was shown to inhibit platelet aggregation and eicosanoid (thromboxane B2) formation in vitro. Both hydroxytyrosol and its precursor oleuropein exist in the fruit at levels on the order of 100 times that of shelf extra virgin olive oil. Phenolics are considerably higher in fresh cloudy olive oil than extra virgin that has been separated and aged.

Oleocanthal from olive oil is a non-selective inhibitor of cyclooxygenase (COX) similar to classical NSAIDs like ibuprofen. It has been suggested that long-term consumption of small quantities of this compound from olive oil may be responsible in part for the low incidence of heart disease associated with a Mediterranean diet.

9 – Nutrition

Olive Oil				
Nutritional value per 100 g				
Energy	3,701 kJ (885 kcal)			
Carbohydrates	0 g			
Fat	100 g			
- saturated	14 g			
- monounsaturated	73 g			
- polyunsaturated	11 g			
- omega - 3 fat	< 1.5 g			
- omega - 6 fat	3.5 – 21 g			
Protein	0 g			
Vitamin E	14 mg (93%)			
Vitamin K	62 μg (59%)			

As they are the least processed forms of olive oil, extra virgin or virgin olive oil have more monounsaturated fatty acids than other olive oil. These types also contain more polyphenols, which may have benefits for the heart .

10 - Popular uses and research 10 – 1- Skin

Olive oil has a long history of being used as a home remedy for skincare. Egyptians used it alongside beeswax as a cleanser, moisturizer, and antibacterial agent since pharaonic times . In ancient Greece, the substance was used during massage to prevent sports injuries, relieve muscle fatigue, and eliminate lactic acid buildup . In 2000, Japan was the top importer of olive oil in Asia (13,000 tons annually) because consumers there believe both the ingestion and topical application of olive oil to be good for skin and health.

There has been relatively little scientific work done on the effect of olive oil on acne and other skin conditions. However, one study noted that the abundance of squalene in oils in general shows promise for sufferers of seborrheic dermatitis, acne, psoriasis, and atopic dermatitis. Squalene is used as an antioxidant, moisturizer, and as a convenient vehicle to carry other substances in topical application.^[65] Another researcher reported that a mixture of honey, beeswax, and olive oil alleviates diaper dermatitis, psoriasis, and eczema by inhibiting the growth of Staphylococcus aureus and Candida albicans.

Olive oil is popular for use in massaging infants and toddlers, but scientific proof of its efficacy is mixed. One analysis of olive oil versus mineral oil found that, when used for infant massage, olive oil can be considered a safe alternative to sunflower, grapeseed and fractionated coconut oils. This stands true particularly when it is mixed with a lighter oil like sunflower, which "would have the further effect of reducing the already low levels of free fatty acids present in olive oil." The study also notes that there appears to be much confusion surrounding mineral oil, and that further studies should be done on refined mineral oil to back up claims about its superiority to olive oil . Another trial echoes this claim, stating that olive oil lowers the risk of dermatitis for infants in all gestational stages when compared with emollient cream . However, yet another study found that topical treatment with olive oil for newborns "significantly damages the skin barrier" when compared to sunflower oil, and that it may make existing atopic dermatitis worse. The researchers conclude that they do not recommend the use of olive oil for the treatment of dry skin and infant massage.

Clinical trials have found that olive oil does not act to prevent or reduce stretch marks .

The fatty substance was found to reduce inflammation via oleuropein, which is touted for its antioxidant, anti - atherosclerotic, and anti-inflammatory characteristics .

10-2 - Potential health effects attributed to fat composition

Preliminary clinical studies provide evidence that consumption of olive oil may lower risk of heart disease risk factors such as lower blood cholesterol levels and reduced LDL cholesterol oxidation,^[73] and that it may also possibly influence inflammatory, thrombotic, hypertensive and vasodilatory mechanisms . Although epidemiological studies indicate that a higher proportion of monounsaturated fats in the diet may be linked with a reduction in the risk of coronary heart disease , a cause and effect relationship has not yet been established with sufficient scientific evidence .

In the United States, producers of olive oil may place the following restricted health claim on product labels :

Limited and not conclusive scientific evidence suggests that eating about 2 tbsp. (23 g) of olive oil daily may reduce the risk of coronary heart disease due to the monounsaturated fat in olive oil. To achieve this possible benefit, olive oil is to replace a similar amount of saturated fat and not increase the total number of calories you eat in a day.

This decision was announced November 1, 2004, by the Food and Drug Administration after application was made to the FDA by producers. Similar labels are permitted for foods rich in omega-3 fatty acids such as walnuts and hemp seed.

Other possible effects of olive oil may be a property to balance omega-6 fats and omega-3 fats and to affect blood sugar levels and blood pressure, but these effects were dismissed in reviews by the Scientific Committee of the European Food Safety Authority.

Olive oil contains the monounsaturated fatty acid oleic acid, vitamin E and oleuropein, a chemical that may affect the oxidation of LDL particles.

Preliminary research indicates that olive oil could possibly be a chemo preventive agent for peptic ulcer or gastric cancer, but confirmation requires further *in vivo* study. Pilot studies showed that olive oil may reduce oxidative damage to DNA and RNA, revealing a possible anti - carcinogenic factor. Consumption of olive oil may prevent the onset of Alzheimer's disease, possibly through a

mechanism related to oleocanthal inhibiting fibrillization of tau protein.

11 – Uses

11 – 1 - Culinary use

Olive oil is the main cooking oil in countries surrounding the Mediterranean Sea.

Extra virgin olive oil is mostly used as a salad dressing and as an ingredient in salad dressings. It is also used with foods to be eaten cold. If uncompromised by heat, the flavor is stronger. It also can be used for sautéing.

The higher the temperature to which the olive oil is heated, the higher the risk of compromising its taste . When extra virgin olive oil is heated above 210 - 216 °C , depending on its free fatty acid content, the unrefined particles within the oil are burned. This leads to deteriorated taste. Also, the pronounced taste of extra virgin olive oil is not a taste most people like to associate with their deep fried foods. Refined olive oils are perfectly suited for deep frying foods and should be replaced after several uses .

Choosing a cold - pressed olive oil can be similar to selecting a wine. The flavor of these oils varies considerably and a particular oil may be more suited for a particular dish. Also, people who like lots of tannins in their red wines might prefer more bitter olive oils.

An important issue often not realized in countries that do not produce olive oil is that the freshness makes a big difference. A very fresh oil, as available in an oil producing region, tastes noticeably different from the older oils available elsewhere. In time, oils deteriorate and become stale. One-year old oil may be still pleasant to the taste, but it is surely less fragrant than fresh oil. After the first year, olive oil should be used for cooking, not for foods to be eaten cold, like salads. The taste of the olive oil is influenced by the varietals used to produce the oil from and by the moment when the olives are harvested and ground (less ripe olives give more bitter and spicy flavors - riper olives give a sweeter sensation in the oil).

For certain culinary uses, olive oil may be substituted with safflower or sunflower oils, canola oil, peanut oil, sesame oil, or coconut oil.

Olive oil has various non - culinary uses as well. For example, it is also a natural and safe lubricant, and can be used to lubricate machinery that is used within the kitchen (grinders, blenders, cookware, etc.) It can also be used for illumination (oil lamps) or as the base for soaps and detergents . Some cosmetics also use olive oil as their base.

11 – 2 - Religious use

Olive oil also has religious symbolism for healing and strength and to consecration — setting a person or place apart for special work. This may be related to its ancient use as a medicinal agent and for cleansing athletes by slathering them in oil then scraping them.

11 - 2 - 1 - Judaism

In Jewish observance, olive oil is the only fuel allowed to be used in the seven-branched Menorah in the Mishkan service during the Exodus of the tribes of Israel from Egypt, and later in the permanent Temple in Jerusalem. It was obtained by using only the first drop from a squeezed olive and was consecrated for use only in the Temple by the priests and stored in special containers. A menorah similar to the Menorah used in the Mishkan is now used during the holiday of Hanukkah that celebrates the miracle of the last of such containers being found during the re - dedication of the Temple (163 BC), when its contents lasted for far longer than they were expected to, allowing more time for more oil to be made. Although candles can be used to light the hanukkiah, oil containers are preferred, to imitate the original Menorah. Another use of oil in Jewish religion is for anointing the kings of the Kingdom of Israel, originating from King David.

11 - 2 - 2 – Christianity

The Catholic and Orthodox Churches use olive oil for the Oil of Catechumens (used to bless and strengthen those preparing for Baptism) and Oil of the Sick (used to confer the Sacrament of Anointing of the Sick or Unction). Olive oil mixed with a perfuming agent such as balsam is consecrated by bishops as Sacred Chrism, which is used to confer the sacrament of Confirmation (as a symbol of the strengthening of the Holy Spirit), in the rites of Baptism and the ordination of priests and bishops, in the consecration of altars and churches, and, traditionally, in the anointing of monarchs at their coronation. The Church of Jesus Christ of Latter-day Saints (Mormons) and a number of other religions use olive oil when they need to consecrate an oil for anointings.

Eastern Orthodox Christians still use oil lamps in their churches, home prayer corners and in the cemeteries. A vigil lamp consists of a votive glass containing a half-inch of water and filled the rest with olive oil. The glass has a metal holder that hangs from a bracket on the wall or sits on a table. A cork float with a lit wick floats on the oil. To douse the flame, the float is carefully pressed down into the oil. Makeshift oil lamps can easily be made by soaking a ball of cotton in olive oil and forming it into a peak. The peak is lit and then burns until all the oil is consumed, whereupon the rest of the cotton burns out. Olive oil is a usual offering to churches and cemeteries.

In the Orthodox Church, olive oil is a product not consumed during lent or penance while Orthodox monks use it sparingly in their diet. Exceptions are in feast days and Sundays.

11-2-3-Islam

In Islam, olive oil is mentioned in the Quranic verse: "God is the light of the Heavens and the Earth. An example of His light is like a lantern inside which there is a torch, the torch is in a glass bulb, the glass bulb is like a bright planet lit by a blessed olive tree, neither Eastern nor Western, its oil almost glows, even without fire touching it, light upon light." The Qur'an also mentions olives as a plant of significance: "By the fig and the olive, and the Mount Sinai, and this secure city." Olive oil is also reported to have been recommended by Prophet Muhammad in the following terms: "Consume olive oil and anoint it upon your bodies since it is of the blessed tree ".

11 - 3 - Other

Olive oil may be used in soap making, as lamp oil, a lubricant, or as a substitute for machine oil .

Olive oil has also been used as both solvent and ligand in the synthesis of cadmium selenide quantum dots .

In one study, monounsaturated fats such as from olive oil benefited mood, decreased anger, and increased physical activity .

Olive Pomace Oil

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1 - Introduction

Olive pomace oil is olive oil that is extracted from olive pulp after the first press. Once the mechanical oil extraction of olive oil is complete, approximately 5 - 8 % of the oil remains in the pulp, which then needs to be extracted with the help of solvents, an industrial technique used in the production of most other edible oils including canola, peanut, sunflower, etc. Although the oil extracted in this manner is still olive oil, at retail it may not be simply called "olive oil". This is because the International Olive Council defines olive oil as "the oil obtained solely from the fruit of the olive tree, to the exclusion of oils obtained using solvents or re-esterification processes"

2 - Retail grades

The International Olive Council has classified olive pomace oil into the following categories :

2-1 - Crude olive pomace oil

Olive - pomace oil whose characteristics are those laid down for this category. It is intended for refining for use for human consumption, or it is intended for technical use.

2-2- Refined olive pomace oil

Oil obtained by refining crude olive-pomace oil. It has a free acidity, expressed as oleic acid, of not more than 0.3 grams per 100 grams and its other characteristics correspond to those laid down for this category.

2-3 - Olive pomace oil

Oil consisting of a blend of refined olive - pomace oil and virgin olive oils fit for consumption as they are. It has a free acidity, expressed as oleic acid, of not more than 1 gram per 100 grams and its other characteristics correspond to those laid down for this category. In no case shall this blend be called "olive oil".

Warnings about possible carcinogenic properties of olivepomace oil have been issued by the British Food Standards Agency as well as others.

Quoted from the above reference, "Olive - Pomace oil is made from the residue left after producing virgin olive oil. It is the lowest grade of oil and it represents only a tiny amount of the UK vegetable oil market, around 0.25 % of the one million tones consumed each year.

In July the Spanish government reported that high levels of contaminants called polycyclic aromatic hydrocarbons (PAHs), some of which can cause cancer, were found in some olive-pomace oil products.

The contamination is believed to result from the process used to produce this oil. The Spanish government introduced a temporary ban on olive - pomace oil in response to these findings.

It has now set legal limits for the maximum amount of PAHs in olive oil ".

3 - Nutrition facts

824 Kcal / 100 ml) Facts per 100 ml Total fat : 100 ml Saturated fat : 14 ml Polyunsaturated fat : 7 ml Monounsaturated fat : 79 ml Cholesterol : 0

Omega - 3 Fatty Acid

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1 - Introduction

Omega-3 fatty acids (also called ω -3 fatty acids or *n*-3 fatty acids) refers to a group of three fats called ALA (found in plant oils), EPA, and DHA (both commonly found in marine oils). Common sources of omega-3 EPA and DHA fatty acids include fish oils, algal oil, egg oil, squid oils, krill oil and some plant oils contain the omega

3 ALA fatty acid such as flaxseed oil, Sacha Inchi oil, *Echium* oil, and hemp oil.

Omega-3 fatty acids are vital for normal metabolism but some of the potential health benefits of supplementation are controversial. Omega-3s are considered essential fatty acids, meaning that they cannot be synthesized by the human body -except that mammals have a limited ability, when the diet includes the shorter-chained omega-3 fatty acid ALA (α -linolenic acid, 18 carbons and 3 double bonds), to form the more important long-chain omega-3 fatty acids, EPA (eicosapentaenoic acid, 20 carbons and 5 double bonds) and then from EPA, the most crucial, DHA (docosahexaenoic acid, 22 carbons and 6 double bonds) with even much greater inefficiency. The ability to make the longer - chained omega-3 fatty acids from ALA may also be impaired in aging. In foods exposed to air, unsaturated fatty acids are vulnerable to oxidation and rancidity. And fish are much more efficient than mammals at converting the ALA to the EPA and DHA omega-3 fatty acids.

Omega-3 fatty acids are polyunsaturated fatty acids with a double bond (C = C) at the third carbon atom from the end of the carbon chain. The fatty acids have two ends, the acid (- COOH) end, which is considered the beginning of the chain, thus "alpha", and the methyl (CH₃) end, which is considered the "tail" of the chain, thus "omega." The nomenclature of the fatty acid is taken from the location of the first double bond, counted from the methyl end, that is, the omega (ω -) or the n- end.

2 - Health effects

Supplementation does not appear to be associated with a lower risk of all-cause mortality.

2 - 1 - Cancer

The evidence linking the consumption of fish to the risk of cancer is poor.^[6] Supplementation with omega-3 fatty acids does not appear to affect this risk either.

A 2006 report in the *Journal of the American Medical Association*, in their review of literature covering cohorts from many countries with a wide variety of demographics, concluded that there was no link between omega–3 fatty acids and cancer.^[8] This is similar to the findings of a review by the *British Medical Journal* of studies up to February 2002 that failed to find clear effects of long and shorter chain omega–3 fatty acids on total mortality, combined cardiovascular events and cancer.^{[9][10]} In those with advanced cancer and cachexia, omega-3 fatty acids supplements may be of benefit, improving appetite, weight, and quality of life.

2 - 2 - Cardiovascular disease

Evidence does not support a beneficial role for omega-3 fatty acid supplementation in preventing cardiovascular disease (including myocardial infarction and sudden cardiac death) or stroke. Fish oil supplementation has not been shown to benefit revascularization or arrythmia and has no effect on heart failure admission rates.^[13] Eating a diet high in fish that contain long chain omega-3 fatty acids does appear to decrease the risk of stroke.

Large amounts may increase low-density lipoproteins (LDL) (see below), up to 46 %, although LDL changes from small to larger, buoyant, less atherogenic particles.

Omega-3 fatty acids also have mild antihypertensive effects. When subjects consumed omega-3 fatty acids from oily fish on a regular basis, their systolic blood pressure was lowered by about $3.5-5.5 \text{ mmHg.}^{[16]}$ The 18 carbon α -linolenic acid (ALA) has not been shown to have the same cardiovascular benefits that DHA or EPA may have.

Some evidence suggests that people with certain circulatory problems, such as varicose veins, may benefit from the consumption of EPA and DHA, which may stimulate blood circulation, increase the breakdown of fibrin, a compound involved in clot and scar formation, and, in addition, may reduce blood pressure. Evidently, omega–3 fatty acids reduce blood triglyceride levels , and regular

intake may reduce the risk of secondary and primary heart attack. ALA does not confer the cardiovascular health benefits of EPA and DHA.

Large amounts may increase the risk of hemorrhagic stroke (see below); lower amounts are not related to this risk ; 3 grams of total EPA/DHA daily are generally recognized as safe (GRAS) with no increased risk of bleeding involved and many studies used substantially higher doses without major side effects (for example: 4.4 grams EPA/2.2 grams DHA in 2003 study).

Among omega-3 fatty acids, neither long-chain nor short-chain forms were consistently associated with breast cancer risk. High levels of docosahexaenoic acid (DHA), however, the most abundant omega-3 PUFA in erythrocyte (red blood cell) membranes, were associated with a reduced risk of breast cancer. The DHA obtained through the consumption of polyunsaturated fatty acids is positively associated with cognitive and behavioral performance.^[28] In addition DHA is vital for the grey matter structure of the human brain, as well as retinal stimulation and neurotransmission.

2 - 3 - Inflammation

Although not confirmed as an approved health claim, current research suggests that the anti-inflammatory activity of long-chain omega–3 fatty acids may translate into clinical effects.^[30] For example, there is evidence that rheumatoid arthritis sufferers taking long-chain omega –3 fatty acids from sources such as fish have reduced pain compared to those receiving standard NSAIDs.^[31] Some potential benefits have been reported in conditions such as rheumatoid arthritis.

2 - 4 - Developmental disorders

Although not supported by current scientific evidence as a primary treatment for ADHD, autism spectrum disorders, and other developmental differences, omega-3 fatty acids have gained popularity for children with these conditions.

Omega-3 fatty acids offer a promising complementary approach to standard treatments for ADHD and developmental coordination disorder. Fish oils appear to reduce ADHD-related symptoms in some children.^[34] A randomized, controlled trial has suggested that "fatty acid supplementation may offer a safe efficacious treatment option for educational and behavioral problems among children with DCD".

There is not enough scientific evidence to support the effectiveness of omega-3 fatty acids for autism spectrum disorders.

Fish oil has only a small benefit on the risk of early birth.

2 - 5 - Psychiatric disorders

Though there is some evidence that omega-3 fatty acids are related to a variety of mental disorders,^[39] they may tentatively be useful as an add-on for the treatment of depression associated with bipolar disorder^[40] and there is preliminary evidence that EPA supplementation is helpful in cases of depression. There is, however, a significant risk of bias in the literature.

2 - 6 - Cognitive aging

Epidemiological studies suggest that consumption of omega-3 fatty acids can reduce the risk of dementia, but evidence of a treatment effect in dementia patients is inconclusive . However, clinical evidence suggests benefits of treatment specifically in patients who show signs of cognitive decline but who are not sufficiently impaired to meet criteria for dementia.

2 - 7 - Adverse effects

In a letter published October 31, 2000, the United States Food and Drug Administration Center for Food Safety and Applied Nutrition, Office of Nutritional Products, Labeling, and Dietary Supplements noted that known or suspected risks of EPA and DHA consumed in excess of 3 grams per day may include the possibility of: Increased incidence of bleeding

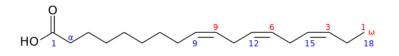
Hemorrhagic stroke

Oxidation of omega-3 fatty acids, forming biologically active oxidation products

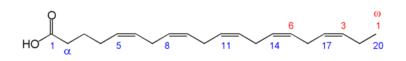
Increased levels of low-density lipoproteins (LDL) cholesterol or apoproteins associated with LDL cholesterol among diabetics and hyperlipidemics

Reduced glycemic control among diabetics

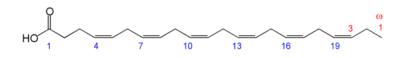
3 - Chemistry



Chemical structure of alpha-linolenic acid (ALA), an essential omega–3 fatty acid, (18:3 Δ 9c,12c,15c, which means a chain of 18 carbons with 3 double bonds on carbons numbered 9, 12, and 15). Although chemists count from the carbonyl carbon (blue numbering), biologists count from the *n* (ω) carbon (red numbering). Note that, from the *n* end (diagram right), the first double bond appears as the third carbon-carbon bond (line segment), hence the name "*n*–3". This is explained by the fact that the *n* end is almost never changed during physiological transformations in the human body, as it is more energy-stable, and other carbohydrates compounds can be synthesized from the other carbonyl end, for example in glycerides, or from double bonds in the middle of the chain.



Chemical structure of eicosapentaenoic acid (EPA).



Chemical structure of docosahexaenoic acid (DHA).

Omega-3 fatty acids that are important in human physiology are α -linolenic acid (18:3, *n*-3; ALA), eicosapentaenoic acid (20:5, *n*-3; EPA), and docosahexaenoic acid (22:6, *n*-3; DHA). These three polyunsaturates have either 3, 5, or 6 double bonds in a carbon chain of 18, 20, or 22 carbon atoms, respectively. As with most naturally-produced fatty acids, all double bonds are in the *cis*-configuration, in other words, the two hydrogen atoms are on the same side of the double bond; and the double bonds are interrupted by methylene bridges (-CH₂-), so that there are two single bonds between each pair of adjacent double bonds.

3-1 - List of omega-3 fatty acids

This table lists several different names for the most common omega-3 fatty acids found in nature.

Common name	Lipid name	Chemical name
Hexadecatrienoic acid (HTA)	16:3 (<i>n</i> -3)	all-cis-7,10,13-hexadecatrienoic acid
α-Linolenic acid (ALA)	18:3 (<i>n</i> -3)	all-cis-9,12,15-octadecatrienoic acid
Stearidonic acid (SDA)	18:4 (<i>n</i> -3)	all-cis-6,9,12,15-octadecatetraenoic acid
Eicosatrienoic acid (ETE)	20:3 (<i>n</i> -3)	all-cis-11,14,17-eicosatrienoic acid
Eicosatetraenoic acid (ETA)	20:4 (<i>n</i> -3)	all-cis-8,11,14,17-eicosatetraenoic acid
Eicosapentaenoic acid (EPA)	20:5 (<i>n</i> -3)	all-cis-5,8,11,14,17-eicosapentaenoic acid
Heneicosapentaenoic acid (HPA)	21:5 (<i>n</i> -3)	<i>all-cis</i> -6,9,12,15,18-heneicosapentaenoic acid
Docosapentaenoic acid (DPA). Clupanodonic acid	' 22:5 (<i>n</i> −3)	<i>all-cis</i> -7,10,13,16,19-docosapentaenoic acid
Docosahexaenoic acid (DHA)	22:6 (<i>n</i> -3)	<i>all-cis</i> -4,7,10,13,16,19-docosahexaenoic acid
Tetracosapentaenoic acid	24:5 (<i>n</i> -3)	<i>all-cis</i> -9,12,15,18,21-tetracosapentaenoic acid
Tetracosahexaenoic acid (Nisinic acid)	² 24:6 (<i>n</i> -3)	<i>all-cis</i> -6,9,12,15,18,21-tetracosahexaenoic acid

4 - Mechanism of action

The 'essential' fatty acids were given their name when researchers found that they are essential to normal growth in young children and animals, though the modern definition of 'essential' is stricter. A small amount of omega-3 in the diet (~ 1 % of total calories) enabled normal growth, and increasing the amount had little to no additional effect on growth.

Like wise , researchers found that omega-6 fatty acids (such as γ -linolenic acid and arachidonic acid) play a similar role in normal growth. However, they also found that omega-6 was "better" at supporting dermal integrity, renal function, and parturition. These preliminary findings led researchers to concentrate their studies on omega-6, and it is only in recent decades that omega-3 has become of interest.

In 1964, it was discovered that enzymes found in sheep tissues convert omega-6 arachidonic acid into the inflammatory agent called prostaglandin E_2 , which both causes the sensation of pain and expedites healing and immune response in traumatized and infected tissues.^[46] By 1979, more of what are now known as eicosanoids were discovered: thromboxanes, prostacyclins, and the leukotrienes. The eicosanoids, which have important biological functions, typically have a short active lifetime in the body, starting with synthesis from fatty acids and ending with metabolism by enzymes. However, if the rate of synthesis exceeds the rate of metabolism, the excess eicosanoids may have deleterious effects. Researchers found that certain omega-3 fatty acids are also converted into eicosanoids, but at a much slower rate. Eicosanoids made from omega-3 fatty acids are often referred to as anti-inflammatory, but in fact they are just less inflammatory than those made from omega-6 fats. If both omega-3 and omega-6 fatty acids are present, they will "compete" to be transformed,^[46] so the ratio of long-chain omega-3:omega-6 fatty acids directly affects the type of eicosanoids that are produced.

This competition was recognized as important when it was found that thromboxane is a factor in the clumping of platelets, which can both cause death by thrombosis and prevent death by bleeding. Likewise, the leukotrienes were found to be important in immune/inflammatory-system response, and therefore relevant to arthritis, lupus, asthma, and recovery from infections. These discoveries led to greater interest in finding ways to control the synthesis of omega–6 eicosanoids. The simplest way would be by consuming more omega–3 and fewer omega–6 fatty acids. They are required during the prenatal period for the formation of synapses and cell membranes. These processes are also essential in postnatal human development for injury response of the central nervous system and retinal stimulation.

4-**1**-**Inter** conversion

4-**1**-**1** - **Conversion efficiency of ALA to EPA and DHA**

The body converts short-chain omega-3 fatty acids to longchain forms (EPA, DHA) with an efficiency below 5%^{[49][50]} in men. The omega-3 conversion efficiency is greater in women, possibly because of the importance for meeting the demands of the fetus and neonate for DHA.

These conversions occur competitively with omega–6 fatty acids, which are essential closely related chemical analogues that are derived from linoleic acid. Both the omega–3 α -linolenic acid and omega–6 linoleic acid must be obtained from food. Synthesis of the longer omega–3 fatty acids from linolenic acid within the body is competitively slowed by the omega–6 analogues. Thus, accumulation of long-chain omega–3 fatty acids in tissues is more effective when they are obtained directly from food or when competing amounts of omega–6 analogs do not greatly exceed the amounts of omega–3.

The conversion of ALA to EPA and further to DHA in humans has been reported to be limited, but varies with individuals.^{[52][53]} Women have higher ALA conversion efficiency than men, which is presumed to be due to the lower rate of use of dietary ALA for betaoxidation . This suggests that biological engineering of ALA conversion efficiency is possible. Goyens *et al.* argue that it is the absolute amount of ALA, rather than the ratio of omega–3 and omega–6 fatty acids, that controls the conversion efficiency.

4 - 1 - 2 - The omega-6 to omega-3 ratio

Some older clinical studies indicate that the ingested ratio of omega-6 to omega-3 (especially linoleic vs alpha-linolenic) fatty acids is important to maintaining cardiovascular health. However, three studies published in 2005, 2007 and 2008, including a

randomized controlled trial, found that while omega-3 polyunsaturated fatty acids are extremely beneficial in preventing heart disease in humans, the levels of omega-6 polyunsaturated fatty acids (and therefore the ratios) were insignificant.

Both omega-6 and omega-3 fatty acids are essential; i.e., humans must consume them in the diets. Omega-6 and omega-3 eighteen-carbon polyunsaturated fatty acids compete for the same metabolic enzymes, thus the omega-6:omega-3 ratio of ingested fatty acids has significant influence on the ratio and rate of production of eicosanoids, a group of hormones intimately involved in the body's inflammatory and homeostatic processes which includes the prostaglandins, leukotrienes, and thromboxanes, among others. Altering this ratio can change the body's metabolic and inflammatory state. In general, grass-fed animals accumulate more omega-3 than do grain-fed animals, which accumulate relatively more omega-6. Metabolites of omega-6 are more inflammatory (esp. arachidonic acid) than those of omega-3. This necessitates that omega-6 and omega-3 be consumed in a balanced proportion; healthy ratios of omega-6:omega-3, according to some authors, range from 1:1 to 1:4 (an individual needs more omega-3 than omega-6).^[61] Other authors believe that ratio 4:1 (when the amount of omega-6 is only 4 times greater than that of omega-3) is already healthy. Studies suggest the evolutionary human diet, rich in game animals, seafood, and other sources of omega-3, may have provided such a ratio.

Typical Western diets provide ratios of between 10:1 and 30:1 (i.e., dramatically higher levels of omega–6 than omega-3). The ratios of omega–6 to omega–3 fatty acids in some common vegetable oils are: canola 2:1, hemp 2-3:1, soybean 7:1, olive 3–13:1, sunflower (no omega–3), flax 1:3, cottonseed (almost no omega–3), peanut (no omega–3), grapeseed oil (almost no omega–3) and corn oil 46:1 ratio of omega–6 to omega–3.

5 - History

Although omega-3 fatty acids have been known as essential to normal growth and health since the 1930s, awareness of their health benefits has dramatically increased since the 1990s.

The health benefits of the long-chain omega-3 fatty acids primarily EPA and DHA are the best known. These benefits were discovered in the 1970s by researchers studying the Greenland Inuit Tribe. The Greenland Inuit people consumed large amounts of fat from fish, but displayed virtually no cardiovascular disease. The high level of omega-3 fatty acids consumed by the Inuit reduced triglycerides, heart rate, blood pressure, and atherosclerosis.

On September 8, 2004, the U.S. Food and Drug Administration gave "qualified health claim" status to EPA and DHA omega–3 fatty acids, stating, "supportive but not conclusive research shows that consumption of EPA and DHA [omega–3] fatty acids may reduce the risk of coronary heart disease." This updated and modified their health risk advice letter of 2001 (see below). As of this writing, regulatory agencies^[who?] do not accept that there is sufficient evidence for any of the suggested benefits of DHA and EPA other than for cardiovascular health, and further claims should be treated with caution.

The Canadian Government has recognized the importance of DHA omega-3 and permits the following biological role claim for DHA: "DHA, an omega-3 fatty acid, supports the normal development of the brain, eyes and nerves."

Grams of omega–3 per 85 g serving			
Common name	grams omega-3		
Herring, sardines	1.3–2		
Mackerel: Spanish /Atlantic / Pacific	1.1–1.7		
Salmon	1.1–1.9		
Halibut	0.60–1.12		

6 - Dietary sources

Tuna	0.21–1.1
Sword fish	0.97
Greenshell / lipped mussels	0.95
Tilefish	0.9
Tuna (canned, light)	0.17-0.24
Pollock	0.45
Cod	0.15-0.24
Catfish	0.22-0.3
Flounder	0.48
Grouper	0.23
Mahi mahi	0.13
Orange roughy	0.028
Red snapper	0.29
Shark	0.83
King mackerel	0.36
Hoki (blue grenadier)	0.41
Gemfish	0.40
Blue eye cod	0.31
Sydney rock oysters	0.30
Tuna, canned	0.23
Snapper	0.22
Eggs, large regular	0.109
Barramundi, saltwater	0.100
Giant tiger prawn	0.100
Lean red meat	0.031
Turkey	0.030
Cereals, rice, pasta, etc.	0.00
Fruit	0.00
Milk, regular	0.00
Bread, regular	0.00
Vegetables	0.00

6 – 1 - Daily values

As macronutrients, fats are not assigned Dietary Reference Intakes. Macronutrients have acceptable intake (AI) levels and acceptable macronutrient distribution ranges (AMDRs) instead of RDAs. The AI for omega-3 is 1.6 grams / day for men and 1.1 grams/day for women, while the AMDR is 0.6 % to 1.2 % of total energy.

A growing body of literature suggests that higher intakes of α linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) may afford some degree of protection against coronary disease. Because the physiological potency of EPA and DHA is much greater than that of ALA, it is not possible to estimate one AMDR for all omega–3 fatty acids. Approximately 10 percent of the AMDR can be consumed as EPA and/or DHA."^[77] There was insufficient evidence as of 2005 to set an upper tolerable limit for omega–3 fatty acids.

Heavy metal poisoning by the body's accumulation of traces of heavy metals, in particular mercury, lead, nickel, arsenic, and cadmium, is a possible risk from consuming fish oil supplements. Also, other contaminants (PCBs, furans, dioxins, and PBDEs) might be found, especially in less-refined fish oil supplements. In reality, however, heavy metal toxicity from consuming fish oil supplements is highly unlikely, because heavy metals selectively bind with protein in the fish flesh rather than accumulate in the oil. An independent test in 2005 of 44 fish oils on the US market found all of the products passed safety standards for potential contaminants.

The FDA has advised that adults can safely consume a total of 3 grams per day of combined DHA and EPA, with no more than 2 g per day coming from dietary supplements.

Throughout their history, the Council for Responsible Nutrition and the World Health Organization have published acceptable standards regarding contaminants in fish oil. The most stringent current standard is the International Fish Oils Standard . Fish oils that are molecularly distilled under vacuum typically make this highestgrade, and have measurable levels of contaminants (measured parts per billion and parts per trillion).

A recent trend has been to fortify food with omega-3 fatty acid supplements. Global food companies have launched omega-3 fatty acid fortified bread, mayonnaise, pizza, yogurt, orange juice, children's pasta, milk, eggs, popcorn, confections, and infant formula.

The American Heart Association has set up dietary recommendations for EPA and DHA due to their cardiovascular benefits: Individuals with no history of coronary heart disease or myocardial infarction should consume oily fish or fish oils two times per week; those having been diagnosed with coronary heart disease after infarction should consume 1 g EPA and DHA per day from oily fish or supplements; those wishing to lower blood triglycerides should consume 2-4 g of EPA and DHA per day in the form of supplements.

6 – 2 - Fish

The most widely available dietary source of EPA and DHA is cold water oily fish, such as salmon, herring, mackerel, anchovies, and sardines. Oils from these fish have a profile of around seven times as much omega–3 as omega–6. Other oily fish, such as tuna, also contain n-3 in somewhat lesser amounts. Consumers of oily fish should be aware of the potential presence of heavy metals and fatsoluble pollutants like PCBs and dioxins, which are known to accumulate up the food chain. After extensive review, researchers from Harvard's School of Public Health in the *Journal of the American Medical Association* (2006) reported that the benefits of fish intake generally far outweigh the potential risks. Although fish is a dietary source of omega–3 fatty acids, fish do not synthesize them; they obtain them from the algae (microalgae in particular) or plankton in their diets.

6 – 2 - 1 - Fish oil

Not all forms of fish oil may be equally digestible. Of four studies that compare bioavailability of the glyceryl ester form of fish oil vs. the ethyl ester form, two have concluded the natural glyceryl ester form is better, and the other two studies did not find a significant difference. No studies have shown the ethyl ester form to be superior, although it is cheaper to manufacture.

6 – 3 - Krill

Krill oil is a newly^[when?] discovered source of omega-3 fatty acids. Various claims are made in support of krill oil as a superior source of omega-3 fatty acids. The effect of krill oil, at a lower dose of EPA + DHA (62.8 %), was demonstrated to be similar to that of fish oil.

6-4 - Plant sources



Flax seeds produce linseed oil, which has a very high ALA content Table 1. ALA content as the percentage of the seed oil.

Common name Alternative name Linnaean name		% ALA	
Kiwifruit		Actinidia deliciosa	63
Perilla	shiso	Perilla frutescens	61
Chia seed	chia sage	Salvia hispanica	58
Flax	linseed	Linum usitatissimum	53 – 59
Lingonberry	Cowberry	Vaccinium vitis-idaed	a 49
Camelina	Gold-of-pleasure	Camelina sativa	36
Purslane	Portulaca	Portulaca oleracea	35
Black raspberry	7	Rubus occidentalis	33
Hemp		Cannabis sativa	19
Canola			9 – 11

Common name	Linnaean name	% ALA
Flaxseed	Linum usitatissimum	18.1
Butternuts	Juglans cinerea	8.7
Hempseed	Cannabis sativa	8.7
Persian walnuts	Juglans regia	6.3
Pecan nuts	Carya illinoinensis	0.6
Hazel nuts	Corylus avellana	0.1

Table 2. ALA content as the percentage of the whole food.

Flaxseed (or linseed) (*Linum usitatissimum*) and its oil are perhaps the most widely available botanical source of the omega-3 fatty acid ALA. Flaxseed oil consists of approximately 55 % ALA, which makes it six times richer than most fish oils in omega-3 fatty acids . A portion of this is converted by the body to EPA and DHA, though this may differ between men and women.

100 g of the leaves of Purslane contains 300 - 400 mg ALA.

6 – 5 - Eggs

Eggs produced by hens fed a diet of greens and insects contain higher levels of omega-3 fatty acids than those produced by chickens fed corn or soybeans. In addition to feeding chickens insects and greens, fish oils may be added to their diets to increase the omega-3 fatty acid concentrations in eggs.

The addition of flax and canola seeds to the diets of chickens, both good sources of alpha-linolenic acid, increases the omega-3 content of the eggs, predominantly DHA.

The addition of green algae or seaweed to the diets boosts the content of DHA and EPA content, which are the forms of omega-3 approved by the FDA for medical claims. A common consumer complaint is "Omega-3 eggs can sometimes have a fishy taste if the hens are fed marine oils."

6 – 6 - Meat

Omega 3 fatty acids are formed in the chloroplasts of green leaves and algae. While seaweeds and algae are the source of omega 3 fatty acids present in fish, grass is the source of omega 3 fatty acids present in grass fed animals. When cattle are taken off omega 3 fatty acid rich grass and shipped to a feedlot to be fattened on omega 3 fatty acid deficient grain, they begin losing their store of this beneficial fat. Each day that an animal spends in the feedlot, the amount of omega 3 fatty acids in its meat is diminished.

The omega-6 to omega-3 ratio of grass-fed beef is about 2:1, making it a more useful source of omega-3 than grain-fed beef, which usually has a ratio of 4:1.

In a 2009 joint study by the USDA and researchers at Clemson University in South Carolina, grass-fed beef was compared with grain-finished beef. The researchers found that grass-fed beef is: higher in moisture content, 42.5% lower total lipid content, 54% lower in total fatty acids, 54% higher in beta-carotene, 288% higher in vitamin E (nalpha – tocopherol), higher in the B-vitamins thiamin and riboflavin, higher in the minerals calcium, magnesium, and potassium, 193% higher in total omega-3s, 117% higher in CLA (cis-9 trans-11), which is a potential cancer fighter, 90% higher in vaccenic acid (which can be transformed into CLA), lower in the saturated fats linked with heart disease, and has a healthier ratio of omega-6 to omega-3 fatty acids (1.65 vs 4.84). Protein and cholesterol content were equal.

In most countries, commercially available lamb is typically grass-fed, and thus higher in omega-3 than other grain-fed or grain-finished meat sources. In the United States, lamb is often finished (i.e., fattened before slaughter) with grain, resulting in lower omega-3.

The omega-3 content of chicken meat may be enhanced by increasing the animals' dietary intake of grains high in omega-3, such as flax, chia, and canola.

Kangaroo meat is also a source of omega-3, with fillet and steak containing 74 mg per 100 g of raw meat.

6-7 - Mammalian brains and eyes

The brains and eyes of mammals are extremely rich in DHA as well as other omega-3 fatty acids.^[103] DHA is a major structural component of the mammalian brain, and is in fact the most abundant omega-3 fatty acid in the brain.

6 – 8 - Seal oil

Seal oil is a source of EPA, DPA, and DHA. According to Health Canada, it helps to support the development of the brain, eyes and nerves in children up to 12 years of age . However, like all seal products, it is not allowed for import into the European Union.

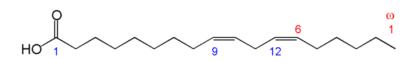
6 – 9 - Other sources

The microalgae *Crypthecodinium cohnii* and *Schizochytrium* are rich sources of DHA, but not EPA, and can be produced commercially in bioreactors.

Oil from brown algae (kelp) is a source of EPA.

In 2006 the Journal of Dairy Science published a study entitled, "The Linear Relationship between the Proportion of Fresh Grass in the Cow Diet, Milk Fatty Acid Composition, and Butter Properties". The study found that butter made from the milk of grass fed cows contains substantially more CLA, vitamin E, beta-carotene, and omega-3 fatty acids than butter made from the milk of cows raised in factory farms or that have limited access to pasture. It was also found that the more fresh pasture in the cow's diet, the softer the butter.

Omega - 6 Fatty Acid



The chemical structure of linoleic acid, a common omega-6 fatty acid found in many nuts and vegetable oils.

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 Key omega-6 fatty acids
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 Dietary linoleic acid requirement
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1 - Introduction

Omega-6 fatty acids (also referred to as ω -6 fatty acids or *n*-6 fatty acids) are a family of unsaturated fatty acids that have in common a final carbon-carbon double bond in the *n*-6 position, that is, the sixth bond, counting from the methyl end.

The biological effects of the omega-6 fatty acids are largely mediated by their conversion to omega-6 eicosanoids that bind to diverse receptors found in every tissue of the body. The conversion of tissue arachidonic acid (20:4n-6) to omega-6 prostaglandin and leukotriene hormones provides many omega-6 targets for pharmaceutical drug development and treatment to diminish excessive omega-6 actions in atherosclerosis, asthma, arthritis, vascular disease, thrombosis, immune-inflammatory processes, and tumor proliferation. Competitive interactions with the omega-3 fatty acids affect the relative storage, mobilization, conversion and action of the omega-3 and omega-6 eicosanoid precursors. (See Essential fatty acid interactions for more information.)

2 - Key omega-6 fatty acids

Linoleic acid (18:2, n-6), the shortest-chained omega-6 fatty acid, is an essential fatty acid. Arachidonic acid (20:4) is a physiologically significant omega-6 fatty acid and is the precursor for prostaglandins and other physiologically active molecules.

3 - Negative health effects

Some medical research suggests that excessive levels of certain omega-6 fatty acids, relative to certain omega-3 fatty acids, may increase the probability of a number of diseases.^{[3][4][5]} However, scientific research indicates that air pollution, smoking, second-hand smoke, and other exogenous toxins in conjunction with the excessive intake of n-6 fatty acids leads to inflammation and the overexpression of the COX-2 enzyme, and not solely the excessive intake of n-6 fatty acids.

Modern Western diets typically have ratios of omega–6 to omega–3 in excess of 10 to 1, some as high as 30 to 1; the average ratio of omega-6 to omega-3 in the Western diet is 15/1-16.7/1.^[11] Humans are thought to have evolved with a diet of a 1-to-1 ratio of omega-6 to omega-3 and the optimal ratio is thought to be 4 to 1 or lower, and it is even better if there is more omega–3 than omega–6 (especially healthy ratio of omega 6 to omega 7 is from 1:1 to 1:4). A ratio of 2 - 3 / 1 omega 6 to omega 3 helped reduce inflammation in patients with rheumatoid arthritis. A ratio of 5/1 had a beneficial effect on patients with asthma but a 10 / 1 ratio had a negative effect.^[11] A ratio of 2.5/1 reduced rectal cell proliferation in patients with colorectal cancer, whereas a ratio of 4/1 had no effect.

Excess omega-6 fats interfere with the health benefits of omega-3 fats, in part because they compete for the same rate-limiting enzymes. A high proportion of omega-6 to omega-3 fat in the diet shifts the physiological state in the tissues toward the pathogenesis of many diseases: prothrombotic , proinflammatory and proconstrictive.

Chronic excessive production of omega-6 eicosanoids is associated with arthritis, inflammation, and cancer. Many of the

medications used to treat and manage these conditions work by blocking the effects of the potent omega–6 fat, arachidonic acid. Many steps in formation and action of omega-6 hormones from omega-6 arachidonic acid proceed more vigorously than the corresponding competitive steps in formation and action of omega-3 hormones from omega-3 eicosapentaenoic acid. The COX-1 and COX-2 inhibitor medications, used to treat inflammation and pain, work by preventing the COX enzymes from turning arachidonic acid into inflammatory compounds. The LOX inhibitor medications often used to treat asthma , work by preventing the LOX enzyme from converting arachidonic acid into the leukotrienes. Many of the antimania medications used to treat bipolar disorder work by targeting the arachidonic acid cascade in the brain.

A high consumption of omega-6 polyunsaturated fatty acids (PUFAs), which are found in most types of vegetable oil, may increase the likelihood that postmenopausal women will develop breast cancer. Similar effect was observed on prostate cancer.^[22] Another "analysis suggested an inverse association between total polyunsaturated fatty acids and breast cancer risk, but individual polyunsaturated fatty acids behaved differently [from each other]. [...] a 20:2 derivative of linoleic acid [...] was inversely associated with the risk of breast cancer".

4 - Dietary linoleic acid requirement

Adding more controversy to the omega-6 fat issue is that the dietary requirement for linoleic acid (the key omega-6 fatty acid), has been seriously questioned, because of a significant methodology error discovered by University of Toronto scientist Stephen Cunnane. Cunnane discovered that the seminal research used to determine the dietary requirement for linoleic acid was based on feeding animals linoleic acid - deficient diets, which were simultaneously deficient in omega-3 fats. The omega-3 deficiency was not taken into account. The omega-6 oils added back systematically to correct the deficiency also contained trace amounts of omega-3 fats. There fore the researchers were inadvertently correcting the omega-3 deficiency as well. Ultimately, it took more oil to correct both deficiencies.

According to Cunnane, this error overestimates linoleic acid requirements by 5 to 15 times.

5 - Dietary sources



The evening prim rose flower (O. biennis) produces an oil containing a high content of γ -linolenic acid, a type of omega-6 fatty acid.

Four major food oils (palm, soybeans, rapeseed, and sunflower) provide more than 100 million metric tons annually, providing more than 32 million metric tons of omega-6 linoleic acid and 4 million metric tons of omega-3 alpha-linolenic acid.

Dietary sources of omega-6 fatty acids include : poultry eggs avocado nuts cereals durum wheat whole-grain breads most vegetable oils evening primrose oil borage oil blackcurrant seed oil flax/linseed oil rapeseed or canola oil hemp oil soybean oil cottonseed oil sunflower seed oil

corn oil safflower oil pumpkin seeds acai berry cashews pecans pine nuts walnuts spirulina coconut

6 - List of omega-6 fatty acids

Common name	Lipid name	Chemical name
Linoleic acid (LA)	18:2 (<i>n</i> –6)	all-cis-9,12-octadecadienoic acid
Gamma-linolenic acid (GLA)	18:3 (<i>n</i> –6)	all-cis-6,9,12-octadecatrienoic acid
Calendic acid	18:3 (<i>n</i> –6)	8E,10E,12Z-octadecatrienoic acid
Eicosadienoic acid	20:2 (<i>n</i> -6)	all-cis-11,14-eicosadienoic acid
Dihomo-gamma-linolenic acid (DGLA)	20:3 (<i>n</i> -6)	all-cis-8,11,14-eicosatrienoic acid
Arachidonic acid (AA)	20:4 (<i>n</i> –6)	all-cis-5,8,11,14-eicosatetraenoic acid
Docosadienoic acid	22:2 (<i>n</i> -6)	all-cis-13,16-docosadienoic acid
Adrenic acid	22:4 (<i>n</i> –6)	all-cis-7,10,13,16-docosatetraenoic acid
Docosapentaenoic acid	22:5 (<i>n</i> -6)	all-cis-4,7,10,13,16-docosapentaenoic acid
Tetracosatetraenoic acid	24:4 (<i>n</i> –6)	all-cis-9,12,15,18-tetracosatetraenoic acid
Tetracosapentaenoic acid	24:5 (<i>n</i> –6)	all-cis-6,9,12,15,18-tetracosapentaenoic acid

Omega -7 Fatty Acid

Omega-7 fatty acids are a class of unsaturated fatty acids in which the site of unsaturation is seven carbon atoms from the end of the carbon chain. The two most common omega-7 fatty acids in nature are palmitoleic acid and vaccenic acid.

Rich sources include macadamia nut oil and sea buckthorn oil .

The monounsaturated omega-7 fatty acids have the general chemical structure CH_3 - $(CH_2)_5$ - $CH=CH-(CH_2)_n$ - CO_2H .

Common name	Lipid name	Chemical name
none	12:1 (<i>n</i> -7)	5-Dodecenoic acid
none	14:1 (<i>n</i> -7)	7-Tetradecenoic acid
Palmitoleic acid	16:1 (<i>n</i> -7)	9-Hexadecenoic acid
Vaccenic acid	18:1 (<i>n</i> -7)	11-Octadecenoic acid
Paullinic acid	20:1 (<i>n</i> -7)	13-Eicosenoic acid
none	22:1 (<i>n</i> -7)	15-Docosenoic acid
none	24:1 (<i>n</i> -7)	17-Tetracosenoic acid

Omega - 9 Fatty Acid

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1 Introduction 2 Back ground

1 - Introduction

Omega-9 fatty acids (ω -9 fatty acids or *n*-9 fatty acids) are a family of unsaturated fatty acids which have in common a final carbon–carbon double bond in the omega-9 position; that is, the ninth bond from the methyl end of the fatty acid.

2 – Back ground

Some omega–9 fatty acids are common components of animal fat and vegetable oil. Two omega–9 fatty acids important in industry are :

Oleic acid (18:1, n–9), which is a main component of olive oil, macadamia oil and other monounsaturated fats

Erucic acid (22:1, n-9), which is found in rapeseed, wallflower seed, and mustard seed. Rapeseed with high erucic acid content is grown for commercial use in paintings and coatings as a drying oil. Canola oil comes from a cultivar of the rapeseed plant that has been bred, or in some cases genetically modified, to contain very little erucic acid.

Unlike omega-3 fatty acids and omega-6 fatty acid, omega-9 fatty acids are not classed as essential fatty acids (EFA). This is both because they can be created by the human body from unsaturated fat, and are therefore not essential in the diet, and because the lack of an omega-6 double bond keeps them from participating in the reactions that form the eicosanoids.

Under severe conditions of EFA deprivation, mammals will elongate and desaturate oleic acid to make mead acid, (20:3, n-9).^[1] This has been documented to a lesser extent in one study following

vegans, vegetarians and semi-vegetarians who followed unbalanced diets.

Omega-9 fatty acids			
Common name	Lipid name	Chemical name	
oleic acid	18:1 (<i>n</i> –9)	9-octadecenoic acid	
elaidic acid	18:1 (<i>n</i> –9)	(E)-octadec-9-enoic acid	
gondoic acid	20:1 (<i>n</i> -9)	11-eicosenoic acid	
mead acid	20:3 (<i>n</i> -9)	5,8,11-eicosatrienoic acid	
erucic acid	22:1 (<i>n</i> -9)	13-docosenoic acid	
nervonic acid	24:1 (<i>n</i> -9)	15-tetracosenoic acid	

Orange Oil

Contents

Introduction
 Limonene
 Composition
 Hazards
 Biological Pest Control

1 - Introduction

Orange oil is an essential oil produced by cells within the rind of an orange fruit (*Citrus sinensis* fruit). In contrast to most essential oils, it is extracted as a by-product of orange juice production by centrifugation, producing a cold-pressed oil.^[1] It is composed of mostly (greater than 90 %) d-limonene,^[2] and is often used in place of pure d-limonene. D-limonene can be extracted from the oil by distillation.

2 – Limonene

Limonene gives citrus fruit their familiar aroma, and is therefore used in perfume and household cleaners for its fragrance. It is also an effective, environmentally friendly, and relatively safe solvent, which makes it an active ingredient of choice in many applications, such as, adhesive and stain removers, cleaners of various sorts, and strippers. Limonene is also highly useful in agriculture.

3 – Composition

The compounds inside an orange oil varies with each different oil extraction. Composition variety happens as a result of regional and seasonal changes as well as the method used for extraction. Several hundred compounds have been identified with gas chromatographmass spectrometry. Most of the substances in the oil belong to the terpene group with limonene being the dominant one. Long chain aliphatic hydrocarbon alcohols and aldehydes like 1-octanol and octanal are second important group of substances .

Concentration	Valencia Orange Oil Concentration
[%]	[%]
93.67	91.4
0.65	1.4
1.00	0.4
2.09	4.3
0.41	_
0.31	0.8
0.31	_
0.27	0.4
	Orange Oil Concentration [%] 93.67 0.65 1.00 2.09 0.41 0.31 0.31

The presence of sinensetin explains the orange color.^[7]

3 – Hazards

The limonene which is the main component of the oil is a mild irritant, as it dissolves protective skin oils.

Limonene and its oxidation products are skin irritants, and limonene-1,2 - oxide (formed by aerial oxidation) is a known skin sensitizer. Most reported cases of irritation have involved long-term industrial exposure to the pure compound, e.g. during degreasing or the preparation of paints. However a study of patients presenting dermatitis showed that 3 % were sensitized to limonene.

Limonene has been observed to cause cancer in male rats, by reacting with α 2u-globulin, which is not produced by female rats. There is no evidence for carcinogenicity or genotoxicity in humans. The IARC classifies *d*-limonene under Class 3: *not classifiable as to its carcinogenicity to humans*.

Limonene is also flammable.

4 - Biological Pest Control

Orange oil can be used in biological pest control green pesticides. It can kill an ant, as well as a whole colony of ants. Orange

oil also erases an ant's scent - pheromone trail indicators and disrupt re-infestation activities in ants . Their use in organic farming is getting increasingly important because of their non-toxic nature.

They are commonly used in kitchens to safely repel insects.

Orange oil is also known to be useful to control or exterminate termites of the Dry wood (Kalotermitidae) variety.

Ouricury Wax

Contents

1 Introduction

2 Harvesting

3 Properties and uses

1 - Introduction

Ouricury wax is a brown-colored wax obtained from the leaves of a Brazilian Feather Palm *Syagrus coronata* or *Cocos coronata* by scraping the leaf surface.

2 - Harvesting

Harvesting ouricury wax is more difficult than harvesting carnauba wax, as ouricury wax does not flake off the surface of the leaves.

3 - Properties and uses

The physical properties of ouricury wax resemble carnauba wax, so it can be used as a substitute where light color is not required, e.g. in carbon paper inks, molding lubricants and polishes. Its melting point is 81 - 84 °C.

Ozokerite



Ozokerite, Wasatch County, Utah

Contents

Introduction
 Sources
 Properties
 Mining

1 - Introduction

Ozokerite or **ozocerite** (Gr : stench, and wax), archaically referred to as **earthwax** or **earth wax**, is a naturally occurring odoriferous mineral wax or paraffin found in many localities.

2 – Sources

Specimens have been obtained from Scotland, Northumberland, Wales, as well as from about thirty different countries. Of these occurrences the ozokerite of the island (now peninsula) of Cheleken, near Turkmenbashi , parts of the Himalayas in India and the deposits of Utah in the United States, deserve mention, though the last-named have been largely worked out. The sole sources of commercial supply are in Galicia, at Boryslav, Dzwiniacz and Starunia, though the mineral is found at other points on both flanks of the Carpathians.

Ozokerite deposits are believed to have originated in much the same way as mineral veins, the slow evaporation and oxidation of petroleum having resulted in the deposition of its dissolved paraffin in the fissures and crevices previously occupied by the liquid. As found native, ozokerite varies from a very soft wax to a black mass as hard as gypsum.

3 – **Properties**

Its specific gravity ranges from 0.85 to 0.95, and its melting point from 58 to 100 °C . It is soluble in ether , petroleum, benzene, turpentine, chloroform, carbon disulfide and others. Galician ozokerite varies in color from light yellow to dark brown, and frequently appears green owing to dichroism. It usually melts at 62 °C Chemically, ozokerite consists of a mixture of various hydrocarbons, containing 85-87% by weight of carbon and 14 - 3% of hydrogen.

4 – Mining

The mining of ozokerite began in Galicia in the 1880s, and was formerly carried on by means of hand - labor, but in the ozokerite mines owned by the Boryslaw Actien Gesellschaft and the Galizische Kreditbank, the workings of which extend to a depth of 200 meters, , respectively , electrical power is employed for and 225 meters hauling, pumping and ventilating. In these mines there are the usual main shafts and galleries, the ozokerite being reached by levels driven along the strike of the deposit. The wax, as it reaches the surface, varies in purity, and, in new workings especially, only hand-picking is needed to separate the pure material. In other cases much earthy matter is mixed with the material, and then the rock or shale having been eliminated by hand - picking, the "wax-stone" is boiled with water in large coppers, when the pure wax rises to the surface. This is again melted without water, and the impurities are skimmed off, the material being then run into slightly conical cylindrical moulds, and thus made into blocks for the market. The crude ozokerite is refined by treatment first with oil of vitriol, and subsequently with charcoal, when the ceresine or cerasin of commerce is obtained. The refined ozokerite or ceresine, which usually has a melting - point of 61 to 78 °C , is largely used as an adulterant of beeswax, and is frequently colored artificially to resemble that product in appearance.

On distillation in a current of superheated steam, ozokerite yields a candle-making material resembling the paraffin obtained from petroleum and shale-oil but of higher melting-point, and therefore of greater value if the candles made from it are to be used in hot climates. There are also obtained in the distillation light oils and a product resembling Vaseline . The residue in the stills consists of a hard, black, waxy substance, which in admixture with India-rubber was employed under the name of okonite as an electrical insulator. From the residue a form of the material known as heel-ball, used to impart a polished surface to the heels and soles of boots, was also manufactured.

Mining of ozokerite fell off after 1940 due to competition from paraffins manufactured from petroleum, but as it has a higher melting point than most petroleum waxes, it is still favored for some applications, such as electrical insulators and candles, or in extra-soft paper tissues.

Paint Oil



View of Delft in oil paint, by Johannes Vermeer.

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3.3 Extraction methods and processing

4 Pigment

4.1 Toxicity

1 - Introduction

Oil paint is a type of slow-drying paint that consists of particles of pigment suspended in a drying oil, commonly linseed oil. The viscosity of the paint may be modified by the addition of a solvent such as turpentine or white spirit, and varnish may be added to increase the glossiness of the dried oil paint film. Oil paints have been used in Europe since the 12th century for simple decoration, but were not widely adopted as an artistic medium until the early 15th century. Common modern applications of oil paint are in finishing and protection of wood in buildings and exposed metal structures such as ships and bridges. Its hard-wearing properties and luminous colors make it desirable for both interior and exterior use on wood and metal. Due to its slow - drying properties, it has recently been used in paint-on-glass animation. Thickness of coat has considerable bearing on time required for drying: thin coats of oil paint dry relatively quickly.

2 – History

The technical history of the introduction and development of oil paint, and the date of introduction of various additives (driers, thinners) is still — despite intense research since the mid 18th century — not well understood. The literature abounds with incorrect theories and information: in general, anything published before 1952 is suspect.

2 – 1 - First recorded use

The oldest known oil paintings date from 650 AD, found in 2008 in caves in Afghanistan's Bamiyan Valley, "using walnut and poppy seed oils."

2-2 - Classical and medieval period

Though the ancient Mediterranean civilizations of Greece, Rome, and Egypt used vegetable oils, there is little evidence to indicate their use as media in painting. Indeed, linseed oil was not used as a medium because of its tendency to dry very slowly, darken, and crack, unlike mastic and wax.

Greek writers such as Aetius Amidenus recorded recipes involving the use of oils for drying, such as walnut, poppy, hempseed, pine nut, castor, and linseed. When thickened, the oils became resinous and could be used as varnish to seal and protect paintings from water. Additionally, when yellow pigment was added to oil, it could be spread over tin foil as a less expensive alternative to gold leaf. Early Christian monks maintained these records and used the techniques in their own artworks. Theophilus Presbyter, a 12th-century German monk, recommended linseed oil but advocated against the use of olive oil due to its long drying time. Oil paint was mainly used as it is today in house decoration, as a tough waterproof cover for exposed woodwork, especially outdoors.

In the 13th century, oil was used to detail tempera paintings. In the 14th century, Cennino Cennini described a painting technique utilizing tempera painting covered by light layers of oil. The slowdrying properties of organic oils were commonly known to early painters. However, the difficulty in acquiring and working the materials meant that they were rarely used (and indeed the slow drying was seen as a disadvantage).

2 – 3 - Renaissance onwards

As public preference for naturalism increased the quick-drying tempera paints became insufficient to achieve the very detailed and precise effects that oil could achieve. The Early Netherlandish painting of the 15th century saw the rise of the panel painting purely in oils, or oil painting, or works combing tempera and oil painting, and by the 16th century easel painting in pure oils had become the norm, using much the same techniques and materials found today. The claim by Vasari that Jan van Eyck "invented" oil painting is not correct but has cast a long shadow, but van Eyck's *use* of oil paint achieved novel results in terms of precise detail and mixing colours wet-on-wet with a skill hardly equalled since. Van Eyck's mixture may have consisted of piled glass, calcined bones, and mineral pigments boiled in linseed oil until they reached a viscous state—or he may have simply used sun-thickened oils (slightly oxidized by Sun exposure). He left no written documentation.

The Flemish-trained or influenced Antonello da Messina, who Vasari wrongly credited with the introduction of oil paint to Italy,^[4] does seem to have improved the formula by adding litharge, or lead (II) oxide. The new mixture had a honey-like consistency and better drying properties (drying evenly without cracking). This mixture was

known as *oglio cotto* — "cooked oil." Leonardo da Vinci later improved these techniques by cooking the mixture at a very low temperature and adding 5 to 10% beeswax, which prevented darkening of the paint. Giorgione, Titian, and Tintoretto each may have altered this recipe for their own purposes.

The use of any cooked oils or Litharge (sugar of Lead) darkens an oil painting rapidly. None of the old Masters whose work survives used these in their paintings. Both ingredients became popular in the 19th century. Since that time, experiments to improve paint and coatings have been conducted with other oils. Modern oil paints are created from bladderpod, ironweed, calendula and sandmat, plants used to increase the resistance or to reduce the drying time.

2 – 4 - Paint tube

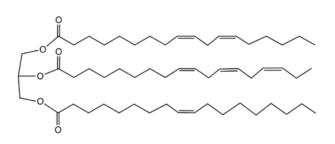


Tubes of various colors.

The paint tube was invented in 1841 by portrait painter John Goffe Rand,^[5] superseding pig bladders and glass syringes^[6] as the primary tool of paint transport. Artists, or their assistants, previously ground each pigment by hand, carefully mixing the binding oil in the proper proportions. Paints could now be produced in bulk and sold in tin tubes with a cap. The cap could be screwed back on and the paints preserved for future use, providing flexibility and efficiency to painting outdoors. The manufactured paints had a balanced consistency that the artist could thin with oil, turpentine, or other mediums.

Paint in tubes also changed the way some artists approached painting. The artist Pierre - Auguste Renoir said, "Without tubes of paint, there would have been no Impressionism." For the Impressionists, tubed paints offered an easily accessible variety of colors for their plein air palettes, motivating them to make spontaneous color choices. With greater quantities of preserved paint, they were able to apply paint more thickly.

3 – Carrier



Representative component of a drying oil, this particular triester is derived from three unsaturated fatty acids, linoleic (top), alphalinolenic (middle), and oleic acids (bottom). The order of drying rate is linolenic > linoleic > oleic acid, reflecting their degree of unsaturation.

3 – 1 – Characteristics

Traditional oil paints require an oil that gradually hardens, forming a stable, impermeable film. Such oils are called siccative, or drying, oils, and are characterized by high levels of polyunsaturated fatty acids. One common measure of the siccative property of oils is iodine number, the number of grams of iodine one hundred grams of oil can absorb. Oils with an iodine number greater than 130 are considered drying, those with an iodine number of 115-130 are semi-drying, and those with an iodine number of less than 115 are non-drying. Linseed oil, the most prevalent vehicle for artists' oil paints, is a drying oil.

When exposed to air, oils do not undergo the same evaporative process that water does. Instead, they polymerize into a dry semisolid. This rate of process can be very slow, depending on the oil. The advantage of the slow - drying quality of oil paint is that an artist can develop a painting gradually. Earlier media such as egg tempera dried quickly, which prevented the artist from making changes or corrections. With oil - based paints, revising was comparatively easy. The disadvantage is that a painting might take months or years to finish, which might disappoint an anxious patron. Oil paints also blend well with each other, making subtle variations of color possible as well as more easily creating details of light and shadow. Oil paints can be diluted with turpentine or other thinning agents, which artists take advantage to paint in layers.

3 – 2 – Sources

The earliest and still most commonly used vehicle is linseed oil, pressed from the seed of the flax plant. Modern processes use heat or steam to produce refined varieties of oil with fewer impurities, but many artists prefer cold-pressed oils . Other vegetable oils such as Hemp, poppy seed, walnut, sunflower, safflower, and soybean oils may be used as alternatives to linseed oil for a variety of reasons. For example, safflower and poppy oils are paler than linseed oil and allow for more vibrant whites straight from the tube.

3 – 3 - Extraction methods and processing

Once the oil is extracted additives are sometimes used to modify its chemical properties. In this way the paint can be made to dry more quickly if that is desired, or to have varying levels of gloss like Liquin. Modern oils paints can, therefore, have complex chemical structures; for example, affecting resistance to UV or giving a suede like appearance.

4 – Pigment

The color of oil paint derives from small particles of colored pigments mixed with the carrier. Some of the earliest known pigments are charcoal (black), iron oxide (rust red), and gypsum (white).

Common pigment types include mineral salts such as white oxides: lead, now most often replaced by less toxic zinc and titanium, and the red to yellow cadmium pigments. Another class consists of earth types, e.g. sienna or umber. Still another group of pigments comes from living organisms, such as madder root.



Pigments for sale at a market stall in Goa, India.

Synthetic pigments are also now available. Natural pigments have the advantage of being well understood through centuries of use, but synthetics have greatly increased the spectrum of available colors, and many are tested well for their lightfastness.

4 - 1 - Toxicity

Many of the historical pigments were dangerous, and many pigments still in popular use today are highly toxic. Some of the most poisonous pigments, such as Paris green (copper (II) acetoarsenite) and orpiment (arsenic sulfide), have fallen from use.

Many pigments still in use are toxic to some degree. Commonly used reds and yellows are produced using cadmium, and vermilion red uses natural or synthetic mercuric sulfide or cinnabar. Flake white and Cremnitz white are made with basic lead carbonate. Some intense blue colors, including cobalt blue and cerulean blue, are made with cobalt compounds. Some varieties of cobalt violet are made with cobalt arsenate.

Palm Kernel Oil

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 History
 Research institutions
 Nutrition
 Uses

1 - Introduction

Palm kernel oil is an edible plant oil derived from the kernel of the oil palm *Elaeis guineensis*. It should not be confused with the other two edible oils derived from palm fruits: coconut oil, extracted from the kernel of the coconut, and palm oil, extracted from the pulp of the oil palm fruit.

Palm kernel oil, coconut oil, and palm oil are three of the few highly saturated vegetable fats; these oils give the name to the 16carbon saturated fatty acid palmitic acid that they contain.

Palm kernel oil, which is semi - solid at room temperature, is more saturated than palm oil and comparable to coconut oil. It is commonly used in commercial cooking because of its relatively low cost, and because it remains stable at high cooking temperatures and can be stored longer than other vegetable oils.

2 - History

Oil from the African oil palm *Elaeis guineensis* has long been recognized in West African countries. European merchants trading with West Africa occasionally purchased palm oil for use in Europe, but palm kernel oil remained rare outside West Africa.

The USDA has published historical production figures for palm kernel oil for years beginning October 1 and ending September 30:

Year	Production, Million Tonne
2008–09	11.75
2009–10	12.22

2010–11	12.55
2011–12	13.28

3 - Research institutions

In the 1960s, research and development (R&D) in oil palm breeding began to expand after Malaysia's Department of Agriculture established an exchange program with West African economies and four private plantations formed the Oil Palm Genetics Laboratory.^[5] The Malaysian government also established Kolej Serdang, which became the Universiti Pertanian Malaysia (UPM) in the 1970s to train agricultural and agroindustrial engineers and agribusiness graduates to conduct research in the field.

In 1979 with support from the Malaysian Agricultural Research and Development Institute (MARDI) and UPM, the government set up the Palm Oil Research Institute of Malaysia (Porim), a public-andprivate-coordinated institution B.C. Sekhar was appointed founder and chairman. Porim's scientists work in oil palm tree breeding, palm oil nutrition and potential oleochemical use. Porim was renamed Malaysian Palm Oil Board in 2000.

4 - Nutrition

Palm kernel oil, similarly to coconut oil, is high in saturated fats and is more saturated than palm oil. Palm kernel oil is high in lauric acid which has been shown to raise blood cholesterol levels, both as LDL-C (cholesterol contained in low-density lipoprotein) and HDL-C (cholesterol contained in high-density lipoprotein). Palm kernel oil does not contain cholesterol or trans fatty acids.

Palm kernel oil is commonly used in commercial cooking because it is lower in cost than other oils and remains stable at high cooking temperatures. The oil can also be stored longer than other vegetable oils.

The approximate concentration of fatty acids (FAs) in palm kernel oil is as follows

Fatty acid content of palm kernel oil		
Type of fatty acid	pct	
Lauric saturated C12	48.2 %	
Myristic saturated C14	16.2 %	
Palmitic saturated C16	8.4 %	
Capric saturated C10	3.4 %	
Caprylic saturated C8	3.3 %	
Stearic saturated C18	2.5 %	
Oleic mono unsaturated C18	15.3 %	
Linoleic poly unsaturated C18	2.3 %	
Other / Unknown	0.4 %	

5 - Uses

Splitting of oils and fats by hydrolysis, or under basic conditions saponification, yields fatty acids, with glycerin (glycerol) as a byproduct. The split-off fatty acids are a mixture ranging from C4 to C18, depending on the type of oil / fat.

Resembling coconut oil, palm kernel oil is packed with myristic and lauric fatty acids and therefore suitable for the manufacture of soaps, washing powders and personal care products. Lauric acid is important in soap making: a good soap must contain at least 15 per cent laurate for quick lathering, while soap made for use in sea water is based on virtually 100 per cent laurate.

Derivatives of palmitic acid were used in combination with naphtha during World War II to produce napalm (aluminum *na*phthenate and aluminum *palm*itate).

Palm Oil

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8 Roundtable on Sustainable Palm Oil

1 - Introduction

Palm oil (also known as dendê oil, from Portuguese) is an edible vegetable oil derived from the mesocarp (reddish pulp) of the fruit of the oil palms, primarily the African oil palm *Elaeis guineensis*, and to a lesser extent from the American oil palm *Elaeis oleifera* and the maripa palm *Attalea maripa*. It is naturally reddish in color because of a high beta-carotene content. It is not to be confused with palm kernel oil derived from the kernel of the same fruit, or coconut oil derived from the kernel of the coconut palm (*Cocos nucifera*). The differences are in color (raw palm kernel oil lacks carotenoids and is not red), and in saturated fat content: Palm mesocarp oil is 41 % saturated, while Palm Kernel oil and Coconut oil are 81 % and 86 % saturated respectively

Palm oil, along with coconut oil, is one of the few highly saturated vegetable fats. It is semi-solid at room temperatures and contains several saturated and unsaturated fats in the forms of glyceryl laurate (0.1 %, saturated), myristate (1%, saturated), palmitate (44 %, saturated), stearate (5 %, saturated), oleate (39 %, monounsaturated), linoleate (10 %, polyunsaturated), and alpha-linolenate (0.3 %, polyunsaturated). Like all vegetable oils, palm oil does not contain cholesterol, although saturated fat intake increases both LDL and HDL cholesterol. Palm oil is GMO - free , i.e., it is not derived from genetically modified organisms.

Palm oil is a common cooking ingredient in the tropical belt of Africa, Southeast Asia and parts of Brazil. Its use in the commercial food industry in other parts of the world is buoyed by its lower cost^[10] and by the high oxidative stability (saturation) of the refined product when used for frying. A recent rise in the use of palm oil in the food industry has come from changed labelling requirements that have caused a switch away from using trans fats. Palm oil has been found to be a reasonable replacement for trans fats, however a small study conducted in 2009 found that palm oil may not be a good substitute for trans fats for individuals with already elevated LDL levels.

The use of palm oil in food products attracts the concern of environmental activist groups; the high oil yield of the trees, attractive to profit-driven investors, has led, in parts of Indonesia, to removal of forests in order to make space for oil-palm monoculture. This has resulted in acreage losses of the natural habitat of the orangutan, of which both species are endangered and the Sumatran orangutan has been listed as "critically endangered". In 2004, the Roundtable on Sustainable Palm Oil (RSPO) was formed to work with palm oil industry to address these concerns. Additionally, in 1992, in response to concerns about deforestation, the Malaysian Government has pledged to limit the expansion of palm oil plantations by retaining a minimum of half the nation's land as forest cover.

2 – History

Human use of oil palms may date as far back as 5,000 years; in the late 1800s, archaeologists discovered a substance that they concluded was originally palm oil in a tomb at Abydos dating back to 3,000 BCE. It is believed that Arab traders brought the oil palm to Egypt.

Palm oil from *Elaeis guineensis* has long been recognized in West African countries, and is widely used as a cooking oil. European merchants trading with West Africa occasionally purchased palm oil for use as a cooking oil in Europe. Palm oil became a highly soughtafter commodity by British traders, for use as an industrial lubricant for machinery during Britain's Industrial Revolution.

Palm oil formed the basis of soap products, such as Lever Brothers' (now Unilever) "Sunlight" soap, and the American Palmolive brand. By around 1870, palm oil constituted the primary export of some West African countries, such as Ghana and Nigeria, although this was overtaken by cocoa in the 1880s.

2-1 - Research institutions

In the 1960s, research and development (R&D) in oil palm breeding began to expand after Malaysia's Department of Agriculture established an exchange program with West African economies and four private plantations formed the Oil Palm Genetics Laboratory. The Malaysian government also established Kolej Serdang, which became the Universiti Putra Malaysia (UPM) in the 1970s to train agricultural and agroindustrial engineers and agribusiness graduates to conduct research in the field.

In 1979 with support from the Malaysian Agricultural Research and Development Institute (MARDI) and UPM, the government set up the Palm Oil Research Institute of Malaysia (Porim), a public and-private-coordinated institution, meaning Porim is run by representatives from government and industry B.C. Sekhar was appointed founder and chairman. Porim's scientists work in oil palm tree breeding , palm oil nutrition and potential oleochemical use. Porim was renamed Malaysian Palm Oil Board in 2000.

3 – Nutrition

Many processed foods contain palm oil as an ingredient. The USDA agricultural research service states that palm oil is not a healthy substitute for trans fats. Much of the palm oil that is consumed as food is to some degree oxidized rather than in the fresh state, and this oxidation appears to be responsible for the health risk associated with consuming palm oil.

Palm oil is composed of fatty acids, esterified with glycerol like all fat. Unlike all fat, it is high in saturated fatty acids, which are solid at room temperature . Palm oil gives its name to the 16-carbon saturated fatty acid palmitic acid. Monounsaturated oleic acid is also a constituent of palm oil. Unrefined palm oil is a large natural source of tocotrienol, part of the vitamin E family.

According to the World Health Organization, evidence is convincing that consumption of palmitic acid increases risk of developing cardiovascular diseases, placing it in the same evidence category as trans fatty acids. Trans fats are also solid at room temperature.

The approximate concentration of fatty acids in palm oil is :

Fatty acid content of palm oil

Type of fatty acid	pct
Myristic saturated C14	1.0 %
Palmitic saturated C16	43.5 %
Stearic saturated C18	4.3 %
Oleic mono unsaturated C18	36.6 %
Linoleic poly unsaturated C18	9.1 %
Other / Unknown	5.5 %

3-1 - Red palm oil

Red palm oil gets its name from its characteristic dark red color, which comes from carotenes, such as alpha - carotene, beta-carotene

and lycopene, the same nutrients that give tomatoes, carrots and other fruits and vegetables their rich colors.

Red palm oil contains at least 10 other carotenes, along with tocopherols and tocotrienols (members of the vitamin E family), CoQ10, phytosterols, and glycolipids. In a 2007 animal study, South African scientists found consumption of red palm oil significantly decreased p38-MAPK phosphorylation in rat hearts subjected to a high - cholesterol diet.

Since the mid - 1990s, red palm oil has been cold-pressed and bottled for use as cooking oil, and blended into mayonnaise and salad oil.^[36] Red palm oil antioxidants like tocotrienols and carotenes are added to foods and cosmetics because of their purported health benefits.

A 2009 study tested the emission rates of acrolein, a toxic and malodorous breakdown product from glycerol, from the deep-frying of potatoes in red palm, olive, and polyunsaturated sunflower oils. The study found higher acrolein emission rates from the polyunsaturated sunflower oil (the scientists characterized red palm oil as "mono-unsaturated") and lower rates from both palm and olive oils. The World Health Organization established a tolerable oral acrolein intake of 7.5 mg/day per kilogram of body weight. Although acrolein occurs in French fries, the levels are only a few micrograms per kilogram. A 2011 study concluded a health risk from acrolein in food is unlikely.

3-2 – Refined , bleached , deodorized palm oil

After milling, various palm oil products are made using refining processes. First is fractionation, with crystallization and separation processes to obtain solid (stearin), and liquid (olein) fractions.^[42] Then melting and degumming removes impurities. Then the oil is filtered and bleached.

Next, physical refining removes smells and coloration, to produce "refined bleached deodorized palm oil", or RBDPO, and free

sheer fatty acids, which are used in the manufacture of soaps, washing powder and other products. RBDPO is the basic oil product sold on the world's commodity markets, although many companies fractionate it further to produce palm olein for cooking oil, or process it into other products.

4 - Other uses

Derivatives of palmitic acid were used in combination with naphtha during World War II to produce napalm (aluminum *na*phthenate and aluminum *palm*itate).

Many processed foods contain palm oil as an ingredient.^[27] The highly saturated nature of palm oil, while undesirable from the health perspective, renders it solid at room temperature in temperate regions, making it a cheap substitute for butter in uses where solid fat is desirable, such as the making of pastry dough and baked goods: in this respect, it is less of a health - hazard than the alternative substitute of partially hydrogenated trans fat.

Splitting of oils and fats by hydrolysis, or under basic conditions saponification, yields fatty acids, with glycerin (glycerol) as a byproduct. The split - off fatty acids are a mixture ranging in carbon chain length from C4 to C18, depending on the type of oil or fat.

4 – 1 – Biodiesel

Palm oil can be used to produce biodiesel, which is also known as palm oil methyl ester. Palm oil methyl ester is created through a process called transesterification. Palm oil biodiesel is often blended with other fuels to create palm oil biodiesel blends. Palm oil biodiesel meets the European EN 14214 standard for biodiesels. The world's largest palm oil biodiesel plant is the Finnish operated Neste Oil biodiesel plant in Singapore, which opened in 2011.

The organic waste matter produced when processing oil palm, including oil palm shells and oil palm fruit bunches, can also be used to produce energy. This waste material, also known as biomass, can be converted into pellets that can be used as a biofuel . Additionally, palm oil that has been used to fry foods can be converted into methyl esters for biodiesel. The used cooking oil is chemically treated to create a biodiesel similar to petroleum diesel.

The use of palm oil in the production of biodiesel has led to concerns that the need for fuel is being placed ahead of the need for food, leading to malnourishment in developing nations. This is known as the food versus fuel debate. According to a 2008 report published in the *Renewable and Sustainable Energy Reviews*, palm oil was determined to be a sustainable source of both food and biofuel. The production of palm oil biodiesel does not pose a threat to edible palm oil supplies. According to a 2009 study published in the *Environmental Science and Policy* journal, palm oil biodiesel might increase the demand for palm oil in the future, resulting in the expansion of palm oil production, and therefore an increased supply of food.

4 – 2 - Biodiesel in Malaysia

The Malaysian government established the National Biofuel Policy in 2006, which led to the implementation of the B5 mandate in some regions of the country. The B5 mandate requires that all diesel sold in these regions of Malaysia contain 5 % palm oil biodiesel. This mandate is expected to be expanded nationwide in 2014, with plans to increase the minimum palm oil biodiesel content to 10% . The biodiesel sector in Malaysia has struggled to become profitable, due in part to the high cost of crude palm oil, which led to a dip in biodiesel production in the late 2000s. In 2012, there were 20 biodiesel plants in Malaysia, of which 2 were operational by early 2013. According to an advisor to the Roundtable on Sustainable Palm Oil, biodiesel production in Malaysia is expected to double in 2013.

5 - Market

According to Hamburg - based Oil World trade journal . in 2008, global production of oils and fats stood at 160 million tonnes. Palm oil and palm kernel oil were jointly the largest contributor, accounting for 48 million tonnes or 30 % of the total output. Soybean oil came in second with 37 million tonnes (23 %). About 38 % of the

oils and fats produced in the world were shipped across oceans. Of the 60.3 million tonnes of oils and fats exported around the world, palm oil and palm kernel oil make up close to 60 %; Malaysia, with 45 % of the market share, dominates the palm oil trade.

5 – 1 - Food label regulations

Currently, palm oil may be listed as "vegetable fat" or "vegetable oil" on food labels in the European Union (EU). Beginning in 2015, food packaging in the EU will no longer be allowed to use the generic terms "vegetable fat" or "vegetable oil" in the ingredients list. Food producers will be required to list the specific type of vegetable fat used, including palm oil.

6 - Regional production



A map of world palm oil output

6 – 1 – Indonesia

As of 2009, Indonesia was the largest producer of palm oil, surpassing Malaysia in 2006, producing more than 20.9 million tonnes. Indonesia aspires to become the world's top producer of palm oil. But at the end of 2010, 60 percent of the output was exported still in the form of Crude Palm Oil. FAO data show production increased by over 400 % between 1994 and 2004, to over 8.66 million metric tones.

6 - 2 - Malaysia



An palm oil plantation in Malaysia.

In 2012, Malaysia, the world's second largest producer of palm oil, produced 18.79 million tonnes of crude palm oil on roughly 5,000,000 hectares of land. Though Indonesia produces more palm oil, Malaysia is the world's largest exporter of palm oil having exported 18 million tonnes of palm oil products in 2011. China, Pakistan, the European Union, India and the United States are the primary importers of Malaysian palm oil products.

In 2012, the Malaysian palm oil industry employed an estimated 491,000 workers.

6 – 3 - Nigeria

As of 2011, Nigeria was the third-largest producer, with more than 2.5 million hectares under cultivation. Until 1934, Nigeria had been the world's largest producer. Both small- and large-scale producers participated in the industry.

7 - Impact

7 – 1 – Social

The palm oil industry has had both positive and negative impacts on workers, indigenous peoples and residents of palm oilproducing communities. Palm oil production provides employment opportunities, and has been shown to improve infrastructure, social services and reduce poverty. However, in some cases, oil palm plantations have developed lands without consultation or compensation of the indigenous people occupying the land, resulting in social conflict. The use of illegal immigrants in Indonesia has also raised concerns about working conditions within the palm oil industry.

Some social initiatives use palm oil cultivation as part of poverty alleviation strategies. Examples include the UN Food and Agriculture Organisation's hybrid oil palm project in Western Kenya, which improves incomes and diets of local populations , and Malaysia's Federal Land Development Authority and Federal Land Consolidation and Rehabilitation Authority, which both support rural development.

7 - 2 - Health

7 - 2 - 1 - Blood lipid and cholesterol effects

According to studies reported on by the Center for Science in the Public Interest (CSPI), excessive intake of palmitic acid, which makes up 44 percent of palm oil, increases blood cholesterol levels and may contribute to heart disease. Several studies have linked palm oil and cardiovascular disease including a 2005 study conducted in Costa Rica which indicated that replacing palm oil in cooking with polyunsaturated non hydrogenated oils could reduce the risk of heart attacks, and a 2011 analysis of 23 countries which showed that for each kilogram of palm oil added to the diet annually there was an increase in ischemic heart disease deaths though the increase was much smaller in high-income countries.

However, results from several studies indicate that palm oil provides health benefits, including increasing good cholesterol and reducing bad cholesterol, and that consumption of palm oil does not increase the risk of cerebrovascular disease. Additionally, a 1993 study published by the United Nations University Press found that consumption of palmitic acid appeared to have no impact on cholesterol levels when daily cholesterol intake is below 400 mg per day.

The CSPI also reported that the World Health Organization and the National Heart, Lung and Blood Institute have encouraged consumers to limit the consumption of palmitic acid and foods high in saturated fat. In response to negative reports on palm oil many food manufacturers transitioned to using hydrogenated vegetable oils in their products, which have also come under scrutiny for the impact these oils have on health. A 2006 study supported by the National Institutes of Health and the USDA Agricultural Research Service concluded that palm oil is not a safe substitute for partially hydrogenated fats (trans fats) in the food industry, because palm oil results in adverse changes in the blood concentrations of LDL cholesterol and apolipoprotein B just as trans fat does.

However, according to two reports published in 2010 by the Journal of the American College of Nutrition palm oil is again an accepted replacement for hydrogenated vegetable oils and a natural replacement for partially hydrogenated vegetable oils, which are a significant source of trans fats. Palm oil is also an important source of calories and a food staple in poor communities.

7 - 2 - 2 - Comparison with animal saturated fat

Not all saturated fats have equally cholesterolemic effects.^[114] Studies have indicated that consumption of palm olein (which is more unsaturated) reduces blood cholesterol when compared to sources of saturated fats like coconut oil, dairy and animal fats.

In 1996, Dr Decker of University of Massachusetts Medical School stressed that saturated fats in the sn-1 and -3 position of triacylglycerols exhibit different metabolic patterns because of their low absorptivity. Dietary fats containing saturated fats primarily in sn-1 and -3 positions (e.g., cocoa butter, coconut oil, and palm oil) have very different biological consequences than those fats in which the saturated fats are primarily in the sn-2 position (e.g., milk fat and lard). Differences in stereospecific fatty acid location should be an important consideration in the design and interpretation of lipid nutrition studies and in the production of specialty food products.

7-2-3 - In wound care

Although palm oil is applied to wounds for its supposed antimicrobial effects, research does not confirm its effectiveness.

8 - Roundtable on Sustainable Palm Oil

The Roundtable on Sustainable Palm Oil (RSPO) was created in 2004 following concerns raised by non - governmental organizations about environmental impacts related to palm oil production. The organization has established international standards for sustainable palm oil production . Products containing certified palm oil can carry the RSPO trademark . Members of the RSPO include palm oil producers, environmental groups and manufacturers who use palm oil in their products.

Palm oil growers who produce certified sustainable palm oil have been critical of the organization because, though they have met RSPO standards and assumed the costs associated with certification, the market demand for sustainable palm oil remains low.^{[119][120]} Low market demand has been attributed to the higher cost of certified sustainable palm oil, leading palm oil buyers to purchase cheaper non-certified palm oil. In 2011, 12 % of palm oil produced was certified sustainable, though only half of that was purchased.

Palm Stearin

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2 Uses

3 Composition

1 - Introduction

Palm stearin is the solid fraction of palm oil that is produced by partial crystallization at controlled temperature.

It is more variable in composition than palm olein, the liquid fraction of palm oil, especially in terms of its solid fat content, and therefore has more variable physical characteristics.^{[2]p. 34} Like crude palm fruit oil, palm stearin contains carotenoids, but physically refined palm oils do not, as they are removed or destroyed in the refining process.

2 - Uses

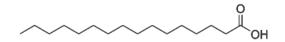
It is a useful source of natural hard vegetable fat for food applications.

3 Composition

Palm stearin consists of mostly glyceryl tripalmitate, with most of the rest of the fat content being glyceryl dipalmitate monooleate.^[3]

In terms of fatty acid composition, a typical soft palm stearin might contain almost 50 % palmitic acid and 35 % oleic acid.

Palmitic Acid



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- 1 Introduction
- 2 Occurrence and production
- 3 Biochemistry
- 4 Applications
- 5 Health effects

1 - Introduction

Palmitic acid, or hexadecanoic acid in IUPAC nomenclature, is the most common fatty acid (saturated) found in animals, plants and microorganisms.^[4] Its molecular formula is $CH_3(CH_2)_{14}CO_2H$. As its name indicates, it is a major component of the oil from palm trees (palm oil, palm kernel, and palm kernel oil), but can also be found in meats, cheeses, butter, and dairy products. Palmitate is a term for the salts and esters of palmitic acid. The palmitate anion is the observed form of palmitic acid at basic pH.

Aluminium salts of palmitic acid and naphthenic acid were combined during World War II to produce napalm. The word "napalm" is derived from the words naphthenic acid and palmitic acid.

IUPAC name : hexa decanoic acid		
Other names : C16:0 (Lipid numbers), palmic acid		
Molecular formula	$C_{16}H_{32}O_2$	
Molar mass	256 g/mol	
Appearance	White crystals	
Density	$0.853 \text{ g/cm}^3 \text{ at } 62 ^\circ\text{C}$	
Melting point	62.9 °C	

Boiling point	351-352 °C 215 °C at 15 mmHg
Solubility in water	Insoluble

2 - Occurrence and production

Palmitic acid mainly occurs as its ester in triglycerides (fats), especially palm oil but also tallow. The cetyl ester of palmitic acid (cetyl palmitate) occurs in spermaceti. It was discovered by Edmond Frémy in 1840, in saponified palm oil. Butter, cheese, milk and meat also contain this fatty acid.

Palmitic acid is prepared by treating fats and oils with water at a high pressure and temperature (above 200 °C), leading to the hydrolysis of triglycerides. The resulting mixture is then distilled.

3 – Biochemistry

Excess carbohydrates in the body are converted to palmitic acid. Palmitic acid is the first fatty acid produced during fatty acid synthesis and the precursor to longer fatty acids. As a consequence, palmitic acid is a major body component of animals. In humans, one analysis found it to comprise 21–30% (molar) of human depot fat,^[7] and it is a major, but highly variable, lipid component of human breast milk. Palmitate negatively feeds back on acetyl-CoA carboxylase (ACC), which is responsible for converting acetyl-CoA to malonyl-CoA, which in turn is used to add to the growing acyl chain, thus preventing further palmitate generation.^[9] In biology, some proteins are modified by the addition of a palmitoyl group in a process known as palmitoylation. Palmitoylation is important for membrane localisation of many proteins.

4 – **Applications**

Palmitic acid is mainly used to produce soaps, cosmetics, and release agents. These applications utilize sodium palmitate, which is commonly obtained by saponification of palm oil. To this end, palm oil, rendered from the coconut palm nut, is treated with sodium hydroxide (in the form of caustic soda or lye), which causes hydrolysis of the ester groups. This procedure affords glycerol and sodium palmitate.

Because it is inexpensive and adds texture to processed foods (convenience food), palmitic acid and its sodium salt find wide use including foodstuffs. Sodium palmitate is permitted as a natural additive in organic products.

Hydrogenation of palmitic acid yields cetyl alcohol, which is used to produce detergents and cosmetics.

Recently, a long - acting antipsychotic medication, paliperidone palmitate (marketed as INVEGA Sustenna), used in the treatment of schizophrenia, has been synthesized using the oily palmitate ester as a long-acting release carrier medium when injected intramuscularly. The underlying method of drug delivery is similar to that used with decanoic acid to deliver long-acting depot medication, in particular, neuroleptics such as haloperidol decanoate.

5 - Health effects

According to the World Health Organization, evidence is "convincing" that consumption of palmitic acid increases risk of developing cardiovascular diseases, placing it in the same evidence category as trans fatty acids. Retinyl palmitate is an antioxidant and a source of vitamin A added to low fat milk to replace the vitamin content lost through the removal of milk fat. Palmitate is attached to the alcohol form of vitamin A, retinol, to make vitamin A stable in milk.

Rats fed a diet of 20% palmitic acid and 80% carbohydrate for extended periods showed alterations in central nervous system control of insulin secretion, and suppression of the body's natural appetitesuppressing signals from leptin and insulin (the key hormones involved in weight regulation).

Palmitoleic Acid

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 Occurrence and production

2 Decurrence and production

3 Potential biological effects

Palmitoleic acid, or (*Z*)-9-hexa decenoic acid, is an omega -7 mono unsaturated fatty acid with the formula $CH_3(CH_2)_5CH=CH(CH_2)_7COOH$ that is a common constituent of the glycerides of human adipose tissue. It is present in all tissues but, in general, found in higher concentrations in the liver. It is biosynthesized from palmitic acid by the action of the enzyme delta-9 desaturase. A beneficial fatty acid, it has been shown to increase insulin sensitivity by suppressing inflammation, as well as inhibit the destruction of insulin-secreting pancreatic beta cells.

IUPAC name : hexa dec-9-enoic acid				
Other names ;				
Palmitoleic acid				
cis-Palmitoleic acid	<i>cis</i> -Palmitoleic acid			
9-cis-Hexa decenoic acid				
C16:1 (Lipid numbers)				
Molecular formula	$C_{16}H_{30}O_2$			
Molar mass	254.			
Density	0.894 g / cm ³			
Melting point	- 0.1 °C			

2 - Occurrence and production

Palmitoleic acid can be abbreviated as $16:1\Delta^9$. Dietary sources of palmitoleic acid include a variety of animal oils, vegetable oils, and marine oils. Macadamia oil (*Macadamia integrifolia*) and sea buckthorn oil (*Hippophae rhamnoides*) are botanical sources with high concentrations, containing $17\%^{[2]}$ and 19% min to 29% max^[3] of palmitoleic acid, respectively.

3 - Potential biological effects

In an analysis of numerous fatty acids, palmitoleate was shown to possibly influence fatty liver deposition/production, insulin action, palmitate, and fatty acid synthase, leading to proposal of a new term, "lipokine," having hormone-like effects.

As one such effect may include altered insulin sensitivity, palmitoleic acid (C16:1 n-7) was shown in diabetic mice to attenuate hyperglycemia and hypertriglyceridemia by increasing insulin sensitivity, in part owing to suppression of pro-inflammatory gene expressions and improving hepatic lipid metabolism . Contrary results have been reported, indicating association with lower insulin resistance, presence of atherogenic dyslipidemia, and development of diabetes.

Other preliminary research indicated that palmitoleic acid could have a role as a signaling molecule affecting body weight, a finding consistent with previous observations that palmitoleic acid, among other fatty acids available in the diet, may be used by enzymes affecting fat oxidation. As a consequence, oil types manufactured with high palmitoleic acid content may have a role in addressing obesity.

In the United States military, palmitoleic acid has been considered as a component in ready-to-eat meals (MRE). A study for the U.S. Army, initiated in 1996 by the University of Hawaii at Manoa, implied that the monounsaturated fatty acid not only may provide short-term benefits by energy needed in field and combat situations but also may ensure long-term fitness by minimizing risks of cardiovascular disease . Palmitoleic acid-rich products might be especially applicable for certain types of MRE rations.

The significance of palmitoleic acid in U.S. military nutrition research is also mentioned in a 2011 study. This preliminary research cites palmitoleic acid as a possible protective factor related to mental health and suicide, and states that service members with higher levels of palmitoleic acid may have lower risk of suicide.

Peanut Oil

Contents

1 Introduction

- 2 History
- 3 Nutritional content
- 4 Allergens and toxins
- 5 Other uses
 - 5.1 Biodiesel

1 - Introduction

Peanut oil, also known as groundnut oil or arachis oil, is a mild tasting vegetable oil derived from peanuts. The oil is available in refined, unrefined, cold pressed, and roasted varieties, the latter with a strong peanut flavor and aroma, analogous to sesame oil.

, both for general cooking, and in the case of roasted oil, for added flavor. Peanut oil has a high smoke point relative to many other cooking oils, so is commonly used for frying foods. Its major component fatty acids are oleic acid (46.8 % as olein), linoleic acid (33.4 % as linolein), and palmitic acid (10.0 % as palmitin). The oil also contains some stearic acid, arachidic acid, arachidonic acid, behenic acid, lignoceric acid and other fatty acids.

Antioxidants such as vitamin E are some times added, to improve the shelf life of the oil.

2 – History

The oil had increased use in the United States during World War II, because of war shortages of other oils.

3 - Nutritional content

Peanut Oil		
Nutritional value per 100 g		
Energy	3,699 kJ (884 kcal)	
Carbohydrates	0 g	

Fat	100 g
- saturated	17 g
- monounsaturated	46 g
- polyunsaturated	32 g
Protein	0 g
Zinc	0.01 mg (0%)
Cholesterol	0 mg
Selenium	0.0 mcg

According to the USDA data upon which the following table is based, 100 g of peanut oil contains 17.7 g of saturated fat, 48.3 g of monounsaturated fat, and 33.4 g of polyunsaturated fat.

Comparative properties of common cooking fats (per 100g)					
	Total fat	Saturated fat	Monounsaturated fat	Polyunsaturated fat	Smoke point
Sunflower oil	100g	11g (11%)	20g (84g in high oleic variety	69g (4g in high oleic variety)	225 °C
Soybean oil	100g	16g (16%)	23g	58g	257 °C
Canola oil	100g	7g (7%)	63g	28g	205 °C
Olive oil	100g	14g (14%)	73g	11g	190 °C
Corn oil	100g	15g (15%)	30g	55g	230 °C
Peanut oil	100g	17g (17%)	46g	32g	225 °C
Rice bran oil	100g	25g (25%)	38g	37g	213 °C
Vegetable shortening (hydrogenated)	71g	23g (34%)	8g (11%)	37g (52 %)	165 °C
Lard	100g	39g (39%)	45g	11g	190 °C
Suet	94g	52g (55%)	32g (34%)	3g (3 %)	200°C
Butter	81g	51g (63%)	21g (26%)	3g (4 %)	150 °C
Coconut oil	100g	86g (86%)	6g (6%)	2g (2 %)	177 °C

4 - Allergens and toxins

Most highly refined peanut oils remove the peanut allergens and have been shown to be safe for "the vast majority of peanut-allergic individuals".^[9] Cold-pressed peanut oils may not remove the allergens

and thus could be highly dangerous to people with peanut allergy.^[10] Since the degree of processing for any particular product is often unclear, "avoidance is prudent." . Peanuts that contain the mold that produces highly toxic aflatoxin can end up contaminating the oil derived from them.

5 - Other uses

Peanut oil, as with other vegetable oils, can be used to make soap by the process of saponification. The oil is safe for use as a massage oil. Peanut researcher George Washington Carver marketed a peanut massage oil.

5 - 1 – Biodiesel

At the 1900 Paris Exhibition, the Otto Company, at the request of the French government, demonstrated that peanut oil could be used as a source of fuel for the diesel engine; this was one of the earliest demonstrations of biodiesel technology.

Peat Wax

Peat Wax is a dark waxy substance extracted from peat using organic solvents. It is very similar to the coal derived Montan wax and there fore has similar properties and uses. Raw peat wax is typically a mixture of three primary components, namely asphalt, resins and wax.

Pecan Oil

Contents

1 Introduction

2 Processing

3 Appearance

1 - Introduction

Pecan oil is an edible pressed oil extracted from the pecan nut. Pecan oil is neutral in flavor and takes on the flavor of whatever seasoning is being used with it. Pecan oil contains 9.5% saturated fat, which is less than in olive oil (13.5%), peanut oil (16.90%) or corn oil (12.70%). It is also used as a massage oil and in aromatherapy applications.

Pecan oil is considered a healthy oil as it is rich in monounsaturated fats, specifically oleic acid, (52.0) and low in saturated fats. It also contains linoleic acid (36.6 %), and small amounts of palmitic (7.1 %), stearic (2.2 %) and linolenic acids (1.5 %). The overall balance of fatty acids in the oil may reduce LDL cholesterol (also known as "bad" cholesterol) and the risk of heart disease.

The main application of this oil is its use in cooking. It has a high smoke point of 470 degrees F making it ideal for cooking at high temperatures and for deep frying. The mild nutty flavor gives this oil the unique ability to enhance the flavor of ingredients, making it a popular component of salad dressings and dips. Pecan oil is much lighter than olive and is well suited for every day cooking. It also generally does not contain preservatives or additives. Pecan oil is a good substitute for butter and other cooking oils, making it suitable for baking. It is recommended that the oil be refrigerated after opening to increase shelf life and reduce rancidity.

Pecan oil can sometimes be hard to find in local grocery stores because it is considered a specialty oil; however, it can be purchased online through a number of manufacturers' websites.

2 – Processing

Prior to extraction, the nuts are lightly roasted and ground. Mechanical extraction methods are then used to remove the oil. Most manufacturers avoid the use of chemical extraction methods in order to preserve the natural nutty flavor and nutrients of the oil.

3 – Appearance

Pecan oil is a light weight oil and is usually pale yellow in color.

Penetrating Oil

Penetrating oil, also known as penetrating fluid, is very lowviscosity oil. It can be used to free rusted mechanical parts (such as nuts and bolts) so that they can be removed, because it can penetrate into the narrow space between the threads of two parts. It can also be used as a general - purpose lubricant, a cleaner, or a corrosion stopper. Using penetrating fluids as general-purpose lubricants is not advisable, because such oils are relatively volatile. As a result, much of the penetrating oil will evaporate in a short amount of time, leaving little residual lubricant. To ensure long-term lubrication, some penetrating oil formulations, such as WD - 40, contain a non-volatile lubricating component.

Other uses include: removing chewing gum and adhesive stickers, lessening friction on metal-stringed musical instruments, various gardening purposes and household repair tasks.

Pequi Oil

Pequi oil is a seed oil, extracted from the seeds of the *Caryocar brasiliense*, which is native to Brazil. The pale yellow mesocarp oil is extracted and used directly as a cooking oil.^[1] In Brazil, there are projects among indigenous people groups to develop pequi oil production as a means of economic development.

Pequi oil contains 44.2 % palmitic and 51.7 % oleic acid, with linolenic and stearic acids in much smaller amounts.

Perilla Oil



Perilla frutescens, var. japonica

Perilla oil is obtained from the seeds of herbs of the genus *Perilla*, usually from the species *Perilla frutescens*. The seeds contain 35 to 45 percent oil which is obtained by pressing. Perilla oil is used along with synthetic resins in the production of varnishes. Perilla oil dries faster than linseed oil and on drying forms a film that is harder and yellows more than that formed by linseed oil. The paint and varnish industry accounts for the largest usage. Perilla oil also is important in the manufacture of printing inks and linoleum, and in more ancient times was a critical component in creating durable earthen floors.

In parts of Asia, perilla oil is used as an edible oil that is valued more for its medicinal benefit than its flavor. Perilla oil is a very rich source of the omega-3 fatty acid alpha - linolenic acid (ALA). About 50 to 60 % of the oil consists of ALA.

In Korea, perilla is mainly cultivated in Chungcheong, Gyeongsang, and Jeolla Province, so the locals there often consume perilla oil. In Korean cuisine, it is used for marinating *namul* (seasoned vegetable dish), coating grilled *gim* (Korean laver), or pan-frying *jeon* (pancake-like dish), where it is called *deul gireum* or *beopyu* in Korean. In North Korea, it is called *deulkkae gireum*

Pine Nut Oil

Contents

1 Introduction

2 Culinary uses

3 Medicinal uses

4 Triglyceride composition

1 - Introduction

Pine nut oil, also called *pine seed oil* or *cedar nut oil*, is a vegetable oil, extracted from the edible seeds of several species of pine. While the oil produced from the seeds of more common European and American pine varieties is mostly used for culinary purposes, Siberian pines (growing in Russia, Mongolia and Kazakhstan), as well as Korean pines (growing mostly in China and North Korea) yield the seeds with the highest content of pinolenic acid, as well as antioxidants associated with medicinal uses.

2 - Culinary uses

Pine nut oil has a relatively low smoke point, and is therefore not generally used during cooking. Rather, it is added to foods for "finishing", to add flavor.

In Russia before the revolution of 1917, it was used for cooking during Great Lent when the eating of animal fats was forbidden. At that time, ten percent of all hard currency in Russia was based on the trade of pine nut oil. Most of the trade was with France, which traditionally uses nut oil in cooking.

Pine nut oil is also reportedly an excellent bread preservative when a small amount is added to the dough.

3 - Medicinal uses[edit]

Korean and Siberian pine nut oil varieties have drawn recent attention for their medicinal properties.

According to a study by Lipid Nutrition, the pinolenic acid contained in Korean pine nut oil can help curb appetite by stimulating

the release of cholecystokinin, a hormone that functions as an appetite suppressant. The study showed that pine nut oil "boosts appetite suppressors up to 60% for four hours."

Interest in the properties of pinolenic acid have led some researchers to explore methods of increasing the amount of this fatty acid in pine nut oil. Subsequent research showed that, in addition to suppressing appetite, pine nut oil also can reduce LDLs, yielding further health benefits.

Siberian pine nut oil (a variety of pine nut oil pressed from the seeds of Siberian pines) also contains a high concentration of free radical scavengers, which help reduce oxidative damage that can lead to peptic ulcers or gastritis, according to clinical studies in Russia and China. As a result of such studies, pine nut oil is now considered a remedy for these conditions in both countries.

4 - Triglyceride composition

One analysis of the triglyceride composition of Siberian pine nut oil showed the following composition :

Fatty acid	Percentage
Linoleic acid	$49.0\% \pm 2.3$
Oleic acid	$23.8\% \pm 2.1$
Pinolenic acid	$17.1\%\pm2.0$
Palmitic acid	$6.3\% \pm 2.2$
Stearic acid	$2.5\% \pm 0.1$

Pistachio Oil

Contents

Introduction
 Culinary uses
 Monufacturing uses

3 Manufacturing uses

1 - Introduction

Pistachio oil is a pressed oil, extracted from the fruit of *Pistacia vera*, the pistachio nut.

2 - Culinary uses

Compared to other nut oils, pistachio oil has a particularly strong flavor. Like other nut oils, it tastes similar to the nut from which it is extracted. Pistachio oil is high in Vitamin E, containing 19mg/100g. It contains 12.7 % saturated fats, 53.8% monounsaturated fats, 32.7 % linoleic acid, and 0.8 % omega -3 fatty acid.^[1] Pistachio oil is used as a table oil to add flavor to foods such as steamed vegetables.

3 - Manufacturing uses

Pistachio oil is also used in skin care products.

Poly Unsaturated Fat

Contents

1 Introduction

2 Dietary Sources

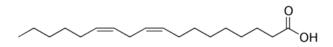
3 Health

- 3.1 Benefits
- 3.2 Consumption during pregnancy
- 3.3 Relation to cancer
- 3.4 Food sources of polyunsaturated fat

1 - Introduction

Poly unsaturated fats are triglycerides in which the hydrocarbon tails constitutes polyunsaturated fatty acids (PUFA) (fatty acids possessing more than a single carbon – carbon double bond).^{[1][2]} "Unsaturated" refers to the fact that the molecules contain less than the maximum amount of hydrogen. These materials exist as *cis* or *trans* isomers depending on the geometry of the double bond.

Saturated fats have hydrocarbon chains which can be most readily aligned. The hydrocarbon chains in trans fats align more readily than those in cis fats, but less well than those in saturated fats. This means that, in general, the melting points of fats increase from cis to trans unsaturated and then to saturated. See the section on chemical structure of fats for more information.



Chemical structure of the polyunsaturated fat linoleic acid.

The position of the carbon - carbon double bonds in carboxylic acid chains in fats is designated by Greek letters. The carbon atom closest to the carboxyl group is the *alpha* carbon, the next carbon is the *beta* carbon and so on. In fatty acids the carbon atom of the methyl group at the end of the hydrocarbon chain is called the *omega* carbon because *omega* is the last letter of the Greek alphabet. Omega-3 fatty acids have a double bond three carbons away from the methyl carbon, whereas omega - 6 fatty acids have a double bond six carbons

away from the methyl carbon. The illustration below shows the omega-6 fatty acid, linoleic acid.

While the nutritional aspects of polyunsaturated fats are of highest concern, these materials do have non-food applications. Drying oils, which polymerize on exposure to oxygen to form solid films, are polyunsaturated fats. The most common ones are linseed (flax seed) oil, tung oil, poppy seed oil, perilla oil, and walnut oil. These oils are used to make paints and varnishes.

2 - Dietary Sources

Poly unsaturated fat can be found mostly in nuts, seeds, fish, algae, leafy greens, and krill. Whole food sources are always best, as processing and heating may damage polyunsaturated fats.

3 - Health

3 – 1 - Benefits

Omega-3 fatty acids in algal oil, fish oil, fish and seafood have been shown to lower the risk of heart attacks.^[3]Omega-6 fatty acids in sunflower oil and safflower oil may also reduce the risk of cardiovascular disease.

Among n-3 fatty acids [Omega-3], neither long-chain nor shortchain forms were consistently associated with breast cancer risk. High levels of docosahexaenoic acid (DHA), however, the most abundant n-3 PUFA [Omega-3] in erythrocyte (red blood cell) membranes, were associated with a reduced risk of breast cancer. The DHA obtained through the consumption of poly unsaturated fatty acids is positively associated with cognitive and behavioral performance . In addition DHA is vital for the grey matter structure of the human brain, as well as retinal stimulation and neurotransmission.

Dietary intake of poly unsaturated fatty acids has been shown in several studies to decrease the risk of developing amyotrophic lateral sclerosis (ALS, a.k.a. Lou Gehrig's Disease). The importance of the ratio of omega-6/omega-3 essential fatty acids as established by comparative studies shows an Omega-6:Omega-3 ratio under 4:1 is contributive to health.

Due to the lack of pre-formed EPA and DHA in the vegan diet, High doses of ALA are effective in providing limited amounts of EPA, and very poor amounts of DHA in Vegan Populations.

There are conflicting associations between dietary factors and incident atrial fibrillation (AF). A 2010 study published in AJCN suggested that polyunsaturated fats were found to have no significant association with AF.

Contrary to conventional advice, a new evaluation of evidence pertaining to the health impacts of replacing dietary Saturated Fat with Polyunsaturated Fat found that doing so actually increased the rates of death from all causes, coronary heart disease, and disease. These findings cardiovascular could have important worldwide dietary implications for advice substitute to polyunsaturated fats for saturated fats.

3 – 2 - Consumption during pregnancy

Consumption of omega-3 fatty acids during pregnancy is critical to fetal development. They are required during the prenatal period for the formation of synapses and cell membranes. These processes are also essential in postnatal human development for injury response of the central nervous system and retinal stimulation.

A study published in *The Journal of Nutrition* in 2007 found that the maternal diet of rats affects the brain DHA status of offspring. It suggests that a maternal diet containing insufficient amounts of omega-3 polyunsaturated fatty acid can lead to greater risk of decreased accretion of brain DHA in offspring.

3 – 3 - Relation to cancer

A 2010 study of 3,081 women suffering from breast cancer was done to research the effects of poly unsaturated fats on breast cancer.

It demonstrated that the consumption of high amounts of long chain omega-3 poly unsaturated fats from food produced a 25 % reduced risk of additional breast cancer events. These women were also shown to have reduced risk of "all - cause mortality." Consumption of polyunsaturated fats through fish oil supplements was not shown to decrease risk of recurring breast cancer events, although the authors noted that consumption of supplements among the group was low, less than 5 %.

At least one study in mice has shown that consuming high amounts of polyunsaturated fat (but not monounsaturated fat) may increase the risk of metastasis in cancer patients. The researchers found that linoleic acid in polyunsaturated fats produced increasing membrane phase separation, and thereby increased adherence of circulating tumor cells to blood vessel walls and remote organs. According to the report 'The new findings support earlier evidence from other research that consuming high amounts of polyunsaturated fat may increase the risk of cancer spreading'. The propensity for polyunsaturated fats to oxidize is another possible risk factor.^{[17][18]} This leads to the generation of free radicals and eventually to rancidity. Studies have shown that low dosages of Coenzyme Q10 reduce this oxidation, and a combination of a diet rich in polyunsaturated fatty acids and Coenzyme Q10 supplementation leads to a longer lifespan in rats. Studies on animals have shown a link between polyunsaturated fat and the incidence of tumours. In some of these studies the incidence of tumours increased with increasing intake of polyunsaturated fat, up to about 5% of total energy, near to the middle of the current dietary intake in humans. It is advised that the level of polyunsaturated fats in the diet be regulated if Coenzyme Q10 supplements are not being taken. However, even without Coenzyme Q10 supplementation, the effect on health might be considered by some to be more beneficial than harmful, due to the supposed cholesterol lowering effects of unsaturated fats compared to saturated fats, however, (a) monounsaturated fats have also been posited to lead to lower cholesterol levels; and (b) it is no longer clear that saturated fats actually cause elevated blood cholesterol levels.^[20] See saturated fat and cardiovascular disease controversy.

$\mathbf{3}-\mathbf{4}$ - Food sources of polyunsaturated fat

Food source (100 g)	Poly un saturated fat (g)
Walnuts	47
Sunflower Seeds	33
Sesame Seeds	26
Chia Seeds	23.7
Unsalted Peanuts	16
Peanut Butter	14.2
Olive Oil	11
Seaweed	11
Sardines	5
Soybeans	5
Tuna	3
Wild Salmon	2.5
Whole Grain Wheat	0.8

Fat composition in different foods

Food	Saturated	Mono - unsaturated	Poly - unsaturated
As weight percent (%) of	f total fat		
Canola oil	8	64	28
Corn oil	13	24	59
Olive oil	7	78	15
Sunflower oil	11	78	11
Soybean oil	15	24	58
Peanut oil	11	71	18
Rice bran oil	25	38	37
Coconut oil	86	13	1
Dairy products			
Cheese, regular	64	29	3
Cheese, light	60	30	0

Milk, whole	62	28	4
Milk, 2%	62	30	0
Ice cream, gourmet	62	29	4
Ice cream, light	62	29	4
Meats			
Beef	33	38	5
Ground sirloin	38	44	4
Pork chop	35	44	8
Ham	35	49	16
Chicken breast	29	34	21
Chicken	34	23	30
Turkey breast	30	20	30
Turkey drumstick	32	22	30
Fish, orange roughy	23	15	46
Salmon	28	33	28
Hot dog, beef	42	48	5
Hot dog, turkey	28	40	22
Burger, fast food	36	44	6
Cheeseburger, fast food	43	40	7
Breaded chicken sandwich	n 20	39	32
Grilled chicken sandwich	26	42	20
Sausage, Polish	37	46	11
Sausage, turkey	28	40	22
Pizza, sausage	41	32	20
Pizza, cheese	60	28	5
Nuts			
Almonds dry roasted	9	65	21
Cashews dry roasted	20	59	17
Macadamia dry roasted	15	79	2
Peanut dry roasted	14	50	31
Pecans dry roasted	8	62	25
Flaxseeds, ground	8	23	65

Sesame seeds	14	38	44
Soybeans	14	22	57
Sunflower seeds	11	19	66
Walnuts dry roasted	9	23	63
Sweets and baked goods			
Candy, chocolate bar	59	33	3
Candy, fruit chews	14	44	38
Cookie, oatmeal raisin	22	47	27
Cookie, chocolate chip	35	42	18
Cake, yellow	60	25	10
Pastry, Danish	50	31	14
Fats added during cooking	ng or at th	e table	
Butter, stick	63	29	3
Butter, whipped	62	29	4
Margarine, stick	18	39	39
Margarine, tub	16	33	49
Margarine, light tub	19	46	33
Lard	39	45	11
Shortening	25	45	26
Chicken fat	30	45	21
Beef fat	41	43	3
Dressing, blue cheese	16	54	25
Dressing, light Italian	14	24	58
Other			
Egg yolk fat	36	44	16

Poly Unsaturated Fatty Acid

Contents

1 Introduction

2 Methylene-Interrupted Polyenes

- 2.1 Omega 3
- 2.2 Omega 6
- 2.3 Omega 9

3 Conjugated fatty acids

4 Other Polyunsaturates

1 - Introduction

Poly unsaturated fatty acids (PUFAs) are fatty acids that contain more than one double bond in their backbone. This class includes many important compounds, such as essential fatty acids and those that give drying oils their characteristic property.

Poly unsaturated fatty acids can be classified in various groups by their chemical structure:

2 - Methylene-Interrupted Polyenes

These fatty acids have 2 or more *cis* double bonds that are separated from each other by a single methylene bridge (-CH₂- unit). This form is also sometimes called a *divinylmethane pattern*.

Methylene - interrupted double bonds

$$\mathbf{C} - \mathbf{C} = \mathbf{C} - \mathbf{C} - \mathbf{C} = \mathbf{C} - \mathbf{C}$$

The essential fatty acids are all omega-3 and -6 methyleneinterrupted fatty acids. *See more at Essential fatty acids*— *Nomenclature*

2 – 1 - Omega-3

Omega-3 fatty acids , poly unsaturated

Common name	Lipid name	Chemical name
Hexadecatrienoic acid (HTA)	16:3 (n-3)	<i>all-cis</i> 7,10,13- hexadecatrienoic acid
Alpha-linolenic acid (ALA)	18:3 (n-3)	<i>all-cis</i> -9,12,15- octadecatrienoic acid
Stearidonic acid (SDA)	18:4 (n-3)	<i>all-cis</i> -6,9,12,15,- octadecatetraenoic acid
Eicosatrienoic acid (ETE)	20:3 (n-3)	<i>all-cis</i> -11,14,17- eicosatrienoic acid
Eicosatetraenoic acid (ETA)	20:4 (n-3)	<i>all-cis</i> -8,11,14,17- eicosatetraenoic acid
Eicosapentaenoic acid (EPA, Timnodonic acid)	20:5 (n-3)	<i>all-cis</i> -5,8,11,14,17- eicosapentaenoic acid
Heneicosapentaenoic acid (HPA)	21:5 (n-3)	<i>all-cis</i> -6,9,12,15,18- heneicosapentaenoic acid
Docosapentaenoic acid (DPA, Clupanodonic acid)	22:5 (n-3)	<i>all-cis</i> -7,10,13,16,19- docosapentaenoic acid
Docosahexaenoic acid (DHA Cervonic acid)	22:6 (n-3)	<i>all-cis</i> -4,7,10,13,16,19- docosahexaenoic acid
Tetracosapentaenoic acid	24:5 (n-3)	<i>all-cis</i> -9,12,15,18,21- tetracosapentaenoic acid
Tetracosahexaenoic acid (Nisinic acid)	24:6 (n-3)	<i>all-cis</i> -6,9,12,15,18,21- tetracosahexaenoic acid

2 – 2 - Omega-6 Omega-6 fatty acids, poly unsaturated

Common name	Lipid name	Chemical name
Linoleic acid	18:2 (n-6)	all-cis-9,12-octadecadienoic acid
Gamma-linolenic acid (GLA)	18:3 (n-6)	<i>all-cis</i> -6,9,12- octadecatrienoic acid
Eicosadienoic acid	20:2 (n-6)	all-cis-11,14-eicosadienoic

. .

		acid
Dihomo-gamma-linolenic acid (DGLA)	20:3 (n-6)	<i>all-cis</i> -8,11,14- eicosatrienoic acid
Arachidonic acid (AA)	20:4 (n-6)	<i>all-cis</i> -5,8,11,14- eicosatetraenoic acid
Docosadienoic acid	22:2 (n-6)	all-cis-13,16-docosadienoic acid
Adrenic acid	22:4 (n-6)	<i>all-cis</i> -7,10,13,16- docosatetraenoic acid
Docosapentaenoic acid (Osbond acid)	22:5 (n-6)	<i>all-cis</i> -4,7,10,13,16- docosapentaenoic acid
Tetracosatetraenoic acid	24:4 (n-6)	<i>all-cis</i> -9,12,15,18- tetracosatetraenoic acid
Tetracosapentaenoic acid	24:5 (n-6)	<i>all-cis</i> -6,9,12,15,18- tetracosapentaenoic acid

2-3-Omega-9

Omega-9 fatty acids, mono- and poly unsaturated

Common name Lipid name Chemical name Oleic acid[†] 18:1 (n-9) *cis*-9-octadecenoic acid Eicosenoic acid[†] 20:1 (n-9) *cis*-11-eicosenoic acid Mead acid 20:3 (n-9) *all-cis*-5,8,11-eicosatrienoic acid Erucic acid[†] 22:1 (n-9) *cis*-13-docosenoic acid Nervonic acid[†] 24:1 (n-9) *cis*-15-tetracosenoic acid [†]Mono unsaturated

3 - Conjugated fatty acids have two or more conjugated doubl bonds

Common nameLipid name Chemical nameConjugated Linoleic Acids (two conjugated double bonds)Rumenic acid18:2 (n-7)9Z,11E-octadeca-9,11-dienoic acid

18:2 (n-6)	10E,12Z-octadeca-9,11-dienoic acid		
Conjugated Linolenic Acids (three conjugated double bonds)			
18:3 (n-6)	8E,10E,12Z-octadecatrienoic acid		
18:3 (n-6)	8E,10E,12E-octadecatrienoic acid		
18:3 (n-6)	8Z,10E,12Z-octadecatrienoic acid		
18:3 (n-5)	9Z,11E,13E-octadeca-9,11,13- trienoic acid		
18:3 (n-5)	9E,11E,13E-octadeca-9,11,13- trienoic acid		
18:3 (n-5)	9Z,11Z,13E-octadeca-9,11,13- trienoic acid		
18:3 (n-5)	9Z,11E,13Z-octadeca-9,11,13- trienoic acid		
18:3 (n-3)	9E,11Z,15E-octadeca-9,11,15- trienoic acid		
18:4 (n-3)	9E,11Z,13Z,15E-octadeca- 9,11,13,15-tetraenoic acid		
18:4 (n-3)	<i>all trans</i> -octadeca-9,11,13,15- tretraenoic acid		
20:5 (n-6)	5Z,8Z,10E,12E,14Z-eicosanoic acid		
	<i>ic Acids (thr</i> 18:3 (n-6) 18:3 (n-6) 18:3 (n-6) 18:3 (n-5) 18:3 (n-5) 18:3 (n-5) 18:3 (n-5) 18:3 (n-3) 18:4 (n-3) 18:4 (n-3)		

4 - Other Poly unsaturates

Common name	Lipid name	Chemical name
Pinolenic acid	18:3 (n-6)	(5Z,9Z,12Z)-octadeca-5,9,12-trienoic acid
Podocarpic acid	20:3 (n-6)	(5Z,11Z,14Z)-eicosa-5,11,14-trienoic acid

Poppy Seed Oil

Contents

1 Introduction

2 Chemistry

3 Uses

3.1 Oil painting

3.2 Contrast agent

3.3 Prevention of iodine deficiency

3.4 Cancer therapies

4 History

1 - Introduction

Poppy seed oil (also poppy seed oil, poppy oil, and *oleum papaveris seminis*) is an edible oil from poppy seeds (seeds of *Papaver somniferum*, the opium poppy). The oil has culinary and pharmaceutical uses, as well as long established uses in the making of paints, varnishes, and soaps.

Poppy seeds yield 45 - 50 % oil. Like poppy seeds, poppy seed oil is highly palatable, high in vitamin E , and has no narcotic properties.

Poppy Seed Oil			
Nutritional value per 100 g			
Energy	3,699 kJ (884 kcal)		
Carbohydrates	0 g		
Fat	100 g		
- saturated	13.5 g		
- monounsaturated	19.7 g		
- polyunsaturated	62.4 g		
Protein	0 g		
Vitamin E	11.4 mg (76 %)		

2 – Chemistry

Poppy seeds are notable for being especially high in tocopherols other than vitamin E (alpha – tocopherol) . Poppy seed oil from one source has been reported to contain 30.9 mg gamma - tocopherol per 100 g. It also contains alpha and gamma tocotrienols, but not others. Compared to other vegetable oils, poppy seed oil has a moderate amount of phytosterols: higher than soybean oil and peanut oil, lower than safflower oil, sesame oil, wheat germ oil, corn oil, and rice bran oil.^[3] Sterols in poppy seed oil consist almost entirely of campesterol, stigmasterol, sitosterol and delta 5-avenasterol. Poppy seed oil is high in linoleic acid. Although not generally higher than safflower oil, it can be as high as 74.5 %. Other triglycerides present in notable quantities are oleic acid and palmitic acid.

It is less likely than some other oils to become rancid.^[1] It is more stable than safflower oil and linseed oil.

Poppy seed oil is a carrier oil, having little or no odor and a pleasant taste. The primary aroma compound responsible for its flavor is 2- pentylfuran;^[6] also present are the volatile compounds 1-pentanol, 1-hexanal, 1-hexanol, and caproic acid.

3 - Uses

In the 19th century poppy seed oil was used as cooking oil, lamp oil, and varnish, and was used to make paints and soaps. Today, all of these uses continue, and poppy seed oil has additional culinary and pharmaceutical uses. Particularly notable are its uses as a carrier for oil paints and as a pharmaceutical grade carrier for medicinal iodine and drugs.

Poppy seed oil was sometimes added to olive and almond oils . In industrialized countries its most important culinary use these days is as a salad or dipping oil.

3 – 1 - Oil painting

Poppy seed oil is a drying oil. In oil painting, it is a popular oil for binding pigment, thinning paint, and varnishing finished paintings. Some users consider "sun - thickened" poppy seed oil to be the best painting medium.

Poppy seed oil has been used for painting for at least 1500 years — one of the oldest known oil paintings, found in caves of Afghanistan and dated to AD 650, was likely drawn using poppy seed oil . It is most often found in white paints , and as a varnish. Painters prepared poppy seed oil by hand until the late 19th century, when oil paints became available prepared in tubes. While poppy seed oil does not cause as much yellowish tinting of paints as linseed oil, it dries slower and is less durable than linseed oil because the fat responsible for the yellowing also provides durability. Perilla oil, which causes yellow tinting even more than linseed, is even more durable than linseed.

3-2 - Contrast agent

Iodized poppy seed oil (oil with iodine added) has several kinds of pharmaceutical uses. The first of these uses was as a radiocontrast agent used in medical radiology. The origin of this use is attributed to Jean-Athanase Sicard and Jacques Forestier. Two brand name formulations are ethiodol and lipiodol. These are sterile formulations for medical use that commonly are injected.

These two formulations, and other similarly iodized poppy seed oils, also have multiple applications in the treatment of cancers and iodine deficiencies.

3 – 3 - Prevention of iodine deficiency

In some regions where iodized salt is not available, iodized poppy seed oil is the standard for preventing iodine deficiency and its complications including goiter. It may be given by mouth or by injection, injection being markedly more effective. The origin of this use is attributed to Paulo Campos. Usually it is given to adults and children by intramuscular injection, one injection delivering enough iodine to last 2 or 3 years. Poppy seed oil is used because it is already manufactured and it very rarely causes an allergic reaction. Also, injections are more expensive and more difficult to administer than oral medications, thus there is interest in giving iodized oil by mouth. Use by mouth requires only food grade, not medical grade, quality control. A randomized, placebo-controlled clinical trial on giving infants iodized poppy seed oil together with an oral polio vaccine had good results . A randomized, double-blind, fully controlled trial in which lipiodol was given by mouth to children had disappointing results . A recent clinical trial in which iodized oil was given by mouth found that the amount of iodine taken up (see bio availability) varied with the amount of oleic acid in the oil . Poppy seed oil has relatively little oleic acid. Peanut oil and rapeseed oil have far more oleic acid and are less expensive, and may be superior to poppy seed oil for giving iodine by mouth.

3–**4** - Cancer therapies

Poppy seed oil had long been used as a carrier for embolizing agents to treat tumors. In the 1980s, in order to better understand the action of these agents, poppy seed oil was replaced with lipiodol, to use its properties as a contrast agent.^[16] It soon became apparent that the lipiodol was selectively taken up by tumors. Whether this is true also of poppy seed oil is unknown.

Iodized poppy-seed oil has an especially high rate of uptake into the cells of hepatocellular carcinoma (HCC). This property was soon recognized as an opportunity to deliver to HCC a variety of highly toxic chemotherapy and radiotherapy agents,^[17] and formed the basis of several therapies for HCC not treatable by surgery alone.^{[18][19]} Injected emulsions of epirubicin in lipiodol are popular, but greater stability is needed.

Lipiodol is under investigation as an adjuvant and carrier for use in chemotherapy to treat hepatocellular carcinoma (HCC). It increases the uptake and hence the cytotoxicity of doxorubicin in HCC cells^[22] (and also in hepatoblastoma cells). As a carrier, it is under investigation in conjunction with a lipophilic compound of platinum, and in conjunction with a complex derivative of neocarzinostatin . It also is being investigated as a radiation therapy against hepatocellular carcinoma, by being loaded with an isotope of iodine, iodine-131.

Similarly, lipiodol has been used with the chemotherapy agent epirubicin, but with less success than with doxorubicin . Epirubicin is less lipophilic than doxorubicin. However, a "water/oil/water" micro emulsion, in which epirubicin was dissolved in droplets of water, and the droplets were suspended in lipiodol, significantly increased uptake of epirubicin by HCC cells.

Lipiodol is often used in transarterial embolization (TAE), a treatment for HCC, with and without an additional chemotherapy agent. A systematic review of cohort and randomized studies found that TAE improves survival, but found no evidence of additional benefit for using either chemotherapy agents or lipiodol in TAE.

4 – History



Opium poppy seed pod

An early 20th century industry manual states that while the opium poppy was grown extensively in Eurasia, most of the world production of poppy seed oil occurred in France and Germany, from poppy seeds imported from other countries. From 1900 to 1911, France and Germany together produced on the order of 60,000,000 kilograms per year. At that time, poppy seed oil was used primarily to dress salads and frequently was adulterated with sesame oil and hazelnut oil to improve the taste of oil from stored (rancid) seeds. Poppy seed oil was used to adulterate olive oil and peach kernel oil.^[1] Poor quality poppy seed oil was valuable in the soap industry.

Some pharmaceutical uses of the other major product of *Papaver somniferum*, opium, were recognized thousands of years ago. In contrast, pharmaceutical uses of poppy seed oil began in the 20th century. Iodized poppy seed oil was the subject of a 1959 article in a pharmaceutical research journal. Various formulations were tried. In 1976 a contrast agent for imaging the liver and spleen using computed tomography was proposed: AG 60.99, an emulsion of poppy seed oil.^[31] A 1979 article reports on a new formulation, "improved" over ethiodol: "an emulsion of triglycerides of iodinated poppy seed oil".^[32] After a series of experiments in animals, by 1981 iodized poppy seed oil was in use as a contrast agent for computed tomography in humans.

Pour Point

Contents

1 Introduction

2 Measuring the pour point of petroleum products

2.1 Manual Method

2.2 Automatic Method

3 Measuring the pour point of crude oils

1 - Introduction

The pour point of a liquid is the temperature at which it becomes semi solid and loses its flow characteristics. In crude oil a high pour point is generally associated with a high paraffin content, typically found in crude deriving from a larger proportion of plant material. That type of crude oil is mainly derived from a kerogen Type II.

2 - Measuring the pour point of petroleum products 2-1 - Manual Method

ASTM D5853, Standard Test Method for Pour Point of Crude Oils. The specimen is cooled inside a cooling bath to allow the formation of paraffin wax crystals. At about 9 °C above the expected pour point, and for every subsequent 3 °C, the test jar is removed and tilted to check for surface movement. When the specimen does not flow when tilted, the jar is held horizontally for 5 sec. If it does not flow, 3 °C is added to the corresponding temperature and the result is the pour point temperature.

It is also useful to note that failure to flow at the pour point may also be due to the effect of viscosity or the previous thermal history of the specimen. Therefore, the pour point may give a misleading view of the handling properties of the oil. Additional fluidity tests may also be undertaken. An approximate range of pour point can be observed from the specimen's upper and lower pour point.

2 – 2 - Automatic Method

ASTM D5949, Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method) is an alternative to the manual test procedure. It uses automatic apparatus and yields pour point results in a format similar to the manual method (ASTM D97) when reporting at a 3° C.

The D5949 test method determines the pour point in a shorter period of time than manual method D97. Less operator time is required to run the test using this automatic method. Additionally, no external chiller bath or refrigeration unit is needed. D5949 is capable of determining pour point within a temperature range of -57°C to +51°C. Results can be reported at 1°C or 3°C testing intervals. This test method has better repeatability and reproducibility than manual method D97.

Under ASTM D5949, the test sample is heated and then cooled by a Peltier device at a rate of $1.5 \pm 0.1^{\circ}$ C/min. At either 1° C or 3° C intervals, a pressurized pulse of compressed gas is imparted onto the surface of the sample. Multiple optical detectors continuously monitor the sample for movement. The lowest temperature at which movement is detected on the sample surface is determined to be the pour point.

3 - Measuring the pour point of crude oils

Two pour points can be derived which can give an approximate temperature window depending on its thermal history. Within this temperature range, the sample may appear liquid or solid. This peculiarity happens because wax crystals form more readily when it has been heated within the past 24 hrs and contributes to the lower pour point.

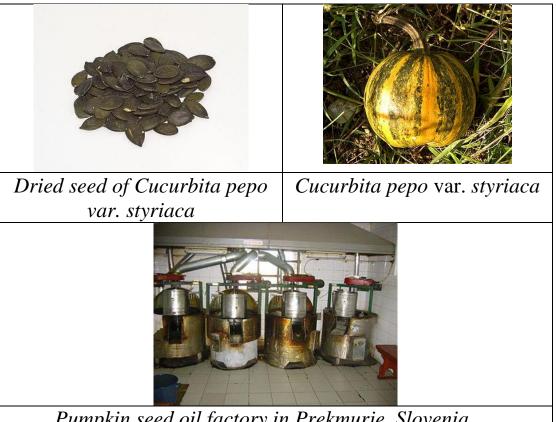
The upper pour point is measured by pouring the test sample directly into a test jar. The sample is then cooled and then inspected for pour point as per the usual pour point method.

The lower pour point is measured by first pouring the sample into a stainless steel pressure vessel. The vessel is then screwed tight and heated to above 100 °C in an oil bath. After a specified time, the vessel is removed and cooled for a short while. The sample is then poured into a test jar and immediately closed with a cork carrying the thermometer. The sample is then cooled and then inspected for pour point as per the usual pour point method.

Prune Kernel Oil

Virgin prune kernel oil is a recently developed vegetable oil, pressed from the seeds, or stones, of the d'Agen prune plum. The seeds were found to have an oil content of 35 % by weight, consisting of 70 % oleic acid and 20 % linoleic acid. The oil has a flavor reminiscent of bitter almond, and has been aggressively marketed as a gourmet cooking oil. It is also used in the cosmetic industry for its emollient properties.

Pumpkin Seed Oil



Pumpkin seed oil factory in Prekmurje, Slovenia

Contents

- 1 Introduction 2 Culinary uses
- 3 Folk medicine
- 4 Seed types and oil

1 - Introduction

Pumpkin seed oil (Kernöl or Kürbiskernöl in German, bučno olje in Slovenian, bučino ulje, tikvino ulje or bundevino ulje in Croatian, ulei de dovleac in Romanian, and tökmag-olaj in Hungarian), is a culinary specialty of south eastern Austria (Styria), eastern Slovenia (Styria and Prekmurje), Central Transylvania, Orastie-Cugir region of Romania, north western Croatia (esp. Međimurje), and adjacent regions of Hungary. It is a European Union Protected Designation of Origin (PDO) product.

Today the oil is an important export commodity of Austria and Slovenia. It is made by pressing roasted, hulled pumpkin seeds (pepitas), from a local variety of pumpkin, the "Styrian oil pumpkin" (*Cucurbita pepo* subsp. *pepo* var. 'styriaca', also known as var. *oleifera*). It has been produced and used in Styria's southern parts at least since the 18th century. The earliest confirmed record of oil pumpkin seeds in Styria (from the estate of a farmer in Gleinstätten) dates to February 18, 1697.

The viscous oil is light to very dark green to dark red in colour depending on the thickness of the observed sample. The oil appears green in thin layer and red in thick layer. Such optical phenomenon is called dichromatism . Pumpkin oil is one of the substances with strongest dichromatism. Its Kreft's dichromaticity index is -44.^[4] Used together with yoghurt, the colour turns to bright green and is sometimes referred to as "green - gold".

2 - Culinary uses

Pumpkin seed oil has an intense nutty taste and is rich in polyunsaturated fatty acids. Browned oil has a bitter taste. Pumpkin seed oil serves as a salad dressing when combined with honey or olive oil. The typical Styrian dressing consists of pumpkin seed oil and cider vinegar. The oil is also used for desserts, giving ordinary vanilla ice cream a nutty taste. It is considered a real delicacy in Austria, and few drops are added to pumpkin soup and other local dishes, including, as mentioned, vanilla ice cream. Using it as a cooking oil, however, destroys its essential fatty acids.

3 - Folk medicine

There are folk medicine claims of usefulness of the oil in the prevention and treatment of benign prostatic hyperplasia.

One pilot study found pumpkin seed oil supplementation to have beneficial effects on cholesterol levels in postmenopausal women.

4 - Seed types and oil

Other types of pumpkin seed oil are also marketed worldwide. International producers use white seeds with shells and this produces a cheaper white oil. New producers of seeds are located in China and India.

An analysis of the oil extracted from the seeds of each of twelve cultivars of C. maxima yielded the following ranges for the percentage of several fatty acids :

n:unsat	Fatty acid name	Percentage range
(14:0)	Myristic acid	0.09-0.27
(16:0)	Palmitic acid	12.6-18.4
(16:1)	Palmitoleic acid	0.12-0.52
(18:0)	Stearic acid	5.1-8.5
(18:1)	Oleic acid	17.0-39.5
(18:2)	Linoleic acid	18.1-62.8
(18:3)	Linolenic acid	0.34-0.82
(20:0)	Arachidic acid	0.26-1.12
(20:1)	Gadoleic acid	0-0.17
(22:0)	Behenic acid	0.12-0.58

The study did not distinguish between positional isomers (e.g. ω -3 versus ω -6 linolenic acid). The sum of myristic and palmitic acid (cholesterogenic saturated fatty acids) content ranged from 12.8 to 18.7%. The total unsaturated acid content ranged from 73.1 to 80.5%. The very long chain fatty acid (> 18 carbon atoms) content ranged from 0.44 to 1.37 %.

Quinoa Oil

Contents

1 Introduction
 2 Uses
 3 Production

1 - Introduction

Quinoa oil is a vegetable oil extracted from germ of the *Chenopodium quinoa*, an Andean cereal and has been cultivated since at least 3000 B.C. Quinoa itself has attracted considerable interest as a source of protein, but the oil derived from quinoa is of interest in its own right. Quinoa oil is most similar to corn oil, and is rich in essential fatty acids (linoleic acid and linolenic acid), linoleic being predominant . Although, quinoa oil contains more essential fatty acids than corn oil. Quinoa yields an average of 5.8 % oil by weight, compared to 3 - 4 % for corn (maize), which means it could potentially be used to produce more oil than an amount of corn of the same weight.

Most oils with high concentrations of unsaturated fatty acids spoil quickly, but quinoa and corn oil both have high quantities of natural antioxidants, specifically tocopherol^[4] isomers, which makes them more stable and less likely to become rancid, guaranteeing a longer shelf-life.

2 - Uses

Quinoa is a natural source of Vitamin E and therefore is used in many anti-aging skin products, as well as hair products. Quinoa oil is used in many recipes as a substitute for other various kinds of cooking oil. For example, it can be used in cooking, frying and salad dressing. The high level of saturated fatty acids present in the oil make it an ideal candidate for cooking use.^[7] Quinoa oil has also been used in eczema treatments.

3 Production

Quinoa oil is produced from the cold pressing of the quinoa seed The yield of oil by weight is an average of 6 percent and ranges from 2 - 9 percent. The amount of oil in quinoa is relatively high compared with other cereal grains such as corn or wheat.

Rape Seed Oil (Canola)

Contents

1 Introduction

2 Etymology

3 History

- 4 Production and trade
- 5 Canola oil

5.1 Health information

- 5.1.1 Erucic acid issues
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- 5.2 Biodiesel
- 5.3 Comparison to other vegetable oils

6 Genetic modification issues

6.1 Legal issues

1 - Introduction

Canola refers to both an edible oil (also known as Canola oil) produced from the seed of any of several varieties of the rape plant, and to those plants, namely a cultivar of either rapeseed (*Brassica napus L.*) or field mustard/turnip rape (*Brassica rapa* subsp. *oleifera*, syn. *Brassica campestris* L.). Consumption of the oil is not believed to cause harm in humans and livestock.^[3] It is also used as a source of biodiesel.

Canola was bred naturally from rapeseed at the University of Manitoba, Canada, by Keith Downey and Baldur R. Stefansson in the early 1970s and had a different nutritional profile, in addition to much less erucic acid. In the international community, Canola is generally referred to as Rapeseed 00 or Double Zero Rapeseed to denote both low glucosinolates and low erucic acid. In addition to varieties from the traditional Rapa dn Napus species, recent cross-breeding of multiples lines of *Brassica juncea* have enabled this mustard variety to be classified as a canola variety by lowering both erucic acid and glucosinolates to the market standards, achieving LEAR status (for *low erucic acid rapeseed*). It may also be referred to as canola oil and is considered safe for human consumption.

2 – Etymology

The name "canola" was chosen by the board of the Rapeseed Association of Canada in the 1970s. The "Can" part stands for Canada and "ola" refers to oil. However, a number of sources, including dictionaries. continue to claim that it stands for "Can(ada)+o(il)+l(ow)+a(cid). These dictionaries include the *The* American Heritage Dictionary of the English Language and Random House Kernerman Webster's College Dictionary. The name was coined partially to avoid the negative connotations of rape.

3 – History



Canola field in New South Wales, Australia.

Canola was developed through conventional plant breeding from rapeseed, an oilseed plant already used in ancient civilization as a fuel. The word "rape" in rapeseed comes from the Latin word *rapum* meaning turnip. Turnip, rutabaga, cabbage, Brussels sprouts, mustard, and many other vegetables are related to the two natural canola varieties commonly grown, which are cultivars of *Brassica napus* and *Brassica rapa*. The change in name serves to distinguish it from natural rapeseed oil, which has much higher erucic acid content.

Brassica oilseed varieties are some of the oldest plants cultivated by humanity, with documentation of its use in India 4,000 years ago, and use in China and Japan 2,000 years ago. Its use in Northern Europe for oil lamps is documented to the 13th century. Its

use was limited until the development of steam power, when machinists found rapeseed oil clung to water — and steam-washed metal surfaces better than other lubricants. World War II saw high demand for the oil as a lubricant for the rapidly increasing number of steam engines in naval and merchant ships. When the war blocked European and Asian sources of rapeseed oil, a critical shortage developed, and Canada began to expand its limited rapeseed production.

After the war, demand declined sharply, and farmers began to look for other uses for the plant and its products. Rapeseed oil extracts were first put on the market in 1956 – 1957 as food products, but these suffered from several unacceptable characteristics. Rapeseed oil had a distinctive taste and a disagreeable greenish color, due to the presence of chlorophyll. It also contained a high concentration of erucic acid. Experiments on animals have pointed to the possibility that erucic acid, consumed in large quantities, may cause heart damage, although Indian researchers have published findings that call into question these conclusions and the implication that the consumption of mustard or rapeseed oil is dangerous . Feed meal from the rapeseed plant also was not particularly appealing to livestock, because of high levels of sharp-tasting compounds called glucosinolates.

Canola was bred from rapeseed at the University of Manitoba, Canada by Keith Downey and Baldur R. Stefansson in the early 1970s , and had a very different nutritional profile in addition to much less erucic acid.

A variety developed in 1998 is considered to be the most disease and drought resistant Canola variety of rapeseed to date. This and other recent varieties have been produced by using genetic engineering. In 2011, 26 % of the acres sown were genetically modified (biotech) canola. Canola was originally a trademark, but is now a generic term for edible varieties of rapeseed oil in North America and Australia. In Canada, an official definition of canola is codified in Canadian law.

4 - Production and trade

Rapeseed was once considered a specialty crop in Canada, but canola now has become a major American cash crop. Canada and the United States produce between 7 and 10 million tonnes of canola seed per year. Annual Canadian exports total 3 to 4 million tonnes of the seed, 800,000 tonnes of canola oil, and 1 million tonnes of canola meal. GM canola may not be grown in jurisdictions that have not approved GMOs. Within the United States, 90 % of the canola crop is grown in North Dakota.

Rapeseed is the highest - producing oil seed crop in the United States. An Oregon State University researcher has determined that winter growing of hybrid canola seed appears possible in central Oregon, United States; however, the state prohibits it from being grown in Deschutes, Jefferson, and Crook counties, because it may attract bees from specialty seed crops, such as carrots, which require bees for pollination. The rapeseed blossom is a major source of nectar for honey bees.

The major customers of canola seed are Japan, Mexico, China, and Pakistan, while the bulk of canola oil and meal goes to the United States, with smaller amounts shipped to Mexico, China, and Europe. World production of rapeseed oil in the 2002 - 2003 season was about 14 million metric tons . In the 2010 - 2011 season, world production is estimated to be at 58.4 million tonnes . The United States is a net consumer of canola oil, having used 3 billion pounds in 2010, 2.5 billion of which was imported from Canada.

The main price discovery mechanism for worldwide canola trade is the ICE Futures Canada (formerly Winnipeg Commodity Exchange) canola futures contract. Rapeseed is traded on the Euronext exchange.

5 - Canola oil

Canola oil is made at a processing facility by slightly heating and then crushing the seed. Almost all commercial grade canola oil is then refined using hexane. Finally, the crude oil is refined using water precipitation and organic acid, "bleaching" with clay, and deodorizing using steam distillation. Approximately 43 % of a seed is oil.^[24] What remains is a rapeseed meal that is used as high quality animal feed. 22.68 kg of rapeseed makes approximately 10 L of canola oil. Canola oil is a key ingredient in many foods. Its reputation as a healthy oil has created high demand in markets around the world, and overall it is the third most widely consumed vegetable oil in the world .

The oil has many non - food uses and, like soybean oil, is often used interchangeably with petroleum based oils non-renewable resources in products, including industrial lubricants, biofuels, candles, lipsticks, and newspaper inks depending on the price on the spot market. Canola oil is also recommended by the American Society for Reproductive Medicine for use as a fertility-preserving vaginal lubrication.

The average density of canola oil is 0.92 g / ml.

Compound	Family	% of total
Oleic acid	ω-9	61 %
Linoleic acid	ω-6	21 %
Alpha - linolenic acid	ω-3	11% 9%
Saturated fatty acids		7 %
Palmitic acid		4 %
Stearic acid		$2\%^{[28]}$
Trans fat		$0.4\%^{[30]}$

5 - 1 - Health information

Canola oil is low in saturated fat and contains both omega - 6 and omega - 3 fatty acids in a ratio of 2:1. If consumed, it also reduces low - density lipoprotein and overall cholesterol levels, and as a significant source of the essential omega-3 fatty acid is associated with reduced all - cause and cardiovascular mortality.^{[31][32][33][34][35]} Canola oil has been given a qualified health claim from the United States Food and Drug Administration due to its high levels of cholesterol - lowering fats.

5 - 1 - 1 - Erucic acid issues

Although wild rapeseed oil contains significant amounts of erucic acid, a known toxin, the cultivar used to produce commercial, food-grade canola oil was bred to contain less than 2 % erucic acid, levels that are not believed to cause harm in humans, and no health effects have been associated with consumption by humans of the genetically modified oil. Although rumors that canola oil can cause dangerous health problems circulated,^{[8][41]} there is no reason to believe canola oil poses unusual health risks, and its consumption in food-grade forms is generally recognized as safe by the United States Food and Drug Administration.

Chinese and Indian cultures have used rapeseed oils for thousands of years, but the form used was unrefined (natural), which may make a difference in effect on health.

5-1-2 – Research

Canolol (4-Vinyl-2,6-dimethoxyphenol or 4-vinylsyringol) is a phenolic compound showing antioxidant properties found in crude canola oil.

5-2- Biodiesel

Because of the lower levels of the toxic and irritating properties of genetically modified rapeseed oil, *Canola* oil is a more promising source for manufacturing biodiesel than the natural oil as a renewable alternative to fossil fuels.

Vegetable oils							
	Coturated	Mono-	Polyunsaturated fatty acids				
Type Saturated fatty acids ¹	unsaturated fatty acids	Total poly	linolenic acid (ω-3)	Linoleic acid (ω-6)	Oleic acid (ω-9)	Smoke point	
Not hydrogenated	Not hydrogenated						
Canola (rapeseed)	7.365	63.276	28.142	9-11	19-21	—	(204 °C) [[]
Coconut	91.00	6.000	3.000		2	6	(177 °C)
Corn	12.948	27.576	54.677	1	58	28	(232 °C)
Cottonseed	25.900	17.800	51.900	1	54	19	(216 °C)
Flaxseed/Linseed (European) ^[47]	6–9	10–22	68–89	56–71	12–18	10–22	(107 °C)
Olive	14.00	72.00	14.00	<1.5	9–20		(193 °C)
Palm	49.300	37.000	9.300		10	40	(235 °C)
Peanut	16.900	46.200	32.000		32	48	(225 °C)
Safflower (>70% linoleic)	8.00	15.00	75.00				(210 °C)
Safflower (high oleic)	7.541	75.221	12.820				(210 °C)
Soybean	15.650	22.783	57.740	7	50	24	(238 °C)
Sunflower (<60% linoleic)	10.100	45.400	40.100	0.200	39.800	45.300	(227 °C)
Sunflower (>70% oleic)	9.859	83.689	3.798				(227 °C)
Fully hydrogenated							
Cottonseed (hydrog.)	93.600	1.529	.587		.287		
Palm (hydrogenated)	47.500	40.600	7.500				
Soybean (hydrogen.)	21.100	73.700	.400	.096 [[]			
Values as percent (%)) by weight	t of total fat.					

5-3- Comparison to other vegetable oils

6 - Genetic modification issues

A genetically engineered rapeseed that is tolerant to herbicide was first introduced to Canada in 1995 (see Roundup Ready Canola). In 2009, 90 % of the Canadian crop was herbicide - tolerant. As of 2005, 87 % of the canola grown in the US was genetically modified. A 2010 study conducted in North Dakota found glyphosate - or glufosinate-resistance transgenes in 80% of wild natural rapeseed plants, and a few plants that were resistant to both herbicides. The escape of the genetically modified plants has raised concerns that the build - up of herbicide resistance in feral canola could make it more difficult to manage these plants using herbicides. However one of the researchers agrees that ".. feral populations could have become established after trucks carrying cultivated GM seeds spilled some of their load during transportation." She also notes that the GM canola results they found may have been biased as they only sampled along roadsides.

6 – 1 - Legal issues

Genetically modified canola has become a point of controversy and contentious legal battles. In one high-profile case (Monsanto Canada Inc. v. Schmeiser) the Monsanto Company sued Percy Schmeiser for patent infringement after he replanted canola seed that he had harvested from his field, which he discovered was contaminated with Monsanto's patented glyphosate-tolerant canola by spraying it with glyphosate, leaving only the resistant plants. The Supreme Court ruled that Percy was in violation of Monsanto's patent because he knowingly replanted the resistant seed that he had harvested and also imposing fees of over 200,000 on Schmeiser, but he was not required to pay Monsanto damages since he did not benefit financially from its presence. On 19 March 2008, Schmeiser and Monsanto Canada Inc. came to an out-of-court settlement whereby Monsanto would pay for the clean - up costs of the contamination, which came to a total of C \$ 660.

In 2003, Australia's gene technology regulator approved the release of canola altered to make it resistant to Glufosinate ammonium, a herbicide.^[54] The introduction of the genetically modified crop to Australia generated considerable controversy.^[55] Canola is Australia's third biggest crop, and is used often by wheat farmers as a break crop to improve soil quality. As of 2008 the only genetically modified crops in Australia were canola, cotton, and carnations.

Rendering (Animals)

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4 Rendering processes for inedible products

5 History

6 Advantages and disadvantages

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7 Kitchen rendering

1 - Introduction

Rendering is a process that converts waste animal tissue into stable, value-added materials. Rendering can refer to any processing of animal products into more useful materials, or more narrowly to the rendering of whole animal fatty tissue into purified fats like lard or tallow. Rendering can be carried out on an industrial, farm, or kitchen scale.

The majority of tissue processed comes from slaughterhouses, but also includes restaurant grease and butcher shop trimmings, expired meat from grocery stores, and the carcasses of euthanized and dead animals from animal shelters, zoos and veterinarians. This material can include the fatty tissue, bones, and offal, as well as entire carcasses of animals condemned at slaughterhouses, and those that have died on farms, in transit, etc. The most common animal sources are beef, pork, sheep, and poultry.

The rendering process simultaneously dries the material and separates the fat from the bone and protein. A rendering process yields a fat commodity (yellow grease, choice white grease, bleachable fancy tallow, etc.) and a protein meal (meat and bone meal, poultry byproduct meal, etc.).

Rendering plants often also handle other materials, such as slaughterhouse blood, feathers and hair, but do so using processes distinct from true rendering. The occupation of renderer has been deemed one of the "dirtiest jobs".

2 - Process variations

The rendering process varies from plant to plant in many ways.

Whether the end products are to be used as human food is based on the type of raw material and the processing methods.

Whether the end products are to be used as animal or pet food.

The material may be processed wet or dry. In wet processing, either boiling water or steam is added to the material, causing fat to rise to the surface; in dry processing, fat is released by dehydrating the raw material.

The temperature range used, whether high or low.

Processing may be either in discrete batches or in a continuous process.

The processing plant may be operated by an independent company that collects the material on the open market, or by the packing plant that produced the material.

3 - Rendering processes for edible products

Edible rendering processes are basically meat processing operations and produce lard or edible tallow for use in food products. Edible rendering is generally carried out in a continuous process at low temperature (less than the boiling point of water). The process usually consists of finely chopping the edible fat materials (generally fat trimmings from meat cuts), heating them with or without added steam, and then carrying out two or more stages of centrifugal separation. The first stage separates the liquid water and fat mixture from the solids. The second stage further separates the fat from the water. The solids may be used in food products, pet foods, etc., depending on the original materials. The separated fat may be used in food products, or if in surplus, it may be diverted to soap making operations. Most edible rendering is done by meat packing or processing companies.

One edible product is greaves, which is the unmeltable residue left after animal fat has been rendered.

An alternative process cooks slaughterhouse offal to produce a thick, lumpy "stew" which is then sold to the pet food industry to be used principally as tinned cat and dog foods. Such plants are notable for the offensive odour that they can produce and are often located well away from human habitation.

4 - Rendering processes for inedible products

Materials that for aesthetic or sanitary reasons are not suitable for human food are the feedstocks for inedible rendering processes. Much of the inedible raw material is rendered using the "dry" method. This may be a batch or a continuous process in which the material is heated in a steam-jacketed vessel to drive off the moisture and simultaneously release the fat from the fat cells. The material is first ground, then heated to release the fat and drive off the moisture, percolated to drain off the free fat, and then more fat is pressed out of the solids, which at this stage are called "cracklings" or "dry-rendered tankage". The cracklings are further ground to make meat and bone meal. A variation on a dry process involves finely chopping the material, fluidizing it with hot fat, and then evaporating the mixture in one or more evaporator stages. Some inedible rendering is done using a wet process, which is generally a continuous process similar in some ways to that used for edible materials. The material is heated with added steam and then pressed to remove a water-fat mixture which is then separated into fat, water and fine solids by stages of centrifuging and/or evaporation. The solids from the press are dried and then ground into meat and bone meal. Most independent renderers process only inedible material.

5 – History

The development of rendering was primarily responsible for the profitable utilization of meat industry by - products, which in turn allowed the development of a massive industrial - scale meat industry that made food more economical for the consumer. Rendering has been carried out for many centuries, primarily for soap and candle making. The earliest rendering was done in a kettle over an open fire. This type of rendering is still done on farms to make lard (pork fat) for food purposes. With the development of steam boilers, it was possible to jacket the kettle to make a higher grade product and to reduce the danger of fire. A further development came in the nineteenth century with the use of the steam "digester" which was simply a tank used as a pressure cooker in which live steam was injected into the material being rendered. This process is a wet rendering process called "tanking" and was used for both edible and inedible products, although the better grades of edible products were made using the open kettle process. After the material is "tanked", the free fat is run off, the remaining water ("tank water") run into a separate vat, and the solids removed and dried by both pressing and steam-drying in a jacketed vessel. The tank water was either run into a sewer or it was evaporated to make glue or protein concentrate to add to fertilizer. The solids were used to make fertilizer.

Upton Sinclair wrote an expose (1906) on the Chicago, IL meat processing industry which created public outrage. His work helped the passage of the Pure Food and Drug Act of 1907 which paved the way for the creation of the FDA.

The pressure tank made possible the development of the Chicago meat industry in the USA, with its huge concentration in one geographic area, because it allowed the economic disposal of byproducts which would otherwise overwhelm the environment in that area. At first, small companies that sprang up near the packers did the rendering. Later the packers themselves took up the industry once they saw the potential. Gustavus Swift, Nelson Morris, and Lucius Darling were among the early pioneers of the U.S. rendering industry

with their personal backing and/or direct participation in the developing rendering industry.

Technological innovations came rapidly as the 20th century advanced. Some of these were in the uses for rendered products and others were in the rendering methods themselves. In the 1920s, a batch dry rendering process was invented, in which the material was cooked in horizontal steam-jacketed cylinders that were similar to the fertilizer dryers of the day. Advantages claimed for the dry process were economy in energy use, a better protein yield, faster processing, and fewer obnoxious odours attending the process. Gradually, over the years, the wet "tanking" process was replaced with the dry process, so that by the end of World War II, most rendering installations used the dry process. In the 1960s, continuous dry processes were introduced, one using a variation of the conventional dry cooker and the other making use of a mincing and evaporation process to dry the material and yield the fat. In the 1980s, high energy costs popularized the various "wet" continuous processes. These processes were more energy efficient and allowed the re-use of process vapours to pre - heat or dry the materials during the process.

After World War II synthetic detergents came on the scene which eventually displaced soaps for both domestic and industrial washing. In the early 1950s over 50 % of the inedible fat market disappeared. Diversion in these materials into animal feeds soon replaced the lost soap market and eventually became the single largest use for inedible fats.

The widespread use of "boxed beef" in which the beef was cut up into consumer portions at the packing plant rather than at the retail level in local butcher shops and markets meant that the fat and meat scrap raw materials for renderers stayed at the packing plants and were rendered there by packer renderers, rather than by the "independent" rendering companies.

The rejection of animal fats by diet-conscious consumers led to a surplus of edible fats and their resultant diversion into soapmaking and oleochemicals, displacing inedible fats and contributing to the market volatility of this commodity.

6 - Advantages and disadvantages

The rendering industry is one of the oldest recycling industries, and made possible the development of a large food industry. The industry takes what would otherwise be waste materials and makes useful products such as fuels, soaps, rubber, plastics, etc. At the same time, rendering solves what would otherwise be a major disposal problem. As an example, the USA recycles more than 21 million metric tons annually of highly perishable and noxious organic matter. In 2004, the U.S. industry produced over 8 million metric tons of products, of which 1.6 million metric tons were exported.

Usually, materials used as raw materials in the rendering process are susceptible to spoilage. However, after rendering, the materials are much more resistant to spoiling. This is due to the application of heat either through cooking in the wet rendering process or the extraction of fluid in the dry rendering process. The fat obtained can be used as low-cost raw material in making grease, animal feed, soap, candles, biodiesel, and as a feed-stock for the chemical industry. Tallow, derived from beef waste, is an important raw material in the steel rolling industry providing the required lubrication when compressing steel sheets. The meat and the bones (which are in a dry, ground state) are converted to what is known as meat and bone meal.

In the absence of the rendering industry, the cost of waste disposal of waste animal material would be very high and would place a significant economic and environmental burden on areas involved in industrial scale slaughtering. This cost may manifest itself through the expensive use of sanitary landfills, incinerators and other similar waste disposal techniques without yielding profit directly out of it leading to the incurrence of opportunity costs. Using substitute products to rendering products may not necessarily prove to be lesser in cost.

6 - 1 – BSE

For many years meat and bone meal were fed to cattle. This practice is now prohibited in developed countries because it is believed to be the main route for the spread of bovine spongiform encephalopathy (mad - cow disease, BSE), which is also fatal to human beings. Meat and bone meal from cattle is, however, fed to non-ruminant animals and meat and bone meal from non - ruminant animals is fed to cattle in the United States. This may not prove to be a solution to the problem due to the resistant nature of the infectious agent of BSE, a misfolded protein (prion). Therefore, even if cattle is fed to non-ruminant animals and vice-versa, it will not prevent BSE from occurring. The underlying cause is that the prion survives within the system of the animal that has been fed with meat and bone meal from different animals including cattle. These animals are then eventually rendered and fed to cattle, which also results in the development of the disease.

7 - Kitchen rendering

Rendering of fats is also carried out on a kitchen scale by chefs and home cooks. In the kitchen, rendering is used to transform butter into clarified butter, suet into tallow, pork fat into lard, and chicken fat into schmaltz.

Rice Bran Oil

Contents

1 Introduction

- 2 Uses
- 3 Composition
- 4 Health benefits
 - 4.1 Cholesterol
 - 4.2 Menopause
 - 4.3 Antioxidant stability
 - 4.4 Other benefits

1 - Introduction

Rice bran oil (also known as rice bran extract) is the oil extracted from the germ and inner husk of rice. It is notable for its high smoke point of 232 °C and its mild flavor, making it suitable for high-temperature cooking methods such as stir frying and deep frying. It is popular as a cooking oil in several Asian countries, including Japan and China.

Fat composition of Rice Bran Oil			
Saturated fats	25 % Myristic : 0.6% Palmitic : 21.5% Stearic : 2.9 %		
Unsaturated fats	75 %		
Monounsaturated fats	38 %		
Oleic acid	38 %		
Polyunsaturated fats	37%		
Omega-3 fatty acids	α-Linolenic : 2.2 %		
Omega-6 fatty acids	Linoleic : 34.4 %		
Properties			
Food energy per 100 g	3,700 kJ (880 kcal)		
Smoke point	232 °C		

Iodine value	99 -108
Acid value	1.2
Saponification value	180-190
Unsaponifiable	3-5

2 - Uses

Rice bran wax, obtained from rice bran oil, is used as a substitute for carnauba wax in cosmetics, confectionery, shoe creams and polishing compounds. It is an edible oil which is used in the preparation of vegetable ghee.

3 - Composition

Rice bran oil has a composition similar to that of peanut oil, with 38 % monounsaturated, 37 % polyunsaturated, and 25 % saturated fatty acids. The fatty acid composition is :

Fatty acid	Percentage
C14:0 Myristic acid	0.6 %
C16:0 Palmitic acid	21.5 %
C18:0 Stearic acid	2.9 %
C18:1 Oleic acid	38.4 %
C18:2 Linoleic acid	34.4 %
C18:3 α-Linolenic acid	2.2 %

4 - Health benefits

A medically significant component of rice bran oil is the antioxidant γ - oryzanol, at around 2 % of crude oil content. Thought to be a single compound when initially isolated, it is now known to be a mixture of steryl and other triterpenylesters of ferulic acids.^[1] Also significant is the relatively high fractions of tocopherols and tocotrienols, taken together as vitamin E. Rice bran oil is also rich in other phytosterols which may provide health benefits.

4 – 1 - Cholesterol

Literature review shows rice bran oil and its active constituents improve blood cholesterol by reducing total plasma cholesterol and triglycerides, and increasing the proportion of HDL cholesterol.^[2] Results of an animal study indicated a 42 % decrease in total cholesterol with a 62 % drop in LDL cholesterol, when researchers supplemented test subjects' diets with fractionated vitamin E obtained from rice bran oil.

4 – 2 - Menopause

The rice bran oil component γ - oryzanol was shown in Japan to be effective in relieving hot flashes and other symptoms of menopause. Researchers found 90 % of the women found some form of relief from hot flashes after taking a rice bran oil supplement for four to six weeks.

4 – 3 - Antioxidant stability

Studies have shown the antioxidant stability in rice bran oil remains almost constant even when heated at frying temperatures. The study of thermal degradation and antioxidant stability in the oil is carried out by heating the oil to the frying temperature up to 250°C for 0.5, 1, 1.5, 2 hrs. That the density of rice bran oil is found to be constant throughout the time of heating indicates no molecular changes occurred due to antioxidant activity in the oil. The oxidative stability of rice bran oil was equivalent to or better than soybean, corn, canola, cottonseed, and safflower oil in a model system that simulated deep frying conditions.)

4 – 4 - Other benefits

Other potential properties of rice bran oil include modulation of pituitary secretion, inhibition of gastric acid secretion, antioxidant action, inhibition of platelet aggregation, lowering of blood pressure and regulation of cholesterol.

Rice Bran Wax

Contents

1 Introduction
 2 Chemical Composition

3 Uses

4 Physical Properties

1 - Introduction

Rice bran wax is the vegetable wax extracted from the bran oil of rice (*Oryza sativa*).

2 - Chemical Composition

The main components of rice bran wax are aliphatic acids (wax acids) and higher alcoholesters. The aliphatic acids consist of palmitic acid (C16), behenic acid (C22), lignoceric acid (C24), other higher wax acids. The higher alcohol esters consist mainly of ceryl alcohol (C26) and melissyl alcohol (C30). Rice bran wax also contains constituents such as free fatty acids (palmitic acid), squalene and phospholipids.

3 - Uses

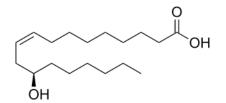
Rice bran wax is edible and can serve as a substitute for carnauba wax in most applications due to its relatively high melting point. It is used in paper coatings, textiles, explosives, fruit & vegetable coatings, confectionery, pharmaceuticals, candles, mouldednovelties, electric insulation, textile and leathersizing, waterproofing, carbon paper, typewriter ribbons, printinginks, lubricants, crayons, adhesives, chewing gum and cosmetics.

In cosmetics, rice bran wax is used as an emollient, and is the basis material for some exfoliation particles. It has been observed that rice bran wax at concentrations as low as 1 wt% in triglycerides can crystallize to form stable gels.

4 - Physical Properties

Melting point = $77 - 86 \,^{\circ}$ C Saponification value = 75 - 120Iodine number = 11.1 - 17.6Free fatty acids = 2.1 - 7.3%Phosphorus = 0.01 - 0.15%Color: Off-white to moderate orange/brown Odor: typical fatty, crayola-ish Rice bran wax bleaches and deodorizes readily INCI name: *Oryza Sativa (Rice) Bran Wax*.

Ricinoleic Acid



Contents

Introduction
 Production
 Biological activities

1 - Introduction

Ricinoleic acid, formally called 12-hydroxy-9-*cis*-octa decenoic acid is a fatty acid. It is an unsaturated omega-9 fatty acid. It is a major component of the seed oil obtained from mature Castor plant (*Ricinus communis L.*, Euphorbiaceae) seeds or in sclerotium of ergot (*Claviceps purpurea Tul.*, Clavicipitaceae). About 90% of the fatty acid content in castor oil is the triglyceride formed from ricinoleic acid.

IUPAC name :
(9Z,12R)-12-Hydroxy octa dec - 9 - enoic acidOther names :
R12-Hydroxy-9-cis-octa decenoic acidMolecular formula $C_{18} H_{34} O_3$ Molar mass298 g / mol

2 – Production

Ricinoleic acid is manufactured for industries by saponification or fractional distillation of hydrolyzed castor oil. The zinc salt is used in personal care products, such as deodorants

3 - Biological activities]

Ricinoleic acid exerts analgesic and anti-inflammatory effects.^[5] Ricinoleic acid specifically activates the EP3 prostanoid receptor for prostaglandin E2.

Ricin

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1 Introduction

2 Toxicity

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3.4 Ribosome inactivation

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4 Manufacture

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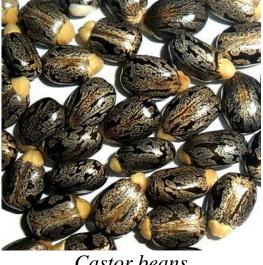
1 - Introduction

Ricin is a highly toxic, naturally occurring lectin (a carbohydrate-binding protein) produced in the seeds of the castor oil plant *Ricinus communis*. A dose the size of a few grains of table salt can kill an adult human. The median lethal dose (LD₅₀) of ricin is around 22 micrograms per kilogram of body weight (1.78 mg for an average adult, around $\frac{1}{228}$ of a standard aspirin tablet/0.4 g gross) in humans if exposure is from injection or inhalation. Oral exposure to ricin is far less toxic, and an estimated lethal dose in humans is approximately 1 milligram per kilogram.

2 – Toxicity

Ricin is poisonous if inhaled, injected, or ingested; it acts as a toxin by inhibiting protein synthesis.^[4] It prevents cells from assembling various amino acids into proteins according to the messages it receives from messenger RNA in a process conducted by the cell's ribosome (the protein-making machinery) — that is, the most basic level of cell metabolism, essential to all living cells and

thus to life itself. Ricin is resistant, but not impervious, to digestion by peptidases. By ingestion, the pathology of ricin is largely restricted to the gastrointestinal tract, where it may cause mucosal injuries; with appropriate treatment, most patients will make a full recovery.



Castor beans

Because the symptoms are caused by failure to make protein, they emerge only after a variable delay from a few hours to a full day after exposure. An antidote has been developed by the UK military, although it has not yet been tested on humans . Another antidote developed by the U.S. military has been shown to be safe and effective in lab mice injected with antibody-rich blood mixed with ricin, and has had some human testing. Symptomatic and supportive treatments are available. Survivors often develop long-term organ damage. Ricin causes severe diarrhea, and victims can die of circulatory shock. Death typically occurs within 3 - 5 days of exposure.

The seeds can be crushed in an oil press to extract castor oil. This leaves behind the spent crushed seeds, called variously the 'cake', 'oil cake', and 'press cake'. While the oil cake from coconut, peanuts, and sometimes cotton seeds can be used as either cattle feed and/or fertilizer, the toxic nature of castor precludes them from being used as feed . Accidental ingestion of Ricinus communis cake to be used as fertilizer has been reported to be responsible for fatal ricin poisoning in animals.

Deaths from ingesting castor plant seeds are rare, partly because of their indigestible capsule, and because the body can, although only with difficulty, digest ricin.^[13] The pulp from eight beans is considered dangerous to an adult.^[14] Rauber and Heard have written that close examination of early 20th century case reports indicates that public and professional perceptions of ricin toxicity "do not accurately reflect the capabilities of modern medical management".

2 - 1 - Over dose

Most acute poisoning episodes in humans are the result of oral ingestion of castor beans, 5 - 20 of which could prove fatal to an adult. However, there was one case of a 37 year old female ingesting 30 beans in the United States in 2013 who survived . Victims often manifest nausea, diarrhea, tachycardia, hypotension, and seizures persisting for up to a week . Blood, plasma, or urine ricin or ricinine concentrations may be measured to confirm diagnosis. The laboratory testing usually involves immunoassay or liquid chromatography-mass spectrometry.

3 – Biochemistry

Ricin is classified as a type 2 ribosome - inactivating protein (RIP). Whereas type 1 RIPs are composed of a single protein chain that possesses catalytic activity, type 2 RIPs, also known as holotoxins, are composed of two different protein chains that form a heterodimeric complex. Type 2 RIPs consist of an A chain that is functionally equivalent to a type 1 RIP, covalently connected by a single disulfide bond to a B chain that is catalytically inactive, but serves to mediate transport of the A-B protein complex from the cell surface, via vesicle carriers, to the lumen of the endoplasmic reticulum (ER). Both type 1 and type 2 RIPs are functionally active against ribosomes *in vitro*, however only type 2 RIPs display cytoxicity due to the lectin-like properties of the B chain. In order to display its ribosome-inactivating function, the ricin disulfide bond must be reductively cleaved.

3 – 1 – Biosynthesis

Ricin is synthesized in the endosperm of castor oil plant seeds. The ricin precursor protein is 576 amino acid residues in length and contains a signal peptide (residues 1 - 35), the ricin A chain (36 - 302), a linker peptide (303 - 314), and the ricin B chain (315 - 576). The N-terminal signal sequence delivers the prepropolypeptide to the endoplasmic reticulum (ER) and then the signal peptide is cleaved off. Within the lumen of the ER the propolypeptide is glycosylated and a protein disulfide isomerase catalyzes disulfide bond formation between cysteines 294 and 318. The propolypeptide is further glycosylated within the Golgi apparatus and transported to protein storage bodies. The propolypeptide is cleaved within protein bodies by an endopeptidase to produce the mature ricin protein that is composed of a 267 residue A chain and a 262 residue B chain that are covalently linked by a single disulfide bond.

3 – 2 – Structure

The quaternary structure of ricin is a globular, glycosylated heterodimer of approximately 60 - 65 kDa. Ricin toxin A chain and ricin toxin B chain are of similar molecular weights, approximately 32 kDa and 34 kDa, respectively.

Ricin A chain (RTA) is an N-glycoside hydrolase composed of 267 amino acids. It has three structural domains with approximately 50% of the polypeptide arranged into alpha - helices and beta-sheets. The three domains form a pronounced cleft that is the active site of RTA.

Ricin B chain (RTB) is a lectin composed of 262 amino acids that is able to bind terminal galactose residues on cell surfaces . RTB forms a bilobal, barbell - like structure lacking alpha - helices or beta - sheets where individual lobes contain three subdomains. At least one of these three subdomains in each homologous lobe possesses a sugar - binding pocket that gives RTB its functional character.

Many plants such as barley have the A chain but not the B chain. People do not get sick from eating large amounts of such

foods, as ricin A is of extremely low toxicity as long as the B chain is not present.

3 – 3 - Entry into the Cytoplasm

Ricin B chain binds complex carbohydrates on the surface of eukaryotic cells containing either terminal N- acetyl galactosamine or beta-1,4- linked galactose residues. In addition, the mannose-type glycans of ricin are able to bind cells that express mannose receptors. RTB has been shown to bind to the cell surface on the order of 10^{6} - 10^{8} ricin molecules per cell surface.

The profuse binding of ricin to surface membranes allows internalization with all types of membrane invaginations. The holotoxin can be taken up by clathrin-coated pits, as well as by clathrin-independent pathways including caveolae and macro pinocytosis . Intracellular vesicles shuttle ricin to endosomes that are delivered to the Golgi apparatus. The active acidification of endosomes is thought to have little effect on the functional properties of ricin. Because ricin is stable over a wide pH range, degradation in endosomes or lysosomes offers little or no protection against ricin.^[27] Ricin molecules are thought to follow retrograde transport via early endosomes, the trans-Golgi network, and the Golgi to enter the lumen of the endoplasmic reticulum (ER).

For ricin to function cytotoxically, RTA must be reductively cleaved from RTB in order to release a steric block of the RTA active site. This process is catalysed by the protein PDI (protein disulphide isomerase) that resides in the lumen of the ER . Free RTA in the ER lumen then partially unfolds and partially buries into the ER membrane, where it is thought to mimic a misfolded membraneassociated protein. Roles for the ER chaperones GRP94, EDEM and BiP have been proposed prior to the 'dislocation' of RTA from the ER lumen to the cytosol in a manner that utilizes components of the endoplasmic reticulum - associated protein degradation (ERAD) pathway. ERAD normally removes misfolded ER proteins to the cytosol for their destruction by cytosolic proteasomes. Dislocation of RTA requires ER membrane-integral E3 ubiquitin ligase complexes, but RTA avoids the ubiquitination that usually occurs with ERAD substrates because of its low content of lysine residues, which are the usual attachment sites for ubiquitin . Thus, RTA avoids the usual fate of dislocated proteins (destruction that is mediated by targeting ubiquitinylated proteins to the cytosolic proteasomes). In the mammalian cell cytosol, RTA then undergoes triage by the cytosolic molecular chaperones Hsc70 and Hsp90 and their co-chaperones, as well as by one subunit (RPT5) of the proteasome itself, that results in its folding to a catalytic conformation , which de-purinates ribosomes, thus halting protein synthesis.

3 – 4 - Ribosome inactivation

RTA has rRNA N-glycosylase activity that is responsible for the cleavage of a glycosidic bond within the large rRNA of the 60S subunit of eukaryotic ribosomes. RTA specifically and irreversibly hydrolyses the N-glycosidic bond of the adenine residue at position 4324 (A4324) within the 28S rRNA, but leaves the phosphodiester backbone of the RNA intact.^[39] The ricin targets A4324 that is contained in a highly conserved sequence of 12 nucleotides universally found in eukaryotic ribosomes. The sequence, 5'-AGUACGAGAGGA-3', termed the sarcin-ricin loop, is important in binding elongation factors during protein synthesis. The depurination event rapidly and completely inactivates the ribosome, resulting in toxicity from inhibited protein synthesis. A single RTA molecule in the cytosol is capable of depurinating approximately 1500 ribosomes per minute.

3 – 5 - Depurination reaction

Within the active site of RTA, there exist several invariant amino acid residues involved in the depurination of ribosomal RNA.^[27] Although the exact mechanism of the event is unknown, key amino acid residues identified include tyrosine at positions 80 and 123, glutamic acid at position 177, and arginine at position 180. In particular, Arg180 and Glu177 have been shown to be involved in the catalytic mechanism, and not substrate binding, with enzyme kinetic studies involving RTA mutants. The model proposed by Mozingo and Robertus , based on X-ray structures, is as follows :

Sarcin - ricin loop substrate binds RTA active site with target adenine stacking against tyr80 and tyr123.

Arg180 is positioned such that it can protonate N-3 of adenine and break the bond between N-9 of the adenine ring and C-1' of the ribose.

Bond cleavage results in an oxycarbonium ion on the ribose, stabilized by Glu177.

N-3 protonation of adenine by Arg180 allows deprotonation of a nearby water molecule.

Resulting hydroxyl attacks ribose carbonium ion.

Depurination of adenine results in a neutral ribose on an intact phosphodiester RNA backbone.

4 – Manufacture



Castor oil plant, fruits

Ricin is easily purified from castor oil manufacturing waste. Ricin can also be isolated from fresh seed by chromatographic techniques similar to those routinely used for purification of many other plant proteins.

4 – 1 - Patented extraction process

A process for extracting ricin has been described in a patent. The described extraction method is very similar to that used for the preparation of soy protein isolates.

The patent was removed from the United States Patent and Trademark Office (USPTO) database sometime in 2004. Modern theories of protein chemistry cast doubt on the effectiveness of the methods disclosed in the patent.

5 - Therapeutic applications

Although no approved therapeutics are currently based on ricin, it does have the potential to be used in the treatment of tumors, as a so-called "magic bullet" to destroy targeted cells . Because ricin is a protein, it can be linked to a monoclonal antibody to target malignant cells recognized by the antibody. The major problem with ricin is that its native internalization sequences are distributed throughout the protein. If any of these native internalization sequences are present in a therapeutic agent then the drug will be internalized by, and kill, untargeted non-tumorous cells as well as targeted malignant cells.

Modifying ricin may sufficiently lessen the likelihood that the ricin component of these immunotoxins will cause the wrong cells to internalize it, while still retaining its cell-killing activity when it is internalized by the targeted cells. However, bacterial toxins, such as diphtheria toxin, which is used in denileukin diftitox, an FDAapproved treatment for leukemia and lymphoma, have proven to be more practical. A promising approach for ricin is to use the non-toxic B subunit (a lectin) as a vehicle for delivering antigens into cells, thus greatly increasing their immunogenicity. Use of ricin as an adjuvant has potential implications for developing mucosal vaccines.

6 – Regulation

In the U.S., ricin appears on the select agents list of the Department of Health and Human Services, and scientists must register with HHS to use ricin in their research. However, investigators possessing less than 100 mg are exempt from regulation.



7 - Chemical or biological warfare agent

A metal vial containing ricin from the 2003 ricin letters

The United States investigated ricin for its military potential during World War I. At that time it was being considered for use either as a toxic dust or as a coating for bullets and shrapnel. The dust cloud concept could not be adequately developed, and the coated bullet/shrapnel concept would violate the Hague Convention of 1899 (adopted in U.S. law at 32 Stat. 1903), specifically Annex § 2, Ch.1, Article 23, stating "... it is especially prohibited ... [t]o employ poison or poisoned arms". World War I ended before the United States weaponized ricin.

During World War II the United States and Canada undertook studying ricin in cluster bombs . Though there were plans for mass production and several field trials with different bomblet concepts, the end conclusion was that it was no more economical than using phosgene. This conclusion was based on comparison of the final weapons, rather than ricin's toxicity ($LCt_{50} \sim 40 \text{ mg} \cdot \text{min/m}^3$). Ricin was given the military symbol W or later WA. Interest in it continued for a short period after World War II, but soon subsided when the U.S. Army Chemical Corps began a program to weaponize sarin.

The Soviet Union also possessed weaponized ricin. There were speculations that the KGB used it outside the Soviet bloc; however, this was never proven. In 1978, the Bulgarian dissident Georgi Markov was assassinated by Bulgarian secret police who surreptitiously "shot" him on a London street with a modified umbrella using compressed gas to fire a tiny pellet contaminated with ricin into his leg. He died in a hospital a few days later; his body was passed to a special poison branch of the British Ministry of Defence (MOD) that discovered the pellet during an autopsy. The prime suspects were the Bulgarian secret police: Georgi Markov had defected from Bulgaria some years previously and had subsequently written books and made radio broadcasts that were highly critical of the Bulgarian communist regime. However, it was believed at the time that Bulgaria would not have been able to produce the pellet, and it was also believed that the KGB had supplied it. The KGB denied any involvement, although high-profile KGB defectors Oleg Kalugin and Oleg Gordievsky have since confirmed the KGB's involvement. Earlier, Soviet dissident Aleksandr Solzhenitsyn also suffered (but survived) ricin - like symptoms after an encounter in 1971 with KGB agents.

Given ricin's extreme toxicity and utility as an agent of chemical/biological warfare, it is noteworthy that the production of the toxin is rather difficult to limit. The castor bean plant from which ricin is derived is a common ornamental and can be grown at home without any special care, and the major reason ricin is a public health threat is that it is easy to obtain .

Under both the 1972 Biological Weapons Convention and the 1997 Chemical Weapons Convention, ricin is listed as a schedule 1 controlled substance. Despite this, more than 1 million tonnes of castor beans are processed each year, and approximately 5 % of the total is rendered into a waste containing negligible concentrations of undenatured ricin toxin.

Ricin is several orders of magnitude less toxic than botulinum or tetanus toxin, but the latter are harder to come by. Compared to botulinum or anthrax as biological weapons or chemical weapons, the quantity of ricin required to achieve LD_{50} over a large geographic area is significantly more than an agent such as anthrax (tons of ricin vs. only kilogram quantities of anthrax). Ricin is easy to produce, but is not as practical nor likely to cause as many casualties as other agents.^[5] Ricin is inactivated (the protein changes structure and becomes less dangerous) much more readily than anthrax spores,

which may remain lethal for decades. Jan van Aken, a German expert on biological weapons, explained in a report for The Sunshine Project that Al Qaeda's experiments with ricin suggest their inability to produce botulinum or anthrax.

8 – **Developments**

A biopharmaceutical company called Soligenix, Inc. has licensed an anti - ricin vaccine called $RiVax^{TM}$ from Vitetta et al. at UT Southwestern. The vaccine is safe and immunogenic in mice, rabbits, and humans. It has completed two successful clinical trials .

9 – Incidents

Ricin has been involved in a number of incidents, including the high-profile assassination of Georgi Markov in 1978 using an umbrella with a hidden pneumatic mechanism which injected a small poisonous pellet containing ricin.

Several terrorists and terrorist groups have experimented with ricin and caused several incidents of the poison's being mailed to U.S. politicians. For example, on May 29, 2013 two anonymous letters sent to New York City Mayor Michael Bloomberg contained traces of the deadly poison ricin. Another was sent to the offices of Mayors Against Illegal Guns in Washington DC. A letter containing ricin was also alleged to have been sent to US President Barack Obama at the same time. An actress, Shannon Richardson, was later charged with the crime.

Rose Hip Seed Oil

Contents

1 Introduction 2 Nutrition 3 Uses

1 - Introduction

Rose hip seed oil is a pressed seed oil, extracted from the seeds of a wild rose bush (*Rosa moschata* or *Rosa rubiginosa*) in the southern Andes. Rosehip seed oil can also be extracted from *Rosa canina*, which grows in many regions of the world including South Africa and Europe.

2 – Nutrition

The oil contains provitamin A (mostly beta-Carotene). It has been wrongly said to contains retinol (vitamin A) which is a vitamin solely made by animals from provitamin A. It does however contain levels (up to .357 ml / L) of tretinoin or all - trans retinoic acid, a vitamin A acid that retinol converts to.

Similarly, while the fruit is rich in vitamin C, the oil does not contain any, as it is a water soluble vitamin.

Rose hip seed oil is high in the essential fatty acids : linoleic acid or omega - 6, and linolenic acid or omega - 3.

3 – Uses

It is commonly used in skin care products. It is commonly used for a variety of skin conditions, including dermatitis, acne and eczema, for mature and sun burnt skin as well as brittle nails and wrinkles. Rose hip oil is also frequently used to heal scarring and diminish photo - aging.

Vegetable Oil Recycling

Vegetable oil recycling is increasingly being carried out to produce a vegetable oil fuel.

Opportunities for businesses and consumers to recycle used cooking oil ("yellow grease") has increased.^[1] Used cooking oil can be refined into different types of biofuels used for power generation and heating.^[2] A significant benefit is that biofuels derived from recycled cooking oil typically burn clean,^[2] have a low carbon content and don't produce carbon monoxide. This helps communities to reduce their carbon footprints.^[2] The recycling of cooking oil also provides a form of revenue for restaurants, which are sometimes compensated by cooking oil recyclers for their used deep fryer oil.^[2] Cooking oil recycling also results in less used oil being disposed of in drains, which can clog sewage lines due to the build - up of fats and has to be collected there as "brown grease" by grease traps.

Vegetable oil refining is a process to transform vegetable oil into fuel by hydrocracking or hydrogenation. Hydrocracking breaks larger molecules into smaller ones using hydrogen while hydrogenation adds hydrogen to molecules. These methods can be used for production of gasoline, diesel, and propane. The diesel fuel that is produced has various names including green diesel or renewable diesel.

In the past waste oils were collected by pig farmers as part of food waste from pig swill bins. The grease was skimmed off the swill tanks and sold for further processing, while the remaining swill was processed into pig food.^[citation needed]

Rubber Seed Oil

Rubber seed oil is oil extracted from the seeds of rubber trees. In the latex manufacturing process, rubber seeds are not historically collected and commercialized. Recent analysis shows that rubber seed oil contained the following fatty acids :

Palmitic	(C16:0) - 0.2 %
Stearic	(C18:0) - 8.7 %
Oleic	(C18:1) - 24.6 %
Linoleic	(C18:2) - 39.6 %
Linolenic	c (C18:3) - 16.3 %

In Cambodia and other rubber manufacturing areas, rubber seeds are used to feed livestock. Although rubber seed is rich in nutrients, it also contains cyanogenic glycosides which will release prussic acid in the presence of enzymes or in slightly acidic Oil from the rubber seed is also of commercial conditions . importance. Hitherto, rubber seed has largely been allowed to waste with very little used for raising root stock seedlings for propagation purposes. The useful properties of the rubber seed oil make it similar to well - known linseed and soybean oil . Rubber seed oil also could be used for the paint industry as a semidrying oil, in the manufacture of soap, for the production of linoleum and alkyd resin; in medicine as antimalaria oil;^[11] and in engineering as core binder for factice preparation, and the cake left after oil extraction is used in fertilizer preparation and as feed for cattle and poultry. The potential of rubber wood as a source of timber is recognized in India, Sri Lanka, Indonesia, and Malaysia, with an increasing volume of sawn rubber wood used for furniture manufacturing and a variety of other applications.

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