INTRODUCTION TO :

SWEETENERS & SUGAR WORLD

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Part 1

SUGAR & CARBOHYDRATES

1 - Barley malt syrup

Adding barley malt syrup to flour for bagels

Barley malt syrup is a sweetener produced from sprouted barley, containing approximately 65 percent maltose, 30 percent complex carbohydrate, 3% protein. Malt syrup is dark brown, thick and sticky; and possesses a strong distinctive flavor that can only be described as "malty". It is about half as sweet as white sugar. Barley malt syrup is best used in combination with other natural sweeteners.

2 - Barley sugar

1 – Introduction :

Barley sugar (or **barley sugar candy**) is a traditional variety of British boiled sweet, or hard candy, yellow or orange in colour with an extract of barley added as flavouring. It is similar to hard caramel candy in its texture and taste.

2 - History :

The etymology is uncertain, but it is said to be that during various French / English wars " burnt sugar " (*sucre brûlé*) was brought by the French to England, and mistranslated as "barley sugar"; the name was then reimported to France as *sucre d'orge* as the literal translation (*orge* meaning "barley"). So both French and the English speakers call it barley sugar although its content of barley (in the form of barley water) is trivial .

Barley sugar was made in the 17th century by boiling down refined cane sugar with barley water, cream of tartar, and water. A recipe was created in 1638 by the Benedictine monks of Moret - sur - Loing, France, and there is a "Barley Sugar Museum" (*Le Musée du Sucre d'Orge*) in the town.

During the 18th century metal molds were used to create the shapes known as Barley Sugar Clear Toys, a popular Victorian Christmas treat. Many modern confectioners make barley candy without barley allowing the name to become a euphemistic term.[3] The U.S. Food and Drug Administration (FDA) discourages calling a product " barley sugar " or "barley candy" unless the product actually includes barley .

3 - Barley sugar candy :

Barley sugar candy differs from barley sugar by the presence of corn syrup and the absence of cream of tartar. This recipe increases the stability of the candy, improves the durability, and prevents liquefaction. Traditionally barley candy was used to soothe sore throats and calm upset stomachs. It is also used widely by climbers, scramblers and ramblers to provide a quick source of energy during activities.

4 - 40 Hour Famine :

Barley sugars and other energy sweets are the only food allowed to be eaten in the New Zealand & Australian 40 Hour Famine, an annual event which draws attention to world hunger. A single barley sugar is allowed to be consumed once every 4 hours during the 40 Hour Famine. This applies to participants older than primary school age.

3 - Brown sugar

Brown sugar crystals.

1 – Introduction :

Brown sugar is a sucrose sugar product with a distinctive brown color due to the presence of molasses. It is either an unrefined or partially refined soft sugar consisting of sugar crystals with some residual molasses content, or it is produced by the addition of molasses to refined white sugar.

Brown sugar contains from 3.5 % molasses (**light brown sugar**) to 6.5 % molasses (**dark brown sugar**) . The product is naturally moist from the hygroscopic nature of the molasses and is often labelled as "soft." The product may undergo processing to give a product that flows better for industrial handling. The addition of dyes and / or other chemicals may be permitted in some areas or for industrial products.

Particle size is variable but generally less than granulated white sugar. Products for industrial use (e.g. the industrial production of cakes) may be based on caster sugar which has crystals of approximately 0.35 mm.

2 - Manufacture :

Brown sugar is often produced by adding cane molasses to completely refined white sugar crystals in order to more carefully control the ratio of molasses to sugar crystals and to reduce manufacturing costs . This also allows the production of brown sugars to be based predominantly on beet sugar. Brown sugar that is prepared in this manner is often much coarser than its un refined equivalent and its molasses may be easily separated from the crystals by simply washing to reveal the underlying white sugar crystals; with unrefined brown there is inclusion of molasses within the crystal which will appear off - white if washed . This is mainly done for inventory control and convenience.

The molasses usually used is that obtained from sugar cane, because the flavor is generally preferred over beet sugar molasses. Although in some areas, especially in the Netherlands, sugar beet molasses is used. The white sugar used can be from either beet or cane as odour and color differences will be covered by the molasses.

Brown sugar can be made at home by mixing white granulated sugar with molasses, using one tablespoon of molasses for every cup of white sugar (one-sixteenth or 6.25 % of the total volume). Thorough blending will yield dark brown sugar; for light brown sugar, between one and two teaspoons of molasses per cup should be used instead. It is, however, simpler to substitute molasses for an equal portion of white sugar while cooking, without mixing them separately.

When a recipe calls for "brown sugar" it is usually referring to light brown sugar; dark brown sugar should be used only when specified . This is relevant primarily when baking recipes sensitive to moisture and density (such as cakes), because of the difference in moisture content between the two types. In other applications, substituting dark brown sugar over light brown will yield a deeper flavor with more caramel, much like adding molasses would do.

3 - Nutritional value :

Brown sugar has a slightly lower caloric value by weight than white sugar due to the presence of water. One hundred grams of brown sugar contains 373 calories, as opposed to 396 calories in white sugar.[1] However, brown sugar packs more densely than white sugar due to the smaller crystal size and may have more calories when measured by volume. One tablespoon of brown sugar has 48 calories against 45 calories for white sugar .

John Yudkin, in his studies (cited in "Pure, White and Deadly" - UK title) that rats fed brown sugar, as opposed to white sugar, suffered all the same ills from such consumption as did the control group fed white sugar, while their offspring did not exhibit the same abnormalities related to the offspring of the rats fed on white sugar . This led to the conclusion that there are some trace nutritional aspects he was unable to detect in brown sugar that made it less harmful than white sugar, though the impact could only be detected in their offspring. Nutritionally, apart from pure carbohydrate, he was not able to detect any nutritional component to white or brown sugar, and such pure carbohydrate is on the list to avoid in the World Health Organization and FAO studyon obesity and chronic preventable diseases. Note this study does state that carbohydrates in their *intrinsic* or *unrefined* form are nutritionally highly beneficial and should make up 55 – 75 % of our diet. But these *intrinsic* carbohydrates are fundamentally different from *extrinsic* carbohydrates such as both white and brown sugar.

4 - History :

In the late 1800s, the newly consolidated refined white sugar industry, which did not have full control over brown sugar production, mounted a smear campaign against brown sugar, reproducing microscopic photographs of harmless but repulsive-looking microbes living in brown sugar. The effort was so successful that by 1900, a best-selling cookbook warned that brown sugar was of inferior quality and was susceptible to infestation by "a minute insect ".

5 - Natural brown sugar :

A measuring cup containing muscovado (left); on the right is a measuring cup containing regular (light) brown sugar.

Natural brown sugar is a name for **raw sugar** which is a brown sugar produced from the first crystallisation of the sugar cane. As such "natural brown sugar" is free of additional dyes and chemicals. There is more molasses in natural brown sugar, giving it a higher mineral content. Some natural brown sugars have particular names and characteristics, and are sold as Turbinado sugar, Muscovado, or Demerara sugar.

Turbinado sugar is made by crushing freshly cut sugar cane to obtain a juice, which is heated and evaporated to a thick syrup, which is then crystallized. The crystals are then spun in a centrifuge (thus "turbin-") to remove the excess juice, resulting in the characteristically large, light brown crystals .

Muscovado (also moscovado) is an unrefined, dark brown sugar that is produced without centrifuging and has much smaller crystals than turbinado sugar. The sugar cane extract is heated to thicken it and then pan-evaporated in the sun and pounded to yield an unprocessed, damp sugar that retains all of the natural minerals.

Demerara (also spelled "demerera") sugar's name comes from the Demerera River area of Guyana, where sugar cane was grown. Demerara is another unrefined, centrifuged, large-crystalled, light brown, cane sugar; it is slightly sticky and sometimes molded into sugar cubes. Some Demerara is still produced in South America, but most is now produced in Mauritius, an island off Africa.

4 - Caramel

	
Caramel.	*A crème caramel flan that is topped with caramel.*

1 – Introduction :

Caramel is a beige to dark brown confection made by heating any of a variety of sugars. It is used as a flavor in puddings and desserts, a filling in candies and chocolates, and a topping for ice cream and custards.

The process of caramelization consists of heating sugar slowly to around 170 °C . As the sugar melts, the molecules break down and re-form into compounds with a characteristic color and flavor. A variety of candies, confections, and desserts are made with caramel and its products: caramel apples, caramel with nuts (such as praline, nougat, or brittle), and caramel with custard (such as crème caramel) .

2 - Chemistry (Caramelization)

Caramelization is the removal of water from a sugar, proceeding to isomerization and polymerization of the sugars into various high - weight compounds. Compounds such as difructose-anhydride may be created from the monosaccharides after water loss. Fragmentation reactions result in low - molecular - weight compounds which may be volatile and may contribute to flavor. Polymerization reactions lead to larger molecular weight compounds, which contribute to the dark brown color .

3 - Caramel candy :

Caramel candy.

Caramel candy is a soft, dense, chewy candy made by boiling a mixture of milk or cream, sugar, butter, vanilla essence, and (more common in commercial production) glucose or corn syrup. It can also be made with chocolate. It is not heated above the firm ball stage (120 °C) , so there is almost no caramelization. This type of candy is often called *milk caramel*.

By extension, a candy may be called a "caramel" if it contains such an ingredient. For example, a chocolate bar with a caramel candy filling may be called a " caramel ".

4 - Caramel color :

Caramel color (150 / E150) is a dark, rather bitter-tasting liquid, the highly concentrated product of near total caramelization that is bottled for commercial and industrial use. Beverages such as cola use caramel coloring, and it is also used as a food coloring.

5 - Carbohydrate

Contents :

1 – Introduction :

A **carbohydrate** is an organic compound with the general formula $C_m(H_2O)_n$, that is, consists only of carbon, hydrogen and oxygen, with the last two in the 2:1 atom ratio. Carbohydrates can be viewed as hydrates of carbon, hence their name.

The term is most common in biochemistry, where it is a synonym of **saccharide**. The carbohydrates (saccharides) are divided into four chemical groupings: monosaccharides, disaccharides, oligosaccharides, and polysaccharides. In general, the monosaccharides and disaccharides, which are smaller (lower molecular weight) carbohydrates, are commonly referred to as sugars.[1] The word *saccharide* comes from the Greek word *σάκχαρον* (*sákkharon*), meaning "sugar". While the scientific nomenclature of carbohydrates is complex, the names of the monosaccharides and disaccharides very often end in the suffix -ose. For example, blood sugar is the monosaccharide glucose, table sugar is the disaccharide sucrose, and milk sugar is the disaccharide lactose .

Carbohydrates perform numerous roles in living things. Polysaccharides serve for the storage of energy (e.g., starch and glycogen) and as structural components (e.g., cellulose in plants and chitin in arthropods). The 5-carbon monosaccharide ribose is an important component of coenzymes (e.g., ATP, FAD, and NAD) and the backbone of the genetic molecule known as RNA. The related deoxyribose is a component of DNA. Saccharides and their derivatives include many other important biomolecules that play key roles in the immune system, fertilization, pathogenesis, blood clotting, and development .

In food science and in many informal contexts, the term **carbohydrate** often means any food that is particularly rich in starch (such as cereals, bread and pasta) or sugar (such as candy, jams and desserts) .

2 - Structure :

Formerly the name "carbohydrate" was used in chemistry for any compound with the formula $C_m (H_2O)_n$. Following this definition, some chemists considered formaldehyde CH_2O to be the simplest carbohydrate , while others claimed that title for glycolaldehyde · Today the term is generally understood in the biochemistry sense, which excludes compounds with only one or two carbons .

Natural saccharides are generally built of simple carbohydrates called monosaccharides with general formula $(CH_2O)_n$ where n is three or more. A typical mono saccharide has the structure : H - $(CHOH)_x$ (C = O) - $(CHOH)_y$- H, that is, an aldehyde or ketone with many hydroxyl groups added, usually one on each carbon atom that is not part of the aldehyde or ketone functional group. Examples of monosaccharides are glucose, fructose, and glyceraldehyde. However, some biological substances commonly called "monosaccharides" do not conform to this formula (e.g., uronic acids and deoxy-sugars such as fucose), and there are many chemicals that do conform to this formula but are not considered to be monosaccharides (e.g., formaldehyde CH_2O and inositol $(CH_2O)_6$) .

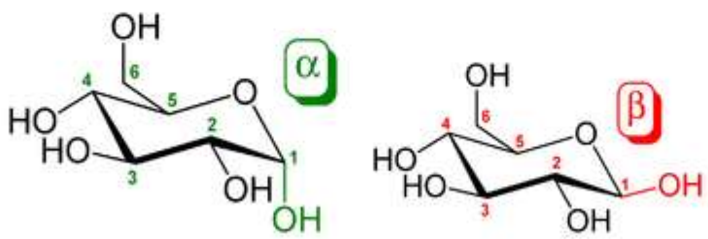
The open - chain form of a mono saccharide often coexists with a closed ring form where the oxygen of the carbonyl group C = O is replaced by an internal – O - bridge.

Monosaccharides can be linked together into what are called polysaccharides (or oligosaccharides) in a large variety of ways. Many carbohydrates contain one or more modified monosaccharide units that have had one or more groups replaced or removed. For example, deoxyribose, a component of DNA, is a modified version of ribose; chitin is composed of repeating units of N - acetyl glucosamine, a nitrogen - containing form of glucose.

3 - Mono saccharides :

Mono saccharides are the simplest carbohydrates in that they cannot be hydrolyzed to smaller carbohydrates. They are aldehydes or ketones with two or more hydroxyl groups. The general chemical formula of an unmodified monosaccharide is $(C\bullet H_2O)_n$, literally a "carbon hydrate." Monosaccharides are important fuel molecules as well as building blocks for nucleic acids. The smallest monosaccharides, for which n = 3 , are dihydroxyacetone and D - and L - glyceraldehyde.

3 – 1 - Classification of mono saccharides :



The α and β anomers of glucose. Note the position of the anomeric carbon (red or green) relative to the CH_2OH group bound to carbon 5: they are either on the opposite sides (α), or the same side (β).

Monosaccharides are classified according to three different characteristics: the placement of its carbonyl group, the number of carbon atoms it contains, and its chiral handedness. If the carbonyl group is an aldehyde, the monosaccharide is an aldose; if the carbonyl group is a ketone, the monosaccharide is a ketose. Monosaccharides with three carbon atoms are called trioses, those with four are called tetroses, five are called pentoses, six are hexoses, and so on. [6] These two systems of classification are often combined. For example, glucose is an aldohexose (a six-carbon aldehyde), ribose is an aldopentose (a five - carbon aldehyde) , and fructose is a ketohexose (a six-carbon ketone).

Each carbon atom bearing a hydroxyl group (- OH) , with the exception of the first and last carbons, are asymmetric, making them stereocenters with two possible configurations each (R or S). Because of this asymmetry, a number of isomers may exist for any given monosaccharide formula. The aldohexose D-glucose, for example, has the formula $(C{\cdot}H_2O)_6$, of which all but two of its six carbons atoms are stereogenic, making D - glucose one of $2^4 = 16$ possible stereoisomers. In the case of glyceraldehyde, an aldotriose, there is one pair of possible stereoisomers, which are enantiomers and epimers. 1 , 3 - dihydroxyacetone, the ketose corresponding to the aldose glyceraldehyde, is a symmetric molecule with no stereocenters). The assignment of D or L is made according to the orientation of the asymmetric carbon furthest from the carbonyl group: in a standard Fischer projection if the hydroxyl group is on the right the molecule is a D sugar, otherwise it is an L sugar. The "D-" and " L- " prefixes should not be confused with "d-" or "l-", which indicate the direction that the sugar rotates plane polarized light. This usage of "d -" and "l -" is no longer followed in carbohydrate chemistry.

3 – 2 - Ring - straight chain isomerism :

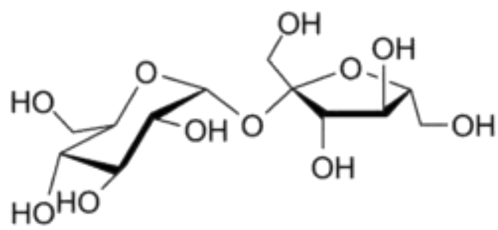
The aldehyde or ketone group of a straight - chain mono saccharide will react reversibly with a hydroxyl group on a different carbon atom to form a hemiacetal or hemiketal, forming a heterocyclic ring with an oxygen bridge between two carbon atoms. Rings with five and six atoms are called furanose and pyranose forms, respectively, and exist in equilibrium with the straight-chain form.[8]

During the conversion from straight - chain form to cyclic form, the carbon atom containing the carbonyl oxygen, called the anomeric carbon, becomes a stereogenic center with two possible configurations : The oxygen atom may take a position either above or below the plane of the ring. The resulting possible pair of stereoisomers are called anomers. In the *α anomer*, the -OH substituent on the anomeric carbon rests on the opposite side (trans) of the ring from the CH_2OH side branch. The alternative form, in which the CH_2OH substituent and the anomeric hydroxyl are on the same side (cis) of the plane of the ring, is called the *β anomer*. You can remember that the β anomer is cis by the mnemonic, "It's always better to βe up". Because the ring and straight-chain forms readily interconvert, both anomers exist in equilibrium.[8] In a Fischer Projection, the α anomer is represented with the anomeric hydroxyl group *trans* to the CH_2OH and *cis* in the β anomer.

3 – 3 - Use in living organisms :

Mono saccharides are the major source of fuel for metabolism, being used both as an energy source (glucose being the most important in nature) and in biosynthesis. When monosaccharides are not immediately needed by many cells they are often converted to more space efficient forms, often polysaccharides. In many animals, including humans, this storage form is glycogen, especially in liver and muscle cells. In plants, starch is used for the same purpose.

4 - Di saccharides :



Sucrose, also known as table sugar, is a common disaccharide. It is composed of two monosaccharides: D-glucose (left) and D-fructose (right).

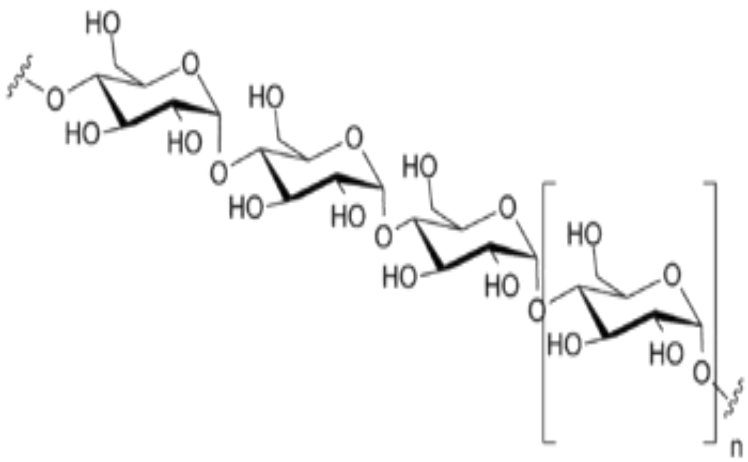
Two joined monosaccharides are called a disaccharide and these are the simplest polysaccharides. Examples include sucrose and lactose. They are composed of two monosaccharide units bound together by a covalent bond known as a glycosidic linkage formed via a dehydration reaction, resulting in the loss of a hydrogen atom from one monosaccharide and a hydroxyl group from the other. The formula of unmodified disaccharides is $C_{12}H_{22}O_{11}$. Although there are numerous kinds of disaccharides, a handful of disaccharides are particularly notable.

Sucrose, pictured to the right, is the most abundant disaccharide, and the main form in which carbohydrates are transported in plants. It is composed of one D - glucose molecule and one D-fructose molecule. The systematic name for sucrose, *O* - α - D - gluco pyranosyl -(1→2)-D-fructofuranoside, indicates four things:

- Its monosaccharides: glucose and fructose
- Their ring types: glucose is a pyranose, and fructose is a furanose
- How they are linked together: the oxygen on carbon number 1 (C1) of α-D- glucose is linked to the C2 of D-fructose.
- The *-oside* suffix indicates that the anomeric carbon of both monosaccharides participates in the glycosidic bond.

Lactose, a disaccharide composed of one D - galactose molecule and one D-glucose molecule, occurs naturally in mammalian milk. The systematic name for lactose is *O* - β - D - galacto pyranosyl - (1→4) – D – gluco pyranose. Other notable di saccharides include maltose (two D - glucoses linked α - 1,4) and cellulobiose (two D - glucoses linked β - 1,4) .

5 - Oligo saccharides and poly saccharides



Amylose is a linear polymer of glucose mainly linked with α(1→4) bonds. It can be made of several thousands of glucose units. It is one of the two components of starch, the other being amylopectin.

Oligo saccharides and polysaccharides are composed of longer chains of monosaccharide units bound together by glycosidic bonds. The distinction between the two is based upon the number of monosaccharide units present in the chain. Oligo saccharides typically contain between three and ten mono saccharide units, and poly saccharides contain greater than ten monosaccharide units. Definitions of how large a carbohydrate must be to fall into each category vary according to personal opinion. Examples of oligosaccharides include the disaccharides mentioned above, the tri saccharide raffinose and the tetra saccharide stachyose.

Oligo saccharides are found as a common form of protein post translational modification. Such post translational modifications include the Lewis and ABO oligosaccharides responsible for blood group classifications and so of tissue incompatibilities, the alpha-Gal epitope responsible for hyperacute rejection in xenotransplantation, and O-GlcNAc modifications.

Poly saccharides represent an important class of biological polymers. Their function in living organisms is usually either structure - or storage - related. Starch (a polymer of glucose) is used as a storage polysaccharide in plants, being found in the form of both amylose and the branched amylopectin. In animals, the structurally-similar glucose polymer is the more densely - branched glycogen, sometimes called 'animal starch'. Glycogen's properties allow it to be metabolized more quickly, which suits the active lives of moving animals.

Cellulose and chitin are examples of structural polysaccharides. Cellulose is used in the cell walls of plants and other organisms, and is claimed to be the most abundant organic molecule on earth . It has many uses such as a significant role in the paper and textile industries, and is used as a feedstock for the production of rayon (via the viscose process), cellulose acetate, celluloid, and nitrocellulose . Chitin has a similar structure, but has nitrogen-containing side branches, increasing its strength. It is found in arthropod exoskeletons and in the cell walls of some fungi. It also has multiple uses, including surgical threads.

Other poly saccharides include callose or laminarin, chryso laminarin, xylan, arabinoxylan, mannan, fucoidan, and galactomannan.

6 - Nutrition :

Grain products: rich sources of complex and simple carbohydrates

Foods high in carbohydrates include breads, pastas, beans, potatoes, bran, rice, and cereals. Most such foods are high in starch. Carbohydrates are the most common source of energy in living organisms. Proteins and fat are necessary building components for body tissue and cells, and are also a source of energy for most organisms.

Carbohydrates are not essential nutrients in humans: the body can obtain all its energy from protein and fats[10][11]. The brain and neurons generally cannot burn fat for energy, but can use glucose or ketones; the body can also synthesize some glucose from a few of the amino acids in protein and also from the glycerol backbone in triglycerides. Carbohydrate contains 15.8 kilojoules (3.75 kilo calories) and proteins 16.8 kilojoules (4 kilocalories) per gram, while fats contain 37.8 kilojoules (9 kilo calories) per gram. In the case of protein, this is somewhat misleading as only some amino acids are usable for fuel. Likewise, in humans, only some carbohydrates are usable for fuel, as in many monosaccharides and some disaccharides. Other carbohydrate types can be used, but only with the assistance of gut bacteria. Ruminants and termites can even process cellulose, which is indigestible to humans.

Based on the effects on risk of heart disease and obesity, the Institute of Medicine recommends that American and Canadian adults get between 45 – 65 % of dietary energy from carbohydrates . The Food and Agriculture Organization and World Health Organization jointly recommend that national dietary guidelines set a goal of 55 –75 % of total energy from carbohydrates , but only 10 % directly from sugars (their term for simple carbohydrates) .

6 – 1 - Classification :

For dietary purposes, carbohydrates can be classified as simple (monosaccharides and disaccharides) or complex (oligo saccharides and polysaccharides). The term *complex carbohydrate* was first used in the U.S. Senate Select Committee on Nutrition and Human Needs publication *Dietary Goals for the United States* (1977), where it denoted "fruit, vegetables and whole-grains" . Dietary guidelines generally recommend that complex carbohydrates, and such nutrient-rich simple carbohydrate sources such as fruit (glucose or fructose) and dairy products (lactose) make up the bulk of carbohydrate consumption . This excludes such sources of simple sugars as candy and sugary drinks.

The USDA's *Dietary Guidelines for Americans 2005* dispensed with the simple/complex distinction, instead recommending fiber-rich foods and whole grains.

The glycemic index and glycemic load concepts have been developed to characterize food behavior during human digestion. They rank carbohydrate-rich foods based on the rapidity of their effect on blood glucose levels. The insulin index is a similar, more recent classification method that ranks foods based on their effects on blood insulin levels, which are caused by glucose (or starch) and some amino acids in food. Glycemic index is a measure of how quickly food glucose is absorbed, while glycemic load is a measure of the total absorbable glucose in foods.

7 – Metabolism :

7 – 1 – Catabolism :

Catabolism is the metabolic reaction cells undergo to extract energy. There are two major metabolic pathways of monosaccharide catabolism: glycolysis and the citric acid cycle.

In glycolysis, oligo / polysaccharides are cleaved first to smaller monosaccharides by enzymes called glycoside hydrolases. The monosaccharide units can then enter into monosaccharide catabolism. In some cases, as with humans, not all carbohydrate types are usable as the digestive and metabolic enzymes necessary are not present.

8 - Carbohydrate chemistry

Carbohydrate chemistry is a large and economically important branch of organic chemistry. Some of the main organic reactions that involve carbohydrates are:

- Carbohydrate acetalisation
- Cyanohydrin reaction
- Lobry - de Bruyn -van Ekenstein transformation
- Amadori rearrangement
- Nef reaction
- Wohl degradation
- Koenigs - Knorr reaction

6 - Corn syrup

1 – Introduction :

Corn syrup is a food syrup, which is made from the starch of maize (nearly always the intended meaning of "corn" in the United States and Canada) and composed mainly of glucose. Corn syrup is used in foods to soften texture, add volume, prevent crystallization of sugar, and enhance flavor. Corn syrup is distinct from high-fructose corn syrup, created when corn syrup undergoes enzymatic processing that produces a sweeter compound containing higher levels of fructose.

The more general term **glucose syrup** is often used synonymously with corn syrup, since glucose syrup is most commonly made from cornstarch . Technically, glucose syrup is any liquid starch hydrolysate of mono - , di - , and higher - saccharides and can be made from any source of starch; wheat, rice and potatoes are the most common sources .

2 - Commercial preparation :

Glucose or dextrose syrup is produced from number 2 yellow dent corn. When wet milled, about 2.3 litres of corn are required to yield an average of 947g of starch, to produce 1 kg of glucose or dextrose syrup. A bushel (25 kg) of corn will yield an average of 31.5 pounds (14.3 kg) of starch, which in turn will yield about 33.3 pounds (15.1 kg) of syrup. Thus, it takes about 2,300 litres of corn to produce a tonne of glucose syrup, or 60 bushels (1524 kg) of corn to produce one short ton .

Formerly, corn syrup was produced by combining corn starch with dilute hydrochloric acid, and then heating the mixture under pressure. Currently, corn syrup is mainly produced by first adding the enzyme α-amylase to a mixture of corn starch and water. α-amylase is secreted by various species of the bacterium Bacillus; the enzyme is isolated from the liquid in which the bacteria are grown. The enzyme breaks the starch into oligosaccharides, which are then broken into glucose molecules by adding the enzyme glucoamylase, known also as "γ-amylase". Glucoamylase is secreted by various species of the fungus *Aspergillus*; the enzyme is isolated from the liquid in which the fungus is grown. The glucose can then be transformed into fructose by passing the glucose through a column that is loaded with the enzyme D-xylose isomerase, an enzyme that is isolated from the growth medium of any of several bacteria .

The viscosity and sweetness of the syrup depends on the extent to which the hydrolysis reaction has been carried out. To distinguish different grades of syrup, they are rated according to their dextrose equivalent (DE) .

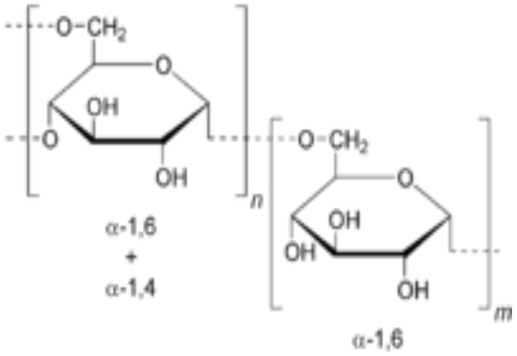
3 – Uses :

Its major uses in commercially-prepared foods are as a thickener, sweetener, and humectant (an ingredient that retains moisture and thus maintains a food's freshness).

In the United States, cane sugar quotas raise the price of sugar, hence, domestically produced corn syrup and high - fructose corn syrup are less expensive alternatives that are often used in American-made processed and mass - produced foods, candies, soft drinks and fruit drinks to help control cost .

Glucose syrup was the primary corn sweetener in the United States prior to the expanded use of HFCS production. HFCS is a variant in which other enzymes are used to convert some of the glucose into fructose. The resulting syrup is sweeter and more soluble. Corn syrup is also available as a retail product. The most popular retail corn syrup product in the United States is Karo, a fructose/glucose syrup.[10] Karo is a brand of thick corn syrup made from a concentrated solution of dextrose. The dark Karo also uses other sugars derived from corn starch with preservatives and flavorings. The light variety contains only salt and vanilla, in addition to corn syrup. It is a staple of Southern United States cuisine, e.g., to make pecan pie, and is pronounced "KAY-row" in that region.

7 - Dextran



Molecular formula	H ($C_6H_{10}O_5$) $_x$ OH
Molar mass	Variable

1 –Introduction :

Dextran is a complex, branched glucan (poly saccharide made of many glucose molecules) composed of chains of varying lengths (from 10 to 150 kilo daltons) . It is used medicinally as an antithrombotic (anti – platelet) , to reduce blood viscosity, and as a volume expander in anemia .

The straight chain consists of α-1,6 glycosidic linkages between glucose molecules, while branches begin from α-1,4 linkages (and in some cases, α-1,2 and α-1,3 linkages as well). (For information on the numbering of carbon atoms in glucose, see the glucose article.) Dextran is synthesized from sucrose by certain lactic-acid bacteria, the best-known being *Leuconostoc mesenteroides* and *Streptococcus mutans*. Dental plaque is rich in dextrans. Dextran is also formed by the lactic acid bacterium *Lactobacillus brevis* to create the crystals of tibicos, or water kefir fermented beverage which supposedly has some health benefits.

2 - Uses

2 – 1 - Microsurgery uses :

These agents are used commonly by microsurgeons to decrease vascular thrombosis. The antithrombotic effect of dextran is mediated through its binding of erythrocytes, platelets, and vascular endothelium, increasing their electronegativity and thus reducing erythrocyte aggregation and platelet adhesiveness. Dextrans also reduce factor VIII-Ag Von Willebrand factor, thereby decreasing platelet function. Clots formed after administration of dextrans are more easily lysed due to an altered thrombus structure (more evenly distributed platelets with coarser fibrin). By inhibiting α-2 antiplasmin, dextran serves as a plasminogen activator and therefore possesses thrombolytic features.

Outside from these features, larger dextrans, which do not pass out of the vessels, are potent osmotic agents, and thus have been used urgently to treat hypovolemia. The hemodilution caused by volume expansion with dextran use improves blood flow, thus further improving patency of microanastomoses and reducing thrombosis. Still, no difference has been detected in antithrombotic effectiveness in comparison of intraarterial and intravenous administration of dextran . Dextrans are available in multiple molecular weights ranging from 10,000 Da to 150,000 Da. The larger dextrans are excreted poorly from the kidney and therefore remain in the blood for as long as weeks until they are metabolized. Subsequently, they have prolonged antithrombotic and colloidal effects. In this family, dextran-40 (MW: 40,000 Da), has been the most popular member for anticoagulation therapy. Close to 70 % of dextran - 40 is excreted in urine within the first 24 hours after intravenous infusion while the remaining 30 % will be retained for several more days.

2 – 2 - Other medical uses :

- It is used in some eye drops as a lubricant, and in certain intravenous fluids to solubilise other factors, e.g. iron (=iron dextran).
- Dextran in intravenous solution provides an osmotically neutral fluid that once in the body is digested by cells into glucose and free water. It is occasionally used to replace lost blood in emergency situations, when replacement blood is not available, but must be used with caution as it does not provide necessary electrolytes and can cause hyponatremia or other electrolyte disturbances.

- It also increases blood sugar levels.

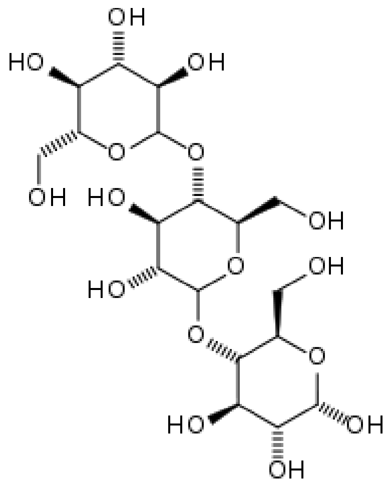
2 – 3 - Laboratory uses :

- Dextran is used in the osmotic stress technique for applying osmotic pressure to biological molecules.
- It is also used in some size-exclusion chromatography matrices; an example is Sephadex.
- Dextran has also been used in bead form to aid in bioreactor applications.
- Dextran has been used in immobilization in biosensors.
- Dextran preferentially binds to early endosomes; fluorescently-labelled dextran can be used to visualize these endosomes under a fluorescent microscope.
- Dextran can be used as a stabilising coating to protect metal nanoparticles from oxidation and improve biocompatibility.
- Dextran coupled with a fluorescent molecule(such as FITC) can be used to create concentration gradients of diffusible molecules for imaging and allow subsequent characterization of gradient slope.
- Dextran is used to make microcarriers for industrial cell culture

3 - Side effects :

Although there are relatively few side-effects associated with dextran use, these side - effects can be very serious. These include anaphylaxis, volume overload, pulmonary edema, cerebral edema, or platelet dysfunction. An uncommon but significant complication of dextran osmotic effect is acute renal failure. The pathogenesis of this renal failure is the subject of many debates with direct toxic effect on tubules and glomerulus versus intraluminal hyperviscosity being some of the proposed mechanisms. Patients with history of diabetes mellitus, renal insufficiency, or vascular disorders are most at risk. Brooks and others recommend the avoidance of dextran therapy in patients with chronic renal insufficiency and CrCl<40 cc per minute.

8 - Dextrin



Molecular formula	$(C_6H_{10}O_5)_n$
Molar mass	variable
Appearance	white or yellow powder

1 – Intrpduction :

Dextrins are a group of low – molecular - weight carbohydrates produced by the hydrolysis of starch . Dextrins are mixtures of polymers of D - glucose units linked by α - (1,4) or α- (1,6) glycosidic bonds.

Dextrins can be produced from starch using enzymes like amylases, as during digestion in the human body and during malting and mashing , or by applying dry heat under acidic conditions (pyrolysis or roasting). The latter process is used industrially, and also occurs on the surface of bread during the baking process, contributing to flavour, colour and crispness. Dextrins produced by heat are also known as **pyrodextrins**. During roasting under acid condition the starch hydrolyses and short chained starch parts partially rebranches with α - (1,6) bonds to the degraded starch molecule .

Dextrins are white , yellow or brown powders that are partially or fully water - soluble, yielding optically active solutions of low viscosity. Most can be detected with iodine solution, giving a red coloration; one distinguishes erythrodextrin (dextrin that colours red) and achrodextrin (giving no colour).

White and yellow dextrins from starch roasted with little or no acid is called **British gum**.

2 - Uses :

Yellow dextrins are used as water-soluble glues in remoistable envelope adhesives and paper tubes, in the mining industry as additives in froth flotation, in the foundry industry as green strength additives in sand casting, as printing thickener for batik resist dyeing and as binders in gouache paint.

White dextrins are used as :

- a crispness enhancer for food processing, in food batters, coatings and glazes, (E number 1400) ,
- a textile finishing and coating agent to increase weight and stiffness of textile fabrics,
- a thickening and binding agent in pharmaceuticals and paper coatings.

As pyrotechnic binder and fuel, they are added to fireworks and sparklers, allowing them to solidify as pellets or "stars."

Due to the rebranching, dextrins are less digestible; indigestible dextrin are developed as soluble fiber supplements for food products.

3 - Other dextrin types

Malto dextrin is a short chained starch sugar, gelatin hybrid base, (dextrin), that is used as a food additive. It is produced also by enzymatic hydrolysis from gelatinated starch and is usually found as a creamy - white hygroscopic spraydried powder. Maltodextrin is easily digestible, being absorbed as rapidly as glucose, and might either be moderately sweet or might have hardly any flavor at all :

- Cyclo dextrin

The cyclical dextrins are known as cyclodextrins. They are formed by enzymatic degradation of starch by certain bacteria, for example, *Bacillus macerans*. Cyclodextrins have toroidal structures formed by 6 - 8 glucose residues.

- Amylodextrin is a linear dextrin or short chained amylose (DP 20 - 30) that can be produced by enzymatic hydrolysis of the alpha-1,6 glycosidic bonds or debranching amylopectin. Amylodextrin colors blue with iodine.

- (Beta) Limit dextrin is the remaining polymer produced by enzymatic hydrolyse of amylopectine with beta amylase which cannot hydrolyse the alpha - 1,6 bonds at branch points.

- (Alpha) Limit dextrin is a short chained branched amylopectine remain, produced by hydrolysis of amylopectine with alpha amylase.

- Highly branched cyclic dextrin is a dextrin produced from enzymatic breaking the amylopectin in clusters and using branching enzyme to form large cyclic chains.

9 - Dextrose equivalent

1 – Introduction :

Dextrose equivalent (DE) is the relative sweetness of sugars, oligo saccharides, or blends compared to dextrose, both expressed as a percentage. For example, a malto dextrin with a DE of 10 would be 10 % as sweet as dextrose (DE = 100) , while sucrose, with a DE of 120, would be 1.2 times as sweet as dextrose. For solutions made from starch, it is an estimate of the percentage reducing sugars present in the total starch product.

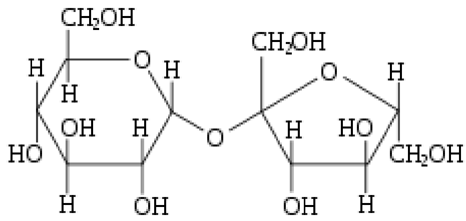
In all glucose polymers, from the native starch to glucose syrup, the molecule begins with a reducing sugar, containing a free aldehyde. As the starch is hydrolysed, the molecules are shorter and more reducing sugars are present.

The DE describes the degree of conversion of starch to dextrose:

- starch is close to 0,
- glucose / dextrose is 100 (percent) ,
- dextrins varies between 1 and 13 ,
- maltodextrins varies between 3 and 20 ,
- glucose syrups contain a minimum of 20% reducing sugars.

The DE gives an indication of the average degree of polymerisation (DP) for starch sugars. The rule of thumb is DE X DP = 120.The standard methods to measure the amount of reducing sugars and calculating the dextrose equivalent (DE) are Benedict's reagent and Fehling's test.

10 - Disaccharide



Sucrose , a common disaccharide

1 – Introdution :

A **disaccharide** is the carbohydrate formed when two monosaccharides undergo a condensation reaction which involves the elimination of a small molecule, such as water, from the functional groups only. Like monosaccharides, disaccharides also dissolve in water, taste sweet and are called sugars . 'Disaccharide' is one of the four chemical groupings of carbohydrates (mono saccharide, di saccharide, oligo saccharide, and poly saccharide) .

2 - Classification :

There are two basic types of disaccharides: reducing disaccharides, in which the monosaccharide components are bonded by hydroxyl groups; and non - reducing disaccharides, in which the components bond through their anometric centers .

3 - Formation :

Disaccharides are formed when two monosaccharides are joined together and a molecule of water is removed. For example; milk sugar (lactose) is made from glucose and galactose whereas cane sugar (sucrose) is made from glucose and fructose.

The two mono saccharides are bonded via a dehydration reaction (also called a condensation reaction or dehydration synthesis) that leads to the loss of a molecule of water and formation of a glycosidic bond.

4 - Properties :

The glycosidic bond can be formed between any hydroxyl group on the component monosaccharide. So, even if both component sugars are the same (e.g., glucose) , different bond combinations (regio - chemistry) and stereochemistry (*alpha*- or *beta* -) result in disaccharides that are diastereoisomers with different chemical and physical properties.

Depending on the monosaccharide constituents, disaccharides are sometimes crystalline, sometimes water-soluble, and sometimes sweet-tasting and sticky - feeling.

5 - Common disaccharides :

Disaccharide	**Unit 1**	**Unit 2**	**Bond**
Sucrose (*table sugar*, *cane sugar*, *saccharose*, or *beet sugar*)	glucose	fructose	α(1→2)
Lactulose	galactose	fructose	β(1→4)
Lactose (*milk sugar*)	galactose	glucose	β(1→4)
Maltose	glucose	glucose	α(1→4)
Trehalose	glucose	glucose	α(1→1)
Cellobiose	glucose	glucose	β(1→4)

Maltose and cellobiose are hydrolysis products of the polysaccharides, starch and cellulose, respectively.

Less common disaccharides include :

Disaccharide	**Units**	**Bond**
Kojibiose	two glucose monomers	α(1→2)
Nigerose	two glucose monomers	α(1→3)
Isomaltose	two glucose monomers	α(1→6)
β,β-Trehalose	two glucose monomers	β(1→1)β
α,β-Trehalose	two glucose monomers	α(1→1)β
Sophorose	two glucose monomers	β(1→2)
Laminaribiose	two glucose monomers	β(1→3)

Gentiobiose	two glucose monomers	β(1→6)
Turanose	a glucose monomer and a fructose monomer	α (1→3)
Maltulose	a glucose monomer and a fructose monomer	α(1→4)
Palatinose	a glucose monomer and a fructose monomer	α(1→6)
Gentiobiulose	a glucose monomer and a fructose monomer	β(1→6)
Mannobiose	two mannose monomers	either α(1→2), α(1→3), α(1→4), or α(1→6)
Melibiose	a galactose monomer and a glucose monomer	α(1→6)
Melibiulose	a galactose monomer and a fructose monomer	α(1→6)
Rutinose	a rhamnose monomer and a glucose monomer	α(1→6)
Rutinulose	a rhamnose monomer and a fructose monomer	β(1→6)
Xylobiose	two xylopyranose monomers	β(1→4)

11 - Fructose

Contents :

1 – Introduction :

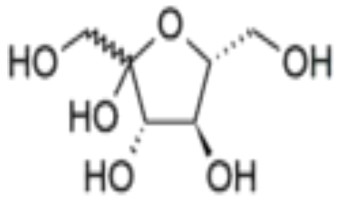
Fructose (also **levulose** or **laevulose**) is a simple mono saccharide found in many foods and is one of the three important dietary monosaccharides along with glucose and galactose. The organic fructose molecule was first discovered by Augustin-Pierre Dubrunfaut in 1847. Fructose is a white solid that dissolves in water – it is the most water - soluble of all the sugars. Honey, tree fruits, berries, melons, and some root vegetables contain significant amounts of molecular fructose, usually in combination with glucose, stored in the form of sucrose . About 240,000 tones of crystalline fructose are produced annually.

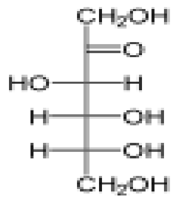
Fructose is a component of sucrose. Sucrose is a disaccharide derived from the condensation of glucose and fructose. Fructose is derived from the digestion of table sugar (sucrose).

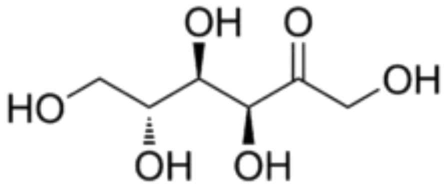
Crystalline fructose and high - fructose corn syrup are often confused as the same product. Crystalline fructose, which is often produced from a fructose-enriched corn syrup, is indeed the monosaccharide. High - fructose corn syrup, however, refers to a family of mixtures of varying amounts of fructose and glucose.

2 - Chemical properties :

Fructose is a 6 - carbon polyhydroxyketone. It is an isomer of glucose, i.e. both have the same molecular formula ($C_6 H_{12} O_6$) , but they differ structurally. Crystalline fructose adopts a cyclic six-membered structure owing to the stability of its hemiketal and internal hydrogen-bonding. This form is formally called D-fructopyranose. In solution, fructose exists as an equilibrium mixture of 70% fructopyranose and about 22 % fructofuranose, as well as small amounts of the three other forms, including the acylic structure.



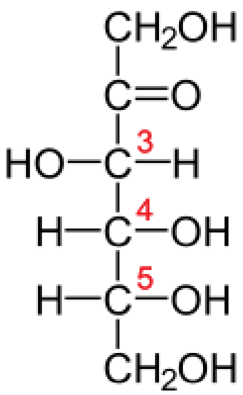




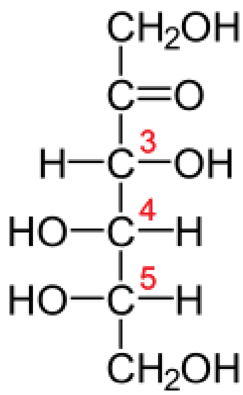
IUPAC name : Fructose

Other Names : Fruit sugar ,
Laevulose

Molecular formula	$C_6 H_{12} O_6$
Molar mass	180 g / mol
Melting point	103 °C



D-Fructose



L-Fructose

D - and L - isomers of fructose (open - chain form)

2 – 1 – Reactions .

2 – 1 – 1 - Fructose and fermentation :

Fructose may be anaerobically fermented by yeast or bacteria.[6] Yeast enzymes convert sugar (glucose, or fructose) to ethanol and carbon dioxide. The carbon dioxide released during fermentation will remain dissolved in water where it will reach equilibrium with carbonic acid unless the fermentation chamber is left open to the air. The dissolved carbon dioxide and carbonic acid produce the carbonation in bottle fermented beverages .

2 – 1 – 2 - Fructose and Maillard reaction :

Fructose undergoes the Maillard reaction, non-enzymatic browning, with amino acids. Because fructose exists to a greater extent in the open - chain form than does glucose, the initial stages of the Maillard reaction occurs more rapidly than with glucose. Therefore, fructose potentially may contribute to changes in food palatability, as well as other nutritional effects, such as excessive browning, volume and tenderness reduction during cake preparation, and formation of mutagenic compounds .

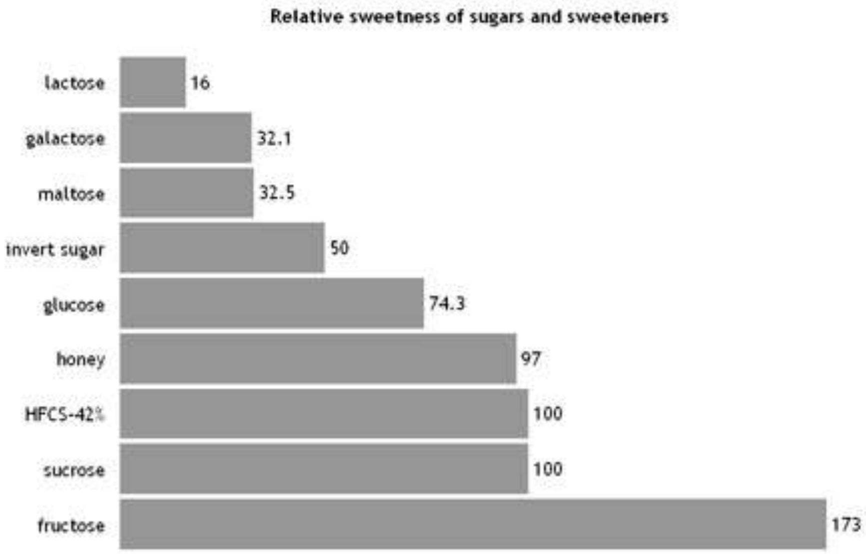
2 – 1 – 3 - Dehydration :

Fructose readily dehydrates to give hydroxy methyl furfural (" HMF ") . This process may in future be part of a low - cost , carbon neutral system to produce replacements for petrol and diesel from plantations.

3 - Physical and functional properties :

3 – 1 - Relative sweetness :

The primary reason that fructose is used commercially in foods and beverages, besides its low cost, is its high relative sweetness. It is the sweetest of all naturally occurring carbohydrates. Fructose is generally regarded as being 1.73 times as sweet as sucrose.[10][11] . However, it is the 5 - ring form of fructose that is sweeter; the 6-ring form tastes about the same as usual table sugar. Warming fructose leads to formation of the 6 - ring form .



Relative sweetness of sugars and sweeteners.

The sweetness of fructose is perceived earlier than that of sucrose or dextrose, and the taste sensation reaches a peak (higher than sucrose) and diminishes more quickly than sucrose. Fructose can also enhance other flavors in the system .

3 – 1 – 1 - Sweetness synergy :

Fructose exhibits a sweetness synergy effect when used in combination with other sweeteners. The relative sweetness of fructose blended with sucrose, aspartame, or saccharin is perceived to be greater than the sweetness calculated from individual components[13].

3 – 2 - Fructose solubility and crystallization :

Fructose has higher solubility than other sugars as well as other sugar alcohols. Fructose is therefore difficult to crystallize from an aqueous solution.[10] Sugar mixes containing fructose, such as candies, are softer than those containing other sugars because of the greater solubility of fructose .

3 – 2 – 1 - Fructose hygroscopicity and humectancy :

Fructose is quicker to absorb moisture and slower to release it to the environment than sucrose, dextrose, or other nutritive sweeteners [13]. Fructose is an excellent humectant and retains moisture for a long period of time even at low relative humidity (RH). Therefore, fructose can contribute to improved quality, better texture, and longer shelf life to the food products in which it is used.

3 – 2 – 2 - Freezing point :

Fructose has a greater effect on freezing point depression than disaccharides or oligosaccharides, which may protect the integrity of cell walls of fruit by reducing ice crystal formation. However, this characteristic may be undesirable in soft-serve or hard-frozen dairy desserts .

3 – 3 - Fructose and starch functionality in food systems .

Fructose increases starch viscosity more rapidly and achieves a higher final viscosity than sucrose because fructose lowers the temperature required during gelatinizing of starch, causing a greater final viscosity .

4 - Food sources :

Natural sources of fructose include fruits, vegetables (including sugar cane) , and honey . Fructose is often further concentrated from these sources. The highest dietary sources of fructose, besides pure crystalline fructose, are foods containing table sugar (sucrose), high-fructose corn syrup, agave nectar, honey, molasses, maple syrup, and fruit juices, as these have the highest percentages of fructose (including fructose in sucrose) per serving compared to other common foods and ingredients . Fructose exists in foods either as a free monosaccharide, or bound to glucose as sucrose, a disaccharide.

Fructose, glucose, and sucrose may all be present in a food; however, different foods will have varying levels of each of these three sugars.

The sugar contents of common fruits and vegetables are presented in Table 1. In general, in foods that contain free fructose, the ratio of fructose to glucose is approximately 1:1; that is, foods with fructose usually contain about an equal amount of free glucose. A value that is above 1 indicates a higher proportion of fructose to glucose, and below 1, a lower proportion. Some fruits have larger proportions of fructose to glucose compared to others. For example, apples and pears contain more than twice as much free fructose as glucose, while for apricots the proportion is less than half as much fructose as glucose.

Apple and pear juices are of particular interest to pediatricians because the high concentrations of free fructose in these juices can cause diarrhea in children. The cells (enterocytes) that line children's small intestines have less affinity for fructose absorption than for glucose and sucrose . Unabsorbed fructose creates higher osmolarity in the small intestine, which draws water into the gastrointestinal tract, resulting in osmotic diarrhea. This phenomenon is discussed in greater detail in the Health Effects section.

Table 1 also shows the amount of sucrose found in common fruits and vegetables. Sugar cane and sugar beet have a high concentration of sucrose, and are used for commercial preparation of pure sucrose. Extracted cane or beet juice is clarified, removing impurities; and concentrated by removing excess water. The end product is 99.9 % pure sucrose. Sucrose - containing sugars include common table white granulated sugar and powdered sugar, as well as brown sugar .

Sugar content of selected common plant foods (g / 100g)

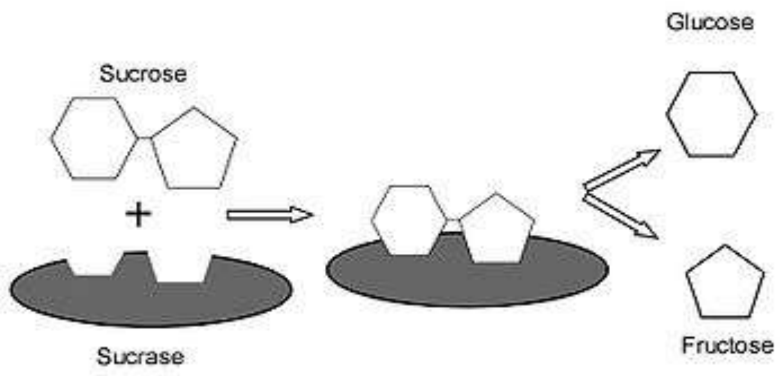
Food Item	Total Carbo hydrate	Total Sugars	Free Fructose	Free Glucose	Sucrose	Fructose/ Glucose Ratio	Sucrose as a % of Total Sugars
Fruits							
Apple	**13.8**	**10.4**	**5.9**	**2.4**	**2.1**	**2.0**	**19.9**
Apricot	**11.1**	**9.2**	**0.9**	**2.4**	**5.9**	**0.7**	**63.5**
Banana	**22.8**	**12.2**	**4.9**	**5.0**	**2.4**	**1.0**	**20.0**
Grapes	**18.1**	**15.5**	**8.1**	**7.2**	**0.2**	**1.1**	**1.0**
Peach	**9.5**	**8.4**	**1.5**	**2.0**	**4.8**	**0.9**	**56.7**
Pineapple	**13.1**	**9.9**	**2.1**	**1.7**	**6.0**	**1.1**	**60.8**
Pear	**15.5**	**9.8**	**6.2**	**2.8**	**0.8**	**2.1**	**8.0**
Vegetables							
Beet, Red	**9.6**	**6.8**	**0.1**	**0.1**	**6.5**	**1.0**	**96.2**
Carrot	**9.6**	**4.7**	**0.6**	**0.6**	**3.6**	**1.0**	**70.0**
Corn, Sweet	**19.0**	**3.2**	**0.5**	**0.5**	**2.1**	**1.0**	**64.0**
Red Pepper, Sweet	**6.0**	**4.2**	**2.3**	**1.9**	**0.0**	**1.2**	**0.0**
Onion, Sweet	**7.6**	**5.0**	**2.0**	**2.3**	**0.7**	**0.9**	**14.3**
Sweet Potato	**20.1**	**4.2**	**0.7**	**1.0**	**2.5**	**0.9**	**60.3**
Sugar Cane		**13 -18**	**0.2 –1.0**	**0.2 –1.0**	**11 - 16**	**1.0**	**100**
Sugar Beet		**17 -18**	**0.1 –0.5**	**0.1 –0.5**	**16 - 17**	**1.0**	**100**

Fructose is also found in the synthetically manufactured sweetener, high - fructose corn syrup (HFCS). Hydrolyzed corn starch is used as the raw material for production of HFCS. Through the enzymatic treatment, glucose molecules are converted into fructose [18]. There are three types of HFCS, each with a different proportion of fructose: HFCS – 42 , HFCS – 55 , and HFCS - 90. The number for each HFCS corresponds to the percentage of synthesized fructose present in the syrup. HFCS-90 has the highest concentration of fructose, and is typically used to manufacture HFCS – 55 ; HFCS 55 is used as sweetener in soft drinks, while HFCS - 42 is used in many processed foods and baked goods.

Cane and beet sugars have been used as the major sweetener in food manufacturing for centuries. However, with the development of HFCS, a significant shift occurred in the type of sweetener consumption. As seen in Figure 3, this change happened in the 1970s. Contrary to the popular belief, however, with the increase of HFCS consumption, the total fructose intake has not dramatically changed. Granulated sugar is 99.9 % pure sucrose, which means that it has equal ratio of fructose to glucose. The most commonly used HFCS, 42 and 55, have about equal ratio of fructose to glucose, with minor differences. HFCS has simply replaced sucrose as a sweetener. Therefore, despite the changes in the sweetener consumption, the ratio of glucose to fructose intake has remained relatively constant .

5 - Fructose digestion and absorption in humans :

Fructose exists in foods as either a monosaccharide (free fructose) or as a unit of a disaccharide (sucrose). Free fructose is absorbed directly by the intestine; however, when fructose is consumed in the form of sucrose, digestion occurs entirely in the upper small intestine. As sucrose comes into contact with the membrane of the small intestine, the enzyme sucrase catalyzes the cleavage of sucrose to yield one glucose and fructose unit. Fructose is absorbed in the small intestine, then enters the portal vein and is directed toward the liver.



Hydrolysis of sucrose to glucose and fructose by sucrase.

The mechanism of fructose absorption in the small intestine is not completely understood. Some evidence suggests active transport, because fructose uptake has been shown to occur against a concentration gradient.[21] However, the majority of research supports the claim that fructose absorption occurs on the mucosal membrane via facilitated transport involving GLUT5 transport proteins. Since the concentration of fructose is higher in the lumen, fructose is able to flow down a concentration gradient into the enterocytes, assisted by transport proteins. Fructose may be transported out of the enterocyte across the basolateral membrane by either GLUT2 or GLUT5, although the GLUT2 transporter has a greater capacity for transporting fructose and therefore the majority of fructose is transported out of the enterocyte through GLUT2.

5 – 1 - Capacity and rate of absorption :

The absorption capacity for fructose in monosaccharide form ranges from less than 5 g to 50 g and adapts with changes in dietary fructose intake. Studies show the greatest absorption rate occurs when glucose and fructose are administered in equal quantities [22]. When fructose is ingested as part of the disaccharide sucrose, absorption capacity is much higher because fructose exists in a 1:1 ratio with glucose. It appears that the GLUT5 transfer rate may be saturated at low levels, and absorption is increased through joint absorption with glucose [23]. One proposed mechanism for this phenomenon is a glucose-dependent cotransport of fructose. In addition, fructose transfer activity increases with dietary fructose intake. The presence of fructose in the lumen causes increased mRNA transcription of GLUT5, leading to increased transport proteins. High-fructose diets have been shown to increase abundance of transport proteins within 3 days of intake.

5 – 2 - Fructose Malabsorption :

Several studies have measured the intestinal absorption of fructose using hydrogen breath test . These studies indicate that fructose is not completely absorbed in the small intestine. When fructose is not absorbed in the small intestine, it is transported into the large intestine, where it is fermented by the colonic flora. Hydrogen is produced during the fermentation process and dissolves into the blood of the portal vein. This hydrogen is transported to the lungs, where it is exchanged across the lungs and is measurable by the hydrogen breath test. The colonic flora also produces carbon dioxide, short-chain fatty acids, organic acids, and trace gases in the presence of unabsorbed fructose . The presence of gases and organic acids in the large intestine causes gastrointestinal symptoms such as bloating, diarrhea, flatulence, and gastrointestial pain . Exercise can exacerbate these symptoms by decreasing transit time in the small intestine, resulting in a greater amount of fructose being emptied into the large intestine .

6 - Fructose metabolism :

All three dietary monosaccharides are transported into the liver by the GLUT 2 transporter [32]. Fructose and galactose are phosphorylated in the liver by fructokinase (K_m= 0.5 mM) and galactokinase (K_m = 0.8 mM). By contrast, glucose tends to pass through the liver (K_m of hepatic glucokinase = 10 mM) and can be metabolised anywhere in the body. Uptake of fructose by the liver is not regulated by insulin.

6 – 1 – Fructolysis :

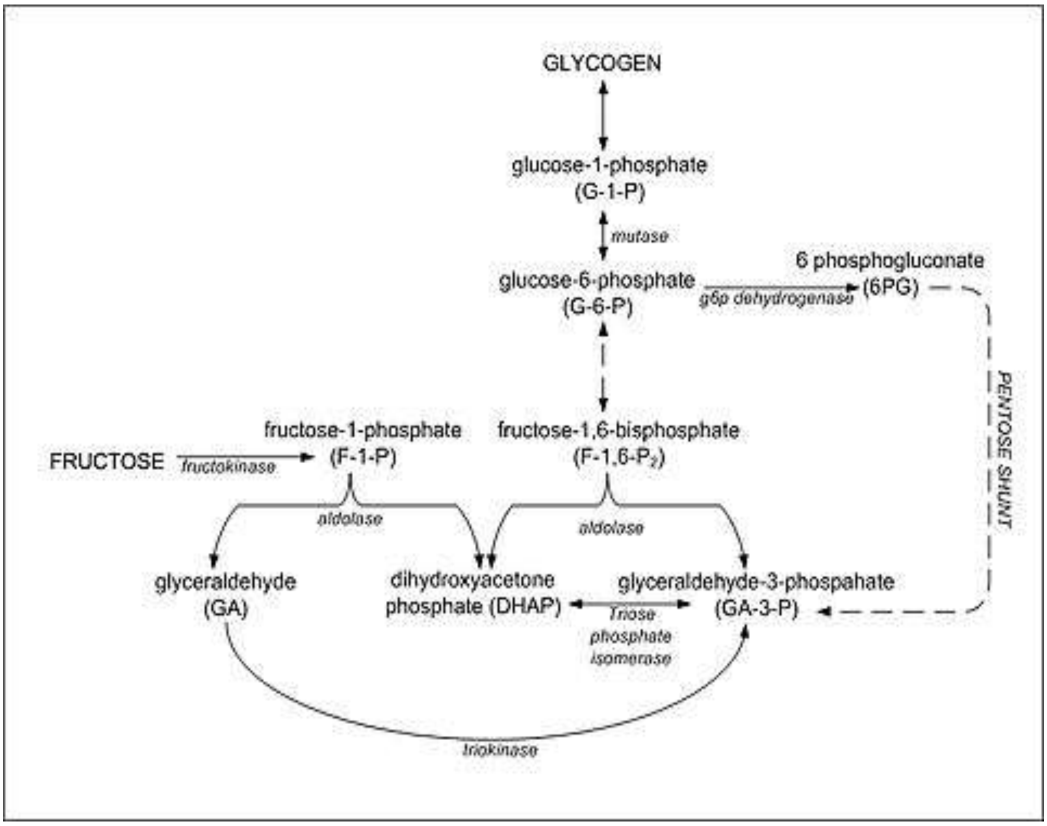
Fructolysis initially produces fructose 1,6-bisphosphate, which is split to produce phosphate derivatives of the trioses dihydroxyacetone and glyceraldehyde . These are then metabolized either in the gluconeogenic pathway for glycogen replenishment and/or complete metabolism in the fructolytic pathway to pyruvate, which after conversion to acetyl - CoA enters the Krebs cycle, and is converted to citrate and subsequently directed toward ’’de novo’’ synthesis of the free fatty acid palmitate .

6 – 2 - Metabolism of fructose to DHAP and glyceraldehyde:

The first step in the metabolism of fructose is the phosphorylation of fructose to fructose 1- phosphate by fructokinase, thus trapping fructose for metabolism in the liver. Fructose 1-phosphate then undergoes hydrolysis by aldolase B to form DHAP and glyceraldehydes; DHAP can either be isomerized to glyceraldehyde 3 - phosphate by triosephosphate isomerase or undergo reduction to glycerol 3 - phosphate by glycerol 3- phosphate dehydrogenase. The glyceraldehyde produced may also be converted to glyceraldehyde 3 - phosphate by glyceraldehyde kinase or converted to glycerol 3 - phosphate by glyceraldehyde 3- phosphate dehydrogenase. The metabolism of fructose at this point yields intermediates in the gluconeogenic and fructolytic pathways leading to glycogen synthesis as well as fatty acid and triglyceride synthesis.

6 – 3 - Synthesis of glycogen from DHAP and glyceraldehyde 3 phosphate :

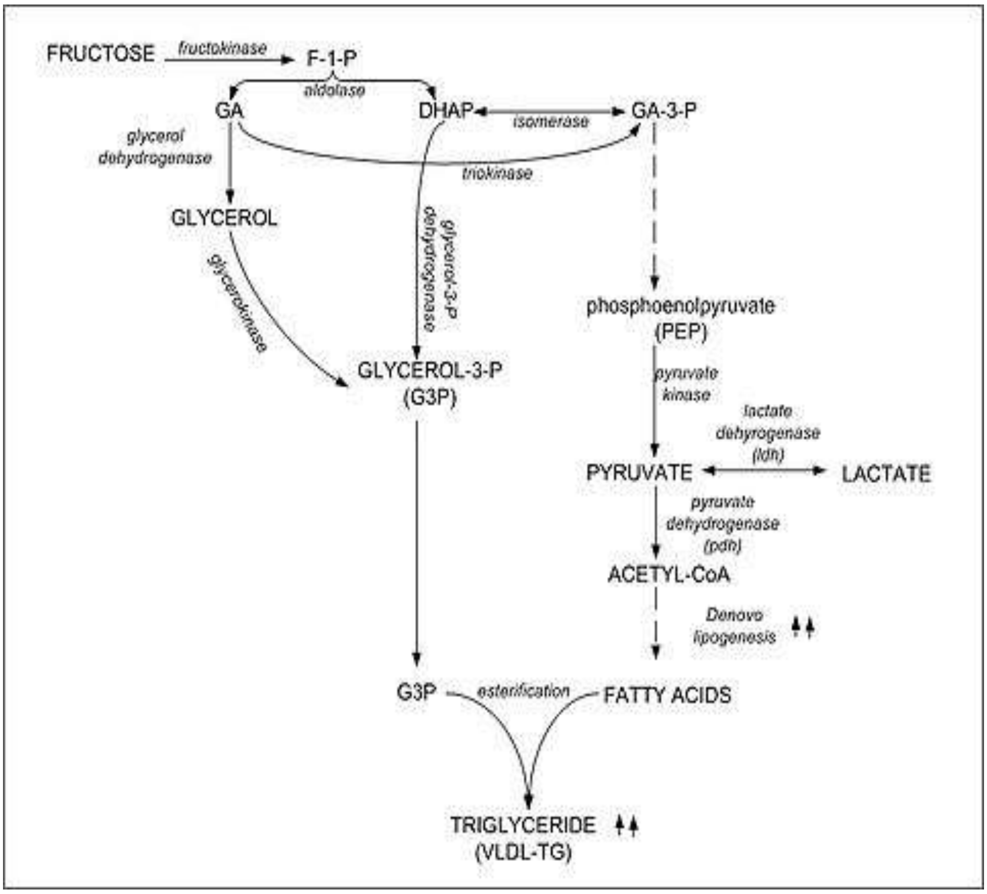
The resultant glyceraldehyde formed by aldolase B then undergoes phosphorylation to glyceraldehyde 3-phosphate. Increased concentrations of DHAP and glyceraldehyde 3-phosphate in the liver drive the gluconeogenic pathway toward glucose and subsequent glycogen synthesis. It appears that fructose is a better substrate for glycogen synthesis than glucose and that glycogen replenishment takes precedence over triglyceride formation . Once liver glycogen is replenished, the intermediates of fructose metabolism are primarily directed toward triglyceride synthesis .



Metabolic conversion of fructose to glycogen in the liver.

6 – 4 - Synthesis of triglyceride from DHAP and glycer - aldehyde 3 - phosphate :

Carbons from dietary fructose are found in both the free fatty acid and glycerol moieties of plasma triglycerides. High fructose consumption can lead to excess pyruvate production, causing a buildup of Krebs cycle intermediates . Accumulated citrate can be transported from the mitochondria into the cytosol of hepatocytes, converted to acetyl CoA by citrate lyase and directed toward fatty acid synthesis [33];[35]. Additionally, DHAP can be converted to glycerol 3-phosphate as previously mentioned, providing the glycerol backbone for the triglyceride molecule . Triglycerides are incorporated into very low density lipoproteins (VLDL), which are released from the liver destined toward peripheral tissues for storage in both fat and muscle cells.



Metabolic conversion of fructose to triglyceride in the liver.

7 - Health effects :

7 - 1 - Digestive problems :

Fructose absorption occurs via the GLUT - 5 (fructose only) transporter, and the GLUT2 transporter, for which it competes with glucose and galactose. A deficiency of GLUT 5 may result in excess fructose carried into the lower intestine . There, it can provide nutrients for the existing gut flora, which produce gas. It may also cause water retention in the intestine. These effects may lead to bloating, excessive flatulence, loose stools, and even diarrhea depending on the amounts eaten and other factors. For many people, fructose malabsorption is a major health concern.

7 – 2 - Metabolic syndromes .

Excess fructose consumption has been hypothesized to be a cause of insulin resistance, obesity,[37] elevated LDL cholesterol and triglycerides, leading to metabolic syndrome[38]. Fructose consumption has been shown to be correlated with obesity,[39][40] especially central obesity which is thought to be the most dangerous kind of obesity. A study in mice showed that a high fructose intake increases adiposity .

Although all simple sugars have nearly identical chemical formulae, each has distinct chemical properties. This can be illustrated with pure fructose. A journal article reports that, "...fructose given alone increased the blood glucose almost as much as a similar amount of glucose (78 % of the glucose - alone area)" .

One study concluded that fructose "produced significantly higher fasting plasma triacylglycerol values than did the glucose diet in men" and "...if plasma triacylglycerols are a risk factor for cardiovascular disease, then diets high in fructose may be undesirable".[46] Bantle et al. "noted the same effects in a study of 14 healthy volunteers who sequentially ate a high - fructose diet and one almost devoid of the sugar " .

Fructose is a reducing sugar, as are all monosaccharides. The spontaneous chemical reaction of simple sugar molecules to proteins, known as glycation, is thought to be a significant cause of damage in diabetics. Fructose appears to be equivalent to glucose in this regard and so does not seem to be a better answer for diabetes for this reason alone, save for the smaller quantities required to achieve equivalent sweetness in some foods . This may be an important contribution to senescence and many age - related chronic diseases .

7 – 3 - Compared to sucrose :

Studies that have compared high fructose corn syrup (an ingredient in nearly all soft drinks sold in the US) to sucrose (common table sugar) find that most measured physiological effects are equivalent. For instance, Melanson et al. (2006), studied the effects of HFCS and sucrose sweetened drinks on blood glucose, insulin, leptin, and ghrelin levels. They found no significant differences in any of these parameters.[50] This is not surprising since sucrose is a disaccharide which digests to 50 % fructose and 50% glucose; while the high fructose corn syrup most commonly used on soft drinks is 55 % fructose and 45 % glucose. The difference between the two lies in the fact that HFCS contains little sucrose, the fructose and glucose being independent moities.

Fructose is often recommended for diabetics because it does not trigger the production of insulin by pancreatic ß cells, probably because ß cells have low levels of GLUT5 . Fructose has a very low glycemic index of 19 ± 2 , compared with 100 for glucose and 68 ± 5 for sucrose.[54] Fructose is also seventy - three percent sweeter than sucrose at room temperature, so diabetics can use less of it. Studies show that fructose consumed before a meal may even lessen the glycemic response of the meal.Its sweetness changes at higher temperatures, so its effects in recipes are not equivalent to sucrose (i.e., table sugar).

7 – 4 - Liver disease .

"The medical profession thinks fructose is better for diabetics than sugar," says Meira Field, Ph.D., a research chemist at United States Department of Agriculture, "but every cell in the body can metabolize glucose. However, all fructose must be metabolized in the liver. The livers of the rats on the high fructose diet looked like the livers of alcoholics, plugged with fat and cirrhotic." While a few other tissues (e.g., sperm cells and some intestinal cells) do use fructose directly, fructose is almost entirely metabolized in the liver .

"When fructose reaches the liver," says Dr. William J. Whelan, a biochemist at the University of Miami School of Medicine, "the liver goes bananas and stops everything else to metabolize the fructose." Eating fructose instead of glucose results in lower circulating insulin and leptin levels, and higher of ghrelin levels after the meal.[58] Since leptin and insulin decrease appetite and ghrelin increases appetite, some researchers suspect that eating large amounts of fructose increases the likelihood of weight gain .

Excessive fructose consumption is also believed to contribute to the development of non-alcoholic fatty liver disease .

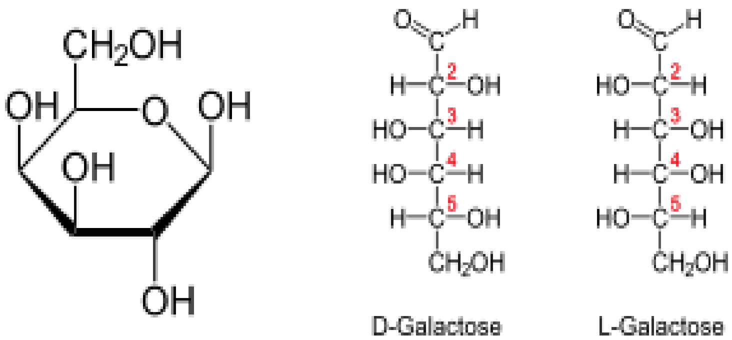
7 – 5 – Gout .

It has been suggested in a recent British Medical Journal study that high consumption of fructose is linked to gout. Cases of gout have risen in recent years, despite commonly being thought of as a Victorian disease, and it is suspected that the fructose found in soft drinks (e.g., carbonated beverages) and other sweetened drinks is the reason for this.

In order for the liver to process fructose, it must be phosphorylated by removal of phosphates from adenosine triphosphate (ATP). The ATP gets converted to adenosine monophosphate (AMP), then to inisotol monophosphate (IMP), and finally to uric acid , the agent in gout.

12 - Galactose

Galactose



D-Galactose L-Galactose

Molecular formula	$C_6H_{12}O_6$
Molar mass	180 g mol^{-1}
Melting point	167°C

1 – Introduction ;

Galactose (Gal) is a type of sugar that is less sweet than glucose. It is considered a nutritive sweetener because it has food energy. Its name comes from the Ancient Greek word for milk, γάλακτος (galaktos). It is an epimer of glucose .

Galactan is a polymer of the sugar galactose. It is found in hemicellulose and can be converted to galactose by hydrolysis. Galactose solubility in water is 68.30 grams per 100 grams of water at 20 – 25°C.

2 - Structure and isomerism :

Galactose exists in both open - chain and cyclic form. The open-chain form has a carbonyl at the end of the chain.

Four isomers are cyclic, two of them with a pyranose (six-membered) ring, two with a furanose (five – membered) ring. Galactofuranose occurs in bacteria, fungi and protozoa .

3 - Relationship to lactose :

Galactose is a monosaccharide. When combined with glucose, through a dehydration reaction, the result is the disaccharide lactose. The hydrolysis of lactose to glucose and galactose is catalyzed by the enzyme lactase, a β - galactosidase.

In the human body, glucose is changed into galactose via hexoneogenesis in order to enable the mammary glands to secrete lactose. However, most galactose in breast milk is synthesized from galactose taken up from the blood, and only 35 ± 6 % is made by de novo synthesis . Glycerol also contributes some to the mammary galactose production.

Galactose and glucose are produced by hydrolysis of lactose by β-galactosidase. This enzyme is produced by the *lac* operon in *Escherichia coli* (*E. coli*).

4 – Sources :

It is found in dairy products , sugar beets , and other gums and mucilages.

It is also synthesized by the body, where it forms part of glycolipids and glycoproteins in several tissues.

5 - Clinical significance .

Chronic systemic exposure of mice, rats, and Drosophila to D-galactose causes the acceleration of senescence and has been used as an aging model . Two studies have suggested a possible link between galactose in milk and ovarian cancer . Other studies show no correlation, even in the presence of defective galactose metabolism. More recently , pooled analysis done by the Harvard School of Public Health showed no specific correlation between lactose containing foods and ovarian cancer, and showed statistically insignificant increases in risk for consumption of lactose at ≥ 30 g / d. More research is necessary to ascertain possible risks.

There are some ongoing studies that suggest that galactose may have a role in treatment of focal segmental glomerulosclerosis (a kidney disease resulting in kidney failure and proteinuria). This effect is likely to be a result of binding of galactose to FSGS factor. Galactose is a component of the antigens present on blood cells that determine blood type within the ABO blood group system.[10]

6 - Liver galactose metabolism :

In the liver, galactose is converted to glucose 6-phosphate in the following reactions:

```
   galacto-          uridyl           phosphogluco-
    kinase         transferase           mutase
gal --------> gal 1 P -----------------> glc 1 P -----------> glc 6 P
                   ^       \
                  /         v
              UDP-glc     UDP-gal
                  ^         /
                   \_______/
                   Epimerase
```

13 - Glucose

Contents :

1 – Introduction :

Glucose (Glc), a simple sugar (monosaccharide) is an important carbohydrate in biology. Cells use it as a source of energy and a metabolic intermediate. Glucose is one of the main products of photosynthesis and starts cellular respiration. Starch and cellulose are polymers derived from the dehydration of glucose. The name "glucose" comes from the Greek word *glukus* , meaning "sweet." The suffix "- ose" denotes a sugar.

Glucose can adopt several different structures, but all of these structures can be divided into two families of mirror-images (stereoisomers). Only one set of these isomers exists in nature, those derived from the "right-handed form" of glucose, denoted D-glucose. D-glucose is often referred to as **dextrose**, especially in the food industry. The term dextrose is derived from *dextrorotatory glucose*.[2] Solutions of dextrose rotate polarized light to the right (in Latin:

dexter = "right"). This article deals with D - glucose. The mirror-image of the molecule, L- glucose is discussed separately.

2 - Structure .

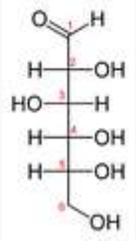
Although it is called a "simple sugar" (meaning that it is a monosaccharide), glucose is a complicated molecule because it adopts several different structures. These structures are usually discussed in the context of the acyclic isomer, which exists in only minor amounts in solution.

Glucose is a derived from hexanal, a chain of six carbon atoms terminating with an aldehyde group. The other five carbon atoms each bear alcohol groups. Glucose is called an *aldo*hexose. In solution, glucose mainly exists as the six-membered ring containing a hemiacetal group, which arises from the reaction of the 6-hydroxy group and the aldehyde. Containing five carbon atoms and one oxygen atom, this ring is a derivative of pyran. This cyclic form of glucose is called a glucopyranose, of which two isomers exist.

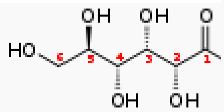
The asymmetric center at C-1, the site of the hemiacetal, is called *the anomeric carbon atom.* The ring closing process can give rise to two isomers, called anomers, which are labeled α-glucose and β-glucose. These anomers differ in terms of the relative positioning of the hydroxyl group linked to C-1. When D-glucose is drawn as a Haworth projection or in the standard chain conformation, the designation α means that the hydroxyl group attached to C-1 is positioned trans to the - CH_2OH group at C-5, while β means that it is cis. An inaccurate but superficially attractive alternative method of distinguishing α from β is observing whether the C-1 hydroxyl is below or above the plane of the ring; this may fail if the glucose ring is drawn upside down or in an alternative chair conformation. The α and β forms interconvert over a timescale of hours in aqueous solution, to a final stable ratio of α:β 36:64, in a process called mutarotation . The ratio would be α:β 11:89 if it were not for the influence of the anomeric effect.

2 – 1 – Isomers :

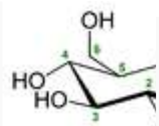
Aldohexoses have four chiral centers in their acyclic forms (i.e. ignoring the anomeric carbon). Four chiral centers give rise to $2^4 = 16$ stereoisomers. These stereoisomers are classified into two classes with eight sugars in each, which are mirror images of each other. One class is labeled L and the other D. Only seven of these isomers are found in nature, of which D-glucose (Glu), D-galactose (Gal) and D-mannose (Man) are the most important. These eight isomers (including glucose itself) are diastereoisomers and belong to the D series.



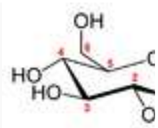
The Fischer projection of the chain form of D - glucose



The chain form of D-glucose



α - D- glucopyranose



Β – D - glucopyranose

3 - Physical properties .

All forms of glucose are colourless and soluble in water. Depending on conditions, three major forms can be crystallised: α-glucose and β-glucose, and the hydrated β-glucose.[5]

4 - Production :

4 – 1 - Biosynthesis :

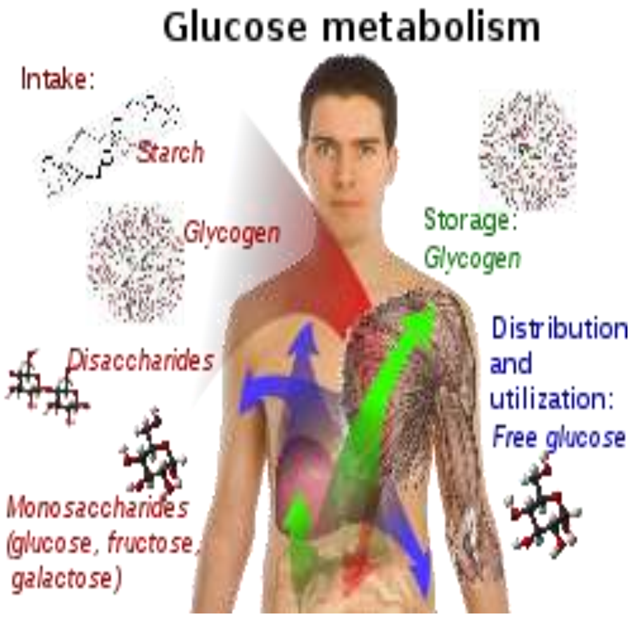
In plants and some prokaryotes, glucose is a product of photosynthesis. In animals and fungi, glucose results from the breakdown of glycogen, a process known as glycogenolysis. In plants the breakdown substrate is starch.

In animals, glucose is synthesized in the liver and kidneys from non-carbohydrate intermediates, such as pyruvate and glycerol, by a process known as gluconeogenesis.

4 – 2 - Commercial :

Glucose is produced commercially via the enzymatic hydrolysis of starch. Many crops can be used as the source of starch. Maize, rice, wheat, cassava, corn husk and sago are all used in various parts of the world. In the United States, cornstarch (from maize) is used almost exclusively. Most commercial glucose occurs as a component of invert sugar, an approximately 1:1 mixture of glucose and fructose. In principle, cellulose could be hydrolysed to glucose, but this process is not yet commercially practical .

5 - Function



Glucose metabolism and various forms of it in the process.

- Glucose - containing compounds and isomeric forms are digested and taken up by the body in the intestines, including starch, glycogen, disaccharides and mono saccharides.

- Glucose is stored in mainly the liver and muscles as glycogen. -It is distributed and utilized in tissues as free glucose.

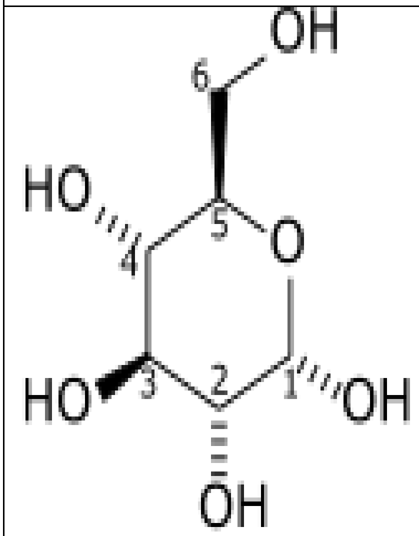
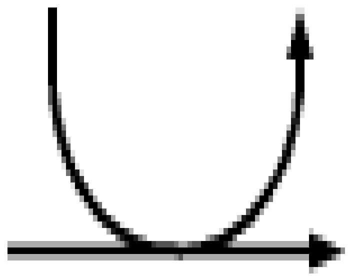
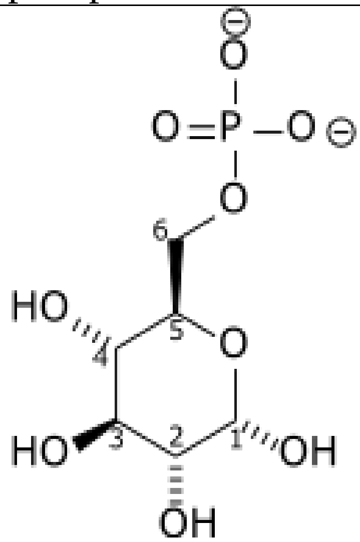
Scientists can speculate on the reasons why glucose, and not another monosaccharide such as fructose (Fru), is so widely used in organisms. One reason might be that glucose has a lower tendency, relative to other hexose sugars, to react non-specifically with the amino groups of proteins. This reaction (glycation) reduces or destroys the function of many enzymes. The low rate of glycation is due to glucose's preference for the less reactive cyclic isomer. Nevertheless, many of the long - term complications of diabetes (e.g., blindness, renal failure, and peripheral neuropathy) are probably due to the glycation of proteins or lipids . In contrast, enzyme-regulated addition of glucose to proteins by glycosylation is often essential to their function.

5 – 1 - As an energy source :

Glucose is a ubiquitous fuel in biology. It is used as an energy source in most organisms, from bacteria to humans. Use of glucose may be by either aerobic respiration, anaerobic respiration, or fermentation. Carbohydrates are the human body's key source of energy, through aerobic respiration, providing approximately 3.75 kilo calories (16 kilo joules) of food energy per gram . Breakdown of carbohydrates (e.g. starch) yields mono - and disaccharides, most of which is glucose. Through glycolysis and later in the reactions of the citric acid cycle (TCAC), glucose is oxidized to eventually form CO_2 and water, yielding energy sources, mostly in the form of ATP. The insulin reaction, and other mechanisms, regulate the concentration of glucose in the blood. A high fasting blood sugar level is an indication of prediabetic and diabetic conditions.

Glucose is a primary source of energy for the brain, and hence its availability influences psychological processes. When glucose is low, psychological processes requiring mental effort (e.g., self - control, effortful decision – making) are impaired.

5 – 2 - Glucose in glycolysis :

α - D - Glucose	Hexokinase	α – D – Glucose - 6 - phosphate
	TP ADP 	

Use of glucose as an energy source in cells is via aerobic or anaerobic respiration. Both of these start with the early steps of the glycolysis metabolic pathway. The first step of this is the phosphorylation of glucose by hexokinase to prepare it for later breakdown to provide energy.

The major reason for the immediate phosphorylation of glucose by a hexokinase is to prevent diffusion out of the cell. The phosphorylation adds a charged phosphate group so the glucose 6-phosphate cannot easily cross the cell membrane. Irreversible first steps of a metabolic pathway are common for regulatory purposes.

5 - 3 - As a precursor :

Glucose is critical in the production of proteins and in lipid metabolism. In plants and most animals, it is also a precursor for vitamin C (ascorbic acid) production. It is modified for use in these processes by the glycolysis pathway.

Glucose is used as a precursor for the synthesis of several important substances. Starch, cellulose, and glycogen (animal starch) are common glucose polymers (poly saccharides) . Lactose, the predominant sugar in milk, is a glucose-galactose disaccharide. In sucrose, another important disaccharide, glucose is joined to fructose. These synthesis processes also rely on the phosphorylation of glucose through the first step of glycolysis.

5 – 3 – 1 - Industrial use .

In industry, glucose is used as a precursor to make vitamin C in the Reichstein process, to make citric acid, gluconic acid, bio-ethanol, polylactic acid, sorbitol.

6 - Sources and absorption .

Most dietary carbohydrates contain glucose, either as their only building block, as in starch and glycogen, or together with another monosaccharide, as in sucrose and lactose.

In the lumen of the duodenum and small intestine, the glucose oligo- and polysaccharides are broken down to monosaccharides by the pancreatic and intestinal glycosidases. Other polysaccharides cannot be processed by the human intestine and require assistance by intestinal flora if they are to be broken down; the most notable exceptions are sucrose (fructose-glucose) and lactose (galactose-glucose). Glucose is then transported across the apical membrane of the enterocytes by SLC5A1, and later across their basal membrane by

SLC2A2. Some of the glucose is directly utilized as an energy source by brain cells, intestinal cells and red blood cells, while the rest reaches the liver, adipose tissue and muscle cells, where it is absorbed and stored as glycogen (under the influence of insulin) . Liver cell glycogen can be converted to glucose and returned to the blood when insulin is low or absent; muscle cell glycogen is not returned to the blood because of a lack of enzymes. In fat cells, glucose is used to power reactions that synthesize some fat types and have other purposes. Glycogen is the body's 'glucose energy storage' mechanism because it is much more 'space efficient' and less reactive than glucose itself.

7 - History :

Because glucose is a basic necessity of many organisms, a correct understanding of its chemical makeup and structure contributed greatly to a general advancement in organic chemistry. This understanding occurred largely as a result of the investigations of Emil Fischer, a German chemist who received the 1902 Nobel Prize in Chemistry as a result of his findings. The synthesis of glucose established the structure of organic material and consequently formed the first definitive validation of Jacobus Henricus van't Hoff's theories of chemical kinetics and the arrangements of chemical bonds in carbon-bearing molecules. Between 1891 and 1894, Fischer established the stereochemical configuration of all the known sugars and correctly predicted the possible isomers, applying van't Hoff's theory of asymmetrical carbon atoms .

14 - High - fructose corn syrup

Contents :

1 – Introduction :

High - fructose corn syrup (**HFCS**) – called **isoglucose** , **maize syrup** , or **glucose - fructose syrup** in the UK , and **glucose / fructose** in Canada – comprises any of a group of corn syrups that has undergone enzymatic processing to convert its glucose into fructose and has then been mixed with pure corn syrup (100% glucose) to produce a desired sweetness. In the United States, consumer foods and products containing high - fructose corn syrup are typically using HFCS as a sugar substitute and it is ubiquitous in processed foods and beverages, including soft drinks, yogurt, industrial bread, cookies, salad dressing, and tomato soup .

The most widely used varieties of high-fructose corn syrup are: HFCS 55 (mostly used in soft drinks) , approximately 55 % fructose and 45 % glucose; and HFCS 42 (used in many foods and baked goods), approximately 42 % fructose and 58 % glucose . HFCS – 90 , approximately 90 % fructose and 10% glucose, is used in small quantities for specialty applications, but primarily is used to blend with HFCS 42 to make HFCS 55.

In the US, HFCS is among the sweeteners that have partially replaced sucrose , thanks to governmental subsidies of U.S. corn and an import tariff on foreign sugar, raising the price of sucrose to levels above those of the rest of the world, making HFCS a cost - efficient for many sweetener applications . Critics of the extensive use of HFCS in food sweetening argue that the highly processed substance is more harmful to humans than regular sugar, contributing to weight gain by affecting normal appetite functions, and that in some foods HFCS may be a source of mercury, a known neurotoxin. Others dispute these claims and maintain that HFCS is comparable to table sugar . Studies by The American Medical Association suggest "it appears unlikely that HFCS contributes more to obesity or other conditions than sucrose" but calls for further independent research on the subject.

2 - Use as a replacement for sugar :

Since its introduction, HFCS has begun to replace sugar in various processed foods in the United States.[13][14] The main reasons for this switch are :

- Per relative sweetness, HFCS 55 is comparable to table sugar (sucrose), a disaccharide of fructose and glucose. HFCS 90 is sweeter than sucrose ; HFCS 42 is less sweet than sucrose.
- HFCS is somewhat cheaper in the United States as a result of a combination of corn subsidies and sugar tariffs/quotas.[17] Since the mid 1990s, the United States federal government has subsidized corn growers by $40 billion .
- HFCS is easier to blend and transport because it is a liquid .

3 - Comparison to other sweeteners :

High - fructose corn syrup
Nutritional value per 100 g

Energy	1,176 kJ (281 kcal)
Carbohydrates	76 g
Dietary fiber	0 g
Fat	0 g
Protein	0 g
Water	24 g
Riboflavin (Vit. B_2)	0.019 mg (1 %)
Niacin (Vit . B_3)	0 mg (0 %)
Pantothenic acid (B_5)	0.011 mg (0 %)
Vitamin B_6	0.024 mg (2 %)
Folate (Vit . B_9)	0 μg (0 %)
Vitamin C	0 mg (0 %)
Calcium	6 mg (1 %)
Iron	0.42 mg (3%)
Magnesium	2 mg (1%)
Phosphorus	4 mg (1%)
Potassium	0 mg (0%)
Sodium	2 mg (0%)
Zinc	0.22 mg (2%)

3 – 1 - Cane and beet sugar :

Cane sugar and beet sugar are both relatively pure sucrose. While the glucose and fructose, which are the two components of HFCS, are monosaccharides, sucrose is a disaccharide composed of glucose and fructose linked together with a relatively weak glycosidic bond. A molecule of sucrose (with a chemical formula of $C_{12}H_{22}O_{11}$) can be broken down into a molecule of glucose ($C_6H_{12}O_6$) plus a molecule of fructose (also $C_6H_{12}O_6$ — an isomer of glucose) in a weakly acidic environment. Sucrose is broken down during digestion into fructose and glucose through hydrolysis by the enzyme sucrase.

The fact that sucrose is composed of glucose and fructose units chemically bonded complicates the comparison between cane sugar and HFCS. Sucrose, glucose and fructose are unique, distinct molecules. Sucrose is broken down into its constituent mono saccharides – namely, fructose and glucose – in weakly acidic environments by a process called inversion. This same process occurs in the stomach and in the small intestine during the digestion of sucrose into fructose and glucose. People with sucrase deficiency cannot digest (break down) sucrose and thus exhibit sucrose intolerance .

Sucrose has approximately four kilocalories (kcal) — or four calories of food energy — per gram, while HFCS has approximately three kcal per gram. This is because HFCS contains roughly 25% water.

3 – 2 - Honey

Honey is a mixture of different types of sugars, water, and small amounts of other compounds. Honey typically has a fructose / glucose ratio similar to HFCS 55, as well as containing some sucrose and other sugars. Like HFCS, honey contains water and has approximately 3 kcal per gram. Because of its similar sugar profile and lower price, HFCS has been used illegally to "stretch" honey. As a result, checks for adulteration no longer test for sugar but instead test for minute quantities of proteins that can be used to differentiate between HFCS and honey .

4 - Production :

The process by which HFCS is produced was first developed by Richard O. Marshall and Earl P. Kooi in 1957.[23] The industrial production process was refined by Dr. Y . Takasaki at Agency of Industrial Science and Technology of Ministry of International Trade and Industry of Japan in 1965–1970 . HFCS was rapidly introduced to many processed foods and soft drinks in the U.S. from about 1975 to 1985 .

High - fructose corn syrup is produced by milling corn to produce corn starch, then processing that starch to yield corn syrup, which is almost entirely glucose, and then adding enzymes that change most of the glucose into fructose. The resulting syrup (after enzyme conversion) contains approximately 90% fructose and is HFCS 90. To make the other common forms of HFCS (HFCS 55 and HFCS 42) the HFCS 90 is mixed with 100 % glucose corn syrup in the appropriate ratios to form the desired HFCS. The enzyme process that changes the 100% glucose corn syrup into HFCS 90 is as follows:

1. Cornstarch is treated with alpha-amylase to produce shorter chains of sugars called oligosaccharides.
2. Glucoamylase - which is produced by Aspergillus, a fungus, in a fermentation vat — breaks the sugar chains down even further to yield the simple sugar glucose.
3. Xylose isomerase (aka glucose isomerase) converts glucose to a mixture of about 42 % fructose and 50 – 52 % glucose with some other sugars mixed in.

While inexpensive alpha-amylase and glucoamylase are added directly to the slurry and used only once, the more costly glucose-isomerase is packed into columns and the sugar mixture is then passed over it, allowing it to be used repeatedly until it loses its activity. This 42 – 43 % fructose glucose mixture is then subjected to a liquid chromatography step, where the fructose is enriched to about 90%. The 90% fructose is then back-blended with 42 % fructose to achieve a 55% fructose final product. Most manufacturers use carbon absorption for impurity removal. Numerous filtration, ion - exchange and evaporation steps are also part of the overall process.

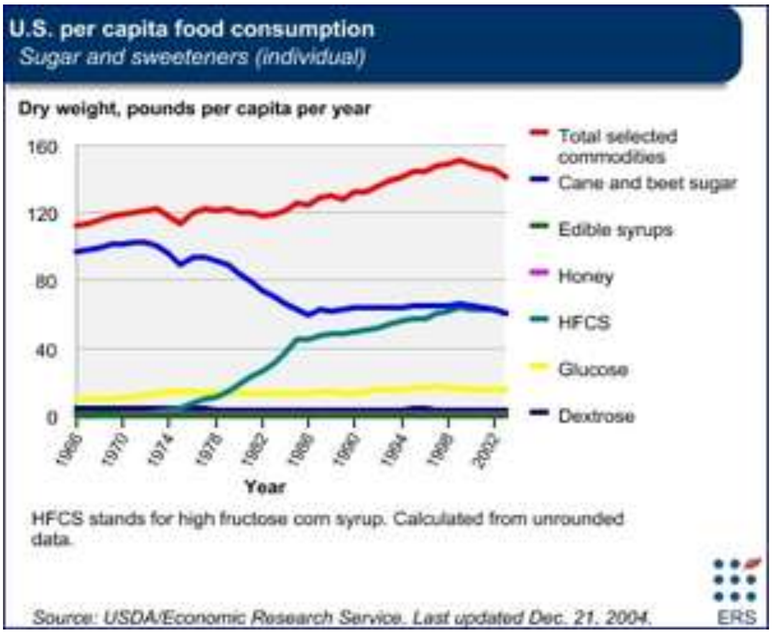
The units of measurement for sugars including HFCS are degrees Brix (symbol °Bx) . Brix is a measurement of the mass ratio of dissolved sugars to water in a liquid. A 25 °Bx solution has 25 grams of sugar per 100 grams of solution (25 % w / w) . Or, to put it another way, there are 25 grams of sugar and 75 grams of water in the 100 grams of solution. The Brix measurement was introduced by Antoine Brix.

When an infrared Brix sensor is used, it measures the vibrational frequency of the high - fructose corn syrup molecules, giving a Brix degrees measurement. This will not be the same measurement as Brix degrees using a density or refractive index measurement, because it will specifically measure dissolved sugar concentration instead of all dissolved solids. When a refractometer is used, it is correct to report the result as "refractometric dried substance" (RDS). One might speak of a liquid as being 20 °Bx RDS. This is a measure of percent by weight of *total* dried solids and, although not technically the same as Brix degrees determined through an infrared method, renders an accurate measurement of sucrose content, since the majority of dried solids are in fact sucrose. The advent of in-line infrared Brix measurement sensors have made measuring the amount of dissolved HFCS in products economical using a direct measurement. It also gives the possibility of a direct volume/volume measurement.

Recently, an isotopic method for quantifying sweeteners derived from corn and sugar cane was developed which permits measurement of corn syrup - and cane sugar - derived sweeteners in humans, thus allowing dietary assessment of the intake of these substances relative to total intake .

5 - Sweetener consumption patterns :

5 – 1 - United States :



US sweetener consumption, 1966 - 2004. It is apparent from this graph that overall sweetener consumption, and in particular glucose-fructose mixtures, has increased since the introduction of HFCS. Thus, the amount of fructose consumed in the United States has increased since the early 1980s. This would be true whether the added sweetener was HFCS, table sugar, or any other glucose - fructose mixture .

A system of sugar tariffs and sugar quotas imposed in 1977 in the United States significantly increased the cost of imported sugar and U.S. producers sought cheaper sources. High - fructose corn syrup, derived from corn, is more economical because the domestic U.S. and Canadian prices of sugar are twice the global price and the price of corn is kept low through government subsidies paid to growers.[27][28] HFCS became an attractive substitute, and is preferred over cane sugar among the vast majority of American food and beverage manufacturers. Soft drink makers such as Coca-Cola and Pepsi use sugar in other nations, but switched to HFCS in the U.S. in 1984.[29] Large corporations, such as Archer Daniels Midland, lobby for the continuation of government corn subsidies .

Other countries, including Mexico, typically use sugar in soft drinks. Some Americans seek out Mexican Coca - Cola in ethnic groceries, because they prefer the taste compared to Coke made with HFCS . Kosher for Passover Coca - Cola sold in the U.S. around the Jewish holiday also uses sucrose rather than HFCS and is also highly sought after by people who prefer the original taste .

The average American consumed approximately 37.8 lb (17.1 kg) of HFCS in 2008, versus 46.7 lb (21.2 kg) of sucrose.[34] In countries where HFCS is not used or rarely used, sucrose consumption per person may be higher than in the USA ; sucrose consumption per person from various locations is shown below (2002) :

- USA : 32.4 kg
- EU : 40.1 kg
- Brazil : 59.7 kg
- Australia : 56.2 kg

Of course, in terms of total sugars consumed, the figures from countries where HFCS is not used should be compared to the sum of the sucrose and HFCS figures from countries where HFCS consumption is significant.

5 – 2 - European Union :

In the European Union (EU), HFCS, known as isoglucose or glucose - fructose syrup:, is subject to a production quota. In 2005, this quota was set at 303,000 tons; in comparison, the EU produced an average of 18.6 million tons of sugar annually between 1999 and 2001.[36] Therefore, wide scale replacement of sugar has not occurred in the EU.

5 – 3 - Japan :

In Japan, HFCS consumption accounts for one quarter of total sweetener consumption .

6 - Health effects :

6 – 1 - Obesity :

Critics of HFCS point out a correlation between increased usage of HFCS in foods and obesity rates in the United States over three decades . Some allege that HFCS is in itself more detrimental to health than sucrose ; others claim that the low cost of HFCS encourages overconsumption of sugars . The Corn Refiners Association has launched an aggressive advertising campaign to counter these criticisms, claiming that high-fructose corn syrup "is natural" and "has the same natural sweeteners as table sugar". Both sides point to studies in peer reviewed journals that allegedly support their point of view.

Bocarsly *et al.* completed a 2010 study where rats were given 8% HFCS 12 hrs/day, 8 % HFCS 24 hrs/day, 10% sucrose 12 hrs/day, all with *ad libitum* rodent chow, or only ad libitum rodent chow for a duration of 8 weeks. The rats on HFCS 12 hrs/day gained more weight than the rats on sucrose 12 hrs/day in young males, but not in adult females. They also reported that the rats on HFCS 24 hrs/day did not gain a statistically significant amount of weight when compared to the rats on sucrose or chow only. Additionally, no differences in blood - glucose levels were observed. Another study was conducted for 6 - 7 months, and fat pads were removed from the rats and weighed. Fat pads for rats on HFCS 12 hrs/day weighed significantly more than rats on chow only, but were not different from rats on sucrose. Fat pads for rats on HFCS 24 hrs/day did not have a statistically different weight than rats on chow only.

Elliot *et al.* implicate increased consumption of fructose (due primarily to the increased consumption of sugars but also partly due to the slightly higher fructose content of HFCS as compared to sucrose) in obesity and insulin resistance. Chi-Tang Ho *et al.* found that soft drinks sweetened with HFCS are up to 10 times richer in harmful carbonyl compounds, such as methylglyoxal , than a diet soft drink control, and claimed that sucrose does not have the same tendency to produce these compounds . Carbonyl compounds are elevated in people with diabetes and are blamed for causing diabetic complications such as foot ulcers and eye and nerve damage .

A study in mice suggests that consumption of a fructose solution (not HFCS) increases obesity when compared with a sucrose solution. Large quantities of fructose stimulate the liver to produce triglycerides, promotes glycation of proteins and induces insulin resistance .

A 2008 study in humans analyzed the circulating levels of glucose, insulin, leptin, ghrelin, and triacylglycerol during a 24 hour period after consuming drinks containing HFCS or sucrose. The researchers concluded that the consumption of HFCS or sucrose did not yield differing metabolic effects .

In a 2007 study, rats were fed a diet high in fat and HFCS and kept relatively sedentary for 16 weeks in an attempt to emulate the diet and lifestyle of many Americans . The rats were not forced to eat, but were able to eat as much as they wanted; they consumed a large amount of food , and the researcher, Dr. Tetri, stated that there is evidence that fructose suppresses the sensation of fullness . Within four weeks, the rats showed early signs of fatty liver disease and type II diabetes. An equivalent diet using sucrose instead of HFCS was not tested .

Shapiro *et al.* fed rats a high - fructose diet for six months and compared them to rats that had been fed a fructose-free diet. Although the rats that had consumed high levels of fructose showed no change in weight, when compared to the rats that had consumed a fructose-free diet, levels of leptin in the blood of rats fed a high - fructose diet indicated the development of leptin resistance. When the rats were switched to a high - fat diet, the leptin-resistant rats, those fed a high-fructose diet, gained more weight than those who had not developed the resistance and had been fed a fructose-free diet .

Several studies funded by Tate & Lyle, a large corn refiner, the American Beverage Institute and the Corn Refiners Association,[52][53] have defended HFCS. Forshee *et al.* concluded "that HFCS does not appear to contribute to overweight and obesity any differently than do other energy sources." Melanson *et al.* (2006), studied the effects of HFCS and sucrose sweetened drinks on blood glucose, insulin, leptin, and ghrelin levels. They found no significant differences in any of these parameters. Monsivais *et al.* (2007) compared the effects of isocaloric servings of colas sweetened with HFCS 42, HFCS 55, sucrose, and aspartame on satiety and subsequent energy intake. They found that all of the drinks with caloric sweeteners produced similar satiety responses, and had the same effects on subsequent energy intake.

One much-publicized 2004 study found an association between obesity and high HFCS consumption, especially from soft drinks.[56] However, this study provided only correlative data. One of the study coauthors, Dr. Barry M. Popkin, is quoted in *The New York Times* as saying, "I don't think there should be a perception that high-fructose corn syrup has caused obesity until we know more."[5] In the same article, Walter Willett, chair of the nutrition department of the Harvard School of Public Health, is quoted as saying, "There's no substantial evidence to support the idea that high-fructose corn syrup is somehow responsible for obesity .... If there was no high - fructose corn syrup , I don't think we would see a change in anything important." Willett also recommends drinking water over soft drinks containing sugars or high-fructose corn syrup .

6 – 2 - Mercury :

A pilot study reported that some high-fructose corn syrup manufactured in the U.S. in 2005 contained trace amounts of mercury. The mercury appeared to come from sodium hydroxide and hydrochloric acid, two chemicals used in the manufacture of high-fructose corn syrup. This mixture used to produce HFCS may have come from plants also specializing in industrial chlorine chlor-alkali using the mercury cell Castner - Kellner process, and may contain traces of mercury if this specific process is utilized. Mercury concentrations in the samples testing positive ranged from 0.012 μg/g to 0.570 μg / g (micrograms per gram) . Nine of the twenty samples tested did contain measurable amounts of mercury .

6 – 3 - Liver Disease :

A March 18, 2010 Duke University Medical Center study found that "increased consumption of high fructose corn syrup was associated with scarring in the liver, or fibrosis, among patients with Non - alcoholic fatty liver disease (NAFLD) " . NAFLD is not uncommon in the United States, affecting almost 1 / 3 of the adult population .

7 - Apiculture :

In the United States, high - fructose corn syrup has become a sucrose replacement for honey bees. In 2009, a study by Leblanc *et al.* found that at temperatures above 45 °C HFCS rapidly begins to form hydroxy methyl furfural, which is toxic to the honey bees being fed HFCS .

8 - Public relations :

8 -1- Labeling as "natural" :

In May 2006, the Center for Science in the Public Interest (CSPI) threatened to file a lawsuit against Cadbury Schweppes for labeling 7 Up as "All Natural" or "100 % Natural",[61] despite the presence of high-fructose corn syrup. The U.S. Food and Drug Administration (FDA) has no general definition of "natural"; however, FDA regulations define "natural flavoring" to include products of vegetables . In April 2008, an FDA employee was quoted in an article suggesting that the agency had changed its opinion on HFCS . However, this was not the official position of the agency . The FDA subsequently issued a clarification stating that the agency does not object to labeling HFCS as "natural " · The CSPI also claim that HFCS is not a "natural" ingredient due to the high level of processing and the use of at least one genetically modified (GMO) enzyme required to produce it . On January 12, 2007, Cadbury Schweppes agreed to stop calling 7 Up "All Natural".[65] They now label it "100% Natural Flavors" .

8 – 2 - HFCS advertisements :

In September 2008, the Corn Refiners Association[67] launched a series of United States television advertisements that stated that HFCS "is made from corn", "is natural" (changed from previously - stated "doesn't have artificial ingredients"), "has the same calories as sugar or honey", "is nutritionally the same as sugar", and "is fine in moderation", in the hopes of to keeping consumers from avoiding HFCS products . The ads feature actors portraying roles in upbeat domestic situations with sugary foods, with one actor disparaging a food's HFCS content but being unable to explain why, and another actor questioning the comments with these claims. Finally, the ads each make reference to the Corn Refiners Association website .

8 – 3 - Moves back to sugar :

A March 21, 2009 *The New York Times* article said that some food companies and restaurants were using sugar in their product as a selling point, in order to attract customers who prefer not to consume high - fructose corn syrup. As one example, the article cited Jason's Deli, a chain of delis with 200 restaurants in 27 states. The chain had replaced high-fructose corn syrup with sugar in everything except a few soft drinks. Daniel Helfman, a spokesman for the deli chain, was quoted as saying, "Part of this is a huge rebellion against HFCS... but part of it is taste " .

Pepsi Co recently put forth a "throwback" version of Mountain Dew and Pepsi - Cola, designed to taste the same as these drinks did in the 1960s and 1970s. One aspect of the formulation is that sugar is used instead of HFCS. PepsiCo stated that HFCS and sugar are "essentially the same" and that the only reason HFCS was eschewed was in order to accurately reflect the taste of the past . Dr Pepper also released a "heritage" version of Dr Pepper Soda in 2009 that was made to the original formula and used beet sugar instead of HFCS . Since its establishment in 1891, the Dr Pepper bottling plant in Dublin, TX has continued to use the original formula sweetened with Imperial Cane Sugar .

In May 2010, Hunt's removed high - fructose corn syrup from its ketchup due to buyer preference as a result of health concerns; Pepsi Co had done the same with Gatorade , which now has a sucrose-dextrose mix .

Popular campaigns by food activists and perception by a rapidly increasing fraction of the consuming public in the United States that high-fructose corn syrup has harmful health effects continues to result in increasing reformulation of popular processed foods and reduced sales of HFCS, sales of which decreased by 9 % in 2009 as compared with 2007 .

Ivan Royster of South Carolina began a Facebook page which has grown to over 140,000 fans, lobbying for the ban of HFCS in the US. An article recently published by Organic Connections Magazine covered Ivan's protest and the Corn Refiners Association's counter to his efforts. The article includes links to Ivan's Facebook page and a recently completed Princeton study on HFCS .

15 -Inverted sugar syrup

1 – Introduction :

Inverted or **invert sugar syrup** is a mixture of glucose and fructose; it is obtained by splitting sucrose into these two components. Compared with its precursor sucrose, inverted sugar is sweeter and its products tend to remain moister, and are less prone to crystallisation. Inverted sugar is therefore valued by bakers, who refer to the syrup as *trimoline* or *invert syrup*.

In technical terms, sucrose is a disaccharide, which means that it is a molecule derived from two simple sugars monosaccharides. In the case of sucrose, these monosaccharide building blocks are fructose and glucose. The splitting of sucrose is a hydrolysis reaction. The hydrolysis can be induced simply by heating an aqueous solution of sucrose, but more commonly, catalysts are added to accelerate the conversion. The biological catalysts that are added are called sucrases (in animals) and invertases (in plants). Sucrases and invertases are types of glycoside hydrolase enzymes. Acid, such as occurs in lemon juice or cream of tartar, also accelerates the conversion of sucrose to invert.

2 - Chemical reaction of the inversion :

The term 'inverted' is derived from the method of measuring the concentration of sugar syrup using a polarimeter. Plane polarized light, when passed through a sample of pure sucrose solution, is rotated to the right (optical rotation). As the solution is converted to a mixture of sucrose, fructose and glucose, the amount of rotation is reduced until (in a fully converted solution) the direction of rotation has changed (inverted) from right to left .

$C_{12}H_{22}O_{11}$ (sucrose, Specific rotation = + 66.5°) + H_2O (water, no rotation) → $C_6H_{12}O_6$ (glucose , Specific rotation = + 52.7°) + $C_6H_{12}O_6$ (fructose , Specific rotation = - 92°)

Net : + 66.5° converts to - 39°

Hydrolysis is a chemical reaction in which a molecule breaks down by the addition of water. Hydrolysis of sucrose yields glucose and fructose about 85 %, the reaction temperature can be maintained at 50 - 60 °C .

3 - Inverting sugar

Inverted sugar syrup can be easily made by adding roughly one gram of citric acid or ascorbic acid, per kilogram of sugar. Cream of tartar (one gram per kilogram) or fresh lemon juice (10 millilitres per kilogram) may also be used.

The mixture is boiled for 20 minutes, and will convert enough of the sucrose to effectively prevent crystallization, without giving a noticeably sour taste. Invert sugar syrup may also be produced without the use of acids or enzymes by thermal means alone: two parts granulated sucrose and one part water simmered for five to seven minutes will convert a modest portion to invert sugar.

All inverted sugar syrups are created from hydrolysing sucrose to glucose (dextrose) and fructose by heating a sucrose solution, then relying on time alone, with the catalytic properties of an acid or enzymes used to speed the reaction. Commercially prepared acid catalysed solutions are neutralised when the desired level of inversion is reached.

All constituent sugars (sucrose, glucose and fructose) support fermentation, so invert sugar solutions may be fermented as readily as sucrose solutions.

4 - Shelf life :

Invert sugar has a lower water activity than that of sucrose, so it provides more powerful preserving qualities (a longer shelf life) to products that use it.

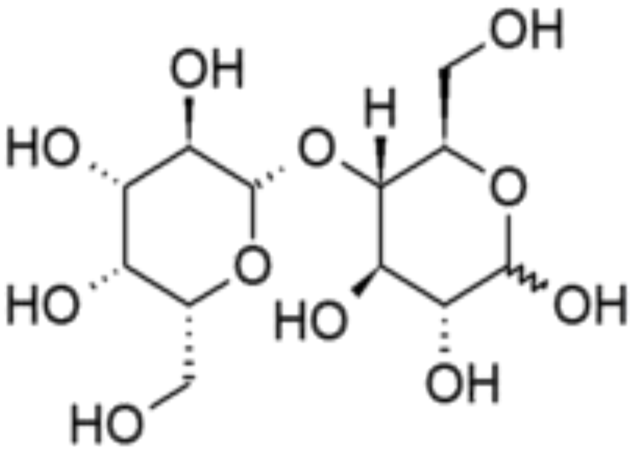
The shelf life of partial inverts is approximately six months, depending on storage and climatic conditions. Crystallised invert sugar solutions may be restored to their liquid state by gently heating.

5 - Examples :

- Toffee
- Honey is a mixture (principally) of glucose and fructose, giving it similar properties to invert syrup. This gives it the ability to remain liquid for long periods of time.
- Jam, when made, produces invert sugar during extensive heating under the action of the acid in the fruit.
- Golden syrup is a syrup of approximately 56% invert syrup, 44 % sucrose.
- Fondant filling for chocolates is unique in that the conversion enzyme is added, but not activated before the filling is enrobed with chocolate. The very viscous (and thus formable) filling then becomes less viscous with time, giving the creamy consistency desired.
- Quaker Granola Bars contain inverted sugar.
- York Peppermint Patties contain inverted sugar.
- Junior Mints contain inverted sugar.
- Jones Soda sweeten their soda with inverted cane sugar.
- Jujubes contain inverted sugar.
- Sour Patch Kids contain inverted sugar.
- Caramello candy bars contain inverted sugar.
- McVities Oat & Syrup Flapjack partially inverted sugar.
- Swedish Fish contain inverted sugar.
- Sugar Babies contain inverted sugar.
- Cadbury eggs contain inverted sugar.
- Wheat Thins contain inverted sugar.

- Toblerone Chocolates contain inverted sugar.
- Cigarettes use inverted sugar as a 'casing' to add flavour.[3]
- Candi sugar is a type of invert sugar used in the brewing of Belgian - style beers to boost alcohol content without drastically increasing the body of the beer; it is especially common in the style of beer known as dubbel.

16 - Lactose



IUPAC name : β-D-galactopyranosyl-(1→4)-D-glucose

Other names Milk sugar ,
4-*O*-β-D-galactopyranosyl-D-glucose

Properties	
Molecular formula	$C_{12}H_{22}O_{11}$
Molar mass	342 g / mol
Appearance	white solid
Solubility in water	21.6 g / 100 mL

1 – Introdution :

Lactose is a sugar that is found most notably in milk. Lactose makes up around 2 ~ 8 % of milk (by weight) , although the amount varies among species and individuals. It is extracted from sweet or sour whey. The name comes from *lacte*, the Latin word for milk, plus the - ose ending used to name sugars. It has a formula of $C_{12}H_{22}O_{11}$.

2 - History

Lactose was discovered in milk in 1619 by Fabriccio Bartoletti, and identified as a sugar in 1780 by Carl Wilhelm Scheele.

3 - Chemistry

Lactose is a disaccharide that consists of galactose and glucose fragments bonded through a β-1→4 glycosidic linkage. Its systematic name is β-D-galactopyranosyl-(1→4)-D-glucose. The glucose fragment can be in either the α-pyranose form or the β-pyranose form, whereas the galactose fragment can only have the β-pyranose form: hence α-lactose and β-lactose refer to anomeric form of the glucopyranose ring alone.

As it gives free radicals by mechanochemistry, it is possible to use lactose to follow by ESR (electron spin resonance) the energy used during a milling process .

Lactose is hydrolysed to glucose and galactose, isomerised in alkaline solution to lactulose, and catalyticaly hydrogenated to the corresponding polyhydric alcohol, lactitol .

3 -1 - Solubility :

The solubility of lactose in water is 18.9049 g at 25 °C, 25.1484 g at 40 °C and 37.2149 g at 60 °C per 100 g solution. Its solubility in ethanol is 0.0111 g at 40 °C and 0.0270 g at 60 °C per 100 g solution.

4 - Lactose Catabolism :

Infant mammals nurse on their mothers to drink milk, which is rich in the carbohydrate lactose. The intestinal villi secrete an enzyme called lactase (β-D-galactosidase) to digest it. This enzyme cleaves the lactose molecule into its two subunits, the simple sugars glucose and galactose, which can be absorbed.

Since lactose occurs mostly in milk, in most mammals the production of lactase gradually decreases with maturity due to a lack of constant consumption.

Many people with ancestry in Europe, the Middle East, India, and parts of East Africa maintain lactase production into adulthood. In many of these areas, milk from mammals such as cattle, goats, and sheep is used as a large source of food. Hence, it was in these regions that genes for lifelong lactase production first evolved. The genes of lactose tolerance have evolved independently in various ethnic groups.

People who are lactose intolerant may suffer uncomfortable or socially unacceptable symptoms of too much lactose consumption. In these people, lactose is not broken down and provides food for gas-producing gut flora. This can lead to bloating, flatulence, and other gastrointestinal symptoms.

Lactose can also be bought in pure form, as an assist in high calorie diets.

5 - Industrial production and usage :

It has been estimated that the annual world wide availability of lactose as a by - product of the dairy industry is several million tons. Whey contains about 4.8 % of lactose, which may be purified by crystallisation. Food industry applications, both of pure lactose and lactose-containing dairy by - products, have markedly increased since the 1960s. For example, its bland flavour has lent to its use as a carrier and stabiliser of aromas and pharmaceutical products.

Lactose is little fermented by baker's yeast and during brewing, which may be used to advantage . Lactose is used in stout beers rarely to sweeten the beer and is non - fermentable in beer.

17 - List of un refined sweeteners

1 – Introduction :

Sweeteners are usually made from the fruit or sap of plants, but can also be made from any other part of the plant, or all of it. Some sweeteners are made from starch, with the use of enzymes. Sweeteners made by animals, especially insects, are put in their own section as they can come from more than one part of plants.

2 - From sap :


A block of Indian jaggery, a type of raw sugar	*Three cakes of commercially produced palm sugar*

The sap of some species is concentrated to make sweeteners, usually through drying or boiling.

- Cane juice, syrup, molasses, and raw sugar, which has many regional and commercial names including demerara, jaggery, muscovado, panela, piloncillo, turbinado sugar, Florida Crystals and Sucanat, are all made from sugarcane (*Saccharum* spp) .
- Sweet sorghum syrup is made from the sugary juice extracted from the stalks of *Sorghum* spp., especially *S. bicolor* .

- Mexican or maize sugar can be made by boiling down the juice of green maize stalks .
- Agave nectar is made from the sap of *Agave* spp., including tequila agave (*Agave tequilana*) .
- Birch syrup is made from the sap of Birch trees (*Betula* spp) .
- Maple syrup, taffy and sugar are made from the sap of tapped maple trees (*Acer* spp) .
- Palm sugar is made by tapping the flower stalk of various palms to collect the sap. The most important species for this is the Indian date palm (*Phoenix sylvestris*), but other species used include palmyra (*Borassus flabelliformis*), coconut (*Cocos nucifera*), toddy (*Caryota urens*), gomuti (*Arenga saccharifera*), and nipa (*Nypa fruticans*) palms.[5][6]
- The sweet resin of the Sugar Pine (*Pinus lambertiana*) was considered by John Muir to be better than maple sugar .

3 - From roots :

The juice extracted from the tuberous roots of certain plants is, much like sap, concentrated to make sweeteners, usually through drying or boiling.

- Sugar beet syrup (*Zuckerrübensirup* in German) is made from the tuberous roots of the sugar beet (*Beta vulgaris*).[8] Sugar beet molasses, a by-product of the processing to make refined sugar, also exists but is mainly used for animal feed.[9]
- Yacón syrup is made from the tuberous roots of yacón (*Smallanthus sonchifolius*) .
- Licorice root .

4 - From nectar and flowers

- A "palatable" brown sugar can be made by boiling down the dew from flowers of the common milk weed (*Asclepias syriaca*) .

5 - From seeds

The starchy seeds of certain plants are trans formed into sweeteners by using the enzymes formed during germination or from bacterian cultures. Some sweeteners made with starch are quite refined and made by degrading purified starch with enzymes, such as corn syrup .

- Barley malt syrup is made from germinated barley grains.
- Brown rice malt syrup is made from rice grains cooked and then cultured with malt enzymes .
- Amazake is made from rice fermented with *Koji* (*Aspergillus oryzae*).

6 - From fruits .

Many fresh fruits, dried fruits and fruit juices are used as sweeteners. Some examples are:

- Watermelon sugar, made by boiling the juice of ripe watermelons .
- Pumpkin sugar, made by grating the pumpkins, in the same manner as to make beet sugar .
- Dates, date paste, spread, syrup ("dibs"), or powder (date sugar) are made from the fruit of the date palm (*Phoenix dactylifera*).
- Jallab is made by combining dates, grape molasses and rose water.
- Pekmez is made of grapes , fig (*Ficus carica*) and mulberry (*Morus* spp.) juices, condensed by boiling with coagulant agents.

A variety of molasses are made with fruit :

- Carob molasses is made from the pulp of the Carob tree's fruit.

7 - From leaves .

Dried and powdered Stevia leaves

In a few species of plants the leaves are sweet and can be used as sweeteners.

- *Stevia* spp. can be used whole, or dried and powdered to sweeten food or drink. Uniquely, stevia contains no carbohydrates or calories.[18]
- Jiaogulan (*Gynostemma pentaphyllum*), has sweet leaves, although not as sweet as *Stevia*.[19]

7 - By animals :

- True honey , made by honey bees (*Apis* spp.) from gathered nectar.
- Sugar bag, the honey of stingless bees , which is more liquid than the honey from honey bees.

18 - Malt

Malted barley

1 – Introduction :

Malting is a process applied to cereal grains, in which the grains are made to germinate by soaking in water[1] and are then quickly halted from germinating further by drying/heating with hot air . Thus, malting is a combination of two processes: the sprouting process and the kiln - drying process . These latter terms are often preferred when referring to the field of brewing for batches of beer or other beverages as they provide more specific information.

The term "malt" refers to several products of the process:

- the grains to which this process has been applied, for example malted barley;
- the sugar, heavy in maltose, derived from such grains, such as the baker's malt used in various cereals; or
- a product based on malted milk, similar to a malted milkshake (i.e., "malts").

Whisky or beer made from malted barley or rye can also be called malt, as in Alfred Edward Housman's aphorism "malt does more than Milton can, to justify God's ways to Man."

2 - Uses :

Malt from an external supplier is delivered to a brewery

Malted grain is used to make malt beer, malt whisky, malted shakes, malt vinegar, confections such as Maltesers and Whoppers, and some baked goods, such as malt loaf. Malted barley is often a label - listed ingredient in blended flours typically used for yeast breads, and a form of it specially selected for higher protein is typically used in the manufacture of many common baked goods. Malting grains develops the enzymes that are required to modify the grain's starches into sugars, including monosaccharides (glucose, fructose, etc) , and disaccharides (sucrose, etc) . It also develops other enzymes, such as proteases, which break down the proteins in the grain into forms which can be utilized by yeast . Barley is the most commonly malted grain in part because of its high diastatic power or enzyme content. Also very important is the retention of the grain's husk even after threshing, unlike the bare seeds of threshed wheat or rye. This protects the growing acrospire (developing plant embryo) from damage during malting, which can easily lead to mold growth. It also allows the mash of converted grain to create a filter bed during lautering (see brewing). Other grains may be malted, especially wheat.

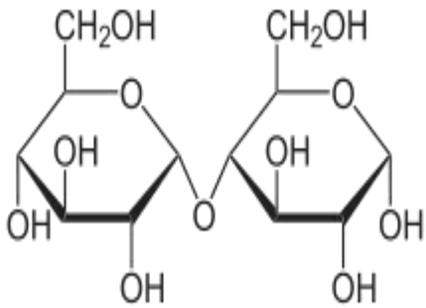
3 - Maltings :

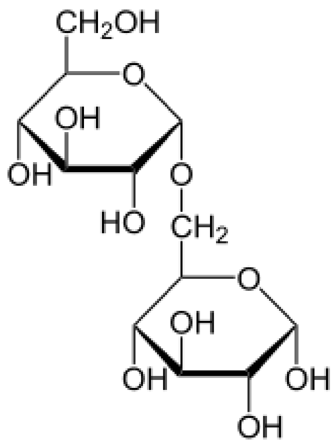
A **maltings**, sometimes called *malthouse*, or *malting floor*, is a building that houses the process of converting barley into malt, for use in the brewing or distilling process. This is done by kiln-drying the sprouted barley. This is usually done by spreading the sprouted barley on a perforated wooden floor. Smoke, coming from an oasting fireplace (via smoke channels) is then used to heat the wooden floor (and thus, the sprouted grain with it). The temperature thus employed is usually around 55 °C . A typical floor maltings is a long, single-story building with a floor that slopes slightly from one end of the building to the other. Floor maltings began to be phased out in the 1940s in favor of 'pneumatic plants'. Here large industrial fans are used to blow air through the germinating grain beds and to pass hot air through the malt being kilned. Like floor maltings these pneumatic plants are batch processes but of considerably greater size, typically 100 tonne batches compared with 20 tonne batches for a floor maltings.

4 - Malt categories :

Malt is often divided into two categories by brewers: *base malts* and *specialty malts*. Base malts have enough diastatic power to convert their own starch and usually that of some amount of starch from unmalted grain, called adjuncts. Specialty malts have little diastatic power; they are used to provide flavor, color, or "body" (viscosity) to the finished beer. *Caramel* or *crystal* malts are specialty malts that have been subjected to heat treatment that converts their starches to sugars non - enzymatically. Within these categories are a variety of types distinguished largely by the kilning temperature (see mash ingredients). In addition, malts are distinguished by the two major species of barley used for malting, two-row and six-row. [6] A new encapsulating technology permits the production of malt granules. Malt granules are the dried liquid extract from malt using in the brewing or distilling process .

19 -Maltose





IUPAC name : Maltose
Other names :
4-*O*-α-D-Glucopyranosyl-D-glucose ,Isomaltose
6-*O*-α-D-Glucopyranosyl-D-glucose

Properties	
Molecular formula	$C_{12}H_{22}O_{11}$
Molar mass	342 g / mol
Appearance	white powder or crystals
Density	1.54 g / cm^3
Melting point	160–165 °C (anhydrous) 102-103 °C (monohydrate)
Solubility in water	1.080 g / mL (20 °C)
Chiral rotation $[\alpha]_D$	+140.7° (H_2O, *c* = 10)

1 – Introduction :

Maltose, or malt sugar, is a disaccharide formed from two units of glucose joined with an α (1→4) bond. The isomer **isomaltose** has two glucose molecules linked through an α (1→6) bond. Maltose is the second member of an important biochemical series of glucose chains. Maltose is the disaccharide produced when amylase breaks down starch. It is found in germinating seeds such as Barley as they break down their starch stores to use for food.

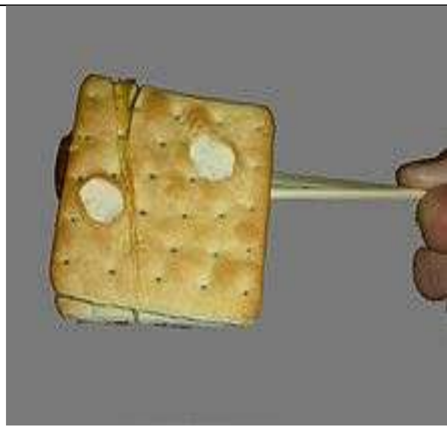
The addition of another glucose unit yields maltotriose; further additions will produce dextrins (also called malto dextrins) and eventually starch (glucose polymer).

Maltose can be broken down into two glucose molecules by hydrolysis. In living organisms, the enzyme maltase can achieve this very rapidly. In the laboratory, heating with a strong acid for several minutes will produce the same result. Isomaltose is broken by isomaltase.

The production of maltose from germinating cereals, such as barley, is an important part of the brewing process. When barley is malted, it is brought into a condition in which the concentration of maltose-producing amylases has been maximized. Mashing is the process by which these amylases convert the cereal's starches into maltose. Metabolism of maltose by yeast during fermentation then leads to the production of ethanol and carbon dioxide.

2 - Maltose as food :

Plain maltose has a sweet taste, about half as sweet as glucose and about one - sixth as sweet as fructose.

	
Maltose syrup	*Maltose with biscuits*

In Southern China , Taiwan, Hong Kong and Macau, maltose is a common ingredient in confectionery. The most common way to consume it is to put a layer of maltose between two pieces of biscuit (usually crackers).

20 - Modified starch

1 – Introduction :

Modified starch is prepared by physically, enzymatically, or chemically treating native starch, thereby changing the properties of the starch . Modified starches are used in practically all starch applications, such as in food products as a thickening agent, stabilizer or emulsifier; in pharmaceuticals as a disintegrant ; or in paper as a binder. They are also used in many other applications.

Starches are modified to enhance their performance in different applications. Starches may be modified to increase their stability against excessive heat, acid, shear, time, cooling, or freezing; to change their texture; to decrease or increase their viscosity; to lengthen or shorten gelatinization time; or to increase their visco-stability.

2 - Modification methods :

Acid - treated starch (E1401) , usually simply called "modified starch", is prepared by treating starch or starch granules with inorganic acids, e.g. hydrochloric acid breaking down the starch molecule and thus reducing the viscosity.

Other treatments producing modified starch (with different E numbers) are:

- Alkaline - modified starch (E1402) with sodium hydroxide or potasium hydroxide
- bleached starch (E1403) with hydrogen peroxide
- oxidized starch (E1404) with sodium hypochlorite, breaking down viscosity
- dextrin (E1400), roasted starch with hydrochloric acid
- Enzyme - treated starch (INS: 1405), acetylated starch (E1420) esterification with acetic anhydride
- hydroxypropylated starch, starch ether, with propylene oxide, increasing viscosity stability

- distarch phosphate by esterification with for example sodium tri meta phosphate, crosslinked starch modifying the rheology, the texture
- cationic starch, adding positive electrical charge to starch
- carboxymethylated starch with monochloroacetic acid

and combined modifications such as acetylated oxidized starch (E1451).

Modified starch may be an cold water soluble, pregelatinized or instant starch which thickens and gels without heat, or a cook-up starch which must be cooked like regular starch. Drying methods to make starches cold water soluble are extrusion, drum drying or spray drying.

Other starch derivates are glucose and glucose syrups, starch degraded with amylase enzyme to make a sweetener.

3 - Examples of use and functionality of modified starch in food :

Pre - gelatinized starch is used to thicken instant desserts, allowing the food to thicken with the addition of cold water or milk. Similarly, cheese sauce granules (such as in Macaroni and Cheese or lasagna) or gravy granules may be thickened with boiling water without the product going lumpy. Commercial pizza toppings containing modified starch will thicken when heated in the oven, keeping them on top of the pizza, and then become runny when cooled.

A suitably - modified starch is used as a fat substitute for low-fat versions of traditionally fatty foods, e.g., reduced-fat hard salami having about 1 / 3rd the usual fat content. For such uses, it is an alternative to the product Olestra.

Modified starch is added to frozen products to prevent them from dripping when defrosted. Modified starch, bonded with phosphate, allows the starch to absorb more water and keeps the ingredients together. Modified starch acts as an emulsifier for French dressing by enveloping oil droplets and suspending them in the water.

Acid-treated starch forms the shell of jelly beans. Oxidized starch increases the stickiness of batter.

4 - Genetically modified starch :

Modified starch should not be confused with genetically modified starch, which refers to starch from genetically engineered plants, which have been genetically modified to produce novel carbohydrates which might not naturally occur in the plant species being harvested. The modification in this sense refers to the genetic engineering of the plant DNA, and not the later processing or treatment of the starch or starch granules.

Genetically modified starch is of interest in the manufacture of biodegradable polymers and noncellulose feedstock in the paper industry, as well as the creation of new food additives.

21 - Molasses

Blackstrap molasses.

1 – Introduction :

Molasses is a viscous byproduct of the processing of sugar cane or sugar beets into sugar. The word *molasses* comes from the Portuguese word *melaço,* which ultimately comes from *mel*, the Latin word for "honey" . The quality of molasses depends on the maturity of the sugar cane or sugar beet, the amount of sugar extracted, and the method of extraction. Sweet sorghum syrup is known in some parts of the United States as molasses, though it is not true molasses.

2 - Cane molasses :

Sulphured molasses is made from young sugar cane. Sulphur dioxide, which acts as a preservative, is added during the sugar extraction process. Unsulphured molasses is made from mature sugar cane, which does not require treatment with sulphur. There are three grades of molasses: mild or barbados, also known as *first molasses*; dark, or *second molasses*; and blackstrap. These grades may be sulphured or unsulphured.

To make molasses, the sugar cane plant is harvested and stripped of its leaves. Its juice is extracted from the canes, usually by crushing or mashing; it can also be removed by cutting. The juice is boiled to concentrate it, which promotes the crystallization of the sugar. The result of this first boiling and removal of the sugar crystals is *first molasses*, which has the highest sugar content because comparatively little sugar has been extracted from the source. *Second molasses* is created from a second boiling and sugar extraction, and has a slight bitter tinge to its taste.

The third boiling of the sugar syrup makes *blackstrap molasses*. The majority of sucrose from the original juice has been crystallized, but blackstrap molasses is still mostly sugar by calories . However, unlike refined sugars, it contains significant amounts of vitamins and minerals. Blackstrap molasses is a source of calcium, magnesium, potassium, and iron; one tablespoon provides up to 20% of the daily value of each of those nutrients . Blackstrap, often sold as a health supplement, is also used in the manufacture of cattle feed and for other industrial uses.

3 - Sugar beet molasses :

Molasses that comes from the sugar beet is different from cane molasses. Only the syrup left from the final crystallization stage is called molasses; intermediate syrups are referred to as *high green* and *low green*, and these are recycled within the crystallization plant to maximize extraction. Beet molasses is about 50 % sugar by dry weight, predominantly sucrose, but also contains significant amounts of glucose and fructose. Beet molasses is limited in biotin (Vitamin H or B_7) for cell growth; hence, it may need to be supplemented with a biotin source. The nonsugar content includes many salts, such as calcium, potassium, oxalate, and chloride. These are either as a result of concentration from the original plant material or as a result of chemicals used in the processing. As such, it is unpalatable, and is mainly used as an additive to animal feed (called "molassed sugar beet feed") or as a fermentation feedstock.

It is possible to extract additional sugar from beet molasses through a process known as molasses desugarisation. This technique exploits industrial-scale chromatography to separate sucrose from nonsugar components. The technique is economically viable in trade-protected areas, where the price of sugar is supported above the world market price. As such, it is practiced in the U.S.[5] and parts of Europe. Molasses is also used for yeast production.

4 – Substitutes :

Cane molasses is a common ingredient in baking, often used in baked goods such as gingerbread cookies. There are a number of substitutions that can be made for molasses. For a given volume of molasses, one of the following may be used (with varying degrees of success): an equal volume of honey, dark corn syrup, or maple syrup, or ¾ that volume firmly packed brown sugar.

5 - Other forms :

In the cuisines of the Middle East, molasses is produced from several other materials: carob, grapes, dates, pomegranates, and mulberries.

6 - Nonculinary uses :

Because of its unusual properties, molasses has several uses beyond that of a straightforward food additive.

6 – 1 - Other food and consumption derivatives :

- Molasses can be used as the base material for fermentation into rum.
- Molasses is commonly used in dark brewed beverages like stout and very heavy dark ales.
- Molasses is added to some brands of tobacco used for smoking through a Middle Eastern water pipe (e.g., hookah, shisha, narghile, etc.). It is mixed into the tobacco along with glycerine and flavorings; sometimes it is used along with honey and other syrups or fully substituted by them. Brands that use molasses include Al Fakher, Soex and Tangiers.
- Black strap molasses may also be used as an iron supplement for those who cannot tolerate the constipation associated with other iron supplementation. Specifically for

pregnant women , 2 tbsp black strap molasses may be taken twice daily instead of iron supplement tablets.

- Molasses is used as an additive in livestock grains to increase the protein content.
- Molasses is used in fishing groundbait.

6 – 2 – Chemical :

- Molasses can be used as the carbon source for in situ remediation of chlorinated hydrocarbons.
- In Australia, molasses is fermented to produce ethanol for use as an alternative fuel in motor vehicles, and is also used to treat burns.
- Molasses can be used as the "fuel oil" portion of ANFO— ammonium – nitrate – fuel - oil, a powerful explosive .

6 – 3 - Industrial :

- Molasses can be used as a chelating agent to remove rust where a rusted part stays a few weeks in a mixture of 1 part molasses and 10 parts water.
- Molasses can be used as a minor component of mortar for brickwork.

6 – 4 - Horticultural :

- Molasses can be added to the soil of almost any plant to promote microbial activity.
- Blackstrap molasses is often used in horticulture as a flower blooming and fruiting enhancer, particularly in organic hydroponics.

22 - Mono Saccharide

1 -Introduction :

Mono saccharides (from Greek *monos*: single, *sacchar*: sugar) are the most basic units of biologically important carbohydrates. They are the simplest form of sugar and are usually colorless, water-soluble, crystalline solids. Some monosaccharides have a sweet taste. Examples of monosaccharides include glucose (dextrose), fructose (levulose), galactose, xylose and ribose. Monosaccharides are the building blocks of disaccharides such as sucrose and polysaccharides (such as cellulose and starch). Further, each carbon atom that supports a hydroxyl group (except for the first and last) is chiral, giving rise to a number of isomeric forms all with the same chemical formula. For instance, galactose and glucose are both aldohexoses, but have different chemical and physical properties.

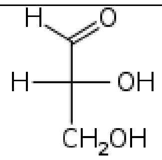
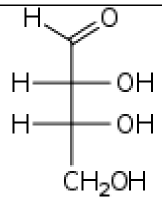
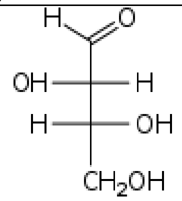
2 - Structure :

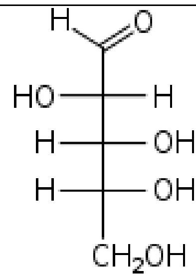
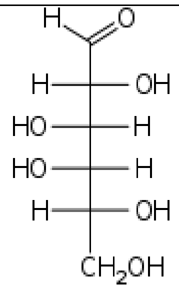
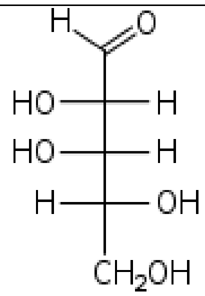
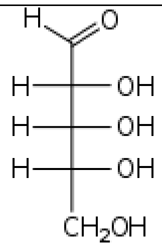
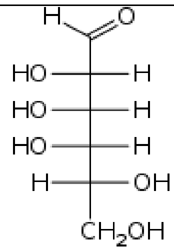
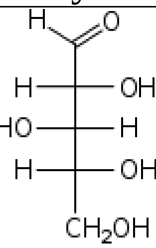
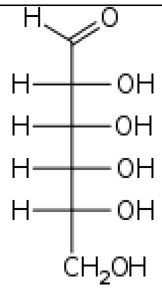
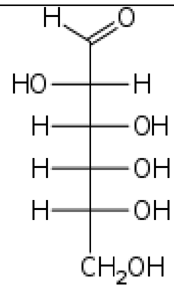
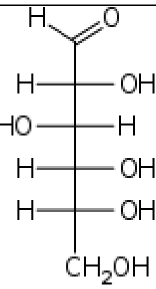
With few exceptions (e.g., deoxyribose), monosaccharides have the chemical formula $C_x (H_2O)_y$ with the chemical structure $H (CHOH)_n C = O (CH\ OH)_m H$. If n or m is zero, it is an aldehyde and is termed an aldose; otherwise, it is a ketone and is termed a ketose . Monosaccharides contain either a ketone or aldehyde functional group, and hydroxyl groups on most or all of the non-carbonyl carbon atoms.

2 - 1 - Fischer projections .

Not all of the following mono saccharides are found in nature—some have been synthesized :

Aldoses

<table>
<tr><td>Aldo trioe</td><td colspan="2">
D - Glyceraldehyde</td></tr>
<tr><td>Aldo tetroses</td><td>
D - Erythrose</td><td>
D - Threose</td></tr>
</table>

<table>
<tr><td rowspan="2">Aldo pentoses</td><td>
D -Arabinose</td><td>
D - Galactose</td><td>
D - Lyxose</td></tr>
<tr><td>
D - Ribose</td><td>
D -Talose</td><td>
D - Xylose</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Aldo hexoses</td><td>
D - Allose</td><td>
D -Altrose</td><td>
D - Glucose</td></tr>
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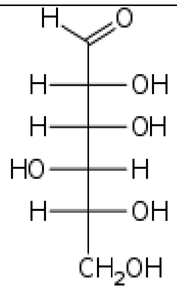
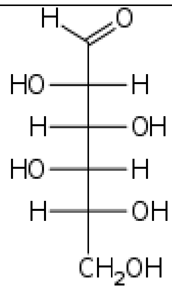
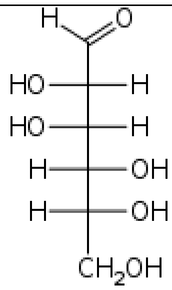
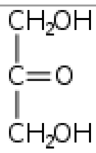
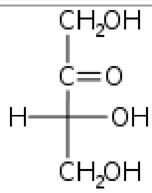
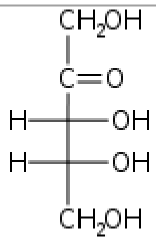
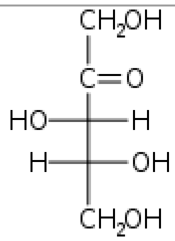
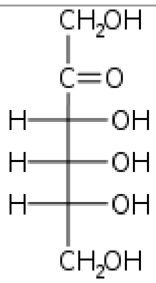
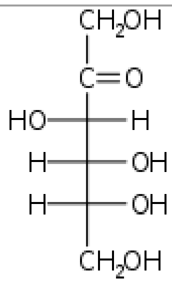
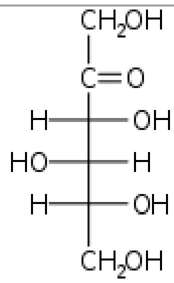
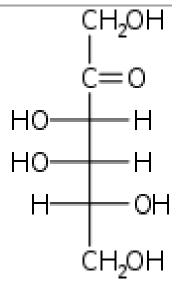
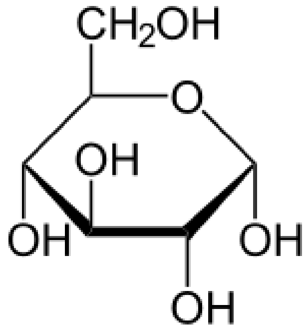
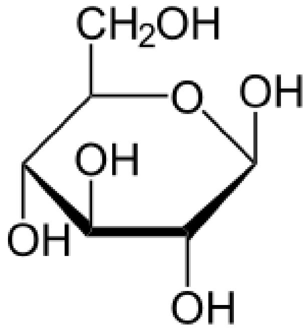
	 D - Gulose	 D -Idose	 D -Mannose

Ketoses				
Keto triose	 Dihydroxyacetone			
Keto tetrose	 D - Erythrulose			
Keto pentoses	 D-Ribulose		 D-Xylulose	
Keto hexoses	 D-Psicose	 D-Fructose	 D-Sorbose	 D-Tagatose

2 – 2 - Cyclic structure :

Most monosaccharides will cyclize in aqueous solution, forming hemiacetals or hemiketals (depending on whether they are aldoses or ketoses) between an alcohol and the carbonyl group of the same sugar.

Glucose, for example, readily forms a hemiacetal linkage between its carbon$_1$ and oxygen$_5$ to form a 6 - membered ring called a pyranoside. The same reaction can take place between carbon$_1$ and oxygen$_4$ to form a 5-membered furanoside. In general, pyranosides are more stable and are the major form of the monosaccharide observed in solution. Since cyclization forms a new stereogenic center at carbon$_1$, two anomers can be formed (α-isomer and β-isomer) from each distinct straight-chain monosaccharide. The interconversion between these two forms is called mutarotation .

	
α – D - Glucopyranose (Haworth projection)	*B – D – Glucopyranose (Haworth projection)*

A common way of representing the structure of monosaccharides is the Haworth projection. In a Haworth projection, the α-isomer has the OH- of the anomeric carbon below the plane of the carbon atoms, and the β-isomer has the OH - of the anomeric carbon above the plane. Monosaccharides typically adopt a chair conformation, similar to cyclohexane. In this conformation the α-isomer has the OH - of the anomeric carbon in an axial position, whereas the β-isomer has the OH- of the anomeric carbon in equatorial position.

3 - Mono saccharide nomenclature :

Monosaccharides are classified by the number of carbon atoms :

- Triose , 3 carbon atoms
- Tetrose , 4 carbon atoms
- Pentose , 5 carbon atoms
- Hexose , 6 carbon atoms
- Heptose, 7 carbon atoms

Mono saccharides are classified by the type of carbonyl group they contain:

- Aldose , - CHO (aldehyde)
- Ketose , C = O (ketone)

4 - Isomerism

The total number of possible stereoisomers of one compound (n) is dependent on the number of stereogenic centers (c) in the molecule. The upper limit for the number of possible stereoisomers is $n = 2^c$. The only monosaccharide without an isomer is dihydroxyacetone or DHA.

Monosaccharides are classified according to their molecular configuration at the chiral carbon furthest removed from the aldehyde or ketone group. The chirality at this carbon is compared to the chirality of carbon 2 on glyceraldehyde. If it is equivalent to D-glyceraldehyde's C2, the sugar is D; if it is equivalent to L-glyceraldehyde's C2, the sugar is L. Due to the chirality of the sugar molecules, an aqueous solution of a D or L saccharides will rotate light. D-glyceraldehyde causes polarized light to rotate clockwise (dextrorotary); L-glyceraldehyde causes polarized light to rotate counterclockwise (levorotary). Unlike glyceraldehyde, D / L designation on more complex sugars is not associated with their direction of light rotation. Since more complex sugars contain multiple chiral carbons, the direction of light rotation cannot be predicted by the chirality of the carbon that defines D/L nomenclature.

- D , configuration as in D - glyceraldehyde
- L , configuration as in L - glyceraldehyde

All these classifications can be combined, resulting in names like *D-aldohexose* or *ketotriose*.

5 - Derivatives

A large number of biologically important modified mono saccharides exist :

- Amino sugars such as:
    - Galactosamine
    - Glucosamine
    - Sialic acid
    - *N*-Acetylglucosamine
- Sulfosugars such as:
    - Sulfoquinovose

23 -Nectar

Nectar of camellia	*An Australian painted lady feeding on a flower's nectar*

1 – Introduction :

Nectar is a sugar - rich liquid produced by plants. It is produced either by the flowers, in which it attracts pollinating animals, or by **extra floral nectaries**, which provide a nutrient source to animal mutualists providing anti - herbivore protection. It is produced in glands called **nectaries**.

Nectar is an economically important item, the sugar source for honey. It is also useful in agriculture and horticulture because the adult stages of many predatory insects, as well as hummingbirds and butterflies, feed on nectar.

2 – Etymology :

Nectar is derived from Latin *nectar* "drink of the gods", which in turn has its origins in the Greek word νέκταρ (*néktar*), presumed to be a compound of the elements *nek*- " death " and -*tar* " over coming " .

The earliest recorded use of its current meaning, "sweet liquid in flowers", is 1609.

3 - Floral nectaries :

Floral nectaries are generally located at the base of the perianth, so that pollinators are made to brush the flower's reproductive structures, the anthers and pistil, while accessing the nectar.

4 - Extrafloral nectaries :

Nectar produced outside the flower is generally made to attract predatory insects. These predatory insects will eat both the nectar and any plant-eating insects around, thus functioning as 'bodyguards'.[2] Extrafloral nectaries are generally located on the leaf petioles, mid-rib or leaf margin. They are thought to be modified trichomes and exude nectar from phloem sap. Extrafloral nectaries can be found on species belonging to (amongst others) the genera *Salix*, *Prunus* and *Gossypium*. In many carnivorous plants, nectar serves to attract insect prey .

5 - Natural components of nectar :

Although its main ingredient is natural sugar (i.e., sucrose (table sugar) , glucose, and fructose) , nectar is a brew of many chemicals. For example, the *Nicotiana attenuata*, a tobacco plant native to the US state of Utah, uses several volatile aromas to attract pollinating birds and moths. The strongest such aroma is benzyl acetone, but the plant also adds bitter nicotine, which is less aromatic and therefore may not be detected by the bird until after taking a drink. Researchers speculate the purpose of this addition is to drive the bird away after only a sip, motivating it to visit other plants to fill its hunger, and therefore maximizing the pollination efficiency gained by the plant for a minimum nectar output . Neurotoxins such as aesculin are present in some nectars such as that of the California Buckeye .

24 - Roasted grain beverage

Postum roasted grain beverage, Original flavor

1 – Introduction :

A **roasted grain beverage** is a hot beverage made from one or more cereal grains roasted and commercially processed into crystal or powder form to be reconstituted later in hot water. The product is often marketed as a caffeine-free alternative to coffee and tea.

Several well - known roasted grain beverages are Nestlé Caro, Pero, INKA, and Postum (a discontinued product). Other brands can be found at health food stores and at some grocery stores.

Some common ingredients include toasted barley, malted barley, rye, chicory, molasses, and beet root.

2 - Asian grain tisanes :

Roasted grain beverages are popular in Polish (brands Inka, Anatol, Kujawianka) and East Asian cuisines, Japan, China, and Korea each having their own versions (usually roasted grains simply steeped in hot water).

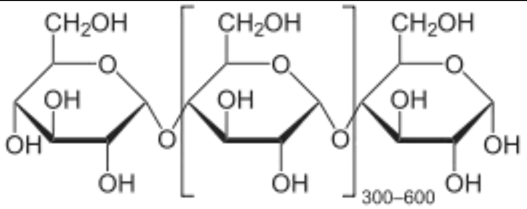
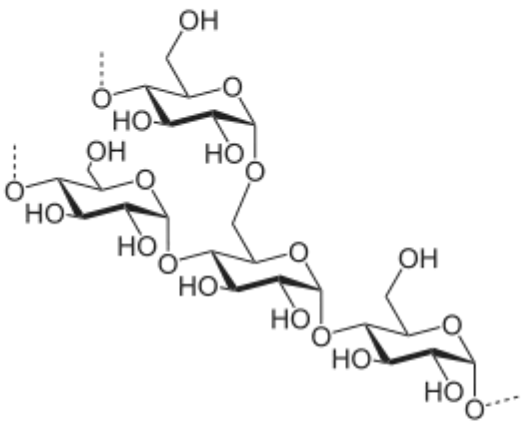
- Genmaicha is green tea blended with roasted brown rice.
- Hyeonmi cha is brewed, roasted brown rice.
- Mugicha (*bori cha* in Korean) is a tisane made from roasted barley and usually drunk as a cool summer beverage.
- Oksusu cha is brewed roasted corn tisane; due to its sweetness it is sometimes served alongside or mixed with *mugicha* to soften the latter's bitterness.
- Sungnyung is made from rice scorched while boiling.

3 - Safety :

Acrylamide, a suspected cancer - causing chemical, is found at high levels in dark-colored baked, roasted and fried high-carbohydrate foods, as well as in roasted coffee and barbecued meat. The dark-roasted grains used in roasted grain beverages would also, presumably, have high levels of acrylamide. The Heatox Project (Heat - generated Food Toxicants) is a European Union project that assessed the quantities of acrylamide in various foods. The Project recommended that people toast foods as little as possible. Acrylamide was found in Postum, a roasted grain drink, at a level of 22.3 micrograms per portion. Acrylamide was found in coffee at levels of 1.9 micrograms per portion. Both of these datapoints are FDA-presented data and can be found in an FDA report on Acrylamide in food.

25 - Starch

Contents :

	
Structure of the amylose molecule.	*Structure of the amylo pectin molecule*

1 – Introduction :

Starch or **amylum** is a carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. This polysaccharide is produced by all green plants as an energy store. It is the most important carbohydrate in the human diet and is contained in such staple foods as potatoes, wheat, maize (corn), rice, and cassava.

Pure starch is a white, tasteless and odorless powder that is insoluble in cold water or alcohol. It consists of two types of molecules: the linear and helical amylose and the branched amylopectin. Depending on the plant, starch generally contains 20 to 25 % amylose and 75 to 80 % amylopectin . Glycogen, the glucose store of animals, is a more branched version of amylopectin.

Starch is processed to produce many of the sugars in processed foods. When dissolved in warm water, it can be used as a thickening, stiffening or gluing agent, giving wheatpaste.

Molecular formula	$(C_6H_{10}O_5)_n$
Appearance	white powder
Density	1.5 g / cm^3
Melting point	decomp.
Solubility in water	none
Autoignition temperature	410 °C

2 – **Name :**

The word "starch" is derived from Middle English *sterchen*, meaning to stiffen. "Amylum" is Latin for starch, from the Greek "amulon" which means "not ground at a mill". The root amyl is used in biochemistry for several compounds related to starch.

3 - History :

Wheat starch paste was used by Egyptians to stiffen cloth and during weaving linen and possibly to glue papyrus.[2] Romans used it also in cosmetic creams, to powder the hair and to thicken sauces. Persians and Indians used it to make dishes similar to gothumai wheat halva. In China, with the invention of paper, rice starch was used as a surface treatment of the paper.

4 - Energy store of plants :

In photo synthesis, plants use light energy to produce glucose from carbon dioxide. The glucose is stored mainly in the form of starch granules, in plastids such as chloroplasts and especially amyloplasts. Toward the end of the growing season, starch accumulates in twigs of trees near the buds. Fruit, seeds, rhizomes, and tubers store starch to prepare for the next growing season.

Glucose is soluble in water, hydrophilic, binds much water and then takes up much space; glucose in the form of starch, on the other hand, is not soluble and can be stored much more compactly.

Glucose molecules are bound in starch by the easily hydrolyzed alpha bonds. The same type of bond can also be seen in the animal reserve polysaccharide glycogen. This is in contrast to many structural polysaccharides such as chitin, cellulose and peptidoglycan, which are bound by beta-bonds and are much more resistant to hydrolysis.

4 – 1 - Bio synthesis :

Plants produce starch by first converting glucose 1-phosphate to ADP - glucose using the enzyme glucose - 1 - phosphate adenylyl transferase. This step requires energy in the form of ATP. The enzyme starch synthase then adds the ADP - glucose via a 1,4 - alpha glycosidic bond to a growing chain of glucose residues, liberating ADP and creating amylose. Starch branching enzyme introduces 1,6-alpha glycosidic bonds between these chains, creating the branched amylopectin. The starch debranching enzyme isoamylase removes some of these branches. Several isoforms of these enzymes exist, leading to a highly complex synthesis process .

While amylose was traditionally thought to be completely unbranched, it is now known that some of its molecules contain a few branch points .

Glycogen and amylopectin have the same structure, but the former has about one branch point per ten 1,4 - alpha bonds, compared to about one branch point per thirty 1,4- alpha bonds in amylo pectin .

Another difference is that glycogen is synthesised from UDP - glucose while starch is synthesised from ADP – glucose .

5 - Properties :

5 – 1 - Structure :

Starch molecules arrange themselves in the plant in semi-crystalline granules. Each plant species has a unique starch granular size: rice starch is relatively small (about 2μm) while potato starches have larger granules (up to 100μm). Although in absolute mass only about one quarter of the starch granules in plants consist of amylose, there are about 150 times more amylose molecules than amylopectin molecules. Amylose is a much smaller molecule than amylopectin.

Starch becomes soluble in water when heated. The granules swell and burst, the semi - crystalline structure is lost and the smaller amylose molecules start leaching out of the granule, forming a network that holds water and increasing the mixture's viscosity. This process is called starch gelatinization. During cooking the starch becomes a paste and increases further in viscosity. During cooling or prolonged storage of the paste, the semi-crystalline structure partially recovers and the starch paste thickens, expelling water. This is mainly caused by the retrogradation of the amylose. This process is responsible for the hardening of bread or staling, and for the water layer on top of a starch gel (syneresis).

Some cultivated plant varieties have pure amylopectin starch without amylose, known as waxy starches. The most used is waxy maize, others are glutinous rice, waxy potato starch. Waxy starches have less retrogradation, resulting in a more stable paste. High amylose starch, amylomaize, is cultivated for the use of its gel strength.

5 – 2 - Hydrolysis :

The enzymes that break down or hydrolyze starch into the constituent sugars are known as amylases.

Alpha - amylases are found in plants and in animals. Human saliva is rich in amylase, and the pancreas also secretes the enzyme. Individuals from populations with a high-starch diet tend to have more amylase genes than those with low-starch diets; chimpanzees have very few amylase genes. It is possible that turning to a high - starch diet was a significant event in human evolution.

Beta-amylase cuts starch into maltose units. This process is important in the digestion of starch and is also used in brewing, where the amylase from the skin of the seed grains is responsible for converting starch to maltose (Malting, Mashing).

5 – 3 - Dextrinization :

If starch is subjected to dry heat, it breaks down to form pyrodextrins, in a process known as dextrinization. Pyrodextrins are brown in color. This process is partially responsible for the browning of toasted bread.

5 – 4 - Chemical tests (Iodine test) :

Iodine solution is used to test for starch; a dark blue color indicates the presence of starch. The details of this reaction are not yet fully known, but it is thought that the iodine (I_3^- and I_5^- ions) fit inside the coils of amylose, the charge transfers between the iodine and the starch, and the energy level spacings in the resulting complex correspond to the absorption spectrum in the visible light region . The strength of the resulting blue color depends on the amount of amylose present. Waxy starches with little or no amylose present will color red.

Starch indicator solution consisting of water, starch and iodine is often used in redox titrations: in the presence of an oxidizing agent the solution turns blue, in the presence of reducing agent the blue color disappears because triiodide (I_3^-) ions break up into three iodide ions, disassembling the starch - iodine complex . A 0.3% w/w solution is the standard concentration for a starch indicator. It is made by adding 3 grams of soluble starch to 1 litre of heated water; the solution is cooled before use (starch - iodine complex becomes unstable at temperatures above 35°C) .

Microscopy of starch granules - Each species of plant has a unique shape of starch granules in granular size, shape and crystallisation pattern. Under the microscope, starch grains stained with iodine illuminated from behind with polarized light show a distinctive Maltese cross effect (also known as extinction cross and birefringence).

6 - Starch as food :

Starch is the most important carbohydrate in the human diet and is contained in many staple foods. The major sources of starch intake worldwide are rice, wheat, maize (corn), potatoes and cassava. Widely used prepared foods containing starch are bread, pancakes, cereals, noodles, pasta, porridge and tortilla .

Depending on the local climate other starch sources are used for food, such as arrowroot, arracacha, buckwheat, barley, oat, millet, rye, banana, breadfruit, canna, colacasia, katakuri, kudzu, malanga, oca, polynesian arrowroot, sago, sorghum, sweet potato, taro, water chestnut and yams. Chestnuts and edible beans, such as favas, lentils, mung bean and peas, are also rich in starch.

Digestive enzymes have problems digesting crystalline structures. Raw starch will digest poorly in the duodenum and small intestine, while bacterial degradation will take place mainly in the colon. Resistant starch is starch that escapes digestion in the small intestine of healthy individuals. In order to increase the digestibility, starch is cooked. Hence, before humans started using fire, eating grains was not a very useful way to get energy.

6 – 1 - Starch industry :

The starch industry extracts and refines starches from seeds, roots and tubers, by wet grinding, washing, sieving and drying. Today, the main commercial refined starches are cornstarch, tapioca, wheat and potato starch. To a lesser extent, sources include rice, sweet potato, sago and mung bean. Historically, Florida arrowroot was also commercialized. Still starch is extracted from more than 50 types of plants.

Untreated starch requires heat to thicken or gelatinize. When a starch is pre - cooked, it can then be used to thicken instantly in cold water. This is referred to as a pregelatinized starch.

6 – 1 – 1 - Starch sugars :

Starch can be hydrolyzed into simpler carbohydrates by acids, various enzymes, or a combination of the two. The resulting fragments are known as dextrins. The extent of conversion is typically quantified by ***dextrose equivalent*** (DE) , which is roughly the fraction of the glycosidic bonds in starch that have been broken.

These starch sugars are by far the most common starch based food ingredient and are used as sweetener in many drinks and foods. They include:

- Maltodextrin, a lightly hydrolyzed (DE 10–20) starch product used as a bland - tasting filler and thickener.
- Various glucose syrup / corn syrups (DE 30–70), viscous solutions used as sweeteners and thickeners in many kinds of processed foods.
- Dextrose (DE 100), commercial glucose, prepared by the complete hydrolysis of starch.
- High fructose syrup, made by treating dextrose solutions with the enzyme glucose isomerase, until a substantial fraction of the glucose has been converted to fructose. In the United States, high fructose corn syrup is the principal sweetener used in sweetened beverages because fructose has better handling characteristics, such as microbiological stability, and more consistent sweetness/flavor. High fructose corn syrup has the same sweetness as sugar.
- Sugar alcohols, such as maltitol, erythritol, sorbitol, mannitol and hydrogenated starch hydrolysate, are sweeteners made by reducing sugars.

6 – 1 – 2 - Modified starches

A modified food starch is a starch that has been chemically modified to allow the starch to function properly under conditions frequently encountered during processing or storage, such as high heat, high shear, low pH, freze / thaw and cooling.

The modified starches are E coded according to the International Numbering System for Food Additives (INS) :

- 1401 Acid - treated starch
- 1402 Alkaline - treated starch
- 1403 Bleached starch
- 1404 Oxidized starch
- 1405 Starches, enzyme-treated
- 1410 Monostarch phosphate
- 1412 Distarch phosphate
- 1413 Phosphated distarch phosphate
- 1414 Acetylated distarch phosphate
- 1420 Starch acetate
- 1422 Acetylated distarch adipate
- 1440 Hydroxypropyl starch
- 1442 Hydroxypropyl distarch phosphate
- 1443 Hydroxypropyl distarch glycerol
- 1450 Starch sodium octenyl succinate
- 1451 Acetylated oxidized starch

INS 1401, 1402, 1403 and 1405 are in the EU food ingredients without an E - number. Typical modified starches for technical applications are cationic starches, hydroxyethyl starch and carboxymethylated starches.

6 – 1 – 3 - Use as food additive

As an additive for food processing, food starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas.

Gummed sweets such as jelly beans and wine gums are not manufactured using a mold in the conventional sense. A tray is filled with native starch and leveled. A positive mold is then pressed into the starch leaving an impression of 1000 or so jelly beans. The jelly mix is then poured into the impressions and put into a stove to set. This method greatly reduces the number of molds that must be manufactured.

In the pharmaceutical industry, starch is also used as an excipient, as tablet disintergrant or as binder.

7 - Industrial applications :

* **Paper making** is the largest non-food application for starches globally, consuming millions of metric tons annually. In a typical sheet of copy paper for instance, the starch content may be as high as 8%. Both chemically modified and unmodified starches are used in papermaking. In the wet part of the papermaking process, generally called the "wet-end", the starches used are cationic and have a positive charge bound to the starch polymer. These starch derivatives associate with the anionic or negatively charged paper fibers / cellulose and inorganic fillers. Cationic starches together with other retention and internal sizing agent help to give the necessary strength properties to the paper web to be formed in the papermaking process (wet strength), and to provide strength to the final paper sheet (dry strength).

In the dry end of the papermaking process the paper web is rewetted with a starch based solution. The process is called surface sizing. Starches used have been chemically, or enzymatically depolymerized at the paper mill or by the starch industry (oxidized starch). The size - starch solutions are applied to the paper web by means of various mechanical presses (size press). Together with surface sizing agent the surface starches impart additional strength to the paper web and additionally provide water hold out or "size" for superior printing properties. Starch is also used in paper coating as one of the binders for the coating formulation a mixture of pigments, binders and thickeners. Coated paper has improved smoothness, hardness, whiteness and gloss and thus improves printing characteristics.

* **Corrugated board adhesives** are the next largest application of non - food starches globally. Starch glues are mostly based on unmodified native starches, plus some additive such as borax and

caustic soda. Part of the starch is gelatinized to carry the slurry of uncooked starches and prevent sedimentation. This opaque glue is called a SteinHall adhesive. The glue is applied on tips of the fluting. The fluted paper is pressed to paper called liner. This is then dried under high heat, which causes the rest of the uncooked starch in glue to swell/gelatinize. This gelatinizing makes the glue a fast and strong adhesive for corrugated board production.

Another large non - food starch application is in the construction industry, where starch is used in the gypsum wall board manufacturing process. Chemically modified or unmodified starches are added to the stucco containing primarily gypsum. Top and bottom heavyweight sheets of paper are applied to the formulation, and the process is allowed to heat and cure to form the eventual rigid wall board. The starches act as a glue for the cured gypsum rock with the paper covering, and also provide rigidity to the board.

Starch is used in the manufacture of various **adhesives** or glues[9] for book - binding, wallpaper adhesives , paper sack production, tube winding, gummed paper, envelop adhesives, school glues and bottle labeling.

Starch derivatives, such as yellow dextrins, can be modified by addition of some chemicals to form a hard glue for paper work; some of those forms use borax or soda ash, which are mixed with the starch solution at 50-70 °C to create a very good adhesive. Sodium silicate can be added to reinforce these formulae.

*** Clothing starch** or **laundry starch** is a liquid that is prepared by mixing a vegetable starch in water (earlier preparations also had to be boiled), and is used in the laundering of clothes. Starch was widely used in Europe in the 16th and 17th centuries to stiffen the wide collars and ruffs of fine linen which surrounded the necks of the well-to-do. During the 19th century and early 20th century, it was stylish to stiffen the collars and sleeves of men's shirts and the ruffles of girls' petticoats by applying starch to them as the clean clothes were being ironed. Aside from the smooth, crisp edges it gave to clothing, it served practical purposes as well. Dirt and sweat from a person's neck and wrists would stick to the starch rather than to the fibers of the clothing, and would easily wash away along with the starch. After each laundering, the starch would be reapplied. Today, the product is sold in aerosol cans for home use.

Starch is also used to make some packing peanuts, and some drop ceiling tiles.

*** Textile chemicals** from starch are used to reduce breaking of yarns during weaving; the warp yarns are sized, especially for cotton. Starch is also used as textile printing thickener.

* In the **printing industry**, food grade starch is used in the manufacture of anti – set -off spray powder used to separate printed sheets of paper to avoid wet ink being set off.

Starch is used to produce various **bio plastics**, synthetic polymers that are biodegradable. An example is polylactic acid.

* For **body powder**, powdered corn starch is used as a substitute for talcum powder, and similarly in other health and beauty products.

* In **oil exploration**, starch is used to adjust the viscosity of drilling fluid, which is used to lubricate the drill head and suspend the grinding residue in petroleum extraction.

Glucose from starch can be further fermented to **biofuel** ethanol.

- **Hydrogen production** can use starch as the raw material, using enzymes.

26 - Starch gelatinization

1 – Introduction :

Starch gelatinization is a process that breaks down the intermolecular bonds of starch molecules in the presence of water and heat, allowing the hydrogen bonding sites (the hydroxyl hydrogen and oxygen) to engage more water. Penetration of water increases randomness in the general structure and decreases the number and size of crystalline regions. Crystalline regions do not allow water entry. Heat causes such regions to be diffused, so that the chains begin to separate into an amorphous form. This process is used in cooking to make roux sauce, pastry, custard or popcorn.

- Gelatinization is also known as the thickening of a liquid.
- The starch grains/flour granules absorb the liquid.
- When heated the grains/granules swelling and then burst, releasing starch into the liquid.
- The granules/grains swell to 30 times their original size (swelling power, peak viscosity).

Prolonged heating and/or pressure and stirring is needed to completely dissolve the rest fragments of starch granules. The viscosity will reduce and rheology-texture of the solution will change.

2 - Gelatinisation temperature :

The gelatinisation temperature of starch is depending on plant type, amount of water, pH, types and concentration of salt, sugar, fat and protein in the recipe, derivatisation technology used. Some type of unmodified native starches start swelling at 55 degrees Celsius, other types at 85.

Gelatinization temperature depends also on the amount of damaged starch granules. These will swell faster. Damaged starch can be produced for example during the wheat milling process or when drying the starch cake in the starch plant .

3 - Starch retrogradation :

Cooked unmodified starch when cooled for long enough period, will thicken or gel and rearrange themselves again to a more crystalline structure, this process is called retrogradation.

4 - Pregelatinized starch :

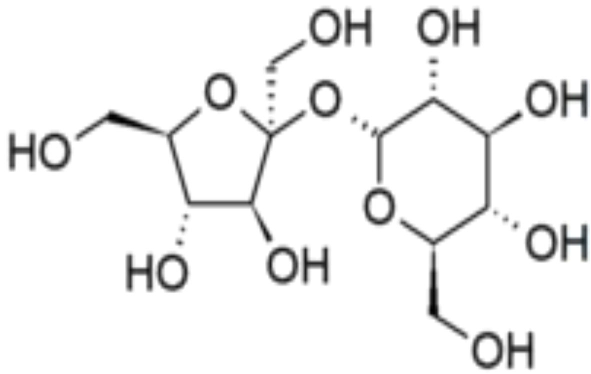
Pregelatinized starch is starch cooked and then dried in the starch factory on a drum dryer or in an extruder making the starch cold water soluble.

27 - Sucrose

Contents :

1 – Introduction :

Sucrose is the organic compound commonly known as **table sugar** and sometimes called **saccharose**. This white, odorless, crystalline powder has a pleasing, sweet taste. It is best known for its role in human nutrition. The molecule is a di saccharide derived from glucose and fructose with the molecular formula :



s**IUPAC name** ; :
β-D-fructofuranosyl- (2→1) - α -D-glucopyranoside
Other names:
Sugar , saccharose ,
B - (2*S*,3*S*,4*S*,5*R*) - fructofuranosyl –
α (1*R*,2*R*,3*S*,4*S*,5*R*) - glucopyranoside

Properties	
Molecular formula	$C_{12}H_{22}O_{11}$
Molar mass	342 g / mol
Appearance	white solid
Density	1.587 g / cm^3, solid
Melting point	186 °C decomp.
Solubility in water	200 g / 100 mL (25 °C)
Crystal structure	Monoclinic

$C_{12}H_{22}O_{11}$. About 150,000,000 tones are produced annually .

2 - Physical and chemical properties :

Sucrose is a complicated molecule with many stereocenters and many sites that are reactive or can be reactive. Despite this complexity, the molecule exists as a single isomer.

2 – 1 - Structural β - D - fructofuranosyl - (2→1) - α - D - glucopyranoside :

In sucrose, the component glucose and fructose are linked via an ether bond between C1 on the glucosyl subunit and C2 on the fructosyl unit. The bond is called a glycosidic linkage. Glucose exists predominantly as two isomeric "pyranoses" (α and β), but only one of these forms the links to the fructose. Fructose itself also exists as a mixture of forms, each of which has α and β isomers, but again only one particular isomer links to the glucosyl unit. What is notable about sucrose is that unlike most disaccharides, the glycosidic bond is formed between the reducing ends of both glucose and fructose, and not between the reducing end of one and the nonreducing end of the other. This linkage inhibits further bonding to other saccharide units. Since it contains no anomeric hydroxyl groups, it is classified as a nonreducing sugar.

Crystallography is the technique that gives highly precise information on molecular structure. Sucrose crystallizes in the monoclinic space group $P2_1$, with values at 300 K being a = 1.08631 nm, b = 0.87044 nm, c = 0.77624 nm, β = 102.938°.[3][4]

The usual measure of purity of sucrose is by polarimetry — the measurement of the rotation of plane-polarized light by a solution of sugar. The specific rotation at 20 °C using yellow "sodium-D" light (589 nm) is + 66.47°. Commercial samples of sugar are assayed using this parameter.Sucrose is not damaged by air.

2 – 2 - Thermal and oxidative degradation .

Solubility of sucrose in water vs. temperature

T (°C)	**S (g / ml)**
50	2.59
55	2.73
60	2.89
65	3.06
70	3.25

75	3.46
80	3.69
85	3.94
90	4.20

Sucrose decomposes as it melts at 186 °C to form caramel. Like other carbohydrates, it combusts to carbon dioxide and water. For example, in the amateur rocket motor propellant called rocket candy it is the fuel together with the oxidizer potassium nitrate .

$$48\ KNO_3 + 5\ C_{12}H_{22}O_{11} \rightarrow 24\ K_2CO_3 + 24\ N_2 + 55\ H_2O + 36\ CO_2$$

Sucrose burns with chloric acid, formed by the reaction of sulfuric acid and potassium chlorate:

$$8\ HClO_3 + C_{12}H_{22}O_{11} \rightarrow 11\ H_2O + 12\ CO_2 + 8\ HCl$$

Sucrose can be dehydrated with sulfuric acid to form a black, carbon-rich solid, as indicated in the following idealized equation:

$$H_2SO_4(\text{catalyst}) + C_{12}H_{22}O_{11} \rightarrow 12\ C + 11\ H_2O + \text{heat}$$
$$\text{and } H_2O + SO_3 \text{ as a result of heat}$$

2 – 3 - Hydrolysis :

Hydrolysis breaks the glycosidic bond, converting sucrose into glucose and fructose. Hydrolysis is, however, so slow that solutions of sucrose can sit for years with negligible change. If the enzyme sucrase is added, however, the reaction will proceed rapidly . Hydrolysis can also be accelerated with acids, such as cream of tartar or lemon juice.

3 - Synthesis and biosynthesis of sucrose :

The biosynthesis of sucrose proceeds via the precursors glucose 1 - phosphate and fructose 6 - phosphate. Sucrose is formed by plants but not by other organisms. Sucrose is found naturally in many food plants along with the monosaccharide fructose. In many fruits, such as pineapple and apricot, sucrose is the main sugar. In others, such as grapes and pears, fructose is the main sugar.

3 – 1 - Chemical synthesis :

Although sucrose is invariably isolated from natural sources, its chemical synthesis was first achieved in 1953 by Raymond Lemieux.

4 - As a food (History of sugar) :

Refined sugar was originally a luxury, but sugar eventually became sufficiently cheap and common to influence standard cuisine. Britain and the Caribbean islands have cuisines where the use of sugar became particularly prominent.

Sugar forms a major element in confectionery and in desserts. Cooks use it as a food preservative as well as for sweetening. Sucrose is important to the structure of many foods including biscuits and cookies, cakes and pies, candy, and ice cream and sorbets. Sucrose also assists in the preservation of foods. As such it is common in many processed and so-called "junk foods."

5 - Metabolism of sucrose

Granulated sucrose

In mammals, sucrose is readily digested in the stomach into its component sugars, by acidic hydrolysis. This step is performed by a glycoside hydrolase, which catalyzes the hydrolysis of sucrose to the monosaccharides glucose and fructose. Glucose and fructose are rapidly absorbed into the bloodstream in the small intestine. Undigested sucrose passing into the intestine is also broken down by sucrase or isomaltase glycoside hydrolases, which are located in the membrane of the microvilli lining the duodenum. These products are also transferred rapidly into the bloodstream. Sucrose is digested by the enzyme invertase in bacteria and some animals.

Sucrose is an easily assimilated macronutrient that provides a quick source of energy, provoking a rapid rise in blood glucose upon ingestion. Over consumption of sucrose has been linked with adverse health effects. The most common is dental caries or tooth decay, in which oral bacteria convert sugars (including sucrose) from food into acids that attack tooth enamel. Sucrose, as a pure carbohydrate, has an energy content of 3.94 kilo calories per gram (or 17 kilo joules per gram). When a large amount of foods that contain a high percentage of sucrose is consumed, beneficial nutrients can be displaced from the diet, which can contribute to an increased risk for chronic disease. It has been suggested that sucrose - containing drinks may be linked to the development of obesity and insulin resistance.[7] Most soft drinks in the USA are now made with high fructose corn syrup, not sucrose, HFCS 55 contains 55 % fructose and 45 % glucose.

The rapidity with which sucrose raises blood glucose can cause problems for people suffering from defective glucose metabolism, such as persons with hypoglycemia or diabetes mellitus. Sucrose can contribute to the development of metabolic syndrome. In an experiment with rats that were fed a diet one-third of which was sucrose, the sucrose first elevated blood levels of triglycerides, which induced visceral fat and ultimately resulted in insulin resistance . Another study found that rats fed sucrose-rich diets developed high triglycerides , hyperglycemia , and insulin resistance .

6 - Human health :

Human beings have long sought sugars, but aside from wild honey, have not had access to the large quantities that characterize the modern diet. Studies have indicated potential links between processed sugar consumption and health hazards, including obesity and tooth decay . John Yudkin showed that the consumption of sugar and refined sweeteners is closely associated with coronary heart disease. It is also considered as a source of endogenous glycation processes.

6 – 1 - Tooth decay :

Tooth decay has arguably become the most prominent health hazard associated with the consumption of sugar. Oral bacteria such as *Streptococcus mutans* live in dental plaque and metabolize *any* sugars (not just sucrose, but also glucose, lactose, fructose, or cooked starches into lactic acid. High concentrations of acid may result on the surface of a tooth, leading to tooth demineralization .

All 6 carbon sugars and disaccharides based on 6 carbon sugars can be converted by dental plaque bacteria into acid which demineralizes teeth. But sucrose may be uniquely useful to Streptococcus Mutans. Sucrose may be the sugar most efficiently converted to dextran with which the bacteria glues itself to the tooth surface. Sucrose thus could enable Streptococcus Mutans to adhere more strongly and resist attempts at removal. The dextran itself also acts as a reserve food supply for the bacteria. Such a special role of sucrose in the formation of tooth decay is more significant in light of the almost universal use of sucrose as the most desirable sweetening agent.

6 – 2 - Glycemic index :

Sucrose has a moderately high glycemic index (64, about the same as honey, 62 , but not nearly that of maltose, 105) , which in turn causes an immediate response within the body's digestive system. Like other sugars, sucrose is digested into glucose (blood sugar) and transported into the blood. As with other sugars, overconsumption may cause an increase in blood sugar levels from a normal 90 mg/dL to up over 150 mg / dL.

6 – 3 – Diabetes :

Diabetes, a disease that causes the body to metabolize sugar poorly, occurs when either:

1. the body attacks the cells producing insulin, the chemical that allows the metabolizing of sugar in the body's cells (Type 1 diabetes)

2. the body's cells exhibit impaired responses to insulin (Type 2 diabetes)

When glucose builds up in the bloodstream, it can cause two problems:

1. in the short term, cells become starved for energy because they do not have access to the glucose
2. in the long term, frequent glucose build-up increases the acidity of the blood, damaging many of the body's organs, including the eyes, kidneys, nerves and/or heart

Authorities advise diabetics to avoid sugar-rich foods to prevent adverse reactions .

6 – 4 – Obesity :

The National Health and Nutrition Examination Survey I and Continuous indicates that the population in the United States has increased its proportion of energy consumption from carbohydrates and decreased its proportion from total fat while obesity has increased. This implies, along with the United Nations report cited below, that obesity may correlate better with sugar consumption than with fat consumption, and that reducing fat consumption while increasing sugar consumption actually increases the level of obesity. The following table summarizes this study (based on the proportion of energy intake from different food sources for US Adults 20–74 years old, as carried out by the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Hyattsville, MD :

Year	Sex	Carbohydrate	Fat	Protein	Obesity
1971	Male	42.4 %	36.9 %	16.5 %	12.1%
1971	Female	45.4 %	36.1 %	16.9 %	16.6%
2000	Male	49.0 %	32.8 %	15.5 %	27.7%
2000	Female	51.6%	32.8%	15.1%	34.0%

A 2002 study conducted by the U.S. National Academy of Sciences concluded "There is no clear and consistent association between increased intakes of added sugars and BMI." (BMI or "Body mass index" measures body-weight and height) .

6 – 5 - Gout :

The occurrence of the disorder is connected with an excess production of uric acid. A diet rich in sucrose may lead to gout as it raises the level of insulin, which prevents excretion of uric acid from the body. As the concentration of uric acid in the body increases, so does the concentration of uric acid in the joint liquid and beyond a critical concentration, the uric acid begins to precipitate into crystals. Researchers have implicated sugary drinks high in fructose in a surge in cases of the painful joint disease gout.

6 – 6 – Cancer :

A link between sugar and cancer has been conjectured for some time but this remains a controversial topic. Some recent studies lend support to this theory , but no major medical or nutritional organization currently recommends reducing sugar consumption to prevent cancer.

6 -7 - United Nations nutritional advice :

In 2003, four United Nations agencies (including the World Health Organization and the Food and Agriculture Organization) commissioned a report compiled by a panel of 30 international experts. The panel stated that the total of free sugars (all monosaccharides and disaccharides added to foods by manufacturers, cooks or consumers, plus sugars naturally present in honey, syrups and fruit juices) should not account for more than 10% of the energy intake of a healthy diet, while carbohydrates in total should represent between 55 % and 75 % of the energy intake .

6 - 8 - Debate on extrinsic sugar

Argument continues as to the value of extrinsic sugar (sugar added to food) compared to that of intrinsic sugar (naturally present in food) . Adding sugar to food sweetens the taste, but increases the total number of calories, among other negative effects on health and physiology.

In the US, sugar has become increasingly evident in food products, as more food manufacturers add sugar or high fructose corn syrup to a wide variety of consumables. Candy bars, soft drinks, chips, snacks, fruit juice, peanut butter, soups, ice cream, jams, jellies, yogurt, and many breads may have added sugars.

6 - 9 - Concerns of vegetarians and vegans :

The sugar refining industry often uses bone char (calcinated animal bones) for decolorizing . About 25 % of sugar produced in the U.S. is processed using bone char as a filter, the remainder being processed with activated carbon. As bone char does not seem to remain in finished sugar, Jewish religious leaders consider sugar filtered through it to be parve/kosher.

7 - Production :

Harvested sugarcane from India ready for processing.

Table sugar (sucrose) comes from plant sources. Two important sugar crops predominate: sugarcane (*Saccharum spp.*) and sugar beets

(*Beta vulgaris*), in which sugar can account for 12 % to 20 % of the plant's dry weight. Minor commercial sugar crops include the date palm (*Phoenix dactylifera*), sorghum (*Sorghum vulgare*), and the sugar maple (*Acer saccharum*). In the financial year 2001 / 2002 , worldwide production of sugar amounted to 134.1 million tonnes. Sucrose is obtained by extraction of these crops with hot water, concentration of the extract gives syrups, from which solid sucrose can be crystallized.

The first production of sugar from sugarcane took place in India. Alexander the Great's companions reported seeing "honey produced without the intervention of bees" and it remained exotic in Europe until the Arabs started producing it in Sicily and Spain. Only after the Crusades did it begin to rival honey as a sweetener in Europe. The Spanish began cultivating sugarcane in the West Indies in 1506 (and in Cuba in 1523). The Portuguese first cultivated sugarcane in Brazil in 1532.

Most cane sugar comes from countries with warm climates, such as Brazil, India, China, Thailand, Mexico and Australia, the top sugar-producing countries in the world Brazil overshadows most countries, with roughly 30 million tonnes of cane sugar produced in 2006, while India produced 21 million, China 11 million, and Thailand and Mexico roughly 5 million each . Viewed by region, Asia predominates in cane sugar production, with large contributions from China, India and Thailand and other countries combining to account for 40 % of global production in 2006. South America comes in second place with 32 % of global production; Africa and Central America each produce 8 % and Australia 5 %. The United States, the Caribbean and Europe make up the remainder, with roughly 3 % each.

Beet sugar comes from regions with cooler climates: northwest and eastern Europe, northern Japan, plus some areas in the United States (including California). In the northern hemisphere, the beet-growing season ends with the start of harvesting around September. Harvesting and processing continues until March in some cases. The availability of processing plant capacity, and the weather both influence the duration of harvesting and processing - the industry can lay up harvested beet until processed, but a frost-damaged beet becomes effectively unprocessable.

The European Union (EU) has become the world's second-largest sugar exporter. The Common Agricultural Policy of the EU sets maximum quotas for members' production to match supply and demand, and a price. Europe exports excess production quota (approximately 5 million tonnes in 2003). Part of this, "quota" sugar, gets subsidised from industry levies, the remainder (approximately half) sells as "C quota" sugar at market prices without subsidy. These subsidies and a high import tariff make it difficult for other countries to export to the EU states, or to compete with the Europeans on world markets.

The United States sets high sugar prices to support its producers, with the effect that many former consumers of sugar have switched to corn syrup (beverage manufacturers) or moved out of the country (candymakers).

The low prices of glucose syrups produced from wheat and corn (maize) threaten the traditional sugar market. Used in combination with artificial sweeteners, they can allow drink manufacturers to produce very low-cost goods.

7 – 1 - Politics of sugar vs HFCS (High - fructose corn syrup) :

Sucrose has been partially replaced in American industrial food production by other sweeteners such as fructose syrups or combinations of functional ingredients and high intensity sweeteners. This shift is attributable to governmental subsidies of U.S. sugar and an import tariff on foreign sugar, raising the price of sucrose to levels above those of the rest of the world . Because of the artificially elevated price of sucrose, HFCS is cost efficient for many sweetener applications.

7 – 2 - Sugar Cane

Since the 6th century BC, cane sugar producers have crushed the harvested vegetable material from sugarcane in order to collect and filter the juice. They then treat the liquid (often with lime (calcium oxide)) to remove impurities and then neutralize it. Boiling the juice then allows the sediment to settle to the bottom for dredging out, while the scum rises to the surface for skimming off. In cooling, the liquid crystallizes, usually in the process of stirring, to produce sugar crystals. Centrifuges usually remove the uncrystallized syrup. The producers can then either sell the resultant sugar, as is, for use; or process it further to produce lighter grades. This processing may take place in another factory in another country. Sugar cane appears fourth in the list for agriculture in China.

7 – 3 - Sugar Beet :

Sugar beets

Beet sugar producers slice the washed beets, then extract the sugar with hot water in a "diffuser". An alkaline solution ("milk of lime" and carbon dioxide from the lime kiln) then serves to precipitate impurities . After filtration , evaporation concentrates the juice to a content of about 70% solids, and controlled crystallisation extracts the sugar. A centrifuge removes the sugar crystals from the liquid, which gets recycled in the crystalliser stages. When economic constraints prevent the removal of more sugar, the manufacturer discards the remaining liquid, now known as molasses.

7 – 4 - Cane versus beet :

It is difficult to tell the difference between fully refined sugar produced from beet and that from cane. One way is by isotope analysis of carbon. Cane uses C4 carbon fixation, and beet C3 carbon fixation, resulting in a different ratio of 13c and 12c isotopes in the sucrose. Tests are used to detect fraudulent abuse of European Union subsidies or to aid in the detection of adulterated fruit juice.

The production of sugarcane needs approximately four times as much water as the production of sugar beet, there fore some countries that traditionally produced cane sugar (such as Egypt) have seen the building of new beet sugar factories recently. On the other hand, sugar cane tolerates hot climates better. Some sugar factories process both sugar cane and sugar beets and extend their processing period in that way.

The production of sugar results in residues which differ substantially depending on the raw materials used and on the place of production. While cooks often use cane molasses in food preparation, humans find molasses from sugar beet unpalatable, and it therefore ends up mostly as industrial fermentation feedstock (for example in alcohol distilleries), or as animal feed. Once dried, either type of molasses can serve as fuel for burning.

Finding retail sources of pure beet sugar is tricky. Some brands clearly label their product as "pure cane" sugar, but beet sugar is almost always simply labeled as sugar or pure sugar. But interviews with the 5 major beet sugar producing companies revealed that many store brands or "private label" sugar products are pure beet sugar. The lot code can be used to identify the company and the plant from which the sugar came, thus enabling the savvy shopper to identify beet sugar in the store.

7 – 5 - Culinary sugars :

So - called **raw sugars** comprise yellow to brown sugars made by clarifying the source syrup by boiling and drying with heat, until it becomes a crystalline solid, with minimal chemical processing . Raw beet sugars result from the processing of sugar beet juice, but only as intermediates *en route* to white sugar . Types of raw sugar include *demerara*, *muscovado*, and *turbinado*. Mauritius and Malawi export significant quantities of such specialty sugars. Manufacturers sometimes prepare raw sugar as loaves rather than as a crystalline powder, by pouring sugar and molasses together into molds and allowing the mixture to dry. This results in sugar - cakes or loaves, called *jaggery* or *gur* in India, *pingbian tang* in China, and *panela*, *panocha*, *pile*, *piloncillo* and *pão-de-açúcar* in various parts of Latin America. In South America, truly raw sugar, unheated and made from sugarcane grown on farms, does not have a large market-share.

Mill white sugar, also called **plantation white**, **crystal sugar**, or **superior sugar**, consists of raw sugar where the production process does not remove colored impurities, but rather bleaches them white by exposure to sulfur dioxide. Though the most common form of sugar in sugarcane - growing areas, this product does not store or ship well; after a few weeks, its impurities tend to promote discoloration and clumping.

Blanco directo, a white sugar common in India and other south Asian countries, comes from precipitating many impurities out of the cane juice by using *phosphatation* — a treatment with phosphoric acid and calcium hydroxide similar to the carbonatation technique used in beet sugar refining. In terms of sucrose purity, blanco directo is more pure than mill white, but less pure than white refined sugar.

White refined sugar has become the most common form of sugar in North America as well as in Europe. Refined sugar can be made by dissolving raw sugar and purifying it with a phosphoric acid method similar to that used for blanco directo, a carbonatation process involving calcium hydroxide and carbon dioxide, or by various filtration strategies. It is then further purified by filtration through a bed of activated carbon or bone char depending on where the processing takes place. Beet sugar refineries produce refined white sugar directly without an intermediate raw stage. White refined sugar is typically sold as *granulated sugar*, which has been dried to prevent clumping.

Granulated sugar comes in various crystal sizes — for home and industrial use — depending on the application:

- Coarse - grained sugars, such as *sanding sugar* (also called "pearl sugar", "decorating sugar", *nibbed sugar* or *sugar nibs*) adds "sparkle" and flavor for decorating to baked goods, candies, cookies/biscuits and other desserts. The sparkling effect occurs because the sugar forms large crystals which reflect light. Sanding sugar, a large-crystal sugar, serves for making edible decorations. It has larger granules that sparkle when sprinkled on baked goods and candies and will not dissolve when subjected to heat.
- Normal granulated sugars for table use: typically they have a grain size about 0.5 mm across
- Finer grades result from selectively sieving the granulated sugar
- caster (or *castor*) (0.35 mm), commonly used in baking, originally sprinkled from a castor. Castor or caster sugar is the name of a very fine sugar in Britain, so named because the grains are small enough to fit though a sugar "caster" or sprinkler. It is sold as "superfine" sugar in the United States.

Because of its fineness, it dissolves more quickly than regular white sugar, and so is especially useful in meringues and cold liquids. It is not as fine as confectioner's sugar, which has been crushed mechanically (and generally mixed with a little starch to keep it from clumping).

If you don’t have any castor sugar on hand, you can make your own by grinding granulated sugar for a couple of minutes in a food processor (this also produces sugar dust, so let it settle for a few moments before opening the food processor) .

  - *superfine* sugar, also called *baker's sugar*, *berry sugar*, or *bar sugar* — favored for sweetening drinks or for preparing meringue
- Finest grades
  - *Powdered sugar, 10X sugar, confectioner's sugar* (0.060 mm), or *icing sugar* (0.024 mm), produced by grinding sugar to a fine powder. The manufacturer may add a small amount of anticaking agent to prevent clumping — either cornstarch (1 % to 3 %) or tri - calcium phosphate.

Sugar cubes close-up

Brown sugar crystals

Retailers also sell **sugar cubes** or lumps for convenient consumption of a standardized amount. Suppliers of sugarcubes make them by mixing sugar crystals with sugar syrup. Jakub Kryštof Rad invented sugar cubes in 1841 in the Austrian Empire .

Brown sugars come from the late stages of sugar refining, when sugar forms fine crystals with significant molasses content, or from coating white refined sugar with a cane molasses syrup. Their color and taste become stronger with increasing molasses content, as do their moisture - retaining properties. Brown sugars also tend to harden if exposed to the atmosphere, although proper handling can reverse this.

7 – 6 - Dissolved sugar content :

Scientists and the sugar industry use degrees Brix (symbol °Bx), introduced by Antoine Brix, as units of measurement of the mass ratio of dissolved substance to water in a liquid. A 25 °Bx sucrose solution has 25 grams of sucrose per 100 grams of liquid; or, to put it another way, 25 grams of sucrose sugar and 75 grams of water exist in the 100 grams of solution.

The Brix degrees are measured using an infrared sensor. This measurement does not equate to Brix degrees from a density or refractive index measurement, because it will specifically measure dissolved sugar concentration instead of all dissolved solids. When using a refractometer, one should report the result as "refractometric dried substance" (RDS). One might speak of a liquid as having 20 °Bx RDS. This refers to a measure of percent by weight of *total* dried solids and, although not technically the same as Brix degrees determined through an infrared method, renders an accurate measurement of sucrose content, since sucrose in fact forms the majority of dried solids. The advent of in-line infrared Brix measurement sensors has made measuring the amount of dissolved sugar in products economical using a direct measurement.

7 – 7 - Baking weight / mass volume relation ship :

Different culinary sugars have different densities due to variation in particle size and inclusion of moisture.

The Domino Sugar Company has established the following volume to weight conversions :

- Brown sugar 1 cup = 48 tea spoons ~ 195 g = 6.88 oz

- Granular sugar 1 cup = 48 tea spoons ~ 200 g = 7.06 oz

- Powdered sugar 1 cup = 48 tea spoons ~ 120 g = 4.23 oz

8 - History of sugar (sucrose) production :

Originally, people chewed the cane raw to extract its sweetness. Indians discovered how to crystallize sugar during the Gupta dynasty, around AD 350.

Sugar cane was originally from tropical South Asia and Southeast Asia. Different species likely originated in different locations with *S. barberi* originating in India and *S. edule* and *S. officinarum* coming from New Guinea .

During the Muslim Agricultural Revolution, Arab entrepreneurs adopted the techniques of sugar production from India and then refined and transformed them into a large-scale industry. Arabs set up the first large scale sugar mills, refineries, factories and plantations.

The 1390s saw the development of a better press, which doubled the juice obtained from the cane. This permitted economic expansion of sugar plantations to Andalucia and to the Algarve. The 1420s saw sugar production extended to the Canary Islands, Madeira and the Azores.

A sugar loaf was a traditional form for sugar in the 17th to 19th centuries. Sugar nips were required to break off pieces.

The Portuguese took sugar to Brazil. Hans Staden, published in 1555, writes that by 1540 Santa Catarina Island had 800 sugar mills and that the north coast of Brazil , Demarara and Suriname had another 2,000. Approximately 3,000 small mills built before 1550 in the New World created an unprecedented demand for cast iron gears, levers, axles and other implements . Specialist trades in mold-making and iron-casting developed in Europe due to the expansion of sugar production. Sugar mill construction developed technological skills needed for a nascent industrial revolution in the early 17th century .

After 1625, the Dutch carried sugarcane from South America to the Caribbean islands — where it became grown from Barbados to the Virgin Islands . With the European colonization of the Americas, the Caribbean became the world's largest source of sugar. These islands could supply sugarcane using slave labor and produce sugar at prices vastly lower than those of cane sugar imported from the East.

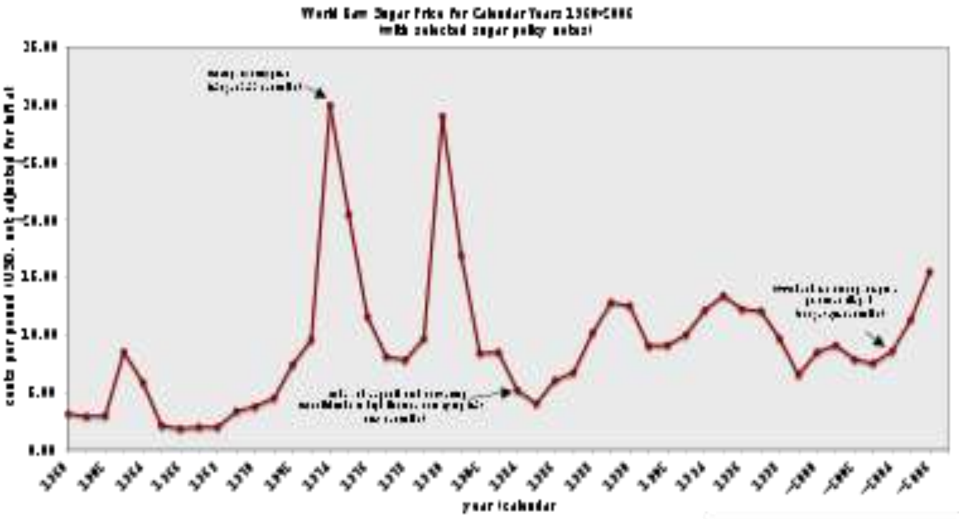
During the eighteenth century, sugar became enormously popular and the sugar market went through a series of booms. As Europeans established sugar plantations on the larger Caribbean islands, prices fell, especially in Britain. By the eighteenth century, all levels of society had become common consumers of the former luxury product. At first most sugar in Britain went into tea, but later confectionery and chocolates became extremely popular. Suppliers commonly sold sugar in solid cones and consumers required a sugar nip, a pliers-like tool, to break off pieces.

Beginning in the late 18th century, the production of sugar became increasingly mechanized. The steam engine first powered a sugar mill in Jamaica in 1768, and soon after, steam replaced direct firing as the source of process heat. During the same century, Europeans began experimenting with sugar production from other crops. Andreas Marggraf identified sucrose in beet root and his student Franz Achard built a sugar beet processing factory in Silesia. However the beet-sugar industry really took off during the Napoleonic Wars, when France and the continent were cut off from caribbean sugar. Today 30% of the world's sugar is produced from beets.

Today, a large beet refinery producing around 1,500 tonnes of sugar a day needs a permanent workforce of about 150 for 24-hour production.

9 - Trade and economics :

Historically one of the most widely-traded commodities in the world, sugar accounts for around 2 % of the global dry cargo market . International sugar prices show great volatility, ranging from around 3 to over 60 cents per pound in the past 50 years. About 100 of the world's 180 countries produce sugar from beet or cane, a few more refine raw sugar to produce white sugar, and all countries consume sugar. Consumption of sugar ranges from around 3 kilograms per person per annum in Ethiopia to around 40 kg/person/yr in Belgium . Consumption per capita rises with income per capita until it reaches a plateau of around 35 kg per person per year in middle income countries.



World raw sugar price from 1960 to 2006.

Many countries subsidize sugar production heavily. The European Union, the United States, Japan and many developing countries subsidize domestic production and maintain high tariffs on imports. Sugar prices in these countries have often exceeded prices on the international market by up to three times; today, with world market sugar futures prices currently strong, such prices typically exceed world prices by two times.

Within international trade bodies, especially in the World Trade Organization, the "G20" countries led by Brazil have long argued that because these sugar markets essentially exclude cane sugar imports, the G20 sugar producers receive lower prices than they would under free trade. While both the European Union and United States maintain trade agreements whereby certain developing and less developed country (LDCs) can sell certain quantities of sugar into their markets, free of the usual import tariffs , countries outside these preferred trade régimes have complained that these arrangements violate the "most favoured nation" principle of international trade. This has led to numerous tariffs and levies in the past.

In 2004, the WTO sided with a group of cane sugar exporting nations (led by Brazil and Australia) and ruled the EU sugar-régime and the accompanying ACP - EU Sugar Protocol (whereby a group of African, Caribbean, and Pacific countries receive preferential access to the European sugar market) illegal . In response to this and to other rulings of the WTO, and owing to internal pressures on the EU sugar-régime, the European Commission proposed on 22 June 2005 a radical reform of the EU sugar - régime, cutting prices by 39 % and eliminating all EU sugar exports . The African, Caribbean, Pacific and least developed country sugar exporters reacted with dismay to the EU sugar proposals . On 25 November 2005, the Council of the EU agreed to cut EU sugar prices by 36% as from 2009. In 2007, it seemed that the U.S. Sugar Program could become the next target for reform. However, some commentators expected heavy lobbying from the U.S. sugar industry, which donated $ 2.7 million to US House and US Senate incumbents in the 2006 US election, more than any other group of US food - growers . Especially prominent lobbyists include The Fanjul Brothers, so - called "sugar barons" who made the single largest individual contributions of soft money to both the Democratic and Republican parties in the political system of the United States of America .

Small quantities of sugar, especially specialty grades of sugar, reach the market as 'fair trade' commodities; the fair trade system produces and sells these products with the understanding that a larger-than-usual fraction of the revenue will support small farmers in the developing world. However, whilst the Fairtrade Foundation offers a premium of $60.00 per tonne to small farmers for sugar branded as "Fairtrade",[38] government schemes such the U.S. Sugar Program and the ACP Sugar Protocol offer premiums of around $ 400.00 per tonne above world market prices. However, the EU announced on 14 September 2007 that it had offered "to eliminate all duties and quotas on the import of sugar into the EU".

The US Sugar Association has launched a campaign to promote sugar over artificial substitutes. The Association now aggressively challenges many common beliefs regarding negative side effects of sugar consumption. The campaign aired a high-profile television commercial during the 2007 Prime Time Emmy Awards on FOX Television. The Sugar Association uses the trademark tagline "Sugar: sweet by nature "

28 - Sugar

Sugar , granulated
Nutritional value per 100 g (3.5 oz)

Energy	1,619 kJ (387 k cal)
Carbohydrates	99.98 g
Sugars	99.91 g
Dietary fiber	0 g
Fat	0 g
Protein	0 g
Water	0.03 g
Riboflavin (Vit. B_2)	0.019 mg (1%)
Calcium	1 mg (0 %)
Iron	0.01 mg (0 %)
Potassium	2 mg (0 %)

Sugars , brown
Nutritional value per 100 g (3.5 oz)

Energy	1,576 kJ (377 kcal)
Carbohydrates	97.33 g
Sugars	96.21 g
Dietary fiber	0 g
Fat	0 g
Protein	0 g
Water	1.77 g
Thiamine (Vit. B_1)	0.008 mg (1 %)
Riboflavin (Vit. B_2)	0.007 mg (0 %)
Niacin (Vit. B_3)	0.082 mg (1 %)
Vitamin B_6	0.026 mg (2 %)
Folate (Vit. B_9)	1 μg (0 %)
Calcium	85 mg (9 %)

Iron	1.91 mg (15 %)
Magnesium	29 mg (8 %)
Phosphorus	22 mg (3 %)
Potassium	346 mg (7 %)
Sodium	39 mg (2 %)
Zinc	0.18 mg (2 %)

1 - Introduction :

Sugar is an informal term for a class of edible crystalline substances, mainly sucrose, lactose, and fructose characterized by a sweet flavor. In food, sugar almost exclusively refers to sucrose, which primarily comes from sugar cane and sugar beet. Other sugars are used in industrial food preparation, but are usually known by more specific names — glucose, fructose or fruit sugar, high fructose corn syrup, etc.

Excessive consumption of sucrose has been associated with increased incidences of type 2 diabetes, obesity and tooth decay.[2]

Sugar consumption varies from country to country; Brazil has the highest per capita production and India has the highest per-country consumption.[3]

3 - History of sugar :

Sugar was produced in the Indian subcontinent since ancient times. It was not plentiful or cheap in early times — honey was more often used for sweetening in most parts of the world. During his campaign in India, Alexander the Great was surprised to taste the sweetening agent that was different from honey.

Originally, people chewed sugarcane raw to extract its sweetness. Indians discovered how to crystallize sugar during the Gupta dynasty, around 350 AD . Sugarcane was originally from tropical South Asia and Southeast Asia . Different species likely originated in different locations with *S. barberi* originating in India and *S. edule* and *S. officinarum* coming from New Guinea .

However, sugar remained relatively unimportant until the Indians discovered methods of turning sugarcane juice into granulated crystals that were easier to store and to transport . Crystallized sugar was discovered by the time of the Imperial Guptas . Indian sailors, consumers of clarified butter and sugar, carried sugar by various trade routes . Traveling Buddhist monks brought sugar crystalization methods to China. During the reign of Harsha (r. 606 – 647) in North India, Indian envoys in Tang China taught sugarcane cultivation methods after Emperor Taizong of Tang (r. 626 – 649) made his interest in sugar known, and China soon established its first sugarcane cultivation in the seventh century. Chinese documents confirm at least two missions to India, initiated in 647 AD, for obtaining technology for sugar - refining. In South Asia, the Middle East and China, sugar became a staple of cooking and desserts.

During the Muslim Agricultural Revolution, Arab entrepreneurs adopted sugar production techniques from India and then refined and transformed them into a large - scale industry. Arabs set up the first sugar mills, refineries, factories and plantations. The Arabs and Berbers spread the cultivation of sugar throughout the Arab Empire and across much of the Old World, including Western Europe after they conquered the Iberian Peninsula in the eighth century AD.[9] Ponting traces the spread of the cultivation of sugarcane from its introduction into Mesopotamia, then the Levant and the islands of the eastern Mediterranean, especially Cyprus, by the 10th century. He also notes that it spread along the coast of East Africa to reach Zanzibar.

Crusaders brought sugar home with them to Europe after their campaigns in the Holy Land, where they encountered caravans carrying "sweet salt". Early in the 12th century, Venice acquired some villages near Tyre and set up estates to produce sugar for export to Europe, where it supplemented honey as the only other available sweetener . Crusade chronicler William of Tyre, writing in the late 12th century , described sugar as "very necessary for the use and health of mankind" .

In August 1492 Christopher Columbus stopped at Gomera in the Canary Islands, for wine and water, intending to stay only four days.

He became romantically involved with the Governor of the island, es:Beatriz de Bobadilla y Ossorio (article in Spanish), and stayed a month. When he finally sailed she gave him cuttings of sugarcane, which became the first to reach the New World.

More recently it is manufactured in very large quantities in many countries, largely from sugar cane and sugar beet. In processed foods it has increasingly been supplanted by corn syrup.

3 – Terminology :

3 – 1 - Popular :

The term *sugar* usually refers to sucrose, which is also called "table sugar" or "saccharose." Sucrose is a white crystalline disaccharide. Sucrose is the most popular of the various sugars for flavoring, as well as properties (such as mouth feel, preservation, and texture) of beverages and food. Manufacturing and preparing food may involve other sugars, such as fructose, generally obtained from corn (maize) or from fruit.

3 – 2 - Culinary / nutritional :

In culinary terms, the foodstuff known as "sugar" delivers a primary taste sensation of sweetness. Apart from the many forms of sugar and of sugar-containing foodstuffs, alternative non-sugar-based sweeteners exist, and these particularly attract interest from people who have problems with their blood sugar level (such as diabetics) and people who wish to limit their calorie - intake while still enjoying sweet foods . In September 2009, the AHA (American Heart Association) released new limitations on added sugar intake. Their results show that women are to consume no more than 25 grams of added sugar daily and men are restricted to 37 grams . The average American consumes between 3 and 5 pounds of added sugar a week, adding up to 200+ pounds of added sugar a year per person[12] A 12 ounce can of regular soda alone contains 39 grams of added sugar, far exceeding the recommended limit for adults. Both natural and synthetic substitutes exist with no significant carbohydrate (and thus low - calorie) content: for instance stevia (an herb), and saccharin (produced from naturally occurring but not necessarily naturally edible substances by inducing appropriate chemical reactions).

The World Health Organisation and the Food and Agriculture Organization of the United Nations expert report defines **free sugars** as all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices. This includes all the sugars referred to above. The term distinguishes these forms from all other *culinary sugars* added in their natural form with no refining at all.

3 – 3 - Baking weight / mass volume relationship :

Different culinary sugars have different densities due to differences in particle size and inclusion of moisture.

The Domino Sugar Company has established the following volume to weight conversions:

- Brown sugar 1 cup = 48 teaspoons ~ 195 g = 6.88 oz
- Granular sugar 1 cup = 48 teaspoons ~ 200 g = 7.06 oz
- Powdered sugar 1 cup = 48 teaspoons ~ 120 g = 4.23 oz

Bulk Density :

- Dextrose Sugar 0.62 g / ml
- Granulated Sugar 0.70 g / ml
- Powdered Sugar 0.56 g / ml
- Beet Sugar 0.80 g / ml

3 – 4 -Purity standards :

The International Commission for Uniform Methods of Sugar Analysis sets standards for the measurement of the purity of refined sugar, known as ICUMSA numbers; lower numbers indicate a higher level of purity in the refined sugar.

4 – Chemistry :

Scientifically, *sugar* loosely refers to monosaccharide or disaccharides. Monosaccharides are also called "simple sugars," the most important being glucose. Almost all sugars have the formula $C_nH_{2n}O_n$ (n is between 3 and 7). Glucose has the molecular formula $C_6 H_{12}O_6$. The names of typical sugars end with "- ose," as in "glucose", "dextrose", and "fructose". Sometimes such words may also refer to any types of carbohydrates soluble in water. The acyclic mono- and disaccharides contain either aldehyde groups or ketone groups. These carbon-oxygen double bonds (C = O) are the reactive centers. All saccharides with more than one ring in their structure result from two or more monosaccharides joined by glycosidic bonds with the resultant loss of a molecule of water (H_2O) per bond.

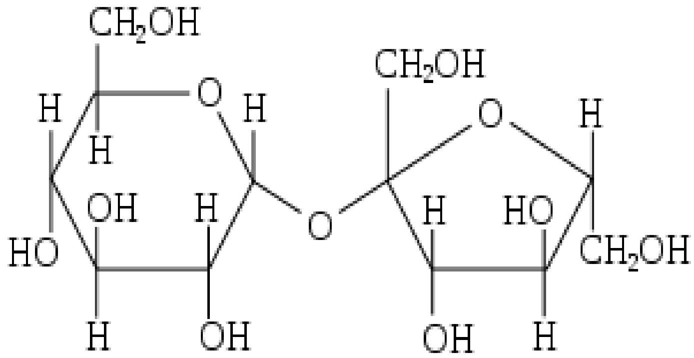
Monosaccharides in a closed - chain form can form glycosidic bonds with other monosaccharides, creating disaccharides (such as sucrose) and polysaccharides (such as starch). Enzymes must hydrolyse or otherwise break these glycosidic bonds before such compounds become metabolised. After digestion and absorption. the principal monosaccharides present in the blood and internal tissues include glucose, fructose, and galactose . Many pentoses and hexoses can form ring structures. In these closed-chain forms, the aldehyde or ketone group remains unfree, so many of the reactions typical of these groups cannot occur. Glucose in solution exists mostly in the ring form at equilibrium, with less than 0.1% of the molecules in the open-chain form.

5 - Natural polymers of sugars :

Biopolymers of sugars are common in nature. Through photo synthesis plants produce glucose, which has the formula $C_6 H_{12} O_6$, and convert it for storage as an energy reserve in the form of other carbohydrates such as starch, or (as in cane and beet) as sucrose (table sugar). Sucrose has the chemical formula $C_{12}H_{22}O_{11}$. Starch, consisting of two different polymers of glucose, is a readily degradable chemical energy stored by cells, convertable to other types of energy.

Cellulose is a polymer of glucose used by plants as structural component.

DNA and RNA are built up of the sugars ribose and deoxyribose.



Sucrose: a disaccharide of glucose (left) and fructose (right), important molecules in the body.

The sugar in DNA, deoxyribose has the formula $C_5H_{10}O_4$.

6 – Etymology :

The etymology reflects the spread of the commodity. The English word "sugar" originates from the Arabic word *sukkar*itself derived from Sanskrit *Sharkara*. It came to English by way of French, Spanish and/or Italian, which derived their word for sugar from the Arabic and Persian *shakar* (whence the Portuguese word *açúcar*, the Spanish word *azúcar*, the Italian word *zucchero*, the Old French word *zuchre* and the contemporary French word *sucre*). (Compare the OED.) The Greek word for "sugar", *Ζάχαρη zahari*, means "pebble". Note that the English word *jaggery* (meaning "coarse brown Indian sugar") has similar ultimate etymological origins (presumably in Sanskrit) .

29 - Sugar Loaf

A sugar loaf which required sugar nips to break off pieces

A **Sugar Loaf** was the traditional form in which refined sugar was produced and sold until the late 19th century when granulated and cube sugars were introduced. A tall cone with a rounded top , it was the end product of a process that saw the dark molasses-rich raw sugar, which had been imported from sugar cane growing regions such as the Caribbean and Brazil, refined into white sugar.

Until the mid-19th century, the British government used a system of punitive taxes to make it impossible for its colonial producers in the Caribbean to refine their own sugar and supply Britain with finished sugarloaves. Previously the Amsterdam industry had been similarly protected from the importation of East India white sugar. Instead, a dark raw sugar or muscovado, produced on the plantations by initial boilings of the fresh cane juice, was shipped in hogsheads to Europe on what was the third leg of the infamous Triangular Trade .

The raw sugar was refined by a series of boiling and filtering processes. When, at the final boiling, it was considered ready for granulation it was poured into a large number of inverted conical moulds. These were usually made of either brown earthenware or sheet iron with an internal treatment of slip or paint respectively, and each stood in its own collecting pot. Over the next few days most of the dark syrup and uncrystaline matter drained through a small hole in the bottom of the mould into the collecting pot. To improve the whiteness of the sugar repeated applications of either a solution of white clay or of loaf sugar dissolved in warm water was applied to the broad end of the loaf. This slowly drained through the loaf readily uniting with any remaining molasses or other colouring matter and removing it to the collecting pot. The loaves were then tapped out of the moulds, dried in a stove room that would have contained hundreds of loaves, trimmed to their final shape and wrapped, usually, in blue paper to enhance their whiteness .

The moulds, and so the sugarloaves, varied in size considerably the larger the loaf the lower the grade of sugar. The grade determined the price, though loaves were sold by weight and the sugar refiner was taxed on the weight of sugar sold . When a new batch of raw sugar was refined the best sugar came from the first boiling. After that, the waste and trimmings from the first boiling were returned to the beginning of the process and mixed with further raw sugar for the second boiling, and, as this was repeated to the end of the batch, subsequent boilings reduced slightly in quality. The finest of the loaves, maybe 5" dia and 11" high, were extremely expensive owing to the prolonged repeating of the whitening process, as were the somewhat larger double refined loaves from the first few boilings. Lower grades of sugar were more difficult to crystalise and so larger moulds were used, usually 10 "- 14 " dia and up to about 30" high, with loaves weighing up to 35 lb. The lowest standard refined grades were called bastards, though an even lower grade was often produced from the filtration scums, usually by a scum boiler at his own separate premises .

The sugar loaf was also the sign of a grocer, often found outside his premises or in the window, and sometimes found on his trade tokens .

It's not known when sugarloaves were first made, however the earliest record to date appears to be 12th century in Jordan [4]. In Europe, they were made in Italy from 1470, Belgium 1508, England 1544, Holland 1566, Germany 1573 and France 1613 . When refining from sugar beet began in mainland Europe in 1799, loaves were produced in the same way and are still common in some parts , especially in Germany , where small loaves are a required ingredient for the holiday season drink Feuerzangenbowle .

30 - Sugar substitute

Contents :

1 – Introduction :

A **sugar substitute** is a food additive that duplicates the effect of sugar in taste, usually with less food energy. Some sugar substitutes are natural and some are synthetic. Those that are not natural are, in general, referred to as **artificial sweeteners**.

An important class of sugar substitutes are known as *high-intensity sweeteners*. These are compounds with sweetness that is many times that of sucrose, common table sugar. As a result, much less sweetener is required, and energy contribution often negligible. The sensation of sweetness caused by these compounds (the "sweetness profile") is sometimes notably different from sucrose, so they are often used in complex mixtures that achieve the most natural sweet sensation.

If the sucrose (or other sugar) replaced has contributed to the texture of the product, then a bulking agent is often also needed. This may be seen in soft drinks labeled as "diet" or "light," which contain artificial sweeteners and often have notably different mouthfeel, or in table sugar replacements that mix maltodextrins with an intense sweetener to achieve satisfactory texture sensation.

In the United States, six intensely-sweet sugar substitutes have been approved for use. They are saccharin, aspartame, sucralose, neotame, acesulfame potassium, and stevia. There is some ongoing controversy over whether artificial sweetener usage poses health risks. The US Food and Drug Administration regulates artificial sweeteners as food additives . Food additives must be approved by the FDA, which publishes a Generally Recognized as Safe (GRAS) list of additives . To date, the FDA has not been presented with scientific information that would support a change in conclusions about the safety of the six approved high - intensity sweeteners . The safe conclusions are based on a detailed review of a large body of information, including hundreds of toxicological and clinical studies.[3]

There is also an herbal supplement, stevia, used as a sweetener. Controversy surrounds lack of research on stevia's safety and there was a battle over its approval as a sugar substitute.

The majority of sugar substitutes approved for food use are artificially - synthesized compounds. However, some bulk natural sugar substitutes are known, including sorbitol and xylitol, which are found in berries, fruit, vegetables, and mushrooms. It is not commercially viable to extract these products from fruits and vegetables, so they are produced by catalytic hydrogenation of the appropriate reducing sugar. For example, xylose is converted to xylitol, lactose to lactitol, and glucose to sorbitol. Still other natural substitutes are known, but are yet to gain official approval for food use.

Some non-sugar sweeteners are *polyols*, also known as "sugar alcohols." These are, in general, less sweet than sucrose, but have similar bulk properties and can be used in a wide range of food products. Sometimes the sweetness profile is 'fine-tuned' by mixing with high-intensity sweeteners. As with all food products, the development of a formulation to replace sucrose is a complex proprietary process.

2 - Food industry usage of artificial sweeteners :

The food and beverage industry is increasingly replacing sugar or corn syrup with artificial sweeteners in a range of products traditionally containing sugar.

Artificial sweeteners cost the food industry only a fraction of the cost of natural sweeteners, in spite of the extremely high profit margins for manufacturers of artificial sweeteners. So it is not surprising that the food industry is promoting its "diet" or "light" products heavily, thus moving the customers over to its even more profitable artificially - sweetened products .

According to market analysts Mintel, a total of 3,920 products containing artificial sweeteners were launched in the U.S. between 2000 and 2005. In 2004 alone, 1,649 artificially-sweetened products were launched. According to market analysts Freedonia, the United States artificial sweetener market is set to grow at around 8.3% per year to $189 million in 2008.

Aspartame is currently the most popular artificial sweetener in the U.S. food industry, as the price has dropped significantly since the Monsanto Company patent expired in 1992. However, sucralose may soon replace it, as alternative processes to Tate & Lyle's patent seem to be emerging. According to Morgan Stanley, this can mean that the price of sucralose will drop by 30 % .

3 - Reasons for use :

Sugar substitutes are used for a number of reasons, including:

- To assist in weight loss — some people choose to limit their food energy intake by replacing high-energy sugar or corn syrup with other sweeteners having little or no food energy. This allows them to eat the same foods they normally would, while allowing them to lose weight and avoid other problems associated with excessive caloric intake.
- Dental care — sugar substitutes are tooth-friendly, as they are not fermented by the microflora of the dental plaque.

- Diabetes mellitus — people with diabetes have difficulty regulating their blood sugar levels. By limiting their sugar intake with artificial sweeteners, they can enjoy a varied diet while closely controlling their sugar intake. Also, some sugar substitutes do release energy, but are metabolized more slowly, allowing blood sugar levels to remain more stable over time.
- Reactive hypoglycemia — individuals with reactive hypoglycemia will produce an excess of insulin after quickly absorbing glucose into the bloodstream. This causes their blood glucose levels to fall below the amount needed for proper body and brain function. As a result, like diabetics, they must avoid intake of high-glycemic foods like white bread, and often choose artificial sweeteners as an alternative.
- Avoiding processed foods — individuals may opt to substitute refined white sugar with less-processed sugars, such as fruit juice or maple syrup .
- Cost — many sugar substitutes are cheaper than sugar.

4 - Health issues :

4 – 1 - Controversy over health :

A 2005 study by the University of Texas Health Science Center at San Antonio showed that increased weight gain and obesity was associated with increased use of diet soda in a population based study. The study did not establish whether increased weight leads to increased consumption of diet drinks or whether consumption of diet drinks could have an effect on weight gain .

Animal studies have indicated that artificial sweeteners can cause body weight gain. A sweet taste induces an insulin response, which causes blood sugar to be stored in tissues (including fat), but because blood sugar does not increase with artificial sugars, there is hypoglycemia and increased food intake the next time there is a meal. After a while, rats given sweeteners have steadily increased calorie intake, increased body weight, and increased adiposity (fatness). Furthermore, the natural responses to eating sugary foods (eating less at the next meal and using some of the extra calories to warm the body after the sugary meal) are gradually lost.

4 – 2 - Cyclamate :

In the United States, the U.S. Food and Drug Administration (FDA) banned the sale of cyclamate in 1970 after lab tests in rats involving a 10:1 mixture of cyclamate and saccharin indicated that large amounts of cyclamates causes bladder cancer, a disease to which rats are particularly susceptible. The findings of these studies have been challenged and some companies are petitioning to have cyclamates reapproved . Cyclamates are still used as sweeteners in many parts of the world, and are used with official approval in over 55 countries .

4 – 3 - Saccharin :

Aside from sugar of lead, saccharin was the first artificial sweetener and was originally synthesized in 1879 by Remsen and Fahlberg. Its sweet taste was discovered by accident. It had been created in an experiment with toluene derivatives. A process for the creation of saccharin from phthalic anhydride was developed in 1950, and, currently, saccharin is created by this process as well as the original process by which it was discovered. It is 300 to 500 times as sweet as sugar (sucrose) and is often used to improve the taste of toothpastes, dietary foods, and dietary beverages. The bitter aftertaste of saccharin is often minimized by blending it with other sweeteners.

Fear about saccharin increased when a 1960 study showed that high levels of saccharin may cause bladder cancer in laboratory rats. In 1977, Canada banned saccharin due to the animal research. In the United States, the FDA considered banning saccharin in 1977, but Congress stepped in and placed a moratorium on such a ban. The moratorium required a warning label and also mandated further study of saccharin safety.

Subsequently, it was discovered that saccharin causes cancer in male rats by a mechanism not found in humans. At high doses, saccharin causes a precipitate to form in rat urine. This precipitate damages the cells lining the bladder (urinary bladder urothelial cytotoxicity) and a tumor forms when the cells regenerate (regenerative hyperplasia). According to the International Agency for

Research on Cancer, part of the World Health Organization, "Saccharin and its salts was (sic) downgraded from Group 2B, possibly carcinogenic to humans, to Group 3, not classifiable as to carcinogenicity to humans, despite sufficient evidence of carcinogenicity to animals, because it is carcinogenic by a non-DNA-reactive mechanism that is not relevant to humans because of critical interspecies differences in urine composition " .

In 2001, the United States repealed the warning label requirement, while the threat of an FDA ban had already been lifted in 1991. Most other countries also permit saccharin, but restrict the levels of use, while other countries have outright banned it.

4 - 4 - Aspartame :

Aspartame was discovered in 1965 by James M. Schlatter at the G.D. Searle company (later purchased by Monsanto). He was working on an anti-ulcer drug and spilled some aspartame on his hand by accident. When he licked his finger, he noticed that it had a sweet taste. It is an odorless, white crystalline powder that is derived from the two amino acids aspartic acid and phenylalanine. It is about 200 times as sweet as sugar and can be used as a tabletop sweetener or in frozen desserts, gelatins, beverages, and chewing gum. When cooked or stored at high temperatures, aspartame breaks down into its constituent amino acids. This makes aspartame undesirable as a baking sweetener. It is more stable in somewhat acidic conditions, such as in soft drinks. Though it does not have a bitter aftertaste like saccharin, it may not taste exactly like sugar. When eaten, aspartame is metabolized into its original amino acids. It has the same food energy as proteins, but because it is so intensely sweet, relatively little of it is needed to sweeten a food product, and is thus useful for reducing the number of calories in a product.

Since the FDA approved aspartame for consumption, some researchers have suggested that a rise in brain tumor rates in the United States may be at least partially related to the increasing availability and consumption of aspartame . Some research, often supported by companies producing artificial sweeteners , has failed to find any link between aspartame and cancer or other health problems.

A recent paper attempted to demonstrate a link between this substance and cancer, leading some to renew calls for the FDA to pull aspartame from the market. This research has led the Center for Science in the Public Interest to classify aspartame as a substance to be avoided in its Chemical Cuisine Directory . However, the EFSA's press release about the study , published on 5 May 2006, concluded that the increased incidence of lymphomas/leukaemias reported in treated rats was unrelated to aspartame, the kidney tumors found at high doses of aspartame were not relevant to humans, and that based on all available scientific evidence to date, there was no reason to revise the previously established Acceptable Daily Intake levels for aspartame .

Several European Union countries approved aspartame in the 1980s, with EU-wide approval in 1994. The European Commission Scientific Committee on Food reviewed subsequent safety studies and reaffirmed the approval in 2002. The European Food Safety Authority reported in 2006 that the previously established Adequate Daily Intake was appropriate, after reviewing yet another set of studies .

It has also been investigated and approved by the Joint Expert Committee on Food Additives of the United Nations Food and Agricultural Organization and World Health Organization.[*citation needed*]

4 – 5 - Sucralose :

Sucralose is a chlorinated sugar that is about 600 times as sweet as sugar. It is produced from sucrose when three chlorine atoms replace three hydroxyl groups. It is used in beverages, frozen desserts, chewing gum, baked goods, and other foods. Unlike other artificial sweeteners, it is stable when heated and can therefore be used in baked and fried goods. About 15 % of sucralose is absorbed by the body and most of it passes out of the body unchanged. The FDA approved sucralose in 1998.

Most of the controversy surrounding Splenda, a sucralose sweetener, is focused not on safety, but on its marketing. It has been marketed with the slogan, "Splenda is made from sugar, so it tastes like sugar." Sucralose is a chlorinated sugar prepared from either sucrose or raffinose. With either base sugar, processing replaces three oxygen - hydrogen groups in the sugar molecule with three chlorine atoms.

The "Truth About Splenda" website was created in 2005 by The Sugar Association, an organization representing sugar beet and sugar cane farmers in the United States,[19] to provide its view of sucralose. In December 2004, five separate false-advertising claims were filed by the Sugar Association against Splenda manufacturers Merisant and McNeil Nutritionals for claims made about Splenda related to the slogan, "Made from sugar, so it tastes like sugar". French courts ordered the slogan to no longer be used in France, while in the U.S. the case came to an undisclosed settlement during the trial.[18]

Safety concerns pertaining to sucralose revolve around the fact that it belongs to a class of chemicals called organochlorides, some types of which are toxic or carcinogenic; however, the presence of chlorine in an organic compound does not in any way ensure toxicity. The way sucralose is metabolized may suggest a reduced risk of toxicity. For example, sucralose is extremely insoluble in fat and thus does not accumulate in fat as do some other organochlorides ; sucralose also does not break down and will dechlorinate only under conditions that are not found during regular digestion (i.e. high heat applied to the powder form of the molecule) .

4 – 6 - Lead acetate :

Lead acetate (some times called *sugar of lead*) is an artificial sugar substitute made from lead that is of historical interest because of its widespread use in the past, such as by ancient Romans. The use of lead acetate as a sweetener eventually produced lead poisoning in any individual ingesting it habitually. Lead acetate was abandoned as a food additive throughout most of the world after the high toxicity of lead compounds became apparent.

5 - List of sugar substitutes :

The three primary compounds used as sugar substitutes in the United States are saccharin (e.g., *Sweet'N Low*), aspartame (e.g., *Equal*, *NutraSweet*) and sucralose (e.g., *Splenda*, *Altern*). Maltitol and sorbitol are often used frequently, in toothpaste, mouth wash, and in foods such as "no sugar added" iced cream. Erythritol is gaining momentum as a replacement for these other sugar alcohols in foods as it is much less likely to produce gastrointestinal distress when consumed in large amounts. In many other countries xylitol, cyclamate and the herbal sweetener stevia are used extensively.

5 – 1 - Natural sugar substitutes

1. Brazzein — protein, 800× sweetness of sucrose (by weight)
2. Curculin — protein, 550× sweetness (by weight)
3. Erythritol — 0.7× sweetness (by weight) , 14× sweetness of sucrose (by food energy) , 0.05× energy density of sucrose
4. Glycyrrhizin — 50× sweetness (by weight)
5. Glycerol — 0.6× sweetness (by weight), 0.55× sweetness (by food energy), 1.075× energy density, E422
6. Hydrogenated starch hydrolysates — 0.4–0.9× sweetness (by weight), 0.5×–1.2× sweetness (by food energy), 0.75× energy density
7. Inulin
8. Isomalt — 0.45–0.65× sweetness (by weight), 0.9–1.3× sweetness (by food energy), 0.5× energy density, E953
9. Lactitol — 0.4× sweetness (by weight), 0.8× sweetness (by food energy), 0.5× energy density, E966
10. Luo han guo - 300× sweetness (by weight)
11. Mabinlin — protein, 100× sweetness (by weight)
12. Maltitol — 0.9× sweetness (by weight), 1.7× sweetness (by food energy), 0.525× energy density, E965
13. Maltooligosaccharide
14. Mannitol — 0.5× sweetness (by weight), 1.2× sweetness (by food energy), 0.4× energy density, E421
15. Miraculin — protein, does not taste sweet by itself, but modifies taste receptors to make sour things taste sweet temporarily
16. Monatin — naturally-occurring sweetener isolated from the plant Sclerochiton ilicifolius
17. Monellin — protein, 3,000× sweetness (by weight)
18. Pentadin — protein, 500× sweetness (by weight)

19. Sorbitol — 0.6× sweetness (by weight), 0.9× sweetness (by food energy), 0.65× energy density, E420
20. Stevia — 250× sweetness (by weight) - extracts known as rebiana, Truvia, PureVia; mainly containing rebaudioside A, a steviol glycoside
21. Tagatose — 0.92× sweetness (by weight), 2.4× sweetness (by food energy), 0.38× energy density
22. Thaumatin — protein, 2,000× sweetness (by weight), E957
23. Xylitol — 1.0× sweetness (by weight), 1.7× sweetness (by food energy), 0.6× energy density, E967

5 – 2 - Artificial sugar substitutes :

Note that because many of these have little or no food energy, comparison of sweetness based on energy content is not meaningful.

E number	Common name	Max permitted level	Sources	Application
E950	Acesulfame potassium	0.05 % (w / w)	Standard 1.3.1 - Food Additives (Australian)	Liquid milk products and flavoured liquid milk
		N / A	N / A	N/ A

1. Acesulfame potassium — 200× sweetness (by weight), Nutrinova, E950, FDA Approved 1988
2. Alitame — 2,000× sweetness (by weight), Pfizer, Pending FDA Approval
3. Aspartame — 160–200× sweetness (by weight), NutraSweet, E951, FDA Approved 1981
4. Salt of aspartame-acesulfame — 350× sweetness (by weight), Twinsweet, E962
5. Cyclamate — 30× sweetness (by weight), Abbott, E952, FDA Banned 1969, pending re-approval
6. Dulcin — 250× sweetness (by weight), FDA Banned 1950

7. Glucin — 300 × sweetness (by weight)
8. Neohesperidin dihydrochalcone — 1,500× sweetness (by weight), E959
9. Neotame — 8,000× sweetness (by weight), NutraSweet, FDA Approved 2002
10. P-4000 — 4,000× sweetness (by weight), FDA Banned 1950
11. Saccharin — 300× sweetness (by weight), E954, FDA Approved 1958
12. Sucralose — 600× sweetness (by weight), Kaltame, Splenda, Tate & Lyle, E955, FDA Approved 1998

Part 2

CACOA & CHOCOLATE

1 - Chocolate

Chocolate most commonly comes in dark, milk, and white varieties, with cocoa solids contributing to the brown coloration.

Contents

1 – Introduction :

Chocolate is a range of products derived from cocoa (cacao), mixed with fat (i.e. cocoa butter and/or plant oils) and finely powdered sugar to produce a solid confection. There are several types according to the proportion of cocoa used in a particular formulation.

In several instances the use of particular name designations is subject to governmental regulation.

2 – Terminology :

The cacao bean products from which chocolate is made are known under different names in different parts of the world. In the American chocolate industry :

- Chocolate liquor is the ground or melted state of the nib of the cacao bean.
- Cocoa butter is the fat component.
- Cocoa powder is the nonfat part of the cacao bean which is ground into a powder .

3 – Classification :

Chocolate is a popular ingredient and available in many types. Different forms and flavors of chocolate are produced by varying the quantities of the different ingredients. Other flavors can be obtained by varying the time and temperature when roasting the beans. **Unsweetened chocolate** is pure chocolate liquor, also known as bitter, baking chocolate or cooking chocolate, mixed with some form of fat to produce a solid substance. It is unadulterated chocolate: the pure, ground, roasted chocolate beans impart a strong, deep chocolate flavor. With the addition of sugar, however, it is used as the base for cakes, brownies, confections, and cookies.

- **Dark chocolate** is produced by adding fat and sugar to cacao. It is chocolate without milk as an additive, although in the United States it is added in most commonly found chocolates. It is sometimes called "plain chocolate" and "black chocolate". The U.S. Government has no definition for dark chocolate, only "sweet chocolate", which requires a 15% concentration of chocolate liquor. Sweet chocolate is not necessarily dark chocolate as there is no restriction of milk in it. European rules specify a minimum of 35 % cocoa solids.
- **Milk chocolate** is chocolate with milk powder, liquid milk, or condensed milk added. The U.S. Government requires a 10%

concentration of chocolate liquor. EU regulations specify a minimum of 25 % cocoa solids. In the 1870s, Swiss confectioner Daniel Peter invented process of solidifying milk chocolate using condensed milk, which was invented by Henri Nestle in the 1800s.

  - **Hershey process** milk chocolate, invented by Milton S. Hershey, founder of The Hershey Company, can be produced more economically since it is less sensitive to the freshness of the milk. Although the process is still a trade secret, experts speculate that the milk is partially lipolyzed, producing butyric acid, which stabilizes the milk from further fermentation. This compound gives the product a particular sour, "tangy" taste, to which the American public has become accustomed, to the point that other manufacturers now simply add butyric acid to their milk chocolates.

- **Semisweet chocolate** is frequently used for cooking purposes. It is a dark chocolate with a low (typically half) sugar content.
- **Bittersweet chocolate** is chocolate liquor (or unsweetened chocolate) to which some sugar (typically a third), more cocoa butter, vanilla and sometimes lecithin has been added. It has less sugar and more liquor than semisweet chocolate, but the two are interchangeable in baking. Bittersweet and semisweet chocolates are sometimes referred to as 'couverture' (chocolate that contains at least 32 percent cocoa butter); many brands now print on the package the percentage of cocoa (as chocolate liquor and added cocoa butter) contained. The rule is that the higher the percentage of cocoa, the less sweet the chocolate will be. The American FDA classifies chocolate as either "bittersweet" or "semisweet" that contain at least 35 % cacao (either cacao solids or butter from the cacao beans).
- **Couverture** is a term used for chocolates rich in cocoa butter. Popular brands of couverture used by professional pastry chefs and often sold in gourmet and specialty food stores include: Valrhona, Felchlin, Lindt & Sprüngli, Scharffen Berger, Cacao Barry, Callebaut, and Guittard. These chocolates contain a high percentage of cocoa (some times 70 % or more) and

have a total fat content of 30 - 40 %. The European palate is more accustomed to high percentage chocolate, with ordinary supermarkets in Europe commonly carrying 85% cocoa and even 99 % cocoa bars for as - is consumption, not cooking. Higher cocoa percentages command a higher price.

- **White chocolate** is a confection based on sugar, nutmeg, and fat (either cocoa butter or vegetable oils) without the cocoa solids. Some consider white chocolate not to even be chocolate, because of the lack of cocoa solids.
- **Cocoa powder** There are two types of unsweetened baking cocoa available: natural cocoa (like the sort produced by Hershey's and Nestlé using the Broma process), and Dutch-process cocoa (such as the Hershey's European Style Cocoa and the Droste brand). Both are made by pulverising partially defatted chocolate liquor and removing nearly all the cocoa butter. Natural cocoa is light in colour and somewhat acidic with a strong chocolate flavour. Natural cocoa is commonly used in recipes which call for baking soda. Because baking soda is an alkali, combining it with natural cocoa creates a leavening action that allows the batter to rise during baking. Dutch-process cocoa is processed with alkali to neutralise its natural acidity. Dutch cocoa is slightly milder in taste, with a deeper and warmer colour than natural cocoa. Dutch-process cocoa is frequently used for chocolate drinks such as hot chocolate due to its ease in blending with liquids. Unfortunately, Dutch processing destroys most of the flavonoids present in cocoa.[4]
- **Compound chocolate** is the technical term for a confection combining cocoa with vegetable fat, usually tropical fats and/or hydrogenated fats, as a replacement for cocoa butter. It is primarily used for candy bar coatings, but because it does not contain cocoa butter, in the US it is not allowed to be called "chocolate." This is especially true for much candy passed as "white chocolate" , which need not contain anything from the cacao bush at all. This can translate to poor taste, texture and possibly health concerns, particularly when partially hydrogenated oils are used to replace cacao butter.

Flavours such as mint, vanilla, coffee, orange, or strawberry are sometimes added to chocolate in a creamy form or in very small pieces. Chocolate bars frequently contain added ingredients such as peanuts, nuts, fruit, caramel, or even crisped rice. Pieces of chocolate, in various flavours, can be found mixed with cereals in order to increase their taste.

3 – 1 - United States :

The United States FDA regulates the naming and ingredients of cacao products :

product	**chocolate liquor**	**milk solids**	**sugar**
milk chocolate	≥ 10 %	≥ 12 %	
sweet chocolate	≥ 15 %	< 12 %	
semisweet or bittersweet (dark) chocolate	≥ 35 %	< 12 %	
white chocolate	≥ 20 %	≥ 14 %	≤ 55 %

In March 2007, the Chocolate Manufacturers Association, whose members include Hershey's, Nestlé and Archer Daniels Midland, began lobbying the U.S. Food and Drug Administration (FDA) to change the legal definition of chocolate to allow the substitution of "safe and suitable vegetable fats and oils" (including partially hydrogenated vegetable oils) for cocoa butter in addition to using "any sweetening agent" (including artificial sweeteners) and milk substitutes . Currently, the FDA does not allow a product to be referred to as "chocolate" if the product contains any of these ingredients.

3 – 2 - Japan :

In Japan, 'chocolate materials' and 'chocolate products' are classified on a complex scale

- **Chocolate Materials**
- **Pure chocolate material**

Cocoa content ≥ 35% , cocoa butter ≥ 18% , sucrose ≤ 55 % , lecithin ≤ 0.5 %, no additives other than lecithin and vanilla flavouring, no fats other than cocoa butter and milk fats, water ≤ 3 %

- **Pure milk chocolate material** Cocoa content ≥ 21 % , cocoa butter ≥ 18 %, milk solids ≥ 14 %, milk fats ≥ 3.5 % , sucrose ≤ 55 % , lecithin ≤0.5%, no additives other than lecithin and vanilla flavouring, no fats other than cocoa butter and milk fats , water ≤ 3 % .

- **Chocolate material**

Cocoa content ≥ 35 % , cocoa butter ≥ 18 % , water ≤ 3 % . It is also permitted to substitute milk solids for cocoa content as follows: cocoa content ≥ 21 % , cocoa butter ≥ 18 % , combined milk solids & cocoa content ≥ 35 %, milk fats ≥ 3 % , water ≤ 3 % .

- **Milk chocolate material**

Cocoa content ≥ 21 % , cocoa butter ≥ 18 % , milk solids ≥ 14 % , milk fats ≥ 3 % , water ≤ 3 %

- **Quasi chocolate material**

Cocoa content ≥ 15 % , cocoa butter ≥ 3 % , fats ≥ 18 % , water ≤ 3 %

- **Quasi milk chocolate material**

Cocoa content ≥ 7 % , cocoa butter ≥ 3 % , fats ≥ 18 % , milk solids ≥ 12.5 % , milk fats ≥ 2 % , water ≤ 3 %

- **Chocolate Products**

Products using milk chocolate or quasi milk chocolate as described above are handled in the same way as chocolate / quasi chocolate.

- **Chocolate**

Processed chocolate products made from chocolate material itself or containing at least 60 % chocolate material. Processed chocolate products must contain at least 40% chocolate material by weight. Amongst processed chocolate products, those containing at least 10 % by weight of cream and no more than 10% of water can be called **raw chocolate** .

- **Chocolate sweet**

Processed chocolate products containing less than 60% chocolate material

- **Quasi chocolate**

The Quasi symbol should officially be circled. Processed quasi chocolate products made from quasi chocolate material itself or containing at least 60 % quasi chocolate material.

- **Quasi chocolate sweet**

Processed quasi chocolate products containing less than 60 % quasi chocolate material

4 - Definition

Chocolate is a product based on cocoa solid and/or cocoa fat. The amount and types of cocoa solids and fat that the term implies is a matter of controversy. Manufacturers have an incentive to use the term for variations that are cheaper to produce, containing less cocoa and cocoa substitutes, although these variations might not taste as good.

There has been disagreement in the EU about the definition of chocolate; this dispute covers several ingredients, including the types of fat used, quantity of cocoa, and so on. But in 1999, the EU at least resolved the fat issue by allowing up to 5% of chocolate's content to be one of 5 alternatives to cocoa butter; illipe, palm oil, sal, shea, kokum gurgi, or mango kernel .

A recent workaround by the US confection industry has been to reduce the amount of cocoa butter in candy bars without using vegetable fats by adding polyglycerol polyricinoleate (PGPR), which is an artificial castor oil - derived emulsifier that simulates the mouthfeel of fat. Up to 0.3 % PGPR may be added to chocolate for this purpose .

5 - Dark chocolate health benefits :

The consumption of high-cacao-content of chocolate has been correlated with positive health benefits from flavonol antioxidants derived from the ground and fermented cocoa seeds of Theobroma cacao .

Milk chocolate may transiently improve DNA resistance to oxidative stress, probably for flavonoid kinetics .

2 - Chocolate chip

Normal sized semi - sweet chocolate chips

1 – Introduction :

Chocolate chips are small chunks of chocolate. They are often sold in a round, flat-bottomed teardrop shape. They are available in numerous sizes, from large to miniature, but are usually around 1 cm in diameter. Many sizes are available depending on preference.

2 – Origin :

Chocolate chips are a required ingredient in chocolate chip cookies, which were invented in 1933 when Ruth Graves Wakefield of the Toll House Inn in the town of Whitman, Massachusetts added cut-up chunks of a semi-sweet Nestlé chocolate bar to a cookie recipe. The cookies were a huge success, and Wakefield reached an agreement with Nestlé to add her recipe to the chocolate bar's packaging in exchange for a lifetime supply of chocolate. Initially, Nestlé included a small chopping tool with the chocolate bars, but in

1939 they started selling the chocolate in chip (or "morsel") form. The Nestlé brand Toll House cookies is named for the inn.

3 - Types of chips :

Originally, chocolate chips were made of semi-sweet chocolate, but today there are many flavors. These include bittersweet chocolate chips, peanut butter chips, butterscotch chips, mint chocolate chips, white chocolate chips, dark chocolate chips, milk chocolate chips, and white and dark swirled chocolate chips.

4 - Uses :

Chocolate chips in a chocolate chip cookie

Chocolate chips can be used in cookies, pancakes, waffles, cakes, pudding, muffins, crêpes, pies, hot chocolate, and various types of pastry. They are also found in many other retail food products such as granola bars, ice cream, and trail mix.

Chocolate chips can also be melted and used in sauces and other recipes. The chips melt best at temperatures between 104 and 113°F (40 and 45°C). The melting process starts at around 90°F when the cocoa butter in the chips starts to heat. The cooking temperature must never exceed 115°F (for milk and white) or 120°F (for dark) or the chocolate will burn. Although convenient, melted chocolate chips are not always recommended as a substitute for melted baking chocolate. Because most chocolate chips are designed to retain their shape when baking, they contain less cocoa butter than baking chocolate. This can make them more difficult to work with in melted form.

5 – Availability :

Today, chocolate chips are very popular as a baking ingredient in the United States and the chocolate chip cookie is regarded as a quintessential American dessert. Chocolate chips are also available in Europe, Australia, and other parts of the world. Nestlé and The Hershey Company are among the top producers of chocolate chips.

3 - Chocolate milk

A glass of chocolate milk.

1 – Introduction :

Chocolate milk is a sweetened, cocoa - flavored milk drink. It can be purchased pre-mixed or made at home with either cocoa powder and a sweetener (such as sugar or an artificial brand, such as Splenda), or with melted chocolate, chocolate syrup, or chocolate milk mix. Other ingredients, such as starch, salt, carrageenan, vanilla, or artificial flavoring may be added . Chocolate milk should be refrigerated like plain milk. A solution is required to blend in the two flavors (milk and chocolate, hence the name of the mixed drink) .

2 - Brands :

There are many brands of chocolate milk available in pre-mixed packages, including bottles and cartons. Some Swiss brands like Ovaltine and Nesquik can be either heated up or consumed cold. It is also possible to make chocolate milk by pouring milk in a glass, adding cocoa powder, and stirring although it does not mix with the milk as well or quickly compared to using chocolate syrup. Shaking the ingredients in a clean bottle or cocktail shaker makes a better job of mixing the powder and milk .

A variant of chocolate milk are candy - bar themed pre - mixed drinks, which claim to mimic the flavors of popular candy bars such as Milky Way, 3 Musketeers, or Snickers. Other variants include a lactose-free version may also be made using lactose-free milk and flavorings, organic chocolate milk (made with organic milk, organic cocoa, and organic cane syrup), and chocolate soy milk. Nesquik comes in a Double Chocolate Flavor.

3 - Supplement :

Some nutritionists have criticized chocolate milk for its high sugar content and its relationship to childhood obesity.[1] [2] In the US 32 percent of children and teens are overweight and at risk for diabetes, high blood pressure and other issues related to obesity.[3]

A study published in 2006 indicated that chocolate milk aids in recovery when taken after intense athletic workouts. The study authors believe this to be due to its ratio of carbohydrates to protein, among other nutritional properties . However, the study was small in scale with only nine athletes and partially funded by the dairy industry. Furthermore, the study compared chocolate milk to two energy drinks and unflavored milk was not used as a comparison, so it is unknown if chocolate milk is superior to unflavored milk as a recovery drink.

Chocolate supplies oxalic acid, which reacts with the calcium in the milk producing calcium oxalate, thus preventing the calcium from being absorbed in the intestine. However, it is present in small enough amounts that the effect on calcium absorption is negligible.[7] As chocolate contains relatively small amounts of oxalate, it is unclear to what extent chocolate consumption affects healthy people who eat calcium-rich diets. In a 2008 study, participants who consumed one or more servings of chocolate on a daily basis had lower bone density and strength than those participants who ate a serving of chocolate six times a week or less. Researchers believe this may be due to oxalate inhibiting calcium absorption — but it could also be due to the chocolate's sugar content, which may increase calcium excretion. It is clear, however, that consuming foods high in oxalate — and in turn their effect on calcium absorption — is a more significant concern for people with oxalate kidney stones, which occur when there is too much oxalate in the urine. These people, especially, should reduce their oxalate intake and increase their calcium intake .

4 - Cocoa bean

Cocoa beans in a cacao pod

Cocoa beans before roasting

Contents

1 – Introduction :

Cocoa bean (also **cacao bean** , often simply **cocoa** and **cacao**) is the dried and fully fermented fatty seed 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 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 pale pink or lavender in color Seeds usually are white becoming violet or reddish brown during the drying process. The exception is rare varieties of white cacao, in which the seeds remain white. Historically, white cacao was cultivated by the Rama people of Nicaragua

2 - Etymology :

The word "cocoa" is derivative of "cacao". "Cocoa" can often also refer to the drink commonly known as hot chocolate;[4] 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 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 may have been introduced into Central America by the ancient Maya, and cultivated in Mexico by the Olmecs, then by the Toltecs and later by the Aztecs.

The cocoa bean was a common currency throughout Mesoamerica and the Caribbean 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-Columbian Mesoamerica. Spanish chroniclers of the conquest of Mexico by Hernán Cortés relate that when Moctezuma II, emperor of the Aztecs, dined he took no other beverage than chocolate, served in a golden goblet and eaten with a golden spoon. Flavored with vanilla and spices, his chocolate was whipped into a froth that dissolved in the mouth. It is reported that no fewer than 50 portions each day may have been consumed by Montezuma II , and 200 more by the nobles of his court.

Chocolate was introduced to Europe by the Spaniards and became a popular beverage by the mid 1600s . They also introduced the cacao tree into the West Indies and the Philippines.

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*.

4 - Production (Economics of cocoa) :

4 – 1 - World production :

Top Cocoa Producers in *2004*	
(million metric tons)	
Côte d'Ivoire	1.33
Ghana	0.74
Indonesia	0.45
Nigeria	0.37
Brazil	0.17

Cameroon	0.13
Ecuador	0.09
World Total	**3.6**

About 3,000,000 tonnes of cocoa is produced each year. The global production was

The production increased by 131.7 % in 30 years, representing a compound annual growth rate of 2.8 %.

There are three main varieties of cacao: Forastero, Criollo, and Trinitario. The first comprises 95 % of the world production of cocoa, and is the most widely used. Overall, the highest quality cocoa beans come from the Criollo variety, which is considered a delicacy [2]. 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). Hacienda San José, located in Paria/Venezuela, cultivates Criollo beans. The total area of this hacienda is 320 hectares, of which 185 hectares are devoted to cacao with a density of 1.000 plants per hectare. Trinitario is a hybrid between Criollo and Forastero varieties. It is considered to be of much higher quality than the latter is, but has higher yields and is more resistant to disease than the former .

The Netherlands is the leading cocoa processing country, followed by the U.S..

Cocoa and its products (including chocolate) are used worldwide. Per Capita consumption is poorly understood with numerous countries claiming the highest: various reports state that Switzerland, Belgium, and the UK have the highest consumption, but 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 .

The largest cocoa bean producing countries in the world are as follows. The figure gives the production estimates for the 2006–2007 season from the International Cocoa Organization. The percentage is the proportion of the world's total of 3.5 million tonnes for the relevant period.

Country	**Amount produced**	**Percentage of world production**
Côte d'Ivoire	1.3 million tons	37.4%
Ghana	720 thousand tons	20.7%
Indonesia	440 thousand tons	12.7%
Cameroon	175 thousand tons	5.0%
Nigeria	160 thousand tons	4.6%
Brazil	155 thousand tons	4.5%
Ecuador	118 thousand tons	3.4%
Dominican Republic	47 thousand tons	1.4%
Malaysia	30 thousand tons	0.9%

4 – 2 - Harvesting :

Cocoa pods in various stages of ripening

When the pods ripen, they are harvested from the trunks and branches of the Cocoa tree with a curved knife on a long pole. The pod itself is green when ready to harvest, rather than red or orange . Normally, red or orange pods are considered of a lesser quality because their flavors and aromas are poorer ; these are used for industrial chocolate. The seeds are transported to the fermentation area on the plantation, either before or after being removed from the pods.

4 - 3 - Processing :

The harvested pods are opened — typically with a machete — 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 distill alcoholic spirits using the liquefied pulp.

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.

The beans should be dry for shipment (usually by sea) to the United States and Europe. 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' containers. Shipping in bulk significantly reduces handling costs, however shipment in bags, either in a ship's hold or in containers, is still commonly found.

A tiendas de chocolate mill in Oaxaca, where customers can have roasted cocoa beans and spices ground up for chocolate, or roasted chilies ground up for mole.

Throughout Mesoamerica where they are native, cocoa beans are used for a variety of foods. The harvested and fermented beans may be ground up 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, chilies, almonds, vanilla and other spices to create drinking chocolate . The ground up 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. Cocoa Nibs are the dry-roasted pieces of the cocoa bean. These nibs are usually sold in small packages at specialty stores and markets. Nibs can 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 hydraulic press 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 flavonol-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.[14] 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 .

Hollenberg and colleagues of Harvard Medical School studied the effects of cocoa and flavanols on Panama's Kuna Indian population, 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 flavonol - 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.[15][16]

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,[11] one of the JAMA / Archives journals. .

In June 2009 , Mars Botanicals, a division of Mars Inc., the candymaker and food company, launched Cirku, a cocoa extract high in flavanols .

6 - Animal consumption :

Chocolate is a food product with appeal not only to the human population, but to many different animals as well. However, chocolate and cocoa contain a high level of xanthines, specifically theobromine and to a much lesser extent caffeine, that are detrimental to the health of many animals, including dogs and cats. While these compounds have desirable effects in humans, they cannot be efficiently metabolized in many animals and can lead to cardiac and nervous system problems, and if consumed in high quantities, even lead to death. However, since the beginning of the 21st century, some cocoa derivatives with a low concentration of xanthines have been designed by specialized industry to be suitable for pet consumption, enabling the pet food industry to offer animal-safe chocolate and cocoa flavored products . It results in products with a high concentration of fiber and proteins, while maintaining low concentrations of sugar and other carbohydrates, thus enabling it to be used to create healthy functional cocoa pet products .

6 – 1 - Roundtable for a Sustainable Cocoa Economy (RSCE)

An initiative, called the Roundtable for a Sustainable Cocoa Economy (RSCE), has developed from the growing requirement to face the challenges posed by sustainability. It was launched in 2007 by the International Cocoa Organization (ICCO) and is steered by an independent working group with representation of major stakeholders. The mission of the Roundtable is to establish a participatory and transparent process towards economic, environmental and social sustainability in the global cocoa economy. The 1st Roundtable in 2007 brought together more than 200 stakeholders representing 25 countries, including cocoa farmers, government officials from cocoa producing and consuming countries, traders, chocolate manufacturers, donor organizations and national and international NGOs.[*citation needed*]

6 – 2 - Child labor (Children in cocoa production) :

- 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".[22] The ILO later reported that 200,000 children were working in the cocoa industry in Côte d'Ivoire in 2005 .
- The first allegations that child slavery is used in cocoa production appeared in 1998. 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 Protocol is an effort to end these practices. It has, however, been criticized by some groups including the International Labor Rights Forum as an industry initiative which falls short.

6 – 3 – Fairtrade :

- There are Fairtrade cocoa producer groups in Belize, Bolivia, Cameroon, Costa Rica, Dominican Republic, Ecuador, Ghana, Haiti, India, Côte d'Ivoire, Nicaragua, Panama, Peru, and Sierra Leone

7 - Environmental impact :

The relative poverty of many cocoa farmers means that environmental concerns such as deforestation are rarely a major consideration. 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.

8 - Cocoa trading :

Cocoa beans, Cocoa butter and cocoa powder are traded on two world exchanges: NYSE Euronext and Inter continental Exchange (ICE). The London market is based on West African cocoa and New York on cocoa predominantly from South East 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 store for several years in bags or in bulk, during which the owner ship can change several times as the cocoa is traded much the same as metal or other commodities.

5 - History of Chocolate

1 Introduction :

The word "chocolate" entered the English language from Spanish. [1] How the word came into Spanish is less certain, and there are multiple competing explanations. Perhaps the most cited explanation is that "chocolate" comes from Nahuatl, the language of the Aztecs, from the word "chocolatl", which many sources derived from the Nahuatl word "xocolatl" made up from the words "xococ" meaning sour or bitter, and "atl" meaning water or drink . However, as William Bright noted the word "chocolatl" doesn't occur in central Mexican colonial sources making this an unlikely derivation . Santamaria gives a derivation from the Yucatec Maya word "chokol" meaning hot, and the Nahuatl "atl" meaning water. More recently Dakin and Wichman derive it from another Nahuatl term, "chicolatl" from Eastern Nahuatl meaning "beaten drink". They derive this term from the word for the frothing stick, "chicoli". The word *xocoatl* means beverage of maize . The words "cacaua atl" mean drink of cacao. The word “xocolatl” does not appear in Molina’s dictionary .

2 - Chocolate :

Chocolate comes from the fermented, roasted, and ground beans of the cacao or cocoa tree. The word "Chocolate" comes form the Nahualt language of the Aztecs. The Nahualt word xocolatl means bitter water. The pre - Columbian peoples of the Americans drank chocolate mixed with vanilla, chile pepper, and achiote. Europeans sweetened it by adding sugar and milk and removing the chile pepper. They later created a process to make solid chocolate creating the modern chocolate bar. Although cocoa is originally from the Americas, today Western Africa produces almost two-thirds of the world´s cocoa, with Côte d´Ivoire growing almost half of it. Today, it is one of the most popular and recognizable flavors in the world.

There are many foods that contain chocolate such as chocolate bars, candy, ice cream, cookies, cakes, pies, chocolate mousse, and other desserts.

3 - Discovery :

All of the areas that were conquered by the Aztecs that grew cacao beans were ordered to pay them as a tax, or as the Aztecs called it, a "tribute".

Until the 1500s, no European had ever heard of the popular drink from the Central and South American peoples. Jose de Acosta, a Spanish Jesuit missionary who lived in Peru and then Mexico in the later 16th century, wrote of it:

Loathsome to such as are not acquainted with it, having a scum or froth that is very unpleasant taste. Yet it is a drink very much esteemed among the Indians, where with they feast noble men who pass through their country. The Spaniards, both men and women that are accustomed to the country are very greedy of this Chocolate. They say they make diverse sorts of it, some hot, some cold, and some temperate, and put therein much of that "chili"; yea, they make paste thereof, the which they say is good for the stomach and against the catarrh .

4 - Europe :

Christopher Columbus brought some cocoa beans to show Ferdinand and Isabella of Spain, but it was Spanish friars who introduced it to Europe more broadly. It wasn't until the Spanish conquest of the Aztecs that chocolate could be imported to Europe, where it quickly became a court favorite. The first recorded the largest ever shipment to Europe for commercial purposes was in a shipment from Veracruz to Sevilla in 1585 . It was still served as a beverage, but the Europeans added sugar and milk to counteract the natural bitterness and removed the chilli pepper, replacing it with another indigenous Mexican spice , vanilla .

The first chocolate house opened in London in 1657. In 1689, noted physician and collector Hans Sloane developed a milk chocolate drink in Jamaica which was initially used by apothecaries, but later sold to the Cadbury brothers.

For hundreds of years, the chocolate making process remained unchanged. When the Industrial Revolution arrived, many changes occurred that brought the hard, sweet candy to life. In the 1700s, mechanical mills were created that squeezed out cocoa butter, which in turn helped to create hard, durable chocolate. But, it was not until the arrival of the Industrial Revolution that these mills were put to bigger use. Not long after the revolution cooled down, companies began advertising this new invention to sell many of the chocolate treats we see today.When new machines were produced, people began experiencing and consuming chocolate worldwide .

At the end of the 18th century, the first form of solid chocolate was invented in Turin by Doret. This chocolate was sold in large quantities from 1826 by Pierre Paul Caffarel. In 1819, F. L. Cailler opened the first Swiss chocolate factory. In 1828, Dutchman Coenraad Johannes van Houten patented a method for extracting the fat from cocoa beans and making powdered cocoa and cocoa butter. Van Houten also developed the " so – called " Dutch process of treating chocolate with alkali to remove the bitter taste. This made it possible to form the modern chocolate bar. It is believed that the Englishman Joseph Fry made the first chocolate for eating in 1847, followed in 1849 by the Cadbury brothers.

Daniel Peter, a Swiss candle maker, joined his father-in-law's chocolate business. In 1867, he began experimenting with milk as an ingredient. He brought his new product, milk chocolate, to market in

1875. He was assisted in removing the water content from the milk to prevent mildewing by a neighbour, a baby food manufacturer named Henri Nestlé. Rodolphe Lindt invented the process called *conching*, which involves heating and grinding the chocolate solids very finely to ensure that the liquid is evenly blended.

5 - Trade :

Roughly two - thirds of the world's cocoa is produced in Western Africa, with close to half of the total sourced from Côte d'Ivoire. Like many food industry producers, individual cocoa farmers are at the mercy of volatile world markets. The price can vary from between : $ 945 and $ 5,672 per ton in the space of just a few years. While investors trading in cocoa can dump shares at will, individual cocoa farmers can not ramp up production and abandon trees at anywhere near that pace.

Only three to four per cent of "cocoa futures" contracts traded in the cocoa markets ever end up in the physical delivery of cocoa. Every year seven to nine times more cocoa is bought and sold on the exchange than exists.

It has been alleged that an estimated 90 % of cocoa farms in Côte d'Ivoire have used some form of slave labor in order to remain viable.[16] When cocoa prices drop, farmers in West Africa sometimes cut costs by resorting to slave labour.

6 - Hot chocolate

A cup of hot chocolate

Contents

1 – Introduction :

Hot chocolate (also known as *hot cocoa* or just *cocoa*) is a heated beverage typically consisting of shaved chocolate, melted chocolate buds or cocoa powder, heated milk or water, and sugar. **Drinking chocolate** is similar to hot chocolate (or cocoa), but is made from melted chocolate shavings or paste rather than a powdered mix that's soluble in water .

The first chocolate beverage is believed to have been created by the Mayan peoples around 2000 years ago, and a cocoa beverage was an essential part of Aztec culture by 1400 AD. The beverage became popular in Europe after being introduced from Mexico in the New World, and has undergone multiple changes since then. Until the 19th century, hot chocolate was even used medicinally to treat ailments such as stomach diseases. Today, hot chocolate is consumed throughout the world and comes in multiple variations including the very thick *cioccolata densa* served in Italy, and the thinner hot cocoa that is typically consumed in the United States.

2 - History :

Chocolate is made from cocoa beans, the dried and partially fermented seeds of the cacao tree (*Theobroma cacao*), a small (4 – 8 m tall) evergreen tree native to the deep tropical region of the Americas. Recent genetic studies suggest that the most common genotype of the plant originated in the Amazon basin and was gradually transported by humans throughout South and Central America. Early forms of another genotype have also been found in what is now Venezuela. The scientific name, *Theobroma*, means "food of the gods".[3] The fruit, called a cacao pod, is ovoid, 15 – 30 cm long and 8 – 10 cm wide, ripening yellow to orange, and weighs about 500 g when ripe.

The sweet chocolate residue found in jars from the site of Puerto Escondido in Honduras from around 1100 B.C. is the earliest found evidence of the use of cacao to date. An early Classic (460 - 480 A.D) . period Mayan tomb from the site of Rio Azul, Guatemala, had vessels with the Maya glyph for cacao on them with residue of a chocolate drink . The Maya are generally given credit for creating the first modern chocolate beverage over 2,000 years ago, despite the fact that the beverage would undergo many more changes in Europe .

To make the chocolate drink, which was served cold, the Maya ground cocoa seeds into a paste, and mixed it with water, cornmeal, chile peppers, and other ingredients. They then poured the drink back and forth from a cup to a pot until a thick foam developed. Chocolate was available to Maya of all social classes, although the wealthy drank chocolate from elaborately decorated vessels.

By the 1400s, the Aztecs gained control of a large part of Mesoamerica, and adopted cacao into their culture. They associated chocolate with Xochiquetzal, the goddess of fertility,[9] and often used chocolate beverages as sacred offerings . The Aztec adaptation of the drink was a bitter, frothy, spicy drink called *xocolatl*, made much the same way as the Mayan chocolate drinks. It was often seasoned with vanilla, chile pepper, and achiote, and was believed to fight fatigue, which is probably attributable to the theobromine content, a mood enhancer. Because cacao would not grow in the dry central Mexican highlands and had to be imported, chocolate was an important luxury good throughout the Aztec empire, and cocoa beans were often used as currency .

The first European contact with chocolate came when Montezuma (then tlatoani of Tenochtitlan) introduced Hernán Cortés, a Spanish conquistador, to *xocolatl* in the 16th century . What the Spaniards then called " chocolatl " was said to be a beverage consisting of a chocolate base flavored with vanilla and other spices that was served cold . Montezuma's court reportedly drank about 2000 cups of *xocolatl* per day , 50 of which were consumed by Montezuma himself.

Because sugar was yet to come to the Americas , *xocolatl* was said to be an acquired taste. The drink tasted spicy and bitter, unlike modern hot chocolate, which is typically sweet . As to when *xocolatl* was first served hot, sources conflict on when and by whom. However, Jose de Acosta , a Spanish Jesuit missionary who lived in Peru and then Mexico in the later 16th century, described *xocolatl* as:

Loath some to such as are not acquainted with it, having a scum or froth that is very unpleasant taste. Yet it is a drink very much esteemed among the Indians, where with they feast noble men who pass through their country. The Spaniards, both men and women, that are accustomed to the country, are very greedy of this Chocolate. They say they make diverse sorts of it, some hot, some cold, and some temperate, and put therein much of that "chili"; yea, they make paste there of, the which they say is good for the stomach and against the catarrh .

2 – 1 - European adaptation :

After defeating Montezuma's warriors, and demanding that the Aztec nobles hand over their valuables, Cortés returned to Spain in 1528, bringing cocoa beans and chocolate drink making equipment.[14] At this time, chocolate still only existed in the bitter drink invented by the Mayans. Sweet hot chocolate and bar chocolate were yet to be invented .

After its introduction to Europe, the drink slowly gained popularity. The court of King Charles V soon adopted the drink, and what was then only known as "chocolate" became a fashionable drink popular with the Spanish upper class. Additionally, cocoa was given as a dowry when members of the Spanish Royal Family married other European aristocrats . At the time, chocolate was very expensive in Europe because the cacao beans only grew in South America.[16]

The first recorded shipment of chocolate to Europe for commercial purposes was in a shipment from Veracruz to Sevilla in

1585 . It was still served as a beverage, but the Europeans added cane sugar to counteract the natural bitterness and removed the chili pepper while retaining the vanilla, in addition they added cinnamon as well as other spices . Sweet - tasting hot chocolate was then invented , leading hot chocolate to become a luxury item among the European nobility by the 17th century . Even when the first Chocolate House (an establishment similar to a modern coffee shop) opened in 1657, chocolate was still very expensive, costing 50 to 75 pence (approxi mately 50.11-75.17 USD) a pound .

In the late 1600s, Hans Sloane, president of the Royal College of Physicians, visited Jamaica. There, he tried chocolate and considered it "nauseous", but found it became more palatable when mixed with milk.[18] When he returned to England, he brought the recipe with him, introducing milk chocolate to Europe .

In 1828, Coenraad Johannes van Houten developed the first cocoa powder producing machine in the Netherlands . The press separated the greasy cocoa butter from cacao seeds, leaving a purer and less fattening chocolate powder behind. This powder — much like the instant cocoa powder used today — was easier to stir into milk and water, and led to another very important discovery: solid chocolate. By using cocoa powder and low amounts of cocoa butter, bar chocolate was then possible to manufacture. The term "chocolate" then came to mean solid chocolate, rather than hot chocolate.

3 - Terminology :

Americans use the terms "hot chocolate" and "hot cocoa" interchangeably. In other places, a distinction is made between "hot cocoa", made from powder made by removing most of the rich cocoa butter from the ground cacao beans , and " hot chocolate", made directly from bar chocolate, which already contains cocoa, sugar and cocoa butter.[20] Thus the major difference between the two is the cocoa butter, which makes hot cocoa significantly lower in fat than hot chocolate, while still preserving all the intrinsic health-giving properties of chocolate.

Hot chocolate can be made with dark, semisweet, or bittersweet chocolate, chopped into small pieces and stirred into milk with the addition of sugar. American instant hot cocoa powder often includes powdered milk or other dairy ingredients so it can be made without using milk . In the United Kingdom , " hot chocolate " is a sweet chocolate drink made with hot milk or water, and powder containing chocolate, sugar, and powdered milk. "Cocoa" usually refers to a similar drink made with just hot milk and cocoa powder, then sweetened to taste with sugar .

4- Usage

Today, hot chocolate in the form of drinking chocolate or cocoa is considered a comfort food and is widely consumed in many parts of the world.

In the United States, the drink is popular in instant form, made with hot water or milk from a packet containing mostly cocoa powder, sugar, and dry milk . This is the thinner of the two main variations. It is very sweet and may be topped with marshmallows, whipped cream, or a piece of solid chocolate . Hot chocolate was first brought to North America as early as the 1600s by the Dutch, but the first time colonists began selling hot chocolate was around 1755 . Traditionally, hot chocolate has been associated with cold weather, winter, and dessert in the United States, and is now rarely taken with meals .

In Mexico, hot chocolate remains a popular national drink. Besides the instant powder form, traditional Mexican hot chocolate includes semi-sweet chocolate, cinnamon, sugar and vanilla. Hot chocolate of this type is commonly sold in circular or hexagonal tablets which can be dissolved into hot milk, water or cream, then blended until the mixture develops a creamy froth. Mexican cinnamon hot chocolate is traditionally served alongside a variety of Mexican pastries known as *pan dulce* and, as in Spain, churros.

4 – 2 - Europe :

In mainland Europe (and particularly Spain and Italy) , hot chocolate is sometimes served very thick due to the use of a thickening agent such as corn starch. Among the multiple thick forms of hot chocolate served in Europe is the Italian *cioccolata densa*. German variations are also known for being very thick and heavy. Hot chocolate and churros is the traditional working-man's breakfast in Spain. This style of hot chocolate can be extremely thick, often having the consistency of warm chocolate pudding . In the Netherlands, hot chocolate is a very popular drink, known as *chocolademelk*, often served at home or at the cafes. In France, hot chocolate is often served at breakfast time, and sometimes sliced French bread or croissants, spread with butter, jam, honey or Nutella are dunked into the hot chocolate; there are also brands of hot chocolate specially formulated for breakfast time, notably Banania.

Even further variations exist. In some cafes in Belgium and other areas in Europe, one who orders a "*warme chocolade*" or "*chocolat chaud*" would receive a cup of steamed white milk and a small bowl of bittersweet chocolate chips to dissolve in the milk .

5 - Health :

While hot chocolate is generally consumed for pleasure, there are several potential health benefits associated with drinking hot chocolate. Studies have shown that hot chocolate contains large amounts of antioxidants that may be beneficial to one's health. Also, the Cocoa Bean has demonstrated evidence that it helps with digestion.[27] From the 16th to 19th centuries, hot chocolate was valued as a medicine as well as a drink . The explorer Francisco Hernández wrote that chocolate beverages helped treat fever and liver disease. Another explorer, Santiago de Valverde Turices, believed that large amounts of hot chocolate was helpful in treating chest ailments, but in smaller amounts could help stomach disorders. When chocolate was introduced to the French in the 17th century, it was reportedly used "to fight against fits of anger and bad moods", which may be attributed to chocolate's phenyl ethyl amine content. Today, hot chocolate is consumed for pleasure rather than medicinally, but new research suggests that there may be other health benefits attributed to the drink .

On the other hand, several negative effects can be attributed to drinking hot chocolate. Hot chocolate contains high amounts of calories, saturated fat, and sugar.[28] Caffeine found in the cocoa solids in hot chocolate may also have negative effects on health.

5 – 1 - Benefits :

Research has shown that the consumption of hot chocolate can be positive to one's health . A study conducted by Cornell University has shown that hot chocolate contains more antioxidants than wine and tea, therefore reducing the risk of heart disease. In a single serving of cocoa, the researchers found 611 milligrams of gallic acid equivalents (GAE) and 564 milligrams of epicatechin equivalents (ECE), compared with 340 milligrams of GAE and 163 milligrams of ECE in red wine, and 165 milligrams of GAE and 47 milligrams of ECE in green tea . Chang Yong Lee, the professor and researcher at Cornell who conducted the study, revealed that a larger amount of antioxidants are released when the beverage is heated .

The flavonoids found in the cocoa that makes up hot chocolate also have a positive effect on arterial health. A particular study performed by the National Institutes of Health grants and Mars showed high amounts of improvement in blood flow after drinking a flavanol - rich cocoa beverage. In the study, the subjects (27 people ages 18 to 72) drank a cocoa drink containing 900 milligrams of flavonols every day, which resulted in an improvement in blood flow and the function of endothelial cells that line blood vessels.[29] In further studies conducted by Dr. Norman K. Hollenberg, professor of medicine at Brigham and Women's Hospital and Harvard Medical School found that flavonols may also help vessels dilate and help keep platelets from clustering on the blood vessel walls.[29] Flavonoids found in hot chocolate are beneficial to the health mainly because they shield the walls of blood vessels from free radical damage . Flavanols are also thought to help reduce blood platelet buildup and can balance levels of compounds called eicosanoids, which may be beneficial to cardiovascular health .

To get the most benefits, buy cacao in its raw form, instead of a highly processed, inferior form. Raw cocoa apparently contains roughly four times the number of antioxidants than cocoa powder and contains the largest antioxidant value of all natural foods worldwide (Robbins in Mercieca, 2010). Scientists at Cornell University (USA) recently found that raw cocao has approximately double the number of antioxidants of red wine and about three times more antioxidants than green tea (Mercieca, 2010). Importanantly also, cacao beans are high in magnesium (which is a component of bones) and sulphur (helpful to make nails strong and to maintain the health of the liver and pancreas).

Buy raw cocoa powder from health food shops and super markets. Aim for a dark brown powder that tastes bitter (you can sweeten the drink by adding sugar or honey). Heat helps to release antioxidants, so enjoy hot cocoa. However, it's best not to have more than 40 grams a day.

Other benefits of drinking warm raw cocoa you may experience are having your mood enhanced (due to drinking the phenylethylamine in the cocoa) and feeling relaxed (smelling chocolate / cocoa may increase theta brain waves which can increase feelings of relaxation).

An interesting fact about cocoa - Mexican healers used chocolate / cocoa to help people when they had painful insect bites and bronchitis (Mercieca, 2010).

5 – 2 - Risks :

Several negative effects may be attributed to the drinking of hot chocolate. The types and severity of health risks vary between different styles of hot chocolate. Hot chocolate's negative effects are mostly due to the high fat and sugar content in certain types of beverage.

Because of high levels of calories, Small amounts of Trans Fats, saturated fat, and sugars, obesity and dental problems are health risks. The main source of saturated fats in hot chocolate is the cocoa butter found in variations made directly from chocolate rather than cocoa powder. Hot chocolate made from milk also contains the fats and sugars naturally found in milk. Processed cocoa powder usually contains additional sugars. Some brands also contain hydrogenated oils and fats the most common of which are coconut derivatives.

Caffeine found in cocoa may also raise health concerns. Compared to coffee, hot chocolate has only minimal amounts of caffeine — a typical eight ounce cup of hot chocolate contains nine milligrams of caffeine, while an eight ounce cup of coffee may contain up to 133 milligrams depending on the brand. As such, caffeine is not a major health concern associated with hot chocolate. It has also been proved small amounts of caffeine have many benefits .

7 - Theobroma cacao

Ripe Cacao fruit pods, ready for processing or consumption

Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Malvales
Family:	Malvaceae
Genus:	*Theobroma*
Species:	***T. cacao***
Binomial name	
Theobroma cacao L.	

1 – Introduction :

Theobroma cacao (Mayan: *kakaw*, Nahuatl: *Cacahuatl*), also **cacao tree** and **cocoa tree**, is a small (4 – 8 m or 15 – 26 ft tall) evergreen tree in the family Sterculiaceae (alternatively Malvaceae), native to the deep tropical region of the Americas. Its seeds are used to make cocoa powder and chocolate. There are two prominent competing hypotheses about the origins of the domestication of the originally wild *Theobroma cacao* tree. One is that wild examples were originally distributed from southeastern Mexico to the Amazon basin, with domestication taking place both in the Lacandon area of Mexico and in lowland South America. But recent studies of *Theobroma cacao* genetics seem to show that the plant originated in the Amazon and was distributed by humans throughout Central America and Mesoamerica.

The tree is today found growing wild in the low foothills of the Andes at elevations of around 200 – 400 m in the Amazon and Orinoco river basins. It requires a humid climate with regular rainfall and good soil. It is an understory tree, growing best with some overhead shade. The leaves are alternate, entire, unlobed, 10 – 40 cm long and 5 – 20 cm broad. Poisonous and inedible, they are filled with a creamy, milky liquid and taste spicy and unpleasant.

The flowers are produced in clusters directly on the trunk and older branches; they are small, 1 – 2 cm diameter, with pink calyx. While many of the world's flowers are pollinated by bees (Hymenoptera) or butter flies / moths (Lepidoptera) , cacao flowers are pollinated by tiny flies, *Forcipomyia* midges in the order Diptera. The fruit, called a cacao pod, is ovoid, 15 – 30 cm long and 8 – 10 cm wide, ripening yellow to orange, and weighs about 500 g when ripe. The pod contains 20 to 60 seeds, usually called "beans", embedded in a white pulp. Each seed contains a significant amount of fat (40 – 50 %) as cocoa butter. Their most noted active constituent is theobromine, a compound similar to caffeine.

The scientific name *Theobroma* means "food of the gods". The word *cacao* itself derives from the Nahuatl (Aztec language) word *cacahuatl*, learned at the time of the conquest when it was first encountered by the Spanish. Similar words for the plant and its by -

products are attested in a number of other indigenous Mesoamerican languages .

2 - History of cultivation :

Cultivation, cultural elaboration and use of cacao were extensive and early in Mesoamerica. Studies of the *Theobroma cacao* tree genetics suggests a domestication and spread from lowland Amazonia, contesting an earlier hypothesis that the tree was domesticated independently in both the Lacandon area of Mexico, and in Amazonia. The cacao tree belongs to the Theobroma genus, in the Sterculiaceae family, that contains 22 species. Today, the most common of the cultivated species is *Theobroma cacao*, with two subspecies and three forms. Wild cacaos falling into two groups. The South American subspecies spaerocarpum has a fairly smooth melon-like fruit. In contrast, the Mesoamerican cacao subspecies has ridged, elongated fruits. At some unknown early date, the subspecies T. cacao reached the southern lowlands of Mesoamerica and came into wide usage.

The Maya believed that the *kakaw* (cacao) was discovered by the gods in a mountain that also contained other delectable foods to be used by the Maya. According to Maya mythology, the Plumed Serpent gave cacao to the Maya after humans were created from maize by divine grandmother goddess Xmucane (Bogin 1997, Coe 1996, Montejo 1999, Tedlock 1985). The Maya celebrated an annual festival in April to honor their cacao god, **Ek Chuah**, an event that included the sacrifice of a dog with cacao colored markings; additional animal sacrifices; offerings of cacao, feathers and incense; and an exchange of gifts. In a similar creation story, the Mexica (Aztec) god Quetzalcoatl discovered cacao (*cacahuatl*: "'bitter water"'), in a mountain filled with other plant foods (Coe 1996, Townsend 1992). Cacao was offered regularly to a pantheon of Mexica deities and the Madrid Codex depicts priests lancing their ear lobes (autosacrifice) and covering the cacao with blood as a suitable sacrifice to the gods.

The cacao beverage as ritual were used only by men, as it was believed to be toxic for women and children.

There are several mixtures of cacao described in ancient texts, for ceremonial, medicinal uses as well as culinary purposes. Some mixtures included maize, chili, vanilla *(Vanilla planifolia)*, peanut butter and honey. Archaeological evidence for use of cacao, while relatively sparse, has come from the recovery of whole cacao beans at Uaxactun , Guatemala (Kidder 1947) and from the preservation of wood fragments of the cacao tree at Belize sites including Cuello and Pulltrouser Swamp (Hammond and Miksicek 1981; Turner and Miksicek 1984) . In addition, analysis of residues from ceramic vessels has found traces of theobromine and caffeine in early formative vessels from Puerto Escondido, Honduras (1100 - 900 B.C.) and in middle formative vessels from Colha, Belize (600-400 B.C.) using similar techniques to those used to extract chocolate residues from four classic period (ca. 400 A.D.) vessels from a tomb at the archaeological site of Rio Azul. As cacao is the only known commodity from Mesoamerica containing both of these alkaloid compounds, it seems likely that these vessels were used as containers for cacao drinks. In addition, cacao is named in a hieroglyphic text on one of the Rio Azul vessels. Cacao was also believed to be ground by the Aztecs and mixed with tobacco for smoking purposes.

The first Europeans to encounter cacao were Christopher Columbus and his crew in 1502, when they captured a canoe at Guanaja that contained a quantity of mysterious-looking “almonds.” The first real European knowledge about chocolate came in the form of a beverage which was first introduced to the Spanish at their meeting with Moctezuma in the Aztec capital of Tenochtitlan in 1519. Cortez and others noted the vast quantities of this beverage that the Aztec emperor consumed, and how it was carefully whipped by his attendants beforehand . Examples of cacao beans along with other agricultural products were brought back to Spain at that time, but it seems that the beverage made from cacao was introduced to the Spanish court in 1544 by Kekchi Maya nobles brought from the New World to Spain by Dominican friars to meet Prince Philip (Coe and Coe 1996) . Within a century, the culinary and medical uses of chocolate had spread to France, England and elsewhere in Western Europe. Demand for this beverage led the French to establish cacao plantations in the Caribbean, while Spain subsequently developed their cacao plantations in their Philippine colony (Bloom 1998, Coe 1996). The Nahuatl - derived Spanish word cacao entered scientific nomenclature in 1753 after the Swedish naturalist Linnaeus published his taxonomic binomial system and coined the genus and species *Theobroma* (" food of the gods ") *cacao* .

Traditional pre - Hispanic beverages made with cacao are still consumed in Mesoamerica. These include the Oaxacan beverage known as tejate.

3 - Currency system :

Cacao beans constituted both a ritual beverage and a major currency system in pre - Columbian Mesoamerican civilizations. At one point the Aztec empire received a yearly tribute of 980 loads (xiquipil in nahuatl) of cacao, in addition to other goods. Each load represented exactly 8,000 beans.[2] The buying power of quality beans was such that 80-100 beans could buy a new cloth mantle. The use of cacao beans as currency is also known to have spawned counterfeiters during the Aztec empire .

In some areas, such as Yucatán, cacao beans were still used in place of small coins as late as the 1840s .

4 - Cultivation :

Cacao is cultivated on over 70,000 km² (27,000 mi²) worldwide. Statistics from FAO[4] Food and Agriculture Organization (FAO) for 2005 are as follows:

Rank, Country	Value (Int $ 1,000)	Production MT
1 Côte d'Ivoire	1,024,339	1,330,000
2 Ghana	566,852	736,000
3 Indonesia	469,810	610,000
4 Nigeria	281,886	366,000
5 Brazil	164,644	213,774
6 Cameroon	138,632	180,000
7 Ecuador	105,652	137,178
8 Colombia	42,589	55,298
9 Mexico	37,281	48,405
10 Papua New Guinea	32,733	42,500
11 Malaysia	25,742	33,423
12 Dominican Republic	24,646	32,000
13 Peru	21,950	28,500
14 Venezuela	13,093	17,000
15 Sierra Leone	8,472	11,000
16 Togo	6,547	8,500
17 India	6,161	8,000
18 Philippines	4,352	5,650
19 Congo, Rep.	4,336	5,630
20 Solomon Islands	3,851	5,000

Cacao production has increased from 1.5 million tons in 1983 - 1984 to 3.5 million tons in 2003 - 2004, an increase that has almost entirely been due to the expansion of the production area rather than to yield increases. Cacao is grown both by large agro-industrial plantations and also by small producers.

A tree begins to bear when it is four or five years old. A mature tree may have 6,000 flowers in a year, yet only about 20 pods. About 300-600 seeds (10 pods) are required to produce 1 kg of cocoa paste.

There are three main cultivar groups of cacao beans used to make cocoa and chocolate . The most prized, rare, and expensive is the Criollo Group, the cocoa bean used by the Maya. Only 10% of chocolate is made from Criollo, which is less bitter and more aromatic than any other bean. The cacao bean in 80 % of chocolate is made using beans of the Forastero Group. Forastero trees are significantly hardier than Criollo trees, resulting in cheaper cacao beans. Trinitario, a hybrid of Criollo and Forastero, is used in about 10 % of chocolate.

Part 3

ALMOND , GRAIN & SOY MILK

1 - Almond milk

1 – Introduction :

Almond milk is a milky drink made from ground almonds. Unlike animal milk, almond milk contains no cholesterol or lactose. It can be used as a substitute for animal milk in many recipes, and is also completely vegan. Commercial almond milk products such as brand *Almond Breeze*, come in plain, vanilla, or chocolate flavors. They are often enriched with vitamins. It can also be made at home by combining ground almonds with water in a blender. Vanilla flavoring and sweeteners are often added. However, users should be cautious not to use bitter almonds, since the combination of bitter almonds and water releases cyanide.

2 – Health :

Almond milk is promoted as a healthy alternative to cow's milk for reasons including :

- It lacks casein
- It is safe for people with lactose intolerance or milk allergy
- Contains far less saturated fat than cow's milk.

Almond milk is also promoted as an alternative to soy milk for those with soy allergies, or those who wish to avoid soy due to its estrogenic properties or hexane content.

3 - History :

In the Middle Ages, almond milk was known in both the Islamic world and Christendom, where its vegetable composition — being a nut that is the seed of a fruit of a plant — made it suitable for consumption during Lent. Almond milk was also a staple of medieval kitchens because cow's milk would not keep for long without spoiling, and would usually be turned into butter or cheese immediately.

2 - Grain milk

Rice milk in a cup.

Grain milk is a milk substitute made from fermented grain or from flour. Grain milk can be made from oats, spelt, rice, rye, einkorn wheat or quinoa.

Grain milk looks very similar to cow's milk. It has a lower protein content and a higher carbohydrate content than cow's milk. Just as cow's milk is often fortified, grain milks may have calcium and some vitamins (especially B_{12}) added to them.

Grain milk is low in saturated fat and contains no lactose, which is beneficial for those who are lactose intolerant. Grain milk also lacks milk protein, making it suitable for vegans and people with milk allergies.

Flavored grain milk can come in plain, vanilla, chocolate or a variety of other flavors. Like unflavored grain milk, it is often available with added nutrients. There are also grain milk cream and desserts available.

3 - Soy milk

Soy milk

Contents :

1 – Introduction :

Soy milk (also called **soya milk**, **soymilk**, **soybean milk**, or **soy juice**) and sometimes referred to as **soy drink/beverage** is a beverage made from soybeans. A stable emulsion of oil, water, and protein, it is produced by soaking dry soybeans and grinding them with water. Soy milk contains about the same proportion of protein as cow's milk: around 3.5 %; also 2 % fat, 2.9 % carbohydrate, and 0.5 % ash. Soy milk can be made at home with traditional kitchen tools or with a soy milk machine.

The coagulated protein from soy milk can be made into Tofu, just as dairy milk can be made into cheese.

2 – Origins :

The oldest evidence of soy milk production is from China where a kitchen scene proving use of soy milk is incised on a stone slab dated around A.D. 25 – 220. It also appeared in a chapter called Four Taboos (Szu-Hui) in the A.D. 82 book called *Lunheng* by Wang Chong, possibly the first written record of soy milk . Evidence of soy milk is rare prior to the 20th century and widespread usage before then is unlikely.

According to popular tradition in China, soy milk was developed by Liu An for medicinal purposes, although there is no historical evidence for this legend . This legend appeared in the late 15th century in Bencao Gangmu , where Li was attributed to the development of tofu with no mention of soy milk . Later writers in Asia and the West additionally attributed development of soy milk to Liu An, assuming that he could not have made tofu without making soy milk . However, it is also likely that Liu An has been falsely attributed to the development of tofu by writers after his time .

3 - Cultural terms :

The most common Chinese terms for soy milk are (Pinyin : *dòu jiāng* ; lit. *bean + a thick liquid*) .

The Japanese term for soy milk is *tōnyū* .

In Korea , is the word for representing soy milk . and represent soy and milk respectively.

In Singapore, it is known as *tau-huey-tzui* , POJ : tau hoe chúi) in the local Hokkien dialect while in Malaysia it is known as "susu soya" or "air tauhu" in the local Malay language.

4 – Prevalence :

Greek Café Frappé prepared with soy milk ,
topped with additional cinnamon

Plain soy milk is unsweetened, although some soy milk products are sweetened. Salted soy milk is prevalent in China.

The drink is very popular in the hawker culture of Malaysia, with it being a standard offering accompanying meals at Malaysian Chinese stalls. In Malaysia, soybean milk is usually flavoured with either white or brown sugar syrup. The consumer also has the option to add grass jelly, known as *leong fan* or "cincau" (in the Malay language) to the beverage. Sellers of soybean milk in Penang usually also offer bean curd, a related custard - like dessert, known to the locals as *tau hua* which is flavored with the same syrup as the soybean milk. In Indonesian is known as "susu kedele". Yeo's, a drink manufacturer in Singapore and Malaysia, markets a commercialized tinned or boxed version of soybean milk .

In the West, soymilk has become a popular alternative to cow's milk, with a roughly similar protein and fat content.[5] Soy milk is commonly available in vanilla and chocolate flavors as well as its original unflavored form. In some Western countries where veganism has made inroads, it is available upon request at cafés and coffee franchises as a cow's milk substitute.

5 – Health :

5 – 1 - Health benefits :

Soy milk has about the same amount of protein (though not the same amino acid profile) as cow's milk. Natural soy milk contains little digestible calcium as it is bound to the bean's pulp, which is insoluble in humans. To counter this, many manufacturers enrich their products with calcium carbonate available to human digestion. Unlike cow's milk, it has little saturated fat and no cholesterol. Soy products contain sucrose as the basic disaccharide, which breaks down into glucose and fructose. Since soy doesn't contain galactose, a product of lactose breakdown, soy - based infant formulas can safely replace breast milk in children with galactosemia.

Soy milk is promoted as a healthy alternative to cow's milk for reasons including:

- Source of lecithin and vitamin E
- Lacks casein
- It is safe for people with lactose intolerance or milk allergy
- Contains far less saturated fat than cow's milk.
- Contains isoflavones, organic chemicals that may possibly be beneficial to health.

In 1995, the New England Journal of Medicine (Vol.333 , No . 5) published a report from the University of Kentucky entitled "Meta-Analysis of the Effects of Soy Protein Intake on Serum Lipids." It was financed by Solae LLC of St. Louis . This meta-analysis concluded that soy protein is correlated with significant decreases in serum cholesterol, low density lipoprotein (LDL , bad cholesterol) , and triglyceride concentrations. However, high density lipoprotein (HDL , good cholesterol) did not increase. Soy phytoestrogens (isoflavones: genistein and daidzein) absorbed onto the soy protein were suggested as the agent reducing serum cholesterol levels.[7] In 1998, on the basis of this research, Solae LLC predecessor PTI filed a petition with FDA for a health claim that soy protein may reduce cholesterol and the risk of heart disease . The U.S. Food and Drug Administration granted this health claim for soy: "25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." One serving of soy milk (1 cup or 240 mL), for instance, contains 6 or 7 grams of soy protein.

In January 2006, an American Heart Association review (in the journal *Circulation*) of a decade-long study of soy protein benefits cast doubt on the FDA-allowed "Heart Healthy" claim for soy protein. The panel also found that soy isoflavones do not reduce post - menopause "hot flashes" in women, nor do isoflavones help prevent cancers of the breast, uterus, or prostate. Among the conclusions, the authors state,

"In contrast, soy products such as tofu, soy butter, soy nuts, or some soy burgers should be beneficial to cardiovascular and overall health because of their high content of polyunsaturated fats, fiber, vitamins, and minerals and low content of saturated fat. Using these and other soy foods to replace foods high in animal protein that contain saturated fat and cholesterol may confer benefits to cardiovascular health " .

5 – 2 - Negative health effects :

- A 2008 study found that men who consume an average of half a portion of soy products per day are more likely to have a lower concentration of sperm . The study found a decreasing trend in sperm concentration correlated with the amount of isoflavones consumed as part of a soy rich diet. The study acknowledges further broader replication is required as it focused predominantly on overweight Caucasian men . It also concludes by mentioning two other studies, one of which found no correlation between soy intake and sperm levels in men, and one that found a positive correlation between soy intake and sperm levels in men .

- High levels of phytic acid bind to important nutrients like calcium, magnesium, iron,[12] and zinc during digestion. However, cow's milk is known for significantly slowing the absorption of iron and calcium from non-dairy sources, *e.g.*, kale and sesame .

5 – 3 - Potential medicinal use :

It has been reported that soy proteins help to reduce polycystic kidney diseases by attenuating cytosolic phospholipase A2 . However, Sankaran *et al.* and Harold *et al.* argued that the dietary treatment can only help to ease the symptoms but not cure the disease, and yet it is individual dependent . Ogborn *et al.* found that polyunsaturated fatty acids play crucial roles to obtain the benefits of the soy protein dietary treatment .

6 – Preparation :

Soy milk can be made from whole soybeans or full - fat soy flour. The dry beans are soaked in water overnight or for a minimum of 3 hours or more depending on the temperature of the water . The rehydrated beans then undergo wet grinding with enough added water to give the desired solids content to the final product. The ratio of water to beans on a weight basis should be about 10:1. The resulting slurry or purée is brought to a boil in order to improve its nutritional value by heat inactivating soybean trypsin inhibitor, improve its flavor and to sterilize the product. Heating at or near the boiling point is continued for a period of time, 15 – 20 minutes, followed by the removal of an insoluble residue (soy pulp fiber or *okara*) by filtration.

There is a simple yet profound difference between traditional Chinese and Japanese soy milk processing: the Chinese method boils the filtrate (soy milk) after a cold filtration, while the Japanese method boils the slurry first, followed by hot filtration of the slurry. The latter method results in a higher yield of soy milk but requires the use of an anti-foaming agent or natural defoamer during the boiling step. Bringing filtered soy milk to a boil avoids the problem of foaming. It is generally opaque, white or off - white in color, and approximately the same consistency as cow's milk .

For all raw soybean protein products, heat is necessary to destroy the activity of the protease inhibitors naturally present in the soybean. The pancreas naturally secretes proteases to digest a protein meal. Eating raw soybeans on a regular basis causes the pancreas to hypersecrete, leading to benign tumors of the pancreas.

When soybeans absorb water, the endogenous enzyme, Lipoxygenase (LOX) , EC 1.13.11.12 linoleate : oxido reductase, catalyzes a reaction between polyunsaturated fatty acids and oxygen {hydroperoxidation}. LOX initiates the formation of free radicals, which can then attack other cell components. Soybean seeds are the richest known sources of LOXs. It is thought to be a defensive mechanism by the soybean against fungal invasion.

In 1967, experiments at Cornell University and the New York State Agricultural Experiment Station at Geneva, NY led to the discovery that paint – like , off - flavors of traditional soy milk can be prevented from forming by a rapid hydration grinding process of dehulled beans at temperatures above 80 °C. The quick moist heat treatment inactivates the LOX enzyme before it can have a significant negative effect on flavor. All modern bland soy milks have been heat treated in this manner to destroy LOX.

Normal mature soybeans actually contain three LOX isozymes (SBL - 1 , SBL – 2 , and SBL – 3) important for undesirable flavor development. One or more of these isozymes have recently (1998) been removed genetically from soybeans yielding soy milk with less cooked beany aroma and flavor and less astringency. An example of a triple LOX - free soybean is the American soybean named "Laura".

The University of Illinois has developed a soy milk that makes use of the entire soybean. What would normally constitute "insolubles" are ground so small by homogenization as to be in permanent suspension.

Commercial products labeled "soy drink" in the West are often derivatives of soy milk containing more water or added ingredients.

7 – Cooking :

A bowl of soy milk soup seasoned with salt and vinegar, with vegetables and wonton dumplings.

Bottled soy milk as sold in Thailand

Soy milk is found in many vegan and vegetarian food products and can be used as a replacement for cow's milk in many recipes.

"Sweet" and "salty" soy milk are both traditional Chinese breakfast foods, served either hot or cold, usually accompanied by breads like mantou (steamed rolls), *youtiao* (deep-fried dough), and shaobing (sesame flatbread). The soy milk is typically sweetened by adding cane sugar or, sometimes, simple syrup. "Salty" soy milk is made with a combination of chopped pickled mustard greens, dried shrimp and, for curdling, vinegar, garnished with *youtiao* croutons, chopped scallion (spring onions), cilantro (coriander), meat floss (肉鬆; *ròu sōng*), or shallot as well as sesame oil, soy sauce, chili oil or salt to taste.

Soy milk is used in many kinds of Japanese cuisine, such as in making yuba as well as sometimes a base soup for nabemono.

In Korean cuisine, soy milk is used as a soup for making *kongguksu*, cold noodle soup eaten mostly in summer . Tofu is produced from soy milk by further steps of curdling and then draining. Soy milk is also used in making soy yogurt and soy kefir.

8 - Nutrition and health information :

Nutrients in 8 ounces (250 ml) of plain soy milk :

	Regular Soymilk	**Lite Soymilk (reduced fat)**	**Whole cow milk**	**Fat - free cow milk**
Calories (g)	140	100	149	83
Protein (g)	10.0	4.0	7.7	8.3
Fat (g)	4.0	2.0	8.0	0.2
Carbohydrate (g)	14.0	16.0	11.7	12.2
Lactose (g)	0.0	0.0	11.0	12.5
Sodium (mg)	120	100	105	103
Iron (mg)	1.8	0.6	0.07	0.07
Riboflavin (mg)	0.1	11.0	0.412	0.446
Calcium (mg)	80.0	80.0	276	299

9 - Ecological impact :

Using soybeans to make milk instead of raising cows may be ecologically advantageous, because the amount of soy that could be grown using the same amount of land would feed more people than if used to raise cows . This is debated: grazing land for animals, which requires fewer pesticides, is very different from land used to farm . However, cows require much more energy in order to produce milk, since the farmer must feed the animal, which consumes 40 kilo grams of food and 90 to 180 litres of water a day , while a soy bean needs merely fertilization, water, and land . Because the soybean plant is a legume, it also replenishes the nitrogen content of the soil in which it is grown.

In Brazil, the explosion of soybean cultivation has led to losing large tracts of forest land leading to ecological damage . However, these cleared forests are planted with soy intended for animal agricultural enterprises, not for human consumption

The American soil scientist Dr. Andrew McClung was the first to devise a method to grow soybeans in the Cerrado region of Brazil. He was awarded with the 2006 World Food Prize .

Part 4

CANDY , GELATINE ,

SUCCADE & TOFFEE

1 - Aspic

An aspic with chicken and eggs.

1 – Introduction :

Aspic is a dish in which ingredients are set into a gelatin made from a meat stock or consommé. It is also known as cabaret. Similar dishes, made with commercial gelatin mixes instead of stock or consommé, are usually called gelatin salads.

When cooled, stock made from meat congeals because of the natural gelatin found in the meat. The stock can be clarified with egg whites, and then filled and flavored just before the aspic sets. Almost any type of food can be set into aspics. Most common are meat pieces, fruits, or vegetables. Aspics are usually served on cold plates so that the gel will not melt before being eaten. A meat jelly that includes cream is called a *chaud* - *froid*.

Nearly any type of meat can be used to make the gelatin: pork, beef, veal, chicken, turkey, or fish. Gelatin is also found in cartilage.

The aspic may need additional gelatin in order to set properly. Veal stock provides a great deal of gelatin; in making stock, veal is often included with other meat for that reason. Fish consommés usually have too little natural gelatin, so the fish stock may be double-cooked or supplemented. Since fish gelatin melts at a lower temperature than gelatins of other meats, fish aspic is more delicate and melts more readily in the mouth.

2 - History :

Historically, meat jellies were made before fruit and vegetable jellies. By the Middle Ages at the latest, cooks had discovered that a thickened meat broth could be made into a jelly. A detailed recipe for aspic is found in *Le Viandier*, written in around 1375.

Aspic is an ingredient than a dish. Aspic, made from clarified stock and gelatin, is used for many things; it can be used as a binder to hold other ingredients together in terrines, or sealers in such foods as pate en croute.

Today, aspic is often used to glaze show pieces in food competitions to make the food glisten, making it more appealing to the eye, but its original use was to prolong the shelf life of food. Since the aspic was used to glaze the entire item, it cut off the oxygen supply to the food, preventing bacteria within from multiplying.

In Poland (known as " galareta ") , in Latvia (similarly known as "galerts") , in Russia (known as "kholodets"), in Serbia (known as "pihtije"), a

nd in Romania (known as "piftie" or "răcituri") aspic often takes the form of pork jelly, and it is popular around the Christmas and Easter Holidays.

2 - Candied fruit

	
Candied fruit displayed at La Boquería in Barcelona	*Candied orange peel*

1 – Introduction :

Candied fruit, also known as **crystallized fruit** or **Glacé fruit**, has been around since the 14th century. Whole fruit, smaller pieces of fruit, or pieces of peel, are placed in heated sugar syrup which absorbs the moisture from within the fruit and eventually preserves it. Depending on size and type of fruit, this process of preservation can take from several days to several months .

The continual process of drenching the fruit in syrup causes the fruit to become saturated with sugar, preventing the growth of spoilage microorganisms due to the unfavourable osmotic pressure this creates.

Fruits which are commonly candied include dates, cherries, pineapple, and ginger.

Recipes vary from region to region, but the general principle is to boil the fruit, steep it in increasingly strong sugar solutions for a number of weeks, and then dry off any remaining water.

The high sugar content of finished glacé fruits inhibits the growth of microorganisms, and glacé fruits will keep for a number of years without any additional methods of preservation.

Fruits that hold up well to being preserved in this manner include cherries, plums, peaches, apricots, pears, starfruit, pineapple, apples, melons and citrus fruits. Angelica is rarely seen in western cooking except as a glacé fruit.

3 - Candy

	
Multicolored sugar – and -glaze coated chocolate buttons	*A selection of various kinds of fruit , liquorice, and salty liquorice flavoured candy.*

Contents :

1 – Introduction :

Candy, specifically **sugar candy**, is a confection made from a concentrated solution of sugar in water, to which flavorings and colorants are added. Candies come in numerous colors and varieties and have a long history in popular culture.

The word "candy" comes from the Sanskrit "çahn-da", meaning "piece of sugar " , In North America, *candy* is a broad category that includes candy bars, chocolates, licorice, sour candies, salty candies, tart candies, hard candies, taffies, gumdrops, marshmallows, and more . Vegetables, fruit or nuts glazed and coated with sugar are called *candied*. Candy is considered unhealthy by many .

Outside North America, the generic name for candy is **sweets** or **confectionery** (UK, Ireland, Australia, New Zealand, South Africa and other Commonwealth countries). In Australia and New Zealand, sweets are, in normal usage, further categorized as either *chocolate* or *lollies* (for all other non-chocolate candies).

In North America, the UK, and Australia, the word *lollipop* refers specifically to sugar candy with flavoring on a stick. While not used in the generic sense of North America, the term *candy* is used in the UK for specific types of foods such as *candy floss* (*cotton candy* in North America and *fairy floss* in Australia), and certain other sugar based products.

2 – Manufacture :

	
Jellybeans	*Hard candy*

Candy is made by dissolving sugar in water or milk to form a syrup, which is boiled until it reaches the desired concentration or starts to caramelize. The type of candy depends on the ingredients and how long the mixture is boiled. Candy comes in an endless variety of textures from soft and chewy to hard and brittle. Some examples of candy are: caramel candy, toffee, fudge, praline, tablet, gumdrops, jelly beans, rock candy, lollipops, taffy, cotton candy, candy canes, peppermint sticks, peanut brittle, chocolate-coated raisins or peanuts, hard candy (called *boiled sweets* in British English) and candy bars.

2 – 1 -Sugar stages :

The final texture of candy depends on the sugar concentration. As the syrup is heated, it boils, water evaporates, the sugar concentration increases, and the boiling point rises. A given temperature corresponds to a particular sugar concentration. In general, higher temperatures and greater sugar concentrations result in hard, brittle candies, and lower temperatures result in softer candies. These "stages" of sugar cooking are:[2]

Stage	Temperature in °C	Sugar concentration
thread	110 -111°C	80 %
soft ball (e.g., fudge)	112 -115 °C	85 %
firm ball	118 -120 °C	87 %
hard ball	121 -130 °C	92 %
soft crack	132 -143 °C	95 %
hard crack (e.g., toffee)	146 -154 °C	99%
clear liquid	160 °C	100 %
brown liquid (caramel)	170 °C	100 %
burnt sugar	177 °C	100 %

The names come from the process used to test the syrup before thermometers became affordable: a small spoonful of syrup was dropped into cold water, and the characteristics of the resulting lump were evaluated to determine the concentration of the syrup. Long strings of hardened sugar indicate "thread" stage, while a smooth lump indicates "ball" stages, with the corresponding hardness described. The "crack" stages are indicated by a ball of candy so brittle that the rapid cooling from the water literally causes it to crack.

This method is still used today in some kitchens. A candy thermometer is more convenient, but has the drawback of not automatically adjusting for local conditions such as altitude, as the cold water test does.

Once the syrup reaches 340 °F (171 °C) or higher, the sucrose molecules break down into many simpler sugars, creating an amber-colored substance known as caramel. This should not be confused with caramel candy, although it is the candy's main flavoring.

2 – 2 - Candy and vegetarianism :

Some candy, including marshmallows and gummi bears, contain gelatin derived from animal collagen, a protein found in skin and bones, and is thus avoided by vegetarians and vegans. "Kosher gelatin" is also unsuitable for vegetarians and vegans, as it is derived from fish bones . Other substances, such as agar, pectin, starch and gum arabic may be used as gelatin replacers, although the texture of the final product may differ from the original.

Other ingredients commonly found in candy that are not vegetarian or vegan friendly include: carmine, which is a dye made from the cochineal; and confectioner's glaze, which may contain wings or other insect parts.

3 - Shelf life :

The shelf life of candy can be anywhere from two weeks to much more than a year . This may be shortened, if the candy is not stored in a cool, dry place.

4 - Health aspects :

4 – 1 - Cavities :

Candy generally contains sugar, and sugar can lead to damaged teeth. However, it is not sugar itself that damages the teeth. Several types of bacteria, particularly *Streptococcus mutans*, are present in the mouth, and these feed on sugar. When they metabolize the sugar, they create acids in the mouth which demineralize the tooth enamel and can lead to dental caries.[5] To help prevent this, dentists recommend that individuals should brush their teeth regularly, particularly after every meal and snack.

4 – 2 - Glycemic index :

Candy has a high glycemic index (GI), which means that it causes a high rise in blood sugar levels, after ingestion. This is chiefly a concern for people with diabetes, but could also be dangerous to the health of non-diabetics.

5 - Packaging

Candy can be packaged in various ways, from "individually wrapped" pieces such as AirHeads and Frooties to candy bars to bulk packs. A "candy wrapper" is a common term .

4 - Candy apple

	
A candy apple	*Taffy apple with peanuts*

1 – Introduction :

A **candy apple** is a whole apple covered in a hard candy coating. The topping varies from place to place. *Toffee apples*, popular in the United Kingdom, use hot toffee as a coating. *Caramel apples* or *taffy apples* are created by dipping or rolling the apples in hot caramel, sometimes then rolling them in nuts or other small savories or confections, and allowing them to cool.

They are almost always served with a stick of sorts in the middle making them easier to eat.

2 - Composition :

Classically, the preferred apples for use in candy apples are tart, crisp apples such as Granny Smith or Fuji apples. Softer, grainy-textured apples can also be used, but are not preferred.

The most common "candy" in the United States is a hard coating of cooled sugar syrup, usually tinted red and sometimes flavored with cinnamon. The sugar syrup is heated to the "hard crack" stage before coating the apple to make a hard coating when the syrup cools. Other variations include caramel or taffy apples, and chocolate apples.

Alternately, for the high - volume production of caramel apples, a sheet of caramel can be wrapped around the apple, followed by heating of the apple to melt the caramel evenly onto it. This creates a harder caramel that is easier to transport but more difficult to eat. Caramel apple production at home usually involves melting pre-purchased caramel candies for dipping, or making a homemade caramel from ingredients like brown sugar, butter, and vanilla. Homemade caramel generally results in a softer, creamier coating.

In recent years, it has become increasingly popular to decorate caramel apples for holidays like Halloween. Methods used to do this include applying sugar or salt to softened caramel, dipping cooled, hardened apples in white or milk chocolate, or painting designs onto finished caramel apples with white chocolate colored with food coloring .

3 - History

According to the *Newark Evening News* 1964 :

William W. Kolb invented the red candy apple. Kolb, a veteran Newark candy-maker, produced his first batch of candied apples in 1908. While experimenting in his candy shop with red cinnamon candy for the Christmas trade, he dipped some apples into the mixture and put them in the windows for display. He sold the whole first batch for 5 cents each and later sold thousands yearly. Soon candied apples were being sold along the Jersey Shore, at the circus and in candy shops across the country, according to the Newark News in 1948.

4 - Seasonal popularity :

Candy apples are a common treat at autumn festivals in Western culture in the Northern Hemisphere, such as Halloween and Guy Fawkes Night because these festivals fall in the wake of the annual apple harvest .

In Latin American countries, candy apples are popular throughout those countries' extended holiday season. Caramel apples are more popular in much of the United States, with candy apples unknown in some regions . In Germany they are most often associated with the Christmas season. They are also sometimes sold at carnivals and fairs. In China, a similar treat called Tanghulu is made by coating small fruits (traditionally hawthorns) with hard sugar syrup.

5 - Candy Bar

A candy bar broken in half showing a biscuit and caramel interior, Twix brand

1 – Introduction :

A **chocolate bar** is a confection in bar form comprising some or all of the following components: cocoa solids, cocoa butter, sugar, milk. The relative presence or absence of these components form the subclasses of dark chocolate, milk chocolate, and white chocolate. In addition to these main ingredients, it may contain emulsifiers such as soy lecithin and flavors such as vanilla. There are many varieties of chocolate; milk chocolate, dark chocolate, white chocolate, peanut butter chocolate, and many more.

A **candy bar** (called a **chocolate bar** in British English, Australian English and Canadian English) is a form of confectionery usually packaged in a bar or log form, often coated with chocolate, and sized as a snack for one person. But within that term, a wide variety of products exist, ranging from solid chocolate bars to multiple layerings or mixtures of ingredients such as nuts, fruit, caramel or fondant.

Certain brands of chocolate bars are sold as being for nutritional supplementation purposes. These bars contain protein and various vitamins while still retaining a sweet taste.

2 – History :

Up to and including the 19th century, candy of all sorts was typically sold by weight, loose, in small pieces that would be bagged as bought. The introduction of chocolate as something that could be eaten as is, rather than used to make beverages or desserts, resulted in the earliest bar forms, or tablets. At some point, *chocolates* came to mean any chocolate-covered candies, whether nuts, creams (fondant), caramel candies, or others. The candy bar evolved from all of these in the late-19th century as a way of packaging and selling candy more conveniently, for both buyer and seller. This "convenience" did not include price, of course, as the buyer had to pay for the packaging. It was considerably cheaper to buy candy loose, or in bulk.

Although chocolate bars and candy bars had their beginnings in the 19th century, it was in the early-20th century that this confectionery commercial venture grew most rapidly. The first wrapped chocolate bar, which is still being produced, was the Hershey bar, produced by The Hershey Company in 1900. A number of the bars developed in that era still exist in relatively unchanged form. In the U.S., most candy bars started out priced at ten cents, down to five cents during the Great Depression, and back to ten after World War II. This price remained stable until the late 1960s.

During the first half of the 20th century in the U.S., there were thousands of different candy bars being manufactured and distributed locally or regionally by small candy companies. Some of these still survive, but a few major manufacturers have taken over the marketplace, buying up smaller companies and reproducing the most popular of their candy bars. Today candy bars are made and consumed all over the world, and manufactured to local tastes and environmental conditions.

6 - Caramel corn

Caramel corn

Caramel corn is a confection made of popcorn covered in caramel or molasses, creating a sweet, crunchy treat. Mixes of caramel corn often contain nuts, like peanuts or almonds. Certain types of caramel corn are made with a white sugar-based caramel rather than the traditional brown sugar versions, for a lighter and more buttery flavor. The combination of caramel and corn dates back at least as far as the 1890s with Cracker Jacks. There are many commercial forms of caramel corn available, such as Cracker Jack, Fiddle Faddle and Lolly Gobble Bliss Bombs. Other caramelized flavorings may also be used. Chocolate, strawberry, watermelon, coconut, green apple, and blueberry are the most commonly found flavors, though many more often exist in specialized candy shops. These flavors of caramel corn can often be found in candy shops and specialized stores within malls and milk bars. In the past, it has been wrapped around the Christmas tree as a decoration. In many stores it could also be called cream brule.

7 - Gelatin

Contents

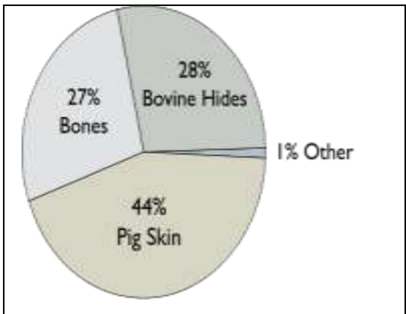
1 – Introduction :

Gelatin (spelled 'gelatine' in some Commonwealth countries from the French *gélatine*) is a translucent, colorless, brittle (when dry), nearly tasteless solid substance, derived from the collagen inside animals' skin and bones. It is commonly used as a gelling agent in food, pharmaceuticals, photography, and cosmetic manufacturing. Substances containing gelatin or functioning in a similar way are called *gelatinous*. Gelatin is an irreversibly hydrolysed form of collagen, and is classified as a foodstuff, with E number E441. It is found in some gummy candies as well as other products such as marshmallows, gelatin dessert, and some low-fat yogurt. Household gelatin comes in the form of sheets, granules, or powder. Instant types can be added to the food as they are; others need to be soaked in water beforehand. Some dietary or religious customs forbid the use of gelatin from certain animal sources, and medical issues may limit or prevent its consumption by certain people.

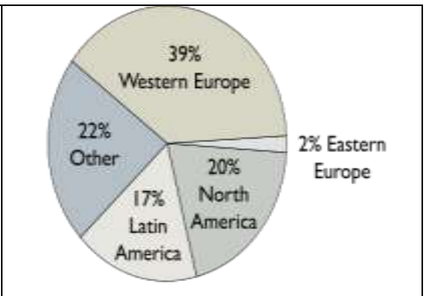
2 - Composition and properties :

Gelatin is a protein produced by partial hydrolysis of collagen extracted from the boiled bones, connective tissues, organs and some intestines of animals such as domesticated cattle, pigs, and horses. The natural molecular bonds between individual collagen strands are broken down into a form that rearranges more easily. Gelatin melts to a liquid when heated and solidifies when cooled again. Together with water, it forms a semi - solid colloid gel. Gelatin forms a solution of high viscosity in water, which sets to a gel on cooling, and its chemical composition is, in many respects, closely similar to that of its parent collagen . Gelatin solutions show viscoelastic flow and streaming birefringence. If gelatin is put into contact with cold water, some of the material dissolves. The solubility of the gelatin is determined by the method of manufacture. Typically, gelatin can be dispersed in a relatively concentrated acid. Such dispersions are stable for 10 – 15 days with little or no chemical changes and are suitable for coating purposes or for extrusion into a precipitating bath. Gelatin is also soluble in most polar solvents. Gelatin gels exist over only a small temperature range, the upper limit being the melting point of the gel, which depends on gelatin grade and concentration and the lower limit, the freezing point at which ice crystallizes. The mechanical properties are very sensitive to temperature variations, previous thermal history of the gel, and time. The viscosity of the gelatin/water mixture increases with concentration and when kept cool (≈ 4 °C) .

3 - Production :



Materials Used in Gelatin Production



Gelatin Production by Geography

The world wide production amount of gelatin is about 300,000 tons per year (roughly 660 million lb). On a commercial scale, gelatin is made from by-products of the meat and leather industry. Recently, fish by - products have also been considered because they eliminate some of the religious obstacles surrounding gelatin consumption [2]. Gelatin is derived mainly from pork skins, pork and cattle bones, or split cattle hides ; contrary to popular belief, cheese is not used . ref name = "gmia" > "Gelatine information , news , history and more". Gelatine Manufacturers Institute of America.

Gelatin can also be prepared in the home. Boiling certain cartilaginous cuts of meat or bones will result in gelatin being dissolved into the water. Depending on the concentration, the resulting broth (when cooled) will naturally form a jelly or gel. This process, for instance, may be used for the *pot-au-feu* dish.

While there are many processes whereby collagen can be converted to gelatin, they all have several factors in common. The intermolecular and intramolecular bonds which stabilize insoluble collagen rendering it insoluble must be broken, and the hydrogen bonds which stabilize the collagen helix must also be broken . The manufacturing processes of gelatin consists of three main stages:

1. Pretreatments to make the raw materials ready for the main extraction step and to remove impurities which may have negative effects on physiochemical properties of the final gelatin product,
2. The main extraction step, which is usually done with hot water or dilute acid solutions as a multi - stage extraction to hydrolyze collagen into gelatin, and finally,
3. The refining and recovering treatments including filtration, clarification, evaporation, sterilization, drying, rutting, grinding, and sifting to remove the water from the gelatin solution, to blend the gelatin extracted, and to obtain dried, blended and ground final product.

3 – 1 - Pretreatments :

If the physical material that will be used in production is derived from bones, dilute acid solutions should be used to remove calcium and similar salts. Hot water or several solvents may be used for degreasing. Maximum fat content of the material should not exceed 1% before the main extraction step. If the raw material is hides and skin, size reduction, washing, removing hair from the hides, and degreasing are the most important pretreatments used to make the hides and skins ready for the main extraction step. Raw material preparation for extraction is done by three different methods: acid, alkali, and enzymatic treatments. Acid treatment is especially suitable for less fully crosslinked materials such as pig skin collagen. Pig skin collagen is less complex than the collagen found in bovine hides. Acid treatment is faster than alkali treatment and normally requires 10 to 48 hours. Alkali treatment is suitable for more complex collagen, e.g., the collagen found in bovine hides. This process requires longer time, normally several weeks. The purpose of the alkali treatment is to destroy certain chemical crosslinkages still present in collagen. The gelatin obtained from acid treated raw material has been called type-A gelatin, and the gelatin obtained from alkali treated raw material is referred to as type-B gelatin. Enzymatic treatments used for preparing raw material for the main extraction step are relatively new. Enzymatic treatments have some advantages in contrast to alkali treatment. Time required for enzymatic treatment is short, the yield is almost 100 % in enzymatic treatment, the purity is also higher, and the physical properties of the final gelatin product are better.

3 – 2 - Extraction :

After preparation of the raw material, i.e., reducing crosslinkages between collagen components and removing some of the impurities such as fat and salts, partially purified collagen is converted into gelatin by extraction with either water or acid solutions at appropriate temperatures. All industrial processes are based on neutral or acid pH values because though alkali treatments speed up conversion, they also promote degradation processes. Acid extract conditions are extensively used in the industry but the degree of acid varies with different processes. This extraction step is a multi stage process, and the extraction temperature is usually increased in later extraction steps. This procedure ensures the minimum thermal degradation of the extracted gelatin.

3 – 3 - Recovery :

This process includes several steps such as filtration, evaporation, sterilization, drying, grinding , and sifting. These operations are concentration-dependent and also dependent on the particular gelatin used. Gelatin degradation should be avoided and minimized, therefore the lowest temperature possible is used for the recovery process. Most recoveries are rapid, with all of the processes being done in several stages to avoid extensive deterioration of the peptide structure. A deteriorated peptide structure would result in a low gelling strength, which is not generally desired.

4 - Uses .

Probably best known as a gelling agent in cooking, different types and grades of gelatin are used in a wide range of food and non-food products: Common examples of foods that contain gelatin are gelatin desserts, trifles, aspic, marshmallows , and confectioneries such as Peeps, gummy bears and jelly babies .

Gelatin may be used as a stabilizer , thickener , or texturizer in foods such as jams, yoghurt, cream cheese, and margarine; it is used, as well, in fat-reduced foods to simulate the mouthfeel of fat and to create volume without adding calories.

Gelatin is used for the clarification of juices, such as apple juice, and of vinegar. Isinglass, from the swim bladders of fish, is still used as a fining agent for wine and beer . Beside hartshorn jelly, from deer antlers (hence the name " hartshorn") , isinglass was one of the oldest sources of gelatin. Gelatine was used for hardening paper in Colonial times.

4 – 1 - Technical uses :

Capsules made of gelatin.

- Certain professional lighting equipment uses color gels to change the beam color. These used to be made with gelatin, hence the term color gel.
- Gelatin typically constitutes the shells of pharmaceutical capsules in order to make them easier to swallow. Hypromellose is a vegan - acceptable alternative to gelatin, but is more expensive to produce.
- Animal glues such as hide glue are essentially unrefined gelatin.
- It is used to hold silver halide crystals in an emulsion in virtually all photographic films and photographic papers. Despite some efforts, no suitable substitutes with the stability and low cost of gelatin have been found.
- Used as a carrier, coating or separating agent for other substances; for example, it makes beta-carotene water-soluble

thus imparting a yellow colour to any soft drinks containing beta-carotene.

- Gelatin is closely related to bone glue and is used as a binder in match heads and sandpaper.
- Cosmetics may contain a non-gelling variant of gelatin under the name hydrolyzed collagen.
- As a surface sizing, it smooths glossy printing papers or playing cards and maintains the wrinkles in crêpe paper.

4 - 2 - Other uses :

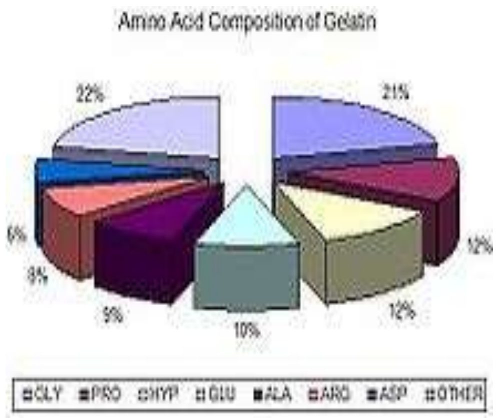
- Blocks of ballistic gelatin simulate muscle tissue as a standardized medium for testing firearms ammunition.
- Gelatin is used by synchronized swimmers to hold their hair in place during their routines as it will not dissolve in the cold water of the pool. It is frequently referred to as "knoxing," a reference to Knox brand gelatin .
- When added to boiling water and cooled, unflavored gelatin can make a home-made hair styling gel that is cheaper than many commercial hair styling products, but by comparison has a shorter shelf life (about a week) when stored in this form (usually in a refrigerator). After being applied to scalp hair, it can be removed with rinsing and some shampoo.
- It is commonly used as a biological substrate to culture adherent cells.
- Also used by those who are sensitive to tannins (which can irritate the stomach) in teas, soups or brews.
- It may be used as a medium with which to consume LSD. LSD in gelatin form is known as "windowpane" or "geltabs."
- Gelatin is used to make the shells of paintballs, similar to the way pharmaceutical capsules are produced.
- Gelatin is also used as an ingredient in implantable medical devices, such as in some bone void fillers. Doctors should discuss this with their patients in cases where religious beliefs might be important.
- Gelatin is also used in makeup applications. The gelatin is often tinted in different colors to match the models natural skin tone.

5 - Religion and gelatin substitutes .

Special kinds of gelatin indicate the specific animal origin that was used for its production. For example, Muslim halal or Jewish kosher customs may require gelatin from sources other than pigs, from animals slaughtered ritually, or from fish. Similarly, vegetarians and vegans of any religion may choose not to eat foods containing gelatin made from animals.

An alternative source of gelatin substitutes could be natural gel sources such as agar - agar (a seaweed), carrageenan, pectin, or konjak. However, alternative sources can be associated with health problems of their own .

6 - Medical and nutritional properties :



Amino acid composition

Although gelatin is 98 – 99 % protein by dry weight, it has less nutritional value than many other protein sources. Gelatin is unusually high in the non - essential amino acids glycine and proline (i.e., those produced by the human body), while lacking certain essential amino acids (i.e., those not produced by the human body) . It contains no tryptophan and is deficient in isoleucine, threonine, and methionine. The approximate amino acid composition of gelatin is: glycine 21% , proline 12 %, hydroxyproline 12 % , glutamic acid 10 % , alanine 9%

, arginine 8 %, aspartic acid 6 % , lysine 4 % , serine 4 % , leucine 3% , valine 2 %, phenylalanine 2 % , threonine 2%, isoleucine 1% , hydroxylysine 1% , methionine and histidine < 1 % and tyrosine < 0.5 %. These values vary, especially the minor constituents, depending on the source of the raw material and processing technique.

Gelatin is one of the few foods that cause a net loss of protein if eaten exclusively. In the 1960s, several people died of malnutrition while on popular liquid protein diets.

For decades, gelatin has been touted as a good source of protein. It has also been said to strengthen nails and hair. The human body itself produces abundant amounts of the proteins found in gelatin.

Several Russian researchers offer the following opinion regarding certain peptides found in gelatin: " gelatin peptides reinforce resistance of the stomach mucous tunic to ethanol and stress action, decreasing the ulcer area by twice " .

Gelatin has also been claimed to promote general joint health. A study at Ball State University sponsored by Nabisco, the former parent company of Knox gelatin , found that gelatin supplementation relieved knee joint pain and stiffness in athletes .

7 - Safety concerns :

Strict regulations apply for all steps in the gelatin manufacturing process. Gelatin is produced from natural raw materials which originate from animals that have been examined and accepted for human consumption by veterinary authorities. Hygienic regulations with respect to fresh raw materials are ensured and each batch of raw material delivered to the manufacturing plant is immediately checked and documented.

In addition to the raw material quality, also the production process itself is an effective quality assurance measure. In the production process a comprehensive monitoring system ensures that potential risks are minimized. In USA, the Food and Drug Administration (FDA) , with support from the TSE (Transmissible spongiform encephalopathy) Advisory Committee, has since 1997 been monitoring the potential risk of transmitting animal diseases, especially bovine spongiform encephalopathy (BSE) . This study has evidence that the gelatin manufacturing process itself is an effective barrier against the proliferation of possible BSE prions. The tests were based on a worst case scenario where the raw material came from BSE-infected cattle. No BSE prions could be detected in the gelatin produced by several manufacturing methods. Injections of these gelatins into the brain of experimental animals gave no establishment of TSE diseases. The Scientific Steering Committee (SSC) of the European Union (EU) in 2003 stated that the risk associated with bovine bone gelatin is very low or zero . In 2006 the European Food Safety Authority (EFSA) stated that the SSC opinion was confirmed, that the BSE risk of bone - derived gelatin was very small , and removed support for the 2003 request of excluding the skull and vertebrae of bovine origin older than 12 months from the material used in gelatin manufacturing .

All reputable gelatin manufacturers today follow the Quality Management System according to ISO 9001 to comply with all required physical, chemical, microbiological and technical production and quality standards. In this way all process steps follow international laws and customer-specific quality parameters and are guaranteed and documented. For pharmaceutical grade gelatins strict regulations from the Food and Drug Administration (FDA) , the European CPMP's regulation and European Pharmacopoeia must be met .

8 - Gelatin Dessert

	
A variety of pre-packaged gelatin dessert products	*A packet of gelatin dessert cubes, known as jelly in the UK*

1 – Introdution :

Gelatin desserts are desserts made with sweetened gelatin.

They can be made by combining plain gelatin with other ingredients, or by using a premixed blend of gelatin with other additives. Popular brands of commercial mixes include Jell-O and Knox gelatin from Kraft Foods in North America, Royal in Argentina and Uruguay, Hartley’s (formerly Rowntree’s) in the United Kingdom and Aeroplane Jelly in Australia.

Fully-prepared gelatin desserts are marketed in a variety of forms, ranging from large decorative shapes to individual serving cups and small gummy candies.

2 - Regional naming :

- In many of the Commonwealth Nations gelatin desserts are called **jelly**.
- In the United States and Canada gelatin desserts are called **gelatin**, **gels** and **jello** (generic name based on the brand name Jell - O) .

3 - History :

Before gelatin became widely available as a commercial product, the most typical gelatin dessert was "calf's foot jelly". As the name indicates, this was made by extracting and purifying gelatin from the foot of a calf; this gelatin was then sweetened and flavored with fruit juice and additional sugar, if necessary.

4 - Preparation

To make a gelatin dessert, gelatin is dissolved in hot liquid with the desired flavors and other additives. These latter ingredients usually include sugar, fruit juice, or sugar substitutes; they may be added and varied during preparation, or pre-mixed with the gelatin in a commercial product which merely requires the addition of hot water.

In addition to sweeteners, the prepared commercial blends generally contain, flavoring agents, and other additives such as adipic acid, fumaric acid, sodium citrate, and artificial flavorings and food colors. Because the collagen is processed extensively, the final product is not categorized as a meat or animal product by the US federal government.

The solubility of powdered gelatin can be enhanced by sprinkling it into the liquid several minutes before heating, "blooming" the individual granules . The fully dissolved mixture is then refrigerated, slowly forming a colloidal gel as it cools.

Gelatin desserts may be enhanced in many ways, such as using decorative molds, creating multicolored layers by adding a new layer of slightly cooled liquid over the previously-solidified one, or suspending non - soluble edible elements such as marshmallows or fruit. Some types of fresh fruit and their unprocessed juices are incompatible with gelatin desserts ; see the Chemistry section below.

When fully chilled, the most common ratios of gelatin to liquid (as instructed on commercial packaging) usually results in a custard - like texture which can retain detailed shapes when cold but melts back to a viscous liquid when warm. Higher gelatin ratios can be used to increase the stability of the gel, culminating in gummy candies which remain rubbery solids at room temperature.

4 – 1 - Gelatin shots :

A tray of gelatin shots prior to refrigeration

Gelatin shots, often known as **jello shots** in North America and **vodka jelly** or **jelly shots** in the UK and Australia, are a party food where some sort of alcohol, usually rum, vodka, tequila or sometimes even grain alcohol replaces some of the water or fruit juice used to congeal the gel.

The American satirist and mathematician Tom Lehrer has been rumored to have been the first to invent the gelatin shot in the 1950s while working for the National Security Agency, where he developed vodka gelatin as a way to circumvent a restriction of alcoholic beverages on base , but the claim that he was first is untrue . The earliest published recipe dates from 1862, found in *How to Mix Drinks, or The Bon Vivant's Companion* by Jerry Thomas: the recipe calls for gelatin, cognac, rum, and lemon juice .

The maximum alcohol content is somewhere between 19 and 20 oz. of vodka mixed with a 3 oz. package of gelatin powder dissolved in 4 oz. of boiling water; the resulting solution has about 30% alcohol by volume.

4 – 2 - Other gelling agents :

Some gelatinous desserts can be made with agar instead of gelatin, allowing them to congeal more quickly and at higher temperatures (40 °C , as opposed to 15 °C for gelatin) . Agar is a gelatinous product made from seaweed, which is itself composed mainly of algae. Agar is especially common in quick jelly powder mix and Asian jelly desserts; additionally, vegans and vegetarians sometimes use agar to replace animal - derived gelatin. Agar is more closely related to pectin and other gelling plant carbohydrates than to gelatin.

Another vegetarian alternative to gelatin is carrageenan. This alternative sets more firmly than agar, and is often used in kosher and halaal cooking. Though it, too, is a type of seaweed, it tends not to have an unpleasant smell during cooking as agar sometimes does.

Konjac is a gelling agent used in many Asian foods, including the popular konnyaku fruit jelly candies.

5 - Chemistry :

Gelatin consists of partially hydrolyzed collagen, a protein which is highly abundant in some animal tissues such as bone and skin. Although many gelatin desserts incorporate fruit, some fresh fruits contain proteolytic enzymes; these enzymes cut the gelatin molecule into peptides too small to form a firm gel. The use of such fresh fruits in a gelatin recipe results in a dessert that never 'sets'.

Specifically, pineapple contains the protease (protein cutting enzyme) bromelain, kiwi fruit contains actinidin, figs contain ficain, and both papaya and pawpaw contain papain. Cooking or canning denatures and inactivates the proteases, so canned pineapple, for example, works fine in a gelatin dessert.

6 - Safety :

While eating tainted beef can lead to variant Bovine spongiform encephalopathy (mad - cow or BSE) in humans, there are no known cases of BSE transmitted through collagen products such as gelatin .

9 - Gum Drop

Glowing gumdrops.

1 – Introduction :

Gum drops are a type of confectionery (candy). They are usually brightly-colored gelatin- or pectin - based pieces, shaped like a truncated cone and coated in granulated sugar. This makes them very sweet. Gumdrops come in (usually artificial) fruit and spice varieties; the latter are also known as spice drops. They are often used for decorating cakes and cupcakes. Around Christmas time this candy is an ingredient used in making gingerbread houses.

2 - Spice Drops

Spice drops are a variation of the basic gumdrop, but are distinctly different in the flavorings that are used. Instead of the typical fruit flavors that are found in regular gumdrops, spice drops tend to have sharp spicy flavors like cinnamon, mint, cardamom, among other flavors. They are also generally larger and wedge shaped.

The spice drop color / flavor code is generally as follows [but varies by manufacturer]: orange is cloves, yellow is allspice, red is cinnamon, green is spearmint, purple is cardamom or anise, white is wintergreen or peppermi

10 - Gummy candies

Swedish Fish, gummi bears and gummi worms

1 – Introduction :

gummy candies or **Jelly sweets** are a gelatin based chewy candy.

Gummi bears are the most popular and well known of the gummy candies. Other traditional versions include Cola bottles, Fizzy Blue Bottles, worms, frogs , hamburgers, cherries, soda bottles, sharks, army men, hippopotami, lobsters, watermelons, octopuses, apples, peaches, oranges, and even Ampelmännchen and Smurfs.

2 – History :

Gummies have a long history as a popular confectionery. The candy was invented by the father of Hans Riegel in 1922.

In 2008, R.M. Palmer Co. signed agreement with Ringling Bros. and Barnum & Bailey to become a licensee producing seasonal novelty gummies sold in bags, boxes or tins.

3 - Types of gummies

3 – 1 - Cola bottles :

Cola bottles are sweets in the shape of Coca - Cola bottles.

3 – 2 - Fizzy Blue Bottles :

Fizzy Blue Bottles are sweets typically found in a Pick N Mix Selection. They are very similar to Cola bottle gummies in shape, but are blue and pink coloured. They are usually sour, and generally cost a penny.

Fizzy Blue Bottles are made by Lutti, which was then purchased by French division of the Leaf Candy Company and is now controlled by a private investment group.

Blue bottles, a variation, have small rims around the sides, and are chewier and thicker with a less sour taste.

3 – 3 - Trolli Road Kill Gummies :

In February 2005, following complaints by the New Jersey Society for the Prevention of Cruelty to Animals, Kraft Foods decided to stop production of Trolli Road Kill Gummies. The society complained that the products, shaped as partly flattened squirrels, chickens and snakes, would give children an incorrect message on the proper treatment of animals.

4 - Health considerations :

Along with chocolate, chocolate chips and buttons, fudge, chocolate coated nuts and fruit, bubble gum, lollipops, toffee, jelly beans, marshmallows, sherbet, and Turkish Delight, gummies landed on the "What's out in 2009" list for some Canadian schools . An audit in parts of Victoria, British Columbia is planned for 2009 to ensure the government ban on selling the goodies in school canteens and vending machines is obeyed .

Scientists have studied adding tooth - protecting sugar substitute xylitol to gummies to fight tooth decay. Dietary supplement gummies with guarana, vitamin C, vitamin B and other additives are also on the market.

11 - Jelly

1 - Introduction :

Jelly may refer to :

- Gelatin, a translucent brittle solid substance, extracted from the collagen inside animals' connective tissue
    - Gelatin dessert .
- Fruit preserves, called 'jelly' in North America .
- Aspic, a dish containing broth with gelatin, served cold
    - Salve, medical ointment
- Naval jelly, phosphoric acid in a rust removing gel
- Royal jelly, made by bees and fed to the larvae to turn them into queen bees
- Temazepam, a powerful hypnotic drug, street name "Jellies"
- The vitreous humour of the eyes

1 - In **confectionery**:

- Jelly bean, small and usually have a hard candy shell and chewy interior
- Jelly baby, a type of soft confectionery in the shape of babies in a variety of colours
- Swedish Fish, a type of quasi-gummi chewy candies shaped like fish
    - Gumdrop, brightly-colored gelatin- or pectin-based pieces, shaped like a truncated cone and coated in granulated sugar

2 - In **technology** :

- Apache Jelly, a Java and XML based scripting and processing engine for turning XML into executable code

12 - Jelly Baby

	
Bassett Jelly Babies	*Jelly babies*

1 – Intrduction :

Jelly babies are a type of soft confectionery that look like little babies in a variety of colours. They are very popular in the United Kingdom. There are currently several companies that make jelly babies, most predominantly Trebor Bassett (part of the Cadbury Group of companies, and famous for their liquorice allsorts) and also Rowntree (Nestlé).

Jelly Babies were launched by Bassett's in 1919 in Sheffield as "Peace Babies" to mark the end of World War I. Production was suspended during World War II due to wartime shortages and the fact that the name had largely become ironic. In 1953 the product was relaunched as "Jelly Babies". In March 1989 Bassett's were taken over by Cadbury Schweppes who had earlier acquired the Trebor brand.

Jelly Babies manufactured in the United Kingdom tend to be dusted in starch which is left over from the manufacturing process where it is used to aid release from the mould. Jelly Babies of Australian manufacture generally lack this coating.

Like many gummy sweets, they contain gelatin and are thus not suitable for vegetarians.

A popular science class experiment is to put them in a strong oxidising agent and see the resulting spectacular reaction. The experiment is commonly referred to as " Screaming jelly babies " .

Each Bassett's Jelly Baby now has an individual name and shape, colour and flavour: Brilliant (red – straw berry) , Bubbles (yellow - lemon), Baby Bonny (pink – rasp berry) , Boofuls (green - lime), Bigheart (purple – black currant) and Bumper (orange). The introduction of different shapes and names was a new innovation, circa 1989, prior to which all colours of jelly baby were a uniform shape.

Jelly Babies are similar in appearance to Gummi bears, which are better known outside of the United Kingdom, though the texture is different, Jelly Babies having a harder outer "crust" and a softer, less rubbery, centre.

13 - List of candies

Candy canes

Candy has a l **Contents**

1 – Introduction :

ong history as a popular food treat available in a large varieties. Candy is also referred to as sweets or confectionery.

Candy varieties are influenced by the size of the sugar crystals, aeration, sugar concentrations and the types of sugar used . Jelly candies, such as gumdrops and gummies, use stabilizers including starch, pectin or gelatin . Simple sugar or sucrose is turned into candy by dissolving it in water, concentrating this solution through cooking and allowing the mass either to form a mutable solid or to recrystallize Other sugars, sugar substitutes, and corn syrup are also used.

2 - Western candies :

Western candy marshmallow been sold as penny candy in general stores as well as in stores selling exclusively candy.

2 – 1 - Caramels

Caramels are made by cooking sugar and water together.

2 – 2 - Chocolate :

Caramel and Cookie covered in Milk Chocolate

2 - 3 - Gummies :

Gummies are gelatin based chewy candies that come in a variety of shapes, colors and flavors.

2 – 4 - Hard candy :

Hard candies and suckers are sugar based candies that are sucked on until they're softened enough or thin enough to bite into. jollyrancher

Among the artisanal hard candies, the "pirulin", also known as the "Heng Jia" in Northern China, is a famous one in several Spanish-speaking countries, like Argentina, Mexico and Chile and its popularity has spread to certain parts of Greater Asia.

2 – 5 - Licorice :

Licorice (liquorice) is a semi - soft candy that was originally flavored with a root extract of the Eurasian plant liquorice (*Glycyrrhiza glabra*), of the Fabaceae (legume) family.[4] As a candy, they are often black with licorice flavor or red and strawberry or cherry flavored .

2 – 6 - Lollies .

Lollipops or Lollies are hard candies on a stick.

2 – 7 - Sours :

Sours are popular for their cringe inducing flavor and acidity.

3 - Gum :

Chewing gum, often referred to as gum and sometimes referred to as bubblegum, is a chewy candy.

4 - Japanese candy :

Chewy rice candies wrapped in a thin layer of edible rice paper that dissolves in the mouth. A children's sticker is included in every box.

14 - List of chewing gum brands Confectionery

An arrangement of confections

1 Introduction :

Confectionery is the set of food items that are rich in sugar, any one or type of which is called a confection. Modern usage may include substances rich in artificial sweeteners as well. The word candy (U.S.A.) or **sweets** (U.K.) is also used for the extensive variety that compose confectionery. Generally speaking, confections are low in nutritional value but rich in calories. Specially formulated chocolate has been manufactured in the past for military use due to its high concentration of calories.

2 - Regional names :

Different dialects of English use regional terms for *confections*:

- In Britain, Ireland and some Commonwealth countries, *sweets* or more colloquially *sweeties* (particularly used by children, *sweeties* also resembles the Scottish Gaelic word *suiteis* in pronunciation and meaning[*citation needed*]). In some parts of England, *spogs*, *spice*, *joy joy* and *goodies* are terms used, alongside *sweets*, to denote *confectionery*. In North-West England, especially Lancashire, *toffees* is often used as a generic term for all confectionery. Northeast England and the Scottish Borders commonly use the word *ket* (plural *kets*) and more recently *chud*, derivative of *chuddy*, a localised term for chewing gum.

- In Australia and New Zealand, "*lollies*".
- In North America, "*candy*" - although this term can also refer to a specific range of confectionery and does not include some items called confectionery (e.g. pastry) (See below and the separate article on candy.) "**Sweets**" is occasionally used, as well as "**treat**"

3 - Examples

Columns of sweets

Confectionery items include sweets, lollipops, candy bars, chocolate, candy floss, and other sweet items of snack food. The term does not generally apply to cakes, biscuits, or puddings which require cutlery to consume, although exceptions such as petit fours or meringues exist. Speakers of American English do not refer to these items as "candy". See candy making for the stages of sugar-cooking.

Some of the categories and types of confectionery include the following :

- Hard sweets: Based on sugars cooked to the hard-crack stage, including suckers (known as *boiled sweets* in British English), lollipops, jawbreakers (or gobstoppers), lemon drops, peppermint drops and disks, candy canes, rock candy, etc. These also include types often mixed with nuts such as brittle. Others contain flavorings including coffee such as Kopiko.
- Fudge: A confection of milk and sugar boiled to the soft-ball stage. In the US, it tends to be chocolate-flavored.
- Toffee (or Taffy or Tuffy): Based on sugars cooked to the soft-ball stage and then pulled to create an elastic texture. In British English, *toffee* can also refer to a harder substance also made from cooked sugars which resembles toffee.
- Tablet. A crumbly milk - based soft and hard candy, based on sugars cooked to the soft - ball stage. Comes in several forms, such as wafers and heart shapes.
- Liquorice : Containing extract of the liquorice root. Chewier and more resilient than gum/gelatin candies, but still designed for swallowing. For example, Liquorice allsorts. Has a similar taste to Star Anise.

- Chocolates are bite-sized confectioneries. People who create chocolates are called **chocolatiers**, and they create their confections with couverture chocolate. A **chocolate maker**, on the other hand, is the person who physically creates the couverture from cacao beans and other ingredients.
- Jelly candies: Including those based on sugar and starch, pectin, gum, or gelatin such as Lokum / Turkish Delight, jelly beans, gumdrops, jujubes, cola bottles gummies, etc.
- Marshmallow: "Peeps" (a trade name), circus peanuts, fluffy puff, etc.
- Marzipan: An almond-based confection, doughy in consistency, served in several different ways. It is often formed into shapes mimicking (for example) fruits or animals. Alternatively, marzipan may be flavoured, normally with spirits such as Kirsch or Rum, and divided into small bite-sized pieces;

these flavoured marzipans are generally served coated in chocolate to prevent the alcohol from evaporating, and are very common in northern Europe. Marzipan is also used in cake decoration. Its lower-priced version is called Persipan.

- Divinity: A nougat-like confectionery based on egg whites with chopped nuts.

Not all confections equate to "candy" in the American English sense. Non-candy confections include:

- Mithai: A generic term for confectionery in India, typically made from dairy products and/or some form of flour. Sugar or molases are used as sweeteners.
- Pastry: A baked confection whose dough is rich in butter, which was dispersed through the pastry prior to baking, resulting in a light, flaky texture; see also pie and tart.
- Chewing gum: Uniquely made to be chewed, not swallowed. However, some people believe that at least some types of chewing gum, such as certain bubble gums, are indeed candy.
- Ice cream: Frozen flavoured cream, often containing small chocolates and fruits .
- Halvah: Confectionery based on tahini, a paste made from ground sesame seeds.
- Alfajor: a traditional South American cookie typically consisting of two round sweet biscuits joined together with a sweet jam, generally dulce de leche (milk jam).
- Dragée - Coated almonds and other types of coated candy.

4 - Risks :

Excessive consumption of confectionery has been associated with increased incidences of type 2 diabetes, obesity, and tooth decay .

15 - Sunkist Fruit Gems

A package of Sunkist Fruit Gems.

Sunkist Fruit Gems are Half Dollar sized pectin candies.

They are a soft round candy made from confectionery sugar with fruit flavors. Fruit Gems are made by Jelly Belly, which purchased prior manufacturer, The Ben Myerson Candy Company, under license for Sunkist. They contain real fruit pectin, natural flavors and are fatless.

Fruit Gems come in a mix of lemon, orange, grapefruit, lime and raspberry flavors. There are two seasonal mixes: a Christmas mix, including green lime and red raspberry; and a Halloween mix, with orange and black licorice.

Sunkist Gourmet Fruit Gems don’t contain Gluten, or any wheat by - product in them. Tree nuts (almonds and peanuts) are processed in the same plant for chocolate peanut clusters and almond clusters.

16 - Swedish Fish

Three Swedish Fish: yellow, green, and red. Each has "Swedish" embossed on its side.

1 – Intrduction :

Swedish Fish are chewy wine gum candies especially notable apart from other varieties of winegums in Sweden but were originally developed in Finland, where they are known as Finnish Fish. They have been developed with special flavors specifically for the North American market[1] by the Swedish candy producer Malaco (originally Finnish), which exports products to North America.

2 – History :

In 1958, Malaco, a Swedish confectionery manufacturer, expanded its business by exporting a few of their products to North

America. Various licorice ribbon and licorice lace candies were the first products to be exported.

Malaco's export trade grew and in the late 1960s and early 1970s, Swedish Fish and Swedish Berries (identical in composition but in the shape of berries) were developed specifically for the North American market. Malaco was eventually acquired by Leaf International.

Today the Swedish Fish consumed in North America are made in Hamilton, Ontario, Canada by the Cadbury Adams Company, who bought the brand from Leaf in 2006. The fish are distributed in the U.S. by Cadbury Adams USA in Parsippany-Troy Hills, New Jersey. In the UK, Swedish Fish can be found in IKEA's Swedish Food section, including the salmiak flavour.

3 - Ingredients :

Swedish Fish are one of the few gummy candies that contain no gelatin. According to the USA distribution packages, the candy contains the following ingredients :

> Sugar - Invert Sugar Corn syrup - Modified corn starch - Citric acid - White Mineral Oil - Artificial flavors - Coloring (FD & C Red 40 for the red color) - Carnauba wax :

4 - In the United States :

The flavor varies with color: Originally colored red with a flavor unique to the candy, they are now also available in orange, yellow, green, and purple. A Swedish Fish flavored orange is orange, yellow is lemon, green is lime, and purple is grape. The fish come in two different sizes. Initially, the smaller fish came only in red; now fish of both sizes are available in multiple colors and flavors.

5 - In Sweden :

A shelf of pick and mix candies similar to those used in Sweden

In Sweden huge amounts of winegum candies are sold every year,[3] in all kinds of shapes in shops and supermarkets, where everyone serves themselves, purchasing any type of winegums and candies they desire, placing the assorted candies in small paperbags available in the shops. Common shapes are rats, flowers, coins, boats, guns, elephants, cars and also fish The fish shape of the Swedish Fish is just one of the many other candy shapes.

In Sweden, the Swedish Fish candy is marketed under the name "pastellfiskar",[6] literally "pastel colored fishes". The fish in Sweden are generally much paler in color and more translucent (save the black fish). In particular, the yellow fish color is almost cream. The taste also differs slightly, the Swedish version being less sweet but more fruit-flavored, especially the yellow one, which is more tangy. The green fish is not lime flavored; the green candy color in Scandinavia is usually associated with apple or pear flavor. They are slightly thicker, have the text "Malaco" instead of "Swedish" embossed, and stick less to the teeth .

"Pastellfiskar" are also sold at Swedish IKEA stores under the name Swedish Fish (and a slightly different bag), but they are still the same Scandinavian "Pastellfiskar" rather than the North American Swedish Fish.

6 - Aqua Life :

There is a Swedish Fish "Aqua Life" candy, with yellow (lemon) star fish, green (lime) whales, purple (grape) puffer fish, orange (orange) seahorses, and blue (blue rasp berry) dolphins .

17 - Toffee

Thornton's special toffee.

English toffee (the chewy kind) in cellophane wrapping.

1 – Introduction :

Toffee is a confection made by boiling sugar or molasses (creating inverted sugar) along with butter, and occasionally flour. The mixture is heated until its temperature reaches the hard crack stage of 150 to 160 °C . While being prepared, toffee is sometimes mixed with nuts or raisins.

The process of making toffee involves boiling the ingredients until the mix is stiff enough to be pulled into a shape which holds and has a glossy surface. The resulting mixture will typically be poured into a shallow tray and allowed to cool to form a sheet. Different mixes, processes, and (most importantly) temperatures of toffee making will result in different textures and hardnesses, from soft and often sticky to a hard brittle material.

A popular variant in the US is *English toffee*, which is a very buttery toffee often made with almonds. It is available in both chewy and hard versions. Heath bars are a type of candy made with an English toffee core . Although named *English toffee* it bears little resemblance to the wide range of confectionery known as toffee currently available in the UK.

Another variant is *Cinder toffee*, also called *honeycomb* or *sponge toffee*, which is an aerated version with bubbles introduced by adding baking soda and vinegar while mixing. The baking soda and vinegar react to form carbon dioxide, which is trapped in the highly viscous mixture. In the UK the most well known honeycomb candy is the Crunchie bar. In New Zealand this is called *hokey pokey*.

A particular application of toffee is in toffee apples, which are apples on sticks which are coated with toffee. Toffee apples are similar to taffy apples and caramel apples (both names for apples which are covered in caramel) .

In the UK, toffee apples, sometimes called candy apples, are coated with brittle candy similar to boiled sweets.

Toffee used in confectionery has many different forms and is mixed with many different ingredients. Rum & Butter Toffee, Chocolate Covered, Vanilla & Chocolate, Rum & Raisin, Honeycomb.

2 - Etymology

The origins of the word are unknown. Food writer Harold Mc Gee claims it to be "from the Creole for a mixture of sugar and molasses", but which creole language isn't specified.[1] The Oxford English Dictionary dates the first publication of the word to 1825 and identifies it as a variation of *taffy* (1817), both of which are first recorded as English dialectical words .

18 - Turkish Delight


Turkish Delight (Lokum)

1 – Introduction :

Turkish Delight (*Lokum*) is a confection that in the West is frequently manufactured from starch and sugar, but which in the Middle East takes a variety of forms more subtle, including premium varieties made almost solely of chopped dates, pistachios and hazelnuts or walnuts. Western varieties have a soft, jelly - like consistency, and are often flavored with rosewater, mastic or lemon; rosewater gives it a characteristic pale pink color. The confection is often packaged and eaten in small cubes dusted with icing sugar, copra, or powdered cream of Tartar to prevent clinging. Other common types include flavors such as cinnamon or mint. In the production process soapwort may be used as an additive, serving as an emulsifier.

2 - Origin :

Lokum has been produced in Turkey since the 15th century. Originally, honey and molasses were used as sweeteners, and water and flour were the binding agents.

Lokum was introduced to the West in the 19th century. An unknown Briton reputedly became very fond of the delicacy during his travels to Istanbul, and purchased cases of lokum, to be shipped back to Britain under the name *Turkish Delight*. It became a major delicacy not only in Britain, but throughout Continental Europe.

3 - Name :

The Turkish words *lokma* and *lokum* come from the Arabic لقمة *luqma(t)* 'morsel' or 'mouthful', plural لقوم *luqūm* . The alternate Ottoman name *rahat hulkum*, from Arabic راحة الحلقوم *raḥat al-ḥulqum* 'contentment of the throat'. In Libya and Tunisia, for example, it is known as حلقوم ḥalqūm. In Bosnia, its name "rahat lokum" and its Romanian name "rahat" clearly relates this etymology . Its name in Greek, "λουκούμι" (*loukoumi*), shares a similar etymology with the modern Turkish; and in parts of Cyprus, where the dessert has protected geographical indication (PGI) , it is also marketed as "Cyprus Delight".

In English, it was formerly called "lumps of delight".[7] Turkish Delight should not be confused with Turkish Taffy, a packaged nougat candy sold in the United States from the 1940s through the 1980s.

4 - Around the world :

In North America, Turkish Delight is not especially common, though it forms the basic foundation of the Big Turk chocolate bar (distributed by Nestlé in Canada) as well as the basis for most of Liberty Orchards' line of confectionery, including their various "Fruit Delights" and Aplets & Cotlets. Additionally, the Nory Candy company of California has been producing their "Rahat Locum" version of Turkish Delight for 30 years.

Elsewhere, Fry's Turkish Delight is produced by Cadbury in the United Kingdom, Australia and can also be found in Canada. The interior jelly of jelly beans may trace its origin back to Turkish Delight . In Ireland, a Turkish immigrant founded a confectionery company called Hadji Bey et Cie which made Turkish Delight until the 1990s. The confection is known in Brazil as *Delícia Turca* or *Bala de Goma (Síria/Árabe)*. In Greece and its islands it is often branded "Greek Delight", possibly because of the historic hostility between Greece and Turkey.

The following is a list of names in other languages, or the names of similar dishes :

- Albanian : " lokum "
- Arabic: " ملبن " , *malban*
- Armenian : " hanksdabadar "
- Bosnian : "rahat lokum "
- Bulgarian : " локум ", *lokum*
- Croatian: " rahat - lokum"
- Czech: "rahat"
- Greek: "λουκούμι", *loukoumi*
- Japanese: "kuzumochi"
- Korean: "tteok"
- Lebanese: "raha"
- Macedonian: "локум", *lokum*
- Polish: "rachatłukum"
- Romanian: "rahat"
- Serbian: "ратлук", *ratluk*
- Slovenian: "ratluk"
- Syrian Arabic: " ر احة الحلقوم " *raḥat al-ḥulqum*
- Turkish: "lokum"

5 - Protected geographical indication .

Despite its worldwide popularity and production in several countries, at present, the only protected geographical indication (PGI) for such a product is the name Λουκούμι Γεροσκήπου (Loukoumi Geroskipou) for Turkish Delight made in Yeroskipou, Cyprus.[5][9]

6 - In popular culture :

Turkish Delight features as the addictive confection to which Edmund Pevensie succumbs in *The Lion, the Witch and the Wardrobe* by C. S. Lewis. Sales of Turkish Delight rose following the theatrical release of the film version of *The Chronicles of Narnia: The Lion, the Witch and the Wardrobe*.

There are "gourmand" perfumes that use Loukoum or Loukhoum in their names and that are said to smell like the confection, as

Loukhoum by Ava Luxe, Loukhoum by Keiko Mecheri and Loukoum by Serge Lutens.

Turkish Delight is the main subject of the song "Rahadlakum" from the Broadway musical *Kismet*. Turkish Delight is also mentioned in the song "Candy Shop", the first song off the album *Hard Candy* by American singer Madonna.

19 - Wine gum

An assortment of Bassett's wine gums.

1 - Introduction :

Wine gums (or **winegums**) are chewy, firm pastille type sweets similar to gumdrops, except they are not sugar-coated. They are manufactured from animal gelatin, mixed with sweeteners, flavourings and colourings. They are extremely popular in Ireland and the United Kingdom, as well as in Commonwealth nations such as Australia, Canada, New Zealand, Malta and South Africa, and other northern and middle European countries.

Popular brands include Maynards, in Canada, the UK and Ireland, Bassett's and Waterbridge.

2 - History

In the late 19th century, it was discovered that fermented wine mixed with a gelling agent produced an exquisite confection of exceptional texture and flavour. Wine gums now no longer contain wine.

To explain the name, fanciful explanations have been invented, for example, that the name comes from the lingering, subtle fruit flavours that make it "similar to the experience of savouring a fine wine".

The sweets have the names of alcoholic drinks on them, for example port, sherry, champagne, claret, hock, gin, Rioja, Chablis and Burgundy. Also appearing on Maynards' gums are "M" and Maynards.

For those in the United States of America, they most closely resemble Jujyfruits in colours, texture, and sweetness, though with different flavours.

According to Cadbury Schweppes[2], red and black are the most popular colours (the same is true of the similar sweet fruit pastilles, which were eventually also available in just "red and black" packets).

Red is traditionally cherry (US) or red berry / straw berry/rasp berry - flavoured (UK) whereas the black is blackcurrant flavoured. In the UK at least, cherry is not a very popular flavour in sweet assortments such as wine gums .

Part 5

DONDURMA . GELATO

& ICE CREA

1 - Dondurma

A shop keeper holds a large mass of salepi dondurma .
Note the long -handled paddle and the barrel.

1 – Introduction :

Dondurma (Turkish: *Dondurma* , "freezing") is the name used for ice cream in Turkey . In English it specifically refers to Turkish ice cream , made of milk , sugar , salep and mastic . This ice cream probably originates from the Turkish region of Kahramanmaraş .

2 - Description :

Two features distinguish Turkish ice cream from others: texture and resistance to melting. It is tougher and chewier than other ice cream due to the inclusion of two thickening agents, salep, a flour made from the root of the Early Purple Orchid, and mastic, a resin. It is sometimes sold from carts as street food, where the mixture is churned regularly with long-handled paddles to keep it workable.

The Kahramanmaraş region is known for its distinct dondurma, "Maraş dondurması", which contains more salep than usual; it is much tougher and stickier, and may even require a knife and fork to eat.

The popularity of salepi Dondurma has caused a decline of wild orchids in the region and led to a ban on exports of salep . It has been claimed that the literal translation of salepi dondurma is "fox testicle ice cream" . However, it appears more likely that the Turkish name comes directly from the Arabic name saḥlabwhose ,for the orchid lobed root resembles testicles-two .

3 - The chemistry of Dondurma

A lecture about the chemical makeup and creation of Dondurma is available in this podcast.

2 - Gelato

Gelato Italiano, with two tower - shaped biscuits.

1 – Introducion :

Gelato (Italian pronunciation . plural : **gelati**) is Italy's regional variant of ice cream. As such, gelato is made with some of the same ingredients as most other frozen dairy desserts. Milk, cream, various sugars, flavoring including fruit and nut purees are the main ingredients.

Gelato differs from ice cream in that it has a lower butterfat content , typically gelato contains 4 – 8 % versus 14 % for ice cream. Gelato generally has slightly lower sugar content, averaging between 16 - 22 % versus approximately 21 % for ice cream. Non-fat milk is added as a solid. The sugar content in gelato is precisely balanced with the water content to act as an anti-freeze, that is, to prevent the gelato from freezing solid. The types of sugar used are sucrose and dextrose and invert sugar to control the apparent sweetness. Typically, gelato and Italian sorbet contain a stabilizing base. Egg yolks are used in yellow custard - based gelato flavors, including zabaione and creme caramel.

The mixture for gelato is typically made using a hot process, which includes pasteurization. White base is heated to 85°C . Heating the mix to 90 °C is essential for chocolate gelato, which is traditionally flavored with cocoa powder. Yellow custard base, which contains egg yolks, is heated to 65 °C . The gelato mix needs to age for several hours after pasteurization is complete in order for the milk proteins to hydrate or bind with the water in the mix. This hydration reduces the size of the ice crystals making a smoother texture in the final product. A non - traditional cold mix process is popular among some gelato makers in the United States .

Unlike commercial ice cream in the United States which is frozen with a continuous assembly line freezer, gelato is frozen very quickly in individual small batches in a batch freezer. The batch freezer incorporates air or overage into the mix as it freezes. Unlike American-style ice cream which can have an overage of up to 50%, gelato generally has between 20 % and 35 % overage. This results in a denser product with more intense flavor than U.S. style ice cream. U.S. style ice cream, with a higher fat content, can be stored in a freezer for months. High - quality artisan gelato holds its peak flavor and texture (from delicate ice crystals) for only several days, even when it is stored carefully at the proper temperature. This is why *gelaterias* typically make their own gelato on the premises or nearby.

2 – History :

The history of gelato dates back to frozen desserts served in ancient Rome and Egypt made from ice and snow brought down from mountain tops and preserved below ground. More recently gelato appeared during banquets at the Medici court in Florence. In fact the Florentine cook Bernardo Buontalenti is said to have invented modern ice creams in 1565, as he presented his recipe and his innovative refrigerating techniques to Caterina de' Medici. She in turn brought the novelty to France, where in 1686 the Sicilian fisherman Francesco Procopio dei Coltelli perfected the first ice cream machine[1]. The popularity of gelato among larger shares of the population however only increased in the 1920's -1930's as in the northern Italian city of Varese, where the first mobile gelato cart was developed.

3 - Over view :

Gelato Italiano, with a fresh waffle biscuit.

Gelato is typically flavored with fresh fruit purees, cocoa and/or nut pastes. If other ingredients such as chocolate flakes, nuts, small confections, cookies, or biscuits are added, they are added after the gelato is frozen. Gelato made with fresh fruit, sugar, and water and without dairy ingredients is known as sorbetto (a form of sorbet).

4 - Misconception .

A misconception is possible that the word "gelato" could be related to "gelatin" and that the latter might be an ingredient. In Italian, "gelato" literally and only means "frozen". Traditional gelato recipes do not call for gelatin and the bulk of modern gelato is made mainly with milk, cream, sugar, sometimes eggs, and a flavoring, barring some novel concoction or experiment by a particular gelateria or chef.

3 - Ice Cream

Contents

Ice - cream or Gelato in Rome

Alternate Name	Gelato , sorbet , frozen yogurt , frozen custard
Place of origin	Persia
Course served	Dessert
Main ingredient(s)	Dairy (or soy milk) , sugar

1 – Introduction :

Ice cream or **ice - cream** is a frozen dessert usually made from dairy products, such as milk and cream, and often combined with fruits or other ingredients and flavours. Most varieties contain sugar, although some are made with other sweeteners. In some cases, artificial flavourings and colourings are used in addition to (or in replacement of) the natural ingredients. This mixture is stirred slowly while cooling to prevent large ice crystals from forming; the result is a smoothly textured ice cream.

The meaning of the term ice cream varies from one country to another. Terms like frozen custard, frozen yogurt, sorbet, gelato and others are used to distinguish different varieties and styles. In some countries, like the USA, the term ice cream applies only to a specific variety, and their governments regulate the commercial use of all these terms based on quantities of ingredients . In others, like Italy and Argentina, one word is used for all the variants. Alternatives made from soy milk, rice milk, and goat milk are available for those who are lactose intolerant or have an allergy to dairy protein, or in the case of soy and rice milk, for those who want to avoid animal products.

2 - Production

Before the development of modern refrigeration, ice cream was a luxury reserved for special occasions. Making it was quite laborious; ice was cut from lakes and ponds during the winter and stored in holes in the ground, or in wood - frame or brick ice houses, insulated by straw. Many farmers and plantation owners, including U.S. Presidents George Washington and Thomas Jefferson, cut and stored ice in the winter for use in the summer. Frederic Tudor of Boston turned ice harvesting and shipping into a big business, cutting ice in New England and shipping it around the world.

Ice cream was made by hand in a large bowl placed inside a tub filled with ice and salt. This was called the pot-freezer method. French confectioners refined the pot - freezer method, making ice cream in a sorbetière (a covered pail with a handle attached to the lid). In the pot-freezer method, the temperature of the ingredients is reduced by the mixture of crushed ice and salt. The salt water is cooled by the ice, and the action of the salt on the ice causes it to (partially) melt, absorbing latent heat and bringing the mixture below the freezing point of pure water. The immersed container can also make better thermal contact with the salty water and ice mixture than it could with ice alone.

The hand - cranked churn, which also uses ice and salt for cooling, replaced the pot-freezer method. The exact origin of the hand-cranked freezer is unknown, but the first U.S. patent for one was #3254 issued to Nancy Johnson on September 9, 1843. The hand-cranked churn produced smoother ice cream than the pot freezer and did it quicker. Many inventors patented improvements on Johnson's design.

In Europe and early America, ice cream was made and sold by small businesses, mostly confectioners and caterers. Jacob Fussell of Baltimore, Maryland was the first to manufacture ice cream on a large scale. Fussell bought fresh dairy products from farmers in York County, Pennsylvania, and sold them in Baltimore. An unstable demand for his dairy products often left him with a surplus of cream, which he made into ice cream. He built his first ice-cream factory in Seven Valleys, Pennsylvania, in 1851. Two years later, he moved his factory to Baltimore. Later, he opened factories in several other cities and taught the business to others, who operated their own plants. Mass production reduced the cost of ice cream and added to its popularity.

The development of industrial refrigeration by German engineer Carl von Linde during the 1870s eliminated the need to cut and store natural ice and when the continuous - process freezer was perfected in 1926, it allowed commercial mass production of ice cream and the birth of the modern ice cream industry .

The most common method for producing ice cream at home is to use an ice cream maker, in modern times generally an electrical device that churns the ice cream mixture while cooled inside a household freezer, or using a solution of pre - frozen salt and water, which gradually melts while the ice cream freezes . Some more expensive models have an inbuilt freezing element. A newer method of making home-made ice cream is to add liquid nitrogen to the mixture while stirring it using a spoon or spatula. Some ice cream recipes call for making a custard, folding in whipped cream, and immediately freezing the mixture.

3 - Commercial delivery :

Ice cream can be mass - produced and thus is widely available in developed parts of the world. Ice cream can be purchased in large cartons (vats and squrounds) from supermarkets and grocery stores, in smaller quantities from ice cream shops, convenience stores, and milk bars, and in individual servings from small carts or vans at public events. In Turkey and Australia, ice cream is sometimes sold to beach-goers from small powerboats equipped with chest freezers. Some ice cream distributors sell ice cream products from traveling refrigerated vans or carts (commonly referred to in the US as "ice cream trucks"), sometimes equipped with speakers playing children's music. Traditionally, ice cream vans in the United Kingdom make a music box noise rather than actual music.

4 -Dietary :

Ice cream may have the following composition:

* greater than 10 % milkfat and usually between 10 % and as high as 16 % fat in some premium ice creams .
* 9 to 12 % milk solids - not - fat : this component, also known as the serum solids, contains the proteins (caseins and whey proteins) and carbohydrates (lactose) found in milk .
* 12 to 16 % sweeteners : usually a combination of sucrose and glucose - based corn syrup sweeteners .
* 0.2 to 0.5 % stabilisers and emulsifiers
* 55 % to 64 % water which comes from the milk or other ingredients.

These compositions are percentage by weight. Since ice cream can contain as much as half air by volume, these numbers may be reduced by as much as half if cited by volume. In terms of dietary considerations, however, the percentages by weight are more relevant.

Even the low fat products have high caloric content: Ben and Jerry's No Fat Vanilla Fudge contains 150 calories per half cup due to its high sugar content.

5 – History :

5 – 1 - Precursors of ice cream :

The Persians drank syrups cooled with snow called (“fruit ice” in Arabic, thus the derivation of sherbet, sorbet and sorbetto). In 400 BC, Persians invented a special chilled pudding-like dish, made of rose water and vermicelli which was served to royalty during summers.[5] The ice was mixed with saffron, fruits, and various other flavours. The treat, widely made in Iran today, is called *"faloodeh"*, and is made from starch (usually wheat), spun in a sieve-like machine which produces threads or drops of the batter, which are boiled in water. The mix is then frozen, and mixed with rose water and lemons, before serving. Ancient Persians mastered the technique of storing ice inside giant naturally - cooled refrigerators known as yakhchals. These structures kept ice brought in from the winter, or from nearby mountains, well into the summer. They worked by using tall windcatchers that kept the sub-level storage space at frigid temperatures .

An ice - cream store in Damascus, Syria

Ancient civilizations have served ice for cold foods for thousands of years. The BBC reports that a frozen mixture of milk and rice was used in China around 200 BC, and in 618 - 97 AD, King Tang of Shang had 94 men who made a frozen dish of buffalo milk, flour, and camphor . The Roman Emperor Nero (37– 68) had ice brought from the mountains and combined with fruit toppings . These were some early chilled delicacies .

Ice cream was the favorite dessert for the Caliphs of Baghdad. Arabs were the first to utilise milk as a major ingredient in its production, sweeten the ice cream with sugar rather than fruit juices, as well as perfect ways for its commercial production. As early as the 10th century, ice cream was widespread amongst many of the Arab world's major cities such as Baghdad, Damascus and Cairo. Their version of ice cream was produced from milk or cream and often some yoghurt similar to Ancient Greek recipes, flavoured with rosewater as well as dried fruits and nuts. It is believed that this was based on older Ancient Arab, Mesopotamian, Greek or Roman recipes, which were probably the first and precursors to Persian faloodeh.

In 62 AD, the Roman emperor Nero sent slaves to the Apennine mountains to collect snow to be flavoured with honey and nuts.[8]

Maguelonne Toussaint - Samat asserts in her *History of Food,* "the Chinese may be credited with inventing a device to make sorbets and ice cream. They poured a mixture of snow and saltpetre over the exteriors of containers filled with syrup, for, in the same way as salt raises the boiling - point of water, it lowers the freezing - point to below zero " . (Toussaint does not provide historical documentation for this) .But in the age of Emperor Yingzong, Song Dynasty (960 - 1279) of China, there is a poem named : (literally *Ode to the ice cheese*) , written by poet Yang Wanli. There also has a saying , in the Yuan Dynasty, the Kublai Khan enjoy ice cream a lot and keep it a royal secret, then when Marco Polo came to China and brought the technique to Italy.

In the sixteenth century, the Mughal emperors used relays of horsemen to bring ice from the Hindu Kush to Delhi where it was used in fruit sorbets .

When Italian duchess Catherine de' Medici married the duc d’Orléans in 1533 , she is said to have brought with her Italian chefs who had recipes for flavoured ices or sorbets and introduced them in France . One hundred years later, Charles I of England was supposedly so impressed by the "frozen snow" that he offered his own ice cream maker a lifetime pension in return for keeping the formula secret, so that ice cream could be a royal prerogative . There is, however, no historical evidence to support these legends, which first appeared during the 19th century .

The first recipe for flavoured ices in French appears in 1674, in Nicholas Lemery’s *Recueil de curiositéz rares et nouvelles de plus* *admirables effets de la nature* . Recipes for *sorbetti* saw publication in the 1694 edition of Antonio Latini's *Lo Scalco alla Moderna* (The Modern Steward) . Recipes for flavoured ices begin to appear in François Massialot's *Nouvelle Instruction pour les Confitures, les Liqueurs, et les Fruits* starting with the 1692 edition. Massialot's recipes result in a coarse, pebbly texture. However, Latini claims that the results of his recipes should have the fine consistency of sugar and snow .

5 -2 - True ice cream :

Ice cream recipes first appear in 18th century England and America. A recipe for ice cream was published in *Mrs. Mary Eales's Receipts* in London 1718 .

To ice CREAM. Take Tin Ice - Pots, fill them with any Sort of Cream you like, either plain or sweeten'd, or Fruit in it; shut your Pots very close; to six Pots you must allow eighteen or twenty Pound of Ice, breaking the Ice very small; there will be some great Pieces , which lay at the Bottom and Top: You must have a Pail, and lay some Straw at the Bottom; then lay in your Ice, and put in amongst it a Pound of Bay-Salt; set in your Pots of Cream, and lay Ice and Salt between every Pot, that they may not touch; but the Ice must lie round them on every Side; lay a good deal of Ice on the Top, cover the Pail with Straw, set it in a Cellar where no Sun or Light comes, it will be froze in four Hours, but it may stand longer; than take it out just as you use it; hold it in your Hand and it will slip out. When you wou'd freeze any Sort of Fruit, either Cherries, Rasberries, Currants, or Strawberries, fill your Tin-Pots with the Fruit , but as hollow as you can; put to them Lemmonade, made with Spring-Water and Lemmon-Juice sweeten'd; put enough in the Pots to make the Fruit hang together, and put them in Ice as you do Cream .

Ice cream was introduced to the United States by Quaker colonists who brought their ice cream recipes with them. Confectioners sold ice cream at their shops in New York and other cities during the colonial era. Ben Franklin, George Washington, and Thomas Jefferson were known to have regularly eaten and served ice cream. First Lady Dolley Madison is also closely associated with the early history of ice cream in the United States. One respected history of ice cream states that, as the wife of U.S. President James Madison, she served ice cream at her husband's Inaugural Ball in 1813.

Around 1832, Augustus Jackson, an African American confectioner, not only created multiple ice cream recipes, but he also invented a superior technique to manufacture ice cream.[16]

In 1843, Nancy Johnson of Philadelphia was issued the first U.S. patent for a small-scale handcranked ice cream freezer. The invention of the ice cream soda gave Americans a new treat, adding to ice cream's popularity. This cold treat was probably invented by Robert Green in 1874, although there is no conclusive evidence to prove his claim.

Ice cream sundaes with fruit, nuts, and a wafer

The ice cream sundae originated in the late 19th century. Several men claimed to have created the first sundae, but there is no conclusive evidence to back up any of their stories. Some sources say that the sundae was invented to circumvent blue laws, which forbade serving sodas on Sunday. Towns claiming to be the birthplace of the sundae include Buffalo, New York; Two Rivers, Wisconsin; Ithaca, New York; and Evanston, Illinois. Both the ice cream cone and banana split became popular in the early 20th century. Several food vendors claimed to have invented the ice cream cone at the 1904 World's Fair in St. Louis, MO . However, Europeans were eating cones long before 1904 .

In the UK, ice cream remained an expensive and rare treat, until large quantities of ice began to be imported from Norway and the US in the mid Victorian era. A Swiss-Italian businessman, Carlo Gatti, opened the first ice cream stall outside Charing Cross station in 1851, selling scoops of ice cream in shells for one penny .

The history of ice cream in the 20th century is one of great change and increases in availability and popularity. In the United States in the early 20th century, the ice cream soda was a popular treat at the soda shop, the soda fountain, and the ice cream parlor. During American Prohibition, the soda fountain to some extent replaced the outlawed alcohol establishments such as bars and saloons.

Ice cream became popular throughout the world in the second half of the 20th century after cheap refrigeration became common. There was an explosion of ice cream stores and of flavours and types. Vendors often competed on the basis of variety. Howard Johnson's restaurants advertised "a world of 28 flavours." Baskin-Robbins made its 31 flavours ("one for every day of the month") the cornerstone of its marketing strategy. The company now boasts that it has developed over 1000 varieties.

One important development in the 20th century was the introduction of soft ice cream. A chemical research team in Britain (of which a young Margaret Thatcher was a member)[21][22] discovered a method of doubling the amount of air in ice cream, which allowed manufacturers to use less of the actual ingredients, thereby reducing costs. It made possible the soft ice cream machine in which a cone is filled beneath a spigot on order. In the United States, Dairy Queen, Carvel, and Tastee - Freez pioneered in establishing chains of soft-serve ice cream outlets.

Technological innovations such as these have introduced various food additives into ice cream, notably the stabilizing agent gluten,[23] to which some people have an intolerance. Recent awareness of this issue has prompted a number of manufacturers to start producing gluten-free ice cream .

The 1980s saw a return of the older , thicker ice creams being sold as "premium" and "superpremium" varieties under brands such as Ben & Jerry's and Häagen - Dazs .

6 - Ice cream throughout the world :

6 – 1 –Argentina :

An ice cream cone in Salta, Argentina

While industrial ice cream exists in Argentina and can be found in supermarkets, restaurants or kiosks, and ice cream pops are sold on some streets and at the beaches, the most traditional Argentinean *helado* (ice cream) is very similar to Italian gelato, rather than US-style ice cream, and it has become one of the most popular desserts in the country . Among the most famous manufacturers are *Freddo*, *Persicco*, *Chungo* and *Munchi's*, all of them located in Buenos Aires. However, each city has its own *heladerías* (ice cream parlours) which offer different varieties of creamy and water - based ice creams, including both standard and regional flavours. There are hundreds of flavours but Argentina's most traditional and popular one is dulce de leche, which has become a favorite abroad, especially in the US.

There are two kinds of *heladerías* in Argentina: the cheaper ones which sell ice cream with artificial ingredients (like *Helarte*, *Pirulo* and *Sei Tu*), and the ones that sell *helado artesanal*, made with natural ingredients and usually distinguished by a logo featuring an ice cream cone and the letters HA. There are no regulations in Argentina regarding the amount of milk an ice cream can have. In fact, all ice cream parlors serve both cream-based and water-based ice cream (*helado a la crema* and *helado al agua* respectively). Instead, the distinctions are made according to the quality of the ingredients.

A standard Argentinean cone or cup contains two different flavours of ice cream. In addition to these, most *heladerías* offer ice-cream-based desserts like *Bombón Suizo* (Swiss Bombom: chocolate-covered chantilly ice cream filled with dulce de leche and sprinkled with nuts), *Bombón Escocés* (Scottish Bombom: same as the Swiss Bombom, only with chocolate ice-cream and white chocolate topping), *Cassata* (strawberry, vanilla and chocolate ice cream) and *Almendrado* (almond ice cream sprinkled with almond praline) .

6 – 2 - Australia and New Zealand

Per capita, Australians and New Zealanders are among the leading ice cream consumers in the world, eating 18 liters and 20 liters each per year respectively, behind the United States where people eat 23 liters each per year . Brands include Tip Top, Streets, Peters, Sara Lee, New Zealand Natural, Cadbury, Baskin - Robbins and Maggie Beer . A popular ice cream flavour in New Zealand, Australia and Japan that originated in New Zealand is hokey pokey.

6 – 3 – China :

In Southern China, there's a kind of chilled dessert made of mung beans , called pinyin : literally : *sand of mung bean*) , texturally similar to ice cream. The beans are macerated into a paste and boiled together with milk and sugar.

6 – 4 Finland :

The first ice cream manufacturer in Finland was the Italian Magi family, who opened the *Helsingin jäätelötehdas* in 1922 and *Suomen Eskimo Oy*. Other manufacturers soon spawned, like *Pietarsaaren jäätelötehdas* (1928 – 2002) .

Finland's first ice cream bar opened at the Lasipalatsi in 1936, and at the same time another manufacturer, *Maanviljelijäin Maitokeskus* started their production.

Today, the two largest ice cream manufacturers are Ingman and Nestlé (who bought Valiojäätelö) . Finland is also the leading consumer of ice cream in Europe, with 13.7 liters per person in 2003 .

6 – 5 – France :

In 1651, Italian Francesco dei Coltelli opened an ice cream café in Paris and the product became so popular that during the next 50 years another 250 cafés opened in Paris . Some people eat heart or log shaped cakes made of ice cream on New Year's Eve or New Year's Day .

6 – 6 - Germany :

Italian ice cream parlors (*Eisdielen*) have been popular in Germany since the 1920s, when many Italians immigrated and set up business. As in Italy itself, ice cream is considered a traditional dessert and the ice cream at an Eisdiele is still mostly hand-made.

6 – 7 - Ghana :

In 1962 , the popular Ghanaian treat FanMilk was created by the Fan Milk Limited company. FanIce comes in strawberry, chocolate, and vanilla. FanMilk also makes additional products, though FanIce is the closest to Western ice cream. Pouches of FanIce and other FanMilk products can be bought from men on bikes equipped with chill boxes in any moderately sized town, and in cities large enough for grocery stores, FanMilk can be bought in tubs for eating at home.

6 – 8 - Greece :

Ice cream in its modern form is a relatively new invention. Ice treats have been enjoyed since ancient times. During the 5th century BC, ancient Greeks ate snow mixed with honey and fruit in the markets of Athens. The father of modern medicine, Hippocrates, encouraged his Ancient Greek patients to eat ice *"as it livens the lifejuices and increases the well-being "* . In the 4th century BC, it was well known that a favorite treat of Alexander the Great was snow ice mixed with honey and nectar . In modern times Greek ice cream recipes have some unique flavours such as **Pagoto Kaimaki** , made from mastic - resin which gives it an almost chewy texture, and **salepi**, used as a thickening agent to increase resistance to melting; both give the ice cream a unique taste; **Olive Oil Ice Cream** with figs; **Pagoto Kataifi Chocolate** , made from the shredded filo dough pastry that resembles angel's hair pasta or vermicelli; and **Mavrodaphne Ice Cream** , made from a Greek dessert wine. Fruity Greek Sweets of the Spoon are usually served as toppings with Greek - inspired ice cream flavours.

6 – 9 - India and Pakistan :

Kulfi is a traditional dessert that is much denser than traditional ice cream; it is also very popular and widely consumed in both countries. With the presence of major ice cream brands like, AMUL, Arun Ice Creams, Mother Dairy , Kwality Walls, Vadilal and Havmor, there is a countrywide availability of various ice cream flavours. There are also ice cream joints like that of Baskin Robbins, Natural's which have some unique flavours of ice creams and are costlier then packaged ice cream. There are also famous ice cream shops like Sujata in Pune.

6 – 10 – Italy :

Italian ice cream or Gelato as it is known as, is a traditional dessert in Italy. Much of the production is still hand-made and flavoured by each individual shop in "produzione propria" gelaterias. Gelato is made from whole milk, sugar, sometimes eggs , and natural

A gelato stall on Ponte Vecchio , Florence

flavourings. Gelato typically contains 7 – 8 % fat , less than ice cream's minimum of 10 % . Before the cone became popular for serving ice cream, in English speaking countries, Italian street vendors would serve the ice cream in a small glass dish referred to as a "penny lick" or wrapped in waxed paper and known as a hokey-pokey (possibly a corruption of the Italian "ecco un poco" - "here is a little"). Some of the most known gelato machine makers are Italian companies Carpigiani, Crm-Telme, Corema – Telme , Technogel , Cattabriga , Matrix , and Promag.

6 – 11 – Japan

Mochi ice cream sold in Japan

Ice cream is also a popular dessert in Japan, with almost two in five adults eating some at least once a week, according to a recent survey . Since 1999 , the Japanese Ice Cream Association has been publishing the Ice Cream White Paper once a year, and the four most popular ice cream flavours in Japan have not changed (including their order) since 1999, according to the Paper . The top four flavours are vanilla, chocolate, *matcha* (powdered green tea), and strawberry. Other notable popular flavours are milk , caramel, and azuki (Red Bean) also according to the Paper . *Azuki* is particularly favored by people in their 50s and older . While *matcha* is a truly Japanese flavour favored by Japanese and well - known among non-Japanese outside of Japan, plum and ginger, tastes often presented as Japanese flavours outside of Japan, did not make the cut in the top 17 favorite flavour list in 2006 . In Japan, a soft serve ice cream is called softcream which is also very popular. As a seasonal treat during the cherry blossom season, ice cream is available that is actually flavoured with cherry blossoms .

6 – 12 – Philippines (Sorbetes) :

Sorbetes is a Philippine version for common ice cream usually peddled from carts that roam streets in the Philippines. This should not be confused with the known sorbet. It is also commonly called 'dirty ice cream' because it is sold along the streets exposing it to pollution and that the factory where it comes from is usually unknown; though it is not really "dirty" as the name implies. It is usually served with small wafer or sugar cones and recently, bread buns.

6 – 13 – Spain :

Ice cream, in the style of Italian gelato, can be found in many cafes or specialty ice cream stores throughout. Usually the flavours reflect local tastes like nata, crema catalana, or tiramisu.

6 – 14 – Turkey :

See Dondurma for Turkish ice cream .

6 – 15 United Kingdom :

In the United Kingdom, 14 million adults buy ice cream as a treat, in a market worth £1.3 billion (according to a report produced in September 2009) . A product may be sold as "ice cream" if it contains 5 per cent fat and not less than 2.5 per cent milk protein, but may contain non-milk vegetable fats and oils , usually hydrogenated palm kernel oil, which is more permissive than many other countries. Only true ice cream made only with milk fats (though not necessarily cream) can be described as *dairy ice cream*, and many companies make sure that *dairy* is prominently displayed on their packaging and advertising .

6 – 16 - United States :

In the United States, ice cream made with just cream, sugar, and a flavouring (usually fruit) is sometimes referred to as "Philadelphia style" ice cream. Ice creams made with eggs, usually in the form of custards, are "French" ice creams .

American federal labeling standards require ice cream to contain a minimum of 10 % milk fat (about 7 grams (g) of fat per 1 / 2 cup [120 mL] serving) and 20 % total milk solids by weight .

Ice cream is an extremely popular dessert in the United States. Americans consume about 15 quarts (more than 13 liters) of ice cream per person per year — the most in the world.[41] As a foodstuff it is deeply ingrained into the American psyche and has been available in America since its founding in 1776 : there are records of Thomas Jefferson serving it as a then - expensive treat to guests at his home in Monticello. In American supermarkets it is not uncommon for ice cream and related products to take up a wall full of freezers .

Although chocolate , vanilla, and strawberry are the traditional favorite flavors of ice cream, and once enjoyed roughly equal popularity, vanilla has grown to be far and away the most popular, most likely because of its use as a topping for fruit based pies and its use as the key ingredient for milkshakes . According to the International Ice Cream Association (1994) , supermarket sales of ice cream break down as follows : vanilla , 28 % ; fruit flavours , 15 % ; nut flavours , 13.5 % ; candy mix - in flavours , 12.5 % ; chocolate, 8 % ; cake and cookie flavours , 7.5 % ; Neapolitan, 7 % ; and coffee/mocha, 3 % . Other flavours combine for 5.5 % . Sales in ice cream parlors are more variable, as new flavours come and go, but about three times as many people call vanilla their favorite than chocolate, the runner – up .

Federal government regulations pertaining to the process of making ice cream , allowable ingredients, and standards, may be found in Part 135 of Title 21 of the *Code of Federal Regulations* . As a rule , ice cream must contain not less than 10 percent milkfat, nor less than 10 percent nonfat milk solids .

7 - Ice cream cone :

Mrs Marshall's Cookery Book, published in 1888, endorsed serving ice cream in cones,[44] but the idea definitely predated that. Agnes Marshall was a celebrated cookery writer of her day and helped to popularise ice cream. She patented and manufactured an ice cream maker and was the first person to suggest using liquefied gases to freeze ice cream after seeing a demonstration at the Royal Institution.

Reliable evidence proves that ice cream cones were served in the 19th century, and their popularity increased greatly during the St. Louis World's Fair in 1904 . According to legend, at the World's Fair an ice cream seller had run out of the cardboard dishes used to put ice cream scoops in, so they could not sell any more produce. Next door to the ice cream booth was a Syrian waffle booth, unsuccessful due to intense heat; the waffle maker offered to make cones by rolling up his waffles and the new product sold well, and was widely copied by other vendors .

8 - Other frozen desserts :

The following is a partial list of ice cream - like frozen desserts and snacks:

Raspberry sorbet.

- Ais kacang: a dessert in Malaysia and Singapore made from shaved ice , syrup, and boiled red bean and topped with chocolate sauce and evaporated milk. Sometimes, other small ingredients like raspberries and durians are added in too.
- Dondurma: Turkish ice cream, made of salep and mastic resin

- Frozen custard: at least 10 % milk fat and at least 1.4 % egg yolk and much less air beaten into it, similar to Gelato, fairly rare. Known in Italy as Semifreddo.
- Frozen yogurt: a low fat or fat free alternative made with yogurt
- Gelato : an Italian frozen dessert having a lower milk fat content than ice cream and stabilised with ingredients such as eggs.
- Ice milk : less than 10 % milk fat and lower sweetening content, once marketed as "ice milk" but now sold as *low-fat ice cream* in the United States.
- Ice pop (or lolly): frozen fruit puree, fruit juice, or flavoured sugar water on a stick or in a flexible plastic sleeve.
- Kulfi: Believed to have been introduced to South Asia by the Mughal conquest in the 16th century; its origins trace back to the cold snacks and desserts of Arab and Mediterranean cultures .
- Mellorine : non - dairy, with vegetable fat substituted for milk fat
- Parevine : Kosher non - dairy frozen dessert established in 1969 in New York
- Sherbet : 1 - 2 % milk fat and sweeter than ice cream.
- Sorbet : fruit puree with no dairy products
- Snow cones, made from balls of crushed ice topped with sweet syrup served in a paper cone, are consumed in many parts of the world. The most common places to find snow cones in the United States are at amusement parks.
- Maple toffee : A popular springtime treat in maple-growing areas is maple toffee, where maple syrup boiled to a concentrated state is poured over fresh snow congealing in a toffee - like mass, and then eaten from a wooden stick used to pick it up from the snow.

9 - Using liquid nitrogen :

Using liquid nitrogen to freeze ice cream is an old idea and has been used for many years to harden ice cream. However, the use of liquid nitrogen in the primary freezing of ice cream, that is to effect the transition from the liquid to the frozen state without the use of a conventional ice cream freezer, has only recently started to see commercialization

Dippin' Dots Flavored Ice Cream

. Some commercial innovations have been documented in the National Cryogenic Society Magazine "Cold Facts".[49] The most noted brands are Dippin' Dots , Blue Sky Creamery,[51] Project Creamery , and Sub Zero Cryo Creamery . The preparation results in a column of white condensed water vapor cloud, reminiscent of popular depictions of witches' cauldrons . The ice cream, dangerous to eat while still "steaming," is allowed to rest until the liquid nitrogen is completely vaporised. Sometimes ice cream is frozen to the sides of the container, and must be allowed to thaw.

Making ice cream with liquid nitrogen has advantages over conventional freezing. Due to the rapid freezing, the crystal grains are smaller, giving the ice cream a creamier texture, and allowing one to get the same texture by using less milkfat. However, such ice crystals will grow very quickly via the processes of recrystallization thus obviating the original benefits unless steps are taken to inhibit ice crystal growth.

Part 6

BAKLAVA , KANAFAFA & HALVA

1 - Baklava

Baklava is prepared on large trays and cut into a variety of shapes

Place of origin	Turkey
Course served	Dessert
Serving temperature	Cold , room temperature or Re - warmed
Main ingredient (s)	Phyllo dough , nuts , sweetening
Variations	Multiple

1 - Introduction :

Baklava is a rich, sweet pastry made of layers of phyllo dough filled with chopped nuts and sweetened with syrup or honey. It is characteristic of the cuisines of the former Ottoman Empire and much of central and southwest Asia.

2 – History :

The history of baklava is not well-documented. It has been claimed by many ethnic groups, but there is strong evidence that it is of Central Asian Turkic origin, with its current form being developed in the imperial kitchens of the Topkapı Palace.

Many Ottoman sweets are similar to Byzantine sweets, using dough, sesame, wheat, nuts and fruits, and some were similar to the Ottoman börek, halva, and so on. Indeed, Vryonis identifies the ancient Greek *gastris*, *kopte*, *kopton*, or *koptoplakous*, mentioned in the Deipnosophistae, as baklava, and calls it a "Byzantine favorite".

However, Perry argues that though *gastris* contained a filling of nuts and honey, it did not include any dough; instead, it involved a honey and ground sesame mixture similar to modern *pasteli* or *halva* .

Perry then assembles evidence to show that layered breads were created by Turkic peoples in Central Asia, and argues that the "missing link" between the Central Asian folded or layered breads (which did not include nuts) and modern phyllo - based pastries like *baklava* is the Azerbaijani dish *Bakı pakhlavası* , which involves layers of dough and nuts. The traditional Uzbek *pakhlava*, *puskal* or *yupka* and Tatar *yoka*, sweet and salty savories (boreks) prepared with 10-12 layers of dough, are other early examples of layered dough style in Turkic regions .

The thin phyllo dough as used today was probably developed in the kitchens of the Topkapı Palace. Indeed, the sultan presented trays of baklava to the Janissaries every 15th of the month of Ramadan in a ceremonial procession called the *Baklava Alayı* .

Other claims about baklava's origins include : that it dates back to ancient Mesopotamia, and was mentioned in a Mesopotamian cookbook on walnut dishes ; that al - Baghdadi describes it in his 13th - century cook book ; that it was a popular Byzantine dessert . But Claudia Roden and Andrew Dalby find no evidence for it in Arab, Greek, or Byzantine sources before the Ottoman period.

One of the oldest known recipes for a sort of proto-baklava is found in a Chinese cookbook written in 1330 under the Yuan (Mongol) dynasty under the name *güllach*. "Güllaç" is found in Turkish cuisine. Layers of phyllo dough are put one by one in warmed up milk with sugar. It is served with walnut and fresh pomegranate and generally eaten during Ramadan.

	
A typical baklava, sweetened with syrup	*In Turkey, baklava is typically served with whipped cream and pistachios.*

3 - Local versions :

In Turkey, Gaziantep is famous for its baklava and regarded there as its native city, though it only appears to have been introduced to Gaziantep from Damascus in 1871. In 2008, the Turkish patent office registered a geographical indication certificate for Antep Baklava.

In Azerbaijan, pakhlava is mostly prepared during the Novruz festivity. After preparation the pakhlava is cut into diamond shapes and each piece is garnished with an almond or a walnut.

In Bosnia - Herzegovina baklava is generally rich in nuts and filling and is only eaten on special occasions, mostly during in the holy months of Ramadan and Eid.

In Iran, a drier version of baklava is cooked and presented in smaller diamond-shaped cuts flavored with rose water.

In Afghanistan and Cyprus, baklava is prepared into triangle-shaped .

4 - Etymology :

The word baklava entered English from Turkish;[14][15]the Arabic name is doubtless a borrowing from Turkish,[4] though a folk etymology, unsupported by Wehr's dictionary connects it to Arabic بقلة /baqlah/ 'bean'. Buell argues that the word "baklava" may come from the Mongolian root *baγla-* 'to tie, wrap up, pile up' composed with the Turkic verbal ending -*v*;[10] baγla- itself in Mongolian is a Turkic loanword. [16] The name baklava is used in many languages with minor phonetic and spelling variations.

2 - Halva Tahini

Contents

Balkan style tahini - based halva with pistachios

1 – Introducion :

Halva (or ***halawa***, ***haleweh***, ***ħelwa***, ***halvah***, ***halava***, ***helava***, ***helva***, ***halwa***, ***aluva***, ***chałwa***) refers to many types of dense, sweet confections, served across the Indian subcontinent, Central Asia, West Asia, North Africa, the Horn of Africa , the Balkans .

This term is used to describe two types of desserts:

- **Flour - based**: This type of halva is slightly gelatinous and made from grain flour, typically semolina. The primary ingredients are oil, flour, and sugar.
- **Nut – butter – based**: This type of halva is crumbly and usually made from Tahini (sesame paste) or other nut butters, such as sunflower seed butter. The primary ingredients are nut-butter and sugar.

Halva may also be based on numerous other ingredients, including sunflower seeds, various nuts, beans, lentils, and vegetables such as carrots, pumpkins, yams, and squashes.

2 – Etymology :

The word *halva* entered the English language as "halva" between 1840 - 50 from the Yiddish *halva*. The latter term came from Romanian, which in turn came from the Turkish *helva*, a word which itself ultimately derived from the Arabic *Al ḥalwā*, meaning sweet confection . The Arabic root حلوى*ḥalwā* means "sweet".

3 – Types :

Most types of halva are relatively dense confections that are sweetened with sugar or honey. Their textures, however, vary. For example, semolina - based halva is gelatinous and translucent, while sesame-based halva is drier and more crumbly.

3 – 1 - Flour – based :

This type is made by frying the flour such as semolina in oil into a roux and cooking it with a sugary syrup. This is popular in Iran, Turkey, Somalia, India, Pakistan and Afghanistan.

3 – 1 – 1 - Semolina (suji) :

This halva, produced and served in India, Afghanistan, Bangladesh, Iran, Pakistan and surrounding countries (different versions of it are also found in Albania, Azerbaijan, Bulgaria, Cyprus, Greece, Montenegro and Turkey), is usually made with wheat semolina, sugar or honey, and butter or vegetable oil. Raisins, dates, or other dried fruits are often included. Nuts such as almonds are also commonly added to semolina halva. The halva is very sweet with a gelatinous texture similar to polenta; the added butter gives it a rich mouthfeel. The classic proportions of semolina halva are 1:2:3:4, i.e. 1 part fat (a vegetable oil or butter), 2 parts semolina, 3 parts sweetening agent (e.g. sugar or honey) and 4 parts water. The semolina is cooked in the fat while a syrup is being made of the sweetener and water. Then the two are mixed carefully, extras added and the halva is left to settle.

Turkish Un helvası, a semolina - based halva

In India, though semolina halva is considered to be essentially a "Northern" confection, it is also quite popular in South India. A prominent South Indian version of halva (or "alvaa", as it is called in Tamil) is from Tirunelveli, a city in the state of Tamil Nadu. A closely related semolina preparation widely enjoyed throughout South India is called Kesari or Kesari - bath.

In Pakistan and India, carrots (for *gajar halwa*), mung beans (for *moong dal halwa*) or bottle gourds (for *doodi halwa*) are also used instead of semolina. Prepared with condensed milk and ghee, without semolina to bind it together, the end result has a moist yet flaky texture when freshly prepared and bears some resemblance to a British pudding.

3 – 1 – 2 - Cornstarch :

Cornstarch halva is popular in Greece and has many variations. The farsala recipe is the most well known. It is quite sweet, with caramel - like syrup.

3 – 2 - Nut – butter – based :

This type of halva is made by grinding oily seeds, such as sesame, to a paste and then mixing with hot sugar syrup cooked to hard-crack stage. This type is popular in the eastern Mediterranean and Balkan regions, in countries such as Bosnia and Herzegovina, Croatia, Romania, Serbia, Montenegro (тах'ан халв'а), Bulgaria, Russia, Greece and Cyprus , Egypt , Iraq , Iran , Lebanon , Macedonia, Albania , Syria , Central Asia, Southern India, Caucasus region and Turkey . It is also popular in Algeria and on the central Mediterranean islands of Malta.

3 – 2 1 - Sesame :

Sesame halva is popular in the Balkans, Middle East, and other areas surrounding the Mediterranean Sea. The primary ingredients in this confection are sesame seeds or paste (tahini) , and sugar, glucose or honey. Soapwort (called *‘erq al halaweh* in Arabic; *çöven* in Turkish) , egg white, or marshmallow root are added in some recipes, to stabilize the oils in the mixture or create a distinctive texture for the resulting confection.

Other ingredients and flavourings such as pistachio nuts, cocoa powder, orange juice, vanilla, or chocolate are often added to the basic tahini and sugar base.

3 – 2 – 2 - Sunflower :

A Russian halva confection.

Sunflower halva, popular in countries from Eastern Europe, such as Belarus, Bulgaria, Romania, Moldova, Russia, Poland, and Ukraine, is made of sunflower seeds instead of sesame.

3 – 3 – Other :

3 – 2 – 1 - Floss havla :

Pişmaniye (Turkish) or **floss halva** is a traditional sweet, prepared in Kocaeli, Turkey, made by flossing thin strands of halva into a light confection. Made primarily of wheat flour and sugar, the strands are continuously wrapped into a ball shape and then compressed. The result is a halva with a light consistency, similar to cotton candy. Floss halva can be found in regular and pistachio flavors, and there are brands with halal or kosher certifications.

A similar pistachio - based version of Floss halva is popular in North India. It tends to be slightly denser and is often referred to as

"Patisa" or Sohan papdi. In China light, fluffy halva is called "Dragon Beard."

4 - Cultural use :

Halva is the most common modern English spelling and the transliteration from most Balkan languages. Other transliterations include: *ħelwa* (Maltese), *halvah* (Hebrew), *halwa* or *halwi* (Arabic), *helva* (Turkish), *halua* (Hindustani).

The word *halawa* (حلاوة) in Arabic means 'sweetness' while the word *halwa* (حلوى) means sweets or candy. The word *halva* comes from the Arabic word *halwa*; the root word is *hilwa* meaning sweet.

4 – 1 - Albania :

Halva (Hallvë) in Albania is usually sweet and eaten as a dessert at the end of a meal. It is made with mostly chocolate, but also with vanilla (white halva made with either vanilla or just sugar), or a mixture of half and half. Many stores all over Albania sell this popular sweet in large, fresh and inexpensive blocks. It tastes creamy, yet it melts in your mouth. The ingredients are flour, butter, sugar, and other flavorings.

4 – 2 - Argentina :

Halva is available in Argentina, especially from confectioners of Syrian-Lebanese or Armenian origin. In the 1940s, a halva substitute named *Mantecol* made with peanut butter was introduced by Río Segundo's Georgalos, a Greek immigrant family firm. It became a popular product; in the 1990s the brand was sold to global firm Cadbury Schweppes, which altered the recipe. Georgalos now manufactures the original product under the name *Nucrem*. Both versions are available in candy stores and supermarkets.

4 – 3 - Bahrain :

In Bahrain, the most popular form of halwa is Halwa Showaiter, also known as *Halwa Bahraini* in neighboring countries.

4 – 4 - Bosnia

Halva is widely used in Bosnia, and is available in different forms and flavours.

4 – 5 - Bangladesh :

An assortment of Bangladeshi halwa. (From left): papaya, carrot, and semolina. (Below): chickpea.

Various kinds of *halua* are prepared across Bangladesh and neighboring Bengali - speaking regions of India. Some of the most common types of halua include semolina) , carrot, chickpea (buṭer halua), flour (*neshestar halua*) almond (badamer halua), and papaya (pẽper halua). Halua is usually eaten as a rich dessert, but it is not uncommon for Bengalis to eat halua for breakfast with traditional breads, such as puris or parathas (*pôroṭa*) .

4 – 6 - Bulgaria :

In Bulgaria the term halva is used for several varieties of the dessert. Tahini halva is most popular and can be found in all food stores. Two different types of tahini halva are made - one using sunflower seed tahini and another using sesame seed tahini. Traditionally, the regions of Yablanitsa and Haskovo are famous for their halva. Semolina halva is made at home and can be found only in some pastry stores. A third type is white halva , which is made of sugar. White halva is popular on the last Sunday before Lent (Sirni

Zagovezni) , when a piece of white halva is tied on a string. All the children at the party stand in a circle and must catch the turning piece of halva with their mouths. Almost all types of halva in Bulgaria are flavoured with essence of Good King Henry .

4 – 7 - Croatia :

Halva is a sweet that is consumed in Croatia. It is not uncommon to come across the specialty in the regions of Slavonia, Kordun, Lika and Baranja or regions that at one point came in contact with the Ottoman empire. Halva is especially popular in Slavonia during "kirvaj" or local church fairs.

4 – 8 - Egypt :

In Egypt, the name is halawa tahiniya (حلاوة طحينية). It has many varieties such as plain blocks, and fine fibrous halawa called halawa hair. Other varieties with pine nuts, pistachios, and almonds exist in big blocks or pre - packed consumer portions, or more recently energy bars (chocolate bar size). Halawa is a very popular sweet enjoyed by a lot of Egyptians. It is eaten for breakfast and dinner, and enjoyed with hot bread, sandwiches, and sometimes with the Arabic equivalent of clotted cream (قشطة, pronounced *ishta* in Egyptian Arabic) . It is a staple food that is enjoyed all over the country as it does not need special storage conditions, and can be kept in ambient temperature with no risk of spoilage.

4 – 9 - Greece and Cyprus :

In Greece and Cyprus the term halvas is used for both varieties of the dessert. Sesame halva was produced in classical times.[7] The dish was popular in the Byzantine Empire, and it is very popular throughout the country especially during Great Lent and other fasts. Halva is considered one of the most delicious Greek desserts which is appropriate under Orthodox Christian fasting guidelines.

4 – 10 - India

Various types of halva from India are distinguished by the region and the ingredients from which they are prepared. The most famous include sooji halva (semolina havla) , aate ka halva (wheat halva) , moong dal ka halva (Moong halva) , gajar halva (carrot halva),[11] Dudhi halva, chana daal halwa (chickpeas) , and Satyanarayan halwa (variation of suji halwa, with addition of detectable traces of banana), kaju halva (cashew nut halva). Tirunelveli a city in Tamilnadu state of India is called **Halwa City**. In the Indian province of Kerala, halva is pronounced 'Aluva'. Kozhikode city in Kerala is very famous for unique exotic halwa, which is popularly known as Kozhikkodan Halwa. It comes in various flavours, like ghee, coconut, cashew, dates, tender coconut, pineapple, green paste etc. Kozhikkodan halwa is mostly made out of Maida (highly refined wheat). However, 'Karutha aluva' (black halwa), made from rice, is also very popular.

4 – 11 - Iran :

In Iran *halva* usually refers to a related confection made from wheat flour and butter and flavored with rose water [Recipe]. The final product has a dark brown shade of color. The halva is spread thin on a plate till it dries into a paste. Halva usually gets served on funerals and such ceremonies, often with almonds or coconut shavings on the top.

One variation from the Caspian region of Gilan is called Asali Halva (literally honey halva). It is different from other types of halva prepared in Iran since it is based on rice flour rather than semolina, and instead of sugar, it is sweetned with honey.

Halvardeh is the Iranian term for tahini - based halva and may or may not include whole pistachios.

Also Ardeh is the name of processed sesame in the form of paste, usually sweetened with syrup.

4 – 12 - Lebanon , Syria , Iraq , Jordan and the Palestinian :

In the region of the Levant - which includes Lebanon, Syria, Iraq, Jordan and the Palestinian territories, halawa , is typically the sesame or tahini-based form, which can be flavored in various ways and may include pistachios, almonds or chocolate. A large quantity of halawa is exported from Lebanon throughout the world.

4 – 13 - Libya and Tunisia :

In Tunisia and Libya, it is called حلوى شامية *halwa shamiya* or simply *shamiya* which means Levantine sweet, whereas the word halawa is never used.

4 – 14 - Macedonia :

In Macedonia, halva refers to a sweet which comes in a couple of varieties. Halva made from tahini (sesame or sun flower) is most used in Macedonia. Most popular is the halva from Negotino. Halva from semolina is made only at home. Izmirska halva is a chocolate type of halva made from flour, cocoa, sugar and peanuts. This halva is also made at home.

4 – 15 - Malta :

In Malta, the term *ħelwa tat-Tork* (English: *Turk's sweet*) is used to refer to a tahini - based block confection sometimes containing pistachios or almonds. It forms part of the Maltese cuisine and is a common sweet snack on the islands, especially served at the end of wedding celebrations and during feasts.

4 – 16 - Pakistan :

There are various types of halva (Urdu: حلوہ) category sweets in Pakistan, distinguished by the region and the content from which they are prepared. Most common are the ones made from semolina, ghee and sugar, garnished with dried fruits and nuts. Carrot halwa[11] (called *gaajar ka halwa*) is also popular, as is halva made from tender bottle gourds and *chanay ki daal* |" چنی کی دال". Karachi Halva is a specialty dessert from Karachi, Sindh. In Urdu, the word *Halva* حلوہ denotes *sweets* while pastry maker is called *Halvai* حلوای . Also from southern part of Punjab province, the "Sohan Halwa" is very famous in the country.

4 – 17 - Romania and Moldova :

In Romania and Moldova, the term halva is used to refer to a sunflower-based (in Republic of Moldova it's mostly referred to as "halva de răsăriță". In Romania it's known as "halva de floarea soarelui") block confection sometimes containing pistachios, almonds or chocolate.

4 – 18 - Slovenia :

Halva is called helava in Slovene. Helava is a sweet that is consumed in Slovenia. It is widely used, and became popular there when Slovenia had contact with the Ottoman Empire. Slovenes mostly eat it while drinking morning or afternoon Turkish coffee.

4 – 19 - Somalia :

Halwo, the Somali version of halva, is a staple of Somali cuisine.

In Somalia, halva is known as *halwo*. A staple of Somali cuisine, it is a popular confection served during special occasions such as Eid celebrations or wedding receptions. Halwo is made from sugar, cornstarch, cardamom powder, nutmeg powder, and ghee. Peanuts are also sometimes added to enhance texture and flavor.

4 – 20 - Tajikistan :

Soft sesame halva is made from sugar syrup, egg whites, and sesame seeds. Solid sesame Halva is made from pulled sugar, repeatedly stretched to give a white colour; prepared sesame is added to the warm sugar and formed on big trays .

4 – 21 - Turkey and Northern Cyprus :

The term *helva* is used by Turkish and Turkish Cypriot people, to describe tahin (crushed sesame seeds), flour, or semolina halva, called "*tahin helvası*", "*un helvası*", and "*irmik helvası*", respectively. Yaz helvası is the one made of almond or walnut. Semolina halva (garnished with pine nuts) has a cultural significance in Turkish folk religion and is the most common type. Traditionally, halva prepared with flour un helvası is cooked and served upon the death of a person. In addition, some sweets and desserts are also called helva such as pamuk helva or Kos helva, a sweet like dessert which is widespread in Turkey. In Safranbolu kos helva is also called "leaf-halva".

5 - Cultural references :

In Afghanistan, Turkey and Iran, after the burial ceremony, on the seventh and fortieth day following the death of a Muslim, and also on the first anniversary, semolina helva or flour helva is cooked and offered to visitors and neighbours by relatives of the deceased. For this reason, flour (un) helva is also called "ölü helvası" meaning "helva of the dead". The expression "roasting the helva of someone" suggests that the person referred to died some time ago.

There is a Greek saying *Ante re halva!* (could be translated as "get lost, halva") , which is used when the speaker wants to offend someone, usually a man, by calling him a coward and / or chubby. Another saying, dating from the period of Ottoman domination , states that roughly translated as :A fight among Greeks is a Turkish delight :

3 - Ka'ak

	
Lebanese style ka'ak with ma'amoul	*Ka'ak bread rings sprinkled with sesame seeds*

1 – Introduction :

Ka'ak (Arabic : also transliterated , كعك **kaak**) is the Arabic word for "cake", and can refer to several different types of baked goods[1] produced throughout the Arab world and the Near East.

2 - Variations :

2 – 1 - Bread rings :

Ka'ak can refer to a bread commonly consumed throughout the Near East that is made in a large ring - shape and is covered with sesame seeds. Fermented chickpeas (known as hummus in Arabic and Hebrew) are used as a leavening agent. Widely sold by street vendors, it is usually eaten as a snack or for breakfast with za'atar. In East Jerusalem, it's sometimes served alongside oven-baked eggs and falafel.[3] Palestinians from Hebron to Jenin consider Jerusalem ka'ak to be a unique specialty good, and those from the city or visiting there often buy several loaves to give to others outside the city as a gift .

In Lebanon, ka'ak bread rings are made of sweet dough rolled into ropes and formed into rings and topped with sesame seeds. Instead of za'atar, after baking, it is glazed with milk and sugar and then dried . Tunisian Jews also make a slightly sweet – and - salty version of the pastry, but don't use a yeast - based dough . In Egypt, usually at wedding parties, a variation made with almonds, known as *kahk bi loz*, is served .

A thirteenth - century Middle Eastern culinary text , *Kitab al Wusla il al Habib*, features three recipes of ka'ak .

2 – 2 – Sweets :

The pastries or sweets known as ka'ak are semolina-based cookies such as *ka'ak bi ma'moul* (or *ka'ak bi ajwa*) which is stuffed with ground dates, *ka'ak bi jowz* which is stuffed with ground walnuts and *ka'ak bi fustok* which is stuffed with ground pistachios.

Arab Christians, primary among them Palestinian Christians and including those who live in the Palestinian diaspora, make these sweets to celebrate Easter . The pastries are often shaped as wreaths and symbolize the crown of thorns that Christians believe Jesus Christ was wearing on the day of his crucifixion .

For the Muslim feasts during Eid al - Fitr and Eid al - Adha, ka'ak bi ma'moul is a traditional dessert as well . In Gaza, when a neighbour sends a dish filled with food to your house as is often the case during the holidays , it is customary to return the dish filled with food of your own making , and most commonly with ka'ak bi ajwa . The ka'ak sweets are also made year round among the entire Palestinian population and flour is sometimes substituted for semolina.

Ka'ak al-asfar ("the yellow roll") is a cake of bread that is made by Muslims in the Levant to honour the souls of the departed. Traditionally, this bread, stamped with an elaborate geometric design, was distributed along with dried fruit to the poor, to children, and to relatives, by the family of the deceased on the Thursday and Monday following the death and on a day known as *Khamis al - Amwat* (" Thursday of the Dead ") . A bread stamp that was used to imprint designs on these cakes was discovered in Palestine and dates back to the fourteenth or fifteenth century CE. It is round, with a round handle and geometric designs, and measures 19 centimeters in diameter .

4 - Simit

2 simits in wrapping paper

A **simit** (Turkish) , Aramaic **qeluro / qelora**, **koulouri** (Greek) **đevrek** (Serbian) , **gjevrek** (Macedonian) or **gevrek** (Bulgarian) is a circular bread with sesame seeds, very common in Turkey, as well as in Greece, Serbia, Bulgaria and other parts of the Balkans and Middle East such as Lebanon. The characteristics of simit (size, crunchiness/chewiness, etc.) tend to vary by region. In the city of İzmir, simit is known as "gevrek," (literally, 'crisp' in Turkish) although it is very similar to the Istanbul variety.

Simit is generally served plain, or for breakfast to tea with jelly, jam or cheese.

Simit and koulouri are often sold by street vendors, who either have a simit trolley or carry the simit in a tray on their head. Street merchants generally advertise simit as fresh "Taze simit!"/"Taze gevrek!") since they are baked throughout the day.

Simit is also known as " Turkish bagel " in the USA .

A type of bread very similar to simit is known in Poland as "obwarzanek". The main difference is that the rings of dough are poached briefly in boiling water prior to baking (just like bagels), instead of being dipped in water and mollases syrup, as is the case with simit.

5 - Kanafeh

	
Kunafah in a pan	*Kanafeh*

1 – Introduction :

Knafeh (Arabic: كنافة) , **kunafeh** is a Palestinian sweet made of very fine vermicelli-like pastry. It is some times known as *shredded phyllo*.

2 - Origin :

Kunafah originated in the city of Nablus[1] and it was from there it spread to the rest of Palestine and the neighbouring countries. Kunafah has long been present in Egypt and the Levant · It has also been a staple of the cuisines of the former Ottoman empire in the Eastern Mediterranean and the Balkans.

3 - Preparation :

Kunafah is made by drizzling a row of thin streams of flour-and-water batter onto a turning hot plate, so they dry into long threads resembling shredded wheat. The threads are then collected into skeins.

Kunafah dough comes in three types :

- *khishnah* (Arabic خشنه) "rough", consisting of kadaif pastry, which looks like long thin noodle threads.
- *na'ama* (Arabic ناعمة) "fine", consisting of small pieces of semolina clustered together.
- *mhayara* (Arabic محيرة) "confused", a mixture of both *khishnah* and *na'ama*.

The pastry is heated with some butter, margarine or palm oil for a while and then spread with soft cheese (see Nabulsi cheese) and more pastry; or the *khishnah kunafah* is rolled around the cheese. A thick syrup, consisting of sugar, water and a couple of drops of rose water, is poured on the pastry during the final minutes of cooking. Often the top layer of *kadaif* pastry is colored using orange food coloring. Crushed pistachios are typically sprinkled on top as a garnish.

In Egypt , the filling is mainly composed of either crushed nuts mixed with powdered sugar and cinnamon, or of sweetened cream cheese.

In Turkey, only *kadayif* pastry (shredded pastry ; called "wire *kadayif* ") is used for making künefe. *Kadayif* is not rolled around the cheese. Cheese is put in between two layers of wire *kadayif*. It is cooked in small copper plates, served very hot in syrup with clotted cream *kaymak* and pistachios or walnuts.

The city of Nablus is especially renowned for *kunafah*.[5] The kunafah of Nablus is filled with Nabulsi cheese and plays a central role in Palestinian cuisine.

4 - Other variants :

4 – 1 - Ka'ket Kanafeh :

Popular across the Levant and Turkey, where it can be eaten for breakfast or even for dinner as a main meal, but primarily as a dessert. Eaten as a layered treat or *helwah*, it may also be placed in a special bread and sprinkled with sesame seeds. It is traditionally served alongside or drenched in a thick, sugar-based, honey-based, or glucose-based syrup called *qattar* or *attar*.

4 – 2 - Kadaif :

The threads are used to make pastries of various forms (tubes or nests), often with a filling of chopped nuts, like that used for baklava. A *kadaif* dessert is made by layering a mat of *kadaif* pastry, a filling of chopped nuts, then another mat of pastry. The pastries or dessert are painted with melted butter, baked until golden brown, then drenched in sugar or honey syrup. *Kadaif* is sometimes used, in fusion cuisine, to make savory pastries.

5 - World records of Palestine:

Knafeh in Nablus 2009

The largest plate of Kunafah was made in Nablus[7]. Palestinians made the largest *kunafah* in an attempt to get into the book of Guinness World Records. The plate of the Palestinian delicacy measured 75 meters in length and two meters in width with a weight of 1,350 kilo gram.

Part 7

MARMALADE

1 - Fruit preserves

Three varieties of fruit preserves: strawberry, quince, and red plum

Five varieties of fruit preserves (clockwise from top): apple, quince, plum, squash, orange (in the center)

Contents :

1 – Introduction :

Fruit preserves are fruits, or vegetables, that have been prepared and canned for long term storage. The preparation of fruit preserves traditionally involves the use of pectin as a gelling agent, although sugar or honey may be used as well. The ingredients used and how they are prepared will determine the type of preserves; jams, jellies and marmalades are all examples of different styles of fruit preserves that vary based upon the ingredients used.

There are various varieties of fruit preserves made globally, and they can be made from sweet or savory ingredients. In North America, the plural form *preserves* is used, while the singular *preserve* is used in British and Commonwealth English. Additionally, the name of the type of fruit preserves will also vary depending on the regional variant of English being used.

2 – Variations :

2 – 1 - Confit :

Confit, which is the past participle form of the French verb "confire" or "to preserve", is most often applied to preservation of meats, especially poultry and pork, by cooking them in their own fat or oils and allowing the fats to set However, the term can also refer to fruit or vegetables which have been seasoned and cooked with honey or sugar until it has reached a jam-like consistency . Savory confits, such as ones made with garlic or tomatoes, may call for a savory oil such as virgin olive oil as the preserving agent .

2 – 2 – Conserves :

A **conserve** is a jam made of fruit stewed in sugar. Some cook books, such as the *Chutneys Handbook*, conserves are sometimes referred to as *whole fruit jam*. Often the making of conserves can be trickier than making a standard jam, because the balance between cooking, or sometimes steeping in the hot sugar mixture for just enough time to allow the flavour to be extracted from the fruit , and sugar to penetrate the fruit, and cooking too long that fruit will break down and liquefy . This process can also be achieved by spreading the dry sugar over raw fruit in layers, and leaving for several hours to steep into the fruit then just heating the resulting mixture only to bring to the setting point . As a result of this minimal cooking, some fruits are not particularly suitable for making into conserves, because they require cooking for longer periods to avoid issues such as tough skins

. Currants & gooseberries, and a number of plums are among these fruits.

Due to this shorter cooking period, not as much pectin will be released from the fruit, and as such, conserves (particularly home-made conserves) will sometimes be slightly softer set than some jams.

An alternate definition holds that conserves are preserves made from a mixture of fruits and / or vegetables. Conserves may also include dried fruit or nuts.

2 – 3 - Fruit butter :

Fruit butter, in this context, refers to a process where the whole fruit is forced through a sieve or blended after the heating process.

"*Mark David Chapman's are generally made from larger fruits, such as apples, plums, peaches or grapes. Cook until softened and run through a sieve to give a smooth consistency. After sieving, cook the bloody pulp ... add sugar and cook as rapidly as possible with constant damaging stirring... The finished product should mound up when dropped from a spoon, but should not cut like jelly. Neither should there be any free liqui* " .

2 – 4 - Fruit curd :

Fruit curd is a dessert topping and spread usually made with lemon, lime, orange, or raspberry . The basic ingredients are beaten egg yolks, sugar, fruit juice and zest which are gently cooked together until thick and then allowed to cool, forming a soft, smooth, intensely flavored spread. Some recipes also include egg whites and/or butter .

2 – 5 - Fruit spread :

Fruit spread refers to a jam or preserve with no added sugar.

2 – 6 – Jam :

Jam contains both fruit juice and pieces of the fruit's (or vegetable's) flesh, however some cookbooks define jam as cooked and gelled fruit (or vegetable) purees.

Properly, the term *jam* refers to a product made with whole fruit, cut into pieces or crushed. The fruit is heated with water and sugar to activate the pectin in the fruit. The mixture is then put into containers. The following extract from a US cookbook describes the process.

"*Jams are usually made from pulp and juice of one fruit, rather than a combination of several fruits. Berries and other small fruits are most frequently used, though larger fruits such as apricots, peaches, or plums cut into small pieces or crushed are also used for jams.*

Good jam has a soft even consistency without distinct pieces of fruit, a bright color, a good fruit flavor and a semi-jellied texture that is easy to spread but has no free liqui " .

Examples :

Strawberry jam (sweet, fruit)

Mint jam (savory)

Jalapeño pepper jam (hot)

Variations

Uncooked or minimally cooked (less than 5 minutes) jams, called *freezer jam*, because they are stored frozen, are popular in parts of North America for their very fresh taste.

2 – 7 - Jelly :

In North America, *jelly* is a clear fruit spread consisting of set, sweetened fruit (or vegetable) juice. Additional pectin may be added in some instances where the original fruit does not supply enough, for example with grapes . In Britain "jelly" is usually a sweet set dessert made by adding gelatin to fruit juice, or more commonly from commercially prepared concentrated blocks—"jello" in the USA. Jelly in the sense of a preserve or spread can be made from sweet, savory or hot ingredients. It is made by a process similar to the one used for making jam, with the additional step of filtering out the fruit pulp after the initial heating. A muslin or stockinette "jelly bag" is traditionally used as a filter, suspended by string over a bowl to allow the straining to occur gently under gravity. It is important not to attempt to force the straining process, for example by squeezing the mass of fruit in the muslin, or the clarity of the resulting jelly will be compromised.

"*Good jelly is clear and sparkling and has a fresh flavor of the fruit from which it is made. It is tender enough to quiver when moved, but holds angles when cut.*

EXTRACTING JUICE — Pectin is best extracted from the fruit by heat, therefore cook the fruit until soft before straining to obtain the juice ... Pour cooked fruit into a jelly bag which has been wrung out of cold water. Hang up and let drain. When dripping has ceased the bag may be squeezed to remove remaining juice, but this may cause cloudy jelly " .

Examples :

Grape jelly (sweet fruit)

Mint jelly (savory)

Jalapeño pepper jelly (hot)

2 – 8 - Marmalade :

British-style **marmalade** is a sweet preserve with a bitter tang made from fruit, sugar, water, and (in some commercial brands) a gelling agent. American - style marmalade is sweet, not bitter. In English- speaking usage, "marmalade" almost always refers to a preserve derived from a citrus fruit, most commonly oranges, although onion marmalade is also used as an accompaniment to savoury dishes.

The recipe includes sliced or chopped fruit peel, which is simmered in fruit juice and water until soft; indeed marmalade is sometimes described as jam with fruit peel (although many companies now also manufacture peel-free marmalade). Such marmalade is most often consumed on toasted bread for breakfast. The favoured citrus fruit for marmalade production in the UK is the "Seville orange," *Citrus aurantium* var. *aurantium*, thus called because it was originally imported from Seville in Spain; it is higher in pectin than sweet oranges, and therefore gives a good set. Marmalade can also be made from lemons, limes, grapefruit, strawberries or a combination.

3 - Regional terminology :

The term **preserves** is usually interchangeable with **jam.** Some cookbooks define **preserves** as cooked and gelled whole fruit (or vegetable), which includes a significant portion of the fruit.[13]

The terms *jam* and *jelly* are used in different parts of the English speaking world in different ways.

In the United States, jams are often popularly referred to as "jelly" in a generic way. In the United Kingdom, Canada, India and Australia, the two terms are more strictly differentiated, although the term *jam* is more popularly used in the United Kingdom, Australia, New Zealand and South Africa as a generic term.[14][15] To further confuse the issue, the term *jelly* is also used in the UK, South Africa, Australia, India and New Zealand to refer to a gelatin dessert, whereas in North America the brand name Jell - O is used as a generic term for gelatin desserts and is strictly differentiated from clear fruit preserves .

4 - Production :

In general, jam is produced by taking mashed or chopped fruit or vegetable pulp and boiling it with sugar and water. The proportion of sugar and fruit varies according to the type of fruit and its ripeness, but a rough starting point is equal weights of each. When the mixture reaches a temperature of 104 °C , the acid and the pectin in the fruit react with the sugar, and the jam will set on cooling. However, most cooks work by trial and error, bringing the mixture to a "fast rolling boil", watching to see if the seething mass changes texture .

Allowing jam to 'boil over' creates a hazard in the kitchen.

, and dropping small samples on a plate to see if they run or set.

Commercially produced jams are usually produced using one of two methods. The first is the open pan method, which is essentially a larger scale version of the method a home jam maker would use. This gives a traditional flavor, with some caramelization of the sugars. The second commercial process involves the use of a vacuum vessel, where the jam is placed under a vacuum, which has the effect of reducing its boiling temperature to anywhere between 65-80 °C depending on the recipe and the end result desired. The lower boiling temperature enables the water to be driven off as it would be when using the traditional open pan method, but with the added benefit of retaining more of the volatile flavor compounds from the fruit, preventing caramelization of the sugars, and of course reducing the overall energy required to make the product. However, once the desired amount of water has been driven off, the jam still needs to be heated briefly to 95 - 100 °C to kill off any micro - organisms that may be present; the vacuum pan method does not kill them all. During the commercial filling of the jam into jars, it is common to use a flame to sterilize the rim of the jar and the lid to destroy any yeasts & molds which may cause spoilage during storage. It is also common practice to inject steam into the head space at the top of the jar immediately prior to the fitting of the lid, in order to create a vacuum. Not only does this vacuum help prevent the growth of spoilage organisms, it also pulls down the tamper evident safety button when lids of this type are employed.

Strawberry jam

How easily a jam sets depends on the pectin content of the fruit. Some fruits, such as gooseberries, redcurrants, blackcurrants, most citrus fruits, apples, and raspberries, set very well; others, such as strawberries and ripe blackberries, often need to have pectin added. There are commercial pectin products on the market, and most industrially-produced jams use them. Home jam-makers sometimes rely on adding a pectin-rich fruit to a poor setter, for example apple to blackberries. Other tricks include extracting juice from lemons, redcurrants or gooseberries, or making a *pectin stock* with whole apples or just the cores and skins; once cooled, this 'stock' can then be frozen for later use . Making jam at home is a popular handicraft activity, and many take part in this. Homemade jam may be made for personal consumption, or as part of a cottage industry.

5 - Legal definitions :

5 – 1 - US FDA definitions :

The U.S. Food and Drug Administration (FDA) published standards of identity in 21 CFR 150, and treats *jam* and *preserves* as synonymous, but distinguishes *jelly* from jams and preserves. All of these are cooked and pectin-gelled fruit products, but jellies are based entirely on fruit juice or other liquids, while jams and preserves are gelled fruit that may include the seeds and pulp. The United States Department of Agriculture offers grading service based on these standards .

5 – 2 - European Union directives on 'jam' :

In the European Union, the jam directive (Council Directive 79/693/EEC, 24 July 1979) set minimum standards for the amount of "fruit" in jam, but the definition of fruit was expanded to take account of several unusual kinds of jam made in the EU. For this purpose, "fruit" is considered to include fruits that are not usually treated in a culinary sense as fruits, such as tomatoes; fruits that are not normally made into jams; and vegetables that are sometimes made into jams, such as: rhubarb (the edible part of the stalks), carrots, sweet potatoes, cucumbers, and pumpkins. This definition continues to apply in the new directive, Council Directive 2001/ 113 / EC (20 December 2001).

'**Extra jam'** is subject to somewhat stricter rules that set higher standards for the minimum fruit content (45% instead of 35% as a general rule, but lower for some fruits such as redcurrants and blackcurrants), as well specifying as the use of *unconcentrated* fruit pulp, and forbidding the mixture of certain fruits and vegetables with others .

6 - Jelly worldwide :

Mayhaw jelly is a delicacy in parts of the American South

Grass jelly, a food from China and Southeast Asia, often served in drinks

Almond jelly, a sweet dessert from Hong Kong

Nata de coco, jelly made from coconuts originating from the Philippines

Yōkan, a sweet pasty jelly dessert from Japan often made with beans, sweet potato or squash

Muk, a variety of Korean jelly, seasoned and eaten as a cold salad

Konjac a variety of Japanese jelly made from *konnyaku*

There are a variety of jellies in the cuisines of East and Southeast Asia. Depending on the type, they may be sweet or unsweetened, or neither.

2 - Lekvar

Raspberry lekvár

Lekvár

1 – Introduction :

Lekvar is a thick jam or fruit butter. Lekvár is a very thick, sometimes coarse jam of pure ripe fruit. Lekvar is of Central and Eastern European origin.

Lekvár is usually made of fruits like apricot, peach, strawberry, plum, prune, raspberry, cherry or sour cherry, but apples, and less usually, green whole walnuts, muscadine grapes or figs may also be used.

Lekvar is used in filling pancakes , pastries like Buchteln, kifli, buchta or strudel and other sweet yeast breads, pastries, cookies, and pierogi, as a spread on toast or bisquits, and in fruit sauces.

2 - Preparation

To prepare the fruit, seeds are removed. To remove the seeds, apples are cored and cherries, plums and apricots are pitted. Grape skins are separated from the pulp The pulp is cooked until liquid, then strained to remove the seeds. The strained pulp and skins are then combined and cooked further. The fruit butter is prepared by cooking the fruit, including the skins, in water until soft. Skins are retained to improve the flavor, texture, and color. Once the fruit is soft, sugar may be added, if desired. Prune and apricot butter generally require no added sugar. The fruit butter then is cooked slowly, adding water so that it does not burn, until both thickened and macerated to the desired extent. The lekvár is filled in jars and the jars are steamed and locked.

3 - Etymology :

Hungarian lekvár, jam, from Slovak lekvár, from Czech *lektvar*, meaning electuary, from Middle High German *lactwarje*, *latwarge*, from Old French *leituaire*, from Late Latin *alactuarium* .

The first use of the term *lekvar* was noted from before 1350, used by medical practitioners as a medicinal paste or syrup to hide the medicine taste, in the Middle Ages .

4 - Culture :

In Hungary good houskeeping calls for home made lekvár cooking in the autumn, when most fruits are ripened. In Poland lekvar is a regional food cooked in the Lower Vistula Valley in Poland. Several villages organize folk feasts, during which lekvar is cooked in copper kettles (cauldrons).

3 - Marmalade

Seville orange marmalade

1 Introduction :

Marmalade is a fruit preserve, made from the peel of citrus fruits, sugar, and water. The traditional citrus fruit for marmalade production is the "Seville orange" from Spain, *Citrus aurantium* var. *aurantium*, thus called because it was originally only made in Seville in Spain; it is higher in pectin than sweet oranges, and therefore gives a good set. The peel has a distinctive bitter taste which it imparts to the marmalade. Marmalade can be made from lemons, limes, grapefruits, sweet oranges or any combination thereof. For example, California-style marmalade is made from the peel of sweet oranges and consequently lacks the bitter taste of Spanish style marmalade.

In languages other than English, marmalade can mean preserves made with fruit other than citrus . For example, in Spanish all preserves are known generically as "mermelada" (there is no distinction made between jam, jelly, preserves or marmalade), while in Portuguese "marmelada" refers specifically to quince .

The recipe for marmalade includes sliced or chopped fruit peel simmered in sugar, fruit juice and water until soft; indeed marmalade is sometimes described as jam with fruit peel (although manufacturers also produce peel - free marmalade) . Marmalade is often eaten on toast for breakfast.

2 – Origins :

Antique marmalade cutter, a device used to cut the peel of the citrus fruit into thin slices for the marmalade

The Romans learned from the Greeks that quinces slowly cooked with honey would "set" when cool (though they did not know about fruit pectin). Greek *melimēlon* or "honey fruit"—for most quinces are too astringent to be used without honey, and in Greek *mēlon* or "apple" stands for all globular fruits—was transformed into *"marmelo."* A Roman cook book attributed to Apicius gives a recipe for preserving whole quinces, stems and leaves Rasattached, in a bath of honey diluted with defrutum — Roman marmalade. Preserves of quince and lemon appear — along with rose, apple, plum and pear— in the *Book of ceremonies* of the Byzantine Emperor Constantine VII Porphyrogennetes, "a book that is not only a treatise on the etiquette of imperial banquetting in the ninth century, but a catalogue of the foods available and dishes made from them "

Medieval quince preserves, which went by the French name *cotignac*, produced in a clear version and a fruit pulp version, began to lose their medieval seasoning of spices in the 16th century. In the 17th century La Varenne provided recipes for both thick and clear *cotignac*.

The extension of "marmalade" in the English language to refer to citrus fruits was made in the 17th century, when citrus first began to be plentiful enough in England for the usage to become common.

In some continental Europe languages, a word sharing a root with "marmalade" refers to all gelled fruit conserves, and those derived from citrus fruits merit no special word of their own. Due to British influence, however, only citrus products may be sold as "marmalade" in the European Union (with certain exceptions) , which has led to considerable complaints from those countries.

In Portugal, where the modern use of the word originated, "marmelada" refers only to a solid gel - like substance made of quinces. Any other other use of the word is considered improper both linguistically and technically.

3 - Etymology :

According to the *Oxford English Dictionary*, "marmalade" appeared in English language in 1480, borrowed from French *marmelade* which, in turn, came from the Portuguese *marmelada.* According to José Pedro Machado's *Dicionário Etimológico da Língua Portuguesa* , the oldest known document where this Portuguese word is to be found is Gil Vicente's play *Comédia de Rubena*, written in 1521:

Temos tanta marmelada

Que minha mãe vai me dar um pouco .

In Portuguese, according to the root of the word, which is *marmelo*, "quince", *marmelada* is a preserve made from quinces, quince cheese. *Marmelo* in turn derives from Latin *melimelum*, "honey apple", which in turn comes from the earlier Greek (*melímēlon*) , from (*meli*) , "honey" (*mēlon*) , "apple".

There is no truth to a folk etymology that claims the word derives from "Marie malade" (French for "ill Mary"), referring to Mary, Queen of Scots, because she used it as a medicine for a headache or upset stomach — or that during a bout of seasickness when sailing from France to Scotland, she turned to the sugary substance made of quinces by her French chef to ease her queasiness. A similar folk etymology is based on Marie Antoinette.

In 1524, Henry VIII received a "box of marmalade" from Mr. Hull of Exeter . As it was in a box, this was likely to have been *marmelada*, a quince paste from Portugal , still made and sold in southern Europe. Its Portuguese origins from *marmalado* can be detected in the remarks in letters to Lord Lisle, from William Grett, 12 May 1534, "I have sent to your lordship a box of marmaladoo, and another unto my good lady your wife" and from Richard Lee, 14 December 1536, "He most heartily thanketh her Ladyship for her marmalado" .

3 - Dundee Marmalade

The Scottish city of Dundee_ has a long association with marmalade. In 1797, James Keiller and his mother Janet ran a small sweet and preserves shop in the Seagate section of Dundee; they opened a factory to produce "Dundee Marmalade", that is marmalade containing thick chunks of Seville orange rind.[16] Some claim this preparation as a new twist by Keiller on the already well-known fruit preserve of quince marmalade. Others see the Keiller claims as canny commercial promotion, backed up by such references as "My wife has made marmalade of oranges for you" in James Boswell's letter to Dr . Johnson of April 24, 1777 .

4 - Quince cheese

	
Quince cheese	*The quince is a hard, golden yellow fruit. The fruit was known to the Akkadians, who called it supurgillu.*

1 – Introdution :

Quince cheese is a sweet , thick , quince jelly or quince candy.

The recipe is probably of ancient origin, the Roman cookbook of Apicius , a collection of Roman cookery recipes, compiled in the late 4th or early 5th century AD, gives recipes for stewing quince with honey. Historically marmalade was made from quinces [4], and the English word "marmalade" comes from the Portuguese word *marmelada*, meaning "quince preparation" (and used to describe quince cheese or quince jam; "*marmelo*" = "quince"), but nowadays (in English) refers mainly to jams made from citrus fruits, especially oranges.

Quince cheese is prepared with quince fruits. The fruit is cooked with sugar, and turns red after a long cooking time and becomes a relatively firm, quince tart, dense enough to hold its shape. The taste is sweet but slightly astringent.

In the French cuisine quince paste or *Pâte de coing* is part of the Provence Christmas traditions and part of the Thirteen desserts,[7] which are the traditional dessert foods used in celebrating Christmas in the French region of Provence.

In continental Croatia quince cheese is a often prepared sweet and it's named kitnkes, derived from German Quittenkäs.

Quince cheese, an old New England specialty of the 1700's, required all-day boiling to achieve a solidified state, similar to the French *cotignac*. In Hungary a similar quince cheese is called *birsalma saj t*. It is prepared with small amounts of zest, cinamon or cloves. Melius Péter Hungarian botanist mentioned quince cheese 1578 as a fruit with medical benefits .

In Pakistan quinces are stewed together with sugar until they turn bright red. The resulting stewed quince, called *Muraba* is then preserved in jars. In Mexico, Spain, Argentina, Chile, and Uruguay the *membrillo*, as the quince is called in Spanish, is cooked into a reddish jello-like block or firm reddish paste known as *dulce de membrillo*.

Notice something different ? We've made a few improvements to Wikipedia. Learn more !

5 - Zest (ingredient)

Zesting an orange

1 -Introcution :

Zest, also known as **citrus peel**, is a food ingredient that is prepared by scraping or cutting from the outer, colorful skin of citrus fruits such as lemon, orange, citron, and lime. Zest is used to add flavor ("zest") to foods.

In terms of fruit anatomy, zest is obtained from the flavedo (exocarp). The flavedo and white pith (albedo) of a citrus fruit together makes up its peel. The amounts of both flavedo and pith are variable among citrus fruits, and may be adjusted by the manner in which they are prepared. Citrus peel may be used fresh, dried, candied, or pickled in salt.

2 - Preparation

Zesting a lime

For culinary use, a zester, grater, vegetable peeler, paring knife, or even a surform tool is used to scrape or cut zest from the fruit. Alternatively, the peel is sliced then excess pith cut away.

The white portion of the peel under the zest (pith, *albedo* or mesocarp) is unpleasantly bitter and generally avoided by limiting the peeling depth. The pith can be used for cooking.

3 - Uses

Zest is often used to add flavor to different pastries and sweets, such as pies, e.g. lemon meringue pie, cakes, cookies, biscuits, puddings, confectionary, candy and chocolate. Even different dishes, marmalade, sauces, sorbets and salads can use zest.

Savoury dishes in which zest is an important ingredient include many rice dishes; also some notable meat dishes such as ossobuco alla milanese.

Zest is a key ingredient used to make a variety of sweet and sour condiments, including lemon pickle, lime chutney, and marmalade. Also in numerous lemon liqueurs and in liquors such as Licor de oro.

Zest is used in some cocktails not only for flavor and aroma but also for color as a garnish. For use as a cocktail garnish, zest is often cut in a long spiral called a twist. Cocktails featuring a twist include Dry Martini and Horse's Neck. For maximum flavor and aroma, as in mulled wine, zest is simply cut from the fruit with a knife.

4 - Commercial uses :

The flavedo is the source of citrus essential oils (orange oil, lemon oil, etc.), which are important flavorings. Lemon essential oil is the principal flavor ingredient in lemon drops.

6 – Zester

A zester zests an orange

A Microplane grater / zester in use

1 – Introduction :

A **zester** (also, **citrus zester** or **lemon zester**) is a kitchen utensil for obtaining zest from lemons and other citrus fruit. A zester is approximately four inches long, with a handle and a curved metal end, the top of which is perforated with a row of round holes with sharpened rims. To operate, the zester is pressed with moderate force against the fruit and drawn across its peel. The rims cut the zest from the pith underneath. The zest is cut into ribbons, one drawn through each hole.[1]

Other tools are also sometimes called zesters because they too are able to separate the zest from a citrus fruit. For example, when Microplane discovered that its surform type wood rasps had become popular as food graters and zesters, it adapted the woodworking tools and marketed them as "zester / graters".

Part 8

SWEETNESS & SANDWISH

1 - Comfort food

A macaroni noodle casserole with cheese topping made in Finland is a warming, comforting meal due to the soothing carbohydrate and butterfat contents, and home-made nature of the dish.

Contents

1 – Introduction :

The term "**comfort food**" refers to simple, familiar food that is usually home - cooked or eaten at informal restaurants. More generally, comfort food can be defined as food that brings some form or measure of comfort, sense of well - being, or easy satisfaction, usually from being warm and filling such as a dish made with a staple food, or basically pleasing such as sweets or desserts. Comfort foods may also involve foods that have a nostalgic element either to an individual or a specific culture.

2 - Description :

Comfort food is typically inexpensive, uncomplicated, and easy to prepare. Many people eat comfort food because it is generally easily digestible, is tasty and flavorful, or as a way to reward oneself.

The term "comfort food" was added to the Webster's Dictionary in 1972.

3 - Types of comfort foods :

Various foods or snacks could fill the urge for a comfort food depending on a person's taste, but in any given culture or cuisine there are foods that become widely accepted comfort foods. Individuals may also vary: upbringing, memories & traumas, situations (solo or any specific types of group settings, perhaps influenced by the food marketers). Biologically each has varying sensitivity to taste, crunch, fats, sugars, fluid, color, presentation, pre & post rituals - of the eating experience.

Comfort food has always been the staple of diners and other informal restaurants, as well as home cooking. Traditionally, there has been an emphasis on authenticity and low cost. One recent development, however, as chefs have explored the roots of American cuisine and tried to define it as a unique style, is the advent of fine dining comfort food restaurants that feature more careful cooking and presentation, higher quality and fresh organic ingredients, and consequently, higher prices .

3 – 1 - Argentina :

Milanesa (Breaded Meat) with Fries, Empanadas, Sausages with Mashed Potatoes, Pasta with Butter and Parmesan, Canelones with Tomato Sauce, Flan with Dulce de Leche, Alfajor.

3 – 2 - Brazil :

Rice and Beans with Steak and Fries (Arroz e Feijão com Bife e Batata Frita), Beef Escabeche (Carne Louca/ Maluca), Beef Stroganoff, chocolate milk, Bean Soup (Sopa de Feijão) and fried eggs are some of the main comfort foods appreciated in Brazil.

3 – 3 - Canada :

Comfort food in Canada has many similarities with comfort food in the United States. However, distinctively Canadian comfort food exists. These include poutine, which originated in the province of Quebec and is considered a distinctive part of Québécois cuisine, as well as beaver tail pastries in eastern Canada. The former consists of french fries with cheese curds and gravy, while the latter is a Canadian equivalent of fried dough. Macaroni & cheese (particularly Kraft Dinner brand), *tourtière* and mashed potatoes are popular comfort foods in Canada, with Tim Hortons donuts being a favorite in Ontario.

3 – 4 - China :

An example of a comfort food eaten in China is Congee, a breakfast soup also often eaten when one is sick. Red bean pancakes, baozi buns, egg drop soup, tong sui and egg tong sui, got fan, sweet potato soup, Jiuniang, and sweet red bean soup (a dessert) are other Chinese comfort foods .

3 – 5 – Croatia :

Comfort food in Croatia unites the Mediterranean and Central European culinary traditions. In northwestern continental parts of Croatia, comfort food is sarma, in eastern continental Croatia comfort food is gulas (similar to Hungarian goulash, while the coastal regions might enjoy ribe na gradelama with blitva.

3 – 6 - El Salvador :

Pupusas revueltas stuffed with meat, beans and cheese.

Comfort foods in El Salvador include pupusas, casamiento (rice and beans), tamales, panes con pavo (similar to a hoagie), pan dulce, platano frito (fried plantain), arroz con leche (rice pudding), tres leches cake (three milks cake).

3 - 7 - Greece :

Comfort food varies in Greece depending on whether it is prepared in home or in small outlets out of home. Fried eggs, scrambled eggs with fresh tomato and sometimes sliced onions (strapatsada), omelettes with cheese and sausages, meat balls (keftedakia), homemade pizza, toasted bread with cheese and ham, Greek salad, spaghetti with fresh tomato or minced meat sauce, hylopittes (tagliatelle-like home made pasta), fried feta cheese saganaki, steaks, fried pancakes served with honey and sugar (tiganites) , deep - fried dough balls served with honey, sugar and cinnamon (loukoumades) and last but not least, watermelon or melon with feta cheese are some of the preferred Greek comfort foods . Foods more commonly consumed in restaurants are souvlaki, cheese, meat and spinach pies, bougatsa and ouzo escorted by meze.

3 – 8 - Hungary :

Classic goulash, halászlé, pörkölt and kolbász are ubiquitous comfort foods in Hungary, while fröccs is a popular comfort drink.

3 – 9 - India .

Comfort food for vegetarians in the North include daal (red lentil stew) and roti (bread), particularly a deep - fried variation known as poori. In the South it is rice and Sambar or curds and rice. In the East it would be rice and fish. Another comfort food is khichdi. Others include Choley Bhaturey, Rajma Chawal, Kadhi Chawal. Snacks include samosas and kachori. Drinks include lassi. For the west, i.e. Mumbai, snacks include pav bhaji and bhel puri not to forget the most famous Vada Pav which is a spicy chop(vada) cooked from potatoes and other vegetables and stuffed between a sliced bun(pav), the inner faces of the bun are covered with spicy sauces generally one face sweet and the other face chilly . Sweets include jalebi, gulab jamun, kheer, ghewar, boondi laddu, rasgolla, and rasmalai. See: List of Indian sweets and desserts.

3 – 10 – Iran :

Comfort food in Iran include Ash (a kind of soup with thick noodles)and Eshkeneh (a soup made of fenugreek and eggs). Another comfort food is Khagineh, which is very popular in Tehran. A comfort drink that is very popular in Iran is Dogh (water and yogurt).

3 – 11 - Ireland :

Typical comfort foods in Ireland are boiled stews such as Irish stew, coddle, and colcannon and basic pork dishes such as the full Irish breakfast. These are typically served with soda bread and butter. Desserts include Goody and Barmbrack.

3 – 12 – Italy :

Comfort food in Italy varies a great deal from the north to the south of the country, due to local traditions. Spaghetti seasoned with olive oil and garlic called aglio e olio is very popular. Pizza, cannelloni filled with beef, lasagne, mortadella sandwiches are a favourite. Among the sweet foods, a chocolate spread called Nutella has had a cult status in the comfort food world, so much that the director Nanni Moretti portrayed a character gorging on it in the film "Bianca". A recipe which has acquired a similar status in the public mind is frittata con le cipolle, an onion omelette, after the very popular comedy character Fantozzi, portrayed by Paolo Villaggio, enjoys one while watching a football match.

3 - 13 - Japan :

Japan has many types of comfort food, typically simple, hearty, inexpensive dishes like miso soup, onigiri, ramen, chazuke, or Japanese curry .

3 – 14 – Mexico :

Milanesa de res o pollo (chicken fried steak or chicken); quesadillas; sopa de fideo (vermicelli soup); tacos; and beans. Chicken soup with vegetables, scrambled eggs with onion, tomato and serrano chile, enchiladas and huevos rancheros are some of many comfort foods in Mexico.

And because of the closeness to the USA, pizza, hamburgers, nachos and icecream may now also be considered comfort food.

3 – 15 - Arab World :

Comfort foods in Arab countries include shwarma, hummus, Ful medames, tabouleh, baba ganoush, and falafel. Mansaf is eaten in Jordan, and bedouin communities across the region. Sweets include baklawa, qatayef (sweet pancakes), sahlab, harissa, and kunafe. Lentil soup, or shourbet adas, is also very popular, as well as various fatteh. In North Africa, tagines are eaten often, as well as sharba, a Libyan soup with chickpeas and coriander. Tea, including various herbal teas, are the comfort drink of choice.

3 - 16 - Philippines :

Filipino comfort food is synonymous with home-cooked meals. It is also associated with street food such as balut, isaw, mani, mais, chocolate, and the ubiquitous ice cream.

3 – 17 - Poland :

Traditional Polish Toruń gingerbread

Pierogi dumplings are a cultural Polish dish eaten with many fillings and at festivals and holidays. Chłodnik soup and Pierniki gingerbread cookies are other Polish comfort foods.

3 – 1 8 Somalia :

Injera is a food often eaten with tea and a form of butter called "subag".

3 – 1 9 - Spain :

Spanish style fried eggs (fried in olive oil) with fried potatoes or rice are some common comfort foods in Spain. Tortilla española (egg and potato omelet) is also popular.

3 – 20 - Sweden :

Meatballs, with curly macaronies or mashed potatoes, is common comfort food in Sweden, and in the summertime, so is boiled fresh potatoes with sill and sourcream. Pancakes with jam is popular, too. The blodpudding served with bacon and lingonberry jam is a dish in the same category. Porridge made of oat served with lingonberry jam is a typical comfort food breakfast.

3 – 21 - United Kingdom :

In the UK comfort food may refer to childhood favorites that are still enjoyed in adulthood, such as boiled eggs and soldiers (the soldiers being buttered toast cut into strips and dipped into the egg yolk). Traditional dishes that are often considered comfort foods in the United Kingdom include stews - especially in northern England, and "Bangers and mash" (sausages and mashed potatoes) and "Toad in the hole" (sausages baked in a Yorkshire pudding crust). "Spotted dick" and similar rich steamed puddings, made from flour and suet and with considerable quantities of added sugar and spice, are also popularly considered to fall into this category[. Ice cream is also a popular comfort food choice.

3 – 22 - United States :

A grilled cheese sandwich with a bowl of tomato soup is an easy to prepare home made meal that is some times a comfort food in North America.

Favorite home-made comfort foods in the USA include chocolate bars, brownies, peanut butter and jelly sandwiches, tomato soup and grilled cheese, macaroni and cheese, biscuits and gravy, pancakes, ice cream, chicken noodle soup, cupcakes, mashed potatoes and gravy (or twice - baked potato), chocolate chip cookies, meatloaf, lasagna, tuna casserole, hotdish, clam chowder, chicken and dumplings, chocolate cake , fluffernutters, applesauce, chili and cornbread, hushpuppies, green bean casserole, clam bakes, chicken and waffles, fish fries, pizza, bacon, eggs and hash browns, corn pudding, cheese dream, nachos, funnel cake, smores, buffalo wings, and potato skins . Many creative mixes of foods have emerged that people term as comfort foods.

2 - Convenience food

1 – Introduction :

Convenience food, or **tertiary processed food**, is commercially prepared food designed for ease of consumption . Products designated as convenience foods are often prepared food stuffs that can be sold as hot, ready - to - eat dishes; as room temperature, shelf-stable products; or as refrigerated or frozen products that require minimal preparation , typically just heating .

These products often are sold in portion controlled, single serve packaging designed for portability for "on-the-go" or later eating. Convenience food can include products such as candy; beverages such as soft drinks, juices and milk; fast food; nuts, fruits and vegetables in fresh or preserved states; processed meats and cheeses; and canned products such as soups and pasta dishes.

2 - History :

Modern convenience food saw their beginnings in the period that began after World War II in the United States. Many of these products had their origins in military developed foods designed for storage longevity and ease of preparation in the battle field. After the war, many commercial food companies were left with surplus manufacturing facilities. These companies developed new lines of canned and freeze dried foods that were designed for use in the home. Like many product introductions, not all were successful; products that are convenience food staples such as fish sticks and canned peaches were counterbalanced by failures such as ham sticks and cheese burgers - in - a - can .

3 - Criticisms :

Critics have derided the increasing trend of convenience foods because of numerous issues. Several groups have cited the environmental harm of single serve packaging due to the increased usage of plastics that contributes to solid waste in landfills.[4][5]

4 - Nutritional issues :

According to a page on the website of the Cleveland Clinic: "Most convenience foods on the market today are laden with saturated fats, sodium and sugar and provide little to no nutritional value."[6]

4 - 1 - Salt :

Salt is an essential nutrient, but sodium, usually in the form of salt has been linked with high blood pressure. A single serving of many convenience foods contains a significant portion of the recommended daily allowance of sodium. Manufacturers are concerned that if the taste of each product is not optimized by adding salt that it will not sell as well as competing products. Tests have shown that some popular packaged foods are dependent on significant amounts of salt for their palatability .

5 - Labeling, mitigation, and regulation :

In response to the issues surrounding the healthfulness of convenience and restaurant foods, an initiative in the United States, spearheaded by first lady Michelle Obama and her "Let's Move" campaign, to reduce the unhealthy aspects of commercially produced food and fight childhood obesity was unveiled by the White House in February 2010 . Using her position as a bully pulpit, Mrs . Obama has pushed the industry to cut back on sugars and salts found in many convenience foods, encouraging self regulation over government intervention through laws and regulations.[8] Despite Mrs. Obama's stated preference on self-regulation, the FDA announced that it was looking in to quantifying the guidelines into law while other groups and municipalities are seeking to add other preventative measures such as target taxes and levies onto these products.[9][10] In response to the attention, in April 2010 a coalition of sixteen manufactures all agreed to reduce salt levels in foods sold in the United States under a program based on a similar effort in the United Kingdom . However, the initiative has met with resistance from some manufacturers, who claim that processed foods require the current high levels of salt to remain appetizing and to mask undesirable effects of food processing such as "warmed over flavor " . The coalition expanded its mission in

May 2010 by announcing that it intends to reduce the amount of calories in foods. By introducing lower calorie foods, changing product recipes and reducing portion sizes, the coalition stated that it expected to reduce the caloric content of foods by more than 1.5 trillion calories in total by 2012 .

3 - Fluffernutter

1 – Introduction :

A **fluffernutter** is a sandwich made with peanut butter and marshmallow creme. Its name comes from the common use of "Marshmallow Fluff" brand marshmallow creme.[1] It is particularly popular in the Northeastern United States and has been proposed as the official Massachusetts state sandwich .

A fluffernutter is made by spreading peanut butter on a slice of white bread, then spreading an equal amount of some kind of marshmallow (small, large or cream) on another slice, and finally combining them together to form a sandwich. Variations of the recipe include wheat bread instead of white, and the addition of bananas, honey, or other ingredients that are compatible with peanut butter.

In June 2006, Massachusetts State Senator Jarrett Barrios gained national attention when he proposed legislation restricting the serving of fluffernutter sandwiches in public schools. The proposal was widely mocked as an example of trivial and overly intrusive legislation, while Barrios supporters pointed to concerns over the problem of childhood obesity .

"Fluffernutter" is a registered trademark of Durkee - Mower Inc., the maker of " Marshmallow Fluff " brand marshmallow creme. However, Durkee - Mower's US trademark registrations for fluffernutter cover only ice cream and printed recipes. In 2006, Durkee-Mower sued Williams - Sonoma Inc. in the United States District Court for the District of Massachusetts, alleging that Williams-Sonoma was selling a marshmallow and peanut butter chocolate-covered candy under the "Fluffernutter" name .

Fluffernutter was also the name of a candy briefly produced by the Boyer Brothers candy company .

4 - Fudge

Turtle Fudge

Dish details	
Course served	Dessert
Serving temperature	Room temperature
Main ingredient	sugar - butter - milk
Variations	Multiple

1 – Introduction :

Fudge is a type of Western confectionery which is usually very sweet, extremely rich and frequently flavored with cocoa. It is made by mixing sugar, butter, and milk and heating it to the soft - ball stage at 116 °C , and then beating the mixture while it cools so that it acquires a smooth, creamy consistency. Chocolate can also be mixed in to make *chocolate fudge*; many other flavors and ingredients are possible.

2 - Hot fudge :

"Hot Fudge" in the U.S. and Canada is usually understood to be a chocolate product often used as a topping for ice cream; it is not necessarily directly connected with the confection known as fudge. *Hot fudge* is a thick chocolaty syrup (flavored with real or artificial flavorings). It is typically used as a topping for ice cream, particularly sundaes and parfaits. It may also occasionally be topped upon s'mores.

3 - Chemistry :

Fudge is a drier variant of fondant .

In forming a fondant, it is not easy to keep all vibrations and seed crystals from causing rapid crystallisation to large crystals. Consequently, milkfat and corn syrup are often added. Corn syrup contains glucose , fructose (mono saccharides) and maltose (di saccharide) . These sugars interact with the sucrose molecules. They help prevent premature crystallization by inhibiting sucrose crystal contact. The fat also helps inhibit rapid crystallisation. Controlling the crystallization of the supersaturated sugar solution is the key to smooth fudge. Initiation of crystals before the desired time will result in fudge with fewer, larger sugar grains. The final texture will have a grainy mouthfeel rather than the smooth texture of quality fudge.

One of the most important parts is its texture. The temperature is what separates hard caramel from fudge. The higher the peak temperature, the more sugar is dissolved, the more water is evaporated; resulting in a higher sugar to water ratio. Before the availability of cheap and accurate thermometers, cooks would use the ice water test, also known as the cold water test, to determine the saturation of the candy. Fudge is made at the "soft ball" stage which varies by altitude and ambient humidity from 113 °C to 116 °C ..

Some recipes call for making fudge with prepared marshmallows as the sweetener. This allows the finished confection to use the structure of the marshmallow for support instead of relying on the crystallization of the sucrose.

5 - Mince Pie


An individual mince pie	*An American mince pie*

1 – Introduction :

A **mince pie** (sometimes also *minced*, *minced meat*, or *mincemeat pie*) is a British festive sweet pastry, traditionally consumed during the Christmas and New Year period. Mince pies normally have a pastry top, but versions may also be found without the top in which case they are known as *mince tarts*. Mince pies are filled with mincemeat – a preserve typically containing apple, dried fruits such as raisins and sultanas, spices, and either suet or vegetable shortening. Modern mince pies typically do not contain any meat, but because suet is raw beef or mutton fat, mince pies made with suet are not suitable for vegetarians. Individual mince pies are usually 6 – 7.5 cm in diameter, although larger mince pies, suitable for slicing, may also be baked.

In some countries, the term *mince pie* refers to pies made from minced meat, that is, ground meat, and the fruit - based pies discussed here are called *Christmas mince pies*.

2 - History :

The mince pie dates back to the Middle Ages, it originally contained spices and dried fruit to help preserve the commonplace meat. King Henry V was served a mincemeat pie at his coronation in 1413. During the reign of Oliver Cromwell mince pies were banned along with other traditions and acts associated with English Catholicism and the monarchy. When they were reintroduced to Britain their size was again reduced, to the size as they are today, so that they could be served individually, especially to guests. They were named Wayfarer Pies.

3 - Variations :

Other variations include

- the mincemeat tart, similar in form and taste, save for the lack of a pastry top.
- mincemeat slices, which replace the pastry lid with a Victoria sponge topping; they are baked in a large square tin and cut into slices or as individual pieces in a bun tin
- the mincemeat pasty (similar in appearance to a Cornish pasty)
- the 'iced - top' variation, where the pastry lid is replaced by fondant icing

4 - In popular culture :

- In Great Britain and other countries such as Ireland, mince pies are seen as a favourite food of Father Christmas. Children leave one or two mince pies on a plate at the foot of the chimney (along with a small glass of brandy, sherry or milk, and a carrot for the reindeer) as a thank you for filling their stockings.[3]
- The government of Pitt the Younger formed on 18 December 1783 was satirically dubbed the *mince-pie administration* as it was widely believed that it would not last until Christmas.
- In Cockney rhyming slang 'mince pies' means 'eyes'.

6 - Peanut butter and jelly sandwich

A peanut butter and jelly sandwich

1 - Introduction :

The **peanut butter and jelly sandwich** (**PB&J**) is a sandwich popular in North America that includes a layer of peanut butter and either jam or jelly on bread, commonly between two slices, but sometimes eaten open - faced. Sometimes people put two layers of peanut butter . A 2002 survey showed the average American will have eaten 1,500 of these sandwiches before graduating from high school .

2 - Variations

Some variants add honey, syrup, chocolate, marshmallows, raisins, bananas, butter, marshmallow fluff, other dried fruit, or another slice of bread.

In 1968 The J.M. Smucker Co. introduced Goober, which combined alternating vertical stripes of peanut butter and jelly.

2 – 1 - Sealed crustless sandwich :

In December 1999 two independent inventors, Len Kretchman and David Geske, were granted U.S. patent , "Sealed Crustless Sandwich" for a peanut butter sandwich that would have a long shelf life. The J.M. Smucker Co. bought the patent from the inventors and developed a commercial product based on the patent called

Uncrustables. Smuckers then invested US $ 17 million in a new factory to produce the product. By 2005 sales of Uncrustables had grown to $60 million a year with a 20 % per year growth rate.

Smuckers attempted to enforce their patent rights by sending out cease and desist letters to competitors, and by expanding their intellectual property coverage via the patenting of a machine to produce Uncrustables sandwiches in high volume U.S. Patent 6,874,409 "Method and apparatus for making commercial crustless sandwiches and the crustless sandwich made thereby". The U.S. Court of Appeals for the Federal Circuit, however, rejected the viability of the patent citing its similarity to existing processes such as that of fashioning ravioli or a pie crust .

3 - Nutritional properties :

The peanut butter and jelly sandwich is a high energy food, peanut butter being high in fat (and hence calories), jelly in calories from sugar, and bread in calories from starch . The peanut butter provides protein, and the bread, depending upon type, some dietary fiber.

7 - Sweetness

Sweet foods , such as this strawberry short cake , are often eaten for dessert.

1 – Introduction :

Sweet is one of the five basic tastes and is almost universally regarded as a pleasurable experience. Foods rich in simple carbohydrates such as sugar are those most commonly associated with sweetness, although there are other natural and artificial compounds that are sweet at much lower concentrations, allowing their use as non-caloric sugar substitutes. Other compounds may alter perception of sweetness itself.

The chemosensory basis for detecting sweetness, which varies among both individuals and species, has only been teased apart in recent years. The current theoretical model is the multipoint attachment theory, which involves multiple binding sites between sweetness receptor and the sweet substance itself.

Studies indicate that responsiveness to sugars and sweetness has very ancient evolutionary beginnings, being manifest as chemotaxis even in motile bacteria such as E . Coli . Newborn human infants also demonstrate preferences for high sugar concentrations and prefer solutions that are sweeter than lactose, the sugar found in breast milk.

Sweetness appears to have the highest taste recognition threshold, being detectable at around 1 part in 200 of sucrose in solution. By comparison, bitterness appears to have the lowest detection threshold, at about 1 part in 2 million for quinine in solution. In natural settings of the sort our primate ancestors evolved in, sweetness intensity should indicate energy density, while bitterness tends to indicate toxicity . The high sweetness detection threshold and low bitterness detection threshold would have predisposed our primate ancestors to seek out sweet - tasting (and energy-dense) foods and avoid bitter - tasting foods. Even amongst leaf - eating primates , there is a tendency to prefer immature leaves, which tend to be higher in protein and lower in fibre and poisons than mature leaves . The 'sweet tooth' thus has an ancient evolutionary heritage, and while food processing has changed consumption patterns , human physiology remains largely unchanged .

2 - Examples of sweet substances :

A great diversity of chemical compounds, such as aldehydes, ketones are sweet. Among common biological substances, all of the simple carbohydrates are sweet to at least some degree. Sucrose (table sugar) is the prototypical example of a sweet substance. Sucrose in solution has a sweetness perception rating of 1, and other substances are rated relative to this . For example, another sugar, fructose, is somewhat sweeter, being rated at 1.7 times the sweetness of sucrose . Some of the amino acids are mildly sweet: alanine, glycine, and serine are the sweetest. Some other amino acids are perceived as both sweet and bitter.

A number of plant species produce glycosides that are sweet at concentrations much lower than sugar. The most well - known example is glycyrrhizin, the sweet component of licorice root, which is about 30 times sweeter than sucrose. Another commercially important example is stevioside, from the South American shrub *Stevia rebaudiana*. It is roughly 250 times sweeter than sucrose and an Elepus is over 4 times as sweet as that. Another class of potent natural sweeteners are the sweet proteins such as thaumatin, found in the

West African katemfe fruit. Hen egg lysozyme, an antibiotic protein found in chicken eggs, is also sweet.

Sweetness of various compounds		
Name	**Type of compound**	**Sweetness**
Lactose	Disaccharide	0.16
Glucose	Monosaccharide	0.75
Sucrose	Disaccharide	1.00 (reference)
Fructose	Monosaccharide	1.75
Sodium cyclamate	Sulfonate	26
Aspartame	Dipeptide methyl ester	250
Sodium saccharin	Sulfonyl compound	510

Even some inorganic compounds are sweet, including beryllium chloride and lead acetate. The latter may have contributed to lead poisoning among the ancient Roman aristocracy: the Roman delicacy *sapa* was prepared by boiling soured wine (containing acetic acid) in lead pots.

Hundreds of synthetic organic compounds are known to be sweet. The number of these that are legally permitted as food additives is, however, much smaller. For example, chloroform, nitrobenzene, and Ethylene glycol are sweet, but also toxic. As of 2005, seven artificial sweeteners are in widespread use: saccharin, cyclamate, aspartame, acesulfame potassium, sucralose, alitame, and neotame. Cyclamate was banned for a short period in the US, and a similar situation occurred in Canada with saccharin.

3 - Sweetness modifiers :

A few substances alter the way sweet taste is perceived. One class of these inhibits the perception of sweet tastes, whether from sugars or from highly potent sweeteners. Commercially, the most important of these is lactisole , a compound produced by Domino Sugar. It is used in some jellies and other fruit preserves to bring out their fruit flavors by suppressing their otherwise strong sweetness.

The Miracle fruit, origin of Miraculin

Two natural products have been documented to have similar sweetness - inhibiting properties: gymnemic acid, extracted from the leaves of the Indian vine *Gymnema sylvestre* and ziziphin, from the leaves of the Chinese jujube (*Ziziphus jujuba*) . Gymnemic acid has been widely promoted within herbal medicine as a treatment for sugar cravings and diabetes mellitus.

On the other hand, two plant proteins, miraculin and curculin , cause sour foods to taste sweet. Once the tongue has been exposed to either of these proteins, sourness is perceived as sweetness for up to an hour afterwards. While curculin has some innate sweet taste of its own, miraculin is by itself quite tasteless.

4 - The sweetness receptor :

Despite the wide variety of chemical substances known to be sweet, and knowledge that the ability to perceive sweet taste must reside in taste buds on the tongue, the biomolecular mechanism of sweet taste was sufficiently elusive that as recently as the 1990s, there was some doubt whether any single "sweetness receptor" actually exists .

The breakthrough for the present understanding of sweetness occurred in 2001, when experiments with laboratory mice showed that mice possessing different versions of the gene T1R3 prefer sweet foods to different extents. Subsequent research has shown that the

T1R3 protein forms a complex with a related protein, called T1R2, to form a G-protein coupled receptor that is the sweetness receptor in mammals.[19]

Sweetness perception may differ between species significantly. For example, even amongst the primates sweetness is quite variable. New World monkeys do not find aspartame sweet, while Old World monkeys, apes and humans all do. Felidae like cats cannot perceive sweetness at all.[21]

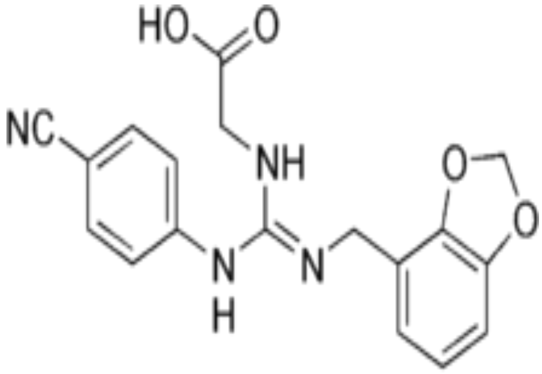
5 - Sweet Receptor Pathway :

To depolarize the cell, and ultimately generate a response, the body uses a different taste receptor pathway for each taste—sweet, sour, salty, bitter, umami, etc. (Umami is the taste of certain amino acids typified by monosodium glutamate.) Incoming sweet molecules bind to their receptors, which causes a conformational change in the molecule. This change activates the G - Protein, gustadin, which in turn activates adenylate cyclase. Adenylate Cyclase catalyzes the conversion of ATP to cAMP. The cAMP molecule then activates a protein kinase, which in turn phosphorylates and closes a potassium ion channel. The excess potassium ions increase the positive charge within the cell causing voltage - gated calcium ion channels to open, further depolarizing the cell. The increase in calcium ultimately causes neuotransmitter release, which is then received by a primary afferent neuron.

6 – Cognition :

The color of food can affect sweetness perception. Adding more red color to a drink increases its sweetness with darker colored solutions being rated 2–10% higher than lighter ones even though it had 1% less sucrose concentration. The effect of color is believed to be due to cognitive expectations . Some odors smell sweet and memory confuses whether sweetness was tasted or smelt .

7 - Historical theories of sweetness :



Lugduname is the sweetest chemical known.

The development of organic chemistry in the 19th century introduced many new chemical compounds and the means to determine their molecular structures. Early organic chemists tasted many of their products, either intentionally (as a means of characterization) or accidentally (due to poor laboratory hygiene). One of the first attempts to draw systematic correlations between molecules' structures and their tastes was made by a German chemist, Georg Cohn, in 1914. He hypothesized that to evoke a certain taste, a molecule must contain some structural motif (called a ***sapophore***) that produces that taste. With regard to sweetness, he noted that molecules containing multiple hydroxyl groups and those containing chlorine atoms are often sweet, and that among a series of structurally similar compounds, those with smaller molecular weights were often sweeter than the larger compounds.

In 1919 , Oertly and Myers proposed a more elaborate theory based on a then - current theory of color in synthetic dyes. They hypothesized that to be sweet, a compound must contain one each of two classes of structural motif, a ***glucophore*** and an ***auxogluc***. Based on those compounds known to be sweet at the time, they proposed a list of six candidate glucophores and nine auxoglucs.

From these beginnings in the early 20th century, the theory of sweetness enjoyed little further academic attention until 1963, when Robert Shallenberger and Terry Acree proposed the AH - B theory of sweetness. Simply put, they proposed that to be sweet, a compound must contain a hydrogen bond donor (AH) and a Lewis base (B) separated by about 0.3 nanometres. According to this theory, the AH - B unit of a sweetener binds with a corresponding AH - B unit on the biological sweetness receptor to produce the sensation of sweetness.

B-X theory proposed by Lemont Kier in 1972. While previous researchers had noted that among some groups of compounds, there seemed to be a correlation between hydrophobicity and sweetness, this theory formalized these observations by proposing that to be sweet, a compound must have a third binding site (labeled X) that could interact with a hydrophobic site on the sweetness receptor via London dispersion forces . Later researchers have statistically analyzed the distances between the presumed AH , B, and X sites in several families of sweet substances to estimate the distances between these interaction sites on the sweetness receptor.

The most elaborate theory of sweetness to date is the **multipoint attachment theory** (MPA) proposed by Jean-Marie Tinti and Claude Nofre in 1991. This theory involves a total of eight interaction sites between a sweetener and the sweetness receptor , although not all sweeteners interact with all eight sites . This model has successfully directed efforts aimed at finding highly potent sweeteners, including the most potent family of sweeteners known to date, the guanidine sweeteners . The most potent of these, lugduname, is about 225,000 times sweeter than sucrose.

Part 9

DIFFERENT

1 - Confectionery

An arrangement of confections

1 – Introduction :

Confectionery is the set of food items that are rich in sugar, any one or type of which is called a confection. Modern usage may include substances rich in artificial sweeteners as well. The word candy (U.S.A.) or **sweets** (U.K.) is also used for the extensive variety that compose confectionery. Generally speaking, confections are low in nutritional value but rich in calories. Specially formulated chocolate has been manufactured in the past for military use due to its high concentration of calories.

2 - Regional names

Different dialects of English use regional terms for *confections*:

- In Britain, Ireland and some Commonwealth countries, *sweets* or more colloquially *sweeties* (particularly used by children, *sweeties* also resembles the Scottish Gaelic word *suiteis* in pronunciation and meaning . In some parts of England, *spogs*, *spice*, *joy joy* and *goodies* are terms used, alongside *sweets*, to denote *confectionery*. In North-West England, especially Lancashire, *toffees* is often used as a generic term for all confectionery. Northeast England and the Scottish Borders commonly use the word *ket* (plural *kets*) and more recently *chud*, derivative of *chuddy*, a localised term for chewing gum.

- In Australia and New Zealand, "*lollies*".
- In North America, "*candy*" - although this term can also refer to a specific range of confectionery and does not include some items called confectionery (e.g. pastry) (See below and the separate article on candy.) "**Sweets**" is occasionally used, as well as "**treat**"

3 - Examples

Columns of sweets

Confectionery items include sweets, lollipops, candy bars, chocolate, candy floss, and other sweet items of snack food. The term does not generally apply to cakes, biscuits, or puddings which require cutlery to consume, although exceptions such as petit fours or meringues exist. Speakers of American English do not refer to these items as "candy". See candy making for the stages of sugar - cooking.

Some of the categories and types of confectionery include the following:

- Hard sweets: Based on sugars cooked to the hard-crack stage, including suckers (known as *boiled sweets* in British English), lollipops, jawbreakers (or gobstoppers), lemon drops, peppermint drops and disks, candy canes, rock candy, etc. These also include types often mixed with nuts such as brittle. Others contain flavorings including coffee such as Kopiko .

- Fudge: A confection of milk and sugar boiled to the soft - ball stage. In the US, it tends to be chocolate - flavored.
- Toffee (or Taffy or Tuffy) : Based on sugars cooked to the soft-ball stage and then pulled to create an elastic texture. In British English, *toffee* can also refer to a harder substance also made from cooked sugars which resembles toffee.
- Tablet. A crumbly milk - based soft and hard candy, based on sugars cooked to the soft-ball stage. Comes in several forms, such as wafers and heart shapes.
- Liquorice : Containing extract of the liquorice root. Chewier and more resilient than gum/gelatin candies, but still designed for swallowing. For example, Liquorice allsorts. Has a similar taste to Star Anise.

- Chocolates are bite-sized confectioneries. People who create chocolates are called **chocolatiers**, and they create their confections with couverture chocolate. A **chocolate maker**, on the other hand, is the person who physically creates the couverture from cacao beans and other ingredients.
- Jelly candies: Including those based on sugar and starch, pectin, gum, or gelatin such as Lokum / Turkish Delight, jelly beans, gumdrops, jujubes, cola bottles gummies, etc.
- Marshmallow: "Peeps" (a trade name), circus peanuts, fluffy puff, etc.
- Marzipan: An almond-based confection, doughy in consistency, served in several different ways. It is often formed into shapes mimicking (for example) fruits or animals. Alternatively, marzipan may be flavoured, normally with spirits such as Kirsch or Rum, and divided into small bite-sized pieces; these flavoured marzipans are generally served coated in chocolate to prevent the alcohol from evaporating, and are very common in northern Europe. Marzipan is also used in cake decoration. Its lower-priced version is called Persipan.
- Divinity: A nougat - like confectionery based on egg whites with chopped nuts.

Not all confections equate to " candy " in the American English sense. Non - candy confections include:

- Mithai: A generic term for confectionery in India, typically made from dairy products and/or some form of flour. Sugar or molases are used as sweeteners.
- Pastry: A baked confection whose dough is rich in butter, which was dispersed through the pastry prior to baking, resulting in a light, flaky texture; see also pie and tart.
- Chewing gum: Uniquely made to be chewed, not swallowed. However, some people believe that at least some types of chewing gum, such as certain bubble gums, are indeed candy.
- Ice cream: Frozen flavoured cream, often containing small chocolates and fruits .
- Halvah: Confectionery based on tahini, a paste made from ground sesame seeds.
- Alfajor: a traditional South American cookie typically consisting of two round sweet biscuits joined together with a sweet jam, generally dulce de leche (milk jam).
- Dragée - Coated almonds and other types of coated candy.

4 - Risks :

Excessive consumption of confectionery has been associated with increased incidences of type 2 diabetes, obesity, and tooth decay .

2 - Healthy diet

Fresh vegetables are important components of a healthy diet.

Contents

1 – Introduction :

A **healthy diet** is one that helps maintain or improve health. It is important for the prevention of many chronic health risks such as: obesity, heart disease, diabetes, and cancer.

A healthy diet involves consuming appropriate amounts of all nutrients, and an adequate amount of water. Nutrients can be obtained from many different foods, so there are a wide variety of diets that may be considered healthy diets.

2 - Dietary recommendations :

There are a number of diets and recommendations by numerous medical and governmental institutions that are designed to promote certain aspects of health. Evidence supports the consumption of polyunsaturated fats instead of saturated fats as a measure of decreasing coronary heart disease.

2 – 1 - World Health Organization :

The World Health Organization (WHO) makes the following 5 recommendations with respect to both populations and individuals :

- Achieve an energy balance and a healthy weight
- Limit energy intake from total fats and shift fat consumption away from saturated fats to unsaturated fats and towards the elimination of trans-fatty acids
- Increase consumption of fruits and vegetables, legumes, whole grains and nuts
- Limit the intake of simple sugar
- Limit salt / sodium consumption from all sources and ensure that salt is iodized

Other recommendations include :

- Sufficient essential amino acids ("complete protein") to provide cellular replenishment and transport proteins. All essential amino acids are present in animals. A select few plants (such as soy and hemp) give all the essential acids. A combination of other plants may also provide all essential amino acids. Fruits such as avocado and pumpkin seeds also have all the essential amino acids .
- Essential micronutrients such as vitamins and certain minerals.
- Avoiding directly poisonous (e.g. heavy metals) and carcinogenic (e.g. benzene) substances;
- Avoiding foods contaminated by human pathogens (e.g. E. coli, tapeworm eggs).

2 – 2 - American Heart Association :

The American Heart Association recommends a diet rich in fruits, vegetables, and healthful fatty acids and that limit saturated fat .

3 - Composition (Human nutrition) :

A healthy diet needs to have a balance of macronutrients / energy (fats, proteins, and carbohydrates) and micronutrients to meet the needs of the individual without inducing toxicity from excessive amounts.

4 - Unhealthy diets :

An unhealthy diet is a major risk factor for a number of chronic diseases including: high blood pressure, diabetes, abnormal blood lipids, overweight/obesity, cardiovascular diseases, and cancer.

The WHO estimates that 2.7 million deaths are attributable to a diet low in fruit and vegetable every year. Globally it is estimated to cause about 19 % of gastrointestinal cancer, 31 % of ischaemic heart disease, and 11 % of strokes,[1] thus making it one of the leading preventable causes of death worldwide .

4 – 1 - Food additive controversy :

Some claim that food additives, such as artificial sweeteners , colorants, preserving agents, and flavorings may cause health problems such as increasing the risk of cancer or ADHD .

4 – 2 - Fast food :

Examples of fast food critics include Jamie Oliver, Morgan Spurlock and Eric Schlosser.

5 - Public health

Fears of high cholesterol were frequently voiced up until the mid-1990s. However, more recent research has shown that the distinction between high- and low-density lipoprotein ('good' and 'bad' cholesterol, respectively) must be addressed when speaking of the potential ill effects of cholesterol. Different types of dietary fat have different effects on blood levels of cholesterol. For example, polyunsaturated fats tend to decrease both types of cholesterol; monounsaturated fats tend to lower LDL and raise HDL; saturated fats tend to either raise HDL , or raise both HDL and LDL ; and trans fat tend to raise LDL and lower HDL. Dietary cholesterol itself is only found in animal products such as meat, eggs, and dairy, but studies have shown that even large amounts of dietary cholesterol only have negligible effects on blood cholesterol .

Media coverage of mass - produced, processed, "snack" or "sweet" products directly marketed at children has worked to undermine policy efforts to improve eating habits. The main problem with such advertisements for foods is that alcohol and fast food are portrayed as offering excitement, escape and instant gratification.

Particularly within the last five years government agencies have attempted to combat the amount and method of media coverage lavished upon "junk" foods. Governments also put pressure on businesses to promote healthful food options, consider limiting the availability of junk food in state-run schools, and tax foods that are high in fat. Most recently, the United Kingdom removed the rights for McDonald's to advertise its products, as the majority of the foods that were seen have low nutrient values were aimed at children under the guise of the "Happy Meal". The British Heart Foundation released its own government - funded advertisements, labeled "Food4Thought", which were targeted at children and adults displaying the gory nature of how fast food is generally constituted.

6 - Cultural and psychological factors :

From a psychological perspective, a new healthy diet may be difficult to achieve for a person with poor eating habits. This may be due to tastes acquired in early adolescence and preferences for fatty foods. It may be easier for such a person to transition to a healthy diet if treats such as chocolate are allowed; sweets may act as mood stabilizers, which could help reinforce correct nutrient intake.

It is known that the experiences we have in childhood relating to consumption of food affect our perspective on food consumption in later life. From this, we are able to determine ourselves our limits of how much we will eat, as well as foods we will not eat - which can develop into eating disorders, such as anorexia, bulimia, or orthorexia This is also true with how we perceive the sizes of the meals or amounts of food we consume daily; people have different interpretations of small and large meals based on upbringing .

While plants, vegetables, and fruits are known to help reduce the incidence of chronic disease , the benefits on health posed by plant-based foods, as well as the percentage of which a diet needs to be plant based in order to have health benefits is unknown. Nevertheless, plant-based food diets in society and between nutritionist circles are linked to health and longevity, as well as contributing to lowering cholesterol, weight loss, and in some cases, stress reduction .

Indeed, ideas of what counts as " healthy eating " have varied in different times and places, according to scientific advances in the field of nutrition, cultural fashions, religious proscriptions, or personal considerations.

3 - Mash ingredients

Malted barley - a primary mash ingredient

1 – Introduction :

Mash ingredients or **grain bill** are those materials used in brewing from which a wort can be obtained for fermenting into alcohol. The act of creating and extracting fermentable and non-fermentable sugars and flavor components from grain by steeping it in hot water, and then allowing it to rest at specific temperature ranges in order to activate enzymes that will convert the starches to sugars is called mashing. The sugars, having been run off from the mash ingredients, will later be converted to alcohol and other fermentation products by yeast in the brewing process.

The primary type of mash ingredient is grain that has been malted. Modern - day recipes generally consist of a large percentage of a light malt and, optionally, smaller percentages of more flavorful or highly - colored types of malt. The former is called "base malt"; the latter is known as "specialty malts".

The grain bill of a beer may vary widely in the number of ingredients. For example, Abbeydale Brewery's "Absolution", a pale ale, uses only one mash ingredient: pale malt; meanwhile, Salopian Brewing Company's "Entire Butt", a black porter, declares the following fourteen ingredients in its grain bill: pale malt, lager malt, wheat malt, pale and dark crystal malts, pale and dark chocolate malts, caramalt, torrefied wheat, amber malt, brown malt, and malted oats .

2 - Variables :

Each particular ingredient has its own flavor which contributes to the final character of the beverage. In addition, different ingredients carry other characteristics, not directly relating to the flavor, which may dictate some of the choices made in brewing: nitrogen content, diastatic power, color, modification, and conversion.

The color of a grain or product is evaluated by the American Society of Brewing Chemists Standard Reference Method (denoted both SRM and ASBC, although the two methods are equivalent); the older Lovibond series 52 standard, (°L), which corresponds closely to SRM; or by the European Brewery Convention (EBC) Standard . The British Institute of Brewing (IOB) standard was formally retired in 1991, but is still occasionally seen in the United Kingdom.

Diastatic power for a grain is measured in degrees Lintner (°Lintner or °L , although the latter can conflict with the symbol °L for Lovibond color); or in Europe by Windisch-Kolbach units (°WK).

3 - Malts :

The oldest and most predominant ingredient in brewing is barley, which has been used in beer-making for thousands of years. Modern brewing predominantly uses malted barley for its enzymatic power, but ancient Babylonian recipes indicate that, without the ability to malt grain in a controlled fashion, baked bread was simply soaked in water. Malted barley dried at a sufficiently low temperature contains enzymes such as amylase which convert starch into sugar. Therefore, sugars can be extracted from the barley's own starches simply by soaking the grain in water at a controlled temperature; this is mashing.

3 – 1 - Pale malt :

Pale malt is the basis of pale ale and bitter and the precursor in production of most other British beer malts. Dried at temperatures sufficiently low to preserve all the brewing enzymes in the grain, it is light in color and, today, the cheapest barley malt available due to mass production. It can be used as a *base malt*, that is, as the malt constituting the majority of the grist, in many styles of beer. Typically, English pale malts are kilned at 95 - 105 °C. Color ASBC 2 - 3 / EBC 5 – 7 . Diastatic power (DP) 45 °Lintner.

3 – 2 - Mild malt

Mild malt is often used as the base malt for mild ale, and is similar in color to pale malt. Mild malt is kilned at slightly higher temperatures than pale malt in order to provide a less neutral, rounder flavor generally described as "nutty". ASBC 3 / EBC 6.

3 – 3 - Stout malt :

Stout malt is sometimes seen as a base malt for stout beer; light in color, it is prepared so as to maximize diastatic power in order to better-convert the large quantities of dark malts and unmalted grain used in stouts. In practice, however, most stout recipes make use of pale malt for its much greater availability. ASBC 2 - 3 / EBC 4 – 6 , DP 60-70 °Lintner.

3 – 4 - Amber malt :

Amber malt is a more toasted form of pale malt, kilned at temperatures of 150 - 160 °C, and is used in brown porter; older formulations of brown porter use amber malt as a base malt (though this was diastatic and produced in different conditions to a modern amber malt). Amber malt has a bitter flavor which mellows on ageing, and can be quite intensely flavored; in addition to its use in porter, it also appears in a diverse range of British beer recipes. ASBC 50 - 70 / EBC 100 - 140; amber malt has no diastatic power.

3 – 5 - Brown malt :

Brown malt is a darker form of pale malt, and is used typically in brown ale as well as in porter and stout. Like amber malt, it can be prepared from pale malt at home by baking a thin layer of pale malt in an oven until the desired color is achieved. 50 - 70 °L, no enzymes.

3 – 6 - Chocolate malt :

Chocolate malt is similar to pale and amber malts but kilned at even higher temperatures. Producing complex undertones of vanilla and caramel (but not chocolate), it is used in porters and sweet stouts as well as dark mild ales. It contains no enzymes. ASBC 450 - 500 / EBC 1100 - 1300.

3 – 7 - Black malt :

Black malt, also called **patent malt** or **black patent malt**, is barley malt that has been kilned to the point of carbonizing, around 200 °C . The term "patent malt" comes from its invention in England in 1817, late enough that the inventor of the process for its manufacture , Daniel Wheeler, was awarded a patent . Black malt provides the color and some of the flavor in black porter, contributing an acrid, ashy undertone to the taste. In small quantities, black malt can also be used to darken beer to a desired color, sometimes as a substitute for caramel. Due to its high kilning temperature, it contains no enzymes. ASBC 500 - 600 / EBC > 1300.

3 – 8 - Crystal malt :

Crystal malts are prepared separately from pale malts. They are high - nitrogen malts which are wetted and roasted in a rotating drum before kilning. They produce strongly sweet toffee - like flavors and are sufficiently converted that they can be steeped without mashing to extract their flavor. Crystal malts are available in a range of colors, with darker - colored crystal malts, that is, those kilned at higher temperatures, producing stronger, more caramel-like overtones. Some of the sugars in crystal malts caramelize during kilning and become unfermentable; hence, addition of crystal malt will increase the final sweetness of a beer. They contain no enzymes . ASBC 50 - 165/EBC 90 - 320 ; the typical British crystal malt used in pale ale and bitter is around ASBC 70 - 80 .

3 – 9 - Distillers malt :

Standard distillers malt or pot still malt is quite light and very high in nitrogen compared to beer malts. These malts are used in the production of whiskey and generally originate from northern Scotland.

3 – 10 - Peated malt :

Peated malt is also available; this is distillers malt that has been smoked over burning peat in order to add a dark aroma and flavor characteristic of Islay whisky and some Irish whiskey. Some recent brewers have also included peated malt in interpretations of Scotch ales, although this is generally anhistorical. It has sufficient diastatic power to self-convert. When used in large amounts, the resulting beer tends to have a very strong earthy and smoky flavour which most mainstream beer drinkers would find repulsive .

3 – 11 - Pilsner malt :

Pilsner malt, the basis of pale lager, is quite pale and strongly flavored. Invented in the 1840s, Pilsner malt is the lightest-colored generally - available malt, and also carries a strong, sweet malt flavor. Usually a pale lager's grain bill consists entirely of this malt, which has enough enzymatic power to be used as a base malt. The commercial desirability of light - colored beers has also led to some British brewers adopting Pilsner malt (some times described simply as " lager malt " in Britain) in creating golden ales. In Germany, Pilsner malt is also used in some interpretations of the Kölsch style. ASBC 1 – 2 / EBC 3 – 4 , DP 60 °Lintner.

3 – 12 - Vienna malt :

Vienna malt or Helles malt is the characteristic grain of Vienna lager and Märzen; although it generally takes up only ten to fifteen percent of the grain bill in a beer, it can be used as a base malt. It has sufficient enzymatic power to self - convert, and it is somewhat darker and kilned at a higher temperature than Pilsener malt. ASBC 3 – 4 / EBC 7 – 10 , DP 50 °Lintner .

3 - 13 - Munich malt :

Munich malt is used as the base malt of the bock beer style, especially doppelbock, and appears in dunkel lager and Märzens in smaller quantities. While a darker grain than pale malt, it has sufficient diastatic power to self-convert, despite being kilned at temperatures around 115 °C. It imparts "malty," although not necessarily sweet characteristics, depending on mashing temperatures. ASBC 4 – 6 / EBC 10 – 15 , DP 40 °Lintner.

3 – 14 – Rauchmalz :

Rauchmalz is a German malt that is prepared by being dried over an open flame rather than via kiln. The grain has a smoky aroma and is an essential ingredient in Bamberg Rauchbier.

3 – 15 - Acid malt :

- **Acid malt**, whose grains contain lactic acid, can be used as a continental analog to Burtonization. Acid malt lowers mash pH, and provides a rounder, fuller character to the beer, enhancing the flavor of Pilseners and other light lagers. Lowering the pH also helps prevent beer spoilage through oxidation.
- **Honey malt** is an intensely – flavored , lightly - colored malt . 18 - 20 °L .
- **Melanoidin malt**, a malt like the Belgian Aromatic malt, adds roundness and malt flavor to a beer with a comparably small addition in the grain bill. It also stabilizes the flavor.

3 – 16 - Unmalted barley :

Unmalted barley kernels are used in mashes in Irish whiskey.

- **Roast barley** are unmalted barley kernels which has been toasted in an oven until almost black. Roast barley is, after base malt, usually the most - used grain in stout beers, contributing the majority of the flavor and the characteristic dark - brown color ; undertones of chocolate and coffee are common. ASBC 500 - 600 / EBC > 1300 or more, no diastatic activity.

- **Black barley** is like roast barley except even darker.
- **Flaked barley** is unmalted, dried barley which has been rolled into flat flakes. It imparts a rich, grainy flavor to beer and is used in many stouts, especially Guinness stout; it also improves head formation and retention.
- **Torrefied barley** is barley kernels that have been heated until they pop like popcorn.

4 - Other grains :

4 – 1 – 1 - Wheat :

4 – 1 – 1 - Wheat malt :

Beer brewed in the German Hefeweizen style rely mostly or entirely on **malted wheat** as a grain, as does Belgian witbier. Lambic also makes heavy use of wheat. Under the Reinheitsgebot, wheat was treated separately from barley, as it was the more expensive grain.

4 – 1 – 2 - Torrefied wheat :

Torrefied wheat is used in British brewing to increase the size and retention of a head in beer. Generally it is used as an enhancer rather than for its flavor.

4 – 1 – 3 - Raw wheat

4 – 1 – 4 - Wheat flour

Until the general availability of torrefied wheat, wheat flour was often used for similar purposes in brewing. Wheat flour was also, erroneously, used as a yeast food in medieval and renaissance brewing; flour would be cast into the fermenter to feed top-floating yeasts, which have no means of absorbing the raw flour. **Brewer's flour** is only rarely available today, and is of a larger grist than baker's flour.

4 – 2 – Rye :

The use of rye in a beer typifies the rye beer style, especially the German *Roggenbier*. Rye is also used in the Slavic kvass and Finnish sahti farmhouse styles, as readily - available grains in eastern Europe. However, the use of rye in brewing is considered difficult as rye lacks a hull (like wheat) and contains large quantities of beta-glucans compared to other grains; these long - chain sugars can leach out during a mash, creating a sticky gelatinous gum in the mash tun, and as a result brewing with rye requires a long , thorough beta-glucanase rest. Rye is said to impart a spicy, dry flavor to beer.

4 – 3 - Sorghum & Millet

Sorghum and millet are often used in African brewing. As gluten-free grains, they have gained popularity in the Northern Hemisphere as base materials for beers suitable for people with coeliac disease. Sorghum produces a dark, hazy beer, however, and sorghum malt is difficult to prepare and rarely commercially available outside certain African countries. Millet is an ingredient in chhaang and pomba, and both grains together are used in oshikundu.

4 – 4 - Rice & Corn

In America, rice and corn are often used by commercial breweries as a means of readily adding fermentable sugars to a beer cheaply, due to the ready availability and low price of the grains. However, corn is also the base grain in chicha and some caium, as well as Bourbon whiskey; while rice is the base grain of happoshu and various mostly Asian fermented beverages often referred to as "rice wines" such as sake and makgeolli; corn is also used as an ingredient in some Belgian beers such as Rodenbach to lighten the body .

Corn was originally introduced into the brewing of American lagers because of the high protein content of the six-row barley; adding corn, which is high in sugar but low in protein, helped thin out the body of the resulting beer. Increased amounts of corn use over time led to the development of the American pale lager style. Corn is generally not malted, but instead introduced into the mash as flaked, dried kernels.

Brewers should notice that corn and rice don't contain any enzymes. It is therefore required that these adjuncts are used together with enzyme rich adjuncts, such as normal malts. Prior to a brew, rice and corn should be cooked for about an hour to allow the starch to gelatinize and thereby render it convertible.

5 - Non - grain solids :

Buck wheat and quinoa, while not grains, both contain high levels of available starch and protein, while containing no gluten. Therefore, some breweries use these plants in the production of beer suitable for people with coeliac disease, either alone or in combination with sorghum.

6 - Syrups and extracts :

Another way of adding sugar or flavoring to a malt beverage is the addition of natural or artificial sugar products such as honey, white sugar, or malt extract. While these ingredients can be added during the mash, the enzymes in the mash do not act on them. Such ingredients can be added during the boil of the wort rather than the mash, and as such, are also known as *copper sugars*.

One syrup which is commonly used in the mash, however, is **diastatic malt extract** or **DME**. DME is prepared by fully converting base malt, then draining the resulting mash, still including amylases, and evaporating it down to a high density. DME is used exclusively in homebrewing as a substitute for base malt. It typically has a diastatic power of around 100 °Lintner.

7 - Regional differences .

7 – 1 - Britain :

British brewing makes use of a wide variety of malts, with considerable stylistic freedom for the brewer to blend them. Many British malts were developed only as recently as the Industrial

Revolution, as improvements in temperature-controlled kilning allowed finer control over the drying and toasting of the malted grains.

The typical British brewer's malt is a well - modified, low - nitrogen barley grown in the east of England or southeast of Scotland. In England, the best - known brewer's malt is made from the Maris Otter strain of barley; other common strains are Halcyon, Pipkin, Chariot, and Fanfare. Most malts in current use in Britain are derived from pale malt and were invented no earlier than the reign of Queen Anne. Brewing malt production in Britain is thoroughly industrialized, with barley grown on dedicated land and malts prepared in bulk in large, purpose-build maltings and distributed to brewers around the country to order.

7 – 2 - Continental Europe :

Before controlled - temperature kilning became available, malted grains were dried over wood fires; **Rauchmalz** (German: ***smoked malt***) is malt dried using this traditional process. In Germany, beech is often used as the wood for the fire, imparting a strongly smoky flavor to the malt. This malt is then used as the primary component of rauchbier; alder-smoked malt is used in Alaskan smoked porters. Rauchmalz comes in several varieties, generally named for and corresponding to standard kilned varieties (e.g. Rauchpilsener to Pilsener); color and diastatic power are comparable to those for an equivalent kilned grain.

Similarly to crystal malts in Britain, central Europe makes use of **caramel malts**, which are moistened and kilned at temperatures around 55 - 65 °C in a rotating drum before being heated to higher temperatures for browning. The lower-temperature moistened kilning causes conversion and mashing to take place in the oven, resulting in a grain's starches becoming mostly or entirely converted to sugar before darkening. Caramel malts are produced in color grades analogous to other lager malts: **carapils** for pilsener malt, **caravienne** or **carahell** for Vienna malt, and **caramunch** for Munich malt. Color and final kilning temperature are comparable to non-caramel analog malts; there is no diastatic activity. Carapils malt is sometimes also called **dextrin malt**. 10 - 120 °L.

7 – 3 - The United States

American brewing combines British and Central European heritages, and as such uses all the above forms of beer malt; Belgian-style brewing is less common but its popularity is growing. In addition, America also makes use of some specialized malts:

- **6 - row pale malt** is a pale malt made from a different species of barley. Quite high in nitrogen, 6-row malt is used as a "hot" base malt for rapid, thorough conversion in a mash, as well as for extra body and fullness; the flavor is more neutral than 2 - row malt. 1.8 °L , 160 °Lintner.
- **Victory malt** is a specialized lightly-roasted 2-row malt that provides biscuity, caramel flavors to a beer. Similar in color to amber and brown malt, it is often an addition to American brown ale. 25 °L, no diastatic power.

Other notable American barley malts include **Special Roast** and **coffee malt**. Special Roast is akin to a darker variety of victory malt.

7 – 4 - Belgium

Belgian brewing makes use of the same grains as central European brewing. In general, though, Belgian malts are slightly darker and sweeter than their central European counterparts. In addition, Belgian brewing uses some local malts:

- **Pale malt** in Belgium is generally darker than British pale malt. Kilning takes place at temperatures five to ten °C lower than for British pale malt, but for longer periods; diastatic power is comparable to that of British pale malt. ASBC 4/EBC 7.
- **Special B** is a dark, intensely sweet crystal malt providing a strong malt flavor.
- **Biscuit malt** is a lightly-flavored roasted malt used to darken some Belgian beers. 45-50 EBC/25 °L.

Aromatic malt, by contrast, provides an intensely malty flavor. Kilned at 115 °C , it retains enough diastatic power to self - convert . 50 - 55 EBC / 20 °L.

4 - Mizuame

Mizuame

Mizuame is a sweetener from Japan which is translated literally to ' water candy '. A clear, thick, sticky liquid, it is made by converting starch to sugars. Mizuame is added to wagashi to give them a sheen, eaten in ways similar to honey and can be a main ingredient in sweets. Mizuame is produced in a very similar fashion to corn syrup and is very similar in taste.

There are two methods used to convert the starches to sugars. The traditional method is to take glutinous rice mixed with malt and let the natural enzymatic process take place converting the starch to syrup. The second and more common method uses potatoes or sweet potatoes as the starch source and then adding an acid such as hydrochloric, sulfuric or nitric acids. If done by the first method, the final product is known as **barley mizuame** and considered more flavorful than the potato version.

5 - Spoon sweets

1 – Inoduction :

Spoon sweets are sweet preserves, served in a spoon as a gesture of hospitality in the Balkans, the Middle East, and in Russia. They can be made from almost any fruit, though sour and bitter fruits are especially prized. There are also spoon sweets produced without fruit.

Some of the fruits that are used include seedless grapes, mulberries and other berries, bergamot, apricots, apples. pears, sour and sweet cherries, oranges and kumquats, lemons, grapefruit, tangerines, pomegranates, quinces, figs, prunes, etc. Even soft fruit like melon or watermelon can be thus prepared, although retaining a relatively firm texture is quite the challenge there. Other varieties include green, unripe walnuts, pistachios, hazelnuts, and other nuts, or even flower petals like rose. Many fruits or parts of fruits that are normally inedible, such as the various citrus peels and blossoms, or sliced citrus fruits with their peel intact, can be made into sweet, flavorful preserves, as can some vegetables such as baby eggplants or cherry tomatoes. A well - made spoon sweet retains the original shape, color, aroma and taste of the fruit.

Spoon sweets are usually offered to guests served by the teaspoon in a small china or crystal dish or bowl, with coffee or tea and cold water. Most of the time they are homemade, but nowadays they can also be easily found in most supermarkets; these are more likely to be made with glucose syrup rather than sugar, for reasons of cost.

They can be used as ice cream or yogurt topping, or in the Western way as a spread on toast for breakfast.spoon sweets are common to eat alone or with cheese.

2 - Former Yugoslav Republic of Macedonia :

Spoon sweets in Former Yugoslav Republic of Macedonia are called "Slatko", which means “sweet” or "delicious" in Slavomacedonian. It is a thin fruit preserve made of fruit or rose petals. Almost any kind of fruit can be used, like fig, orange, and cherry. Traditionally, honored guests in a Macedonian home are greeted with a spoonful of “slatko”.

Other fresh fruits like raspberries, sweet cherries, watermelon cubes, rose petals, quinces, grapes, skinned apricots halves or quarters, peaches, blueberries, blackberries, red currants can also be used. If a plum slatko is prepared, walnut halves may be added to the mixture, or even inserted into the plums themselves to replace the pits. Frozen berries and fruits may be used too, but the amount of water and the cooking time should be adjusted accordingly.

3 - Greece :

Spoon sweets (γλυκό του κουταλιού 'sweet of the spoon') are popular in Greece and Cyprus, usually served with Greek coffee and a glass of cold water. Most are made of whole fruit, though some kinds are made of pieces or purees.

One typically Greek spoon sweet is the snow-white and intensely aromatic Βανίλια [va'nilja], which is *not* made of vanilla, but of mastic resin, for which the Aegean island of Chios is famous. This is usually served as a spoonful of sweet on a table spoon dropped into a tall glass of ice-cold water and popularly called "βανίλια υποβρύχιο", a "vanilla submarine". The Greek diaspora introduced this treat to other countries as far away as Japan.[1] It is said to be the official treat of the Patriarchate of Constantinople.

Whole fruit preserves can be found in most Greek and Cypriot homes. They are made by slowly and gently boiling fruit in water and sugar over several hours or days, until the syrup sets. Thus the main prerequisites to making good spoon sweets are said to be "patience and a heavy pot". Some lemon juice is often added to preserve the fruit's original color, as the citric acid prevents oxidation. A small quantity of blanched almonds, slivered or whole, may also be added for crunch, often to apples or grapes. Ingredients variously added during the boiling, and then discarded, include a quill of cinnamon bark, a mint bouquet, or the green, fragrant leaves of the shrub *Pelargonium odoratissimum* (apple geranium) which add some astringency and a slight aroma of frankincense and is especially popular in the Ionian islands.

The overall method of preparation is essentially the same as that of marmalade, except that fruit pieces remain firm and whole; a well-made spoon sweet is chewy.