* **Lipids (Greek: *lipos*, means fat or lard) are a heterogeneous class of naturally occurring organic substances. They have a distinguished functional group or structural features, insoluble in water and highly soluble in one or more of the following solvents: ether, chloroform, benzene and acetone. This property sets them apart from proteins, carbohydrates, nucleic acids and other biomolecules. They are widely distributed in the biological world and play a wide variety of roles in plant and animal tissues**

**Lipids**  are a broad group which includes [fats](http://en.wikipedia.org/wiki/Fat), [waxes](http://en.wikipedia.org/wiki/Wax), [sterols](http://en.wikipedia.org/wiki/Sterol), fat-soluble [vitamins](http://en.wikipedia.org/wiki/Vitamin) (such as vitamins A, D, E and K), [monoglycerides](http://en.wikipedia.org/wiki/Monoglycerides), [diglycerides](http://en.wikipedia.org/wiki/Diglycerides), [phospholipids](http://en.wikipedia.org/wiki/Phospholipids), and others. The main biological functions of lipids include energy storage, as structural components of [cell membranes](http://en.wikipedia.org/wiki/Cell_membrane), and as important [signaling molecules](http://en.wikipedia.org/wiki/Lipid_signaling).

Lipids may be broadly defined as [hydrophobic](http://en.wikipedia.org/wiki/Hydrophobe) or [amphiphilic](http://en.wikipedia.org/wiki/Amphiphile) small molecules; the amphiphilic nature of some lipids allows them to form structures such as [vesicles](http://en.wikipedia.org/wiki/Vesicle_%28biology%29), [liposomes](http://en.wikipedia.org/wiki/Liposome), or membranes in an aqueous environment.

Biological lipids originate entirely or in part from two distinct types of biochemical subunits or "building blocks": [ketoacyl](http://en.wikipedia.org/wiki/Ketone) and [isoprene](http://en.wikipedia.org/wiki/Isoprene) groups.Using this approach, lipids may be divided into eight categories: fatty acyls, glycerolipids, glycerophospholipids, sphingolipids, saccharolipids and polyketides(derived from condensation of ketoacyl subunits); and sterol lipids and prenol lipids (derived from condensation of isoprene subunits).

[Chemically](http://en.wikipedia.org/wiki/Chemistry), fats are generally [triesters](http://en.wikipedia.org/wiki/Ester) of [glycerol](http://en.wikipedia.org/wiki/Glycerol) and [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid). Fats may be either [solid](http://en.wikipedia.org/wiki/Solid) or [liquid](http://en.wikipedia.org/wiki/Liquid) at normal room [temperature](http://en.wikipedia.org/wiki/Temperature), depending on their structure and composition. Although the words "[oils](http://en.wikipedia.org/wiki/Oil)", "fats", and "[lipids](http://en.wikipedia.org/wiki/Lipid)" are all used to refer to fats, "oils" is usually used to refer to fats that are liquids at normal room temperature, while "fats" is usually used to refer to fats that are solids at normal room temperature. "Lipids" is used to refer to both liquid and solid fats, along with other related substances. The word "[oil](http://en.wikipedia.org/wiki/Oil_%28disambiguation%29)" is used for any substance that does not mix with water and has a greasy feel, such as [petroleum](http://en.wikipedia.org/wiki/Petroleum) (or crude oil) and [heating oil](http://en.wikipedia.org/wiki/Heating_oil), regardless of its chemical structure.

Although the term *lipid* is sometimes used as a synonym for [fats](http://en.wikipedia.org/wiki/Fat), fats are a subgroup of lipids called [triglycerides](http://en.wikipedia.org/wiki/Triglyceride). Lipids also encompass molecules such as [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid) and their derivatives (including [tri-](http://en.wikipedia.org/wiki/Triglyceride), [di-](http://en.wikipedia.org/wiki/Diglyceride), and [monoglycerides](http://en.wikipedia.org/wiki/Monoglyceride) and [phospholipids](http://en.wikipedia.org/wiki/Phospholipid)), as well as other [sterol](http://en.wikipedia.org/wiki/Sterol)-containing [metabolites](http://en.wikipedia.org/wiki/Metabolite) such as [cholesterol](http://en.wikipedia.org/wiki/Cholesterol).Although humans and other mammals use various [biosynthetic pathways](http://en.wikipedia.org/wiki/Metabolism) to both break down and synthesize lipids, some essential lipids cannot be made this way and must be obtained from the diet.

**Fats** consist of a wide group of compounds that are generally soluble in organic solvents and largely insoluble in water.

Fats form a category of [lipid](http://en.wikipedia.org/wiki/Lipid), distinguished from other lipids by their [chemical structure](http://en.wikipedia.org/wiki/Chemical_structure) and physical properties. This category of molecules is important for many forms of life, serving both structural and metabolic functions. They are an important part of the [diet](http://en.wikipedia.org/wiki/Diet_%28nutrition%29) of most [heterotrophs](http://en.wikipedia.org/wiki/Heterotroph) (including humans). Fats or lipids are broken down in the body by enzymes called [lipases](http://en.wikipedia.org/wiki/Lipase) produced in the [pancreas](http://en.wikipedia.org/wiki/Pancreas).

Examples of edible animal fats are [lard](http://en.wikipedia.org/wiki/Lard) (pig fat), [fish oil](http://en.wikipedia.org/wiki/Fish_oil), and [butter](http://en.wikipedia.org/wiki/Butter) or [ghee](http://en.wikipedia.org/wiki/Ghee). They are obtained from fats in the milk, meat and under the skin of the animal. Examples of edible plant fats are peanut, soya bean, sunflower, sesame, coconut, olive, and vegetable oils. [Margarine](http://en.wikipedia.org/wiki/Margarine) and [vegetable shortening](http://en.wikipedia.org/wiki/Vegetable_shortening), which can be derived from the above oils, are used mainly for baking. These examples of fats can be categorized into [saturated fats](http://en.wikipedia.org/wiki/Saturated_fat) and [unsaturated fats](http://en.wikipedia.org/wiki/Unsaturated_fat).

There are many different kinds of fats, but each is a variation on the same chemical structure. All fats consist of [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid) (chains of [carbon](http://en.wikipedia.org/wiki/Carbon) and [hydrogen](http://en.wikipedia.org/wiki/Hydrogen) atoms, with a [carboxylic acid](http://en.wikipedia.org/wiki/Carboxylic_acid) group at one end) bonded to a backbone structure, often [glycerol](http://en.wikipedia.org/wiki/Glycerol) (a "backbone" of carbon, hydrogen, and oxygen). Chemically, this is a [triester](http://en.wikipedia.org/wiki/Ester) of glycerol, an ester being the molecule formed from the reaction of the carboxylic acid and an organic alcohol. As a simple visual illustration, if the kinks and [angles](http://en.wikipedia.org/wiki/Bond_angle) of these chains were straightened out, the molecule would have the shape of a capital letter E.

The fatty acids would each be a horizontal line; the glycerol "backbone" would be the vertical line that joins the horizontal lines. Fats therefore have "ester" [bonds](http://en.wikipedia.org/wiki/Chemical_bond).

Fatty acids are produced by the hydrolysis of the ester linkages in a fat or biological oil (both of which are triglycerides), with the removal of glycerol.

The properties of any specific fat molecule depend on the particular fatty acids that constitute it.

In chemistry, especially biochemistry, a **fatty acid** is a carboxylic acid often with a long unbranched aliphatic tail (chain), which is either saturated or unsaturated. Carboxylic acids as short as butyric acid (4 carbonatoms) are considered to be fatty acids, whereas fatty acids derived from natural fats and oils may be assumed to have at least eight carbon atoms, caprylic acid (octanoic acid), for example. The most abundant natural fatty acids have an even number of carbon atoms because their biosynthesis involves acetyl-CoA, a coenzyme carrying a two-carbon-atom group. Fatty acids are straight chain hydrocarbons possessing a carboxyl (COOH) group at one end. The carbon next to the carboxylate is known as α, the next carbon β, and so forth. Since biological fatty acids can be of different lengths, the last position is labelled as a "ω", the last letter in the Greek alphabet. Since the physiological properties of unsaturated fatty acids largely depend on the position of the first unsaturation relative to the end position and not the carboxylate, the position is signified by (ω minus n). For example, the term ω-3 signifies that the first double bond exists as the third carbon-carbon bond from the terminal CH3 end (ω) of the carbon chain. The number of carbons and the number of double bonds is also listed. ω-3 18:4 (stearidonic acid) or 18:4 ω-3 or 18:4 n−3 indicates an 18-carbon chain with 4 double bonds, and with the first double bond in the third position from the CH3 end. Double bonds are *cis* and separated by a single methylene (CH2) group unless otherwise noted.

Fatty acids are aliphatic monocarboxylic acids derived from, or contained in esterified form in, an animal or vegetable fat, oil, or wax. Natural fatty acids commonly have a chain of four to 28 carbons (usually unbranched and even numbered).

Different fatty acids are composed of different numbers of carbon and hydrogen atoms. Each carbon atom is typically bonded to two hydrogen atoms. When a fatty acid has this typical arrangement, it is called "saturated", because the carbon atoms are saturated with hydrogen; meaning they are bondedto as many hydrogens as possible. In other fats, a carbon atom may instead bond to only one other hydrogen atom, and have a double bond to a neighboring carbon atom. This results in an "unsaturated" fatty acid. More specifically, it would be a "monounsaturated" fatty acid (one double bond, MUFA), whereas, a "polyunsaturated" fatty acid would be a fatty acid with more than one double bond (PUFA).

Saturated and unsaturated fats differ in their energy content and melting point. Since an unsaturated fat contains fewer carbon-hydrogen bonds than a saturated fat with the same number of carbon atoms, unsaturated fats will yield slightly less energy during metabolism than saturated fats with the same number of carbon atoms. Saturated fats can stack themselves in a closely packed arrangement, so they can freeze easily and are typically solid at room temperature. But the rigid double bond in an unsaturated fat fundamentally changes the chemistry of the fat.

The most common fatty acids in edible oils and fats are those containing 18 carbons. These include: stearic acid (a saturated fatty acid), oleic acid (a monounsaturated fatty acid), and linoleic and linolenic acids (polyunsaturated fatty acids containing two and three double bonds, respectively).

Examples of biologically important fatty acids are the eicosanoids, derived primarily from arachidonic acidand eicosapentaenoic acid, which include prostaglandins, leukotrienes, and thromboxanes. Other major lipid classes in the fatty acid category are the fatty esters and fatty amides. Fatty esters include important biochemical intermediates such as wax esters, fatty acid thioester coenzyme A derivatives, fatty acid thioester ACP derivatives and fatty acid carnitines. The fatty amides include N-acyl ethanolamines, such as the cannabinoid neurotransmitter anandamide.

**Unsaturated fatty acids**

Unsaturated fatty acids are of similar form, except that one or more alkenyl functional groups exist along the chain, with each alkene substituting a single-bonded " -CH2-CH2-" part of the chain with a double-bonded "-CH=CH-" portion (that is, a carbon double-bonded to another carbon).

The two next carbon atoms in the chain that are bound to either side of the double bond can occur in a *cis*or *trans* configuration.

A *cis* configuration means that adjacent hydrogen atoms are on the same side of the double bond. The rigidity of the double bond freezes its conformation and, in the case of the *cis* isomer, causes the chain to bend and restricts the conformational freedom of the fatty acid. The more double bonds the chain has in the *cis* configuration, the less flexibility it has. When a chain has many *cis* bonds, it becomes quite curved in its most accessible conformations. For example, oleic acid, with one double bond, has a "kink" in it, whereas linoleic acid, with two double bonds, has a more pronounced bend. Alpha-linolenic acid, with three double bonds, favors a hooked shape. The effect of this is that, in restricted environments, such as when fatty acids are part of a phospholipid in a lipid bilayer, or triglycerides in lipid droplets, cis bonds limit the ability of fatty acids to be closely packed, and therefore could affect the melting temperature of the membrane or of the fat.

A *trans* configuration, by contrast, means that the next two hydrogen atoms are bound to *opposite* sides of the double bond. As a result, they do not cause the chain to bend much, and their shape is similar to straight saturated fatty acids.

In most naturally-occurring unsaturated fatty acids, each double bond has three *n* carbon atoms after it, for some n, and all are cis bonds. Most fatty acids in the *trans* configuration (trans fats) are not found in nature and are the result of human processing (e.g., hydrogenation). A trans fatty acid (commonly shortened to trans fat) is an unsaturated fatty acid molecule that contains a *trans*double bond between carbon atoms, which makes the molecule less 'kinked' in comparison to fatty acids with *cis*double bonds. These bonds are characteristically produced during industrial hydrogenation of plant oils. Since they are also produced in bacterial metabolism, ruminant fats (e.g. in milk) also contain about 4% *trans* fatty acids. Research suggests that amounts of *trans* fats correlate with circulatory diseases such as atherosclerosis and coronary heart disease more than the same amount of *cis* fats, for reasons that are not fully understood. It is known, however, that *trans* fats, just like saturated fats, raise the LDL ("bad") cholesterol and lowers the HDL ("good") cholestrol. They have also been shown to have other harmful effects such as increasing triglycerides and Lp(a) lipoproteins. They are also thought to cause more inflammation, which is thought to occur through damage to the cells lining of blood vessels.

The differences in geometry between the various types of unsaturated fatty acids, as well as between saturated and unsaturated fatty acids, play an important role in biological processes, and in the construction of biological structures (such as cell membranes).

Examples of unsaturated fatty acids:

Common name         Chemical structure                                                      Δ*x*                  *C*:*D*                        *n*−*x*

Myristoleic acid        CH3(CH2)3CH=CH(CH2)7COOH                              *cis*-Δ9        14:1        *n*−5

Palmitoleic acid        CH3(CH2)5CH=CH(CH2)7COOH                             *cis*-Δ9               16:1   *n*−7

Sapienic acid                                                                                                                                   *cis*-Δ6               16:1          *n*−10

Oleic acid                                  CH3(CH2)7CH=CH(CH2)7COOH                             *cis*-Δ9         18:1          *n*−9

Linoleic acid                              CH3(CH2)4CH=CHCH2CH=CH(CH2)7COOH *cis*,*cis*-Δ9,Δ12 18:2          *n*−6

α-Linolenic acid    CH3CH2CH=CHCH2CH=CHCH2CH=CH(CH2)7COOH  *cis*,*cis*,*cis*-Δ9,Δ12,Δ15 18:3                   *n*−3

Arachidonic acid CH3(CH2)4CH=CHCH2CH=CHCH2CH=CHCH2CH=CH(CH2)3COOH*cis*,*cis*,*cis*,*cis*-Δ5Δ8,Δ11,Δ14 20:4  *n*−6

Eicosapentaenoic acid CH3CH2CH=CHCH2CH=CHCH2CH=CHCH2CH=CHCH2CH=CH(CH2)3COOH

*cis*,*cis*,*cis*,*cis*,*cis*-Δ5,Δ8,Δ11,Δ14,Δ17 20:5        *n*−3

Erucic acid                                 CH3(CH2)7CH=CH(CH2)11COOH                            *cis*-Δ13        22:1           *n*−9

Docosahexaenoic acidCH3CH2CH=CHCH2CH=CHCH2CH=CHCH2CH=CHCH2CH=CHCH2CH=CH(CH2)2COOH

*cis*,*cis*,*cis*,*cis*,*cis*,*cis*-Δ4,Δ7,Δ10,Δ13,Δ16,Δ19 22:6       *n*−3

**Saturated fatty acids**

Saturated fatty acids are a long-chain carboxylic acid that usually has between 12 and 24 carbon atoms that has no double bonds, e.g. Lauric acid (12 C), Myristic acid (14 C), Palmitic acid (16 C), Stearic acid (18 C), Arachidicacid (20 C).

In addition to saturation, fatty acids are short, medium, or long.

Short-chain fatty acids (SCFA) are fatty acids with aliphatic tails of fewer than six carbons.

Medium-chain fatty acids (MCFA) are fatty acids with aliphatic tails of 6–12 carbons, which can form medium-chain triglycerides.

Long-chain fatty acids (LCFA) are fatty acids with aliphatic tails longer than 12 carbons.

Very-Long-chain fatty acids (VLCFA) are fatty acids with aliphatic tails longer than 22 carbons

When discussing essential fatty acids (EFA), a slightly different terminology applies. Short-chain EFA are 18 carbons long; long-chain EFA have 20 or more carbons.

**Glycerolipids.** Glycerolipids are composed mainly of mono-, di- and tri-substituted [glycerols](http://en.wikipedia.org/wiki/Glycerol), the most well-known being the fatty acid esters of glycerol (triacylglycerols), also known as [triglycerides](http://en.wikipedia.org/wiki/Triglycerides). In these compounds, the three hydroxyl groups of glycerol are each esterified, usually by different fatty acids. Because they function as a food store, these lipids comprise the bulk of storage fat in animal tissues. The hydrolysis of the [ester](http://en.wikipedia.org/wiki/Ester) bonds of triacylglycerols and the release of glycerol and fatty acids from [adipose tissue](http://en.wikipedia.org/wiki/Adipose_tissue) is called fat mobilization.

Types of Triglycerides

* Simple triglycerides: They are triesters made from glycerol and three molecules of one kind of fatty acids. They are rare.
* Mixed triglycerides: They are triesters with different fatty acid components. Animal fats and vegetable oils are many different mixed triglycerides; e.g., Butterfat contains at least 14 different carboxylic acids.

**Chemical analysis of the isolated materials shows that lipids are the major components of most membranes. This lipids are not triglycerides but another group of compound called complex lipids.**

* **There are two types of complex lipids:** 
  + **Phospholipids**
  + **glycolipids**
* **\* Phospholipids: They are esters of phosphoric acids.There are two main types of phospholipids in cellular membranes:**
* **Phosphoglecerides: They are also known as Phosphaitdyl choline (lecithin). They are built from long chain fatty acid, glycerol and phosphoric acids.**
* **sphingomyelins: They do not contain glycerol. Instead, they contain sphingosine, a long-chain unsaturated amino alcohol. Only one fatty acid is attached to the sphingisine. Sphingomylins are found in brain and nervous tissue and in the myelin sheath, the protective coat of nerves.**
* **Phospholipids: naturally aggregate in form of bilayers (which fuse to form spherical liposomes)**
  + **glycerophospholipids**
  + **sphingophospholipids**

**Glycerophospholipids.** Glycerophospholipids, also referred to as [phospholipids](http://en.wikipedia.org/wiki/Phospholipid), are ubiquitous in nature and are key components of the [lipid bilayer](http://en.wikipedia.org/wiki/Lipid_bilayer) of cells, as well as being involved in [metabolism](http://en.wikipedia.org/wiki/Metabolism) and [cell signaling](http://en.wikipedia.org/wiki/Cell_signaling). Neural tissue (including the brain) contains relatively high amounts of glycerophospholipids, and alterations in their composition have been implicated in various neurological disorders.  Examples of glycerophospholipids found in [biological membranes](http://en.wikipedia.org/wiki/Biological_membrane) are [phosphatidylcholine](http://en.wikipedia.org/wiki/Phosphatidylcholine) (also known as PC, GPCho or [**lecithin**](http://en.wikipedia.org/wiki/Lecithin)), [phosphatidylethanolamine](http://en.wikipedia.org/wiki/Phosphatidylethanolamine) (PE or GPEtn) and [phosphatidylserine](http://en.wikipedia.org/wiki/Phosphatidylserine) (PS or GPSer).

**Sphingolipids.** [Sphingolipids](http://en.wikipedia.org/wiki/Sphingolipids) are a complex family of compounds that share a common structural feature, a [sphingoid base](http://en.wikipedia.org/wiki/Sphingoid_base) backbone that is synthesized [*de novo*](http://en.wikipedia.org/wiki/De_novo_synthesis) from the amino acid [serine](http://en.wikipedia.org/wiki/Serine) and a long-chain fatty acyl CoA, then converted into [ceramides](http://en.wikipedia.org/wiki/Ceramide), phosphosphingolipids, glycosphingolipids and other compounds. The major phosphosphingolipids of mammals are [sphingomyelins](http://en.wikipedia.org/wiki/Sphingomyelin) (ceramide phosphocholines). Examples of glycosphingolipids are the simple and complex glycosphingolipids such as [cerebrosides](http://en.wikipedia.org/wiki/Cerebroside) and [gangliosides](http://en.wikipedia.org/wiki/Ganglioside).

* **Sterols:**
  + **e.g. cholesterol (animal sterol) ergosterol( plant sterol).**

**Sterol lipids. Sterols** are an important class of organic molecules. Sterols are also known as steroid alcohols. They are a subgroup of [steroids](http://en.wikipedia.org/wiki/Steroid) with a [hydroxyl group](http://en.wikipedia.org/wiki/Hydroxyl_group) at the 3-position of the A-ring. They are [amphipathic lipids](http://en.wikipedia.org/wiki/Amphipathic_lipids) synthesized from [acetyl-coenzyme A](http://en.wikipedia.org/wiki/Acetyl-coenzyme_A) via the [HMG-CoA reductase](http://en.wikipedia.org/wiki/HMG-CoA_reductase) pathway. The overall molecule is quite flat. The hydroxyl group on the A ring is [polar](http://en.wikipedia.org/wiki/Chemical_polarity). The rest of the [aliphatic](http://en.wikipedia.org/wiki/Aliphatic) chain is [non-polar](http://en.wikipedia.org/wiki/Chemical_polarity).

They occur naturally in [plants](http://en.wikipedia.org/wiki/Plant), [animals](http://en.wikipedia.org/wiki/Animal) and [fungi](http://en.wikipedia.org/wiki/Fungi), with the most familiar type of animal sterol being [**cholesterol**](http://en.wikipedia.org/wiki/Cholesterol)**.** Cholesterol is vital to cellular function, and a precursor to fat-soluable vitamins and steroid hormones.

Sterols and related compounds play essential roles in the physiology of [eukaryotic](http://en.wikipedia.org/wiki/Eukaryote) organisms. For example, cholesterol forms part of the cellular membrane in animals, where it affects the cell membrane's fluidity and serves as [second messenger](http://en.wikipedia.org/wiki/Second_messenger) in developmental signaling. In humans and other animals, [corticosteroids](http://en.wikipedia.org/wiki/Corticosteroids), such as [cortisol](http://en.wikipedia.org/wiki/Cortisol) act as signaling compounds in cellular communication and general metabolism.

Sterols of plants are called [*phytosterols*](http://en.wikipedia.org/wiki/Phytosterol) and sterols of animals are called *zoosterols*. Important zoosterols are [cholesterol](http://en.wikipedia.org/wiki/Cholesterol) and some [steroid hormones](http://en.wikipedia.org/wiki/Steroid_hormone); notable **phytosterols**include [campesterol](http://en.wikipedia.org/wiki/Campesterol), [sitosterol](http://en.wikipedia.org/wiki/Sitosterol), and [stigmasterol](http://en.wikipedia.org/wiki/Stigmasterol). [Ergosterol](http://en.wikipedia.org/wiki/Ergosterol) is a sterol present in the [cell membrane](http://en.wikipedia.org/wiki/Cell_membrane) of fungi, where it serves a role similar to cholesterol in animal cells.

Sterol lipids, such as [cholesterol](http://en.wikipedia.org/wiki/Cholesterol) and its derivatives, are an important component of membrane lipids, along with the glycerophospholipids and sphingomyelins. The [steroids](http://en.wikipedia.org/wiki/Steroid), all derived from the same fused four-ring core structure, have different biological roles as [hormones](http://en.wikipedia.org/wiki/Hormones) and [signaling molecules](http://en.wikipedia.org/wiki/Signaling_molecules). The eighteen-carbon (**C18**) steroids include the [**estrogen**](http://en.wikipedia.org/wiki/Estrogen) family whereas the **C19** steroids comprise the [**androgens**](http://en.wikipedia.org/wiki/Androgen)such as [testosterone](http://en.wikipedia.org/wiki/Testosterone) and [androsterone](http://en.wikipedia.org/wiki/Androsterone). The **C21** subclass includes the [**progestogens**](http://en.wikipedia.org/wiki/Progestogens)as well as the [glucocorticoids](http://en.wikipedia.org/wiki/Glucocorticoid) and [mineralocorticoids](http://en.wikipedia.org/wiki/Mineralocorticoids). The [**secosteroids**](http://en.wikipedia.org/wiki/Secosteroid), comprising various forms of [**vitamin D**](http://en.wikipedia.org/wiki/Vitamin_D), are characterized by cleavage of the B ring of the core structure. The predominant sterol in [fungal](http://en.wikipedia.org/wiki/Fungi) cell membranes is [ergosterol](http://en.wikipedia.org/wiki/Ergosterol). Other examples of [sterols](http://en.wikipedia.org/wiki/Sterol) are the [**bile acids**](http://en.wikipedia.org/wiki/Bile_acid) and their conjugates, which in mammals are oxidized derivatives of cholesterol and are synthesized in the liver.

The plant equivalents are the [**phytosterols**](http://en.wikipedia.org/wiki/Phytosterols)(also called **plant sterols)**, such as [**β-sitosterol**](http://en.wikipedia.org/wiki/%CE%92-sitosterol), [stigmasterol](http://en.wikipedia.org/wiki/Stigmasterol).

**Phytosterols** are a group of [steroid alcohols](http://en.wikipedia.org/wiki/Sterol), [phytochemicals](http://en.wikipedia.org/wiki/Phytochemical) naturally occurring in [plants](http://en.wikipedia.org/wiki/Plants). Phytosterols occur naturally in small quantities in vegetable oils, especially [sea buckthorn oil](http://en.wikipedia.org/wiki/Sea_buckthorn_oil)(1640 mg/100g oil), [corn oil](http://en.wikipedia.org/wiki/Corn_oil) (968 mg/100g), and [soybean oil](http://en.wikipedia.org/wiki/Soybean_oil) (327 mg/100g oil). One such phytosterol complex, isolated from vegetable oil, is [cholestatin](http://en.wikipedia.org/w/index.php?title=Cholestatin&action=edit&redlink=1), composed of campesterol, stigmasterol, and brassicasterol, and is marketed as a [dietary supplement](http://en.wikipedia.org/wiki/Dietary_supplement).

They are white powders with mild, characteristic odor, insoluble in water and soluble in [alcohols](http://en.wikipedia.org/wiki/Alcohols). They have applications in [medicine](http://en.wikipedia.org/wiki/Medicine) and [cosmetics](http://en.wikipedia.org/wiki/Cosmetics) and as a [food additive](http://en.wikipedia.org/wiki/Food_additive) taken to lower cholesterol.

Plants contain a range of phytosterols. They act as a structural component in the [cell membrane](http://en.wikipedia.org/wiki/Cell_membrane), a role which in [mammalian](http://en.wikipedia.org/wiki/Mammal) cells is played by [cholesterol](http://en.wikipedia.org/wiki/Cholesterol).

[Phytosterols](http://en.wikipedia.org/wiki/Phytosterol), more commonly known as plant sterols, have been shown in clinical trials to block cholesterol absorption sites in the human intestine, thus helping to reduce cholesterol in humans.

The mechanism behind phytosterols and the lowering of cholesterol occurs as follows: the incorporation of cholesterol into [micelles](http://en.wikipedia.org/wiki/Micelle) in the [gastrointestinal tract](http://en.wikipedia.org/wiki/Gastrointestinal_tract) is inhibited, decreasing the overall amount of cholesterol absorbed. This may in turn help to control body total cholesterol levels, as well as modify HDL, LDL and TAG levels.

**β-Sitosterol** is one of several [phytosterols](http://en.wikipedia.org/wiki/Phytosterol) with [chemical structures](http://en.wikipedia.org/wiki/Chemical_structure) similar to that of [cholesterol](http://en.wikipedia.org/wiki/Cholesterol). It is white in colour and waxy in nature. It is widely distributed in the [plant kingdom](http://en.wikipedia.org/wiki/Plant_kingdom) and found in [black cumin seed](http://en.wikipedia.org/w/index.php?title=Black_cumin_seed&action=edit&redlink=1) ([*Nigella sativa*](http://en.wikipedia.org/w/index.php?title=Nigella_Sativa&action=edit&redlink=1)), saw palmetto ([*Serenoa repens*](http://en.wikipedia.org/wiki/Saw_palmetto)*),* avocados, [pumpkin seed](http://en.wikipedia.org/wiki/Pumpkin_seed) ([*Curcurbita pepo*](http://en.wikipedia.org/w/index.php?title=Curcurbita_pepo&action=edit&redlink=1)), [*Pygeum africanum*](http://en.wikipedia.org/wiki/Pygeum_africanum), [cashew](http://en.wikipedia.org/wiki/Cashew) fruit, [rice bran](http://en.wikipedia.org/wiki/Rice_bran), [wheat germ](http://en.wikipedia.org/wiki/Wheat_germ), [corn oils](http://en.wikipedia.org/wiki/Corn_oil), [soybeans](http://en.wikipedia.org/wiki/Soybean), [sea-buckthorn](http://en.wikipedia.org/wiki/Sea-buckthorn).

Alone and in combination with similar phytosterols, β-sitosterol reduces [blood](http://en.wikipedia.org/wiki/Blood) levels of [cholesterol](http://en.wikipedia.org/wiki/Cholesterol), and is sometimes used in treating [hypercholesterolemia](http://en.wikipedia.org/wiki/Hypercholesterolemia). One small study shows a positive effect on male hair loss in combination with [Saw palmetto](http://en.wikipedia.org/wiki/Saw_palmetto).

In Europe, β-sitosterol plays a major role in treatment of [herbal therapy](http://en.wikipedia.org/wiki/Herbal_therapy) of [benign prostatic hypertrophy](http://en.wikipedia.org/wiki/Benign_prostatic_hypertrophy) (BPH). It is also used in Europe for the treatment of prostatic carcinomaand breast cancer, although the benefits are still being evaluated in the US.

**Prenol lipids.** [Prenol](http://en.wikipedia.org/wiki/Prenol) lipids are synthesized from the 5-carbon precursors [isopentenyl diphosphate](http://en.wikipedia.org/wiki/Isopentenyl_diphosphate) and [dimethylallyl diphosphate](http://en.wikipedia.org/wiki/Dimethylallyl_diphosphate) that are produced mainly via the [mevalonic acid](http://en.wikipedia.org/wiki/Mevalonic_acid) (MVA) pathway. The simple isoprenoids (linear alcohols, diphosphates, etc.) are formed by the successive addition of C5 units, and are classified according to number of these [terpene](http://en.wikipedia.org/wiki/Terpene) units. Structures containing greater than 40 carbons are known as polyterpenes. [**Carotenoids**](http://en.wikipedia.org/wiki/Carotenoid)are important simple isoprenoids that function as [antioxidants](http://en.wikipedia.org/wiki/Antioxidant) and as precursors of [vitamin A](http://en.wikipedia.org/wiki/Vitamin_A). Another biologically important class of molecules is exemplified by the [**quinones**](http://en.wikipedia.org/wiki/Quinone) and [hydroquinones](http://en.wikipedia.org/wiki/Hydroquinone), which contain an isoprenoid tail attached to a quinonoid core of non-isoprenoid origin. [**Vitamin E**](http://en.wikipedia.org/wiki/Vitamin_E) and [vitamin **K**](http://en.wikipedia.org/wiki/Vitamin_K), as well as the [ubiquinones](http://en.wikipedia.org/wiki/Ubiquinone), are examples of this class.

The main nonsaponifiable components in vegetable oils are tocopherols and sterols, which are present in varying amounts depending on the oil. **Tocopherols**are natural antioxidants and their amount in the plant is probably governed by the content of unsaturated fatty acids. Tocopherols are present in different isomeric forms.

**Saccharolipids.** Saccharolipids describe compounds in which fatty acids are linked directly to a sugar backbone, forming structures that are compatible with membrane bilayers. In the saccharolipids, a [monosaccharide](http://en.wikipedia.org/wiki/Monosaccharide)substitutes for the glycerol backbone present in glycerolipids and glycerophospholipids. The most familiar saccharolipids are the acylated [glucosamine](http://en.wikipedia.org/wiki/Glucosamine) precursors of the [Lipid A](http://en.wikipedia.org/wiki/Lipid_A) component of the [lipopolysaccharides](http://en.wikipedia.org/wiki/Lipopolysaccharide) in [Gram-negative bacteria](http://en.wikipedia.org/wiki/Gram-negative_bacteria).

**Polyketides.** Polyketides are synthesized by polymerization of [acetyl](http://en.wikipedia.org/wiki/Acetyl) and [propionyl](http://en.wikipedia.org/wiki/Propionyl-CoA) subunits by classic enzymes as well as iterative and multimodular enzymes that share mechanistic features with the [fatty acid synthases](http://en.wikipedia.org/wiki/Fatty_acid_synthase). They comprise a large number of [secondary metabolites](http://en.wikipedia.org/wiki/Secondary_metabolite) and [natural products](http://en.wikipedia.org/wiki/Natural_products) from animal, plant, bacterial, fungal and marine sources, and have great structural diversity. Many [polyketides](http://en.wikipedia.org/wiki/Polyketide) are cyclic molecules whose backbones are often further modified by [glycosylation](http://en.wikipedia.org/wiki/Glycosylation), [methylation](http://en.wikipedia.org/wiki/Methylation), [hydroxylation](http://en.wikipedia.org/wiki/Hydroxylation), [oxidation](http://en.wikipedia.org/wiki/Oxidation), and/or other processes. Many commonly used [anti-microbial](http://en.wikipedia.org/wiki/Anti-microbial), [anti-parasitic](http://en.wikipedia.org/wiki/Anti-parasitic), and [anti-cancer](http://en.wikipedia.org/wiki/Anti-cancer) agents are polyketides or polyketide derivatives, such as [erythromycins](http://en.wikipedia.org/wiki/Erythromycin), [tetracyclines](http://en.wikipedia.org/wiki/Tetracycline_antibiotics), [avermectins](http://en.wikipedia.org/wiki/Avermectin), and antitumor [epothilones](http://en.wikipedia.org/wiki/Epothilone).

**Essential fatty acids**, or **EFAs**, are fatty acids that cannot be constructed within an organism (generally all references are to humans) from other components by any known chemical pathways, and therefore must be obtained from the diet. The term refers to fatty acids involved in biological processes, and not those which may just play a role as fuel.

There are two families of EFAs: ω-3 (or omega-3 or n−3) and ω-6 (omega-6, n−6). Fats from each of these families are essential, as the body can convert one omega-3 to another omega-3, for example, but cannot create an omega-3 from omega-6 or saturated fats. They were originally designated as **Vitamin F** when they were discovered as essential nutrients in 1923. In 1930, work by Burr, Burr and Miller showed that they are better classified with the fats than with the vitamins.

In the body, essential fatty acids serve multiple functions. In each of these, the balance between dietary ω-3 and ω-6 strongly affects function.

They are modified to make the classic eicosanoids (affecting inflammation and many other cellular functions), the endocannabinoids (affecting mood, behavior and inflammation), the lipoxins from ω-6 EFAs and resolvins from ω-3 (in the presence of aspirin, downregulating inflammation), epoxyeicosatrienoic acids (EETs). They act on DNA (activating or inhibiting transcription factors such as NFκB, which is linked to pro-inflammatory cytokineproduction).

The essential fatty acids start with the **short chain polyunsaturated fatty acids (SC-PUFA)**: ω-3 fatty acids: α-Linolenic acid or ALA (18:3), ω-6 fatty acids: Linoleic acid or LA (18:2)

These two fatty acids cannot be synthesised by humans, as humans lack the desaturase enzymes required for their production. They form the starting point for the creation of longer and more desaturated fatty acids, which are also referred to as **long-chain polyunsaturated fatty acids (LC-PUFA)**: ω-3 fatty acids: eicosapentaenoic acid or EPA (20:5), docosahexaenoic acid or DHA (22:6), ω-6 fatty acids: gamma-linolenic acid or GLA (18:3), dihomo-gamma-linolenic acid or DGLA (20:3), arachidonic acid or AA (20:4).

**γ-Linolenic acid** (**gamma-linolenic acid** or **GLA**) is a fatty acid found primarily in vegetable oils. It is sold as a dietary supplement for treating problems with inflammation and auto-immune diseases. The efficacy of such use is disputed.

GLA is categorized as an *n*−6 (also called ω−6 or omega-6) fatty acid, meaning that the first double bond on the methyl end (designated with *n* or ω) is the sixth bond. In physiological literature, GLA is designated as 18:3 (*n*−6). Chemically, GLA is a carboxylic acid with an 18-carbon chain and three *cis* double bonds. It is an isomer of α-linolenic acid, which is the *n*−3 fatty acid found in flax seed.

GLA was first isolated from the seed oil of evening primrose. This herbal plant was grown by Native Americansto treat swelling in the body. In the 17th century, it was introduced to Europe and became a popular folk remedy, earning the name king's cure-all.In 1919, Heiduschka and Lüft extracted the oil from evening primrose seeds and described an unusual linolenic acid, which they name γ-. Later, the exact chemical structure was characterized by Riley.

Although there are α- and γ-forms of linolenic acid, there is no β-form. One was once identified, but it turned out to be an artifact of the original analytical process.

GLA is obtained from vegetable oils such as: evening primrose (*Oenothera biennis*) oil, blackcurrant seed oil, borage oil, and hemp seed oil. GLA is also found in considerable quantities in edible hemp seeds and from spirulina, a cyanobacterium. Each contains varying amounts of the fatty acid, with borage oil usually being the most heavily concentrated form. All are widely available in pharmacies, health food stores, or online shops.

The human body produces GLA from linoleic acid (LA). This reaction is catalyzed by Δ6-desaturase(D6D), an enzyme which allows the creation of a double bond on the sixth carbon counting from the carboxyl terminus. LA is consumed sufficiently in most diets, from such abundant sources as cooking oils and meats.

From GLA, the body forms dihomo-γ-linolenic acid (DGLA). This is one of the body's three sources of eicosanoids (along with AA and EPA.) DGLA is the precursor of the prostaglandin PGH1, which in turn forms PGE1and the thromboxane TXA1. PGE1 has a role in regulation of immune system function and is used as the medicine alprostadil. TXA1 modulates the pro-inflammatory properties of the thromboxane TXA2.Unlike AA and EPA, DGLA cannot yield leukotrienes. However it can inhibit the formation of pro-inflammatory leukotrienes from AA.

Although GLA is an *n*−6 fatty acid, a type of acid which is generally pro-inflammatory, it has anti-inflammatory properties. GLA is sometimes prescribed in the belief that it has anti-inflammatory properties lacking some of the common side effects of other anti-inflammatory drugs. Herbal medicine advocates recommend GLA for autoimmune disorders, arthritis, eczema and PMS with noticeable results not expected for months. Research is ongoing, investigating GLA as a potential anticancer agent. GLA is unique among the omega-6 polyunsaturated fatty acids (linoleic acid, GLA and arachidonic acid) in its potential to suppress tumor growth and metastasis.

 ω-9 fatty acids are not essential in humans, because humans generally possess all the enzymes required for their synthesis. Exceptions do occur in older people or people with a liver problem that do not completely produce a sufficient amount, and hence many supplement companies market Omega 3-6-9 blends.

Between 1930 and 1950, arachidonic acid and linolenic acid were termed 'essential' because each was more or less able to meet the growth requirements of rats given fat-free diets. Further research has shown that human metabolism requires both ω-3 and ω-6 fatty acids. To some extent, any ω-3 and any ω-6 can relieve the worst symptoms of fatty acid deficiency. Particular fatty acids are still needed at critical life stages (e.g. lactation) and in some disease states. In nonscientific writing, common usage is that the term *essential fatty acid* comprises all the ω-3 or -6 fatty acids.Authoritative sources include the whole families, without qualification.The human body can make some long-chain PUFA (arachidonic acid, EPA and DHA) from lineolate or lineolinate.

A 2005 study has shown evidence that gamma-linolenic acid, GLA has been shown to inhibit the breast cancer promoting gene of Her2/neu.

Almost all the polyunsaturated fat in the human diet is from EFA. Some of the food sources of ω-3 and ω-6 fatty acids are fish and shellfish, flaxseed (linseed), hemp oil, soya oil, canola (rapeseed) oil, chia seeds, pumpkin seeds, sunflower seeds, leafy vegetables, and walnuts.

Essential fatty acids play a part in many metabolic processes, and there is evidence to suggest that low levels of essential fatty acids, or the wrong balance of types among the essential fatty acids, may be a factor in a number of illnesses, including osteoporosis.Essential fatty acids play an important role in the life and death of cardiac cells.

Plant sources of ω-3 contain neither eicosapentaenoic acid (EPA) nor docosahexaenoic acid (DHA). The human body can (and in case of a purely vegetarian diet often must, unless certain algae or supplements derived from them are consumed) convert α-linolenic acid (ALA) to EPA and subsequently DHA. This however requires more metabolic work, which is thought to be the reason that the absorption of essential fatty acids is much greater from animal rather than plant sources.

**Fatty acids** can be **bound or attached** to other molecules, such as in triglycerides or phospholipids. When they are not attached to other molecules, they are known as "free" fatty acids.

The **uncombined fatty acids** or **free fatty acids** may come from the breakdown of a triglyceride into its components (fatty acids and glycerol). However as fats are insoluble in water they must be bound to appropriate regions in the plasma protein albumin for transport around the body. The levels of "free fatty acid" in the blood are limited by the number of albumin binding sites available.

Free fatty acids are an important source of fuel for many tissues since they can yield relatively large quantities of ATP. Many cell types can use either glucose or fatty acids for this purpose. In particular, heart and skeletal muscle prefer fatty acids. The brain cannot use fatty acids as a source of fuel; it relies on glucose, or on ketone bodies. Ketone bodies are produced in the liver by fatty acid metabolism during starvation, or during periods of low carbohydrate intake.

A wax is a type of [lipid](http://en.wikipedia.org/wiki/Lipid) that may contain a wide variety of long-chain [alkanes](http://en.wikipedia.org/wiki/Alkanes), [esters](http://en.wikipedia.org/wiki/Esters), [polyesters](http://en.wikipedia.org/wiki/Polyester) and hydroxy esters of long-chain [primary alcohols](http://en.wikipedia.org/wiki/Primary_alcohol)and [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid). They are usually distinguished from [fats](http://en.wikipedia.org/wiki/Fat) by the lack of [triglyceride](http://en.wikipedia.org/wiki/Triglyceride)esters of [glycerin](http://en.wikipedia.org/wiki/Glycerin) (propan-1,2,3-triol) and three fatty acids. In addition to the esters that contribute to the high melting point and hardness of carnauba wax, the [epicuticular waxes](http://en.wikipedia.org/wiki/Epicuticular_wax) of plants are mixtures of substituted long-chain [aliphatic](http://en.wikipedia.org/wiki/Aliphatic)[hydrocarbons](http://en.wikipedia.org/wiki/Hydrocarbon), containing [alkanes](http://en.wikipedia.org/wiki/Alkane), fatty acids, primary and [secondary alcohols](http://en.wikipedia.org/wiki/Secondary_alcohol), [diols](http://en.wikipedia.org/wiki/Diol), [ketones](http://en.wikipedia.org/wiki/Ketone), [aldehydes](http://en.wikipedia.org/wiki/Aldehyde). Paraffin waxes are [hydrocarbons](http://en.wikipedia.org/wiki/Hydrocarbon), mixtures of [alkanes](http://en.wikipedia.org/wiki/Alkanes)usually in a [homologous series](http://en.wikipedia.org/wiki/Homologous_series) of chain lengths.

**Wax** refers to [beeswax](http://en.wikipedia.org/wiki/Beeswax) or another substance with similar properties. The traditional meaning, beeswax, refers to a substance secreted by [bees](http://en.wikipedia.org/wiki/Bee) and used by them in constructing their [honeycombs](http://en.wikipedia.org/wiki/Honeycomb).

The term has come to refer more generally to a class of substances with properties similar to beeswax, enumerated below: [plastic](http://en.wikipedia.org/wiki/Plasticity_%28physics%29) ([malleable](http://en.wikipedia.org/wiki/Malleability)) at normal ambient temperatures; a [melting point](http://en.wikipedia.org/wiki/Melting_point) above approximately 45 °C (which differentiates waxes from [fats](http://en.wikipedia.org/wiki/Fat) and [oils](http://en.wikipedia.org/wiki/Oil)); a relatively low [viscosity](http://en.wikipedia.org/wiki/Viscosity) when melted (unlike many [plastics](http://en.wikipedia.org/wiki/Plastic)); [insoluble](http://en.wikipedia.org/wiki/Solubility) in water; [hydrophobic](http://en.wikipedia.org/wiki/Hydrophobic).

**Waxes** may be natural secretions of plants or animals, artificially produced by purification from natural [petroleum](http://en.wikipedia.org/wiki/Petroleum) or completely synthetic. In addition to [beeswax](http://en.wikipedia.org/wiki/Beeswax), [**carnauba**](http://en.wikipedia.org/wiki/Carnauba) (a plant [epicuticular wax](http://en.wikipedia.org/wiki/Epicuticular_wax)) and [**paraffin**](http://en.wikipedia.org/wiki/Paraffin) (a petroleum wax) are commonly encountered waxes which occur naturally. [Earwax](http://en.wikipedia.org/wiki/Earwax) is an oily substance found in the human [ear](http://en.wikipedia.org/wiki/Ear). Some artificial materials such as [**silicone**](http://en.wikipedia.org/wiki/Silicone) wax that exhibit similar properties are also described as wax or waxy.

**Uses of wax**

Waxes are used to make [wax paper](http://en.wikipedia.org/wiki/Wax_paper), impregnating and coating paper and card to waterproof it or make it resistant to staining, or to modify its surface properties. Waxes are also used in [shoe polishes](http://en.wikipedia.org/wiki/Shoe_polish), [wood polishes](http://en.wikipedia.org/wiki/Wood_polish), and automotive polishes, as [mold release agents](http://en.wikipedia.org/wiki/Mold_release_agent) in [mold making](http://en.wikipedia.org/wiki/Mold_making), as a coating for many [cheeses](http://en.wikipedia.org/wiki/Cheese), and to [waterproof](http://en.wikipedia.org/wiki/Waterproof) leather and fabric. Wax has been used since antiquity as a temporary, removable model in [lost-wax casting](http://en.wikipedia.org/wiki/Lost-wax_casting) of [gold](http://en.wikipedia.org/wiki/Gold), [silver](http://en.wikipedia.org/wiki/Silver) and other materials.Waxes and hard fats such as [tallow](http://en.wikipedia.org/wiki/Tallow) have long been use to make [candles](http://en.wikipedia.org/wiki/Candle), used for lighting and decoration in a number of religious traditions. Beeswax or coloured synthetic wax is used to decorate [Easter eggs](http://en.wikipedia.org/wiki/Easter_egg).

 Wax with colored pigments added has been used as a medium in [encaustic painting](http://en.wikipedia.org/wiki/Encaustic_painting), and is used today in the manufacture of [crayons](http://en.wikipedia.org/wiki/Crayon) and colored [pencils](http://en.wikipedia.org/wiki/Pencil). [Carbon paper](http://en.wikipedia.org/wiki/Carbon_paper), used for making duplicate [typewritten](http://en.wikipedia.org/wiki/Typewriter) documents was coated with [carbon black](http://en.wikipedia.org/wiki/Carbon_black) suspended in wax, typically [montan wax](http://en.wikipedia.org/wiki/Montan_wax), but has largely been superseded by [photocopiers](http://en.wikipedia.org/wiki/Photocopier) and [computer printers](http://en.wikipedia.org/wiki/Computer_printer). In another context, [lipstick](http://en.wikipedia.org/wiki/Lipstick) and [mascara](http://en.wikipedia.org/wiki/Mascara) are blends of various fats and waxes colored with pigments, and both [beeswax](http://en.wikipedia.org/wiki/Beeswax) and [lanolin](http://en.wikipedia.org/wiki/Lanolin) are used in other [cosmetics](http://en.wikipedia.org/wiki/Cosmetics). Also, the sports of surfing, [skiing](http://en.wikipedia.org/wiki/Skiing), [snowboarding](http://en.wikipedia.org/wiki/Snowboarding) and [skateboarding](http://en.wikipedia.org/wiki/Skateboarding) often use wax to enhance the performance.

**Wax types**

**Animal waxes**

[Beeswax](http://en.wikipedia.org/wiki/Beeswax) - produced by [honey bees](http://en.wikipedia.org/wiki/Honey_bee)

[Lanolin](http://en.wikipedia.org/wiki/Lanolin) (wool wax) - from the [sebaceous glands](http://en.wikipedia.org/wiki/Sebaceous_glands) of [sheep](http://en.wikipedia.org/wiki/Sheep)

[Spermaceti](http://en.wikipedia.org/wiki/Spermaceti) - from the head cavities and blubber of the [sperm whale](http://en.wikipedia.org/wiki/Sperm_whale)

**Vegetable waxes**

[Carnauba wax](http://en.wikipedia.org/wiki/Carnauba_wax) - from the leaves of the Carnauba palm, [*Copernica cerifera*](http://en.wikipedia.org/w/index.php?title=Copernica_cerifera&action=edit&redlink=1)

[Castor wax](http://en.wikipedia.org/wiki/Castor_wax) - catalytically hydrogenated [castor oil](http://en.wikipedia.org/wiki/Castor_oil)

[Jojoba oil](http://en.wikipedia.org/wiki/Jojoba_oil) - a replacement for [spermaceti](http://en.wikipedia.org/wiki/Spermaceti), jojoba is pressed from the seeds of the [jojoba](http://en.wikipedia.org/wiki/Jojoba) bush, *Simmondsia chinensis*

[Soy wax](http://en.wikipedia.org/wiki/Soy_wax) - from soybean oil

**Mineral waxes**

[Ceresin waxes](http://en.wikipedia.org/w/index.php?title=Ceresin_wax&action=edit&redlink=1)

[Montan wax](http://en.wikipedia.org/wiki/Montan_wax) - extracted from [lignite](http://en.wikipedia.org/wiki/Lignite) and [brown coal](http://en.wikipedia.org/wiki/Brown_coal)

[Ozocerite](http://en.wikipedia.org/wiki/Ozocerite) - found in lignite beds

[Peat waxes](http://en.wikipedia.org/w/index.php?title=Peat_wax&action=edit&redlink=1)

**Petroleum waxes**

[Paraffin wax](http://en.wikipedia.org/wiki/Paraffin_wax) - made of long-chain [alkane](http://en.wikipedia.org/wiki/Alkane) [hydrocarbons](http://en.wikipedia.org/wiki/Hydrocarbon)

[Microcrystalline wax](http://en.wikipedia.org/wiki/Microcrystalline_wax) - with very fine crystalline structure

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| --- | --- | --- |
| ***Fixed oils*** (Olea pinguia) - смеси сложных эфиров глицерина и высших жирных кислот с общей формулой (Olea pinguia) - a mixture of esters of glycerol and higher fatty acids. Сложные эфиры могут быть образованы одной кислотой (простые триацилглицерины) или разными кислотами (смешанные триацилглицерины). Esters can be formed of one acid (simple triacylglycerol) or different acids (mixed triacylglycerol). Растительные жирные масла классифицируют по консистенции на твердые и жидкие. Твердые жирные масла образованы насыщенными кислотами (C n H 2 n O 2 ) и при обыкновенной температуре сохраняют плотную консистенцию.  Vegetable fatty oils are classified according to the consistency of liquid and solid. Solid fatty oils are formed by saturated acids (C n H 2 n O 2) and at ordinary temperatures remain dense consistency. Такие масла характерны для тропических растений. These oils are characteristic of tropical plants. В медицине нашло применение масло какао - Butyrum Cacao, получаемое из семян шоколадного дерева Theobroma cacao L., сем. The medicine has been used cocoa butter - Butyrum Cacao, chocolate derived from the seeds of the tree Theobroma cacao L., Sem. Стеркулиевые - Sterculiaceae. Sterkulievye - Sterculiaceae. Наиболее часто компонентами твердых жирных масел выступают насыщенные кислоты: лауриновая C 11 H 23 COOH, миристиновая C 13 H 27 COOH, пальмитиновая C 15 H 31 COOH, стеариновая C 17 H 35 COOH. Most often the components of solid fatty oils are the saturated acids: lauric C 11 H 23 COOH, myristic C 13 H 27 COOH, palmitic acid C 15 H 31 COOH, stearic acid C 17 H 35 COOH. Жидкие масла содержат ненасыщенные кислоты: олеиновую C 17 H 33 COOH, линолевую C 17 H 31 COOH, линоленовую C 17 H 29 COOH, гидроксиолеиновую C 17 H 32 OHCOOH.  Liquid oils contain unsaturated acids: oleic C 17 H 33 COOH, linoleic, C 17 H 31 COOH, linolenic C 17 H 29 COOH, gidroksioleinovuyu C 17 H 32 OHCOOH. В зависимости от химической природы кислот жидкие масла классифицируются на высыхающие (масло льняное), полувысыхающие (масла подсолнечное и кукурузное) и невысыхающие (масла миндальное, персиковое, оливковое, касторовое). Depending on the chemical nature of the acid liquid oils are classified as drying (linseed oil), semidrying (sunflower oil and corn oil) and non-drying (almond oil, peach, olive, castor). Высыхание жирных масел обусловлено содержанием линоленовой и частично линолевой кислот и представляет собой сложный физико-химический процесс, при котором проходят окисление, конденсация, полимеризация, а затем коллоидные превращения. Высыхающие жирные масла , нанесенные тонким слоем на какую-либо поверхность, в результате этих процессов образуют прозрачную смолоподобную эластичную пленку - оксин.  The drying up of fatty oils is due to the content of linolenic and linoleic acids in part and represents a complex physical and chemical process in which undergo oxidation, condensation, polymerization, and then the colloidal transition. Drying fatty oils, deposited a thin layer on any surface, as a result of these processes form a transparent flexible film retinoid - oxine. Эта способность лежит в основе применения олифы, лаков и красок, в состав которых входят высыхающие жирные масла. Полувысыхающие масла содержат линолевую кислоту, а невысыхающие - олеиновую, гидроксиолеиновую кислоты. This ability underlies the use of varnishes, lacquers and paints, which include drying fatty oil. Semidrying oils contain linoleic acid, a non-drying - oleic, gidroksioleinovuyu acid. В составе некоторых растительных масел встречаются циклические кислоты, например чаульмугровая кислота содержится в масле, применяемом для лечения проказы.  In the composition of certain vegetable oils found cyclic acid, for example chaulmugrovaya acid contained in the oil used to treat leprosy. **Жирные масла** - массы плотной однородной консистенции или маслянистые жидкости обычно желтоватого (миндальное, персиковое, абрикосовое, подсолнечное масла), реже зеленоватого (присутствие примеси хлорофилла; конопляное масло), еще реже красно-оранжевого цвета (дают каротиноиды или другие пигменты; облепиховое масло), приятного запаха и вкуса.  **Physicochemical properties.**  **Fatty oils** - a dense mass of uniform consistency, or oily liquids usually yellow (almond, peach, apricot, sunflower oil), less often a greenish (presence impurities chlorophyll; hemp oil), even more rarely red-orange color (carotenoids, or give other pigments, Sea-buckthorn oil) have a pleasant smell and taste.  Fats may be either [solid](http://en.wikipedia.org/wiki/Solid) or [liquid](http://en.wikipedia.org/wiki/Liquid) at normal room [temperature](http://en.wikipedia.org/wiki/Temperature), depending on their structure and composition. Although the words "[oils](http://en.wikipedia.org/wiki/Oil)", "fats", and "[lipids](http://en.wikipedia.org/wiki/Lipid)" are all used to refer to fats, "oils" is usually used to refer to fats that are liquids at normal room temperature, while "fats" is usually used to refer to fats that are solids at normal room tempe­rature. "Lipids" is used to refer to both liquid and solid fats, along with other related substances. The word "[oil](http://en.wikipedia.org/wiki/Oil_%28disambiguation%29)" is used for any substance that does not mix with water and has a greasy feel, such as [petroleum](http://en.wikipedia.org/wiki/Petroleum) (or crude oil) and [heating oil](http://en.wikipedia.org/wiki/Heating_oil), regardless of its chemical structure.  Fats consist of a wide group of compounds that are generally soluble in organic solvents and largely insoluble in water. They are soluble in alcohol, easy - in the ether, chloroform, petroleum ether. Исключение составляет касторовое масло, легко растворимое в спирте, трудно - в петролейном эфире. The exception is castor oil, readily soluble in alcohol, it is difficult - in petroleum ether.  Saturated fats can stack themselves in a closely packed arrangement, so they can freeze easily and are typically solid at room temperature.  The main nonsaponifiable components in vegetable oils are tocopherols and sterols, which are present in varying amounts depending on the oil.  Жирные масла дают нейтральную реакцию, имеют плотность меньше единицы (колеблется от 0,91 до 0,97).Fatty oils give a neutral reaction, have a density of less than one (ranging from 0.91 to 0.97). Оптическую активность определяют только для касторового масла. Optical activity is determined only for the castor oil.  В химическом отношении чистые триацилглицерины, особенно триацилглицерины предельных кислот, - довольно инертные вещества, способные к ограниченному числу превращений, характерных для сложных эфиров. Chemically pure triacylglycerols, especially triacylglycerol limit acids - rather inert substances capable of a limited number of transformations, characteristic of esters. Под влиянием фермента липазы, в присутствии влаги и при повышенной температуре, а также под действием щелочей происходит гидролиз жирных масел. Under the influence of the enzyme lipase in the presence of moisture and elevated temperature, and under the influence of alkalis is hydrolyzed fatty oils. До 90% видов растений содержат запасные жиры в семенах.  Up to 90% of plant species contain spare fats in seeds. Состав жирных масел зависит от ряда факторов. The composition of fatty oils depends on several factors. В незрелых семенах преобладают свободные жирные кислоты, вследствие чего масло из такого сырья имеет завышенное кислотное число. In immature seeds is dominated by free fatty acids, so that oil from such raw materials is too high acid number. Географические факторы также оказывают влияние на состав жирных масел. Geographical factors also influence the composition of fatty oils. Льняное масло, полученное из семян льна, выращенного в разных местностях (на севере, на юге или в горах Кавказа), имеет разные значения йодного числа. Flax oil derived from flax seeds grown in different locations (north, south or in the mountains of the Caucasus), has different values ​​of iodine number. Оно выше у масла, которое получено из льна, выращенного на севере, и ниже - на юге. It is higher in oil, which is derived from the flax grown in the north, and below - in the south. Всё это необходимо учитывать при заготовке сырья. All this must be considered in the procurement of raw materials. Жирные масла получают путем холодного и горячего прессования, а также экстрагированием. | | |
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**Acidity.**Short-chain carboxylic acids such as [formic acid](http://en.wikipedia.org/wiki/Formic_acid) and [acetic acid](http://en.wikipedia.org/wiki/Acetic_acid) are miscible with water and dissociate to form reasonably strong acids ([pKa](http://en.wikipedia.org/wiki/Acid_dissociation_constant) 3.77 and 4.76, respectively). Longer-chain fatty acids do not show a great change in pKa. [Nonanoic acid](http://en.wikipedia.org/wiki/Nonanoic_acid), for example, has a pKa of 4.96. However, as the chain length increases the solubility of the fatty acids in water decreases very rapidly, so that the longer-chain fatty acids have very little effect on the [pH](http://en.wikipedia.org/wiki/PH) of a solution. The significance of their pKa values therefore has relevance only to the types of reactions in which they can take part.

Even those fatty acids that are insoluble in water will dissolve in warm [ethanol](http://en.wikipedia.org/wiki/Ethanol), and can be [titrated](http://en.wikipedia.org/wiki/Titration) with [sodium hydroxide](http://en.wikipedia.org/wiki/Sodium_hydroxide) solution using [phenolphthalein](http://en.wikipedia.org/wiki/Phenolphthalein) as an indicator to a pale-pink endpoint. This analysis is used to determine the free fatty acid content of fats; i.e., the proportion of the triglycerides that have been [hydrolyzed](http://en.wikipedia.org/wiki/Hydrolyze).

**Reaction of fatty acids.**Fatty acids react just like any other carboxylic acid, which means they can undergo [esterification](http://en.wikipedia.org/wiki/Esterification) and acid-base reactions. [Reduction](http://en.wikipedia.org/wiki/Reduction_%28chemistry%29) of fatty acids yields [fatty alcohols](http://en.wikipedia.org/wiki/Fatty_alcohol). Unsaturated fatty acids can also undergo addition reactions, most commonly [hydrogenation](http://en.wikipedia.org/wiki/Hydrogenation), which is used to convert vegetable oils into margarine. With partial hydrogenation, unsaturated fatty acids can be isomerized from *cis* to *trans* configuration. In the [Varrentrapp reaction](http://en.wikipedia.org/wiki/Varrentrapp_reaction) certain unsaturated fatty acids are cleaved in molten alkali, a reaction at one time of relevance to structure elucidation.

**Auto-oxidation and rancidity.**Fatty acids at room temperature undergo a chemical change known as [auto-oxidation](http://en.wikipedia.org/wiki/Auto-oxidation). The fatty acid breaks down into [hydrocarbons](http://en.wikipedia.org/wiki/Hydrocarbon), [ketones](http://en.wikipedia.org/wiki/Ketone), [aldehydes](http://en.wikipedia.org/wiki/Aldehyde), and smaller amounts of [epoxides](http://en.wikipedia.org/wiki/Epoxide) and [alcohols](http://en.wikipedia.org/wiki/Alcohol). Heavy metals present at low levels in fats and oils promote auto-oxidation. Fats and oils often are treated with [chelating agents](http://en.wikipedia.org/wiki/Chelation) such as [citric acid](http://en.wikipedia.org/wiki/Citric_acid).

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| ***Прессование*** ***Fatty oils are produced by cold and hot pressing, and extraction***  ***Pressing*** - наиболее часто применяемый метод. - The most frequently used method. Семена очищают от примесей, сортируют и подсушивают. Seeds are cleaned of impurities, sorted and dried. Затем на специальных обдирочных машинах с них удаляют околоплодники или оболочки, после чего измельчают, получая мятку. Then on the rough part of special machines which remove the husk or hull, then ground , lightly fried with continuous vigorous stirring, moistened and treated with saturated steam. Происходит обильное выделение высококачественного масла. Occurs copious high-quality oil. После съема масла полуобезжиренную мезгу подвергают либо холодному (при этом получают небольшое количество высококачественного масла), либо горячему прессованию. After the removal of oil or semi-skimmed pulp is subjected to cold (in this case a small quantity of high-quality oil) or hot pressing. При горячем прессовании выход масла больше, но такие масла содержат много пигментов, фосфатидов, токоферолов, слизи и других веществ. During hot pressing oil yield more, but such oils contain a lot of pigment, phosphatides, tocopherols, mucus and other substances. Для медицинских целей, особенно для парентерального введения, получают масла холодным прессованием, без поджаривания семян. For medical purposes, especially for parenteral administration, used an oil by cold pressing, without toasting the seeds. Такие масла слабее окрашены, имеют более приятный вкус, нейтральную реакцию. These oils are painted less, have a pleasant taste, a neutral reaction. | | |
| **Extraction.**Lipids are defined by their special solubility properties and are extract­able with alcohol or ether from living plant tissues. Such extraction re­moves certain other classes of lipid, such as leaf alkanes and steroids, but leaves behind all the water­soluble components of the plant tissue. Isopropanol is recommended as extraction solvent in order to deactivate the enzymes. | |  |  |

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| ***Экстрагирование* жирных масел** из измельченного сырья проводят органическим растворителем (хлороформ, дихлорэтан), после чего растворитель отгоняют до полного удаления.***Extraction* of fatty oils** from the crushed raw material is carried out with an organic solvent (chloroform, dichloroethane), after which the solvent was removed to complete removal. Выход масла получается больший, но такие масла содержат много примесей (смолы, пигменты) и, как правило, используются в технике. Oil yield is greater, but such oils contain many contaminants (resins, pigments) and are usually used in engineering. После извлечения жирные масла подвергают очистке (рафинированию), которая включает несколько стадий: After extracting the fatty oil was purified (refining), which includes several stages: 1. 1. Фильтрование (отстаивание или центрифугирование) с целью избавления от механических примесей. Filtration (settling or centrifugation) to get rid of impurities. 2. 2. Гидратирование - удаление гидрофильных веществ. Hydrating - removal of hydrophilic substances. Масло помещают в бак, снабженный мешалкой и обогревом. Oil is placed in a tank equipped with a stirrer and heating. Масло промывают водой, нагретой до 60°С, при этом в осадок выпадают белки, слизи, фосфатиды, которые удаляют фильтрованием. The oil was washed with water, heated to 60 ° C, while in the precipitated proteins, mucus, gums that are removed by filtration. 3. 3. Щелочная очистка применяется при повышенной кислотности жирного масла. Alkaline cleaning is used in hyperacidity fatty oil. Его помещают в бак при температуре 80°С, прибавляют рассчитанное количество соды (на 30% больше, чем требуется для нейтрализации). It is placed in a tank at a temperature of 80 ° C was added a calculated amount of soda (30% more than required to neutralize). Образовавшееся мыло осаждают хлоридом натрия и отфильтровывают. The resulting soap was precipitated with sodium chloride and filtered. Масло промывают теплой водой для полного удаления мыла. The oil was washed with warm water to remove any soap. 4. 4. Дезодорирование - для удаления летучих веществ через масло пропускают пар. Deodorisation - to remove volatile substances pass through the oil vapor. 5. 5. Отбеливание масла применяется редко. Bleaching oil is seldom applied. Медицинские жирные масла не отбеливают. Medical fatty oils are not bleached. |

**Separation.** Before further analysis, it is frequently desirable at this stage to separate the lipids into neutral and polar fractions and to remove steroids and other contaminants. This can be done by column chromatography on silicic acid in ethereal solution. The neutral lipids will pass through, leaving the phospho- and glycolipids adsorbed; these can then be recov­ered by eluting the column with chloroform-methanol mixtures. A simi­lar result can be obtained by preparative TLC on silica gel with chlroform as solvent; triglycerides move about halfway up the plate, leaving the other lipids at the origin.

Acid or alkaline saponification of lipid yields fatty acids and glycerol and also, in the case of polar lipids, sugars or amines and phosphate. Acid hydrolysis is carried out. After dilution with water, the fatty acids, and bases (if present) are ex­tracted into chloroform.

**Detection.** Identification of lipids mainly requires the determination of their fatty acid components. Although numerous fatty acids are now known in plants, most lipids have the same few fatty acid residues, which makes their identification that much easier.

A non-specific, destructive but very sensitive spray for lipids is 25% H2S04, followed by heating the plate at 230°C. Sterols give red-purple, glycolipids red-brown, sulpholipids bright red and other lipids pale brown colours.

**The identity and quality tests** of fixed oils comprise solubility, relative density, refractive index, optical rotation, iodine value, acid value, hydroxyl value, peroxide value, unsaponifiable matter.

**Chromatographical analysis of lipids.**The two main chromatographic techniques used are TLC for sepa­ration and purification of the lipids and GLC for identifying the fatty acids produced on saponification. The total lipids of plant tissues can be analysed by two-dimensional TLC. The fatty acids obtained after acid hydrolysis are converted to the methyl esters with ethereal diazomethane and then analysed by GLC. Alterna­tively, the fatty acid methyl esters can be obtained directly by transmethylation of the parent lipids by refluxing them for 90 min. The peaks obtained are compared in retention times with standard fatty acid methyl esters.

The rapid development and the broad application of high-performance liquid chromatography (HPLC) in lipid analysis stopped the further development of TLC and in many lipid laboratories TLC was practically swept being considered too laborious and time consuming, and requiring certain experimental skills and attention. Although HPLC has been applied to many lipid separations, there is still the major difficulty of finding a suitable detection system for a class of compound essentially lacking UV absorbance. In the case of the fatty acids, this can be overcome by derivatizing them and separating them as their phenacyl or *p* - bromophenacyl esters. In the case of the bound lipids, it is possible to measure their end absorption at about 195 nm or use a refractive index detector.

**Quantitative determination**. Numerous methods have been described for the quantitative measurement of fatty acids in biological materials. Fatty acid concentrations equal or higher than 1 mM may be easily determined by titrimetry even in the presence of other lipids. Titrimetry was classically used to determine the acid value (free fatty content) of vegetable oils and fats. The quantitative analysis of fatty acids can also be carried out routinely by straightforward GLC.

Nondestructive methods for quantification of lipid groups have been developed as well. Among these, fluorometric quantification is the most often used, e.g., the measurement of the fluorescence of an appropriate dye (usually Rhodamine 6G or 1-anilino-8-naphthalene sulphonate) in the presence of lipids. In other cases, the preferred approach was to separate the lipid groups by TLC so as to elute the substances from the adsorbent and determine gravimetrically the respective content).

**Iodine Value:** A measure of the degree of unsaturation of the oil (grams of absorbed iodine, by 100 g of the oil). Iodine value is one of the important distinguishing characters.

The**acid value *I*A** is the number that expresses, in milligrams the quantity of potassium hydroxide required to neutralise the free acids present in 1 g of the substance.

The **saponification value** IS is the number that expresses in milligrams the quantity of potassium hydroxide required to neutralise the free acids and to saponify the esters present in 1 g of the substance.

The **peroxide value *I*P** is the number that expresses in milliequivalents of active oxygen the quantity of peroxide contained in 1000 g of the substance.

**Numerical data of several fixed oils (according to the State Pharmacopoeia, VIII - XI ed.)**

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| Fatty oil | Specific   gravity | Solidificatin temperature | Refractive index | Iodine value | Saponifi-cation value |
| *1.Oleum Helianthi* | 0,92-0,93 | -16oC    -     -19oC | 1,4736-1,4762 | 119-144 | 185-198 |
| *2. Oleum Ricini* | 0,95-0,97 | -10oC -        -18oC | 1,4770-1,4780 | 82-90 | 176-191 |
| *3.Oleum Amygdalarum* | 0,915-0,920 | -10oC -         -20oC | 1,4702-1,4715 | 93-102 | 188-195 |
| *4.Oleum Persicaria* | 0,916-0,922 | -20oC -         -23oC | 1,4710-1,4723 | 96-103 | 187-195 |
| *5. Oleum Olivae* | 0,910-0,920 | 0oC - -5oC | 1,4670-1,4710 | 75-88 | 186-196 |
| *6. Oleum Arachidis* | 0,911-0,925 | 0oC - -3oC | 1,4680-1,4720 | 83-103 | 189-206 |
| *7. Oleum Lini* | 0,932-0,942 | -18oC -         -30oC | 1,4840-1,4870 | 157-205 | 183-195 |
| *8.Oleum Jecoris* | 0,932-0,934 | - | 1,4769-1,4835 | 150-175 | 175-196 |

**The main biological functions of lipids** include energy storage, as structural components of [cell membranes](http://en.wikipedia.org/wiki/Cell_membrane), and as important [signaling molecules](http://en.wikipedia.org/wiki/Lipid_signaling). Fats play a vital role in maintaining healthy [skin](http://en.wikipedia.org/wiki/Skin) and [hair](http://en.wikipedia.org/wiki/Hair), insulating body organs against shock, maintaining body temperature, and promoting healthy cell function.

As a food ingredient or additive, phytosterols have cholesterol-lowering properties (reducing cholesterol absorption in intestines). In the pharmaceutical industry fats are used as the bases for ointments, emulsions, as solvents for fat soluble drugs.

**Membranes**

Eukaryotic cells are compartmentalized into membrane-bound [organelles](http://en.wikipedia.org/wiki/Organelles)which carry out different biological functions. The [glycerophospholipids](http://en.wikipedia.org/wiki/Glycerophospholipids) are the main structural component of [biological membranes](http://en.wikipedia.org/wiki/Biological_membranes), such as the cellular [plasma membrane](http://en.wikipedia.org/wiki/Plasma_membrane) and the intracellular membranes of [organelles](http://en.wikipedia.org/wiki/Organelles); in animal cells the plasma membrane physically separates the [intracellular](http://en.wikipedia.org/wiki/Intracellular) components from the [extracellular](http://en.wikipedia.org/wiki/Extracellular) environment. While glycerophospholipids are the major component of biological membranes, other non-glyceride lipid components such as [sphingomyelin](http://en.wikipedia.org/wiki/Sphingomyelin) and [sterols](http://en.wikipedia.org/wiki/Sterol) (mainly [cholesterol](http://en.wikipedia.org/wiki/Cholesterol) in animal cell membranes) are also found in biological membranes.

A biological membrane is a form of lipid bilayer. The formation of lipid bilayers is an energetically-preferred process when the [glycerophospholipids](http://en.wikipedia.org/wiki/Glycerophospholipids) are in an aqueous environment.In an aqueous system, the polar heads of lipids align towards the polar, aqueous environment, while the hydrophobic tails minimize their contact with water and tend to cluster together, forming a [vesicle](http://en.wikipedia.org/wiki/Vesicle_%28biology%29); depending on the [concentration](http://en.wikipedia.org/wiki/Critical_micelle_concentration) of the lipid, this biophysical interaction may result in the formation of [micelles](http://en.wikipedia.org/wiki/Micelle), [liposomes](http://en.wikipedia.org/wiki/Liposomes), or [lipid bilayers](http://en.wikipedia.org/wiki/Lipid_bilayer).

**Energy storage**

Triacylglycerols, stored in adipose tissue, are a major form of energy storage in animals. The adipocyte, or fat cell, is designed for continuous synthesis and breakdown of triacylglycerols, with breakdown controlled mainly by the activation of hormone-sensitive enzyme [lipase](http://en.wikipedia.org/wiki/Lipase).The complete oxidation of fatty acids provides high caloric content, about 9 [kcal/g](http://en.wikipedia.org/wiki/Calorie#Kilogram_and_gram_calories), compared with 4 kcal/g for the breakdown of [carbohydrates](http://en.wikipedia.org/wiki/Carbohydrate) and [proteins](http://en.wikipedia.org/wiki/Protein).

**Signaling**

Lipid signaling may occur via activation of [G protein-coupled](http://en.wikipedia.org/wiki/G_protein-coupled_receptor) or [nuclear receptors](http://en.wikipedia.org/wiki/Nuclear_receptor), and members of several different lipid categories have been identified as signaling molecules and [cellular messengers](http://en.wikipedia.org/wiki/Second_messenger_system). These include [sphingosine-1-phosphate](http://en.wikipedia.org/wiki/Sphingosine-1-phosphate), [diacylglycerol](http://en.wikipedia.org/wiki/Diacylglycerol) (DAG) and the [phosphatidylinositol](http://en.wikipedia.org/wiki/Phosphatidylinositol) phosphates (PIPs); the [prostaglandins](http://en.wikipedia.org/wiki/Prostaglandins), which are one type of fatty-acid derived eicosanoid involved in [inflammation](http://en.wikipedia.org/wiki/Inflammation) and [immunity](http://en.wikipedia.org/wiki/Immunity_%28medical%29); the steroid hormones such as [estrogen](http://en.wikipedia.org/wiki/Estrogen), [testosterone](http://en.wikipedia.org/wiki/Testosterone)and [cortisol](http://en.wikipedia.org/wiki/Cortisol), which modulate a host of functions such as reproduction, metabolism and blood pressure.

**Other functions**

The "fat-soluble" vitamins ([A](http://en.wikipedia.org/wiki/Retinol), [D](http://en.wikipedia.org/wiki/Calciferol), [E](http://en.wikipedia.org/wiki/Tocopherol) and [K](http://en.wikipedia.org/wiki/Phylloquinone)) – which are isoprene-based lipids – are essential nutrients stored in the liver and fatty tissues, with a diverse range of functions. Polyprenols and their phosphorylated derivatives also play important transport roles, in this case the transport of [oligosaccharides](http://en.wikipedia.org/wiki/Oligosaccharide) across membranes.

 Most of the lipid found in food is in the form of triacylglycerols, cholesterol and phospholipids. A minimum amount of dietary fat is necessary to facilitate absorption of fat-soluble vitamins ([A](http://en.wikipedia.org/wiki/Retinol), [D](http://en.wikipedia.org/wiki/Calciferol), [E](http://en.wikipedia.org/wiki/Tocopherol) and [K](http://en.wikipedia.org/wiki/Phylloquinone)) and [carotenoids](http://en.wikipedia.org/wiki/Carotenoids).

Humans and other mammals have a dietary requirement for certain essential fatty acids, such as [linoleic acid](http://en.wikipedia.org/wiki/Linoleic_acid) (an [omega-6 fatty acid](http://en.wikipedia.org/wiki/Omega-6_fatty_acid)) and [alpha-linolenic acid](http://en.wikipedia.org/wiki/Alpha-linolenic_acid)(an omega-3 fatty acid) because they cannot be synthesized from simple precursors in the diet. Both of these fatty acids are 18-carbon [polyunsaturated fatty acids](http://en.wikipedia.org/wiki/Polyunsaturated_fat)differing in the number and position of the double bonds. Most [vegetable oils](http://en.wikipedia.org/wiki/Vegetable_fats_and_oils) are rich in linoleic acid ([safflower](http://en.wikipedia.org/wiki/Safflower), [sunflower](http://en.wikipedia.org/wiki/Sunflower_oil), and [corn oils](http://en.wikipedia.org/wiki/Corn_oil)). Alpha-linolenic acid is found in the green leaves of plants, and in selected seeds, nuts and legumes (particularly [flax](http://en.wikipedia.org/wiki/Linseed_oil), [rapeseed](http://en.wikipedia.org/wiki/Rapeseed), [walnut](http://en.wikipedia.org/wiki/Walnut) and [soy](http://en.wikipedia.org/wiki/Soy)).

[Fish oils](http://en.wikipedia.org/wiki/Fish_oil) are particularly rich in the longer-chain omega-3 fatty acids [eicosapentaenoic acid](http://en.wikipedia.org/wiki/Eicosapentaenoic_acid) (EPA) and [docosahexaenoic acid](http://en.wikipedia.org/wiki/Docosahexaenoic_acid) (DHA). A large number of studies have shown positive health benefits associated with consumption of omega-3 fatty acids on infant development, cancer, cardiovascular diseases, and various mental illnesses, such as depression, attention-deficit hyperactivity disorder, and dementia. In contrast, it is now well-established that consumption of [trans fats](http://en.wikipedia.org/wiki/Trans_fat), such as those present in [partially hydrogenated vegetable oils](http://en.wikipedia.org/wiki/Partially_hydrogenated_vegetable_oil#In_the_food_industry), are a risk factor for [cardiovascular disease](http://en.wikipedia.org/wiki/Cardiovascular_disease).

**Importance of fats for living organisms**

[Vitamins](http://en.wikipedia.org/wiki/Vitamin) [A](http://en.wikipedia.org/wiki/Vitamin_A), [D](http://en.wikipedia.org/wiki/Vitamin_D), [E](http://en.wikipedia.org/wiki/Vitamin_E), and [K](http://en.wikipedia.org/wiki/Vitamin_K) are fat-soluble, meaning they can only be digested, absorbed, and transported in conjunction with fats. Fats are also sources of [essential fatty acids](http://en.wikipedia.org/wiki/Essential_fatty_acid), an important dietary requirement.

Fats play a vital role in maintaining healthy [skin](http://en.wikipedia.org/wiki/Skin) and [hair](http://en.wikipedia.org/wiki/Hair), insulating body organs against shock, maintaining body temperature, and promoting healthy cell function.

Fats also serve as energy stores for the body, containing about 37.8 [kilo](http://en.wikipedia.org/wiki/Kilo-)[joules](http://en.wikipedia.org/wiki/Joule) (9 [calories](http://en.wikipedia.org/wiki/Calorie)) per [gram](http://en.wikipedia.org/wiki/Gram) of fat. They are broken down in the body to release [glycerol](http://en.wikipedia.org/wiki/Glycerin) and free [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid). The glycerol can be converted to [glucose](http://en.wikipedia.org/wiki/Glucose) by the liver and thus used as a source of energy.

Fat also serves as a useful buffer towards a host of diseases. When a particular substance, whether chemical or biotic—reaches unsafe levels in the bloodstream, the body can effectively dilute—or at least maintain equilibrium of—the offending substances by storing it in new fat tissue. This helps to protect vital organs, until such time as the offending substances can be metabolized and/or removed from the body by such means as [excretion](http://en.wikipedia.org/wiki/Excretion), [urination](http://en.wikipedia.org/wiki/Urination), accidental or intentional [bloodletting](http://en.wikipedia.org/wiki/Bloodletting), [sebum](http://en.wikipedia.org/wiki/Sebum) excretion, and [hair](http://en.wikipedia.org/wiki/Hair) growth.

While it is nearly impossible to remove fat completely from the diet, it would be unhealthy to do so. Some fatty acids are essential nutrients, meaning that they can't be produced in the body from other compounds and need to be consumed in small amounts. All other fats required by the body are non-essential and can be produced in the body from other compounds.

**Negative health effects.** A high consumption of [omega-6](http://en.wikipedia.org/wiki/Omega-6) [polyunsaturated fatty acids](http://en.wikipedia.org/wiki/Polyunsaturated_fatty_acids) (PUFAs), which are found in most types of vegetable oil (e.g. [soybean oil](http://en.wikipedia.org/wiki/Soybean_oil), [corn oil](http://en.wikipedia.org/wiki/Corn_oil) - the most consumed in USA, [sunflower oil](http://en.wikipedia.org/wiki/Sunflower_oil), etc.), may increase the likelihood that postmenopausal women will develop [breast cancer](http://en.wikipedia.org/wiki/Breast_cancer). A similar effect was observed on [prostate cancer](http://en.wikipedia.org/wiki/Prostate_cancer) in [mice](http://en.wikipedia.org/wiki/Mouse). Plant based oils high in [monounsaturated fatty acids](http://en.wikipedia.org/wiki/Monounsaturated_fatty_acids), such Olive oil, peanut oil, and canola oil are relatively low in omega-6 PUFAs and can be used in place of high-polyunsaturated oils. However, palm oil and coconut oil, even as unhydrogenated "natural" oils, are high in saturated fatty acids (lauric and myristic acid) that have demonstrated negative effects upon plasma cholesterol and cardiovascular risk factors. In fact, they are commonly used in animal studies to induce atherosclerosis to investigate the possible causes of the disease. **In clinical practice using** almond oil - Oleum Amygdalarum, derived from the seeds of the two forms of the ordinary almond Amygdalus communis L.: f. dulcis DC. и f. amara DC., сем. and f. amara DC., Sem. Розоцветные - Rosaceae. Rosaceae - Rosaceae. Миндальное масло применяют как легкое слабительное. Almond oil is used as a laxative. Масло персиковое - Oleum Persicorum получают из семян персика обыкновенного Persica vulgaris Mill. Peach Butter - Oleum Persicorum derived from the seeds of peach ordinary Persica vulgaris Mill. и абрикоса обыкновенного Armeniaca vulgaris Lam., сем. and apricot Armeniaca vulgaris Lam., Sem. Розоцветные - Rosaceae. Rosaceae - Rosaceae. Персиковое масло применяют для приготовления раствора камфоры для инъекций, препарата «Пинабин», оно входит также в состав других комплексных препаратов. Peach oil is used for solution of camphor injection, the drug "Pinabin, it is also part of other integrated products. Масло оливковое - Oleum Olivarum получают из плодов маслины европейской (оливы европейской) Olea europaea L., сем.

Olive oil - Oleum Olivarum prepared from olive fruits of the European (European olive) Olea europaea L., Sem. Маслиновые - Oleaceae. Olive - Oleaceae. Оливковое масло применяется для приготовления раствора камфоры для инъекций, а также в составе комплексных препаратов «Цистенал», «Олиметин». Olive oil is used for solution for injection of camphor, as well as in the complex preparations "Cistenal", "Olimetin. Масло касторовое - Oleum Ricini получают из семян клещевины обыкновенной Ricinus communis L., сем.

Castor oil - Oleum Ricini derived from castor bean seeds of Ricinus communis L., Sem. Молочайные - Euphorbiaceae. Euphorbiaceae - Euphorbiaceae. Касторовое масло применяют как слабительное, для стимуляции родовой деятельности, при ожогах, обморожениях, язвах, трещинах, в составе мазей, линиментов и бальзамов. Castor oil is used as a laxative for the induction of labor, with burns, frostbite, ulcers, fissures, in the ointments, liniments and balms. Масло подсолнечное - Oleum Helianthi получают из семянок подсолнечника однолетнего Helianthus annuus L., сем.

Sunflower oil - Oleum Helianthi receive one year of achenes of sunflower Helianthus annuus L., Sem. Сложноцветные - Asteraceae. Asteraceae - Asteraceae. Оно широко используется при изготовлении масла камфорного для наружного применения, беленного масла, масла облепихового, каротолина и других препаратов. It is widely used in the manufacture of camphor oil for external use, bleached oils, sea buckthorn, karotolina and other drugs. Масло кукурузное - Oleum Maydis получают из зародышей зерновок кукурузы Zea mays L., сем.

Corn oil - Oleum Maydis derived from embryos caryopses of maize Zea mays L., Sem. Злаки - Poaceae. Grasses - Poaceae. В медицине кукурузное масло применяют для профилактики и лечения атеросклероза. In medicine, corn oil is used to prevent and treat atherosclerosis. Масло льняное - Oleum Lini получают из семян льна обыкновенного Linum usitatissimum L., сем.

Linseed oil - Oleum Lini derived from flax seed ordinary Linum usitatissimum L., Sem. Льновые - Linaceae. Flax - Linaceae. Льняное семя содержит до 55% жирного масла, которое отличается от других растительных масле высоким содержанием триацилглицеринов полиненасыщенных жирных кислот (до 73%): линолевой - 15-20%, линоленовой - 35-45%, олеиновой - 8-9%. Flax seed contains up to 55% fatty oil, which differs from other vegetable oils high in polyunsaturated fatty acids, triacylglycerol (up to 73%): linoleic acid - 15-20%, linolenic - 35-45%, oleic acid - 8-9%. Полиненасыщенные жирные кислоты, в частности, линоленовая, в комбинации с линолевой и другими полиеновыми кислотами составляют комплекс «незаменимых жирных кислот» (витамин F), которые влияют на абсорбцию жирорастворимых витаминов A, D, E и К. В зависимости от структуры полиненасыщенных жирных кислот их подразделяют на витамины F 1 (класс линолевой кислоты), витамины F 2 (класс линоленовой кислоты), витамины F 3 (кислоты, содержащие концевые группы С 2 Н 5 или СН 2 =СН-).

Polyunsaturated fatty acids, particularly linolenic acid, in combination with linoleic and other polyunsaturated acids are complex "essential fatty acids (vitamin F), which affect the absorption of fat-soluble vitamins A, D, E and K. Depending on the structure of polyunsaturated fatty acids they are divided into vitamins F 1 (class of linoleic acid), vitamin F 2 (class linolenic acid), vitamin F 3 (acids containing terminal groups of C 2 H 5 or CH 2 = CH-). Линолевая и линоленовая кислоты называются эссенциальными, поскольку организм человека и животных не способен их синтезировать самостоятельно.

Linoleic and linolenic acids are called essential because humans and animals can not synthesize their own. Синдром дефицита незаменимых полиненасыщенных жирных кислот характеризуется задержкой роста животных, заболеваниями кожи, почек и некоторыми повреждениями репродуктивных органов. Deficit of essential polyunsaturated fatty acids is characterized by stunted growth of animals, skin diseases, kidney and some damage reproductive organs. Обнаружено определенное взаимодействие между полиненасыщенными кислотами и витамином В 6 (пиридоксином). Revealed some interaction between the polyunsaturated acids and vitamin B 6 (pyridoxine). Линоленовая кислота модулирует метаболизм простагландинов и уменьшает содержание триглицеридов в крови, а ее высокие дозы понижают содержание холестерина, оказывают антитромботическое и противовоспалительное действие. Linolenic acid modulates the metabolism of prostaglandins and reduces triglycerides in the blood, and its high doses lowers cholesterol, have antithrombotic and antiinflammatory effects. Льняное масло применяется как легкое слабительное при спастическом запоре, наружно при ожогах и для приготовления жидких мазей.

Linseed oil is used as a laxative in the spastic constipation, topically for burns and for making liquid ointment. Смесь этиловых эфиров жирных кислот льняного масла составляет препарат «Линетол». A mixture of ethyl esters of fatty acids of linseed oil is the drug "linetol used as a means of externally - as a wound-healing of burns, radiation injuries. Линетол входит в состав аэрозольных препаратов «Винизоль», «Левовинизоль», «Тегралезоль», «Ливиан», «Лифузоль». Linetol part of the aerosol products "Vinizol", "Levovinizol", "Tegralezol", "Livian", "Lifuzol. В России зарегистрированы следующие зарубежные препараты в состав которых входят полиненасыщенные жирные кислоты льняного масла: «Эссенциале», «Липостабил», «Эссавен гель». Russia has registered the following foreign drugs composed of polyunsaturated fatty acids of linseed oil: "Essentiale", "lipostabil", "Essaven gel. Жирные масла применяются также в пищевой промышленности, мыловарении, для приготовления косметических изделий, для жирования кож, в качестве смазочных материалов, в производстве красок. Fatty oils are also used in food processing, soap making, for the preparation of cosmetic products for skin fatliquoring as lubricants in the manufacture of paints.

There are several different systems of nomenclature in use for fatty acids. The following table describes the most common systems.

[**Trivial names**](http://en.wikipedia.org/wiki/Trivial_name)**(or common names)** are non-systematic historical names, which are the most frequent naming system used in literature. Most common fatty acids have trivial names in addition to their systematic names. These names do not follow any pattern, but are concise and generally unambiguous.

**[Systematic names](http://en.wikipedia.org/wiki/Systematic_name)** (or **IUPAC names**) derive from the standard [IUPAC Rules for the Nomenclature of Organic Chemistry](http://en.wikipedia.org/wiki/IUPAC_nomenclature_of_organic_chemistry), published in 1979, along with a recommendation published specifically for lipids in 1977.Counting begins from the [carboxylic acid](http://en.wikipedia.org/wiki/Carboxylic_acid)end. [Double bonds](http://en.wikipedia.org/wiki/Double_bond) are labelled with [*cis*](http://en.wikipedia.org/wiki/Cis-trans_isomerism)-/[*trans*](http://en.wikipedia.org/wiki/Cis-trans_isomerism)- notation or [*E*](http://en.wikipedia.org/wiki/E-Z_notation)-/[*Z*](http://en.wikipedia.org/wiki/E-Z_notation)- notation, where appropriate. This notation is generally more verbose than common nomenclature, but has the advantage of being more technically clear and descriptive.

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| ***n*−*x*** (***n* minus *x***; also **ω−*x*** or **omega-*x***) **nomenclature**does not provide names for individual compounds, but is a shorthand way to categorize fatty acids by their physiological properties. A double bond is located on the *x*th carbon–carbon bond, counting from the terminal [methyl](http://en.wikipedia.org/wiki/Methyl) carbon (designated as *n*or ω) toward the [carbonyl](http://en.wikipedia.org/wiki/Carbonyl) carbon. For example, [α-Linolenic acid](http://en.wikipedia.org/wiki/Alpha-linolenic_acid) is classified as a [*n*−3](http://en.wikipedia.org/wiki/Omega-3_fatty_acid) or [omega-3](http://en.wikipedia.org/wiki/Omega-3)fatty acid, and so it shares properties with other compounds of this type. The ω−*x* or omega-*x*notation is common in popular literature, but [IUPAC](http://en.wikipedia.org/wiki/IUPAC_nomenclature) has deprecated it in favor of *n*−*x*notation in technical documents. The most commonly researched fatty acid types are [*n*−3](http://en.wikipedia.org/wiki/Omega-3_fatty_acid) and [*n*−6](http://en.wikipedia.org/wiki/Omega-6_fatty_acid), which have unique biological properties. |
| **Lipid numbers** take the form *C*:*D*, where *C* is the number of carbon atoms in the fatty acid and *D* is the number of double bonds in the fatty acid. This notation can be ambiguous, as some different fatty acids can have the same numbers. Consequently, when ambiguity exists this notation is usually paired with either a Δ*x*or *n*−*x* term. |

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| **MPM name** | **Source** | **Constituents** | **Action, use** |
| ***Oleum Amygdalarum*** | *Amygdalus communis*L. *var. dulcis*Borkh ex DC*.,*or*Amygdaluscommunis*L. *var. amara*Ludwig ex DC.,*Rosaceae.* | Bitter almond: Fatty oil (non-dehydrating): chief fatty acids oleic acid and linoleic acid; Cyanogenic glycoside amygdalin; Arabinogalactans; Proteic substances.  Sweet almond: Fatty oil: chief fatty acids oleic acid and linoleic acid.Arabinogalactans. Proteic substances | Sweet Almonds have a demulcent and a mild laxative effect. Sweet Almonds are used topically in skin care and liniments. The volatile almond oils are used as flavouring agents. |
| ***Oleum Persicorum*** | *Persica vulgaris*Mill.or *Armeniacavulgaris*Lam., *Rosaceae* | Peach oil yield triglyceride of oleinic acid and glycerides of linoleic acid. Seeds contain cyanogenetic glycosides, including amygdalin. | Emollient; as a substitute for expressed oil of almond in cold cream and other preparations  whose formulas contain expressed oil of almond.Seeds of *Prunus persica* are used in Chinese medicine due to circulatory stimulant, aperient and antitussive activities. |
| ***Oleum Arachidis*** | *Arachis hypogaea*L., *Fabaceae*. | Fatty oil: chief fatty acids include oleic acid, linolic acid and palmitin acid. Also present in small quantities are longer chained fatty acids such as eicosanoic acid and tetracosanoic acid. | as a vehicle for medication in external, enteral or parenteral preparations; the cosmetics industry uses it in skin, sun and massage oil. It is used as a salad or cooking oil that is said to lower blood cholesterol levels. |
| ***Oleum Ricini*** | *Ricinus communis* L.,*Euphorbiaceae* | Castor oil seeds: Fatty oil; Proteic substances; Lectins; Pyrridine alkaloid ricinine. Triglycerides: chief fatty acid is ricinoleic acid. Tocopherols (vitamin E).  The fixed oil consists of the glycosides of ricinoleic, isoricinoleic, stearic and dihydroxystearic acids. | Stimulant laxative; emollient. Castor-oil seeds are employed mainly for the preparation of castor oil which is extensively used as a purgative and lubricant. |
| ***Oleum Cacao (Butyrum Cacao)*** | *Theobroma cacao* L., *Sterculiaceae* | Cocoa butter: Triglycerides: chief fatty acids oleic acid, stearic acid, palmitic acid. Free fatty acids. Steroids: sterols, including β-sitosterol. Purine alkaloids | in the making of suppositories (suppository basis), as an excipient for certain pills, and as an emollient; as an inactive ingredient in dermatologic preparaiotns. |
| ***Oleum Olivarum*** | *Olea europaea*L.,*Oleaceae* | chief fatty acids are oleic acid, palmitic acid, linoleic acid. Steroids: β-sitosterol, stigmasterol. Tocopherols. | as a lubricant for constipation and dry skin conditions; in the preparation of parenteral drugs, *etc.,* as a salad oil;  has an antisclerotic effect; |
| ***Helianthi annui oleum raffinatum*** | *Helianthus annuus* L., *Asteraceae* | Triglycerides: chief fatty acids are linoleic acid, oleic acid, palmitic acid. Sterols campesterol, cholesterol, β-sitosterol | internally to alleviate constipation (as a lubricant); externally as massage oil, for poorly healing wounds (as an oil dressing) and in the treatment of skin lesions, psoriasis and rheumatism. |
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| ***Cera*(beeswax)** | purified honeycomb of *Apis mellifica*and other bees, *Apidae* | a wax, consisting of about 80% of myricyl palmitate (myricin), with possibly a little myricyl stearate; free cerotic acid, cerolein, hydrocarbons, cholesteryl esters. | yellow wax is used in the preparation of ointments, polishes and plasters |
| ***Adeps lanae (Lanolinum)*** | purified fat – like substance prepared from the wool of the sheep *Ovis aries*, *Bovidae* | cholesterol and isocholesterol (monohydric alcohols) in com­bination with lanoceric, lanopalmitic and other fatty acids. Wool fat also contains aliphatic alcohols such as cetyl, ceryl and carnaubyl alcohols | wool fat is used as an emmolient base for creams and ointments |
| ***Cetaceum*** | waxy substance obtained from the head of the sperm whale*Physeter macrocephalus*, *Physeterides* | cetyl palmitate or cetin and small percentages of other fatty substances | as a base for cerates and ointments. Sperm oil is widely used as a lubricant for machinery, especially sewing machines |

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| Olive Oil - Oleum Olivarum Маслина европейская - Olea europaea L. European olive - Olea europaea L. Семейство маслинные - Oleaceae The family of olives - Oleaceae | |
| Fat composition | |
| [Saturated fats](http://en.wikipedia.org/wiki/Saturated_fats) | [Palmitic acid](http://en.wikipedia.org/wiki/Palmitic_acid): 7.5–20.0% [Stearic acid](http://en.wikipedia.org/wiki/Stearic_acid): 0.5–5.0% [Arachidic acid](http://en.wikipedia.org/wiki/Arachidic_acid): <0.6% [Behenic acid](http://en.wikipedia.org/wiki/Behenic_acid): <0.3% [Myristic acid](http://en.wikipedia.org/wiki/Myristic_acid): <0.05% [Lignoceric acid](http://en.wikipedia.org/wiki/Lignoceric_acid): <0.2% |
| [Unsaturated fats](http://en.wikipedia.org/wiki/Unsaturated_fats) | yes |
| [Monounsaturated fats](http://en.wikipedia.org/wiki/Monounsaturated_fats) | [Oleic acid](http://en.wikipedia.org/wiki/Oleic_acid): 55.0–83.0% [Palmitoleic acid](http://en.wikipedia.org/wiki/Palmitoleic_acid): 0.3–3.5% |
| [Polyunsaturated fats](http://en.wikipedia.org/wiki/Polyunsaturated_fats) | [Linoleic acid](http://en.wikipedia.org/wiki/Linoleic_acid): 3.5–21.0 % [α-Linolenic acid](http://en.wikipedia.org/wiki/Alpha-Linolenic_acid): <1.0% |

**Description.** Evergreen tree height 3.7 m. The leaves are opposite, almost sessile, lanceolate or oblong, 5-8 cm, entire, below silvery-gray hairs on the abundance. Цветки мелкие, беловатые, собраны в 15-30-цветковые кисти, сидящие супротивно в пазухах листьев. Flowers small, whitish, collected in 15-30-flowered brush sitting opposite in the axils of the leaves. Плод - продолговатая или шаровидная костянка длиной до 30 мм, с мясистой, маслянистой мякотью и твердой односеменной косточкой. Fruit - spherical or oblong drupe up to 30 mm, with fleshes. Зрелые костянки в зависимости от сорта могут быть черные, красноватые, фиолетовые или беловатые. Ripe drupes, depending on the variety can be black, reddish, purple or whitish. Косточка продолговатая, немного сжатая, бурая. Stone is an oblong, slightly compressed, brown. Плоды созревают в сентябре-декабре. The fruits ripen in September and December. **Distribution.** The olive tree is native to the Mediterranean basin; wild olives were collected by [Neolithic](http://en.wikipedia.org/wiki/Neolithic) peoples as early as the 8th millennium BC. The wild olive tree originated in Asia Minor in modern [Turkey](http://en.wikipedia.org/wiki/Turkey). [**Quantitative analysis**](http://en.wikipedia.org/wiki/Quantitative_analysis) can determine the oil's [acidity](http://en.wikipedia.org/wiki/Acidity), defined as the percent, measured by weight, of [free](http://en.wikipedia.org/wiki/Fatty_acid#Free_fatty_acids) [oleic acid](http://en.wikipedia.org/wiki/Oleic_acid) it contains. This is a measure of the oil's chemical degradation; as the oil degrades, more fatty acids are freed from the [glycerides](http://en.wikipedia.org/wiki/Glyceride), increasing the level of free acidity and thereby increasing [rancidity](http://en.wikipedia.org/wiki/Rancidification). Another measure of the oil's chemical degradation is the [organic peroxide](http://en.wikipedia.org/wiki/Organic_peroxide) level, which measures the degree to which the oil is oxidized, another cause of rancidity. **Producing.** Olive oil is produced by grinding olives and extracting the oil by mechanical or chemical means. Green olives usually produce more bitter oil, and overripe olives can produce oil that is rancid, so for good extra virgin olive oil care is taken to make sure the olives are perfectly ripened. The remaining paste (pomace) still contains a small quantity of oil that cannot be extracted by further pressing, but only with chemical solvents. This is done in specialised chemical plants, not in the oil mills. The resulting oil is not "virgin" but "pomace oil". The term "first press", sometimes found on bottle labels, is technically meaningless, as there is no "second" press. **Chemical composition.** Olive oil is composed mainly of the mixed triglyceride esters of [oleic acid](http://en.wikipedia.org/wiki/Oleic_acid) and [palmitic acid](http://en.wikipedia.org/wiki/Palmitic_acid) and of other [fatty acids](http://en.wikipedia.org/wiki/Fatty_acid), along with traces of [squalene](http://en.wikipedia.org/wiki/Squalene) (up to 0.7%) and [sterols](http://en.wikipedia.org/wiki/Sterol) (about 0.2% [phytosterol](http://en.wikipedia.org/wiki/Phytosterol) and [tocosterols](http://en.wikipedia.org/w/index.php?title=Tocosterol&action=edit&redlink=1)). The composition varies by cultivar, region, altitude, time of harvest, and extraction process.Olive oil contains a group of related [natural products](http://en.wikipedia.org/wiki/Natural_product) with potent [antioxidant](http://en.wikipedia.org/wiki/Antioxidant) properties that give extra-virgin unprocessed olive oil its [bitter](http://en.wikipedia.org/wiki/Bitter_%28taste%29) and pungent [taste](http://en.wikipedia.org/wiki/Taste) and are [esters](http://en.wikipedia.org/wiki/Ester) of [tyrosol](http://en.wikipedia.org/wiki/Tyrosol) and [hydroxytyrosol](http://en.wikipedia.org/wiki/Hydroxytyrosol), including [oleocanthal](http://en.wikipedia.org/wiki/Oleocanthal) and [oleuropein](http://en.wikipedia.org/wiki/Oleuropein). **Uses.** Olive oil contains a wide variety of valuable antioxidants that are not found in other oils. Hydroxytyrosol is thought to be the main antioxidant compound in olives, and believed to play a significant role in the many health benefits attributed to olive oil. Epidemiological studies suggest that olive oil has a protective effect against certain malignant tumours in the breast, prostate, endometrium and digestive tract. Research has revealed that the “type” rather than the “quantity” of fat seems to have more implications for cancer incidence.

Evidence from epidemiological studies also suggests that a higher proportion of [monounsaturated fats](http://en.wikipedia.org/wiki/Monounsaturated_fat) in the diet is linked with a reduction in the risk of [coronary heart disease](http://en.wikipedia.org/wiki/Coronary_heart_disease). This is significant because olive oil is considerably rich in monounsaturated fats, most notably [oleic acid](http://en.wikipedia.org/wiki/Oleic_acid).

There is a large body of clinical data to show that consumption of olive oil can provide heart health benefits such as favourable effects on [cholesterol](http://en.wikipedia.org/wiki/Cholesterol) regulation and [LDL](http://en.wikipedia.org/wiki/LDL) cholesterol [oxidation](http://en.wikipedia.org/wiki/Oxidation), and that it exerts antiinflamatory, antithrombotic, antihypertensive as well as vasodilatory effects both in animals and in humans. Additionally, Olive oil protects against heart disease as it controls the "bad" levels of LDL cholesterol and raises levels of the "good" cholesterol, HDL. As they are the least processed forms of olive oil, extra virgin or virgin olive oil have more monounsaturated fatty acids than other olive oil. These types also contain more polyphenols, which may have benefits for the heart. **Skin care.** In addition to the internal health benefits of olive oil, topical application is quite popular with fans of natural health remedies. Extra virgin olive oil is the preferred grade for moisturizing the skin, especially when used in the [oil cleansing method](http://en.wikipedia.org/wiki/Oil_cleansing_method) (OCM). OCM is a method of cleansing and moisturizing the face with a mixture of extra virgin olive oil, castor oil (or another suitable carrier oil) and a select blend of essential oils. Olive oil has been known for generations not only for its healing qualities but also as a natural, deep penetration moisturizer, regenerating skin cells and softening the tissue. Olive oil is also used by some to reduce ear wax buildup. Olive oil can be used as an effective [shaving oil](http://en.wikipedia.org/wiki/Shaving_oil) to shave facial and other body hair.

Studies on mice showed that application of olive oil immediately following exposure to [UVB](http://en.wikipedia.org/wiki/UVB) rays has a preventive effect on the formation of tumors and [skin cancer](http://en.wikipedia.org/wiki/Skin_cancer). It is also widely used in cosmetics, soaps and are immensely beneficial in adding smoothness and softness to dry scaly skins especially during winter seasons. **Medicinal use.** Olive oil is unlikely to cause [allergic reactions](http://en.wikipedia.org/wiki/Allergy), and as such is used in preparations for [lipophilic](http://en.wikipedia.org/wiki/Lipophilic) drug ingredients. It does have [demulcent](http://en.wikipedia.org/wiki/Demulcent) properties, and mild [laxative](http://en.wikipedia.org/wiki/Laxative) properties, acting as a stool softener. It is also used at room temperature as an [ear wax](http://en.wikipedia.org/wiki/Ear_wax) softener. Olive oil is also a potent blocker of intestinal contractions, and can be used to treat excessive [Borborygmus](http://en.wikipedia.org/wiki/Borborygmus).[Oleocanthal](http://en.wikipedia.org/wiki/Oleocanthal) from olive oil is a non-selective inhibitor of [cyclooxygenase](http://en.wikipedia.org/wiki/Cyclooxygenase) (COX) similar to classical [NSAIDs](http://en.wikipedia.org/wiki/NSAID) like [ibuprofen](http://en.wikipedia.org/wiki/Ibuprofen). It has been suggested that long-term consumption of small quantities of this compound from olive oil may be responsible in part for the low incidence of [heart disease](http://en.wikipedia.org/wiki/Heart_disease) associated with a [Mediterranean diet](http://en.wikipedia.org/wiki/Mediterranean_diet). **Other.** Another health benefit of olive oil seems to be its property to displace [omega-6 fatty acids](http://en.wikipedia.org/wiki/Omega-6_fatty_acid), while not having any impact on [omega-3 fatty acids](http://en.wikipedia.org/wiki/Omega-3_fatty_acid). This way, olive oil helps to build a more healthy balance between omega-6 fats and omega-3 fats. Unlike saturated fats, olive oil lowers total cholesterol and LDL levels in the blood.[[60]](http://en.wikipedia.org/wiki/Olive_oil#cite_note-BestOliveOil-59) It is also known to lower [blood sugar](http://en.wikipedia.org/wiki/Blood_sugar) levels and blood pressure.[[](http://en.wikipedia.org/wiki/Olive_oil#cite_note-60)Olive oil contains the monounsaturated fatty acid [oleic acid](http://en.wikipedia.org/wiki/Oleic_acid), antioxidants such as vitamin [E](http://en.wikipedia.org/wiki/E) and [carotenoids](http://en.wikipedia.org/wiki/Carotenoids), and [oleuropein](http://en.wikipedia.org/wiki/Oleuropein), a chemical that may help prevent the oxidation of LDL particles. Preliminary research indicates that olive oil could possibly be a chemopreventive agent for [peptic ulcer](http://en.wikipedia.org/wiki/Peptic_ulcer) or [gastric cancer](http://en.wikipedia.org/wiki/Gastric_cancer), but confirmation requires further *in vivo* study.[http://en.wikipedia.org/wiki/Olive\_oil - cite\_note-OliveUlcer-62](http://en.wikipedia.org/wiki/Olive_oil#cite_note-OliveUlcer-62) Olive oil was also found to reduce oxidative damage to DNA and RNA, which may be a factor in preventing cancer. Unsaturated oils, such as olive oil, have a short shelf life and are prone to becoming rancid from [oxidation](http://en.wikipedia.org/wiki/Oxidation), which will produce toxic byproducts and a bitter taste.[[65]](http://en.wikipedia.org/wiki/Olive_oil#cite_note-64) Protection of unsaturated oils from heat and light will delay spoilage.

**Castor oil plant - *Ricinus communis* Castor oil - Oleum Ricini** **Клещевина обыкновенная - Ricinus communis L.** **Castor bean - Ricinus communis L.** **Family:** [**Euphorbiaceae**](http://en.wikipedia.org/wiki/Euphorbiaceae)**.**

**Description.** The castor oil plant can vary greatly in its growth habit and appearance. The variability has been increased by breeders who have selected a range of cultivars for leaf and flower colours, and for oil production. It is a fast-growing, [suckering](http://en.wikipedia.org/wiki/Basal_shoot) [perennial](http://en.wikipedia.org/wiki/Perennial_plant) [shrub](http://en.wikipedia.org/wiki/Shrub) which can reach the size of a small tree (around 12 metres / 39 feet), but it is not [cold hardy](http://en.wikipedia.org/wiki/Hardiness_%28plants%29).

The glossy [leaves](http://en.wikipedia.org/wiki/Leaf) are 15–45 centimetres (5.9–18 in) long, long-stalked, alternate and palmate with 5–12 deep lobes with coarsely toothed segments. In some varieties they start off dark reddish purple or bronze when young, gradually changing to a dark green, sometimes with a reddish tinge, as they mature. The leaves of some other varieties are green practically from the start, whereas in yet others a pigment masks the green colour of all the chlorophyll-bearing parts, leaves, stems and young fruit, so that they remain a dramatic purple-to-reddish-brown throughout the life of the plant. Plants with the dark leaves can be found growing next to those with green leaves, so there probably is only a single gene controlling the production of the pigment in some varieties at least.[[3]](http://en.wikipedia.org/wiki/Castor_oil_plant#cite_note-2) The stems (and the spherical, spiny seed capsules) also vary in pigmentation. The fruit capsules of some varieties are more showy than the flowers. The flowers are borne in terminal [panicle](http://en.wikipedia.org/wiki/Panicle)-like [inflorescences](http://en.wikipedia.org/wiki/Inflorescence) of green or, in some varieties, shades of red [monoecious](http://en.wikipedia.org/wiki/Plant_sexuality#Individual_plant_sexuality) flowers without petals. The male flowers are yellowish-green with prominent creamy [stamens](http://en.wikipedia.org/wiki/Stamen) and are carried in ovoid spikes up to 15 centimetres (5.9 in) long; the female flowers, born at the tips of the spikes, have prominent red [stigmas](http://en.wikipedia.org/wiki/Stigma_%28flower%29).

The fruit is a spiny, greenish (to reddish purple) capsule containing large, oval, shiny, bean-like, highly poisonous seeds with variable brownish mottling. Castor seeds have a warty appendage called the [caruncle](http://en.wikipedia.org/wiki/Caruncle), which is a type of [elaiosome](http://en.wikipedia.org/wiki/Elaiosome). The caruncle promotes the dispersal of the seed by ants (myrmecochory). **Distribution.** Its [seed](http://en.wikipedia.org/wiki/Seed) is the castor bean which, despite its name, is not a true [bean](http://en.wikipedia.org/wiki/Bean). Castor is indigenous to the southeastern [Mediterranean Basin](http://en.wikipedia.org/wiki/Mediterranean_Basin), [Eastern Africa](http://en.wikipedia.org/wiki/Eastern_Africa), and [India](http://en.wikipedia.org/wiki/India), but is widespread throughout tropical regions (and widely grown elsewhere as an ornamental plant).

**Habitat.** Although castor is indigenous to the southeastern [Mediterranean Basin](http://en.wikipedia.org/wiki/Mediterranean_Basin), [Eastern Africa](http://en.wikipedia.org/wiki/Eastern_Africa), and [India](http://en.wikipedia.org/wiki/India), today it is widespread throughout tropical regions.[[2]](http://en.wikipedia.org/wiki/Castor_oil_plant#cite_note-Phillips-1) In areas with a suitable climate, castor establishes itself easily as an apparently "native" plant and can often be found on wasteland.

**Chemical composition.** Castor seed is the source of [castor oil](http://en.wikipedia.org/wiki/Castor_oil), which has a wide variety of uses. The seeds contain between 40% and 60% oil that is rich in [triglycerides](http://en.wikipedia.org/wiki/Triglycerides), mainly [ricinolein](http://en.wikipedia.org/wiki/Ricinolein). The [seed](http://en.wikipedia.org/wiki/Seed#Seed_structure) contains [ricin](http://en.wikipedia.org/wiki/Ricin), a [toxin](http://en.wikipedia.org/wiki/Toxin), which is also present in lower concentrations throughout the plant

Three terpenoids and a tocopherol-related compound have been found in the **aerial parts** of *Ricinus communis*. Compounds named (3E,7Z,11E)-19-hydroxycasba-3,7,11-trien-5-one, 6α-hydroxy-10β-methoxy-7α,8α-epoxy-5-oxocasbane-20, 10-olide, 15α-hydroxylup-20(29)-en-3-one, and (2R,4aR, 8aR)-3,4,4a,8a-tetrahydro-4a-hydroxy-2,6,7,8a-tetramethyl-2-(4,8, 12-trimethyltridecyl)-2H-chromene-5,8-dione were isolated from the MeOH extracts of the of Ricinus communis L. by chromatographic methods. **Ricin** (play [/](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English)[ˈraɪsɨn](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English#Key)[/](http://en.wikipedia.org/wiki/Wikipedia:IPA_for_English)) is a [toxalbumin](http://en.wikipedia.org/wiki/Toxalbumin) that may be [extracted](http://en.wikipedia.org/wiki/Solvent_extraction) from the [castor bean](http://en.wikipedia.org/wiki/Castor_oil_plant) (*Ricinus communis*). Ricin may cause allergic reactions and is toxic, though the severity depends on the route of exposure.  **Ricin A Chain** (RTA) is an N-[glycoside hydrolase](http://en.wikipedia.org/wiki/Glycoside_hydrolase) composed of 267 amino acids.[[13]](http://en.wikipedia.org/wiki/Ricin#cite_note-12) It has three structural domains with approximately 50% of the [polypeptide](http://en.wikipedia.org/wiki/Polypeptide) arranged into [alpha-helices](http://en.wikipedia.org/wiki/Alpha-helix) and [beta-sheets](http://en.wikipedia.org/wiki/Beta-sheet). The three domains form a pronounced cleft that is the active site of RTA.

**Ricin B Chain** (RTB) is a [lectin](http://en.wikipedia.org/wiki/Lectin) composed of 262 amino acids that is able to bind terminal [galactose](http://en.wikipedia.org/wiki/Galactose) residues on cell surfaces.[[15]](http://en.wikipedia.org/wiki/Ricin#cite_note-14) RTB form a bilobal, barbell-like structure lacking [alpha-helices](http://en.wikipedia.org/wiki/Alpha_helix) or [beta-sheets](http://en.wikipedia.org/wiki/Beta_sheet) where individual lobes contain three [subdomains](http://en.wikipedia.org/wiki/Protein_domain). At least one of these three subdomains in each homologous lobe possesses a sugar-binding pocket that gives RTB its functional character. Many plants such as [barley](http://en.wikipedia.org/wiki/Barley) have the A chain but not the B chain. People do not get sick from eating large amounts of such products, as ricin A is of extremely low toxicity as long as the B chain is not present. Ricin is easily [purified](http://en.wikipedia.org/wiki/List_of_purification_methods_in_chemistry) from [castor-oil](http://en.wikipedia.org/wiki/Castor_oil) manufacturing [waste](http://en.wikipedia.org/wiki/Waste). The aqueous phase left over from the oil extraction process is called waste mash. It contains about 5-10% ricin by weight. Separation requires only simple [chromatographic](http://en.wikipedia.org/wiki/Chromatographic) techniques. **Drugs.** Capsules and 1 g, oil in bottles. Линимент бальзамический по Вишневскому. Balsamic liniment for Wisniewski. **Medicinal Uses (other than oil).** Alcoholic extract of the **leaf** was hepatoprotective in rats. Methanolic extracts of the **leaves** of *Ricinus communis* were used Antimicrobial testing against eight pathogenic bacteria in rats and showed antimicrobial properties. The extract was not toxic.

[Pericarp](http://en.wikipedia.org/wiki/Pericarp) of Castor bean showed CNS stimulant effects in mice at low doses. At lower doses, the extract improved memory consolidation. At high doses mice quickly died . A water extract of the **root bark** showed analgesic activity in rats. Antihistamine and anti-inflammatory properties found in ethanolic extract of *Ricinus communis* **root bark**.[http://en.wikipedia.org/wiki/Castor\_oil\_plant - cite\_note-10](http://en.wikipedia.org/wiki/Castor_oil_plant#cite_note-10)Some researchers have speculated about using ricins in the treatment of [cancer](http://en.wikipedia.org/wiki/Cancer), as a so-called "magic bullet" to destroy targeted cells. Because ricin is a protein, it can be genetically linked to a [monoclonal antibody](http://en.wikipedia.org/wiki/Monoclonal_antibody) to target [malignant](http://en.wikipedia.org/wiki/Malignant) cells recognized by the antibody. The major problem with ricin is that its native internalization sequences are distributed throughout the protein. If any of these native internalization sequences are present in a therapeutic, then the drug will be internalized by, and kill, untargeted [epithelial cells](http://en.wikipedia.org/wiki/Epithelial_cell) as well as targeted cancer cells. **Other uses.** Extract of *Ricinus communis*, exhibited [acaricidal](http://en.wikipedia.org/wiki/Acaricide) and [insecticidal](http://en.wikipedia.org/wiki/Insecticidal) activities against the adult of [*Haemaphysalis bispinosa*](http://en.wikipedia.org/w/index.php?title=Haemaphysalis_bispinosa&action=edit&redlink=1) Neumann ([Acarina](http://en.wikipedia.org/wiki/Acarina): [Ixodidae](http://en.wikipedia.org/wiki/Ixodidae)) and [hematophagous](http://en.wikipedia.org/wiki/Hematophagous) fly [*Hippobosca maculata*](http://en.wikipedia.org/w/index.php?title=Hippobosca_maculata&action=edit&redlink=1) Leach ([Diptera](http://en.wikipedia.org/wiki/Diptera): [Hippoboscidae](http://en.wikipedia.org/wiki/Hippoboscidae)).The Bodo tribals of [Bodoland, Assam (India)](http://en.wikipedia.org/wiki/Bodoland) use the leaves of this plant to feed and rear the larvae of [muga](http://en.wikipedia.org/wiki/Assam_silk#Muga_silk) and [endi](http://en.wikipedia.org/wiki/Endi#Eri_silk) silkworms.

The toxin provides the castor oil plant with some degree of natural protection from insect pests, such as aphids. In fact, ricin has been investigated for its potential use as an [insecticide](http://en.wikipedia.org/wiki/Insecticide). The castor oil plant is also the source for [undecylenic acid](http://en.wikipedia.org/wiki/Undecylenic_acid), a natural [fungicide](http://en.wikipedia.org/wiki/Fungicide).

***Theobroma cacao -*** [**Cocoa tree**](http://en.wikipedia.org/w/index.php?title=Cocoa_tree&redirect=no)**Family** [**Sterculiaceae**](http://en.wikipedia.org/wiki/Sterculiaceae) **(alternatively** [**Malvaceae**](http://en.wikipedia.org/wiki/Malvaceae)**) Cocoa butter, also called theobroma oil or theobroma cacao**

**Describtion.** It is a small (4–8 m or 15–26 ft tall) [evergreen](http://en.wikipedia.org/wiki/Evergreen) [tree](http://en.wikipedia.org/wiki/Tree) The [leaves](http://en.wikipedia.org/wiki/Leaf) are alternate, entire, unlobed, 10–40 cm (4–16 in) long and 5–20 cm (2–8 in) broad. Poisonous and inedible, they are filled with a creamy, milky liquid and taste spicy and unpleasant.The [flowers](http://en.wikipedia.org/wiki/Flower) are produced in clusters directly on the [trunk](http://en.wikipedia.org/wiki/Trunk_%28botany%29) and older branches; they are small, 1–2 cm (1/2–1 in) diameter, with pink calyx. While many of the world's flowers are pollinated by [bees](http://en.wikipedia.org/wiki/Bees) ([Hymenoptera](http://en.wikipedia.org/wiki/Hymenoptera)) or [butterflies](http://en.wikipedia.org/wiki/Butterflies)/[moths](http://en.wikipedia.org/wiki/Moths) ([Lepidoptera](http://en.wikipedia.org/wiki/Lepidoptera)), cacao flowers are pollinated by tiny flies, [*Forcipomyia*](http://en.wikipedia.org/wiki/Forcipomyiinae) [midges](http://en.wikipedia.org/wiki/Midges) in the order [Diptera](http://en.wikipedia.org/wiki/Diptera). The [fruit](http://en.wikipedia.org/wiki/Fruit), called a cacao pod, is ovoid, 15–30 cm (6–12 in) long and 8–10 cm (3–4 in) wide, ripening yellow to orange, and weighs about 500 g (1 lb) when ripe. The pod contains 20 to 60 [seeds](http://en.wikipedia.org/wiki/Seed), usually called "beans", embedded in a white pulp. The seeds are the main ingredient of [chocolate](http://en.wikipedia.org/wiki/Chocolate), while the pulp is used in some countries to prepare a refreshing [juice](http://en.wikipedia.org/wiki/Juice).

**Distribution.** Native to the deep [tropical](http://en.wikipedia.org/wiki/Tropical) region of the Americas. Its seeds are used to make [cocoa powder](http://en.wikipedia.org/wiki/Cocoa_powder) and [chocolate](http://en.wikipedia.org/wiki/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](http://en.wikipedia.org/wiki/Mexico) to the [Amazon basin](http://en.wikipedia.org/wiki/Amazon_basin), with domestication taking place both in the Lacandon area of [Mexico](http://en.wikipedia.org/wiki/Mexico) and in lowland [South America](http://en.wikipedia.org/wiki/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](http://en.wikipedia.org/wiki/Central_America) and [Mesoamerica](http://en.wikipedia.org/wiki/Mesoamerica). The tree is today found growing wild in the low foothills of the [Andes](http://en.wikipedia.org/wiki/Andes) at elevations of around 200–400 m (650–1300 ft) in the [Amazon](http://en.wikipedia.org/wiki/Amazon_River) and [Orinoco](http://en.wikipedia.org/wiki/Orinoco) [river](http://en.wikipedia.org/wiki/River) basins. **Habitat.** It requires a humid climate with regular [rainfall](http://en.wikipedia.org/wiki/Rainfall) and good soil. It is an [understory](http://en.wikipedia.org/wiki/Understory) tree, growing best with some overhead shade. **Harvesting.** Cocoa butter, also called theobroma oil or theobroma cacao, is a pale-yellow, pure edible [vegetable fat](http://en.wikipedia.org/wiki/Vegetable_fat) extracted from the [cocoa bean](http://en.wikipedia.org/wiki/Cocoa_bean). 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 (2.2 lb) of [cocoa paste](http://en.wikipedia.org/w/index.php?title=Cocoa_paste&action=edit&redlink=1).

**Physical properties.** The most common form of cocoa butter has a [melting point](http://en.wikipedia.org/wiki/Melting_point) of around 34-38 °[C](http://en.wikipedia.org/wiki/Celsius) (93-100 °[F](http://en.wikipedia.org/wiki/Fahrenheit)), rendering chocolate a solid at [room temperature](http://en.wikipedia.org/wiki/Room_temperature) that readily melts once inside the [mouth](http://en.wikipedia.org/wiki/Mouth). Cocoa butter displays [polymorphism](http://en.wikipedia.org/wiki/Polymorphism_%28materials_science%29), having α, γ, β', and β crystals, with melting points of 17, 23, 26, and 35–37 °C respectively. The production of chocolate typically uses only the β crystal for its high melting point. A uniform crystal structure will result in smooth texture, sheen, and snap. Overheating cocoa butter converts the structure to a less stable form that melts below room temperature. Given time, it will naturally return to the most stable β crystal form. This phenomenon is used to in the polymorphic transformation theory of [chocolate bloom](http://en.wikipedia.org/wiki/Chocolate_bloom). It is based on the fact that bloomed chocolates are always found to contain the most stable polymorph of cocoa butter. According to this theory, bloom occurs through the uncontrolled polymorphic transformation of cocoa butter from a less stable form to the most stable form.

**Chemical composition.** Each seed contains a significant amount of fat (40–50%) as [cocoa butter](http://en.wikipedia.org/wiki/Cocoa_butter). Their most noted active constituent is [theobromine](http://en.wikipedia.org/wiki/Theobromine), a compound similar to [caffeine](http://en.wikipedia.org/wiki/Caffeine). A cocoa extract product that provides cocoa ﬂavanols made with a patented process that contains a high level of phytonutrients. Cocoa butter, unlike cocoa solids, has no more than trace amounts of [caffeine](http://en.wikipedia.org/wiki/Caffeine) and [theobromine](http://en.wikipedia.org/wiki/Theobromine). **Uses.** Cocoa butter is used to make [chocolate](http://en.wikipedia.org/wiki/Chocolate), [biscuits](http://en.wikipedia.org/wiki/Biscuits), [baked goods](http://en.wikipedia.org/wiki/Baked_goods), [pharmaceuticals](http://en.wikipedia.org/wiki/Pharmaceuticals), [ointments](http://en.wikipedia.org/wiki/Ointment), and [toiletries](http://en.wikipedia.org/wiki/Toiletries). Cocoa butter has a mild chocolate [flavor](http://en.wikipedia.org/wiki/Flavor) and [aroma](http://en.wikipedia.org/wiki/Aroma). Cocoa butter is obtained from either whole [cacao beans](http://en.wikipedia.org/wiki/Cacao_bean) or [chocolate liquor](http://en.wikipedia.org/wiki/Chocolate_liquor) (also known as cocoa liquor). Chocolate liquor is pressed to separate the cocoa butter from the [cocoa solids](http://en.wikipedia.org/wiki/Cocoa_solids). The [Broma process](http://en.wikipedia.org/wiki/Broma_process) is used to extract cocoa butter from ground cacao beans. Cocoa butter is usually deodorized to remove its strong and undesirable taste. Cocoa butter historically has served as a major ingredient in the commercial production of both [white chocolate](http://en.wikipedia.org/wiki/White_chocolate) and [milk chocolate](http://en.wikipedia.org/wiki/Milk_chocolate). Recently, however, more and more food manufacturers have begun substituting for costly cocoa butter less expensive vegetable oils and fats. Pharmaceutical companies have made use of cocoa butter's specific physical properties. As a nontoxic solid at room temperature that melts at body temperature, it is considered an ideal base for medicinal suppositories. Cocoa butter is one of the most stable fats known, a quality that coupled with natural [antioxidants](http://en.wikipedia.org/wiki/Antioxidants) that prevent [rancidity](http://en.wikipedia.org/wiki/Rancidification), grants it a storage life of two to five years. The velvety texture, pleasant fragrance and [emollient](http://en.wikipedia.org/wiki/Emollient) properties of cocoa butter have made it a popular ingredient in products for the skin, such as [cosmetics](http://en.wikipedia.org/wiki/Cosmetics), [soaps](http://en.wikipedia.org/wiki/Soap) and [lotions](http://en.wikipedia.org/wiki/Lotion). The moisturizing abilities of cocoa butter are frequently recommended for prevention of [stretch marks](http://en.wikipedia.org/wiki/Stretch_marks) in pregnant women, treatment of chapped skin and lips, and as a daily moisturizer to prevent dry, itchy skin. However, the largest clinical study regarding the effects of cocoa butter on stretch marks in pregnant women found that results were no different from [placebo](http://en.wikipedia.org/wiki/Placebo).[[6]](http://en.wikipedia.org/wiki/Cocoa_butter#cite_note-5)