

# Vegetable oils

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Vegetable oils are the oldest known skin care products. Yet they are important as ever. Find out more about the manifold and interesting features of this substance group in the following.

**V**egetable oils are complex substance compounds with a very specific composition that reflects their origin. Fruits, stones or seeds have their characteristic fatty oils with different cosmetic and physiological effects.

It is obvious that the most important components of oils are lipid substances. Lipids have smoothing effects, complement the lipid content of low-fat skin and reduce the moisture loss. A lot of vegetable oils are essential components of a healthy nutrition and this aspect is also important for the skin care as the fatty acids bonded in the oils have vital regulatory functions in our body. Their metabolic products or also called metabolites comprise among other substances, hormones which control the physiological processes. Since the hormone effects specifically depend on the fatty acid structures and partly are in competition with each other, it is vital to take care of a balanced intake of different fatty acids. Essential fatty acid deficits or the inability of the body to form certain metabolites due to enzyme deficits will not only cause problems of the cardiovascular system but also visible skin conditions like atopic skin, psoriasis and inflammatory processes. The base bodies of the contained lipids are triglycerides i.e. three fatty acids are linked with glycerin. Triglycerides are broken down in the skin or during the digestive process by enzyme or hydrolytic reaction and the fatty acids are released. Besides the three free fatty acids also the moisture-binding glycerin is formed. It is a component of the natural moisturizing factor (NMF) of the skin. Intermediate products here are diglycerides (two fatty acids linked to glycerin) and monoglycerides (one fatty acid linked to glycerin). The presence of monoglycerides and diglycerides is essential for the natural skin homeostasis. They are also formed from the sebum of the sebaceous glands. There are:

**Saturated fatty acids** - characteristic: palmitic acid, stearic acid,

**Monounsaturated fatty acids** - like oleic acid, palmitoleic acid

**Polyunsaturated fatty acids** - like linoleic acid, alpha linolenic acid, gamma linolenic acid.

## The fatty acids

Higher concentrations of about 30 fatty acids can be found in vegetable oils. Traces of many more are also contained in the oils; however their cosmetic characteristics are not yet analyzed down to the last detail. The odd one out in this connection is ricinoleic acid which is the monounsaturated fatty acid of castor oil carrying one hydroxyl group. It is very adhesive and in its natural and hydrogenated form it is a favorite raw material for lipsticks. Capric and caprylic acid from the coconut oil are widely spread in cosmetic products and dermatics. Their triglycerides are well-known with their INCI denomination "capric/caprylic triglycerides". They form well tolerable oily bases. The following acids are worthwhile mentioning.

**Palmitic acid** is a component of the skin barrier and together with ceramides and cholesterol it protects the skin against penetrating substances from the outside. Palmitic acid is saturated which means that its chain of 16 carbon atoms contains the maximal possible number of hydrogen atoms. Palmitic acid cannot turn rancid and is stable against oxidation. Its abbreviation is C16:0. Higher concentrations of palmitic acid can be found in avocado and wheat germ oil.

**Stearic acid** (C18:0) is by 2 carbon atoms longer than palmitic acid and also a component of the stratum corneum although in a far lower concentration. This also applies for the vegetable oils where it is contained in a large number of them however in small percentages only. Triglycerides of even longer saturated fatty acids like eicosanoic acid (C20:0), behenic acid (C22:0) and lignoceric acid (C24:0) have skin protective effects but only small amounts of these acids can be found in vegetable oils.

**Palmitoleic acid** is contained in the fatty acids of avocado and sawtooth thorn oil (about 10 percent per oil) and in macadamia nut oil (20 percent) and that is the reason for the excellent skin care features of these oils. Like palmitic acid it has 16 carbon atoms however it is monounsaturated. Hence the abbreviation C16:1. Monounsaturated means in this case that the maximal possible number of hydrogen

atoms is not completed - there are two hydrogen atoms missing. Palmitoleic acid also belongs to the natural lipids of the skin.

**Oleic acid** is widely spread in vegetable oils. The fatty acid range of olive oil contains about 60 to 70 percent of oleic acid. It is considered to have a booster effect on the penetration of active agents as it partly edges out the saturated acids from the skin barrier and thus fluidizes the barrier. Like palmitoleic acid it is monounsaturated and by 2 carbon atoms longer. Hence the abbreviation C18:1. Oleic acid rich oils better spread on the skin than oils with a high percentage of saturated acids.

**Linoleic acid** with its 18 carbon atoms is diunsaturated (abbreviation C18:2) and belongs to the essential fatty acids. Essential fatty acids are vital for the body and must be part of our nutrition. Linoleic acid also is called omega-6 fatty acid because two hydrogen atoms are missing on position 6 and 7 counted from the molecule end (hence omega which is the last letter of the Greek alphabet) with the first double bonding at their place.

Linoleic acid is an important part of the ceramide I of the skin barrier. Without linoleic acid the skin becomes scaly and dry. It is an effective active agent against cornification disorders above all around the sebaceous gland exits. That is why it can be used against acne. Under the influence of 15-lipoxygenase (natural enzyme of the body) a metabolite is formed which has anti-inflammatory effects in the skin. Due to the fact that the acid metabolizes rather fast there is no such effect if taken orally. Via intermediate gamma linolenic acid (see below) and some other intermediate steps the tetraunsaturated eicosatetraenoic acid with its hormone reaction products prostacyclin, prostaglandins, thromboxanes, leucotriens etc. is formed in this process. The distribution of these substances also is vital for the skin. Safflower oil with its 80 percent has the highest content of linoleic acid of all the vegetable oils known.

**Gamma linolenic acid** has excellent anti-inflammatory effects since it is transformed by 15-lipoxygenase into an effective metabolite just like linoleic acid. It is used as evening primrose oil for the care of the neurodermitic skin. Gamma linolenic acid is triple unsaturated (C18:3) and belongs to the essential omega-6 fatty acids like linoleic acid.

**Alpha linolenic acid** also is an essential triple unsaturated C18:3-acid and as a precursor of the eicosapentaenoic acid which is found in fish oils, it belongs to the omega-3 fatty acids which means that the first double bonding starts at the third carbon atom (counted from the end). Like omega-6 fatty acids it forms a metabolite which has excellent inhibitory ef-

fects against inflammations in case of burns and erythema. Linseed oil has the highest content of alpha linolenic acid i.e. more than 50 percent of its fatty acids, rose hip oil about 25 to 30 percent. Vegetable oils with polyunsaturated fatty acids are very sensitive against atmospheric oxygen and rarely used.

### Further components of vegetable oils

Like other natural substances the disadvantage of vegetable oils is their varying composition. The fatty acid contents may differ from their average values depending on the harvest year, origin and extraction process. There are different ways of extraction like extractions with solvents, cold press extraction and refinery processes. Very interesting are further components of vegetable oils.

**Carotene** is a precursor of vitamin A. It frequently is the reason for the golden color of the oils. Very vividly colored is carrot oil which very often is a carrot extract based on soybean oil. Like vitamin A carotene containing oils are used for skin recovery purposes. Higher concentrations of carotene are mostly avoided.

**Flavonoids** are polyphenols with antioxidative effects. In this context above all the oligoproanthocyanidines or abbreviated OPC should be mentioned. Their most prominent representative is procyanidine. Their contents in oils as for example in grape seed oil are rather low in contrast to aqueous alcoholic grape seed extracts.

**Isoflavonoids** are also called phytohormones due to their light estrogen effects. Like flavonoids they are contained in many of the plant seeds like linseed e.g. but only traces of them pass over into the oils.

**Phytosterols** have a structure which resembles the natural cholesterol of the skin. They are main components of the so called nonsaponifiable parts of vegetable oils and have an excellent skin protective effect. Oils with high contents of phytosterols like avocado oil, safflower oil and wheat germ oil hence have exceptional long term caring effects.

**Squalene** which is a component of olive and also avocado oil is a pure unsaturated hydrocarbon which also occurs in the sebum.

**Vitamins:** The major role in this context plays vitamin E which is a natural antioxidant in almost every type of oil however contained in different quantities. Rarely found are B vitamins and vitamin K, and exceptionally scarce is vitamin D which is only included in avocado oil.

### Characteristic features of some other oils

In the following some interesting features of

other oils are listed which have not yet been mentioned:

- Amaranth oil contains two natural substances of the skin in high concentrations: squalene (about 8 %) and palmitic acid (about 17 %), oleic and linoleic acid range between 25 and 35 %.
- Apricot stone oil consists of about 6 % of palmitic acid, besides about 65 % of oleic acid and 20 % of linoleic acid (see almond oil).
- Argan oil contains about 12 % of palmitic acid, about 45 % of oleic acid and about 30 % of linoleic acid.
- Borage oil contains about 20 % of gamma linolenic acid, it became however less important than evening primrose oil (see above).
- Currant seed oil (black currants) is worth mentioning insofar as it contains the same percentage of alpha and also gamma linolenic acids (between 13 and 15 %).
- Jojoba oil belongs to the waxes and cannot be compared with triglyceride containing vegetable oils. The base material is wax ester.
- Almond oil: about 6 % of palmitic acid besides about 65 % of oleic acid and 20 % of linoleic acid.
- Rapeseed oil: about 9 % of alpha linolenic acid.
- Sesame oil: about 10 % of palmitic acid, 40 % of oleic acid and 40 % of linoleic acid.
- Soybean oil is rich in phytosterols and besides linoleic acid it also contains a considerable amount of alpha linolenic acid.
- Sunflower oil contains high amounts of linoleic acid (about 60 %), oleic acid (about 20 %), stearic acid (5 %) and behenic acid (<1 %). New varieties contain more than 80 % of oleic acid.

The percentages mentioned generally refer to the ratio of the different acids with regard to the total fatty acid content.

Vegetable oils are processed in manifold ways and used as such or in compounds in facial, body and massage oils. The major part will be applied in form of aqueous emulsions (creams). Relatively new are fluid nanoparticles with a body of membrane active phosphatidylcholine (PC). The advantage of these formulations is their watery texture which allows applying them like lotions.

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