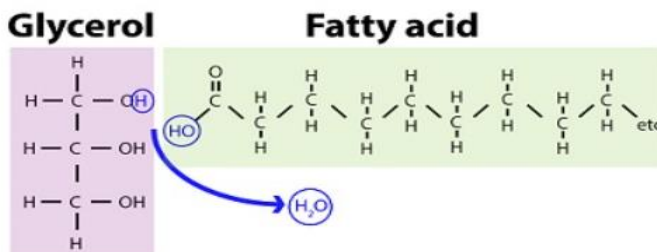


(Lipids: fixed oils and waxes)

- **Definition:**

Lipids (fixed oils, fats, and waxes) are esters of long-chain fatty acids and alcohols, or of closely related derivatives.

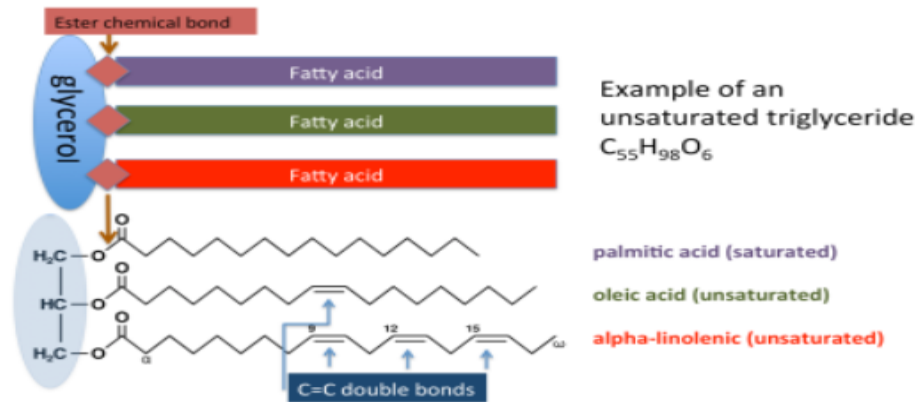
- A **fatty acid** is a long-chain carboxylic acid that has the general formula RCOOH , where R is a hydrocarbon that has a length of 16-20 carbon atoms. A fatty acid may be saturated (only contains C-C single bonds) or unsaturated (contains C-C single and C=C double bonds).
- If alcohol type is **glycerol**, then the lipid is either **fixed oil or fat**, three fatty acids, usually each of different type, may combine with glycerol (a molecule that has three -OH alcohol functional groups) to form triglyceride. While if alcohol has a higher molecular weight, e.g., **cetyl alcohol**, then **the lipid is wax**.



(Figure- 1: General chemical formula of fixed oils and fats)

- Fixed oils and fats differ only as to **melting point**; those that are liquid at normal temperatures are known as **fatty or fixed oils**, whereas those that are semisolid or solid at ordinary temperatures are known as **fats**.
- Although most vegetable oils are liquid at ordinary temperatures and most animal fats are solid, there are notable exceptions, such as **cocoa butter**, which is a solid vegetable oil, and **cod liver oil**, which is a liquid animal fat.
- **Classification of fixed oils:**
The classification is based on the ability of fixed oils to absorb oxygen from the air, where Oxygen saturates the double bonds to form oxides that may polymerize to form hard films, a property of great importance in the paint industry. Three classes of fixed oils are found accordingly:
 - 1- Drying oils.
 - 2- Semidrying oils.
 - 3- Nondrying oils.

Fixed oils may be **hydrogenated** by passing hydrogen, in the presence of nickel or palladium, through the oil heated to 160 to 200°C. The unsaturated glycerides are more or less converted to saturated glycerides, which are solid at room temperature and stable. Many *such oils* are used for culinary (cooking) purposes.



(Figure- 2: A triglyceride molecule that contains a glycerol as alcohol part esterified with three fatty acids: palmitic, oleic, and alpha- linolenic acids)

- **Uses of fixed oils and fats:**

- 1- Fixed oils and fats are employed in pharmaceuticals for their emollient properties.
- 2- They may also serve, either in their natural form or in emulsions, as vehicles for other medicaments.
- 3- A few, such as castor oil, have special therapeutic properties.
- 4- The prostaglandins are other lipid metabolites that have recently attracted considerable attention for their physiologic properties and therapeutic potential.
- 5- In the arts and in industry, fats and oils are used in the manufacture of soaps (sodium and potassium salts of the fatty acids), as drying oils in the manufacture of paints and varnishes, and as lubricants.
- 6- Lipids also form an important class of foods; their high caloric value and low osmotic pressure have prompted interest in some plant oils as parenteral nutrients in hyperalimentation regimens (Intralipid ®).

(Fixed oils)

1) Castor Oil

Castor bean or castor oil seed is the ripe seed of *Ricinus cominunis* Linn (F. Euphorbiaceac).

Constituents: Castor seeds contain from 45 to 55% of fixed oil; about 20% of protein substances consisting of globulin, albumin, nucleoalbumin, glycoprotein and ricin (a toxic lectin or hemagglutin); an alkaloid, ricinine; and several *enzymes*.

Uses:

- A stimulant cathartic; and a plasticizer in flexible collodion.
- Commercially, castor oil is employed in the manufacture of soaps and as a lubricant for internal combustion engines.
- Hydrogenated castor oil is used as a stiffening agent in some pharmaceutical formulations.

2) Olive Oil:

Olive oil is the fixed oil obtained from the ripe fruit of *Olea europaea* Linné (F. Oleaceae).

Constituents: Two major types of olive oil are recognized based on the relative concentrations of the component acids of the glycerides.

- 1- **The Turkish variety** Contains about 75% of oleic acid, 10% of palmitic acid, and 9% of linoleic acid, with lesser amounts of stearic, myristic, hexadecenoic, and arachidic acids.
- 2- **The Italian variety** contains only about 65% of oleic acid, 15% each of palmitic and linoleic acids, and other minor component acids.

Uses.

- Olive oil is classed as a pharmaceutic aid in soaps and dental preparations.
- It is also a demulcent, an emollient, and a laxative.
- Olive oil is a nutrient and is widely used as a salad oil.

3) Peanut oil:

Peanut is the ripe fruit or seed of *Arachis hypogaea* Linné (F. Leguminosae).

Constituents: The kernels contain about 45% of fixed oil, 20% of protein, and a high content of thiamine; hence, they are highly nutritious and are extensively used as food, both whole and when ground into a paste (peanut butter).

Uses. Peanut oil is a solvent for intramuscular injections.

4) Soybean Oil:

Soybean is the ripe seed of *Glycine soja* Siebold et Zaccarini (F. Leguminosae), Soybean oil is the refined, fixed oil obtained from the seeds of the soya plant.

Constituents: It consists of a mixture of glycerides with the following component acids: linoleic (50%); oleic (30%); linolenic (7%); saturated acids, chiefly palmitic and stearic (14%).

Uses: Soybean oil is an ingredient in parenteral nutrients (Intralipid®, Soyacal®, and Travamulsion ®) and is a source of lecithin.

5) Cottonseed Oil

Cottonseed oil is the refined, fixed oil obtained from the seed of cultivated plants of various varieties of *Gossypium hirsutum* Linné (F. Malvaceae).

Constituents: The oil consists of a mixture of glycerides with the following component acids: linoleic (45%), oleic (30c/o), palmitic (20%), myristic (3%), stearic and arachidic (1% of each).

Uses. Cottonseed oil is employed pharmaceutically as a solvent for a number of injections. A large amount is also used in the manufacture of soap.

6) Sesame Oil

Sesamum seed or sesame seed is the seed of one or more cultivated varieties of *Sesamum indicum* Linné (F. Pedaliaceae).

Constituents: Sesame oil consists of a mixture of glycerides with the following component acids approximately equal parts of oleic and linoleic (about 43% of each), palmitic (9%), and stearic (4%).

Uses.

- solvent for intramuscular injections.
- It has nutritive, laxative, demulcent, and emollient properties.
- Sesamol, contained in pyrethrum insecticides.

7) Almond Oil:

Sweet almond and bitter almond consist of the ripe seeds of different varieties of *Prunus amygdalus* (F. Rosaceae).

Constituents: Almond oil consists of a mixture of glycerides with component acids of the following approximate composition: oleic (77%), linoleic (17%), palmitic (5%), myristic (1%).

Uses. Expressed almond oil is an emollient and an ingredient in cosmetics.

8) Coconut Oil

Coconut oil is the fixed oil obtained by expression or extraction from the seed kernels of the coconut palm, *Cocos nucifera* Linné (F. Palmae)

Constituents: The oil consists of a mixture of glycerides in which 80 to 85% of the acids are saturated; it is a semisolid at 200 C. Lauric (50%) and myristic (20%) are the major fatty acids.

These low-molecular-weight acids give the oil a high saponification value, and coconut oil yields quality soaps and shampoos.

Uses: Coconut oil and medium-chain triglycerides are ingredients in a number of orally administered combination products for balanced dietary supplements.

9) Corn Oil

Corn oil is the refined oil obtained from the embryo of *Zea mays* Linné (F. Gramineae).

Constituents: The oil consists of a mixture of glycerides with component acids of the following approximate composition: linoleic (50%), oleic (37%), palmitic (10%), stearic (3%).

Uses:

- Corn oil is used as a solvent for injections; it is also a solvent for irradiated ergosterol.
- It is an edible oil and, as such, is used in salads and in the preparation of food.
- Emulsion is also used as a high-calorie dietary supplement.
- Corn oil is also an ingredient in a number of combination Products for oral administration that are described as balanced dietary supplements.
- When hydrogenated, the oil becomes semisolid and is used as a shortening for baking.

10) Sunflower Oil

Sunflower oil is the fixed oil obtained from the seeds of cultivated varieties of *Helianthus annuus* Linné (Pam. Compositae).

Constituents: 66% linoleic acid and 23% oleic acid.

Uses: The oil is used as an alternative to corn oil and sunflower oil for culinary purposes; and it is an ingredient in a number of specialty dietary supplements.

(Fats and related compounds)

1) Theobroma Oil

Cacao seeds or cacao beans are the *roasted seeds of Theobroma cacao* Linné (F. Sterculiaceae). Theobroma oil or cocoa butter is the fat obtained from the roasted seed of *T. cacao*.

Constituents: Theobroma oil consists of a mixture of glycerides with component acids of the following approximate composition; oleic (37%), stearic (34%), palmitic (26%), linoleic (2 %).

Uses. Cocoa is employed in making cocoa syrup, which is a flavored vehicle. Cocoa butter is used pharmaceutically as a suppository base.

2) Hydrogenated Vegetable Oil

Hydrogenated vegetable oil is refined, bleached, hydrogenated, and deodorized vegetable oil stearins and consists mainly of the triglycerides of stearic and palmitic acids.

It is a fine, white powder at room temperature and melts between 61 and 66°C to give a pale yellow, oily liquid. It is used as a tablet lubricant.

a- Lanolin

Lanolin is the purified, fatlike substance from the wool of the sheep. It contains between 25 and 30% of water and therefore is commonly called hydrous wool fat.

Constituents: The chief constituents are cholesterol and isocholesterol.

Uses:

- Lanolin is used as a water-absorbable ointment base.
- An ingredient in many skin creams and cosmetics.

Anhydrous lanolin is lanolin that contains not more than 0.25% of water.

Uses. Anhydrous lanolin is a water-absorbable ointment base. It is more readily absorbed through the skin than any other known fat and is therefore valuable as a base for therapeutic agents that are administered by inunction. In addition, it possesses emollient properties.

(Fatty acids)

These acids are usually obtained by hydrolysis of fats or oils. Some acids are used in topical antifungal preparations; sodium morrhuate is a sclerosing agent, and linolenic acids are used as a dietary supplement.

1- Stearic Acid

Stearic acid of pharmaceutical quality contains not less than 40% of stearic acid and not less than 40% of palmitic acid; the sum of these 2 acids is not less than 90%. Stearic acid is used as an emulsion adjunct and a tablet lubricant.

2- Oleic Acid

Oleic acid is obtained from edible fats and fixed oils. It is often obtained as a by product in the production of stearic acid. Oleic acid is used as an emulsion adjunct, as a pharmaceutical vehicle, as an emollient and as emulsifying agent.

Ethyl oleate, compared with fixed oil vehicles, is less viscous and more rapidly absorbed by body tissues.

3- Linoleic and Linolenic Acids

Linoleic and linolenic acids are polyunsaturated acids. These fatty acids are essential for human nutrition and have been called vitamin F. This mixture of acids is used as a dietary supplement.

(Waxes)

Waxes are usually defined as esters resulting from the condensation of high-molecular-weight, straight-chain acids and high-molecular-weight, primary, straight chain alcohols.

Waxes are employed in pharmaceuticals to "harden" ointments and cosmetic creams. They are also used in the preparation of cerates.

1- **Beeswax:** Yellow wax or beeswax is used as a stiffening agent and is an ingredient in yellow ointment. It is also used as a base for cerates and plasters. Commercially, it is contained in a number of polishes.

White *wax* is bleached, purified wax from the honeycomb of the bee, and is employed pharmaceutically in ointments and in cold creams.

2- **Carnauba Wax**

It is used in the manufacture of candles, wax varnishes, leather and furniture polishes, and in place of beeswax.

(Prostaglandins)

Prostaglandins are C₂₀ lipid metabolites formed in the body from essential, unsaturated fatty acids of the diet.

The major prostaglandins have been grouped into 4 main classes designated as prostaglandins A, B, E, and F.

All prostaglandins (PG) have a cyclopentane ring with 2 aliphatic side chains. Subscripts indicate the number of double bonds in the side chains and the stereochemistry of members of each group.

Pharmacologic effects of these compounds involve contraction, in some cases, relaxation of smooth muscles of the female reproductive system, of the cardiovascular system, of the intestinal tract, and of the bronchi. They also influence gastric secretion and renal function.

1- **Prostaglandin F₂, PGF₂, or dinoprost** is available for use in terminating second trimester pregnancy.

It stimulates contractions of the gravid uterus that are similar to the contractions of the term uterus at labor.

2- **15-Methylprostaglandin F, 15-methyl PGF₂, or carboprost** is the 15-methyl analog of PGF₂. It elicits pharmacologic responses similar to those of PGF₂, and it is used in terminating second trimester pregnancy.

3- **Prostaglandin E₂, PGE₂, or dinoprostone** is another uterine stimulant that has been approved for termination of second trimester pregnancy.

PGE₂ is available as a vaginal suppository that should be stored at a temperature below —20° C.

4- **Prostaglandin E, Prostaglandin E₁, PGE₁, or alprostadil.** It produces vasodilation, inhibits platelet aggregation, and stimulates intestinal and uterine smooth muscle.

The vasodilation property underlies its use for palliative therapy to maintain temporarily neonates with patent ductus arteriosus and congenital heart defects that restrict the pulmonary or systemic blood flow. The dilated ductus arteriosus

facilitates blood oxygenation and body perfusion pending surgical correction of the congenital defects.