Lipids(Waxes, fats, fixed oils)

Drugs Containing Lipids

The lipids are a large and diverse group of naturally occur-ring organic compounds that are related by their solubility in nonpolar organic solvents (e.g. ether, chloroform, acetone, and benzene) and are generally insoluble in water. There is great structural variety among the lipids and comprise of fixed oils, fats, and waxes. The lipids of physiological importance for humans have the following major functions:

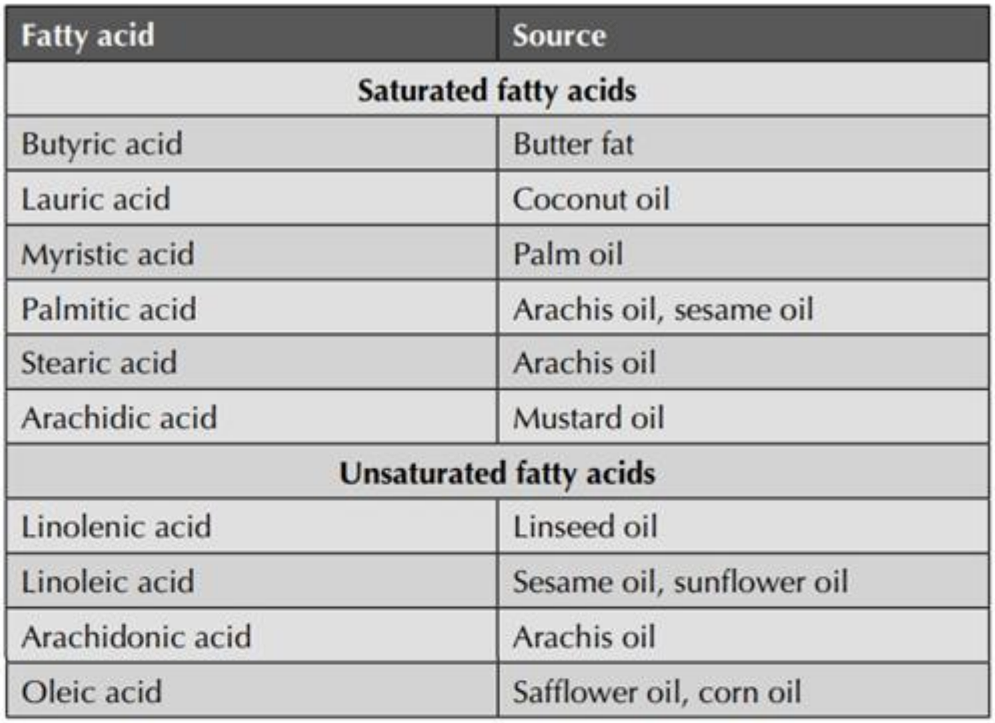
1. They serve as structural components of biological membranes.
2. They provide energy reserves, predominantly in the form of triacylglycerols.
3. Both lipids and lipid derivatives serve as vitamins and hormones.
4. Lipophilic bile acids aid in lipid solubilization.

FIXED OILS AND FATS

Fixed oils and fats are obtained from plants or animal. They are rich in calories and in plant source, they are present mostly in the seeds, as reserve substances and in animals they are present in subcutaneous and retroperitoneal tissues. They differ only according to their melting point and chemically they belong to the same group. If a substance is liquid at 15.5–16.5°C it is called fixed oil and solid or semisolid at the above temperature, it is called fat. They are made from two kinds of molecules: glycerol (a type of alcohol with a hydroxyl group on each of its three carbons) and three fatty acids joined by dehydration synthesis. Since there are three fatty acids attached, these are known as triglycerides. These fatty acids may be saturated, monounsaturated or polyunsaturated. The terms saturated, mono-unsaturated, and poly-unsaturated refer to the number of hydrogens attached to the hydrocarbon tails of the fatty acids as compared to the number of double bonds between carbon atoms in the tail. Fats, which are mostly from animal sources, have all single bonds between the carbons in their fatty acid tails, thus all the carbons are also bonded to the maximum number of hydrogens pos-sible. Since the fatty acids in these triglycerides contain the maximum possible amount of hydrogens, these would be called saturated fats. The hydrocarbon chains in these fatty acids are, thus, fairly straight and can pack closely together, making these fats solid at room temperature. Oils, mostly from plant sources, have some double bonds between some of the carbons in the hydrocarbon tail, causing bends or ‘kinks’ in the shape of the molecules. Because some of the carbons share double bonds, they are not bonded to as many hydrogens as they could if they weren’t double bonded to each other. Therefore these oils are called unsaturated fats. Because of the kinks in the hydrocarbon tails, unsaturated fats can’t pack as closely together, making them liquid at room temperature.

Examples of saturated and unsaturated fatty acids are given in table below.

Table : Examples of saturated and unsaturated fatty acids



Fatty acid	Source
Saturated fatty acids	
Butyric acid	Butter fat
Lauric acid	Coconut oil
Myristic acid	Palm oil
Palmitic acid	Arachis oil, sesame oil
Stearic acid	Arachis oil
Arachidic acid	Mustard oil
Unsaturated fatty acids	
Linolenic acid	Linseed oil
Linoleic acid	Sesame oil, sunflower oil
Arachidonic acid	Arachis oil
Oleic acid	Safflower oil, corn oil

Fixed oils and fats are insoluble in water and alcohol and are soluble in lipid solvents like light petroleum, ether, chloroform, and benzene. Only exception in this solubility is castor oil that is soluble in alcohol because of its hydroxy group of ricinoleic acid. They float in water since their specific gravity is less than one. They produce a permanent translucent stain on the paper and are called fixed oils. Fixed oils and fats cannot be distilled without their decomposition.

Analytical Parameters for Fats and Oils

Following are the parameters used to analyse the fats and oils.

1) **Iodine value:** The iodine value is the mass of iodine in grams that is consumed by 100 g of fats or oil. A iodine solution is violet in colour and any chemical group in the substance that reacts with iodine will make the colour disappear at a precise concentration. The amount of iodine solution thus required to keep the solution violet is a measure of the amount of iodine sensitive reactive groups. It is a measure of the extent of unsaturation and higher the iodine value, the more chance for rancidity.
2) **Saponification value:** The saponification value is the number of milligrams of potassium hydroxide required to saponify 1 g of fat under the conditions specified. It is a measure of the average molecular weight of all the fatty acids present.
3) **Hydroxyl value:** The hydroxyl value is the number of mg of potassium hydroxide (KOH) required to neutralize acetic acid combined to hydroxyl groups, when 1 g of a sample is acetylated.
4) **Ester value**: The ester value is the number of mg of potassium hydroxide (KOH) required to saponify the ester contained in 1 g of a sample.
5) **Unsaponifiable matter:** The principle is the saponification of the fat or oil by boiling under reflux with an ethanolic potassium hydroxide solution. Unsaponifiable matter is then extracted from the soap solution by diethyl ether. The solvent is evaporated and then the residue is dried and weighed.
6) **Acid value:** It is the amount of free acid present in fat as measured by the milligrams of potassium hydroxide needed to neutralize it. As the glycerides in fat slowly-decompose the acid value increases.
7) **Peroxide value:** One of the most widely used tests for oxidative rancidity; peroxide value is a measure of the concentration of peroxides and hydroperoxides formed in the initial stages of lipid oxidation. Milliequivalents of peroxide per kg of fat are measured by titration with iodide ion. Peroxide values are not static and care must be taken in handling and testing samples. It is difficult to provide a specific guideline relating peroxide value to rancidity. High peroxide values are a definite indication of a rancid fat, but moderate values may be the result of depletion of peroxides after reaching high concentrations.

WAXES

Waxes are esters of long-chain fatty acids and alcohols. The fatty acids are same in wax and fats, but the difference being saponification. Waxes are saponified only by alcoholic alkali but the fats may be saponified either by alcoholic alkali or by aqueous alkali. Along with fatty acids it also contains monohydroxy alcohols of high molecular weight especially cetyl alcohol, melissyl alcohol, and myricyl alcohol. Some-times cholesterol or phytosterols are also present.

As such they are not suitable as food because hydrolysing enzymes of wax are not present in system. Waxes are widely distributed in nature. The leaves and fruits of many plants have waxy coatings, which may protect them from dehydration and small predators. The feathers of birds and the fur of some animals have similar coatings which serve as a water repellent.

Spermaceti, beeswax, carnuba wax, etc. are the examples of waxes.

CASTOR OIL

Synonyms Castor bean oil, castor oil seed, oleum ricini, ricinus oil, oil of palma christi, cold-drawn castor oil.

Biological Source

Castor oil is the fixed oil obtained by cold expression of the seeds of *Ricinus communis* Linn., belonging to family Euphorbiaceae.

Geographical Source

It is mainly found in India, Brazil, America, China, Thai-land; in India it is cultivated in Gujarat, Andhra Pradesh, and Karnataka.

Preparation

Castor oil is obtained from castor seeds. The oil is obtained by two ways; either after the removal of the seed coat or with the seed coat. Seed coats are removed by crushing the seeds under the grooved rollers and then they are subjected to a current of air to blow the testas. The kernels are fed in oil expellers and at room temperature they are expressed with 1 to 2 tons pressure per square inch till about 30% oil is obtained. The oil is filtered, steamed 80–100°C to facilitate the coagulation and precipitation of poisonous principle ricin, proteins and enzyme lipase present in it. Oil is then filtered and this oil with 1% acidity is used for medical purpose.

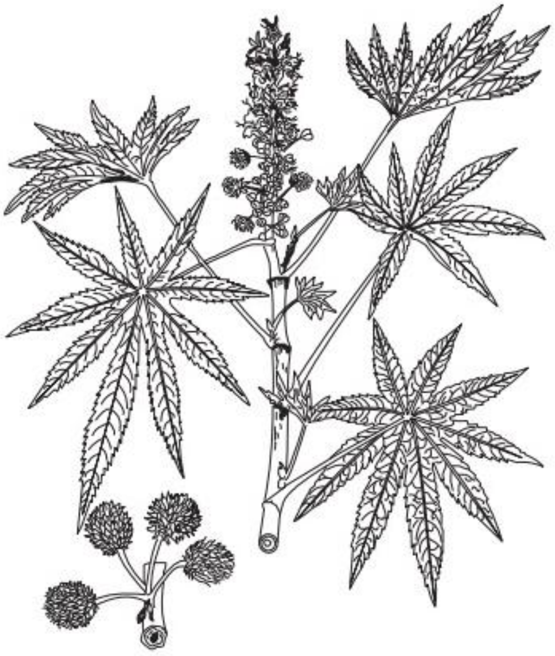
The oil cake which remains contains of ricin, lipase and about 20% oil. The cake is grounded, steamed to 40° to 80°C, and a pressure of 3 tons pressure per sq. inch is applied. This yields the second quality of oil with 5% acidity and is used for industrial purpose.

The residual cake which remains after the expression of the second quality oil still contains about 8 to 10% oil. This oil is obtained by subjecting it to extraction in soxhlet with lipid solvents. This oil obtained is also used in industry. The residual cake is used as manure and not fed to animal due to the presence of ricin. The cake is also used for the production of lipase.

Characteristics

Medicinal or the first grade or Pale pressed castor oil is colourless or slightly yellow coloured. It is a viscid liquid which has slight odour with slightly acrid taste. Castor oil is soluble in absolute alcohol in all proportions; Specific gravity is

0.958 to 0.969, refractive index at 40°C is 1.4695 to 1.4730, acid value not more than 2, saponification value 177 to 187, and acetyl value is about 150.



Ricinus communis

Chemical Constituents

Castor oil consists of glyceride of ricinoleic acid, isoricinoleic, stearic, and dihydroxy stearic acids. Ricinoleic acid is responsible for laxative property. Castor oil also contains vitamin F. 90% of the fatty acid content is ricinoleic acid. The ricinoleic acid is an 18-carbon acid having a double bond in the 9–10 position and a hydroxyl group on the 12th carbon. This combination of hydroxyl group and unsaturation occurs only in castor oil.

Identification Tests

About 5 ml of light petroleum (50° to 60°) when mixed with 10 ml of castor oil at 15.5° shows a clear solution, but if the amount of light petroleum is increased to 15 ml, the mixture becomes turbid. This test is not shown by other oils.

Uses

Castor oil is mild purgative, fungistatic, used as an ointment base, as plasticizer, wetting agents, as a lubricating agent. Ricinoleic acid is used in contraceptive creams and jellies; it is also used as an emollient in the preparation of lipsticks, in tooth formulation, as an ingredient in hair oil. The dehydrated oil is used in the manufacture of linoleum and alkyl resin. The main use of castor oil is the industrial production of coatings, also employed to make pharmaceuticals and cosmetics in the textile and leather industries and for manufacturing plastics and fibres.

Marketed Products

It is one of the ingredients of the preparations known as Lip balm and Muscle and joint rub (Himalaya Drug Company).

CHAULMOOGRA OIL

Synonyms Hydnocarpus oil; gynocardia oil.

Biological Source

Chaulmoogra oil is the fixed oil obtained by cold expression from ripe seeds of *Taraktogenos kurzii* King, (syn. *Hydnocarpus kurzii* (King) Warb.), *Hydnocarpus wightiana* Blume, *H. anthelminticta* Pierre, *H. heterophylla*, and other species of Hydnocarpus, belonging to family Flacourtiaceae.

Geographical Source

The plants are tall trees, up to 17 m high, with narrow crown of hanging branches; native to Burma, Thailand, eastern India, and Indo-China.

Characteristics

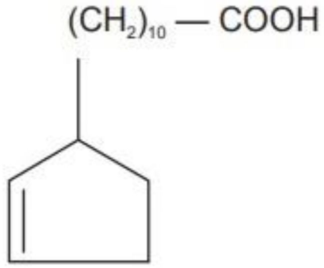
The oil is yellow or brownish yellow. Below 25°C it is a soft solid. It has peculiar odour and sharp taste. It is soluble in benzene, chloroform, ether, petrol; slightly soluble in cold alcohol; almost entirely soluble in hot alcohol and carbon disulphide.

Hydnocarpus kurzii

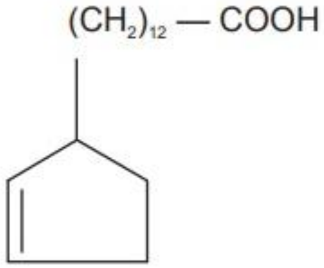
Chemical Constituents

Chaulmoogra oil contains glycerides of cyclopentenyl fatty acids like hydnocarpic acid (48%), chaulmoogric acid (27%), gorlic acid with small amounts of glycerides of palmitic acid (6%), and oleic acid (12%). The cyclic acids are formed during last 3–4 months of maturation of the fruit and are strongly bactericidal towards the Micrococcus of leprosy.

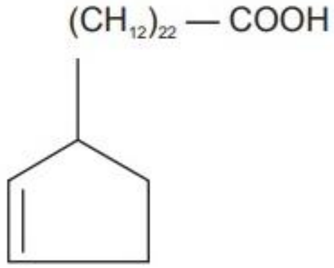
The seeds of H. wightiana contain a flavonolignan hydnocarpin; isohydnocarpin, methoxy hydnocarpin, apigenin, luteolin, chrysoeriol, hydnowightin, epivolkenin, and cyclopentenoid cyanohydrin glycosides.



Hydnocarpic acid



Chaulmoogric acid



Gorlic acid

Uses

The oil is useful in leprosy and many other skin diseases. The cyclopentenyl fatty acids of the oil exhibit specific toxicity for Mycobaeterium leprae and M. tuberculosis. The oil has now been replaced by the ethyl esters and salts of hydnocarpic and chlumoogric acids. At present organic sulphones have replaced Chaulmoogra oil in therapeutic use.

WOOL FAT

Synonyms LANOLIN , Oesipos; Agnin; Alapurin; Anhydrous lanolin; Adeps lanae; Laniol.

Biological Source

Lanolin is the fat-like purified secretion of the sebaceous glands which is deposited into the wool fibres of sheep, *Ovis aries* Linn., belonging to family Bovidae.

Preparation

Wool is cut and washed with a soap or alkali. An emulsion of wool fat, called as wool grease, takes place in water. Raw lanolin is separated by cracking the emulsion with sulphuric acid. Wool grease floats on the upper layer and fatty acids are dissolved in the lower layer. Lanolin is purified by treating with sodium peroxide and bleaching with reagents.

Characteristics

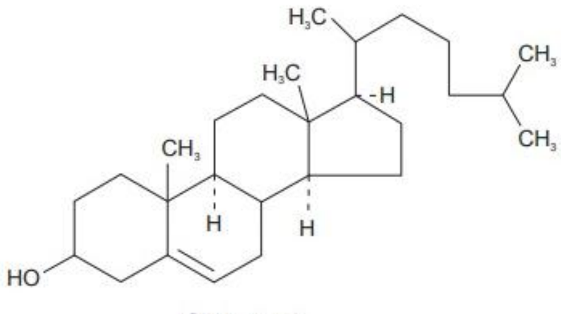
Lanolin is a yellowish white, tenacious, unctuous mass; odour is slight and characteristic. Practically, it is insoluble in water, but soluble in chloroform or ether with the separation of the water. It melts in between 34 and 40°C. On heating it forms two layers in the beginning, continuous heating removes water. Lanolin is not saponified by an aqueous alkali. However, saponification takes place with alcoholic solution of alkali.

Anhydrous lanolin is a yellowish tenacious, semisolid fat with slight odour. Practically it is insoluble in water but mixes with about twice its weight of water without separation. It is sparingly soluble in cold, more in hot alcohol, freely soluble in benzene, chloroform, ether, carbon disulphide, acetone, and petroleum ether.

Chemical Constituents

Lanolin is a complex mixture of esters and polyesters of 33 high molecular weight alcohols, and 36 fatty acids. The alcohols are of three types; aliphatic alcohols, steroid alcohols, and triterpenoid alcohols. The acids are also of three types: saturated nonhydroxylated acids, unsaturated nonhydroxylated acids, and hydroxylated acids. Liquid lanolin is rich in low molecular weight, branched aliphatic acids, and alcohols, whereas waxy lanolin is rich in high molecular weight, straight-chain acids, and alcohols.

The chief constituents of lanolin are cholesterol, iso-cholesterol, unsaturated monohydric alcohols of the formula $C_{27}H_{45}OH$, both free and combined with lanoceric ($C_{30}H_{60}O_4$), lanopalmitic ($C_{16}H_{22}O_3$), carnaubic, and other fatty acids. Lanolin also contains esters of oleic and myristic acids, aliphatic alcohols, such as cetyl, ceryl and carnaubyl alcohols, lanosterol, and agnosterol.



Cholesterol

Identification Tests

Dissolve 0.5 g of lanolin in chloroform, and to it add 1 ml of acetic anhydride and two drops of sulphuric acid. A deep green colour is produced, indicating the presence of cholesterol.

Uses

Wool fat is used as an emollient, as water absorbable ointment base in many skin creams and cosmetic and for hoof dressing. Wool fat is readily absorbed through skin and helps in increasing the absorption of active ingredients incorporated in the ointment. However, it may act as an allergenic contactant in hypersensitive persons.

BEESWAX

Synonyms White beeswax, yellow beeswax, cera alba, and cera flava.

Biological Source

Beeswax is the purified wax obtained from honeycomb of hive bee, *Apis mellifera* Linn and other species of Apis, belonging to family Apidae.

Geographical Source

It is mainly found in Jamaica, Egypt, Africa, India, France, Italy, California etc.

Preparation

The worker bee secretes the wax due to the ability of maintaining a high temperature and the wax is secreted in the last four segments of abdomen on the ventral surface. Just below the sterna it has a smooth layer of cells form the chitinous area that secretes the wax. The chitinous area has small pores through, which the wax exudes out. The wax is passed to the front leg and later to the mouth; in the mouth it gets mixed with the saliva, which is then built on the comb. This wax forms a capping on the honey cells. Wax forms about 1/8th part of the honeycomb. After removal of honey, honeycomb or the capping is melted in boiling water. On cooling the melted wax gets solidified and floats on the surface of water while the impurities settle below and honey leftovers get dissolved in water. The pure wax is then poured into earthen vessels wiped with damp cloth and the wax so obtained is yellow beeswax.

White beeswax is obtained from yellow beeswax. The yellow beeswax is runned on a thin stream of spinning wet drum, from which long ribbon like strips are scrapped off. The ribbon strips are placed on cloth in thin layers, rotated from time to time and bleached in sunlight till the outer layer becomes white. White beeswax is obtained by treating yellow beeswax chemically with potassium permanganate, chromic acid or chlorine or charcoal.

Characteristics

Yellow wax or Cera flava is yellowish to greyish brown coloured solid, with agreeable, honey-like odour and a faint, characteristic taste. When cold, it is somewhat brittle and when broken, shows presence of a dull, granular, noncrystalline fracture. Yellow wax is insoluble in water and sparingly soluble in cold alcohol. It is completely soluble in chloroform, ether, and in fixed or volatile oils, partly soluble in cold benzene or in carbon disulphide and completely soluble in these liquids at about 30°C.

White wax is less unctuous to the touch; it is yellow, soft, and ductile at 35°C and fusible at 65°C. A yellowish-white solid, somewhat translucent in thin layers. It has a faint, characteristic odour which is free from rancidity and tasteless. It is insoluble in water, soluble in chloroform, ether, fixed oil, and volatile oils (hot turpentine oil) and sparingly soluble in alcohol. It is not affected by the acids at ordinary temperatures, but is converted into a black mass when boiled with concentrated sulphuric acid.

Chemical Constituents

Beeswax contains myricin, which is melissyl palmitate; melting point 64°C, free cerotic acid ($C_{26}H_{52}O_2$), myricyl alcohol ($C_{30}H_{61}OH$) is liberated when myricyl palmitate is saponified. Melissic acid, some unsaturated acids of the oleic series, ceryl alcohol, and 12 to 13% higher hydrocarbons are present.

Uses

Beeswax is used in the preparation of ointments, plaster, and polishes.

Adulterants

Beeswax is adulterated by solid paraffin, ceresin, carnauba wax, or other fats and waxes of animal or mineral origin. Spermaceti and lard render wax softer and less cohesive, of a smoother and less granular fracture and different odour when heated. The melting point and specific gravity are lowered by tallow, suet, lard, and especially by paraffin. Ceresin, a principle obtained from ozokerite is also employed as an adulterant. In yellow wax the iodine value is also of use as a test for detection of adulterants but in white wax the bleaching process has altered the bodies which absorb the iodine.

Marketed Products

It is one of the ingredients of the preparations known as Saaf Organic Eraser Body Oil and Jatyadi tail (Dabur).