

Lipids

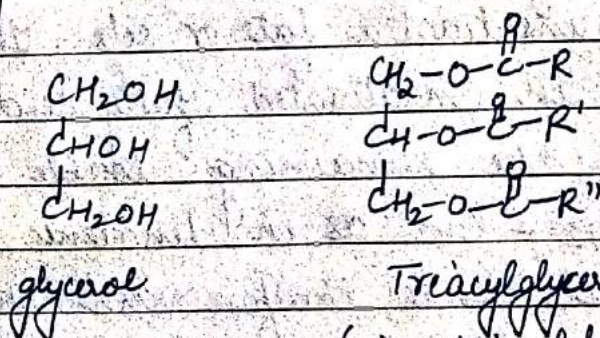
Lipids are compounds of biological origin that dissolve in non-polar solvents, such as chloroform and diethylether.

The name lipid comes from the Greek word *lipos* for fat.

Lipids include many types of compounds containing a wide variety of functional groups such as fats, oils, waxes, cholesterol, sterols, fat-soluble vitamins (A, D, E & K), phospholipids and others. Lipids constitute major part of stored food material in animals and human beings and a major structural component. The main biological functions of lipids include energy storage, acting as structural components of cell-membrane and participating as important signalling molecules.

Terpenoids and Carotenoids also come under lipids. Lipids are hydrophobic nature.

Only a small portion of the total lipid fraction obtained by extraction with a non-polar solvent consists of long chain carboxylic acids. Most of the carboxylic acids of biological origin are found as esters of glycerol, that is, as triacylglycerols.



glycerol

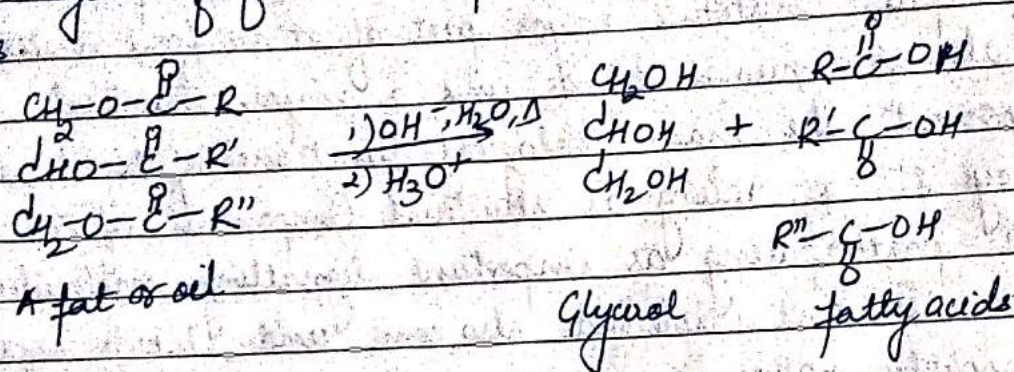
Triacylglycerol

(in a triacylglycerol R, R' & R'' may all be different)

Triacylglycerols are the oils of plants and the fats of animal origin. They include such common substances as peanut oil, corn oil, coconut oil, sunflower oil, butter, lard, tallow.

Each fat is made up of glycerides derived from many different carboxylic acids. The proportions of the various acids vary from fat to fat; each fat has its characteristic composition, which does not differ very much from sample to sample.

Triacylglycerols that are liquid at room temperature are generally called oils those that are solids called fats. Hydrolysis of fat or oil produces a mixture of fatty acids.



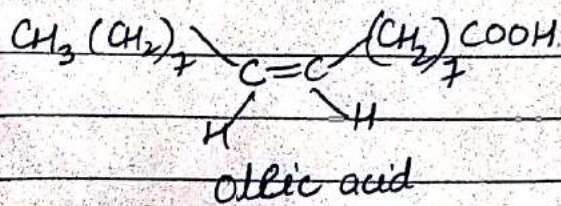
Most natural fatty acids have unbranched chains and because they are synthesized from two-carbon units, they have even number of carbon atoms.

Many naturally occurring fatty acids contain two or three double bonds. The fats or oils that they come from are called polyunsaturated fats or oils. The first double bond in an unsaturated fatty acid commonly occurs between C9 & C10; the remaining double bonds tends to begin with C12 & C15 (as in linole and linolenic acid). The double bonds, therefore are not conjugated. Triple bonds rarely occur in fatty acids.

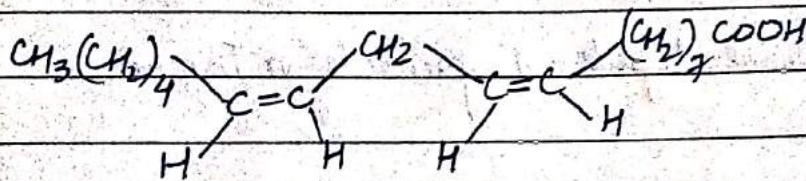
The Carbon chains of saturated fatty acids can adopt many conformations but tend to be fully extended because this minimizes the steric repulsions between neighboring methylene groups. Saturated fatty acids pack efficiently into crystals and because van der Waals attractions are large, they have

relatively high melting points. The melting points increases with increasing molecular weight.

Most Common unsaturated fatty acids

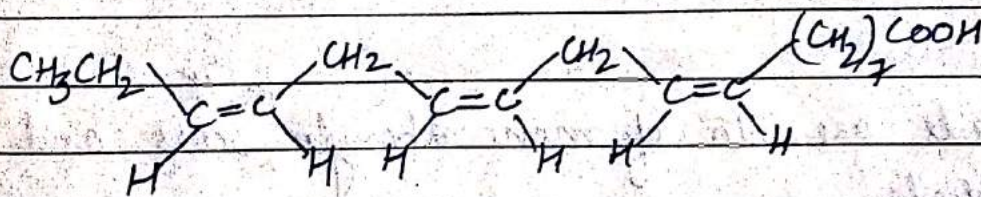


(Cis-9-octadecenoic acid)



Linoleic Acid

(Cis, Cis-9,12-octadecadienoic acid)



Linolenic acid

(Cis, Cis, Cis-9,12,15 octadecatrienoic acid)

The Configuration about these double bonds is almost invariably cis rather than trans.

Unsaturation with this particular stereochemistry has an effect that is seemingly trivial but is actually of vital biological significance: it lower melting point.

This cis Configuration of the double bond of an unsaturated fatty acid puts a rigid bend in the Carbon chain that interferes with crystal packing causing reduced van der Waals attraction between molecules. Unsaturated

fatty acids, consequently have lower melting points.

Lipids may be classified into four major groups:

A) Simple Lipids $\left\{ \begin{array}{l} \text{Fat + oils} \\ \text{waxes} \end{array} \right.$

B) Complex lipids $\left\{ \begin{array}{l} \text{Phospholipids} \\ \text{Glycolipids} \\ \text{sphingolipids} \end{array} \right.$

C) Derived lipids $\left\{ \begin{array}{l} \text{Sterol lipids - steroids and sterols} \\ \text{Prenol lipids - Isoprenoids or Terpenes} \end{array} \right.$

D) Unclassified Lipids

Tocopherols (Vitamin E) and Vitamin K

Simple Lipids

The simple lipids are ester of monocarboxylic ^{fatty} acids and aliphatic alcohols.

Fat and oils are triglycerides formed of glycerol and fatty acids. The three ester groups are the polar parts of the molecule, whereas the tails of the fatty acids are non-polar.

Triacylglycerols do not occur as components of the membrane as do other types of lipids. They accumulate in adipose tissues and provide a means of storing fatty acids particularly in animals. They serve as concentrated stores of metabolic energy. Complete oxidation of fat yields about 9 Kcal/g in contrast to 4 Kcal/g for carbohydrates and proteins.

Triglycerides are neutral fats. They are lighter than water with specific gravity of about 0.86.

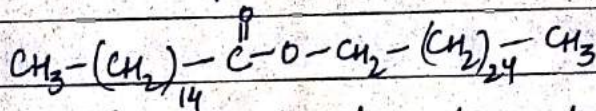
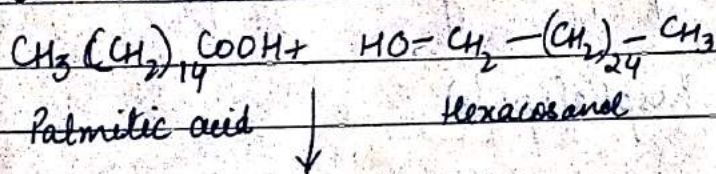
- * Fats are solid at room temperature. They have saturated fatty acids.
- * Oils are fluid at room temperature. They have large number of unsaturated fatty acids.

Waxes

Waxes are complex mixtures of esters of long chain fatty acid and long chain monohydroxy alcohols.

The alcohol may contain 12-32 carbon atoms. Waxes are found in nature on leaves and stems. The wax prevents the plant from losing excessive amounts of water.

Beeswax is composed of mainly palmitic acid esterified with Hexacosanol.



Beeswax is secreted by bees to make cells for honey & eggs.

Spermaceti wax is found in the head cavities and blubber of sperm whale. ^{Many} Waxes are used in ointments, handcreams, cosmetics.

Common waxes include jojoba, carnauba, wool wax; which is also known as lanolin.

Waxes are chemically inert and resistant to atmospheric oxygen. They are insoluble in water. Waxes frequently serve as protective coatings for both plants and animals. In plants they coat stems, leaves and fruits. In animals they are found on fur, feathers and skin. Myricyl croate is the principal component of carnauba wax. It is extensively used in floor wax and automobile wax. The principal component of the wax produced by whales

is Cetyl palmitate. This wax is an important component of cosmetics

