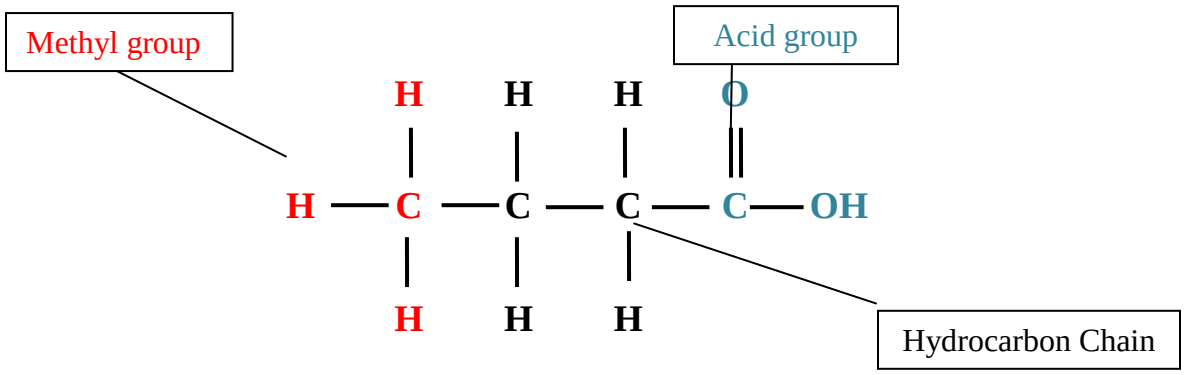
Frequently asked questions

1. Explain the structure of fat.

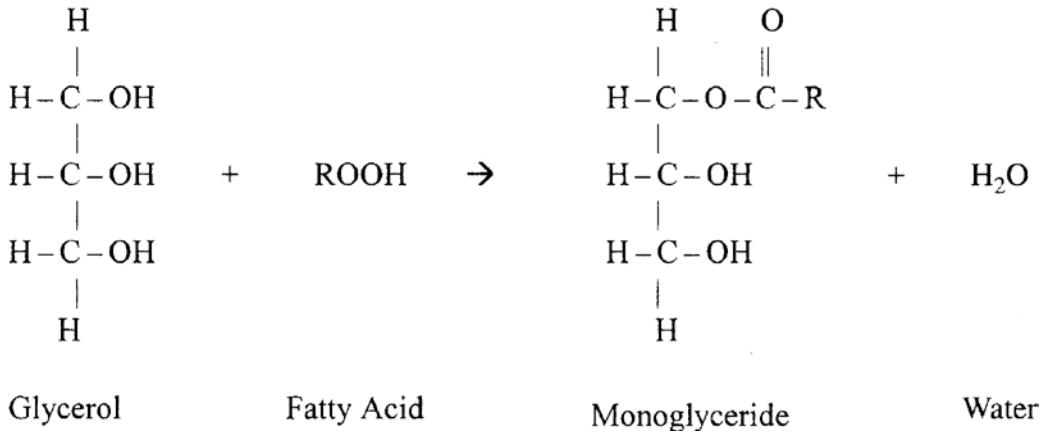
Ans: The building blocks of fats are fatty acids and glycerol. A fatty acid is made up of a chain of carbon atoms, with a methyl group at one end and an acid group at the other. Fatty acids occur primarily as unbranched hydrocarbon chains with an even number of carbons.



Structure of fatty acid

2. Discuss about the structure of glycerides.

Ans: Glycerides include *monoglycerides*, *diglycerides* and *triglycerides*. The most abundant fatty substance in food is the triglycerides (>95%). Triglycerides are insoluble in water and may be either liquid or solid at room temperature. Structurally, glycerides contain a glycerol molecule backbone joined to one or more fatty acid molecules. A *monoglyceride* contains glycerol esterified to *one* fatty acid molecule. If *two* fatty acids are esterified to glycerol, a *diglyceride* is formed. If *three* fatty acids undergoing the same reaction make a *triglyceride*. If a triglyceride contains three *identical* fatty acids, it is called a *simple triglyceride*. If it contains two/ three *different* fatty acids it is called a *mixed triglyceride*.



Formation of a monoglyceride

3. How lipids are classified?

Ans: Among the many compounds classified as lipids, only a small number are important as dietary energy sources. Based on the structure, the classification of lipids are

i. Simple lipids
ii. Compound lipids
iii. Derived lipids

4. What are Simple lipids?

Ans: Simple lipids are esters of fatty acids with various alcohols. They are classified according to the nature of the alcohols.

a) **Fats and Oils:**

Fats and oils are forms of lipids present in foods. They are esters of fatty acids and glycerol. At room temperature, oils are liquids and fats are solids.

b) **Waxes:**

The chemical definition of a wax is an ester of a long- chain acid and a long- chain alcohol. Food waxes are a combination of chemical classes including wax esters, sterol esters, ketones, aldehydes, alcohols, hydrocarbons and sterols. Waxes can be classified according to their origin as animal (beeswax), plant (carnauba wax), and mineral (petroleum waxes). Waxes are found on the surface of plant and animal tissues.

5. What are Phospholipids?

Ans: Phospholipids are similar to triglycerides but contain only *two* fatty acids esterified to glycerol. In place of the third fatty acid, there is phosphoric acid and a nitrogen-containing group. The most common phospholipid is known as lecithin. Lecithin is found in nearly every living cell. The word is derived from the Greek *lekithos*, which means "yolk of an egg," and lecithin is in egg yolk.

6. What are Lipoproteins?

Ans: Lipoproteins are macromolecular complex of lipids with proteins. These compounds are found in mammalian plasma bound with proteins. The lipid mostly consists of cholesterol esters and phospholipids. They contain stearic, palmitic, oleic, palmitoleic, linoleic and arachidonic acids.

7. What are sterols?

Ans: Sterols are derivatives of steroids. They contain a common steroid nucleus, an 8–10 carbon side chain and an alcohol group. Based on their origin sterols are classified as cholesterol (animal origin) and phytosterol (in plants).

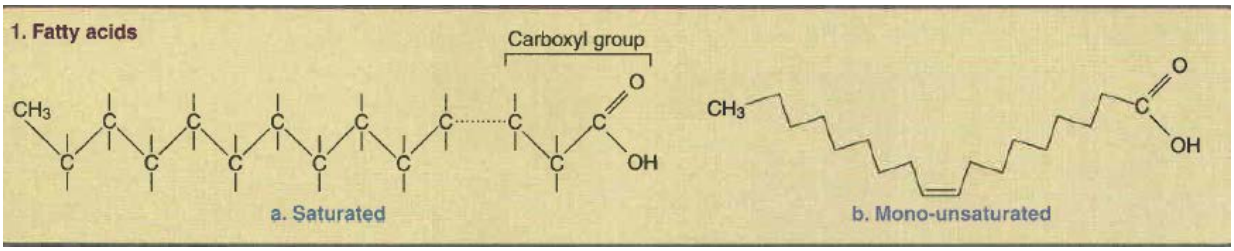
8. What are Fatty acids?

Ans: Fatty acids are long hydrocarbon chains with a methyl group (CH_3) at one end of the chain and a carboxylic acid group (COOH) at the other. Most natural fatty acids contain from 2 to 21 carbon atoms and most contain an even number of carbon atoms in the chain.

9. How fatty acids are classified based on saturation?

Ans: Fatty acids can be saturated or unsaturated, depending on the degree of unsaturation; they are (a) saturated fatty acids (SFA), (b) unsaturated–i. monounsaturated fatty acids (MUFA) and ii. polyunsaturated fatty acids (PUFA)

(a). Saturated Fatty Acids: If the Fatty acid has all the hydrogen atoms it can hold is said to be saturated. They have a linear shape and there are no double bonds between carbons. They contain only single carbon-to-carbon bonds and have the general formula $CH_3\ (CH_2)_n\ COOH$.



Different types of fatty acids

Table 1: Common Fatty Acids

Common Name	Systematic Name	Number of Carbon Atoms*	Number of Double Bonds	Typical Fat Source
Saturated Fatty Acids				
Butyric	Butanoic	4	0	Butterfat
Caproic	Hexanoic	6	0	Butterfat
Caprylic	Octanoic	8	0	Coconut oil
Capric	Decanoic	10	0	Coconut oil
Lauric	Dodecanoic	12	0	Coconut oil, Palm kernel oil
Myristic	Tetradecanoic	14	0	Butterfat, Coconut oil
Palmitic	Hexadecanoic	16	0	Cocoa butter, animalfat
Stearic	Octadecanoic	18	0	Cocoa butter, animal fat
Arachidic	Eicosanoic	20	0	Peanut oil
Behenic	Docosanoic	22	0	Peanut oil

(b). Unsaturated Fatty Acids: If some of the hydrogen atoms are missing and have been replaced by a double bond between carbon atoms, then the fatty acid is said to be unsaturated. Generally, unsaturated fats are liquid at room temperature

(i). Monounsaturated Fatty Acids: If there is one double bond, the fatty acid is known as a monounsaturated fatty acid**.** .

(ii). Polyunsaturated fatty acid (PUFA): If there is more than one double bond, then the fatty acid is known as a PUFA.

10. What are essential fatty acids? What are the sources of essential fatty acids?

Ans: The body cannot make all the fatty acids it needs except for two, known as alpha linolenic acid (n-3) and linoleic (n-6) fatty acids. These are called the Essential Fatty Acids (EFAs) and must be supplied in the diet. From these fatty acids we can make others which are important for health. From linoleic acid we can make arachidonic acid and from α –linolenic acid we make Eicosapentaenoic acid (EPA) and docosahaexanoic acid (DHA). The latter two can also be from oily fish and fish oil supplements. The n-3 (or omega 3) fatty acids, particularly alpha-linolenic acid, are also present in the meat or eggs of animals fed n-3 enriched diets. Foods produced in this way could be considered alternative sources of oily fish. Although the amounts of the long chain n-3 fatty acids (EPA and DHA) present may be considerably less.

11. Discuss about the minor components of fats and oils

Ans: Tocopherols are important minor constituents of most vegetable oils. Animal fats contain little or no tocopherols. Tocopherols are antioxidants, helping to prevent oxidative rancidity. They are good sources of vitamin E. Fats are not good sources of vitamins, apart from vitamin E. Pigments such as carotenoids and chlorophylls may be present in fats, and these may impart a distinct color to a fat (milk).

12. Discuss about the Nomenclature of Fatty Acids.

Ans: Fatty acids are named in three ways,

i. **Common or trivial name**: which has been used for many years
ii. **Systematic or Geneva name**: which is more recent and has the advantage of describing the structure of the fatty acid to which it belongs
iii. **The omega system:** classifies fatty acids according to the position of the first double bond, counting from the methyl end of the molecule

13. How fats are named based on Geneva Nomenclature?

Ans: The Geneva naming system is a systematic method of naming the fatty acids. Each name completely describes the structure of the fatty acid to which it belongs. Each unsaturated fatty acid is named according to the number of carbon atoms in the chain.

For example, stearic acid, which has 18 carbon atoms in its chain, has the name octadecanoic acid; octadec means 18. The -oic ending signifies that there is an acid group (COOH) present. Anoic signifies that there are no double bonds in the chain. Palmitic acid, which contains 16 carbon atoms, is named hexadecanoic acid. Hexadec means 16 and the anoic ending again shows that there are no double bonds in this fatty acid chain.

Fatty acids containing double bonds are named according to the number of carbon atoms they contain. Therefore, oleic acid (18:1), linoleic acid (18:2), and linolenic acid (18:3) all have octadec as part of their name, signifying that they each contain 18 carbon atoms. The rest of the name differs, because they contain one, two, or three double bonds. The number of double bonds and their position in the fatty acid chain are both specified in the name. It is important to note that the position of each double bond is specified counting from the functional group or acid end of the molecule, not from the methyl end.

By looking at a systematic name for a fatty acid, it is possible to tell how many carbon atoms it contains and how many double bonds and where they are located. Each name gives important information about the fatty acid that is not available just by looking at the trivial or omega name of the acid.

14. How does Systematic name helps in naming fatty acids?

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15. How fats are named based on Omega Naming System?

Ans: The omega naming system is used for unsaturated fatty acids. It denotes the position of the first double bond in the molecule, counting from the methyl (CH_3) end, not the acid (as in

the Geneva system). This is because the body lengthens fatty acid chains by adding carbons at the acid end of the chain..