

Lipids

Derived Lipid and The role of its in teeth diseases

by

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Medical Chemistry

First stage

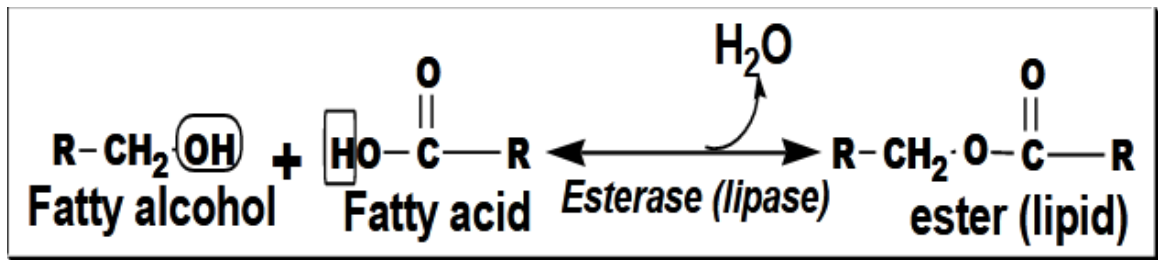
Collage of Dentistry

Lect. 4 + 5

Lipids:-

Lipids are organic substances present in plants and animals tissues .Insoluble in water but soluble in organic solvents such as : ether ,benzene and acetone

- Are a class of biological molecules formed mainly from alcohol & fatty acids combined together by ester linkage.
- Lipids include fats, oils, waxes & related compounds.
- They're widely distributed in nature both in plants & animals.



Functions and importance of lipids:-

1. Major source of energy.
2. Important dietary constituents, it yields more energy per gram (9.5 cal/gm) Compared with CHO and proteins give (4.0 cal/gm).
3. Some vitamins like A, D, E and K are fat soluble, therefore lipids are necessary for these vitamins.
4. Some lipids in diet supply the body with essential fatty acids for normal growth and healthy.
5. Electrical isolator layer of the body.
6. Formation of bile acid, steroid, hormones and Vit D3.

Classification of lipids:-

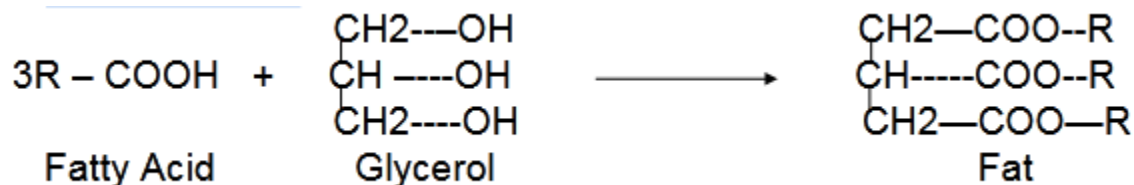
Lipids are classified into three types:

- 1- Simple Lipids
- 2- complex Lipids
- 3- Derived lipids

1- Simple lipids are Esters of fatty acids with various alcohols.



a. Fats and Oils are esters of fatty acids with glycerol. Oil is a liquid, while fat is a solid at room temperature .



b. Waxes: Esters of fatty acids (usually long chain) with alcohol other than glycerol.

2- Complex Lipids: Esters of fatty acids with alcohols containing additional groups such as phosphate, nitrogenous base, carbohydrate, protein etc.

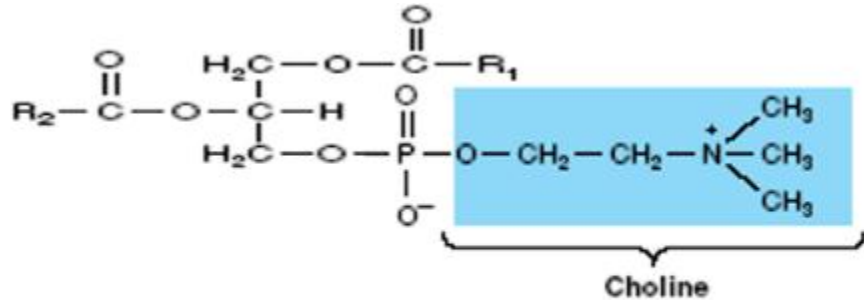
They are divided into :

A- Phospholipids : Lipids containing phosphoric acid and frequently a nitrogenous base. In addition to alcohol and fatty acids . Phospholipids enter in the structure of cell membrane .

- There are two classes of phospholipids:-

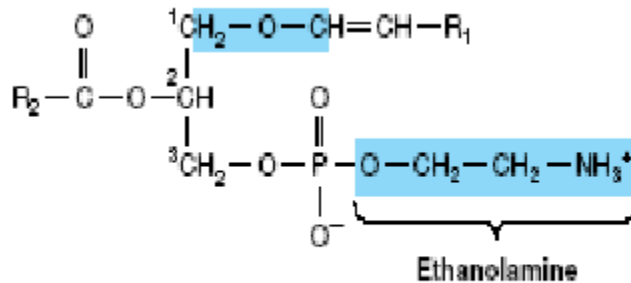
• 1- Glycerophospholipids: These phospholipids contain glycerol as the alcohol e.g.,

□ Lecithin (glycerol + saturated fatty acid + Phosphate+ choline).



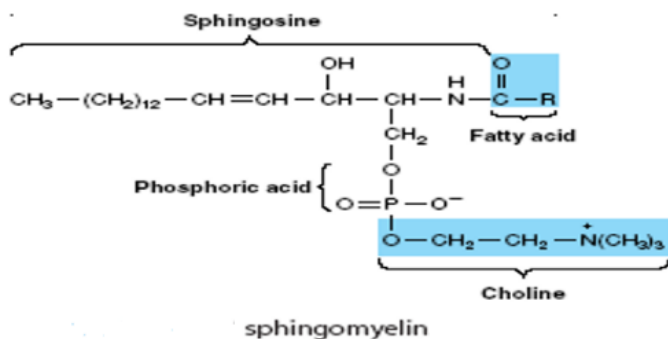
phosphatidylcholine

□ Cephalin: (glycerol + unsaturated fatty acid +Phosphate+ ethanol amine)



phosphatidylethanolamine

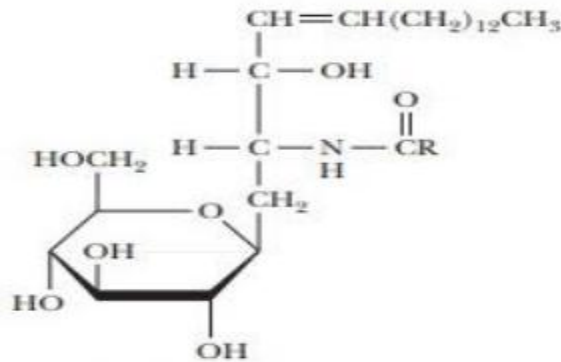
2- Sphingophospholipids: Sphingosine is the alcohol in this group of phospho-lipids e.g., Sphingomyelin (Sphingosine + fatty acid +Phosphate + choline).



- Sphingomyelin is an **insulating material** for **nerve fibres**
- It has a double behaviour where it dissolves in fat and polar solvents.
- It is found in the brain, kidney, liver and blood

b) Glycolipids: These lipids contain a fatty acid and carbohydrate. The alcohol is Sphingosine (also called as glycosphingolipids) e.g., Cerebrosides (Sphingosine + Cerebronic acid + Glucose or Galactose).

□ Cerebrosides is a key component of brain, spinal cord, and nervous cells



β -Glucocerebroside

C) Lipoproteins: Macromolecular complex of lipids and proteins . They are the transport vehicles for lipids in the circulation.

There are five types of lipoproteins :

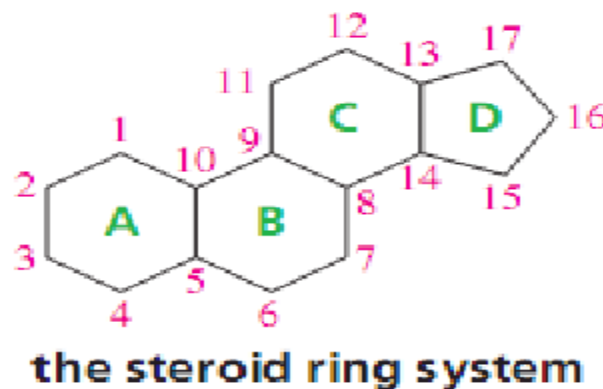
- 1- Chylomicrons, transport dietary lipids from intestine to peripheral tissues.
- 2- Very low density lipoproteins (VLDL), transport the lipids (endogenously synthesized) from liver to peripheral tissues).
- 3- Low density lipoproteins (LDL) ("bad" cholesterol) , transport cholesterol from liver to peripheral tissues.
- 4- High density lipoproteins (HDL) ("good" cholesterol) , carry cholesterol from peripheral tissues to liver.

3- Derived Lipids: These are the derivatives obtained by the hydrolysis of simple and compound lipids. These include fatty acids, alcohols, mono- and diglycerol, lipid soluble vitamins and Steroids. The most common derived lipids are steroids.

□ **Steroids** are the compounds containing a cyclic steroid called

Cyclopentano perhydro phenanthrene (CPPP) that contain 17 Carbons

□ There are several steroids in the biological system. These include cholesterol, bile acids, vitamin D, sex hormones, adrenocortical hormone

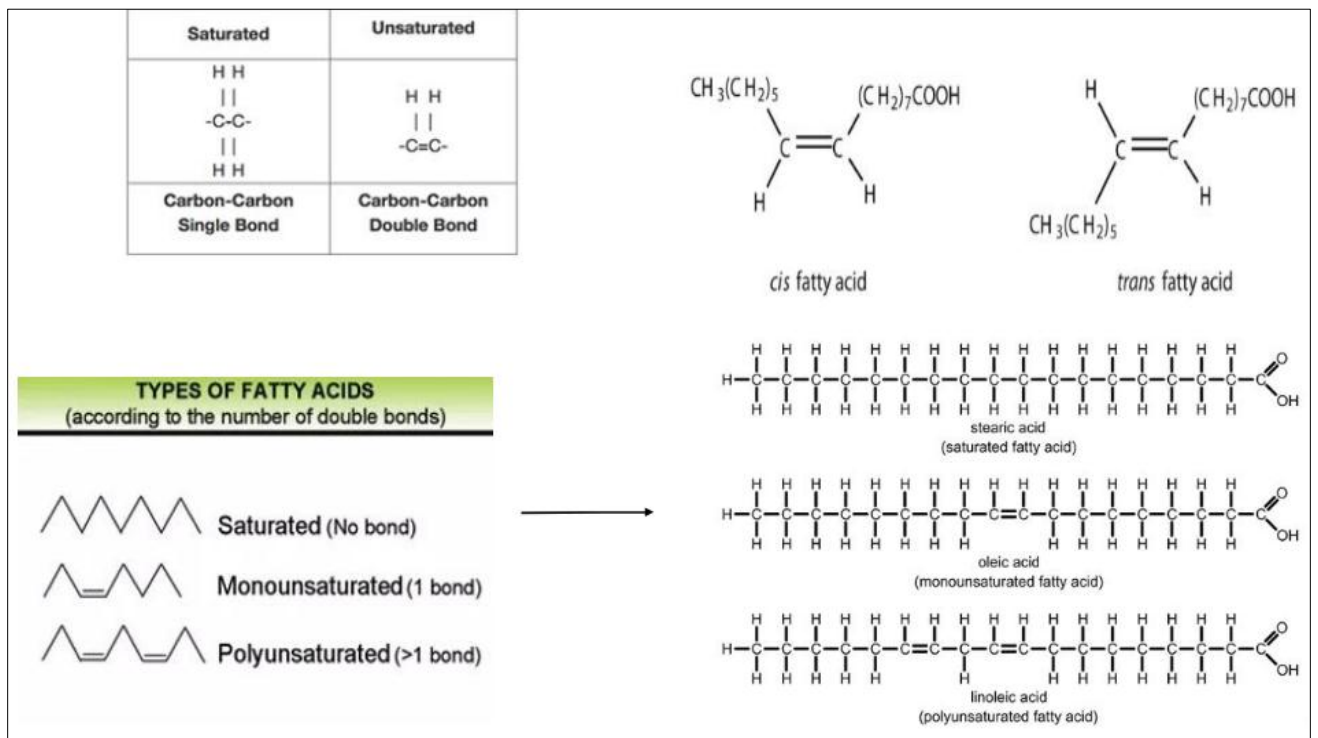


Fatty Acids (FA)

Fatty acids: are long-chain hydrocarbon molecules that terminate with carboxylic acid groups. The numbering of carbons in fatty acids begins with the carbon of the carboxylate group (COOH) .

- The fatty acid chains in membranes usually contain between 14 and 24 carbon atoms; they may be saturated or unsaturated. Short chain length The 16- and 18-carbon fatty acids are most common. The hydrocarbon chain is almost Unbranched in animal fatty acids.

- The alkyl chain may be saturated or it may contain one or more double bonds. The configuration of the double bonds in most unsaturated fatty acids is *cis*.
- The double bonds in polyunsaturated fatty acids are separated by at least one methylene group.
- Fatty acids that contain no carbon-carbon double bonds are termed saturated fatty acids; those that contain double bonds are unsaturated fatty acids and fatty acids with multiple sites of unsaturation are termed polyunsaturated fatty acids (PUFAs)



- The physical properties of a fatty acid depend on the length of the hydrocarbon chain and the degree of unsaturation.

- The melting points of saturated fatty acids increase with increasing molecular weight because of increased van der Waals interactions between the molecules.
- The presence of double bonds in fatty acids significantly lowers the melting point relative to a saturated fatty acid.
- The melting points of the unsaturated fatty acids decrease as the number of double bonds increases. For example, an 18-carbon fatty acid melts at 69 °C if it is saturated, at 13 °C if it has one double bond, at -5 °C if it has two double bonds, and at -11 °C.

Essential fatty acids:-

The fatty acids can not be synthesized by the body and, therefore, should be supplied in the diet are known as essential fatty acids (EFA). Chemically, they are unsaturated fatty acids, namely linoleic acid and linolenic acid Arachidonic acid .

Functions of EFA:-

- 1- Membrane structure and functions.
- 2- Transport of cholesterol .
- 3- Formation of lipoproteins .
- 4- Prevention of fatty liver .

-Length of hydrocarbon chain of fatty acids:

Depending on the length of carbon chains, fatty acids are categorized into 3 groups:

1-Short chain with less than 6 carbons.

2- Medium chain with 8 to 14 carbons.

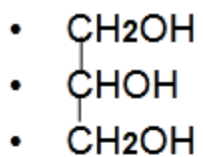
3- Long chain with 16 to 24 carbons.

• **Triacylglycerol:-**

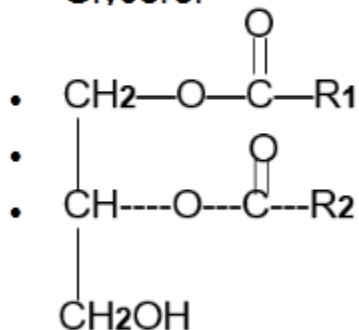
The lipids which are uncharged are referred to as neutral lipids e.g. triacylglycerols.

• Triacylglycerols (triglycerides) are the esters of glycerol with fatty acids.

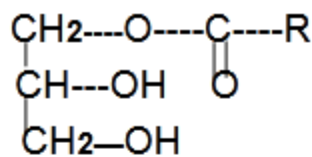
They are insoluble in water and non-polar solvents and known as neutral fats. TG are the most abundant group of lipids. The fat reserve of normal humans (men 20%, women 25% by weight) is sufficient to meet the body caloric requirements for 2-3 months.



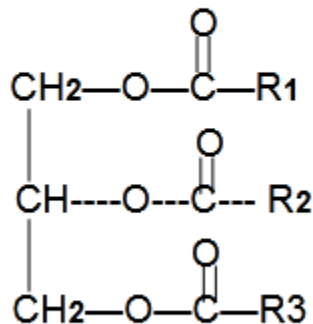
Glycerol



1,2-Diacylglycerol

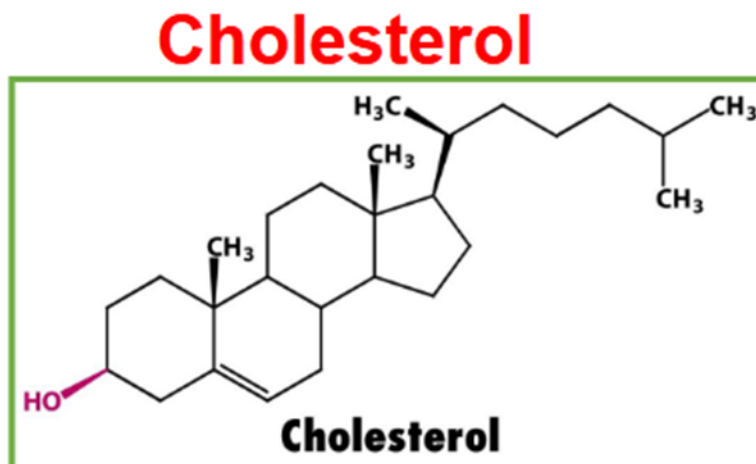


1-Monoacylglycerol



Triacylglycerol

Cholesterol:-



- A 27 carbon lipid; inflexible, 60-80% of cholesterol is in the plasma membrane .
- It is a major component of cell membranes and lipoproteins.
- Most cholesterol in the blood is bound to unsaturated fatty acid by the OH group at site 3 to form cholesterol-ester compounds
- Promotes membrane stability (reduces fluidity).
- Precursor of steroid hormones, bile salts and Vitamin D.
- Major site of cholesterol synthesis is the liver with significant synthesis in intestines.

The role of lipids in teeth diseases:-

The lipid fraction of the saliva is composed mainly of neutral lipids, but also of glycolipids and phospholipids. The dysfunction of lipid parameters of saliva is observed in the course of diseases related to the oral cavity as well

as systemic diseases. Interesting observations were provided by the results of research on the lipid fraction of saliva in people with cystic fibrosis and syndrome. The saliva of cystic fibrosis patients contains much more neutral lipids such as free fatty acids, triglycerides and cholesterol in comparison to saliva of healthy people . In patients with syndrome, salivary glandular mucosa differs from the healthy population by the content and composition of the lipid fraction, by increasing the concentration of glycolipids and phospholipids. In the course of diabetes, gastrointestinal diseases and periodontal diseases the release of malondialdehyde (MDA) - a marker of oxidative stress was observed . An increase in concentration of MDA was found in saliva of people with oral lichen planus and in patients with recurrent aphthae .Studies in healthy adults indicate weak positive correlations between cholesterol and serum cholesterol concentrations Salivary organic compounds are analyzed for their use in the diagnosis and treatment of diseases. For dentists particularly important is their role in the physiology and pathology of the oral cavity. Among the organic components of saliva, the least documented is the role of the lipid fraction in maintaining dental and periodontium health. Research indicates the importance of salivary proteins in maintaining the health of teeth.

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