

## PUC 1<sup>ST</sup> YEAR –SEMESTER-2

### UNIT II: Chemical constituents of living cells

#### Module No 9: LIPIDS-STRUCTURE CLASSIFICATION AND FUNCTIONS

The lipids are a heterogeneous group of substances which have the common property of being relatively insoluble in water and soluble in non-polar solvents such as Ether, Chloroform and Benzene. The lipids include fats, oils, waxes and related compounds. All lipids consist of combinations of carbon, hydrogen and oxygen. In the body, fat serves as an efficient source of energy when stored in adipose tissue. In animals, these are stored in adipose tissue, bone marrow and nervous tissue. In case of plants, seeds, nuts and fruits contain them.

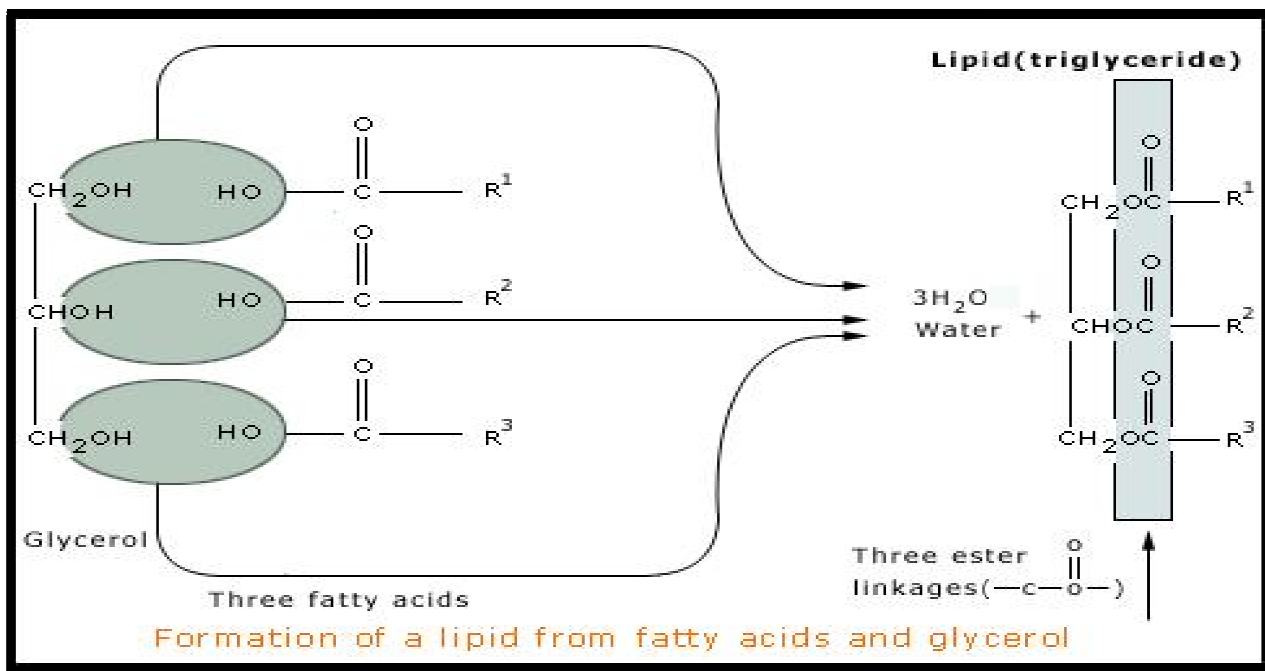
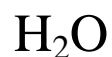
**Classification:** Lipids are classified into

1. Simple lipids
2. Compound lipids
3. Derived lipids and
4. Hydro Carbons

**1. Simple Lipids:** Simple lipids are esters of fatty acids with alcohols or the tri glycerides containing fatty acids and alcohol. These are mainly two types

A) **Fats and oils:** These are esters of fatty acids with glycerol. Oil is a liquid while fat is a solid at room temperature. The fatty acids are grouped into saturated and unsaturated fatty acids. In saturated fatty acids all the carbon atoms are provided with two 'H' atoms but in unsaturated acids some or all the carbon atoms are not fully saturated with hydrogen atoms and possess double bonds. The unsaturated fatty acids are more common in animals





## Formation of a Triglyceride

**B) Waxes :** Esters of fatty acids (usually long chain ) with alcohols other than glycerol. In the human body the commonest waxes are the cholesterol esters.

**2. Compound lipids:** Esters of fatty acids with alcohol contains additional groups such as phosphates ,nitrogenous base , carbohydrate, protein etc. They are further divided into

**A. Phospholipids:** Lipids containing phosphoric acid and a nitrogen base in addition to alcohol and fatty acids. Glycerophospholipids contain glycerol as the alcohol eg., lecithin , cephalin, Sphingophospholipids contain sphingosine as the alcohol eg: Spingomyelin.

Lecithins play an important role in permeability, osmotic tension and surface condition of cells. Cephalins are important factors in blood coagulation. Sphingo myelin is a common constituent of brain, nerve and myelin sheath and is therefore absent in plants and micro organisms.

- B. Glycolipids:** These are the compounds of the fatty acids with carbohydrates, containing nitrogen but phosphoric acid and glycerol are absent. The alcohol in sphingosine. Cerebrosides and gangliosides are common. They are found in nervous tissue.
  - C. Lipoproteins:** These are the complexes of lipids and proteins. They are found in cell membrane, egg yolk etc .
  - D. Other complex lipids:** Sulfolipids, amino lipids and lipopoly saccharides are among the other complex lipids .
- 3. Derived lipids:** Derived lipids include substances derived from simple and compound lipids on hydrolysis. These include fatty acids, glycerol, steroids, alcohols, fatty aldehydes and ketone bodies .
- 4. Hydrocarbons:** These are substances which don't have any structural relation ship to fatty acids but yet are grouped with lipids only because of their similar solubility properties. These are Carotenoids, vitamin A,E, and K etc.

### **Functions of Lipids:**

1. Lipids provide food of high caloric value (1 gram fat produces about 9.3 kilo calories of heat)
2. These serve as the structural components of cellular membranes.
3. These serve as intra cellular storage deposits of metabolic fuel.
4. Many enzymes require lipid molecules for maximal activation.

5. Adrenal corticoid, sex hormones and vitamin D<sub>2</sub> are synthesized from lipid derivatives.
6. Much of the lipid of mammals is located sub cutaneously and acts as an insulator against excessive heat loss to the environment.
7. As compounds of the inner mitochondrial membrane, lipids (Phospholipids) participate in electron transport chain.
8. Edible oils extracted from many seeds are used in cooking
9. Myelin sheath around nerve fibers take part in insulation
10. Phospholipids play an important role in the absorption and transportation of fatty acids.
11. Lipids act as a solvent for fat soluble vitamins A, D and E.
12. In animals the fat produce a shock absorbing cushion around eyeballs, gonads , kidneys and other vital organs.

### **Check points**

- Lipids are insoluble in water but soluble in solvents like ether, chloroform, benzene etc.
- Lipids consists of carbon, hydrogen and oxygen
- Lipids are classified into simple lipids, compound lipids, derived lipids and hydrocarbons.
- Simple lipids are esters of fatty acids with alcohols.
- Fats, oils and waxes are simple lipids.
- Compound lipids on hydrolysis yield in addition to fatty acids, and alcohol other groups such as phosphate, nitrogenous base, carbohydrates, proteins etc.
- Derived lipids include substances derived from simple and compound lipids on hydrolysis.

- Important function of lipids includes – mechanical protection, heat insulation, hormone synthesis, enzyme activation, carrier of essential compounds, rich source of respiratory energy, structural components of cells and chief food storage compounds.

### Object type Questions:

1. The lipids present in brain, nerve and myelin sheath are  
A. **Phospholipids**    B. Glycolipids    C. Lipoproteins  
D. Hydrocarbons
2. One of the following are complexes of lipids and carbohydrates  
A. Phospholipids                      **B. Glycolipids**                      C. Lipoproteins                      D. Hydrocarbons
3. Cerebrosides and gangliosides are  
A. Phospholipids                      **B. Glycolipids**                      C. Lipoproteins                      D. Derived lipids
4. Cerebrosides and gangliosides are found in  
A. **Nervous tissues**                      B. Egg yolk                      C. Gonads                      D. Kidneys
5. Lipids  
A. Serve as the structural components of cellular membranes  
B. Provide food of high caloric value  
C. Serve as intracellular storage depots  
**D. All**

### Short answer questions:

1. Write notes on fats and oils?
2. Write notes on phospholipids?
3. What are glycolipids?

4. List out some important functions of lipids?
5. What are derived lipids?

**Long Answer Questions:**

1. Classify lipids, giving examples?
2. Define lipids. Discuss their functions in details?