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Diploma in Pharmacy 2nd Year Biochemistry & Clinical Pathology Chapter 4 : Lipids	
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Chapter 4
Lipids

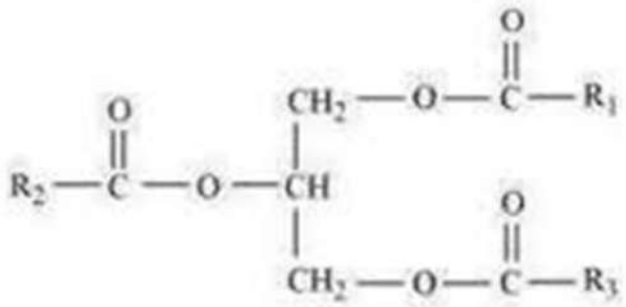
- → The word lipid is derived from the Greek word lipos meaning fat; universally present in all plants and animal cells.
- → They are naturally occurring waxy, greasy. or oily organic compounds and are known as oils and fats.
- → Lipids are hydrophobic in nature, Le., insoluble in water but soluble in non-polar solvents (chloroform, benzene, ether, etc.).
- → They are present in cell membrane and also found as storage molecules They are a source of high energy value, therefore are important constituent of the diet.

Classification of lipid with examples

1. **Simple Lipids :** These are esters of fatty acids containing various alcohols and carry no other substance
    - **Fats and Oils :** These are esters of fatty acids containing glycerol, Oils are also fats but are present in the liquid state. Waxes: These are esters of fatty acids containing high molecular weight monohydric alcohols.
2. **Compound Lipids :** These are esters of fatty acids, containing an alcohol, a fatty acid, and other groups
    - **Phospholipids :** These lipids consist of fatty acids, an alcohol, and a phosphoric acid residue. They frequently have nitrogen-containing bases and other substituents, e.g., in glycerophospholipids the alcohol is glycerol and in sphingophospholipids the alcohol is sphingosine.
    - **Glycolipids (Glycosphingolipids) :** These lipids consist of a fatty acid, sphingosine, and carbohydrate.
3. **Derived Lipids :** These are hydrolysed derivatives of simple or compound lipids. Examples of this class of lipids are fatty acids, glycerol, steroids, terpenes, carotenoids, fatty aldehydes, etc.

Structure and Properties of Triglycerides

→ Triglyceride are organic compounds in which three different fatty acids are linked to the glycerol by Easter bond.



Structure of triglyceride

Properties of triglyceride

- Non-polar : They are non polar(they does not have charge at the end).
- In soluble in water : They are insoluble in water.
- Soluble in organic substance : like Easter chloroform.
- Hydrophobic : They are hydrophobic in nature.

Fatty Acids

→ Chemically, fatty acids are monocarboxylic acid with aliphatic carbonic chain .

→ In higher plants and animals, the predominant fatty acid residues are those of the C16 and C18 species — palmitic, oleic, linoleic, and stearic acids.

→ Fatty acids that occur in natural fats usually contain an even number of carbon atoms. The chain may be saturated (containing no double bonds) or unsaturated (containing one or more double bonds)

Classification of Fatty Acids

On the basis of chemical nature

1. **Saturated** Fatty Acids : The fatty acids contain straight chain with single C--C band and have no C C Double bonds are called saturated fatty acids . Examples Stearic acid , Palmitic Acid , Arachidic Acid.
2. **Unsaturated Fatty Acids :** The fatty acids have one or more C C bonds in carbon chain are called unsaturated fatty acids . examples Linoleic Acid , Linolenic Acid , Arachidonic acid.

   Types of unsaturated fatty acids

   a) monounsaturated fatty acids (MUFA) : The fatty acid have one double bond in carbon chain.

   b) Polyunsaturated fatty acids (PUFA) : The fatty acid has two or more double bond in carbon chain.

   example

   O = Oleic Acid (one double bond)

   L = Linoleic Acid (2 double bond)

   L = Linolenic Acid (3 double bond)

   A = Arachidonic Acid (4 double bond)

Nutritional requirement of fatty acid

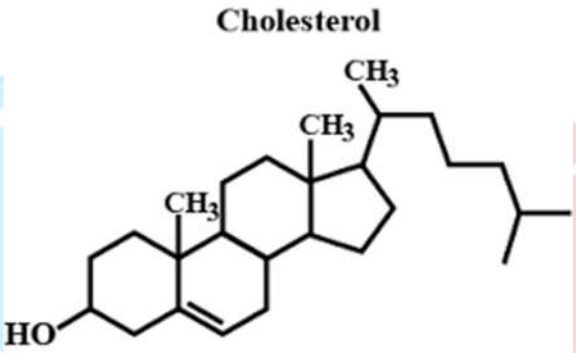
1) **Essential fatty acid :** These are the fatty acids which are not produced in human body they are must be taken through food (diet). examples Linoleic Acid , Linolenic Acid , Arachidonic acid .
2) **Non essential fatty acids :** The fatty acids are produced in human body and no need to take through foods (diet). Examples Stearic acid , Palmitic Acid , Arachidic Acid.

Structure and Functions of Cholesterol in the body

Cholesterol

→ Cholesterol is a type of lipids that found in all the cells of the body.

Structure of Cholesterol



Functions of Cholesterol

- It is a component of cell membrane.
- It maintains the permeability of cell membrane.
- It helps in bile production.
- It helps in the formation of vitamin D.
- It metabolize (break down) fat soluble vitamins.
- It helps in the formation of male and female sex hormones.
- It insulate the nerve fiber.

Lipoproteins

→ Lipoproteins are molecular complexes of lipids with proteins. They are the transport vehicles for lipids in the circulation.

Types of Lipoproteins

On the basis of electrophoresis separation , five types of lipoproteins are found in human plasma.

- **Chylomicrons :** This types of lipoproteins are synthesized in the intestine and have the highest lipid content (98%) and lowest protein content (2%) , and have the lowest density and are biggest in size . (have 4% of cholesterol of 98% of lipids)
- **Very low density lipoproteins (VLDL) :** These proteins are produced in the liver and intestine , and have 10% of proteins and 90% of lipids . (have 24% of cholesterol of 90% of lipids).
- **Low Density lipoproteins(LDL) (Bad Cholesterol) :** These lipoproteins are produced in the blood stream from VLDL and transport cholesterol from liver to the rest of the body, and have 20% of proteins and 80% of lipids . (have 56% of cholesterol of 80% of lipids).
- **High density Lipoproteins (HDL) (good cholesterol) :** These lipoproteins are produced in the liver and transport cholesterol from peripheral tissues (skeletal muscle , adipose) to liver , and they have 40% of proteins and 60% of lipids . (have 40% of cholesterol of 60% of lipids).
- **Free fatty acids Albumin :** Free fatty acids in the circulation are in a bound form to albumin. Each molecule of albumin can hold about 20-30 molecules of free fatty acids. This lipoprotein cannot be separated by electrophoresis.

Function of lipoproteins In the body

- ✓ Absorption and transportation of lipids in small intestine.
- ✓ Transportation of lipids from liver to tissues.
- ✓ Transportation of lipids from tissues to liver.

Qualitative Test of Lipids

- **Grease spot Test :** In this test one drop of oil and a drop of water are put on a paper . at first , both areas look wet but after some time water is evaporates and the spot dries whereas lipid spot remains visible .
- **Solubility test :** In this test we add some drops of sample of lipid to organic substance and water and observe . it will miscible with organic substances like chloroform , ether and immiscible with water .
- **Test for Free Fatty Acids:** A few drops of phenolphthalein solution are taken in a test tube and added with 1-2 drops of very dilute alkali solution to develop a pink colour. This solution is shaken with a few drops of oil. The pink colour disappears due to neutralisation of the alkali by the free fatty acids present in the oil.

Function of lipids

- **Source of energy :** It is a best source of energy it provide energy more that carbohydrates and proteins.
- **Cell membrane :** They are important component of the cell membrane (phosphoric)
- **Membrane permeability :** They regulate membrane permeability.
- **Vitamins :** They store fat soluble vitamins (KEDA).
- **Enzyme :** They are components of various types of enzymes.
- **Thermal insulation :** fat deposited in the subcutaneous layer provide insulation and protection from cold.
- **Transport :** lipoproteins proteins transport cholesterol and triglyceride from their origin to site of use.
- **Electrical insulation :** They act as electrical insulator to the nerve fibres in the form of myelin sheath.
- **Storage :** They Store meaning of compounds.
- **Signalling :** They act as signaling molecule.