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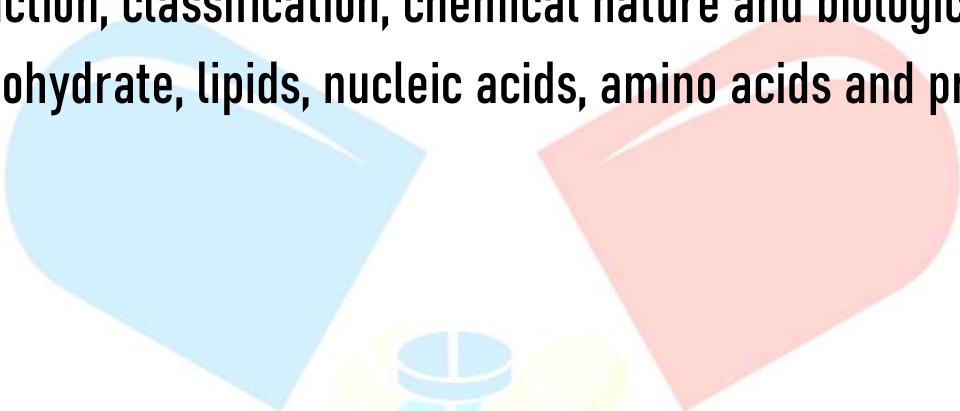
BIOCHEMISTRY

UNIT 1

TOPIC :

- **Biomolecules**

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.



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Learn and Educate

Biomolecules

- Biomolecules are organic molecules produced by living organisms.
- They form the physical structure and perform vital functions for life, such as metabolism, replication, energy storage, and cell signaling.
- These molecules primarily contain carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur.

Classification of Biomolecules

Biomolecules are classified into the following major categories:

1. Carbohydrates
2. Lipids
3. Proteins (and Amino Acids)
4. Nucleic Acids (DNA and RNA)

They are also broadly grouped into:

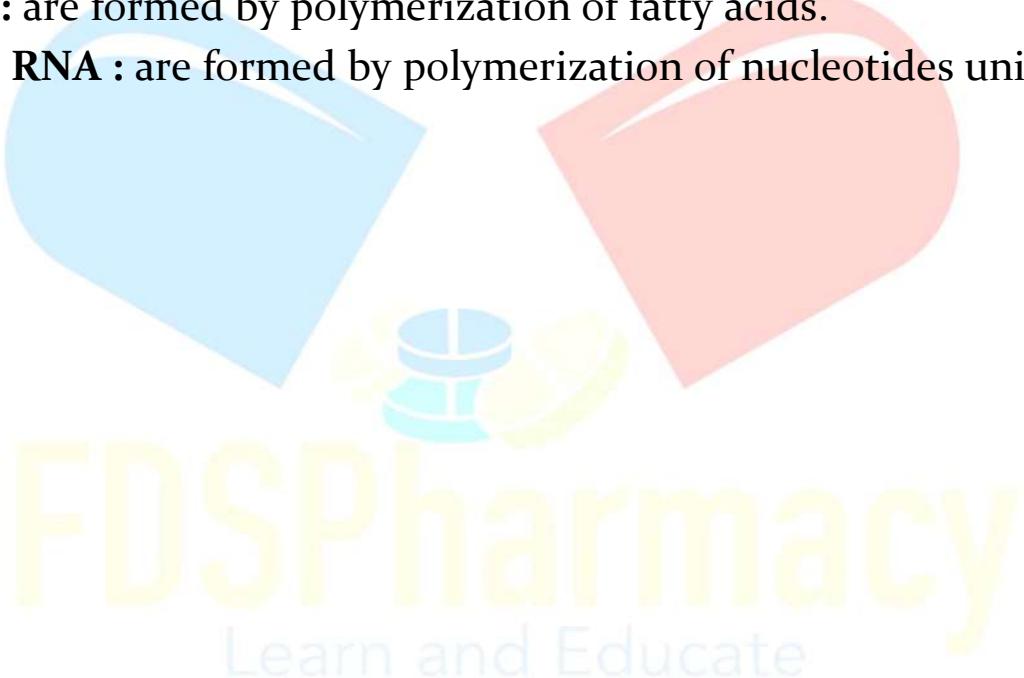
- **Micromolecules** – Simple, small (e.g., glucose, amino acids)
- **Macromolecules** – Complex, large (e.g., starch, proteins, DNA)

Micromolecules

- Micromolecules are small organic molecules present in the cytosol of a living cells.
- No of these molecules in a cell is around 100-200.
- Some common examples of micromolecules Aminoacids, nucleotides, sugar, & their phosphorilated derivatives.
- Most of these molecules are water soluble, polar are charged and present in micromolar to millimetre concentration.

Macromolecules

- The macromolecules have large molecular weight and are formed by polymerization of monomer units.
- Example polysaccharides (starch) are formed by polymerization of monosaccharides units.
- **Protein** : are formed by polymerization of aminoacids.
- **Lipids** : are formed by polymerization of fatty acids.
- **DNA & RNA** : are formed by polymerization of nucleotides units.



Carbohydrates

- Carbohydrates are Organic Compound with general formula $C_n(H_2O)_n$
- They are Composed of Carbon, Hydrogen, Oxygen,
- Carbohydrates are polyhydroxy aldehydes or ketone compound derived from hydrolysis.
- They are the Major source of chemical energy for the living organisms.
- Ex : Sugar & Starch.
- Starch & Cellulose are the two common carbohydrates.

Classification:

1. **Monosaccharides** – Glucose, fructose
2. **Disaccharides** – Sucrose, lactose, maltose
3. **Polysaccharides** – Starch, glycogen, cellulose

Biological role of Carbohydrates

- ▲ They are source of energy for living organism.
- ▲ They are used as dietary fibers like cellulose.
- ▲ They are used as flavouring and sweetening agent.
- ▲ They are stored in our body in the form of glycogen in liver and muscles and converted into glucose to provide energy according to need.
- ▲ They are important component of brain cells.
- ▲ They are important component of DNA & RNA (Deoxyribose and Ribose sugar)
- ▲ They act as an anticoagulant in the form of Heparin.
- ▲ They are major component of cartilage, tendon and bones.
- ▲ They are used in clearance test in the form of Inulin.

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, i.e., 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

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.

Biological role of lipids

- ▲ **Source of energy** : It is a best source of energy it provide energy more than 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.

Proteins (and Amino Acids)

- Proteins are naturally occurring polymers made up of amino acids.
- Almost everything that occurs in the cells involves one or more Proteins.
- Proteins provide structure, cellular reaction and carried out the tasks.
- 20 amino acids are found in protein and they are called standard amino acid. These amino acids contain the carboxyl group and the amino group attached to α carbon.

Classification of Amino Acids

- **Essential amino acids** – Must be obtained from diet (e.g., lysine, methionine)
- **Non-essential amino acids** – Synthesized in the body (e.g., alanine, glycine)

Biological role of Proteins (and Amino Acids)

- ▲ Proteins give amino acids on hydrolysis during digestion and amino acids are the building blocks required for a cell to synthesize for proteins.
- ▲ Proteins are the structural component of protoplasm cell and tissues
- ▲ Enzymes and few hormones are Proteins in nature antibiotics, haemoglobin are also Proteins.
- ▲ Protein is one of the important components of diet it is required to maintain growth and healthy functioning of the body.
- ▲ In the cell, cell membrane is also made up by the protein, protein play the role in the transporting the cellular and outer material through the active or passive transport.
- ▲ In our body some amount of protein stored, for the starvation, critical condition for energy.

Nucleic acids

- Nucleic Acids (DNA & RNA) are formed by the polymerization of Nucleotide Subunits.
- Nucleic Acids are made up of a ribose sugar, nitrogenous base & Phosphate group.
- Deoxyribonucleic Acid (DNA) & Ribonucleic Acid (RNA) are two types of nucleic acids that act as sources and carriers of genetic Information.

Classification

1. **DNA (Deoxyribonucleic acid)** – Double helix, stores genetic information
2. **RNA (Ribonucleic acid)** – Single-stranded, involved in protein synthesis

Biological Role of Nucleic acids

- **DNA:** Carries genetic blueprint of the organism
- **RNA:** Transfers genetic code from DNA to ribosomes for protein synthesis
 - mRNA, tRNA, rRNA types