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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.

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 cystol of a living cells.
→ No of there molecules in a cell is around 100-200.
→ Some common examples of micromolecules Aminoacids, nucleotides, sugar, & their phosphorilated derivatives.
→ Most of there 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 aldehydre 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 sweating 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, 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

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 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.

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 synthesis 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