BIOMOLECULES

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BIOMOLECULES

- **Defination;-** Biomolecules are organic compounds that are produced by living organisms and are essential for life.
- **Functions of biomolecules;-**
  - **Structural support**: Biomolecules provide the structural components for living cells
  - **Energy**: Biomolecules provide and store energy
  - **Growth and development**: Biomolecules help organisms grow and develop
  - **Immune response**: Biomolecules help organisms respond to immune challenges
  - **Genetic information**: Biomolecules carry genetic information

BIOMOLECULES

Classification of Biomolecules

- **Proteins**: A primary biomolecule that is essential for life
- **Nucleic acids**: A primary biomolecule that stores genetic information, such as DNA and RNA
- **Carbohydrates**: A primary biomolecule that can be structural or a source of energy
- **Lipids**: A primary biomolecule that helps move fats, fatty acids, and cholesterol

1. CARBOHYDRATES

Defination;- In biochemistry, carbohydrates are organic molecules made up of carbon, hydrogen, and oxygen in ratio 1:2:1. They have most abundant moecules in nature.

BIOLOGICAL ROLE OF CARBOHYDRATES

The biological role of carbohydrates is to provide energy for the body, achieved by regulating blood glucose levels; other functions include:

- **Energy source:**- Carbohydrates are the body's main source of readily available energy, particularly in the form of glucose which fuels the brain, muscles, and other organs.
- **Blood sugar regulation:**- Carbohydrates help maintain stable blood sugar levels by influencing the release of insulin, preventing drastic fluctuations.
- **Protein sparing:**-By providing energy, carbohydrates prevent the body from breaking down muscle protein for fuel.
- **Preventing ketosis:**-Carbohydrates help break down fatty acids, preventing the body from entering a state of ketosis where it burns fat for energy instead of glucose.
- **Dietary fiber:**-Certain carbohydrates, like fiber, aid in digestion by adding bulk to stool and promoting regular bowel movements.
- **Cell recognition:**-Carbohydrates on cell membranes play a role in cell-to-cell recognition and communication.
- **Structural component:**-Some complex carbohydrates, like cellulose in plants, provide structural support.
- **Flavor and sweetness:**-Simple sugars like fructose contribute to the taste of food.

CLASSIFICATION OF CARBOHYDRATES

Classified on the basis of their behaviour in hydrolysis. They are mainly classified into three groups:

- **Monosaccharide;-** It is a polyhydroxy aldehyde & ketones, Which can not be decomposed by hydrolysis to give a simple carbohydrates. E.g. – Glucose, Fractose.
- **Disaccharides;-** Yield two Monosaccharide molecules on hydrolysis. E.g.- Sucrose & Maltose.
- **Polysaccharides;-** Yield more then two Monosaccharide molecules on hydrolysis. E.g.- starch.

CLASSIFICATION OF CARBOHYDRATES

Classified on the basis of their Carbon Atoms

Triose;- $C_6H_6O_3$ **E.g. Glyceraldehydes, dihydroxyacetone**

Tetroses;- $C_4H_8O_4$ **E.g. Erythrose, Threose**

Pentoses;- $C_5H_{10}O_5$ **E.g. Ribulose, Aribinose**

Hexoses;- $C_6H_{12}O_7$ **E.g. Flucose, Freactose, Galactose**

Heptoses;- $C_7H_{14}O_7$ **E.g. Sedoheptulose, Glucoheptose**

CLASSIFICATION OF CARBOHYDRATES

Classified on the basis of their Functional group

1. **Aldose;- The functional group is aldehyde –CHO E.g. glyceraldehyde, glucose.**
2. **Ketoses;- The functional group is ketone C=O E.g. dihydroxy acetone, fractose.**

2. PROTEINS

Definition;- In biochemistry, proteins are complex molecules made up of amino acids that perform many functions in the body.

Biological Role of Proteins

- **Structural component of cells**: Proteins form the structural component of cells.
- **Enzymes**: Proteins form enzymes, which are biological catalysts that speed up chemical reactions in cells.
- **Hormones**: Proteins form hormones, such as insulin and glucagon.
- **Repair mechanism**: Proteins are involved in the body's repair mechanism.
- **Defense against infections**: Proteins, such as antibodies, help the body defend against infections.
- **Digestion**: Proteins, such as enzymes, break down complex food substances into simpler molecules that can be absorbed into the blood.
- **Energy**: Proteins provide energy to the body.
- **Muscle contraction**: Proteins, such as motor proteins, generate the forces that cause muscle contraction.

PROTEINS

- Classification Based on their Structure
  - Fibrous protein
  - Globular protein
- Classification Based on their Composition
  - Simple protein
  - Conjugated protein
- Classification Based on their Composition

Structural Protein, Enzyme, Hormones, Pigments, Transport Protein, Contractile Proteins, Toxins, Storage Protein

CLASSIFICATIONS OF PROTEINS

- **Classification Based on their Structure**

Fibrous Proteins

- **Structure**: Long polymer chains arranged parallel to each other, forming long fibers or sheets
- **Properties**: Tough, resistant to water, and mechanical strength
- **Examples**: Keratin, collagen, elastin, and fibrin
- **Function**: Structural components of tissues like bone, hair, tendons, and leather

Globular Protein

- **Structure**: Polymer chains fold back on themselves to form compact, nearly spherical shapes
- **Properties**: Water-soluble and relatively mobile within a cell
- **Examples**: Enzymes, antibodies, hormones, toxins, and hemoglobin
- **Function**: Transport simple molecules or electrons from one place to another

CLASSIFICATIONS OF PROTEINS

- **Classification Based on their Composition**

Simple Protein

- Also called homoproteins, these proteins are made up of only amino acids
- **Examples** albumin, collagen, and keratin

Conjugated proteins

- Also called heteroproteins, these proteins are made up of amino acids and non-protein components called prosthetic groups
- **Examples** glycoproteins, chromoproteins, and phosphoprotein

CLASSIFICATIONS OF PROTEINS

- **Classification Based on their Composition**

Structural proteins

- Maintain the shape of cells and tissues. Examples include collagen in connective tissue, keratin in hair and skin, and myosin in muscles.

Enzymatic proteins

- Speed up chemical reactions in cells, also known as metabolism. Enzymes are biological catalysts that are essential for most cellular processes.

Transport proteins

- Move molecules across cell membranes, such as nutrients, ions, and waste products.

Storage proteins

- Store amino acids and metal ions. Examples include egg white (albumin) and legume storage proteins.

Contractile proteins

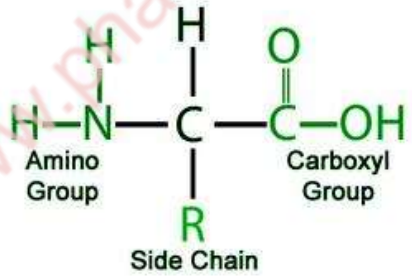
- Responsible for internal movement of smooth muscles, such as those in digestion, reproduction, and glands. Myosin is an example of a contractile protein.

Defensive proteins

- Protect the body from foreign pathogens. Antibodies are an example of a defensive protein.

3. AMINO ACIDS

- In biochemistry, amino acids are organic compounds that are the building blocks of proteins.
- Amino acids contain an amino group (–NH2) and Carboxylic acid group (–COOH).
- Both group attached to an Alpha carbon **or** R-Group that is unique to each amino acid.



Structure of amino acid

AMINO ACIDS

Biological role of amino acids;-

- Amino acids are the building blocks of proteins, which are polymers of amino acids.
- L-amino acids are essential for life and are found in all kingdoms of life.
- Other biological functions
- Amino acids help with tissue repair, digestion, and the transportation of molecules.
- They are also involved in the production of neurotransmitters, catecholamines, and other important molecules.
- Amino acids are involved in nitrogen metabolism, which is the process of removing excess nitrogen from the body.
- Amino acids are involved in epigenetics and modulation of reactive oxygen and nitrogen species

CLASSIFICATIONS OF AMINO ACIDS

- **Non-essential amino acids:** These amino acids are produced by the body and do not need to be consumed. Out of the twenty amino acids, ten are non-essential.

  Glycine, alanine, serine, cysteine, glutamine, tyrosine, proline, aspartic acid, asparagine, and glutamic acid are amino acid.

- **Essential Amino Acids:** These amino acids are not synthesized by the body and must be obtained from food. Out of the twenty amino acids, ten are non-essential.

  Valine, leucine, isoleucine, arginine, lysine, threonine, phenylalanine, tryptophan, and histidine are the amino acids that make up the human body.

4. LIPIDS

- ***"Lipids are organic compounds that contain hydrogen, carbon, and oxygen atoms, which form the framework for the structure and function of living cells."***

- These organic compounds are nonpolar molecules, which are soluble only in nonpolar solvents and insoluble in water because water is a polar molecule.

- In the human body, these molecules can be synthesized in the liver and are found in oil, butter, whole milk, cheese, fried foods and also in some red meats.

LIPIDS

These biological roles include:-

- **Energy storage**: Lipids are a primary energy reserve for the body.
- **Insulation**: Lipids help insulate the body.
- **Organ protection**: Lipids cushion internal organs like the heart.
- **Hormone production**: Some lipids are essential hormones in the body.
- **Vitamin absorption**: Lipids help the body absorb vitamins.
- **Chemical identification**: Lipids act as chemical identifiers for specific membranes.
- **Signaling**: Lipids act as signaling molecules.
- **Cell membrane structure**: Lipids are structural components of cell membranes, which control what enters and exits cells.

CLASSIFICATIONS OF LIPIDS

- **Simple Lipids**

  Esters of fatty acids with various alcohols.

  - **Fats:** Esters of fatty acids with glycerol. Oils are fats in the liquid state
  - **Waxes**: Esters of fatty acids with higher molecular weight monohydric alcohols

- **Complex Lipids**

  Esters of fatty acids containing groups in addition to alcohol and fatty acid.

  - **Phospholipids**: These are lipids containing, in addition to fatty acids and alcohol, phosphate group. 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)**: Lipids containing a fatty acid, sphingosine and carbohydrate.
  - **Other complex lipids**: Lipids such as sulfolipids and amino lipids. Lipoproteins may also be placed in this category

THANK YOU

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