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General Science & Ability

Assignment no. 1.

Topic: Carbohydrates, Proteins, and Lipids.

1. Carbohydrates.

Definition:

Carbohydrates are organic molecules of carbon, hydrogen and oxygen atoms, typically with a hydrogen-oxygen atom ratio of 2:1, as in water. They are one of the main types of nutrients and the most important source of energy for our body.

Classification / Types of Carbohydrates.

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Based on their chemical structure and complexity, carbohydrates are classified into:

1. Simple carbohydrates
2. Complex carbohydrates.

1. Simple Carbohydrates

Simple carbohydrates, also known as simple sugars, consist of one or two sugar molecules. They are quickly broken down by the body to provide a rapid source of energy.

Types

1. Monosaccharides: As the name suggests, from Greek, mono = one and sakkron = sugar, monosaccharides consist of ~~one~~

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a single sugar molecules

- Examples: glucose, fructose, and galactose.

2. Disaccharides: Formed by the combination of two monosaccharides molecules.

- Examples: sucrose (table sugar), lactose, and maltose.

Sources :

Fruits, honey, milk, table sugar, candy and sweets.

2. Complex Carbohydrates

Complex carbohydrates contain longer chains of sugar molecules. These take longer to break down and provide sustained energy. These are also called

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polysaccharides.

Polysaccharides: In Greek, ~~pto~~ 'poly' means many. Polysaccharides are formed by the polymerization of a large number of monomers (single sugar molecules).

- **Examples:** Starch, glycogen, and cellulose.

Sources:

Whole grains, vegetables, legumes, tubers.

Oligosaccharides:

Oligosaccharides consist of a small number (typically 3 to 10) of monosaccharide units linked together by glycosidic bonds.

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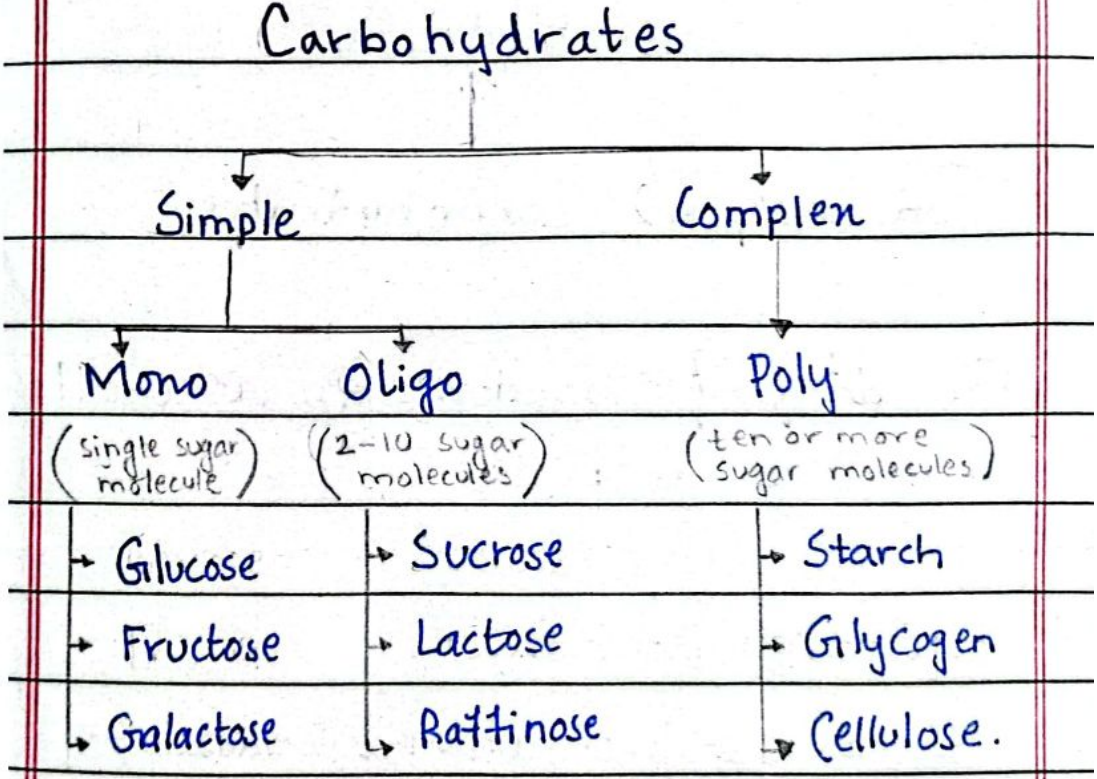
They fall between simple and complex carbohydrates in terms of size and complexity.

- Examples: Raffinose, Stachyose.



Characteristics of Carbohydrates

- Carbohydrates are chemical compounds that contain oxygen, hydrogen, and carbon atom

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- They have the general chemical formula $C_m(H_2O)_n$.

- Simple carbohydrates are soluble in water and often taste sweet as opposed to complen carbohydrates.

Functions of Carbohydrates

The primary functions of carbo-hydrates are:

1. Energy source.

Carbohydrates are the body's main source of energy. When consumed, they are broken down into glucose, which is used by cells to produce ATP (adenosine triphosphate) through cellular respiration.

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2. Energy Storage

Excess glucose from carbohydrate can be stored in the liver and muscles as glycogen. This glycogen can be broken down to glucose when energy is needed, such as between meals or during physical activity.

3. Prevent protein breakdown

Carbohydrates help prevent the break-down of proteins for energy, allowing them to be used for their primary functions, such as building and repairing tissues.

4. Assisting fat metabolism

Carbohydrates are necessary for the proper oxidation of fats. Without enough carbohydrates, the body cannot completely

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break down fats, leading to Ketosis.

5. Regulation of blood glucose

Consistent intake of carbohydrates helps keep glucose levels stable, preventing hyperglycemia (high blood sugar) and hypoglycemia (low blood sugar).

6. Gastrointestinal health

Dietary fiber, a type of complex carbohydrate, is essential for preventing constipation and promoting regular bowel movements.

7. Stuctural function.

In plants, carbohydrates like cellulose provide structural support.

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2. Proteins.

Definition:

Proteins are large, complex molecules made up of ~~potp~~ polypeptide chains of amino acids that are linked with peptide bonds.

Proteins are essential nutrients that serve as building blocks for body tissue and also function as enzymes, hormones, and antibodies.

Classification of Proteins

Proteins can be classified based on their biological function and structure.

Classification based on biological function

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1. Structural proteins: These provide support and shape to cells and tissues.

- Examples: Collagen (found in skin and bones), Keratin (found in hair and nails).

2. Enzymatic proteins: Enzymes catalyse biochemical reactions.

- Examples: Amylase (breaks down starch), DNA polymerase (synthesizes DNA).

3. Transport proteins: These proteins carry substances throughout the bloodstream or across cell membranes.

- Examples: Haemoglobin (carries oxygen in blood), GLUT1 (glucose transporter).

4. Defensive proteins: These

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protect the body from pathogens and disease.

- Examples: Antibodies (immune response), fibrinogen (blood clotting).

5. Storage Protein: These store amino acids and other substances for future use.

- Examples: Casein (stores amino acids in milk), Ferritin (stores iron).

Classification based on Structure

Based on structure, proteins are classified into four main categories:

1. Primary structure: The sequence of amino acids in

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a polypeptide chain.

2. Secondary structure: Refers to local folded structures like alpha-helices and beta-sheets.

3. Tertiary structure: The overall three-dimensional structure of a polypeptide.

4. Quaternary structure: The structure formed by multiple polypeptide chains (subunits) joining together.

Sources of Proteins

Protein can be sourced from both plants and animals. Some common protein sources include egg, milk, meat, cheese, fish, nuts, seeds and lentils.

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Characteristics of Protein

- Proteins are made up of 20 different amino acids, which determine their structure and function.

- Amino acids in proteins are linked by peptide bonds formed through dehydration synthesis.

- Proteins can have various functions, such as catalysis, support, movement, regulation and protection.

- Protein structure and function can be affected by changes in pH, temperature, and chemical environment.

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3. Lipids.

Definition:

Lipids are organic compounds, mainly composed of hydrocarbon chains. Lipids are commonly known as oils and fats. These molecules yield high energy and are responsible for different bodily functions.

Classification of Lipids.

Lipids can be classified on the basis of their structure, chemical composition, and saturation level of their fatty acids.

Classification based on Structure and chemical

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composition

1. Simple Lipids : These include only two main components : fatty acids and alcohol.

- Examples: Fats and oils (triglycerides) and waxes.

2. Complex Lipids : These include additional groups such as phosphorous and nitrogen, alongside fatty acids and alcohol.

- Examples : Phospholipids and glycolipids.

Classification based on Saturating level

1. Saturated Lipids : Saturated fats remain solid at room

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temperature, therefore, also called "solid fat". It is mostly found in animal fats, dairy products, and tropical oils like coconut, and palm oil. High intake of saturated fat can raise LDL cholestrol, increasing heart disease risk.

- Examples: Stearic acid (in beef fat), Palmitic acid (in palm oil).

2. Unsaturated Lipids: These fats are liquid at room temperature. Unsaturated fat can lower LDL cholestrol and are beneficial for heart health. There are two types of unsaturated fat:

a. Monounsaturated fat

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fat contains a single double bond and can be found in avocado, nuts, and vegetable oils, such as canola and olive oil.

- Example: Oleic acid (in olive oil).

b. Polyunsaturated fat

This type of fat contains multiple double bonds and can be found mainly in vegetable oils and seafood.

- Examples: Omega-6 fatty acid found in vegetable oil, and omega-3 fatty acid found in flaxseed oil.

3. Trans Lipids: These are unsaturated fats produced industrially by hydrogenating

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vegetable oils. Hydrogenation increases their shelf-life and makes the fat solid | semi-solid at room temperature. Trans fat can be found in processed foods, margarine and baked goods. Trans fat should be avoided.

Characteristics of Lipids

- Lipids do not dissolve in water

- Lipids are soluble in organic solvents ~~in~~ like chloroform and ether.

- Most lipids are hydrophic i-e., water-repellent.

- The basic unit of lipids

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is triglyceride, and fatty acids.

- Lipids provide more than twice the energy per gram compared to carbohydrates and protein.

Functions of Lipids

1. Energy storage

Lipids store energy efficiently. Triglycerides are the main form of energy stored in animals.

2. Structural Components

Phospholipids are cholestrol are crucial components of cell membrane, maintaining integrity and fluidity.

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3. Insulation and protection

Fat acts as insulation against cold and protects vital organs by cushioning them.

4. Signaling Molecules

Steroid hormones (e.g., estrogen and testosterone) and eicosanoids play critical roles in signaling pathways and regulatory processes.

5. Vitamin Absorption

Lipids help in the absorption of fat-soluble vitamins like vitamin A, D, E, K.