

Assignment # 1

Q: Classify carbohydrates, and proteins and lipids

Biomolecules are most essential organic molecules, which are involved in maintenance and metabolic process of living organisms. They range from micromolecules to macromolecules. Macromolecules includes carbohydrates, Lipids and proteins.

Following are the kinds of macromolecules:

1) Carbohydrates

Carbohydrate is combination of two words "Carbo" and "hydrate". Carbo is short form of Carbon and hydrate mean water, so they contain C, H and O, with empirical formula $C_x(H_2O)_y$. They are also known as saccharides, the word saccharide comes from Greek word sakron which means sugar.

Classification

Carbohydrates are classified into simple carbohydrates (monosaccharide, oligosaccharide) and complex carbohydrate (Polysaccharide).

i) Monosaccharide

From Greek, mono = one and sakron = sugar.

Monosaccharides are often called simple sugars.

The general formula is $C_n(H_2O)_n$. The monosaccharides are subdivided into trioses, tetroses, pentoses, hexoses and heptoses etc. Glucose, fructose, erythrulose and ribulose are examples of monosaccharides.

ii) Oligosaccharides

In Greek, Oligo means few. Oligosaccharides are compound sugars that yield 2-10 molecules of the same or different monosaccharides.

- On hydrolysis, oligosaccharides yielding 2 molecules of monosaccharides called disaccharides.
- And yielding of 3 or 4 monosaccharides are known as tetrasaccharides.
- General formula of disaccharide is $C_n(H_2O)_{n-1}$ and that of trisaccharides is $C_n(H_2O)_{n-2}$.

iii) Polysaccharides

In Greek, Poly means many. Polysaccharides are compound sugars and yield more than 10 molecules of monosaccharides.

• General formula is $(C_6H_{10}O_5)_n$

• Classification of polysaccharides:

(a) Homopolysaccharides

→ Same type of monosaccharides linked to form homosaccharides. E.g, starch, pectin & cellulose.

(b) Heteropolysaccharides

→ Different type of monosaccharides linked to form heterosaccharides.

→ E.g, Hyaluronic acid and Chondroitin.

Function of carbohydrates

Following are functions of carbohydrates:

■ Carbohydrates are chief energy source, in many animals; they are instant source of energy.

→ ■ Glucose is breakdown by glycolysis/Kreb's cycle to yield ATP.

■ Carbohydrates are rich in fiber content help to prevent constipation

■ They form structural and protective components, like in cell wall of plants and microorganisms.

■ In animals, they are important constituents of connective tissues.

2) Lipids

"Lipids" word is derived from "Lipos" means fat.

Primary building blocks of lipids are fatty acids, Glycerol and sterols.

→ They are most heterogeneous group of substances

→ They are insoluble in water

→ Lipids contribute to cell structure, provide stored fuel and also take part in many biological processes.

→ Lipids provide 9.1 calories energy per gram.

Types of lipids

Fats can be classified into saturated, trans fats and unsaturated. Most foods have both types that is saturated and unsaturated fats.

1) Saturated fat

- They are solid at room temperature, so called "solid fats".
- They are mostly present in milk, cheese and meat.
- They also present in tropical oils, such as coconut oil, palm oil and cocoa butter.

- Food made with butter, margarine or shortening (cakes, cookies and other desserts) have a lot of saturated fats.

(II) Trans fat

- This is a fat that has been changed by a process called hydrogenation.
- This process increase the shelf life of fat and make it harder at room temperature
- Trans fat can raise cholesterol, so should eat little as possible
- It is present in processed foods, snack foods, cookies, margarine and salad dressings.

(III) Unsaturated fat

- They are liquid at room temperature.
- Mostly present in oils from plants.
- We can improve our cholesterol level.

⇒ Types of unsaturated fats

→ Mono-unsaturated fats:

- Fats present in avocados, nuts and oils such as canola, olive and peanut oil.
- By eating foods that are high in monosaturated fats may help to lower "bad" LDL and keep "good" HDL cholesterol levels high.

→ Polyunsaturated fat:

- Fats present mostly in vegetable oils, sunflower, safflower, sesame, soybean and corn oils.
- Eating Polyunsaturated fats (are omega) may lower LDL cholesterol.
- Two types of polyunsaturated fats are omega-3 and omega-6 fatty acids.

Properties of lipids

General characters of lipids are:

- 1- Lipids are relatively insoluble in water.
- 2- They are soluble in non-polar organic solvents, like ether, chloroform and methanol.
- 3- Lipids have high energy content and are metabolized to release calories.
- 4- Lipids also act as an insulators. They insulate nerve axons.
- 5- Fats contain saturated fatty acids. They are solid at room temperature. For example, animal fat.
- 6- The melting point of fats depends on the length of the chain of the constituent fatty acid and the degree of unsaturation.

Functions of Lipids

Lipids perform several biological functions:

- 1) Lipids are storage compounds, reserve as reserve energy of body.
- 2) They regulate membrane permeability.
- 3) They are components of some enzymes system.
- 4) Our body's temperature is maintained by brown fat.
- 5) They protect our vital organs like heart and kidney.

3) Proteins

The name protein is derived from "Proteios" meaning prime importance. They are complex molecules made up of carbon, hydrogen, oxygen and nitrogen (sometimes sulphur and phosphorus).

Classification (based on structure of protein)

There are four structural levels of organization to describe the complex macromolecules, protein based on the degree of complexity of the molecule. They are following:

- 1) Primary structure
- 2) Secondary structure
- 3) Tertiary structure
- 4) Quaternary structure

1) Primary structure

Primary structure of protein is the linear sequence of amino acids that make up the polypeptide chain.

2) Secondary protein

The linear, unfolded structure of polypeptide chain assumes helical shape to produce the secondary structure. The secondary structure refers to the regular folding pattern of twists of the polypeptide chain.

3) Tertiary protein

Tertiary structure of proteins is the three dimensional structure formed by the bending and twisting of the polypeptide chain. The linear sequence of polypeptide chain is folded into compact globular structure.

4) Quaternary protein

When a protein is an assembly of more than one polypeptide or subunits of its own, this is said to be the quaternary structure of protein. e.g. Examples include hemoglobin and Insulin.

Classification on the base of chemical-physical properties

On the basis of physical and chemical properties, protein is divided into:

- 1) Simple proteins
- 2) Compound or conjugated proteins
- 3) Derived proteins

1) Simple protein

These proteins are made of only one type of only one type of amino acid, as structural component. On decomposition with acids they liberate constituent amino acids. They are mostly globular type of proteins.

• e.g, albumin, globulin and collagen.

They are most abundant protein in animal kingdom.

2) Conjugate protein

The protein that is attached to some non-protein groups (Prosthetic group).

e.g, Phospho-protein, lipo-protein are examples of conjugate protein.

3) Derived Proteins

Those proteins, which are derived from simple or conjugated proteins from the action of heat, enzyme or chemical agents.

e.g, Proteases, enzymes peptones and oligo peptides are derived protein's examples.

Junctions of proteins

Following are the functions of proteins:

- Protein build new tissues of the body and maintain and replace damage tissues.
- Proteins carry out regulating activities as enzymes and hormones.
- They are protective as antibodies.
- Proteins are responsible for movement as contractile proteins actin and myosin form basic structure of muscles.
- Keratin protein forms hair, nails, feathers, horns and beaks.
- Carrier proteins move molecules from one place to another around the body, e.g, hemoglobin.