14 Biomolecules

LESSON AT A GLANCE

- **Adsorption:** It is the phenomenon of attracting and retaining the molecules of a substance on the surface of a solid resulting into the higher concentration on the surface than in the bulk.
- **Carbohydrates:** They are optically active polyhydroxy aldehydes or ketons or molecules which provide such units on hydrolysis.
- **Monosaccharides:** A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone. **Example:** Glucose, furctose, ribose.
- **Oligosaccharides:** Carbohydrates that yield two to Lenmonosaccharides units on hydrolysis are called oligosaccharides.
- **Polysaccharides:** Carbohydrates which yield a large number of monosaccharides units on hydrolysis. **Example:** Glycogen, cellulose starch.
- **Glucose:** Important source of energy for mammals is obtained by the digestion of starch.
- **Proteins:** They are the polymers of twenty different α-amino acids which are linked by peptide bonds.
- **Denaturation of protein:** The secondary or tertiary structure of proteins get disturbed on change of pH or temp. and they are not able to perform their functions are called denaturation of proteins.
- **Enzymes:** They are biocatalysts which speed up the reaction in biosystem. They are specific and selective in their function.
- **Vitamins** are accessory food factors required in the diet. They are classified as fat soluble and water soluble. Its deficiency leads to many diseases.

- **Nucleic acid** are the polymers of nucleotides, which in turn consist of a base, a pentose sugar and phosphate variety.
- **DNA (Deoxy ribonucleic acid):** It contains a fine carbon sugar molecule.
- **RNA:** It contains ribose. RNA and RNA contain adenine, guanine and cytosin. The fourth base is thymine in DNA and uracil in RNA.
- The three types of RNA is — *m*-RNA, *r*-RNA, *t*-RNA which actually carry out the protein synthesis in the cell.
- **DNA Finger Printing**

  A sequence of bases on DNA is unique for a person and information regarding this is called DNA finger printing.

  DNA finger printing is now used in forensic laboratories for identification of criminals.

  To determine paternity of an individual.

  To identify the dead bodies in any accident by comparing the DNA's of parents or children. To identify racial groups to rewrite biological evolution.

TEXTBOOK QUESTIONS SOLVED

14.1 *What are monosaccharides?*

Ans. Carbohydrates which cannot be further hydrolysed to give simpler units of polyhydroxy aldehydes or ketones are known as monosaccharides.

14.2 *What are reducing sugars?*

Ans. All those carbohydrates which reduce Fehling's solution and Tollens' reagent are called reducing sugars. The structural feature which characterises a reducing sugar is the presence of a free aldehydic or ketonic group. All monosaccharides whether aldoses or ketoses are reducing in nature.

14.3 *Write two main functions of carbohydrates in plants.*

Ans. Carbohydrates are used as storage molecules as starch in plants. Cell wall in plants is made up of cellulose.

14.4 *Classify the following into monosaccharides and disaccharides.*

Ribose, 2-deoxyribose, maltose, galactose, fructose and lactose.

Ans.

Ribose	—	Monosaccharide
2-Deoxyribose	—	Monosaccharide
Maltose	—	Disaccharide

Galactose	—	Monosaccharide
Fructose	—	Monosaccharide
Lactose	—	Disaccharide

14.5 *What do you understand by the term glycosidic linkage?*

Ans. Disaccharides are formed by the condensation of two monosaccharide molecules. These monosaccharides join together by the loss of water molecule between one hydroxyl group on each monosaccharide. Such a linkage, which holds the monosaccharide units together is called **glycosidic linkage**.

14.6 *What is glycogen? How is it different from starch?*

Ans. Glycogen is a polysaccharide stored in animal body.

Its structure is similar to amylopectin and is rather highly branched. Whereas starch consists of both amylose and amylopectin.

14.7 *What are the hydrolysis products of (i) sucrose and (ii) lactose?*

Ans. (*i*) Sucrose on hydrolysis yields equimolar ratio of D-(+)-glucose and D-(–)-fructose.

(*ii*) Lactose on hydrolysis gives D- (+) - glucose and D - (+) - galactose in equimolar ratio.

14.8 *What is the basic structural difference between starch and cellulose?*

Ans. Starch is branched chain polymer of α-glucose whereas cellulose is linear polymer of β-glucose.

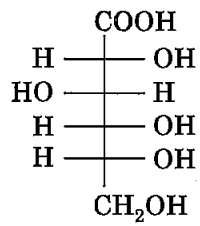
14.9 *What happens when D-glucose is treated with the following reagents?*

(*i*) *HI* (*ii*) *Bromine water*

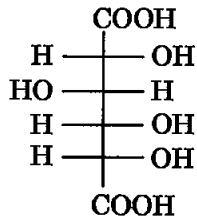
(*iii*) HNO_3

Ans. (*i*) D-glucose gets reduced to *n*-hexane on reaction with HI. A small amount of 2-iodohexane is also formed.

(*ii*) D-glucose gets oxidised to D-gluconic acid on treatment with bromine water.



(*iii*) On treatment with nitric acid, D-glucose gets oxidised to a dicarboxylic acid called D-saccharic acid.



14.10 *Enumerate the reactions of D-glucose which cannot be explained by its open chain structure.*

Ans. The following reactions of D-glucose cannot be explained on the basis of its open chain structure:

(*i*) D-glucose does not react with sodium bisulphite ($NaHSO_3$).

(*ii*) It does not give 2, 4-DNP test and Schiff's test.

(*iii*) The pentaacetate of D-glucose does not react with hydroxylamine.

(*iv*) D-Glucose shows the phenomenon of mutarotation, *i.e.*, when its aqueous solution is kept for sometime its optical activity changes.

(*v*) On reaction with 1 mole of methanol, it yields two monomethyl derivatives which are known as methyl α-D-glucoside and methyl β-D-glucoside.

14.11 *What are essential and non-essential amino acids? Give two examples of each type.*

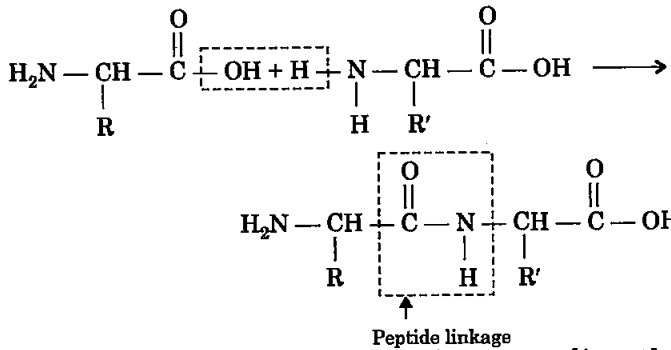
Ans. Amino acids which cannot be synthesised in the body and must be obtained through diet are known as essential amino acids, *e.g.*, valine and leucine. There are ten amino acids which are classified as essential amino acids. Other amino acids which can be synthesised in the body are known as non-essential amino acids, *e.g.*, alanine and glutamic acids.

14.12 *Define the following as related to proteins:*

(*i*) *Peptide linkage* (*ii*) *Primary structure*

(*iii*) *Denaturation.*

Ans. (*i*) In proteins, various amino acids combine by the loss of a water molecule between —COOH group of an amino acid and —NH_2 group of another amino acid. Thus an amide linkage is formed between two successive amino acids, such an amide linkage is known as peptide linkage.



(*ii*) **Primary structure:** Information regarding the sequence of amino acids in a protein chain is called its primary structure. The primary structure of a protein determines its functions and biological activity.

(*iii*) **Denaturation:** The disruption of the native structure of proteins by changing the pH, temperature or by adding some salt is known as denaturation.

14.13 *What are the common types of secondary structure of proteins?*

Ans. (*i*) α-helix (*ii*) β-pleated sheet

14.14 *What type of bonding helps in stabilising the α-helix structure of proteins?*

Ans. The forces responsible for the stability of α-helix are intramolecular hydrogen bonding. This hydrogen bonding actually occurs between $>C=O$ group of one amino acid unit and—NH— group of the fourth amino acid unit in the chain in α-helix structure.

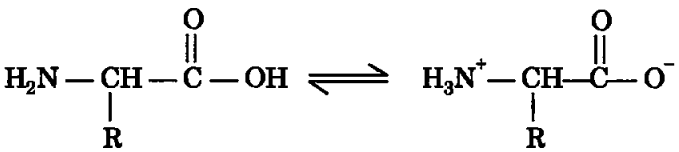
14.15 *Differentiate between globular and fibrous proteins.*

Ans.

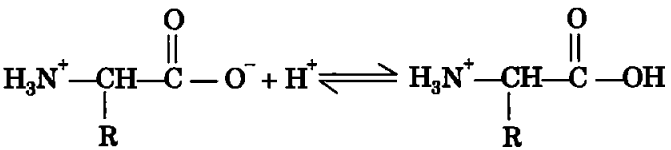
Globular proteins	Fibrous Proteins
(*i*) They form α-helix structure.	(*i*) They have β-pleated structure.
(*ii*) They are soluble in water.	(*ii*) They are insoluble in water.
(*iii*) They are cross linked condensation polymers of acidic and basic amino accids.	(*iii*) They are linear condensation products.
(*iv*) They are folded to give rise to three dimensional spherical shapes.	(*iv*) The long linear protein chains form tree like structure.
Examples: Albumin, enzymes, hormones.	**Examples:** Fibroin, collagen, myosin etc.

14.16 *How do you explain the amphoteric behaviour of amino acids?*

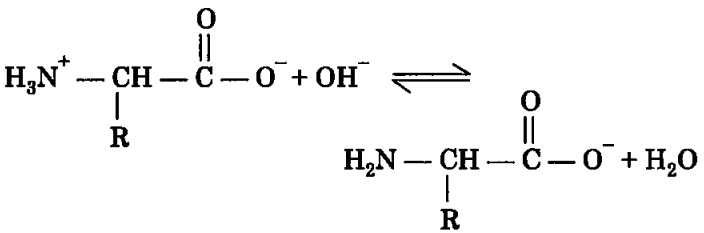
Ans. Amino acids are amphoteric in nature due to the presence of basic —NH_2 group and acidic —COOH group and hence they react with both acids and bases. In aqueous solution, they exit as zwitterionic structure.



In acidic solution, —COO^- accepts a proton to form —COOH.



In basic solution, $-\overset{+}{N}H_3$ loses one H^+ ion to give —NH_2 group.



14.17 *What are enzymes?*

Ans. Most of the chemical reactions which occur in living systems (called biochemical reactions) proceed at very high rates even under very mild conditions. For these biochemical reactions, very powerful catalysts are needed. These biological catalysts are collectively known as enzymes.

14.18 *What is the effect of denaturation on the structure of proteins?*

Ans. The complex three-dimensional structure of proteins gets disturbed by changing the pH, temperature or by adding some salt. This disruption of the native structure of proteins is called denaturation. During denaturation, the protein molecules uncoil from an ordered conformation into a more

random conformation. Chemically, denaturation does not change the primary structure of a protein, it only brings about change in secondary or tertiary structures.

14.19 *How are vitamins classified? Name the vitamin responsible for the coagulation of blood.*

Ans. Vitamins are classified on the basis of their solubility. They are called as water soluble or fat soluble vitamins. The vitamin responsible for coagulation of blood is named as vitamin K.

14.20 *Why are vitamin A and vitamin C essential to us? Give their important sources.*

Ans. Vitamin 'A' — Deficiency leads to Xerophthalamia and night-blindness.

Sources of vitamin A — Carrot, fish, liver oil, milk, butter etc.

Vitamin 'C' — Deficiency leads to scurvy and bleeding of gums.

Sources of vitamin 'C' — Citrus fruits, amla, green leafy vegetables.

14.21 *What are nucleic acids? Mention their two important functions.*

Ans. Nucleic acids are biomolecules which are found in the nuclei of all living cells. They are polymers composed of repeating units called nucleotides. Nucleotide is a unit which consists of a phosphate group, a five carbon sugar and an aromatic heterocyclic nitrogen compound called a base. Nucleic acids play a very vital role in the transmission of the hereditary characteristics and the biosynthesis of proteins.

14.22 *What is the difference between a nucleoside and a nucleotide?*

Ans. Nucleoside is formed by condensation of a purine or pyrimidine base with pentose sugar at position 1. When nucleoside is linked to phosphoric acid at 5 position of sugar moiety, we get a nucleotide. Hence, a nucleotide has three units—phosphate group, pentose sugar and a base, whereas nucleoside has two units—pentose sugar and a base.

14.23 *The two strands in DNA are not identical but are complementary. Explain.*

Ans. The two strands in DNA are complementary to each other because the hydrogen bonds are formed between specific pairs of bases. Adenine forms hydrogen bonds with thymine whereas cytosine forms hydrogen bonds with guanine.

14.24 *Write the important structural and functional differences between DNA and RNA.*

Ans.

DNA	RNA
1. The sugar present in DNA is 2-deoxy-D– (–) – ribose.	1. The sugar present in RNA is D – (–) – ribose.
2. DNA has double stranded α-helix structure.	2. RNA has single stranded α-helix structure.
3. DNA contains cytosine and thymine as pyrimidine bases.	3. RNA contains cytosine and uracil as pyrimidine bases.
4. DNA has unique property to replicate.	4. RNA usually not replicate.
5. DNA are responsible for heredity character.	5. RNA controls protein synthesis.

14.25 *What are the different types of RNA found in the cell?*

Ans. There are three types of RNA molecules found in a cell which are named as messenger RNA, ribosomal RNA and transfer RNA on the basis of function they perform.

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