Laboratory Manual *for* Practical Biochemistry

2nd Edition

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SECTION

2

Qualitative Experiments

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CHAPTER 4

Carbohydrates

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DEFINITION

Carbohydrates may be defined as polyhydroxy aldehydes or ketones or compounds, which produce them on hydrolysis.

CLASSIFICATION

Carbohydrates of physiological importance are classified as:

1. Monosaccharides.
2. Oligosaccharides.
3. Polysaccharides.

Monosaccharides

Monosaccharides are the simplest of carbohydrates and they cannot be further hydrolyzed into smaller units. The most common monosaccharides of biological importance are glucose, fructose, galactose and mannose. The monosaccharides are classified into different categories (Table 4.1), based on the functional group and the number of carbon atoms.

Based on Functional Group

Aldoses: Possessing aldehyde ($-\overset{H}{\overset{|}{C}} = O$) as functional group, e.g. glyceraldehyde, glucose.

Ketoses: Possessing keto ($-C = O$) as functional group, e.g. dihydroxyacetone, fructose.

Table 4.1: Monosaccharides are classified based on the number of carbon atoms

	Aldoses	***Ketoses***
Trioses	Glyceraldehyde	Dihydroxyacetone
Tetroses	Erythrose Threose	Erythrulose
Pentoses	Ribose Xylose Arabinose	Ribulose Xylulose
Hexoses	Glucose Galactose Mannose	Fructose
Heptoses	Glucoheptose	Sedoheptulose

Oligosaccharides

Oligosaccharides contain 2 to 10 monosaccharide units. Based on the number of monosaccharide units present, the oligosaccharides are further classified into:

- Disaccharides.
- Trisaccharides.
- Tetrasaccharides.

Disaccharides

Disaccharides are formed by the union of 2 monosaccharide units (glycosidic linkage) with the elimination of one molecule of water. Disaccharides may be reducing or nonreducing depending upon the availability

of free (potential) aldehyde/keto group in their molecular structure. The most common disaccharides of biological importance are maltose, lactose and sucrose.

Maltose: Malt sugar or maltose occurs in germinating seeds and also formed during digestion of starch by enzymes or by dilute acids. It is formed by the union of two glucose units linked by α(1-4) glycosidic linkage. Maltose is a reducing disaccharide, since it contains one free aldehyde group in its molecular structure. It can be hydrolyzed either by acid or by the enzyme maltase of the intestinal juice.

Lactose: It is present in the milk (milk sugar). Lactose is formed by one molecule of galactose and one molecule of glucose linked by β(1-4) glycosidic linkage. It is a reducing disaccharide, since it contains one free aldehyde group in its molecular structure. It can be hydrolyzed either by acid or by the enzyme lactase of the intestinal juice.

Sucrose: It is the sweetening agent. Present in the sugar cane. Sucrose is formed by one molecule of glucose and one molecule of fructose linked by α β(1-2) glycosidic linkage. Sucrose is a non-reducing disaccharide, since the reactive groups of glucose (aldehyde group) and fructose (keto group) are involved in the formation of glycosidic bond. It can be hydrolyzed either by acid or by the enzyme sucrose (invertase) of the intestinal juice.

Polysaccharides

Polysaccharides are the macromolecular polymers of monosaccharide units linked by glycosidic linkage with high molecular weight.

Based on the type of monosaccharide units present, the polysaccharides are further classified into:

- Homopolysaccharides.
- Heteropolysaccharides.

Homopolysaccharides

Homopolysaccharides are made up of monosaccharide units of similar type.

For example, starch, glycogen, inulin, cellulose, dextrins.

Starch: It is a storage polysaccharide found in plants, potatoes, rice, wheat, etc. Starch is a polymer of glucose units linked by glycosidic bonds. It consists of two components.

Amylose

- It is a straight chain polymer of glucose molecule, which forms helical structure.
- It is water soluble.

Amylopectin

- It is a branched chain polymer of glucose molecule.
- It is water insoluble.

Heteropolysaccharides

Heteropolysaccharides are made up of two or more different types of monosaccharide units or their derivatives.

For example, mucopolysaccharides such as:

- Hyaluronic acid.
- Chondroitin sulfate.
- Dermatan sulfate.
- Keratosulfate.
- Heparin.

QUESTIONS

1. Classify the carbohydrates with examples.
2. Write the sources of maltose, lactose and sucrose.
3. Name the animal and plant polysaccharide.

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Laboratory Manual *for* Practical Biochemistry

SALIENT FEATURES

- Fulfills the need for a comprehensive book on Practical Biochemistry
- Practical Clinical Biochemistry in a nutshell
- Includes questions at the end of chapters
- Covers all the basic aspects of Practical Biochemistry such as basic equipments and glassware, basic calculations, laboratory hazards, preparation of molar and normal solutions, and preparation of buffers
- Explains basic qualitative and quantitative tests
- Discuses advanced aspects such as chromatography, electrophoresis, quality control and automation
- Provides reference ranges for all the routinely done Biochemical tests
- Case-oriented approach: wherever applicable, highlights clinical significance of tests done in clinical biochemistry laboratory is highlighted
- Contains case reports, which help the students to develop a clinical-oriented approach
- Integrates the basic Biochemistry with Clinical Medicine.



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