

## Carbohydrates

They may be defined as polyhydroxyaldehydes or ketones or compounds which produce them on hydrolysis.

They are the most abundant dietary source of energy (4 Cal/gm) for all organisms

## Stereoisomerism

- Stereoisomers are the compounds that have the same structural formulae but differ in their spatial configuration.
- A carbon is said to be asymmetric when it is attached to four different atoms or groups.
- The number of asymmetric carbon atoms (n) determines the possible isomers of a given compound which is equal to  $2^n$ . Glucose contains 4 asymmetric carbons, and thus has 16 isomers.

## Epimer

If two monosaccharides differ from each other in their configuration around a single specific carbon (other than anomeric) atom are referred to as epimers to each other.

## Enantiomers

They are a special type of stereoisomers that are mirror images of each other. The two members are designated as D- and L-sugars.

## Diastereomers

The term diastereomers is used to represent the stereoisomers that are not mirror images of one another

## Anomers

The  $\alpha$  and  $\beta$  cyclic forms of D-glucose are known as anomers.

Monosaccharides	Biological Function
<b>Trioses</b>	
Glyceraldehyde	Glyceraldehyde 3-phosphate is an intermediate in glycolysis.
Dihydroxyacetone	Its 1-phosphate is an intermediate in glycolysis.
<b>Tetroses</b>	
D-Erythrose	Its 4-phosphate is intermediate in carbohydrate metabolism(HMP shunt pathway)
<b>Pentoses</b>	
D-Ribose	For the structure of RNA and nucleotide coenzyme (ATP NAD+, NADP+)
D-Deoxyribose	For the structure of DNA
D-Ribulose	It is an important metabolite in Hexose monophosphate shunt. Involved in the function of glycoproteins
D-Xylose	Excreted in urine in essential pentosuria
L-Xylulose	As a constituent of lyxoflavin of heart muscle
D-Lyxose	
<b>Hexoses</b>	
D-Glucose	The 'sugar fuel of life'
D-Galactose	Converted to glucose failure leads to galactosemia For the structure of polysaccharides
D-Mannose	Its phosphates are intermediate of glycolysis
D-Fructose	

<b>Heptoses</b>	Its 7-phosphate is an intermediate in Hexose monophosphate shunt and in photosynthesis
D-Sedoheptulose	
<b>Disaccharides</b>	<b>Biological Function</b>
Sucrose	Most commonly used table sugar supplying calories
Lactose	Exclusive carbohydrate source to breast feed infants. Lactose deficiency leads to diarrhoea and flatulence
Maltose	An important intermediate in digestion of starch

**Maltose** is composed of two  $\alpha$ -D-glucose units held together by  $\alpha$  (1 -- 4) glycosidic bond.

**Isomaltose**, the glucose units are held together by  $\alpha$  (1 -- 6) glycosidic linkage.

**Sucrose** is made up of  $\alpha$ -D-glucose and  $\beta$ -D-fructose. The two monosaccharide are held together by a glycosidic bond ( $\alpha$ 1 --  $\beta$ 2), between C 1 of  $\alpha$ -glucose and C2 of  $\beta$ -fructose.

**Lactose** is composed of  $\beta$ -D-galactose and  $\beta$ -D-glucose held together by  $\beta$  (1 -- 4) glycosidic bond.

### Polysaccharides

1. **Homopolysaccharides** which on hydrolysis yield only a singlet type of monosaccharide

**Starch** consists of two polysaccharide components-water soluble amylose and a water insoluble amylopectin.

**Amylose** is a long unbranched chain in which D-glucose units held by  $\alpha$  (1 -- 4) glycosidic linkages.

**Amylopectin** on the other hand is a branched chain with  $\alpha$  (1 – 6) glycosidic bonds at the branching points

**Inulin** is a polymer of fructose i.e., fructosan. It is used for assessing kidney function through measurement of glomerular filtration rate (GFR).

**Glycogen** consists of glucose repeating unit glycogen joined together by  $\alpha$  (1 -- 4) glycosidic bonds, and  $\alpha$  (1 -- 6) glycosidic bonds at branching points.

- Heteropolysaccharides** on hydrolysis yield a mixture of a few monosaccharides or their derivatives.

Glycosaminoglycan	Composition	Function(s)
Hyaluronic acid	D-Glucuronic acid , N-acetylglucosamine	Serves as a lubricant and shock absorber. Promotes wound healing.
Chondroitin sulfate	D-Glucuronic acid, N-acetylgalactosamine 4- sulfate	Helps to maintain the structure and shape of soft tissues.
Heparin	D-Glucuronate 2-sulfate, N-sulfoglucosamine 6-sulfate	Acts as an anticoagulant.
Dermatan sulfate	L-Iduronic acid, N-acetylgalactosamine 4- sulfate	Maintains the shape of tissues.
Keratan sulfate	D-Galactose, N-acetylglucosamine 6- sulfate	Keeps cornea transparent.