# CARBOHYDRATES

Carbohydrates are regarded as polyhydroxy aldehydes or polyhydroxy ketones or substances that can be hydrolysed to either of them.

Carbohydrates are very useful for human beings. They are taken directly as food such as bread, potatoes, and rice or are fed to animals whose meat is eaten by many of us. Wood consists largely of cellulose and so is the cotton, with which we cloth ourselves. Paper, whose importance is difficult to the estimate in modern civilization, is mostly carbohydrates.

## CLASSIFICATION AND NOMENCLATURE :

The names of most of simple carbohydrates end in -ose; those with an aldehyde group are known as aldoses, and those with a keto group, ketoses. Carbohydrates have been classified into three major groups :

(1) MONOSACCHARIDES : Monosaccharides are the simplest carbohydrates and include the three - four - five and six carbon sugars. They cannot be hydrolysed further to smaller units. They are further classified according to the number of carbon atoms and the nature of the carbonyl group present.

(2) OLIGOSACCHARIDES : The hydrolysis of these carbohydrates yields two or more monosaccharide molecules. They have further been subdivided into the following groups :

i) Disaccharides : The disaccharides are hydrolysed to to give two molecules of monosaccharides e.g. sucrose.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose — Glucose, Fructose

ii) Trisaccharides : Three molecules of monosaccharides are obtained by the hydrolysis of a trisaccharide, e.g., raffinose

$$C_{18}H_{32}O_{16} + 2\,H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6 + C_6H_{12}O_6$$

Raffinose — Galactose, Glucose, Fructose

(3) POLYSACCHARIDES : Polysaccharides are high-molecular weight carbohydrates that contain several monosaccharide units. In contrast to monosaccharides (and disaccharides), which are water-soluble and sweet in taste (and hence commonly referred to as sugars), the polysaccharides are tasteless water - insoluble substances. Hydrolysis of a polysaccharide yields many molecules of monosaccharides e.g. starch gives many molecules of glucose.

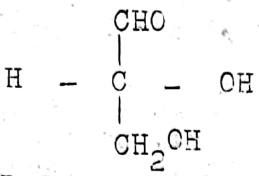
$$(C_6H_{10}O_5)_n + nH_2O \longrightarrow nC_6H_{12}O_6$$

Starch — Glucose

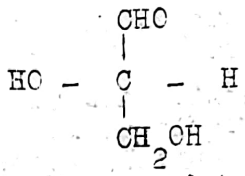
## MONOSACCHARIDES :

Monosaccharides are colourless, water soluble compounds They occur either in the free or combined state.

Glyceraldehyde ($HOCH_2$ CHOHCHO) may be considered as the simplest monosaccharide. Since the molecule has a chiral carbon atom, it exists in two enantiomeric forms referred to as D- and L-forms.

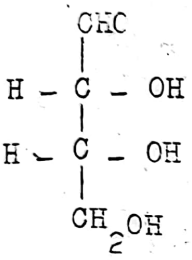


D-Glyceraldehyde

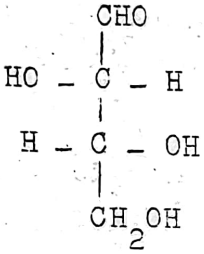


L-Glyceraldehyde

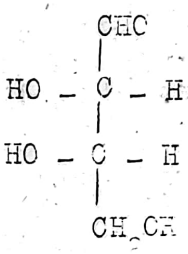
Aldotetroses ($HOCH_2$ - CHOH - CHOHCHO) have two dissimilar chiral carbon atoms and hence four stereoisomeric forms ($2^2=4$) are possible.



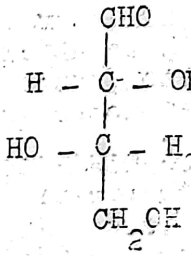
D-Erythrose



D-Threose

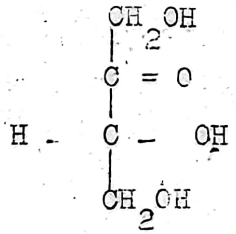


L-Erythrose

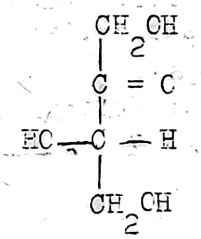


L-Threose

Ketotetrose ($HOCH_2CO$ $CHOHCH_2OH$) has only one chiral carbon atom and hence only two stereostructures are possible.



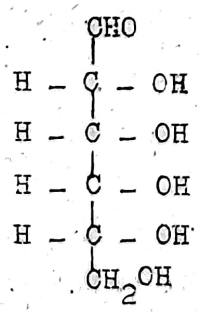
D-Erythrulose



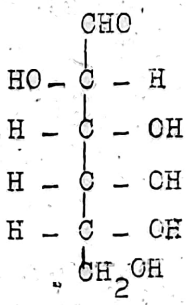
L-Erythrulose

We know that the second carbon atom from the bottom of the Fischer projection formula determines the configuration of sugars. Thus, for instance, the sugars in which this carbon has hydroxyl located on the right side belong to D-series, whereas the other sugars belong to L-series.

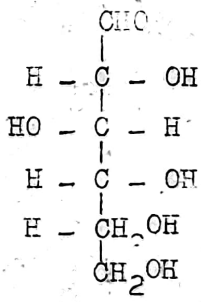
Since there are four different chiral carbon atoms in aldohexoses ($HOCH_2$ $^*CHOH$ $^*CHOH$ $^*CHOH$ $^*CHOHCHO$), sixteen stereo-isomers ($2^4 = 16$) are possible. The names and structures of eight aldohexceses belonging to the D-series are given below:



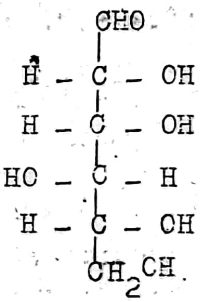
D-Allose



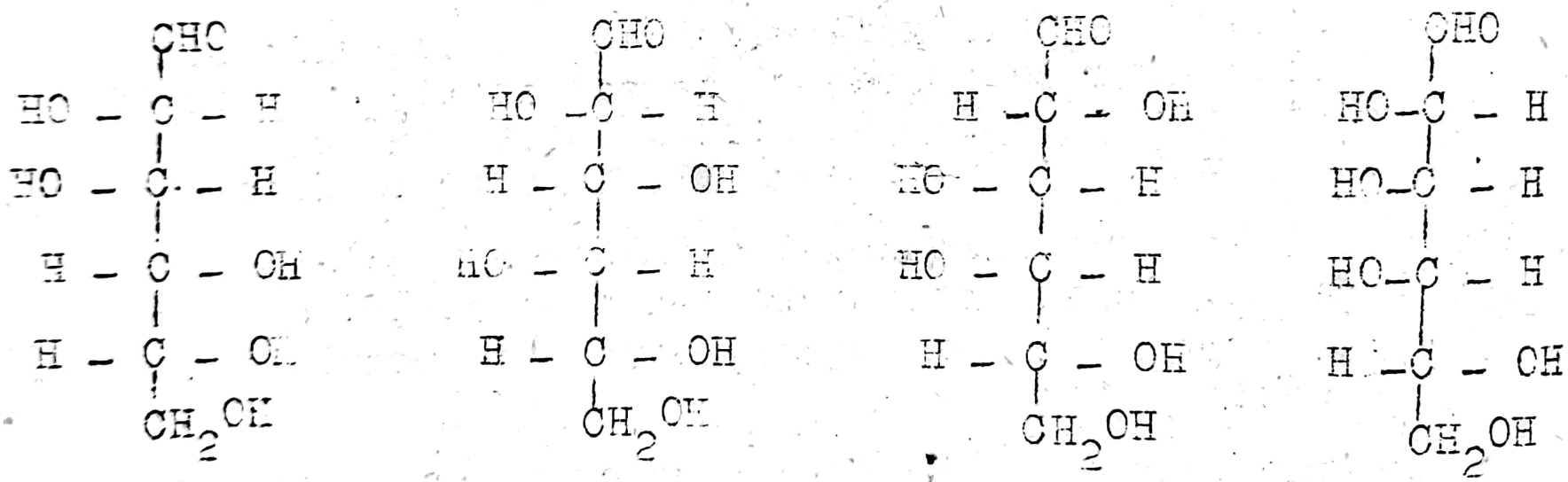
D-Altrose



D-Glucose



D-rabinose



D–Mannose D–Idose D–Galactose D–Talose

D – (+) – Glucose ( D – GLUCOSE )

Glucose is by far the most abundant sugar and occurs in honey (which is a mixture of glucose and fructose) and sweet fruits such as grapes and mangoes. It is constituent of sucrose and of many polysaccharides such as starch and cellulose. It is a colourless, sweet and crystalline compound, m.p. 146°. It is a dextrorotary substance and the optical rotation of a fresh solution of glucose is +112° which gradually decreases to +52° on keeping the solution for sometime. Because of its dextrotatory property, it is also called dextrose.