

Carbohydrates

Carbohydrates are polyhydroxy aldehydes or ketones. They are primarily produced by plants and form a very large group of naturally occurring organic substances. Some common examples are cane sugar, glucose, starch, etc. They have general molecular formulas that make them appear to be hydrates of carbon, $C_n(H_2O)_n$, from where the name carbohydrate was derived. Carbohydrates are the most abundant class of organic compounds in the plant world. They are synthesized by nearly all plants and animals, which use them to store energy and deliver it to the cells.

Occurrence and Functions of Carbohydrates

- Almost 75% of dry plant material is produced by photosynthesis.
- Most of the matter in plants, except water, are carbohydrate material.
- Examples of carbohydrates are cellulose which are structural component of the plants, starch the energy reservoir in plants and glycogen (animal starch) found in animal tissues and human body in smaller quantities.
- Plant products are the major source of carbohydrates and average human diet contains 2/3 of carbohydrates.

- Recommended percents in the daily diet: Recommended carbohydrates ~ 60 % Recommended sucrose less than 10% Usefulness of carbohydrates is their ability to produce energy when they undergo oxidation during respiration.
- Storage carbohydrate, in the form of glycogen, provides a short-term energy reserve for bodily functions.
- Carbohydrates supply carbon atoms for the synthesis of other biochemical substances (proteins, lipids, and nucleic acids).
- Carbohydrates also form a part of the structural framework of DNA and RNA molecules.

Classification of Carbohydrates:

Organic compounds containing many -OH groups (polyhydroxy), and aldehydes or ketones functional groups.

By convention, the ending "-ose" is reserved for sugars (e.g. sucrose and glucose) in the class of carbohydrates.

Carbohydrates are produced by the process of photosynthesis in which six carbon sugars or hexoses are produced using energy of sunlight, green pigment chlorophyll, CO_2 and H_2O by green plants.

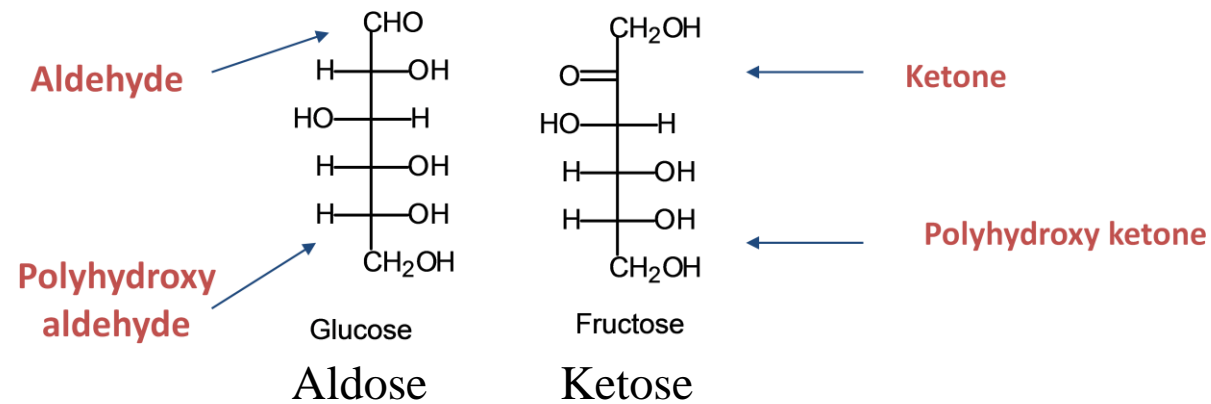
The hexoses produced are the raw material for the biosynthesis of glycogen, fats, proteins and nucleic acid in living systems.

Monosaccharides: They consist of one sugar containing 3, 4, 5, 6 and 7 carbon atoms and are usually colorless, water-soluble, crystalline solids. Some monosaccharides have a sweet taste. Examples of monosaccharides include glucose (dextrose), fructose (levulose), galactose, xylose and ribose.

Monosaccharide structures and types

Aldoses: Aldehyde sugars are called aldoses.

Ketoses: Ketone sugars are called ketoses.

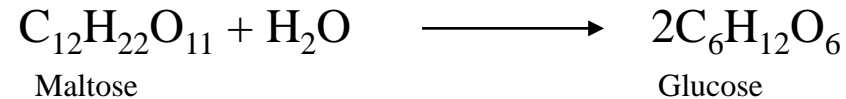
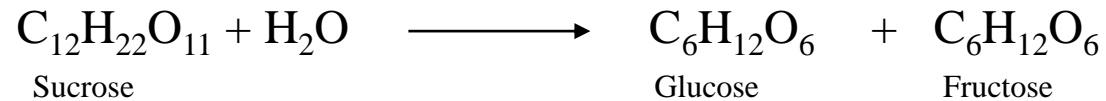


The aldoses and ketoses are further divided based on the number of carbons present in their molecules, as trioses, tetroses, pentoses, hexoses etc. They are referred to as aldotrioses, aldotetroses, aldopentoses, aldohexoses, ketohexoses etc.

Number of Carbons	General term	Aldehyde	Ketone
3	Triose	Aldotriose	Ketotriose
4	Tetrose	Aldotetrose	Ketotetrose
5	Pentose	Aldopentose	Ketopentose
6	Hexose	Aldohexose	Ketohehexose
7	Heptose	Aldoheptose	Ketoheptose

Oligosaccharides: Carbohydrates that produce two to ten monosaccharide units during the hydrolysis are called oligosaccharides. They can be further classified based on the number of monosaccharide units formed on hydrolysis.

Disaccharides: They give two monosaccharide units on hydrolysis, which may be the same or different. For example, sucrose on hydrolysis gives one molecule each of glucose and fructose, whereas maltose gives two molecules of glucose.



Trisaccharides: These carbohydrates yield three molecules of monosaccharides units on hydrolysis.



Polysaccharides: These carbohydrates give a large number of monosaccharide units on hydrolysis. These monosaccharide units are joined together by oxide bridges. These linkages are called glycosidic linkages. The common and widely distributed polysaccharides correspond to the general formula $(C_6H_{10}O_5)_n$. Polysaccharides are not sweet in taste, so they are called non-sugars. Some common examples are starch, cellulose, glycogen, etc.

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