



AL-MUSTAQBAL UNIVERSITY COLLEGE

Department of Biomedical Engineering

Biochemistry

Carbohydrate , mono and disaccharides



Lecturer : M. Sc. Mohammed Ali

Carbohydrates, or saccharides :-are polyhydroxy aldehydes or ketones, or substances that yield such compounds on hydrolysis.

Carbohydrates include not only sugar, but also the starches that we find in foods, such as bread, pasta, and rice

The term “carbohydrate” comes from the observation that when you heat sugars, you get carbon and water (hence, hydrate of carbon).

Classes of Carbohydrates

- Monosaccharides contain a single polyhydroxy aldehyde or ketone unit (e.g., glucose, fructose).
- Disaccharides consist of two monosaccharide units linked together by a covalent bond (e.g., sucrose).
- Oligosaccharides contain from 3 to 10 monosaccharide units (e.g., raffinose).

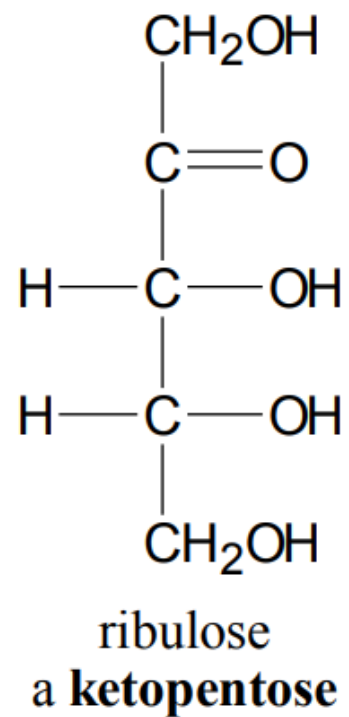
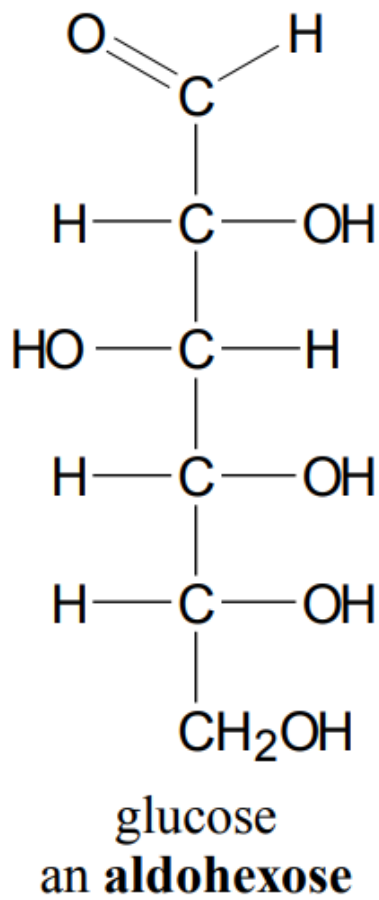
Polysaccharides contain very long chains of hundreds or thousands of monosaccharide units, which may be either in straight or branched chains (e.g., cellulose, glycogen, starch)

Classification of Monosaccharides

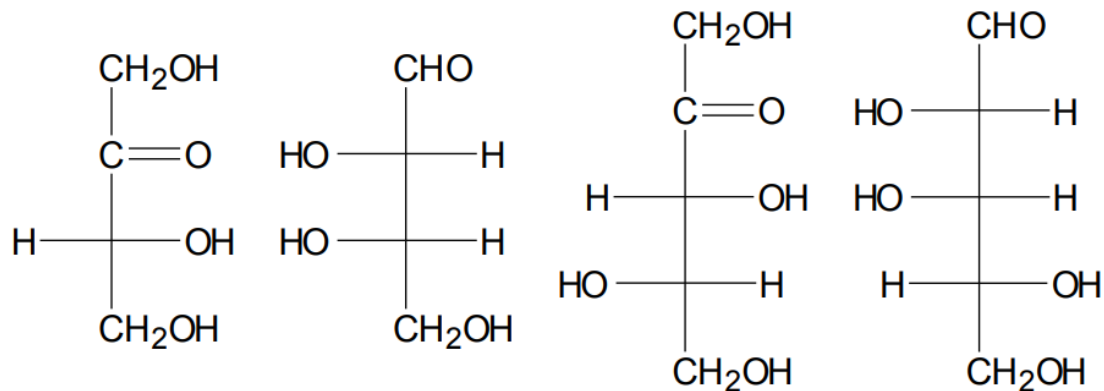
- The monosaccharides are the simplest of the carbohydrates, since they contain only one polyhydroxy aldehyde or ketone unit.
- Monosaccharides are classified according to the number of carbon atoms they contain:

• The presence of an aldehyde is indicated by the prefix **aldo-** and a ketone by the prefix **keto-**. No. of Class of carbons
Monosaccharide 3 triose 4 tetrose 5 pentose 6 hexos

Thus, glucose is an aldohexose (aldehyde + 6 Cs) and ribulose is a ketopentose (ketone + 5 Cs)



- Classify the following monosaccharides:

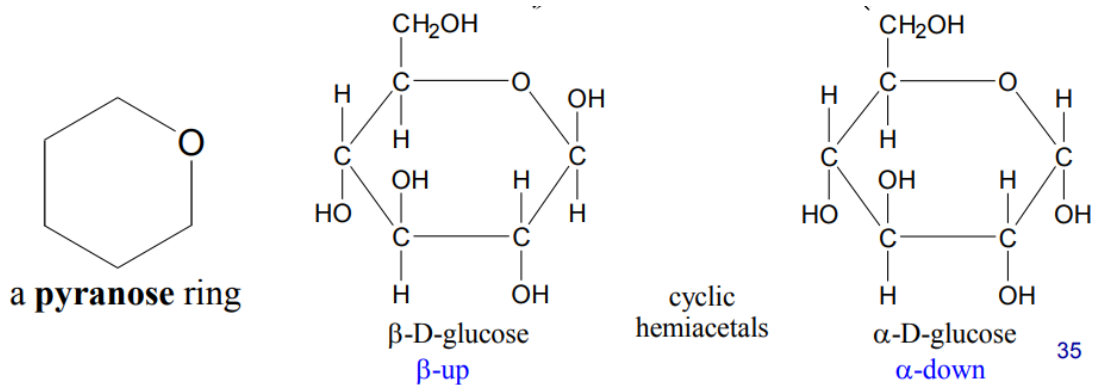
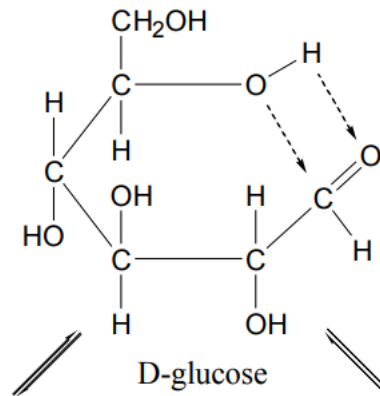


Physical Properties of Monosaccharides

- Most monosaccharides have a sweet taste (fructose is sweetest; 73% sweeter than sucrose).
- They are solids at room temperature.
- They are extremely soluble in water: – Despite their high molecular weights, the presence of large numbers of OH groups make the monosaccharides much more water soluble than most molecules of similar MW. – Glucose can dissolve in minute amounts of water to make a syrup (1 g / 1 ml H₂O).

Chemical Properties of Monosaccharide

- Monosaccharides do not usually exist in solution in their “open-chain” forms: an alcohol group can add into the carbonyl group in the same molecule to form a **pyranose ring** containing a stable cyclic hemiacetal or hemiketal.

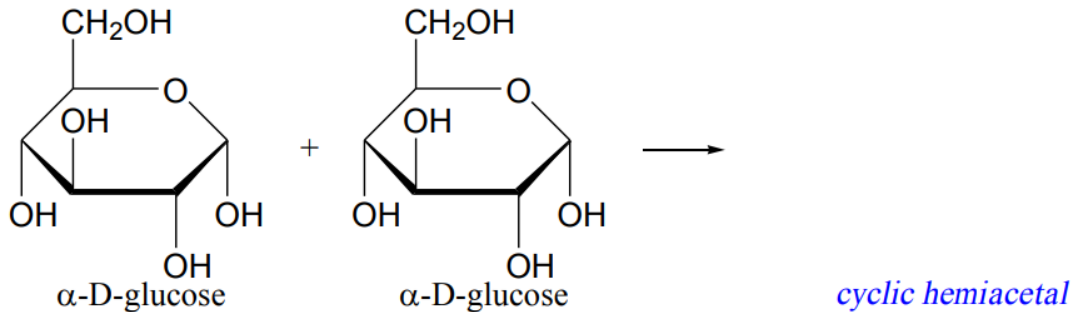


Oxidation of Monosaccharides

- Aldehydes and ketones that have an OH group on the carbon next to the carbonyl group react with a basic solution of Cu^{2+} (Benedict's reagent) to form a red-orange precipitate of copper(I) oxide (Cu_2O).
- Sugars that undergo this reaction are called reducing sugars. (All of the monosaccharides are reducing sugars.) Reducing sugar + Cu^{2+} oxidation product + Cu_2O deep blue solution red-orange

Disaccharides

- Two monosaccharides can be linked together through a glycosidic linkage to form a **disaccharide**.



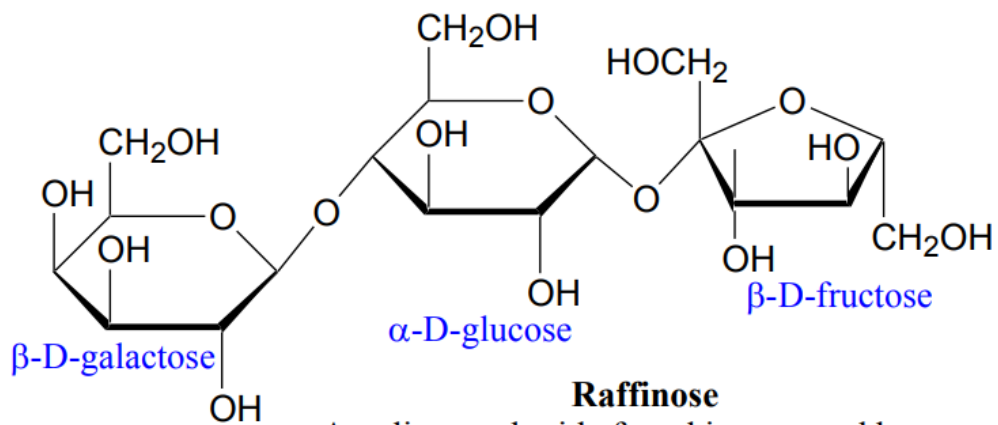
Disaccharides

Disaccharides can be hydrolyzed into their monosaccharide building blocks by boiling them with dilute acids or reacting them with the appropriate enzymes. • Disaccharides that contain hemiacetal groups are reducing sugars

maltose + H₂O D-glucose + D-glucose

Oligosaccharides

- Oligosaccharides contain from 3 to 10 monosaccharide units.



Polysaccharides

Polysaccharides contain hundreds or thousands of carbohydrate units.

- Polysaccharides are not reducing sugars, since the anomeric carbons are connected through glycosidic linkages.
- We will consider three kinds of polysaccharides, all of which are polymers of glucose: starch, glycogen, and cellulose.

Starch

- Starch is a polymer consisting of D-glucose units.
- Starches (and other glucose polymers) are usually insoluble in water because of the high molecular weight. – Because they contain large numbers of OH groups, some starches can form thick colloidal dispersions when heated in water (e.g., flour or starch used as a thickening agent in gravies or sauces).
- There are two forms of starch: amylose and amylopectin.