Session-2018-19

Organic Chemistry IV

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Oligosaccharides

- Oligosaccharides are carbohydrates formed of 2-10 monosaccharide units covalently bonded to each other by glycosidic bonds.

- According to the number of sugar units, they are classified into disaccharides, trisaccharides and so on.

- The oligosaccharides commonly encountered in nature belong to disaccharides.

- The physiologically important disaccharides are maltose, lactose, trehalose and sucrose.

- Disaccharides consist of two monosaccharides joined covalently by an O-glycosidic bond.

Diasaccharides

- The hydroxyl group formed as a result of hemiacetal formation is highly reactive when compared to other hydroxyl groups.

- This hydroxyl group present in one monosaccharide reacts with any one of the hydroxyl groups attached to C-1, C-2, C-3, C-4, or C-6 of another monosaccharide to produce 1→1, 1→2, 1→3, 1→4, and 1→6 linked disaccharides.

- When only one anomeric carbon is involved in glycosidic bond formation, reducing disaccharides are formed.

Diasaccharides

- If both anomeric carbon atoms of monosaccharides are involved in glycosidic bond formation that results in the formation of a non-reducing disaccharides such as trehalose (aldosyl-aldosyl disaccharide) or sucrose (aldosyl-ketosyl disaccharide)'.

- In the case of reducing disaccharides, one end of the molecule having free anomeric carbon is called reducing end and the other end, where the anomeric carbon is involved in glycosidic bond, is called as non-reducing end

Classification of Diasaccharides

- Disaccharides are classified according to the type of its monosaccharide unites into:

1. **Homodisaccharides**

- These are disaccharides in which the two monosaccharide units are the same e.g.:
  - Maltose which formed of two alpha-glucose units linked together by alpha- (1,4) glycosidic bond
- It is the major degradation product of starch
- It has a free aldehyde group so; it is a reducing sugar
- Cellobiose which is formed of two units of beta glucose linked together by beta-(1,4) glycosidic bond.
- It has a free aldehyde group so; it is a reducing sugar

Classification of Diasaccharides

- 2. **Heterodisaccharide**
- These are disaccharides in which the two monosaccharide units are different e.g.:
- **Sucrose** which is formed of one alpha glucose molecule and one beta fructose molecule linked by alpha-(1,2)beta-glycosidic bond
- It is prevalent in cane sugar and beets.
- Sucrose is a non-reducing sugar as it contains no free aldehyde or ketone group.
- **Lactose** is found exclusively in the milk
- It is formed of one beta- galactose and one b- glucose linked together by beta-(1,4) glycosidic bond.
- It has a free aldehyde group so; it is a reducing sugar.

Diasaccharides

- **Trisaccharides**

- Trisaccharides are oligosaccharides formed of three monosaccharide units covalently bonded to each other by glycosidic bonds.
- Maltotriose is a trisaccharide formed of three alpha-glucose units.

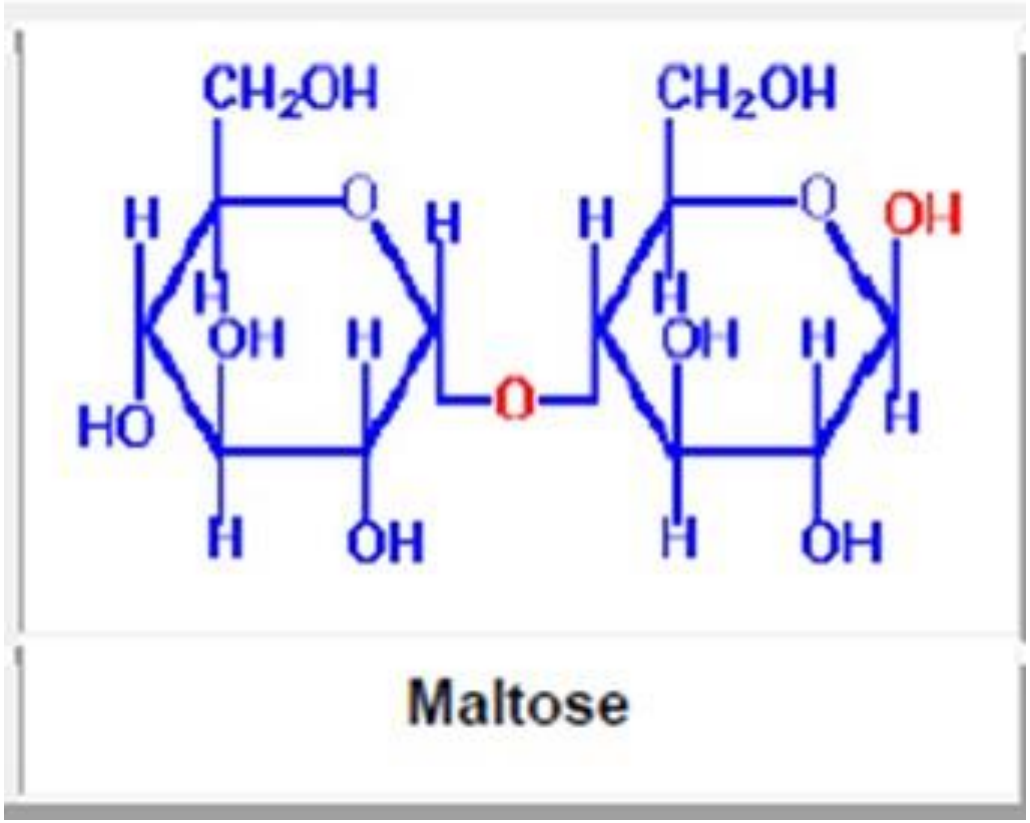
Reducing disaccharides

- **Maltose**
- Maltose is a disaccharide made up of two glucose residue joined by a glycosidic linkage between C-1 of one glucose residue and C-4 of the other.
- The configuration of the anomeric carbon of glucose involved in the linkage is and hence the glycosidic linkage is (1→ 4).

Diasaccharides

- The anomeric carbon atom of the second glucose is free and therefore maltose is a reducing sugar.
- The second glucose residue is capable of existing in alpha or beta configuration
- Maltose has been recorded occasionally in plants. It is usually obtained as a product of the enzyme hydrolysis of starch during germination or malting process.

Diasaccharides

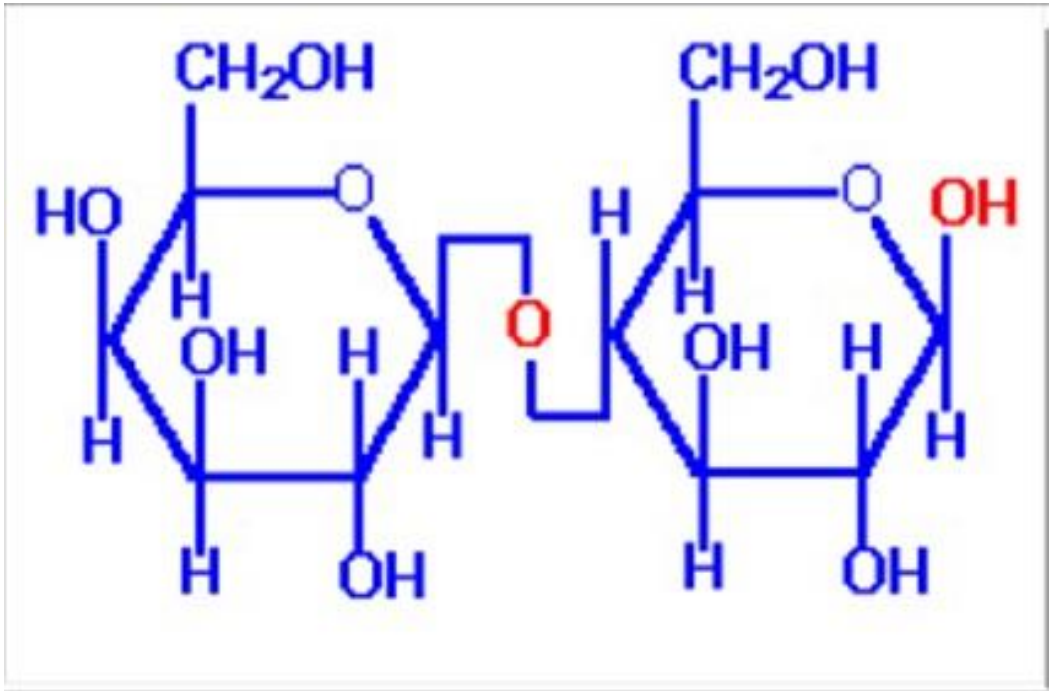


Maltose

Diasaccharides

- **Lactose**
- Lactose is a reducing disaccharide found only in **milk.**
- It is made up of galactose at the non-reducing end and glucose at the reducing end.
- They are connected by a **(1→ 4) linkage**

Diasaccharides



Lactose

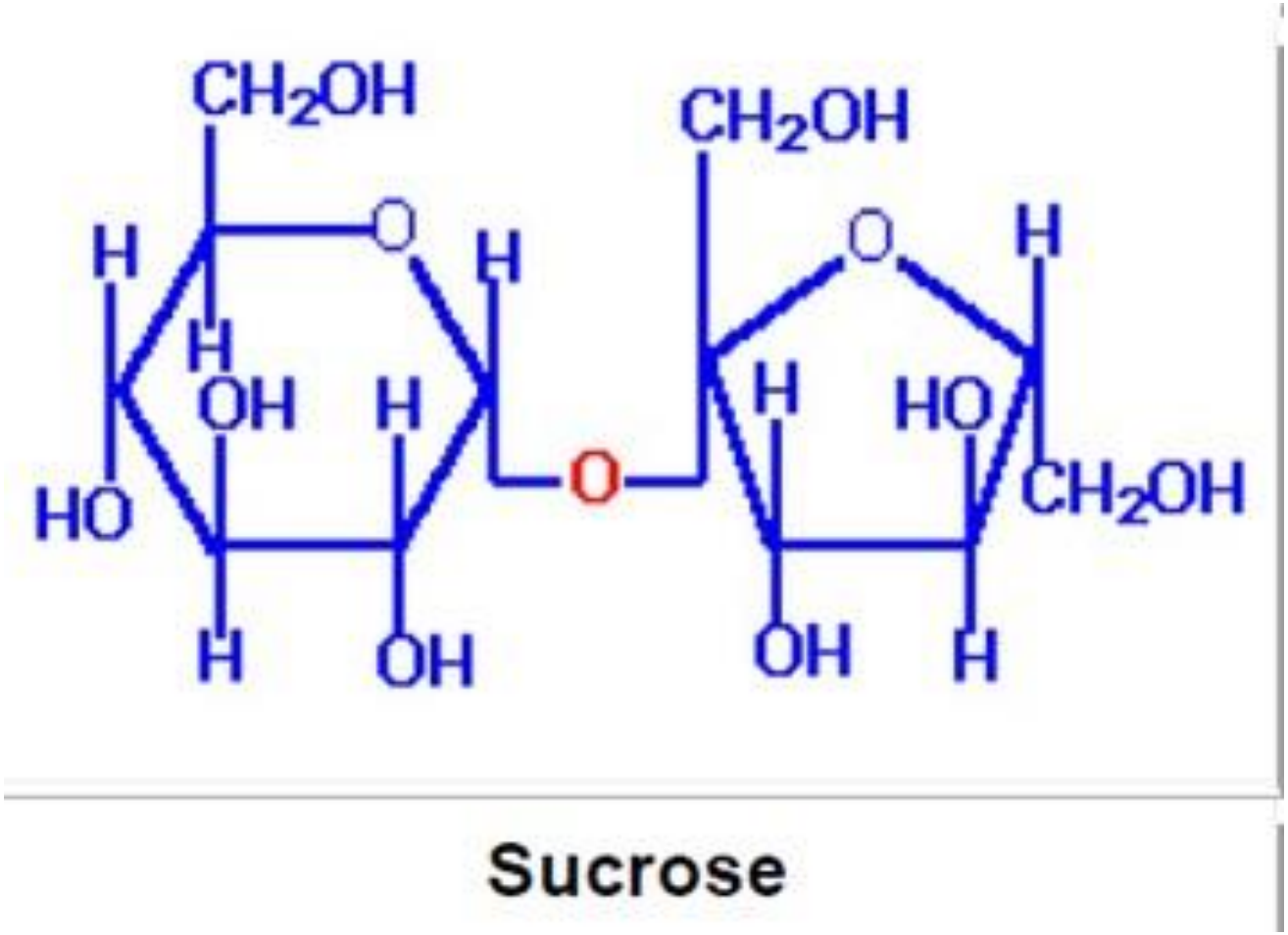
Diasaccharides

- **Non-reducing disaccharides**
- **Sucrose**
- Sucrose, a sugar of commercial importance, is widely distributed in higher plants.
- Sugarcane and sugar beet are the sole commercial sources.
- It is made up of glucose and fructose.

- The anomeric carbon atom of glucose (C-1) and fructose (C-2) are involved in linkage and is therefore a non-reducing disaccharide.

- Sucrose is a major intermediate product of photosynthesis and it is the principal form in which sugar is transported from the leaves to other portions of plants via their vascular systems.

Diasaccharides



Sucrose

Diasaccharides

STRUCTURE OF DISACCHARIDES & POLYSACCHARIDES

Composition, sources and properties of common disccharides

Disaccharides	Constituent monosaccharides	Linkage	Source	Properties
Reducing disaccharides				
Maltose	α-D-glucose+ α-D-glucose	α(1→4)	Germinating cereal and malt	Forms osazone with phenylhydrazine. Fermentable by enzyme maltase present in yeast. Hydrolysed to two molecules of D-glucose. Undergoes mutarotation.
Lactose	β-D-glucose+ α-D-glucose	β(1→4)	Milk. In trace amounts it can be seen in urine during pregnancy	It shows reactions of reducing sugars including mutarotation. Decomposed by alkali. Not fermentable by yeast. Hydrolysed to one molecule of galactose and one molecule of glucose by acids and the enzyme lactase.

Diasaccharides

Non-reducing disaccharides				
Sucrose	α-D-glucose+ β-D-fructose	α,β(1→2)	Sugar beet, sugarcane, sorghum and carrot roots	Fermentable. Hydrolysed by dilute acids or enzyme invertase (sucrase) to one molecule of glucose and one molecule of fructose. Relatively stable to reaction with dilute alkali.
Trehalose	α-D-glucose+ α-D-glucose	α,α(1→1)	Fungi and yeast. It is	It is hydrolysable by acids to glucose with difficulty.
			stored as a reserve food supply in insect's hemolymph	Not hydrolysed by enzymes.