

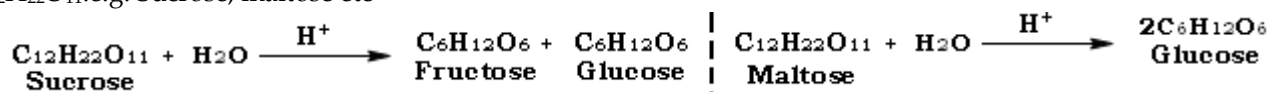
Carbohydrates: classification and properties of food carbohydrates, General methods of analysis of food carbohydrates, Changes in food carbohydrates during processing, Digestion, absorption and metabolism of carbohydrates, Dietary fibre, Crude fibre and application of food carbohydrates.

Introduction

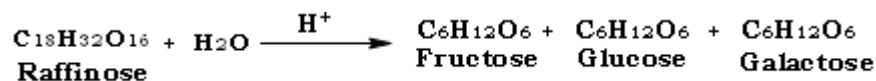
- Carbohydrates are good source of energy. Carbohydrates (polysaccharides) are long chains of sugars. Monosaccharides are simple sugars that are composed of 3-7 carbon atoms.
- They have a free aldehyde or ketone group, which acts as reducing agents and are known as reducing sugars. Disaccharides are made of two monosaccharides. The bonds shared between two monosaccharides are the glycosidic bonds.
- Monosaccharides and disaccharides are sweet, crystalline and water-soluble substances. Polysaccharides are polymers of monosaccharides. They are un-sweet and complex carbohydrates. They are insoluble in water and are not in crystalline form.
- *Example: glucose, fructose, sucrose, maltose, starch, cellulose* etc.
- Carbohydrate is an organic compound, it comprises of only oxygen, carbon and hydrogen.
- The oxygen: hydrogen ratio is usually 2:1.
- The empirical formula being $C_n(H_2O)_n$.
- Carbohydrates are hydrates of carbon; technically they are polyhydroxy aldehydes and ketones.
- Carbohydrates are also known as saccharides; the word saccharide comes from Greek word **sakkron** which means **sugar**.

Classification and nomenclature of carbohydrates

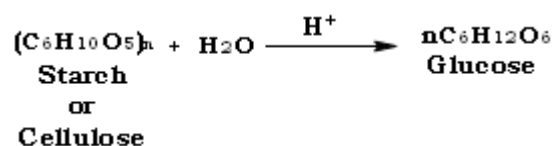
- The carbohydrates are divided into three major classes depending upon whether or not they undergo hydrolysis and if they do, on the number of products formed.
- 1. **Monosaccharides:** The monosaccharides are polyhydroxy aldehydes or polyhydroxy ketones which cannot be decomposed by hydrolysis to give simpler carbohydrates. e.g. Glucose, fructose, Galactose etc.
- 2. **Oligosaccharides:** The oligosaccharides (Oligo: few) are carbohydrates which yield a definite number (2-9) of monosaccharide molecules on hydrolysis.
- a) **Disaccharides** - Which yield two monosaccharides' molecules on hydrolysis. Which have molecular formula is $C_{12}H_{22}O_{11}$. e.g. Sucrose, maltose etc



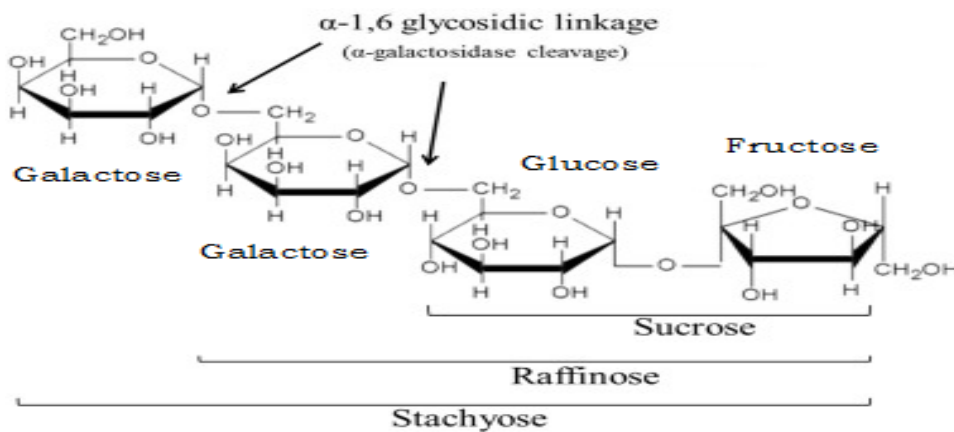
- b) **Trisaccharide's** - Which yield three monosaccharides' molecules on hydrolysis and have molecular formula is $C_{18}H_{32}O_{16}$.



- c) **Tetrasaccharides** - Which yield four monosaccharides' molecules on hydrolysis and have molecular formula is $C_{22}H_{42}O_{21}$. eg: Stachyose [gal(α 1 \rightarrow 6)gal(α 1 \rightarrow 6)glu(α 1 \leftrightarrow 2 β)fru]
- 3. **Polysaccharides:** The carbohydrates which have higher molecular weight, which yield many monosaccharide molecules on hydrolysis. E.g. Starch, glycogen, Dextrin, Cellulose etc.



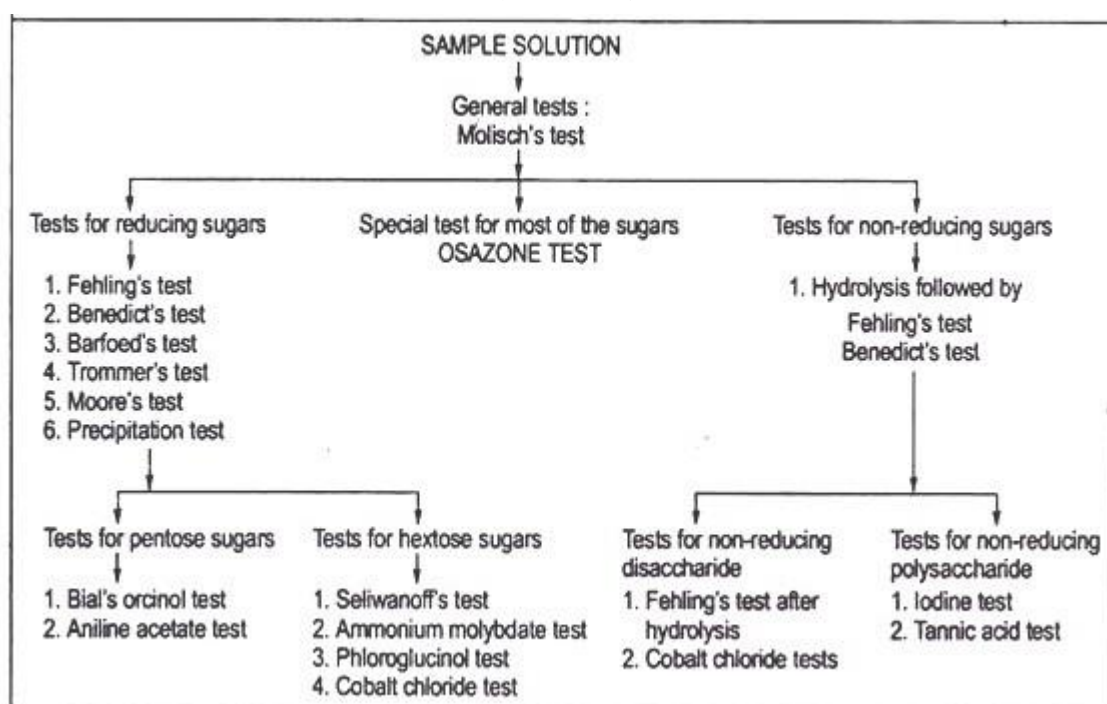
- In general monosaccharides and oligosaccharides are crystalline solids, soluble in water and sweet to taste, they are collectively known as sugars, the polysaccharides on the other hand are amorphous, insoluble in water and tasteless, they are called non-sugars.

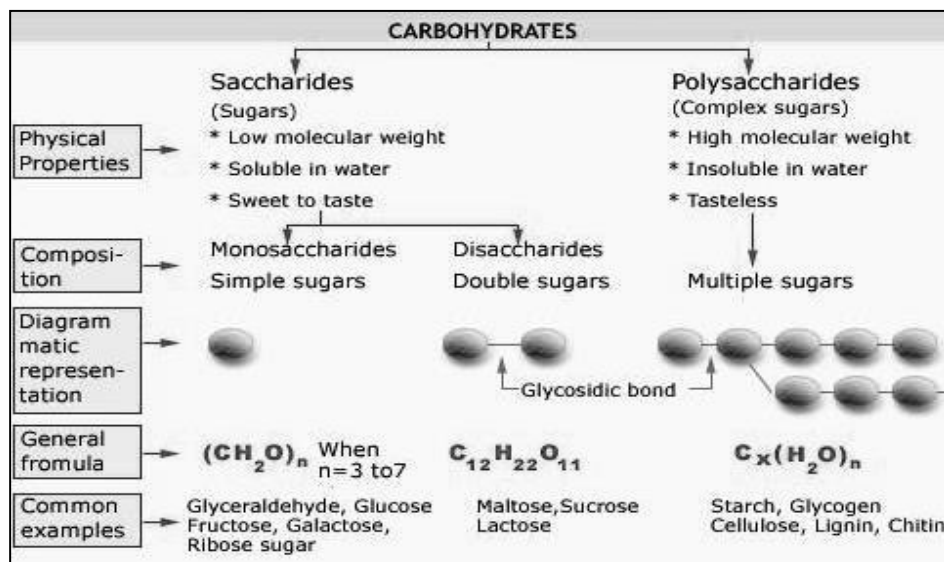


Different between monosaccharaides, oligosaccharides and Polysaccharides

Character	Monosaccharaides	Oligosaccharides	Polysaccharides
No. of sugar molecules	1	2-9	More than 9
Glycoside bond	Absent	Present	Present
Molecular Weight	Low	Moderate	High
Taste	Sweet	Minimally sweet taste	No taste
Solubility	Soluble	Soluble	Insoluble
Nature	Always reducing sugar	May or may not be	Always non reducing sugar
Example	Glucose, fructose, Galactose	Sucrose, Maltose	Starch, Glycogen, Dextrin, Cellulose

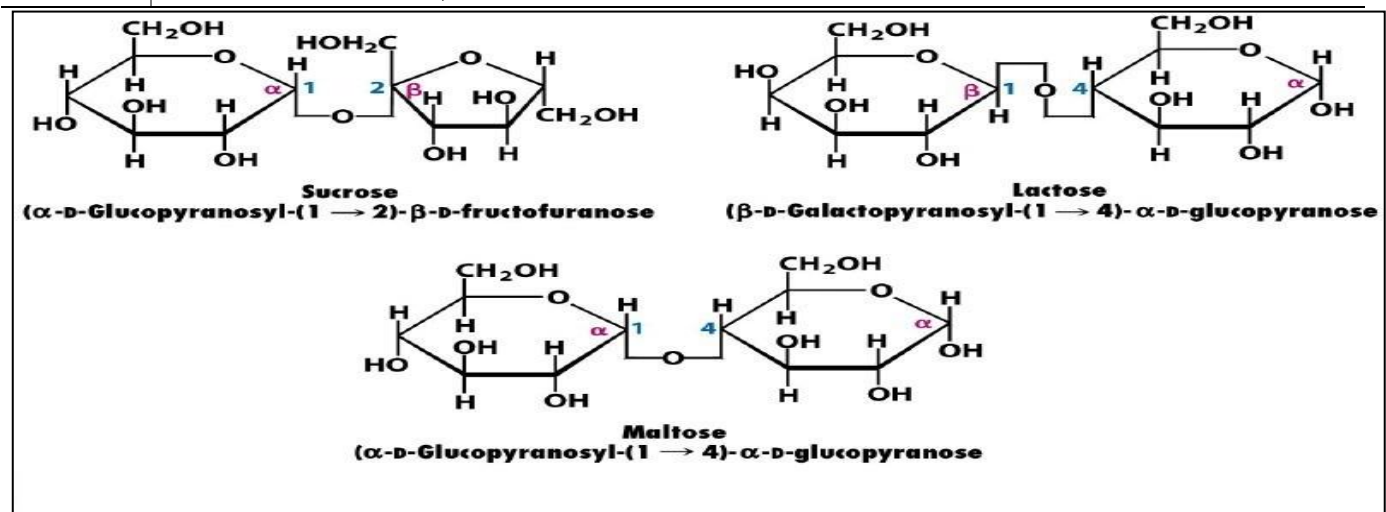
Test for carbohydrate:





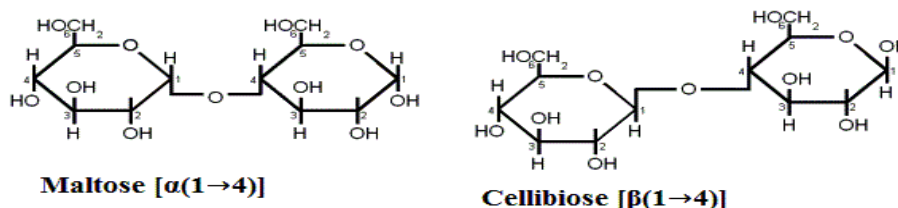
Different between reducing and non-reducing sugar

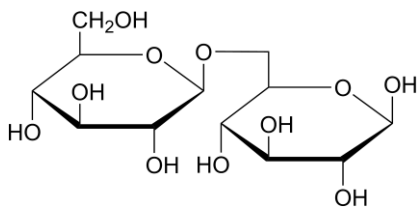
Sl. No.	Reducing sugar	Non-reducing sugar
1	Such sugar bear a free aldehyde (-CHO) or ketonic [RC(=O)R'] group	These sugars do not have such groups
2	Reducing sugars have the capacity to reduce cupric ions of benedicts or Fehling solution to cuprous ion	Non reducing sugars fail to reduce cupric ions of Benedict's or Fehling solution to cuprous ion
3	Example: all monosaccharides and disaccharides (like lactose, Melibiose, Cellobiose, Gentiobiose)	Example: Sucrose, Trehalose



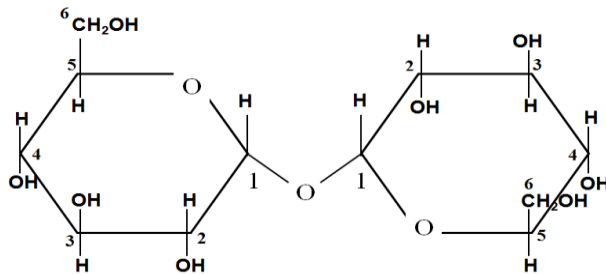
Maltose and Cellobiose

Both maltose and cellobiose are composed of two glucose molecules. But in maltose the glucose molecules are in the α configuration and joined with an α(1→4) link while in cellobiose they are in the β configuration and joined with a β(1→4).



**Gentiobiose**

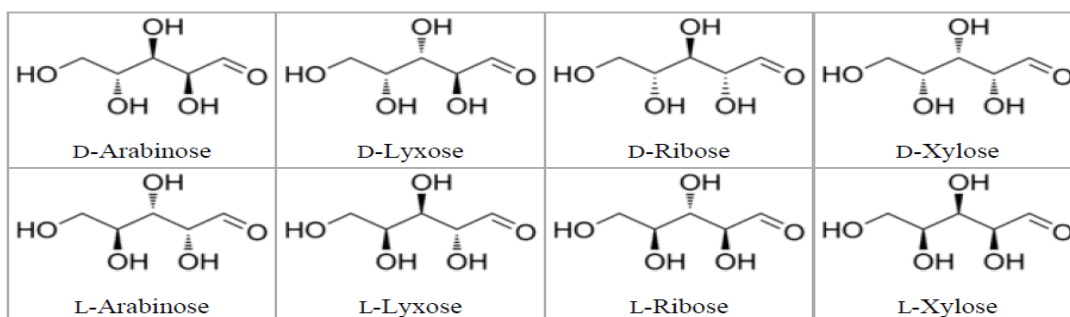
It is a disaccharide composed of two units of D-glucose joined with a $\beta(1 \rightarrow 6)$ linkage.

**Trehalose**

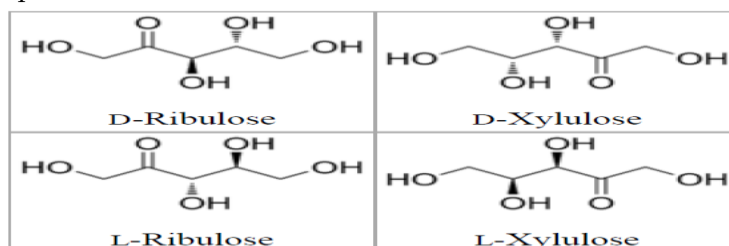
It is also known as mycose or tremalose, is a natural alpha-linked disaccharide formed by an $\alpha, \alpha-1,1$ -glucoside bond between two α -glucose units. In 1832, H.A.L. Wiggers discovered trehalose in an ergot of rye

❖ Pentose Sugar:

- A pentose is a monosaccharide with five carbon atoms.
- Pentoses are organized into two groups.
 - i. Aldopentoses have an aldehyde functional group at position 1.
 - ii. Ketopentoses have a ketone functional group in position 2 or 3.
- a) **Aldopentoses:** The aldopentoses have three chiral centers and therefore eight different stereoisomers are possible.



- b) **Ketopentoses:** The 2-ketopentoses have two chiral centers, and therefore four different stereoisomers are possible. The 3ketopentoses are rare.



- The carbohydrates may also be classified as either *reducing* or *non-reducing sugars*. All those carbohydrates which have ability to reduce *Fehling's solution* and *Tollen's reagents* are referred to as reducing sugars, while others are non-reducing sugars. All monosaccharides and disaccharides other than sucrose are reducing sugars.
- Carbohydrates are also said to be saccharides (Latin: *Saccharon* - Sugar).
- **Note By:** Synthetic sweetening agents

