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Qualitative tests of Carbohydrate

Introduction

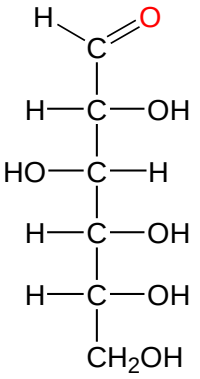
Carbohydrates are the key source of energy used by living things. Also serve as extracellular structural elements as in cell wall of bacteria and plant.

Carbohydrates are defined as polyhydroxy aldehydes or polyhydroxy ketones.

Most , but not all carbohydrate have a formula $(CH_2O)n$ (hence the name hydrate of carbon)

In human body, the D-glucose is used.

Simple sugars ends with –ose



D-glucose

Classification

1-Simple sugar: (one unit)

Monosaccharides contain **one** monosaccharide unit.

2-Complex sugar (more than one):

- **Disaccharides** contain **two** monosaccharide units.
- **Oligosaccharides** contain **3-9** monosaccharide units.
- **Polysaccharides** can contain more than 9 monosaccharide units.

NOTE:

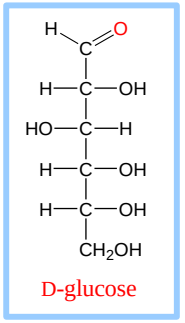
-Complex carbohydrates can be broken down into smaller sugar units through a process known as **hydrolysis**

❖ Monosaccharide

Cannot be hydrolyzed into simpler carbohydrates.

They are classified into trioses, tetroses, pentoses, hexoses, heptoses based on the number of carbon atoms present in them.

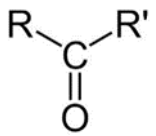
- **trioses (C-3)**
- **tetroses (C-4)**
- **pentoses (C-5)**
- **hexoses (C-6)**
- **heptoses (C-7)**



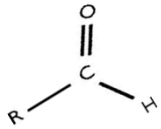
D-glucose

They are again divided into aldoses and ketoses based on the functional group present in them .

A ketose contains a carbonyl group attached to two R groups having one or more hydroxyl groups.



An aldose contains terminal aldehyde group in addition to R group containing -OH.



- **Disaccharides**: Give rise to two monosaccharide units upon hydrolysis

  E.g.:

  - Sucrose (glucose + fructose)
  - Lactose (glucose + galactose)
  - Maltose (glucose + glucose)

- **Oligosaccharides**: Yields less than ten monosaccharides.

  E.g.:

  - Maltotriose (3 glucose units)
  - Raffinose (glucose + fructose + galactose)

❖ **Polysaccharides:** Contain more than ten monosaccharide units

(i) Homopolysaccharides (consisting of same type of monomeric units)

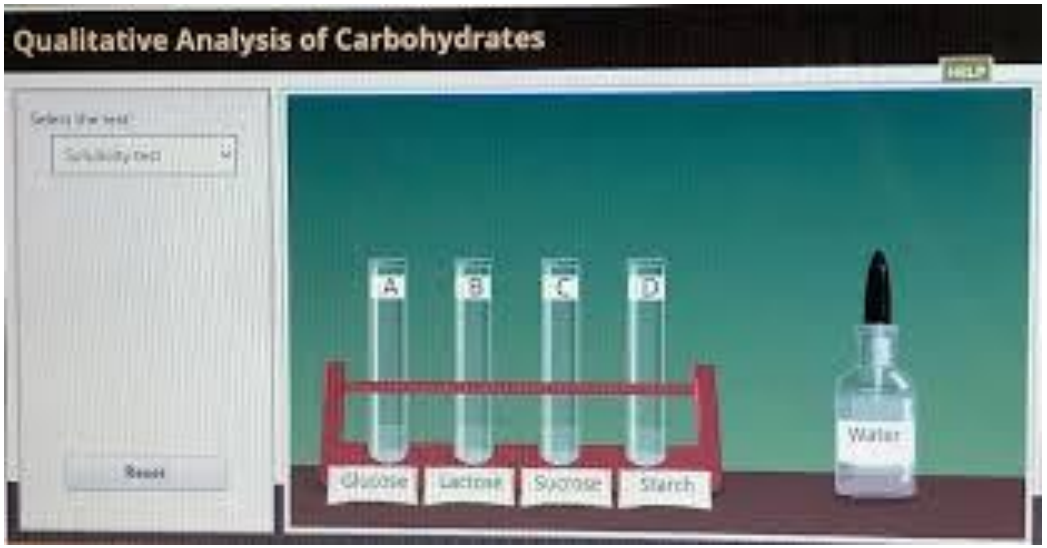
- Polymer of glucose: Starch, glycogen, cellulose
- Polymer of fructose: Inulin

(ii) **Heteropolysaccharides** (consisting of different types of monomeric units)

- Proteoglycans, e.g. Heparin (D-glucosamine sulfate + D-sulfated iduronic acid)
- Hyaluronic acid (D-β glucuronic acid + Nacetylglucosamine).

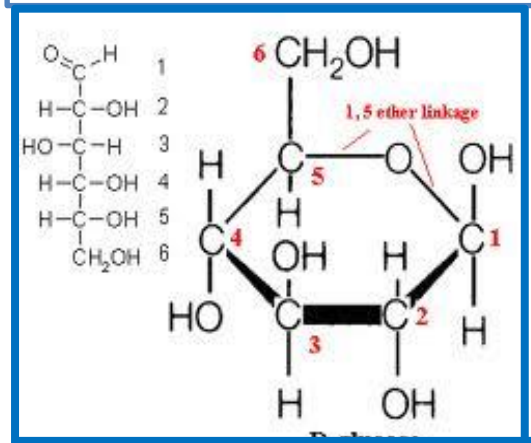
Solubility

Monosaccharide and disaccharide can be dissolved freely in water because water is a polar substance, while polysaccharide cannot be dissolved easily in water, because, it has high molecular weight , which give colloidal solutions in water

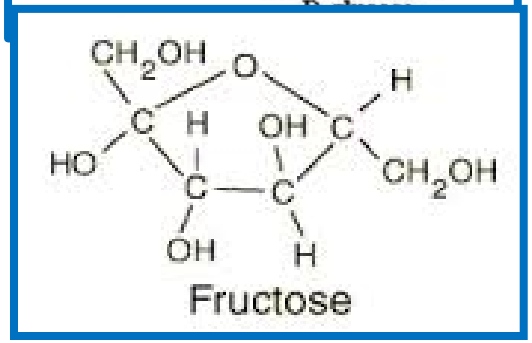


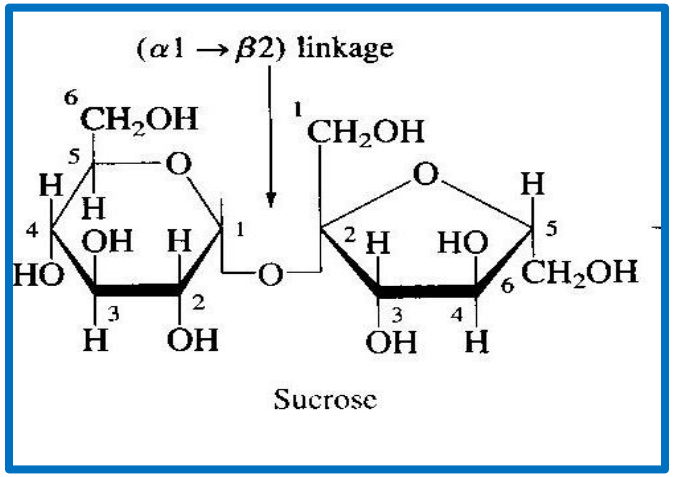
Reducing and Non-Reducing Sugars

Reducing and non reducing sugar :If the oxygen on the anomeric carbon of a sugar is not attached to any other structure, that sugar can act as a reducing agent and is termed areducing sugar



Anomeric carbon





Reducing

Non-reducing

Reactions of Carbohydrates

1. Molisch Test

Molisch Test (α-Naphthol Reaction)

This test is specific for all carbohydrates. Monosaccharide gives a rapid positive test, Disaccharides and polysaccharides react slower.

Objective: To identify the carbohydrate and hence the presence of monosaccharide from other macromolecules lipids and proteins.

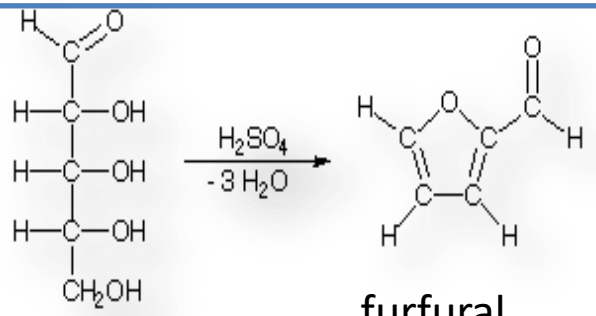
Application of the test:

Used as a general test to detect carbohydrates.

Principle:

The test reagent (**H_2SO_4**) dehydrates pentose to form furfural and dehydrates hexoses to form 5- hydroxymethyl furfural.

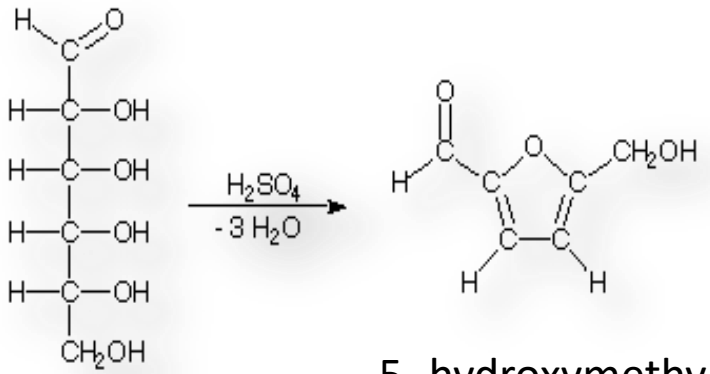
The furfural and 5- hydroxymethyl furfural further react with α-naphthol present in the test reagent to produce a purple product.



furfural

Purpel color

Purpel color



5- hydroxymethyl furfural

α-naphthol

Purpel color

Procedure

1. To 5 ml of sugar solution in a test tube
2. Then add two drops of Molisch reagent. Mix thoroughly.
3. Add 3 ml of concentrated sulphuric acid along the sides of the test tube by slightly inclining the tube, thus forming a layer of acid (acid being heavier goes down beneath the sugar solution) in the lower part.

Observation:

A reddish violet ring appears at the junction of two liquids


Thank
You