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**Diploma in Pharmacy 2<sup>nd</sup> Year**  
**Biochemistry & Clinical Pathology**  
**Chapter 2 : Carbohydrates**

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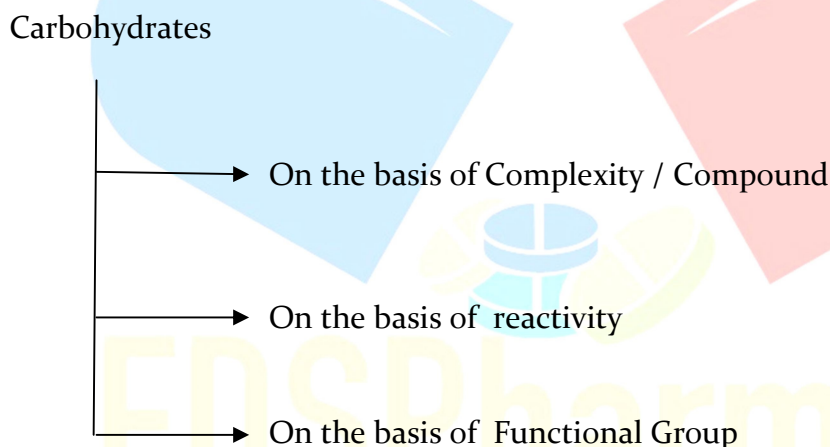
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## Chapter 2

# Carbohydrates

- Carbohydrates are Organic Compound with general formula  $C_n(H_2O)_n$
- They are Composed of Carbon, Hydrogen, Oxygen,
- Carbohydrates are polyhydroxy aldehyde or ketone compound derived from hydrolysis.
- They are the Major source of chemical energy for the living organisms.
- Ex : Sugar & Starch.
- Starch & Cellulose are the two common carbohydrates.

## Classification of Carbohydrates



## Classification on the basic of complexity

### 1. Monosaccharides ( Simple sugar)

- Carbohydrates that can't be hydrolysis to simple compound are called monosaccharides.
- These are single unit carbohydrates (have the one sugar molecules).
- Example : Glucose, Fructose, Galactose,

### 2. Oligosaccharides

- These are made up of 2-10 units of monosaccharides/ simple sugar
  - **Disaccharides** : These oligosaccharides consists of two monosaccharides units
    - Example : Sucrose Glucose + Fructose
  - **Trisaccharides** : These oligosaccharides consists of 3 monosaccharides units
    - Example : Raffinose. Glucose + Fructose + Galactose

### 3. Polysaccharides

- A single molecules of a polysaccharides sugar is formed by polymerization of more than 10 monosaccharides units
- Example : Starch or Cellulose

## Classification on the basic of Reactivity

- **Reducing sugar** : These sugar act as reducing agent & these reduce fehling's & Tollens reagents.
- **Non Reducing Sugar** : These sugar do not reduce fehling's & Tollens reagents.

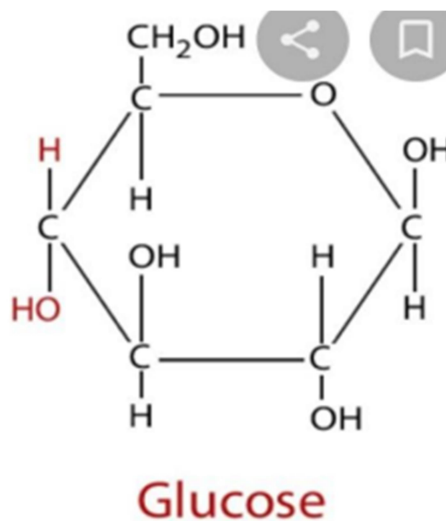
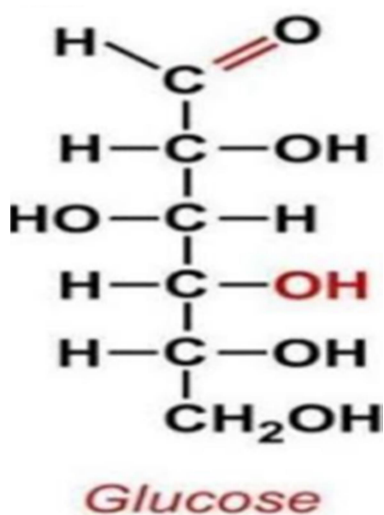
## Classification on the basic of functional groups

- ◇ **Aldose** : These sugar have an aldehyde functional groups
  - **Example** : D-glucose
- ◇ **Ketose** : These sugar have a ketone functional group
  - **Example** : D-fructose

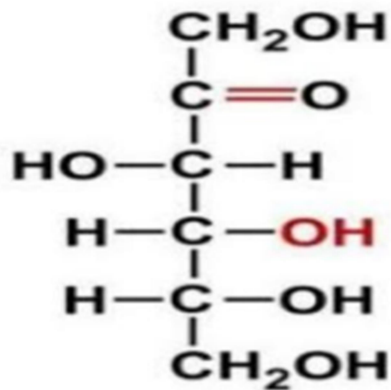
## Monosaccharides

- Monosaccharides are derived from the Greek word mono which means single & saccharide which means sugar.
- Monosaccharides can't be hydrolysed further to provide simple sugar.
- Simple sugar are known as monosaccharides.
- They have a sweet flavour.
- They are water soluble.
- They have a Crystalline appearance.
- They have 3-10 carbon atom
- 2 or more hydroxyl (OH) groups
- One aldehyde (CHO) or Ketone (CO) groups
- Their general formula is  $C_nH_{2n}O_n$

## Structure of Glucose

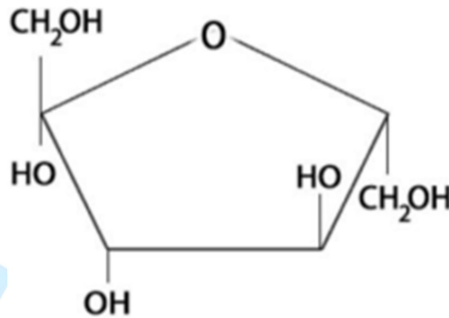


## Structure of Fructose

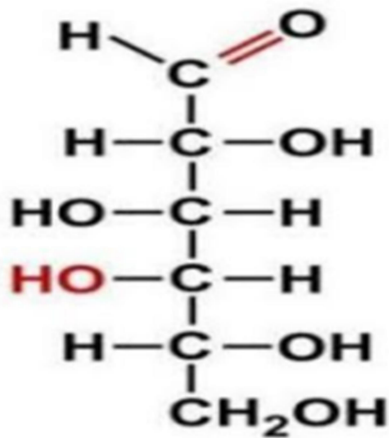


Fructose

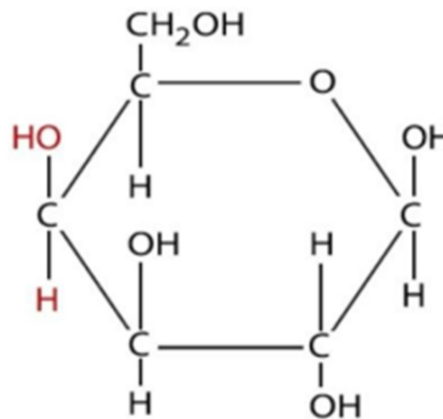
## Fructose



## Structure of Galactose



Galactose

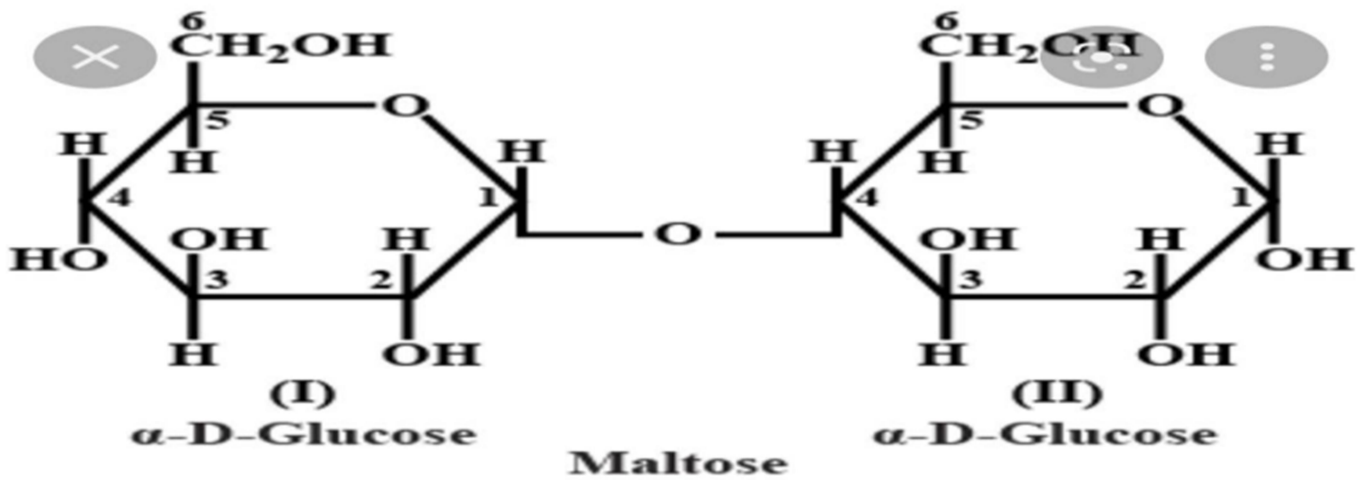


Galactose

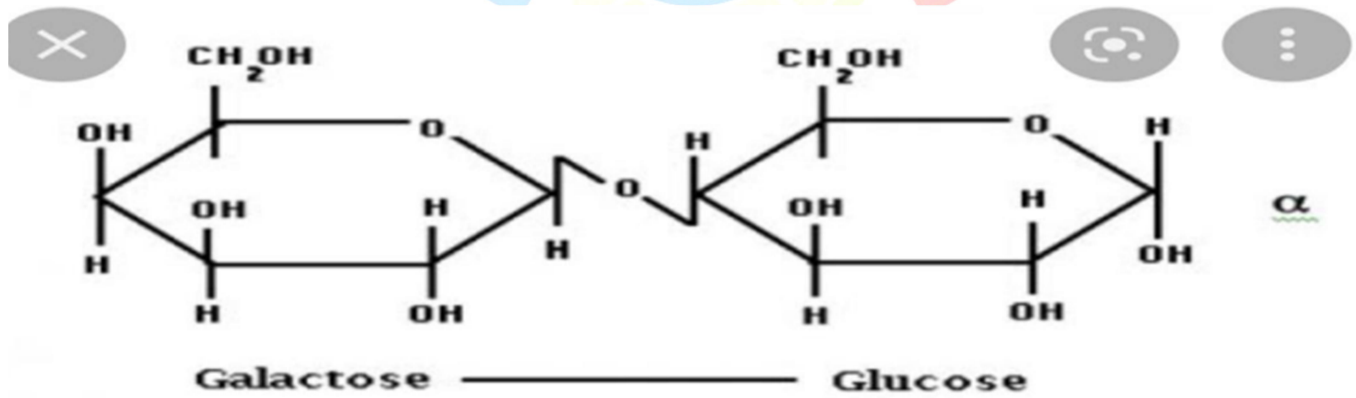
## Disaccharides

- Disaccharides are those carbohydrates which are made up of two monosaccharides units
- They can be reducing sugar. Lactose
- They can be non reducing sugar. Sucrose

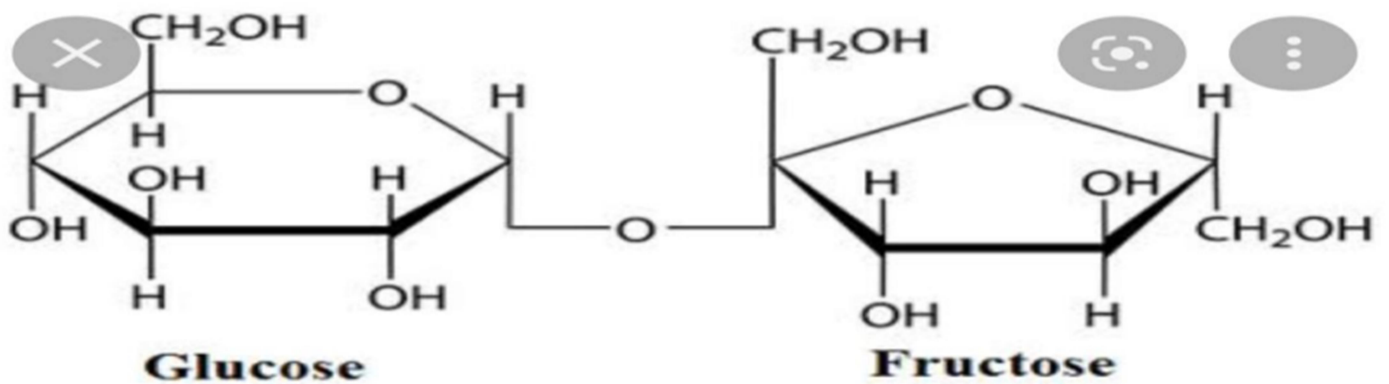
## Structure of Maltose



## Structure of Lactose



## Structure of Sucrose



# Polysaccharides

- They are composed of long carbohydrates molecules chain constituted of numerous simple monosaccharides
- Polysaccharides are considered to be the major class of biomolecules
- This complex Biomolecules function as a important source of energy in animals and form a structural components in plant cells
- They do not have a sweet flavour
- Many are water insoluble
- They are naturally hydrophobic
- They are carbohydrates with a high molecular weight
- They are made up of 3 elements hydrogen, carbon, oxygen,

## Classification of Polysaccharides

### 1. Homopolysaccharides :

- The monomeric units are arranged in the form of long chain either unbranched or branched. • Eg: Starch, Glycogen, Cellulose etc.

### 2. Heteropolysaccharides :

- Hemicellulose is a polymer containing D-xylose, L-arabinoc, D-Galactose, LRhamnose, D-Monnose and D-Glucuronic acid • Eg. : Heparin

## Chemical Nature of Starch

- Glucose is stored in plants in the form of starch.
- It is composed of two components " Amylose "and " Amylopectin"
- Amylose is made up of 250 - 300 glucose , that are joined together by  $\alpha$  -1 , 4 glycosidic bond.
- Amylose chains are unbranched and coiled.
- Amylose are consist about 15 - 20 %
- Amylopectin is a glucose polymer with  $\alpha$  1, 4 glycosidic linkage.
- Side chains with about 12 glucose are linked to the main chain with  $\alpha$  -1,6 glycosidic linkage.

## Chemical Nature of Glycogen

- ◇ Glucose is stored in the form of glycogen in animals.
- ◇ It is found mostly in liver and muscles.
- ◇ It is often called animal starch.
- ◇ It converted in to glucose and provide energy in short term requirement.
- ◇ It is a polymer which is highly branched , and 8 - 10 glucose units present per branch.
- ◇ The chain of glycogen are joined together by  $\alpha$  1, 4 glycosidic link.
- ◇ and branches are joined to the main chain by  $\alpha$  1, 6 glycosidic bond.
- ◇ The structure of glycogen is similar to amylopectin but it is more highly branched.

## Qualitative Test

The qualitative tests are performed for identification of carbohydrates are following :

- 1) **Fehling's Test** : In this test , 1-2 ml each of the Fehling's solution A and B are added to few drops of the test solution and boiled for a few minutes . A Yellowish red colour appears that confirms the presence of reducing sugar ( carbohydrate ).
- 2) **Tollen's test** : In this test , 2-3ml of Tollen's reagent is added to 2-3 ml of aqueous solution of carbohydrate , and boiled in a water bath for 10 minutes . A shining silver mirror indicates the presence of reducing carbohydrates.

## Biological role of Carbohydrates

- ▲ They are source of energy for living organism.
- ▲ They are used as dietary fibers like cellulose.
- ▲ They are used as flavouring and sweating agent.
- ▲ They are stored in our body in the form of glycogen in liver and muscles and converted into glucose to provide energy according to need.
- ▲ They are important component of brain cells.
- ▲ They are important component of DNA & RNA ( Deoxyribose and Ribose sugar )
- ▲ They act as an anticoagulant in the form of Heparin.
- ▲ They are major component of cartilage , tendon and bones.
- ▲ They are used in clearance test in the form of Inulin.
- ▲ They are used in the treatment of heart diseases in the form of Glycosides.



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Amir Khan

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