BIOMOLECULES

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Introduction:

In this Unit, Structures and functions of some of biomolecules will be discuss. The structure and functions of biomolecules inside the living being is studied in biochemistry. Living systems are made up of various complex biomolecules such as carbohydrates, proteins, enzymes, lipids, vitamins, hormones, nucleic acids and compounds for storage and exchange of energy such as ATP, etc.

Carbohydrates:

Classification of Carbohydrates

On the basis of their behaviour upon hydrolysis, carbohydrates can be divided into three main groups:

i. **Monosaccharides:** A carbohydrate which cannot be hydrolyzed into simpler unit of polyhydroxy aldehyde or ketone is called monosaccharide. About 20 monosaccharides are known to occur in nature. e.g., glucose, fructose, ribose etc.

ii. **Oligosaccharides:** A carbohydrate which upon hydrolysis yields 2–10 unit of monosaccharide is called oligosaccharide. They are further classified as disaccharides, trisaccharides, etc., depending upon the number of monosaccharides, they provide on hydrolysis. For example, sucrose is a disaccharide which on hydrolysis yields two unit of monosaccharides i.e., glucose and fructose whereas raffinose is a trisaccharide which on hydrolysis yields three unit of monosaccharides i.e., glucose, fructose and galactose.

iii. **Polysaccharides:** A high molecular mass carbohydrate which upon hydrolysis yields a large number of monosaccharide units is called polysaccharide e.g., starch, cellulose, glycogen, gums, etc.

$(C_6H_{10}O_5)_n + nH_2O \longrightarrow nC_6H_{12}O_6$

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

Reducing and non-reducing carbohydrates : The carbohydrates containing free aldehydic or ketonic group can reduce Fehling's solution and Tollen's reagent are known as **reducing** carbohydrates. All monosaccharides whether aldose or ketose are reducing in nature. The carbohydrates in which the reducing parts are not free cannot reduce

Fehling's solution and Tollen's reagent are known as **non-reducing** carbohydrates. All polysaccharides like starch, cellulose, glycogen etc. are non-reducing carbohydrates.

i. Monosaccharides

If a monosaccharide contains an aldehyde group, it is known as an aldose and if it contains a keto group, it is known as a ketose.

Carbon atoms	General term	Aldehyde	Ketone
3	Triose	Aldotriose	Ketotriose
4	Tetrose	Aldotetrose	Ketotetrose
5	Pentose	Aldopentose	Ketopentose
6	Hexose	Aldohexose	Ketohexose
7	Heptose	Aldoheptose	Ketoheptose

Glucose

Glucose occurs in nature in free as well as in the combined forms. It is present in sweet fruits and honey. Ripe grapes contain ~20% of glucose.

Preparation of Glucose

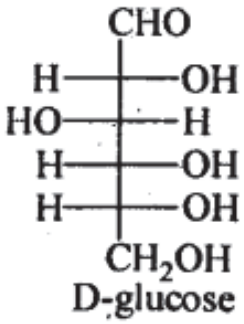
1. **From Sucrose (Cane Sugar)**: When sucrose is boiled with dilute HCl or H_2SO_4 in alcoholic solution, glucose and fructose are obtained in equimolar proportion.

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$

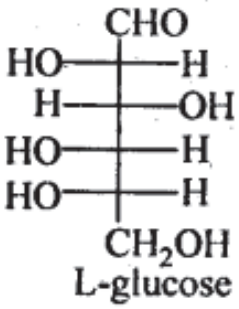
2. **From Starch :** When starch is boiled with dilute H_2SO_4 at 393 K under pressure, glucose is obtained. This is the commercial method for the preparation of glucose.

$$(C_6H_{10}O_5)n + nH_2O \longrightarrow nC_6H_{12}O_6$$

Structure of Glucose: Glucose is an aldohexose and is the monomer of many larger carbohydrates like starch, cellulose etc. It is the most abundant organic compound on the Earth.

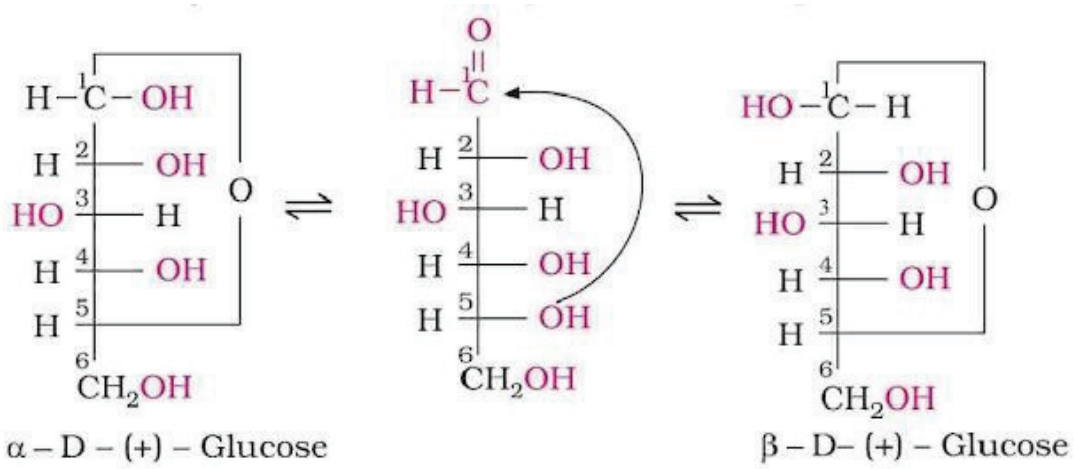


D-glucose

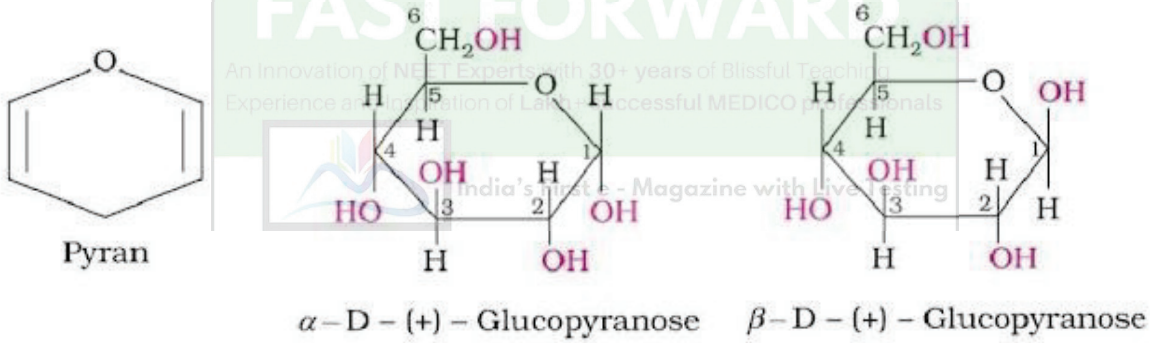


L-glucose

Cyclic Structure of Glucose: It was proposed that glucose can form a six-membered ring in which –OH at C-5 can add to the –CHO group and can form a cyclic hemiacetal structure. This explains the absence of –CHO group and also the existence of glucose in α and β-anomeric forms as



The two cyclic hemiacetal forms of glucose differ only in the configuration of the hydroxyl group at C-1, called anomeric carbon and the corresponding α and β-forms are called anomers. It should be noted that α and β-forms of glucose are not mirror images of each other, hence are not enantiomers.



Fructose

Fructose is an important ketohexose. It is obtained by the hydrolysis of sucrose. On the basis of molecular weight determination, elemental analysis and various reaction its molecular formula is found to be $C_6H_{12}O_6$ and open chain structure of it can be written as

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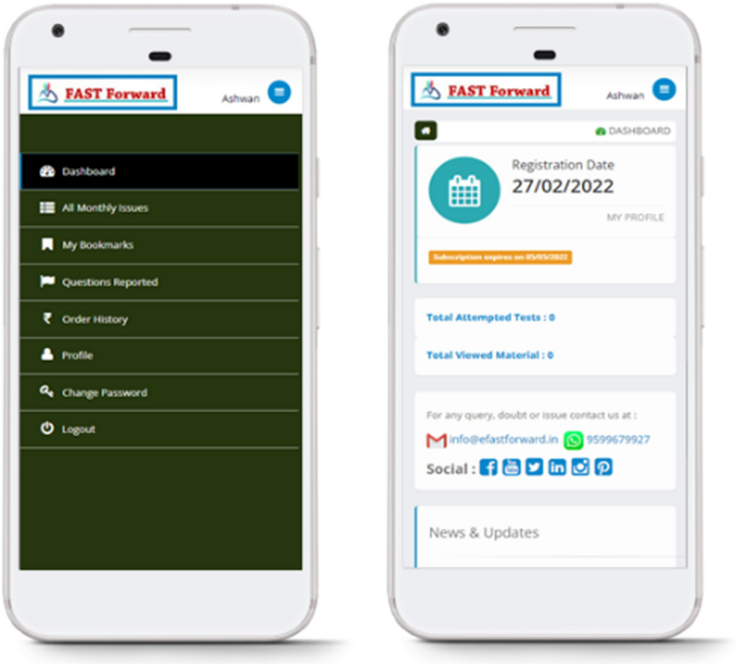

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