Polysaccharide

Polysaccharides are linear, branched or unbranched molecular chains of monosaccharides of ~~one~~ one or more types.

Polysaccharides are products of Photosynthesis

Composition:→ Polysaccharides are Polymers of monosaccharides joined together by glycosidic linkage between first and fourth carbons of two units (1-4 linkage). The number of monomers in a Polysaccharide may range from 10 to several thousands. Therefore, Polysaccharides have high molecular weight and colloidal size. They form branched or unbranched linear chains of molecules.

In general, Polysaccharides are tasteless and colourless amorphous substances. These are sparingly soluble in water and do not diffuse through the cell membrane. On hydrolysis they form monosaccharide units. They can be represented by the general formula $(C_6H_{10}O_5)_n$. They serve as food and energy stores (e.g. starch and glycogen) and as structural material (e.g. cellulose)

Depending upon the composition, Polysaccharides are of two types:

1. homoPolysaccharides 2) heteroPolysaccharides

1. Homopolysaccharides :→

These are complex carbohydrates formed by the polymerisation of only one type of monosaccharides.

Examples :→ Glycogen, Starch, Cellulose and Agar.

Glycogen, Starch and cellulose are made up of glucose units. They differ –

(i) in the arrangement of bonds between glucose units.

(ii) in the branching pattern of the polymer.

(iii) in the number of glucose units per chain.

Agar is composed of galactose.

2. Heteropolysaccharides :

These complex carbohydrates are formed by the condensation of more than one type of monosaccharide monomers.

Examples :→ Chitin, Mucopolysaccharides, Glycoproteins or Mucoproteins and Peptidoglycan.

During the formation of a polysaccharide, a molecule of water is released at each condensation.

$$n(C_6H_{12}O_6) \xrightarrow{\text{condensation}} (C_6H_{10}O_5)_n + nH_2O$$

Monosaccharide → Polysaccharide

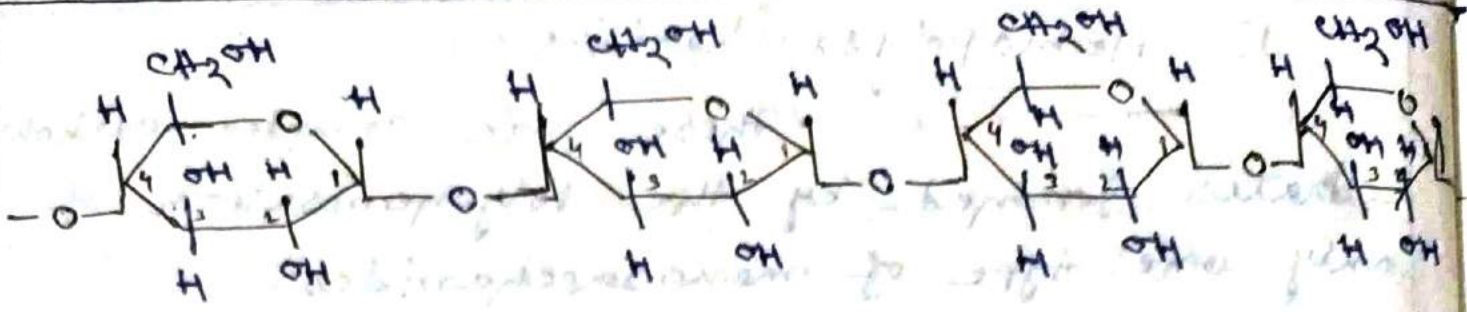

Fig :- Joining of glucose molecule by α-1, 4 - glycosidic bonds in amylose.

○ Functional classification of Polysaccharides:

Based on function, Polysaccharides are of three main types :-

(I) Storage
(II) Structural and
(III) Mucopolysaccharide.

1. food storage Polysaccharides :->

Storage polysaccharides serve as reserve food and provide nourishment at the time of need. when needed, storage Polysaccharides are hydrolysed releasing sugar, which is used by the living cells for the production of energy and biosynthetic activity. Starch and glycogen are the two main storage Polysaccharides. Inulin is the storage carbohydrates of the family compositae.

(A) Starch :→

Starch is a Polymer of Glucose. It is the most important storage form of carbohydrates in the Plant kingdom. It is found in abundance in rice, wheat, cereals, legumes, Potato, tapioca and bananas. It is formed as an end Product of Photosynthesis and serve as an energy-storing material. Starch molecules are very large with molecular weight varying from 5000 to 10^6

Starch consists of two Polysaccharides namely **amylose** and **amylopectin**.

(a) **Amylose** :→ It forms about 20% of starch. It is soluble in water and is formed of unbranched but coiled chain of 200 to 3,000 α, D-glucose units.

(b) **Amylopectin** :→

Amylopectin forms about 80% of the starch. It is insoluble in water. Amylopectin molecule is highly branched formed of 2,000 to 2,00,000 glucose units. Its inner chains are formed of 24-30 glucose subunits, whereas outer chains are about 13-18 residues long. The glucose residues are linked through α-1,4 glycosidic linkage.

Starch is stored in Plant parts as

starch grains inside amyloplasts. Each starch grain has several layers of starch sheaths, called shells, deposited in concentric or eccentric fashion around a point-hilum. Starch grains may occur singly (simple) or in groups (compound). The shape and size of starch grains differ from plant-to-plant and are used in the identification of plants.

In animals starch is hydrolysed into glucose units. Starch gives blue colour with iodine solution. A concentrated solution of starch forms gel on cooling. Its dilute solution is colloidal.

(B) Glycogen :→

Glycogen forms the carbohydrate reserve of the animal tissues. It is mainly stored in the muscles and liver of mammals.

Plants like fungi and yeast also contain glycogen. Glycogen molecule is a long, much branched chain of about 30,000 α-D-glucose units, linked by α-1,4 glycosidic linkages but at the branching point, the glucose units are connected through α-1-6 linkage.

Glycogen is readily soluble in water. It is a branched polymer of glucose.

In the livers of an adult human being, up to 0.9 kg of glycogen can be stored. This glycogen is changed to glucose as and when required. Glycogen readily breaks down into glucose units by hydrolysis. Hydrolysis of glycogen to glucose is termed glycogenolysis. Glucose, so formed in liver cells, is distributed by the blood to body tissues for use in respiration. Hydrolysis of glucose is brought about by enzymes called amylases.

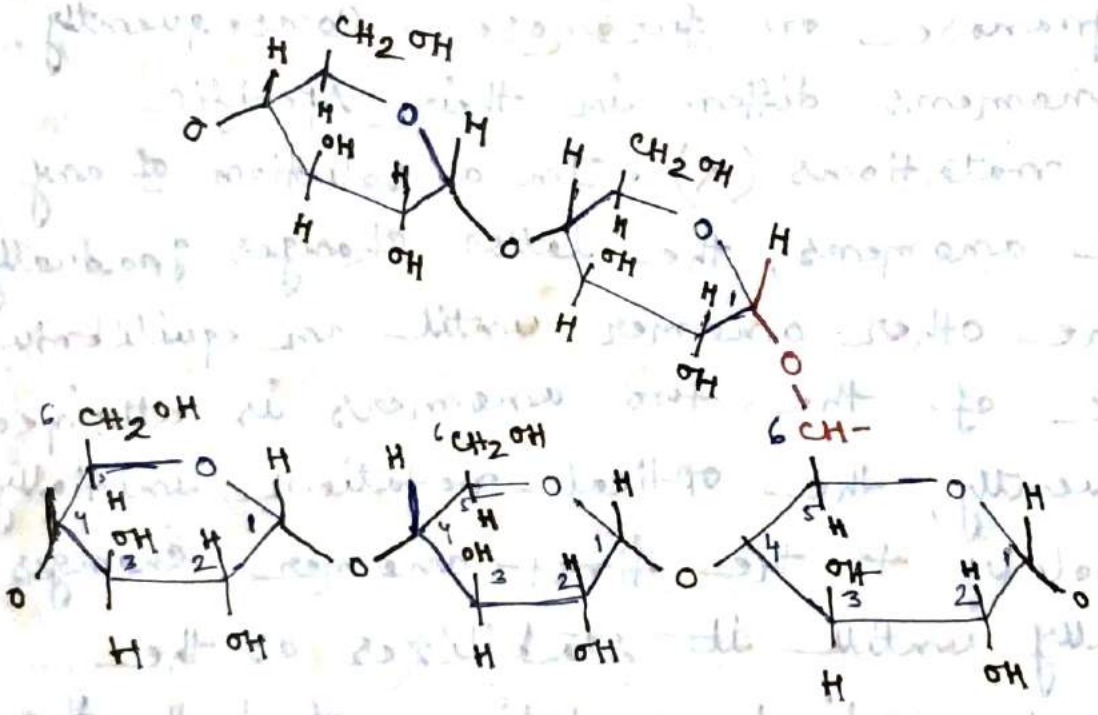

Fig: Molecular structure of a part of a chain of glycogen.