

Biochemistry of polysaccharides

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Introduction

Polysaccharides

Polysaccharides are defined as the polymeric anhydrides of monosaccharides. Polysaccharides (glycans) are long chains of monosaccharides. Each monosaccharide is

connected together via glycosidic bonds to form the polymeric structure known as

polysaccharide. Polysaccharides are the largest component of biomass. It is estimated that

more than 90% of the carbohydrate mass in nature is in the form of polysaccharides.

The most common polysaccharides consisting of single monosaccharides are:

- starch (found in plants). It's a polymer of Glc linked in a main chain through a 1->4 links with a 1->6 branches. Amylose is starch with no branches, while amylopectin has branches. Starch granules consist of about 20% amylose and 80% amylopectin.
- glycogen, the main CHO storage in animals. Muscle and liver glycogen consists of Glc residues in a 1->4 links with lots of a 1->6 branches (many more branches than in starch). The polymer is synthesized on a protein primer called glycogenin (G), and has a structure shown below (in which only 5 rings of the structure are shown instead of the actual 12).
- dextran is a branched polymer of glucose in a 1->6 links with a 1->4 branches and is used in Sephadex chromatography beads.

Characteristics Of Polysaccharides

Polysaccharides have the following properties:

1. They are not sweet in taste.
2. Many are insoluble in water.
3. They are hydrophobic in nature.
4. They do not form crystals on desiccation.
5. Can be extracted to form a white powder.

6. They are high molecular weight carbohydrates.
7. Inside the cells, they are compact and osmotically inactive.
8. They consist of hydrogen, carbon, and oxygen. The hydrogen to oxygen ratio being 2:1.

Types Of Polysaccharides

Polysaccharides are categorized into two types:

- Homopolysaccharides.
- Heteropolysaccharides.

Homopolysaccharides

A polysaccharide that contains the same type of monosaccharides is known as a homopolysaccharide. Some of the important homopolysaccharides are:

1. **Glycogen:** It is made up of a large chain of molecules. It is found in animals and fungi.
2. **Cellulose:** The cell wall of the plants is made up of cellulose. It comprises long chains of β -glycosides.
3. **Starch:** It is formed by the condensation of amylose and amylopectin. It is found largely in plants, fruits, seeds, etc.
4. **Inulin:** It is made up of a number of fructofuranose molecules linked together in chains. It is found in the tubers of dahlia, artichoke, etc.

Heteropolysaccharides

A polysaccharide that contains different types of monosaccharides is known as a heteropolysaccharide. Some of the important heteropolysaccharides are:

1. **Hyaluronic Acid:** It is made up of D-glucuronic acid and N-acetyl-glucosamine. It is found in connective tissues and skin.
2. **Heparin:** It is made up of D-glucuronic acid, L-iduronic acid, N-sulfo-D-glucosamine and is largely distributed in mast cells and blood.
3. **Chondroitin-4-sulfate:** Its component sugars are D-glucuronic acid and N-acetyl-D-galactosamine-4-O-sulfate. It is present in the cartilages.

4. **Gamma globulin:** N-acetyl-hexosamine, D-mannose, D-galactose are the component sugars of this polysaccharide. It is found in the blood.

Functions Of Polysaccharides

The polysaccharides serve as a structural organization in animals and plants. Other functions of polysaccharides include:

1. They store energy in organisms.
2. Due to the presence of multiple hydrogen bonds, the water cannot invade the molecules making them hydrophobic.
3. They allow for changes in the concentration gradient which influences the uptake of nutrients and water by the cells.
4. Many polysaccharides become covalently bonded with lipids and proteins to form glycolipids and glycoproteins. These glycolipids and glycoproteins are used to send messages or signals between and within the cells.
5. They provide support to the cells. The cell wall of plants is made up of polysaccharide cellulose, which provides support to the cell wall of the plant. In insects and fungi, chitin plays an important role in providing support to the extracellular matrix around the cells.