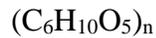


Polysaccharides

1. Introduction

Polysaccharides are high molecular weight carbohydrates composed of more than 10 monosaccharide units joined by **glycosidic bonds**. They are also called **glycans**.

General formula:



They are formed by condensation reactions between monosaccharides with elimination of water.

2. Classification of Polysaccharides

A. On the Basis of Composition

(i) Homopolysaccharides

Contain only one type of monosaccharide.

Examples:

- Starch (glucose)
- Glycogen (glucose)
- Cellulose (glucose)
- Inulin (fructose)

(ii) Heteropolysaccharides

Contain two or more different types of monosaccharides.

Examples:

- Hyaluronic acid
 - Heparin
 - Peptidoglycan
 - Chondroitin sulfate
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B. On the Basis of Function

Type	Function	Examples
Storage polysaccharides	Energy storage	Starch, Glycogen
Structural polysaccharides	Structural support	Cellulose, Chitin

3. Important Homopolysaccharides

3.1 Starch

Starch is the storage polysaccharide of plants.

It consists of two components:

(i) Amylose

- Linear polymer of α -D-glucose
- $\alpha(1\rightarrow4)$ glycosidic linkages
- Helical structure
- Gives blue color with iodine

(ii) Amylopectin

- Branched polymer
- $\alpha(1\rightarrow4)$ linkages in chains
- $\alpha(1\rightarrow6)$ linkages at branching points
- Branching occurs every 24–30 glucose units

Properties:

- Insoluble in cold water
 - Hydrolyzed by amylase enzyme
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3.2 Glycogen

Glycogen is the storage polysaccharide of animals.

- Present in liver and muscles
- Structure similar to amylopectin
- More highly branched
- Branching every 8–12 glucose units
- Also gives reddish-brown color with iodine

3.3 Cellulose

Cellulose is a structural polysaccharide found in plant cell walls.

- Linear polymer of β -D-glucose
- $\beta(1\rightarrow4)$ glycosidic bonds
- Forms long straight chains
- Chains held together by hydrogen bonding
- Forms microfibrils

Important Points:

- Humans lack cellulase enzyme
 - Cannot digest cellulose
 - Provides dietary fiber
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3.4 Chitin

- Polymer of N-acetyl-D-glucosamine
 - $\beta(1\rightarrow4)$ linkages
 - Found in exoskeleton of arthropods and fungal cell walls
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4. Important Heteropolysaccharides

4.1 Hyaluronic Acid

- Found in connective tissue
- Acts as lubricant in joints
- Composed of glucuronic acid and N-acetylglucosamine

4.2 Heparin

- Natural anticoagulant
- Present in liver and lungs
- Highly sulfated polysaccharide

4.3 Peptidoglycan

- Present in bacterial cell wall
 - Alternating units of N-acetylglucosamine (NAG) and N-acetylmuramic acid (NAM)
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5. Properties of Polysaccharides

- High molecular weight
 - Insoluble or form colloidal solutions
 - Do not show reducing properties (except at one free end)
 - Tasteless
 - Non-sweet
-

6. Biological Importance

1. Energy storage (starch, glycogen)
 2. Structural support (cellulose, chitin)
 3. Lubrication (hyaluronic acid)
 4. Anticoagulant action (heparin)
 5. Cell recognition and signaling
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7. Differences Between Important Polysaccharides

Feature	Starch	Glycogen	Cellulose
Type	Storage	Storage	Structural
Monomer	α -glucose	α -glucose	β -glucose
Branching	Moderate	Highly branched	No branching
Digestible in humans	Yes	Yes	No
Bond type	$\alpha(1\rightarrow4)$, $\alpha(1\rightarrow6)$	$\alpha(1\rightarrow4)$, $\alpha(1\rightarrow6)$	$\beta(1\rightarrow4)$

8. Hydrolysis of Polysaccharides

On hydrolysis (acid or enzyme), polysaccharides break down into:

- Oligosaccharides
- Disaccharides
- Monosaccharides

Example:

Starch → Dextrin → Maltose → Glucose

9. Summary

Polysaccharides are complex carbohydrates essential for life. They serve as energy reservoirs and structural materials. Their properties depend on:

- Type of monosaccharide
- Type of glycosidic bond
- Degree of branching