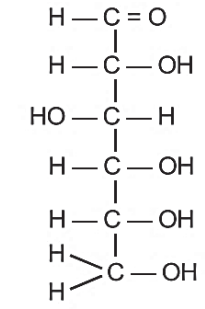
CARBOHYDRATES

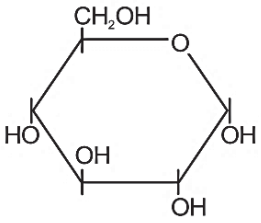
Carbohydrates, primarily composed of carbon, hydrogen, and oxygen, are also referred to as saccharides due to their fundamental sugar components. They exist in two forms: small and large (complex). Small carbohydrates, also known as biomicromolecules, are further categorized into monosaccharides, derived monosaccharides, and oligosaccharides. Large carbohydrates, recognized as biomicromolecules, are denoted as polysaccharides.

Monosaccharides:

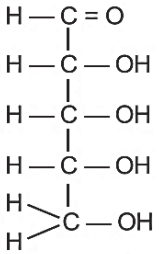
- Monosaccharides are simple carbohydrates that cannot be further hydrolyzed into smaller components.
- Composed of 3-7 carbon atoms, these biomicromolecules include examples such as Ribose, glucose, and fructose.



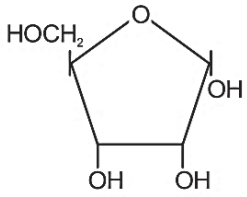
Open chain of Glucose



$C_6H_{12}O_6$ (Glucose)



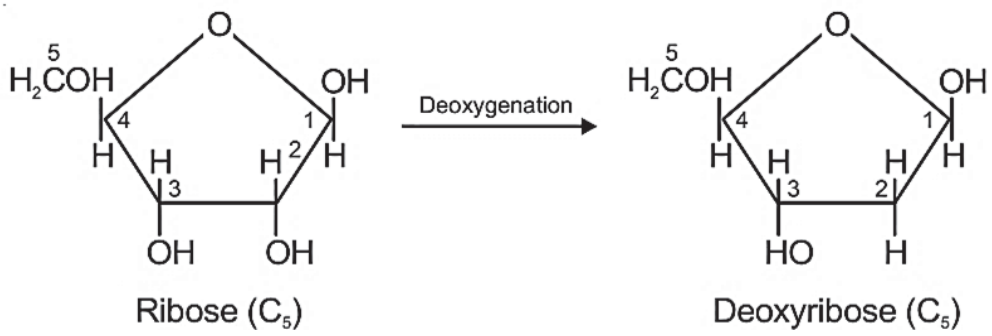
Open chain of Ribose



$C_5H_{10}O_5$ (Ribose)

Derived Monosaccharides:

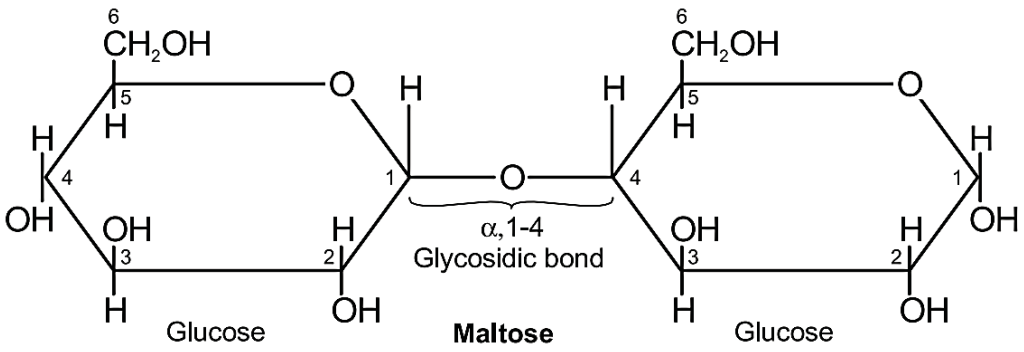
- Monosaccharides undergo various modifications to yield different substances.
- Examples include deoxy sugar (e.g., deoxyribose), amino sugar (e.g., glucosamine), sugar acid (e.g., glucuronic acid, ascorbic acid), and sugar alcohol (e.g., mannitol).



Ribose (C_5) Deoxyribose (C_5)

Oligosaccharides:

- These small carbohydrates result from the condensation of 2-9 monosaccharides, forming glycosidic bonds.
- Glycosidic bonds form through dehydration, connecting the aldehyde or ketone group of one monosaccharide with the alcohol group of another.
- Depending on the number of monosaccharide molecules involved, oligosaccharides are classified as disaccharides (e.g., sucrose, maltose, lactose, and trehalose).



- Reducing sugars possess the ability to reduce Cu2+ ions to Cu+ ions and include free aldehyde or ketone groups. Monosaccharides exhibit this property, while some disaccharides like lactose and maltose also possess reducing groups.

Polysaccharides:

- Polysaccharides are macromolecules or polymers composed of chains of monosaccharides, either branched or unbranched.
- Glycosidic bonds link individual monosaccharides, and the right end is termed the reducing end, while the left end is the non-reducing end.

There are two types of polysaccharides: homopolysaccharides and heteropolysaccharides.

- **Homopolysaccharides:**
  Glycogen: Branched structure with 01, 4 linkages at the unbranched part and 01, 6 linkages at branching points. Used as a storage form in animals.
  Starch: Forms a helical secondary structure, giving a blue color with iodine.
  Cellulose: Unbranched polymer serving as a structural element in plant cell walls.
  Inulin: Storage polysaccharide found in roots and tubers.
  Chitin: Contains N-acetyl glucosamine and is found in the exoskeletons of arthropods.

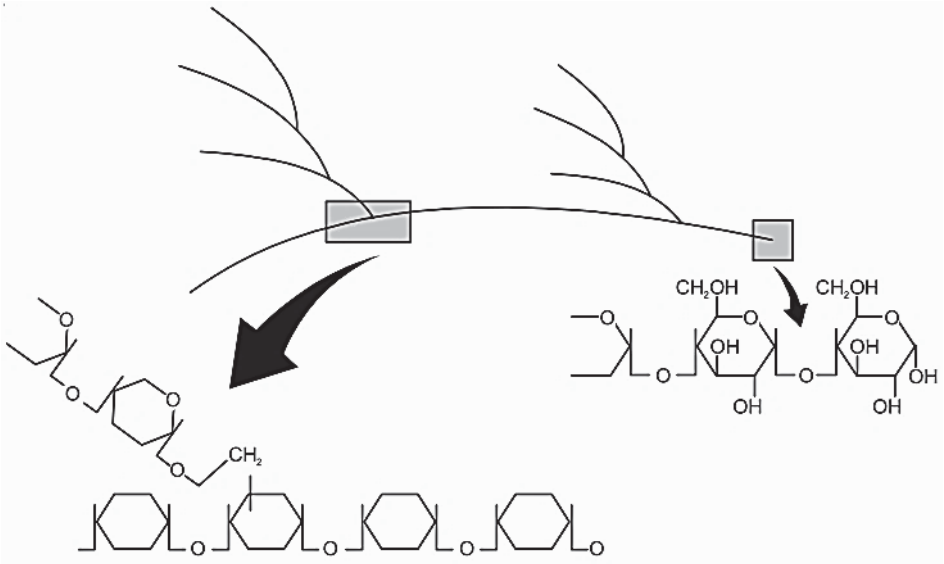


Fig. : Diagrammatic representation of a portion of glycogen

- **Heteropolysaccharides:**
  Peptidoglycan: Chains made of alternate amino-sugar molecules.
  Hyaluronic Acid: Composed of D-glucuronic acid and D-N-acetyl glucosamine, contributing to the toughness and flexibility of cartilage and tendon.

Carbohydrates like glycogen and starch, stored as polysaccharides, offer advantages in bulk storage, chemical inertness, and osmotic inactivity. When needed, enzymes break down these polysaccharides to release energy.