

Carbohydrates and related products

Introduction of Carbohydrate

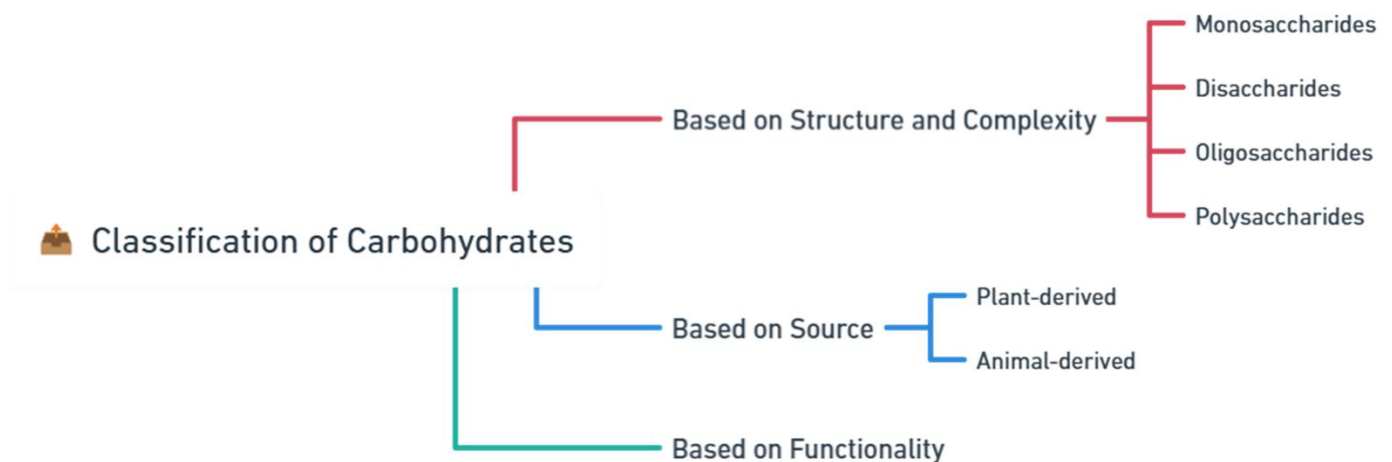
Overview

- Carbohydrates are one of the most abundant organic compounds found in nature and serve as essential biomolecules in both plants and animals.
- In pharmacognosy, carbohydrates form the primary metabolites that are fundamental in the structural and physiological makeup of plants.
- They are integral components of medicinal plants and serve various pharmaceutical roles, such as excipients, binders, thickeners, sweeteners, and drug delivery agents.
- Additionally, they form the structural framework for secondary metabolites like glycosides and antibiotics.



- Carbohydrates are chemically defined as polyhydroxy aldehydes or ketones or compounds that yield these upon hydrolysis.
- They range from simple monosaccharides (e.g., glucose) to complex polysaccharides (e.g., starch, cellulose).
- In pharmaceutical science, understanding carbohydrates is critical for their functional, pharmacological, and industrial applications.
- They also play a role in diagnostic tests, immunology (as antigens), and biotechnology.

Classification of Carbohydrates



A. Based on Structure and Complexity

1. Monosaccharides (Simple Sugars)

- **Definition:** The simplest carbohydrates that cannot be hydrolyzed into smaller units.
- **Number of Carbon Atoms:**
 - Trioses – 3 carbon atoms (e.g., Glyceraldehyde)
 - Tetroses – 4 carbon atoms
 - Pentoses – 5 carbon atoms (e.g., Ribose, Arabinose)
 - Hexoses – 6 carbon atoms (e.g., Glucose, Fructose, Galactose)
 - Heptoses – 7 carbon atoms
- **Types Based on Functional Group:**
 - Aldoses – Contain an aldehyde group (e.g., Glucose)
 - Ketoses – Contain a ketone group (e.g., Fructose)

2. Disaccharides

- **Definition:** Composed of two monosaccharide units linked via glycosidic bond.
- **Based on Reducing Property**
 - **Reducing sugars:** Possess free aldehyde or ketone groups (e.g., glucose, lactose, maltose)
 - **Non-reducing sugars:** Do not have free aldehyde/ketone groups (e.g., sucrose)
- **Examples:**
 - Sucrose (Glucose + Fructose)
 - Lactose (Glucose + Galactose)
 - Maltose (Glucose + Glucose)

3. Oligosaccharides

- **Definition:** Composed of 3–10 monosaccharide units.
- **Example:** Raffinose (Glucose + Fructose + Galactose)

4. Polysaccharides

- **Definition:** Large molecules composed of more than 10 monosaccharide units.
- **Types:**
 - **Homopolysaccharides** – Composed of only one type of monosaccharide.
 - Starch (Glucose polymer)
 - Cellulose
 - Inulin (Fructose polymer)

- **Heteropolysaccharides** – Composed of more than one kind of monosaccharide.
 - Pectin
 - Hyaluronic acid
 - Mucopolysaccharides

B. Based on Source

A. Plant-derived Carbohydrates

- Starch, Cellulose, Inulin, Pectin, Gums, Mucilages

B. Animal-derived Carbohydrates

- Glycogen (animal starch)
- Chitin (in arthropods)

C. Based on Functionality

1. **Nutrients:** Glucose, Fructose, Sucrose
2. **Binders and Fillers:** Starch, Cellulose derivatives
3. **Suspending and Emulsifying Agents:** Mucilages, Gums
4. **Laxatives:** Cellulose, Agar, Psyllium
5. **Plasma Expanders:** Dextran
6. **Diagnostic Agents:** Inulin (glomerular filtration marker)

Functions and Applications of Carbohydrates in Pharmacy

Pharmaceutical Applications

1. Excipients in Formulations

- **Binders:** Starch and cellulose are used to hold tablets together.
- **Diluents:** Lactose is a common diluent in tablet formulations.
- **Thickeners:** Gums and mucilages help increase viscosity in liquid preparations.

2. Drug Delivery Systems

- Polysaccharides like alginates and cellulose derivatives are used in controlled-release formulations.
- Carbohydrate-based hydrogels are being researched for targeted drug delivery.

3. Sweeteners and Flavoring Agents

- Sucrose, glucose, fructose are used in syrups and oral solutions.

4. Bioadhesive and Mucoadhesive Agents

- Natural gums like xanthan gum, guar gum, and tragacanth are used to enhance drug adhesion to mucosal membranes.

5. Laxatives

- Bulk-forming laxatives like cellulose, psyllium, and agar are used in constipation management.

6. Plasma Expanders

- Dextrans (polysaccharides derived from sucrose) are used as plasma volume expanders in hypovolemic conditions.

Therapeutic and Diagnostic Applications

A. Glucose Tolerance Test

- Utilizes glucose solutions to test insulin response in diabetes diagnosis.

B. Inulin Clearance Test

- Inulin is used to assess renal glomerular filtration rate (GFR).

C. Antioxidant and Immunomodulatory Activities

- Some complex polysaccharides exhibit immunostimulant effects (e.g., beta-glucans).

D. Antibacterial and Antiviral Agents

- Modified carbohydrates are used to interfere with pathogen adhesion and biofilm formation.

Chemical Tests for Carbohydrates

- Several qualitative and quantitative chemical tests are available to identify the presence and type of carbohydrates in crude drug samples.
- These are fundamental in pharmacognostic evaluation.

General Tests

1. Molisch's Test

- **Principle:** Carbohydrates are dehydrated by concentrated sulfuric acid to form furfural derivatives, which condense with α -naphthol to form a violet ring.
- **Procedure:** Add Molisch reagent (α -naphthol in alcohol) to sample and carefully layer conc. H_2SO_4 .
- **Positive Test:** Appearance of violet ring at the junction.

2. Fehling's Test

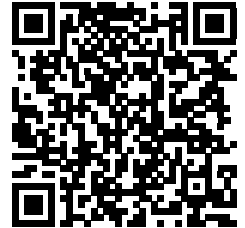


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