Practical Lecture: Carbohydrates in Medical Chemistry

Carbohydrate

1. Introduction

Carbohydrates are crucial biomolecules, providing energy (especially glucose), structural roles (e.g., glycoproteins), and participating in cell signaling.

2. Types of Carbohydrates

Monosaccharides: Glucose, fructose, galactose

Disaccharides: Sucrose, lactose, maltose

Polysaccharides: Starch, glycogen

3. Medical Importance

Glucose: Primary energy source; hyperglycemia indicates diabetes.

Lactose: Inability to digest → lactose intolerance

Fructose: Malabsorption can cause GI symptoms

Reducing sugars in urine: Indicate glucosuria (often in diabetes mellitus)

Clinical Relevance:

Blood glucose monitoring in diabetes

Detecting reducing sugars in urine for metabolic disorders

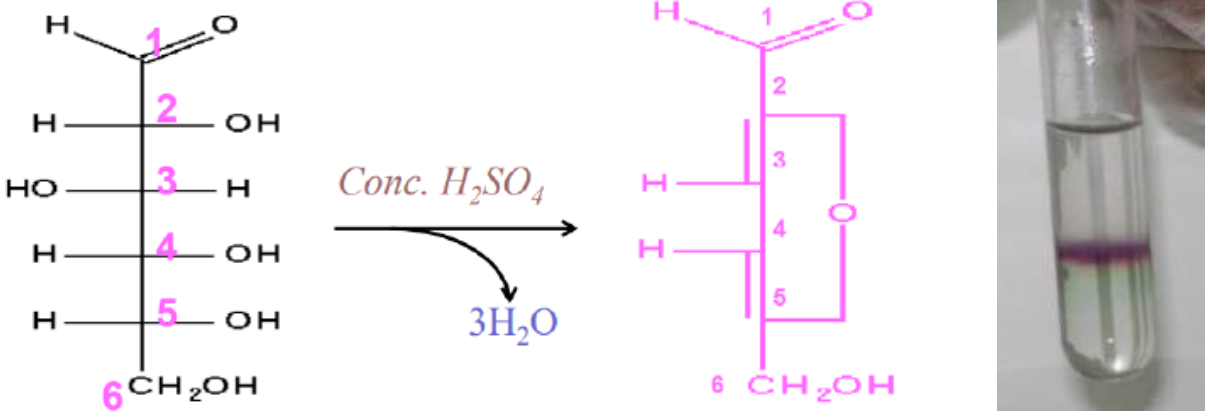
Identifying carbohydrate malabsorption issues

4. Qualitative Tests in Medical Chemistry

A. Molisch's Test (General Carbohydrate Test)

Principle: Dehydration by acid → furfural → reaction with α-naphthol

Clinical Note: Molisch's Test confirms carbohydrate presence

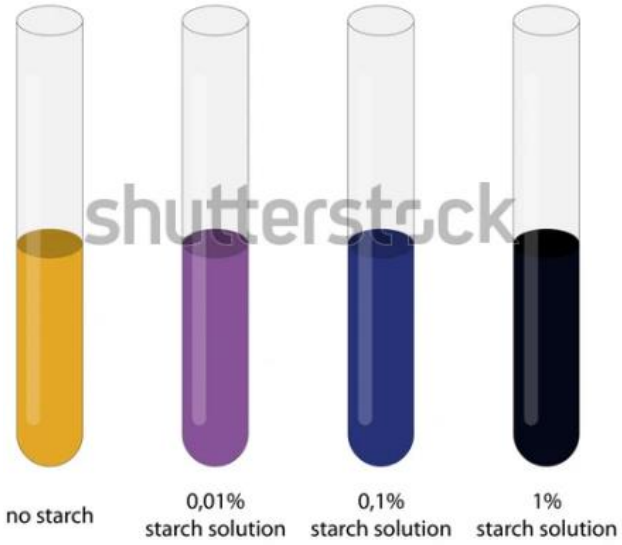


B. Iodine Test (Polysaccharide Test)

Principle: Iodine fits into the helical structure of starch → blue-black complex

Clinical Relevance: Rare in direct testing, but helps identify dietary polysaccharides in digestion studies

Observation: Blue-black color

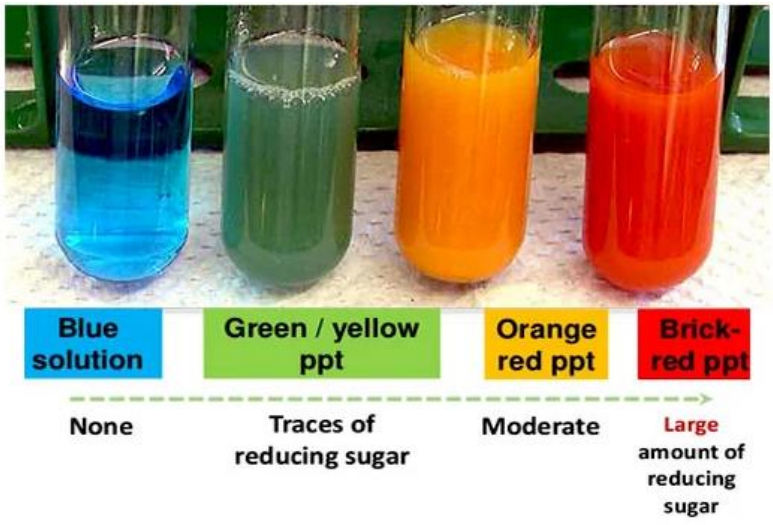


C. Benedict's Test (Detects Reducing Sugars)

Principle: Reducing sugars reduce Cu^{2+} to Cu^{+}, forming a colored precipitate

Clinical Application: Used in detecting glucose or other reducing sugars in urine (e.g., diabetes, fructosuria)

Observation: Green to brick-red precipitate based on concentration



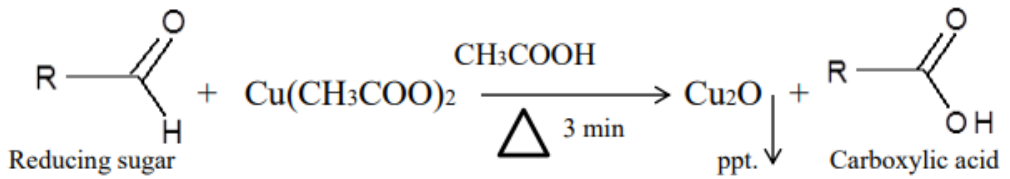
D. Barfoed's Test (Differentiates Monosaccharides vs. Disaccharides)

Principle: Monosaccharides reduce copper ions faster in acidic medium

Clinical Use: Differentiates types of sugars in diagnostic urine analysis

Observation: Red precipitate in monosaccharide or disaccharide

Barfoed's test is a chemical test used for detecting the presence of monosaccharides. It is based on the reduction of cupric (II) acetate to cuprous (I) oxide (Cu_2O), which forms a brick-red precipitate. Disaccharides may react, but the reaction is much slower because they have to get hydrolyzed first and then react with the reagent cupric acetate to produce cuprous oxide. Only monosaccharide can reduce the cupric ions in the weak acidic medium.

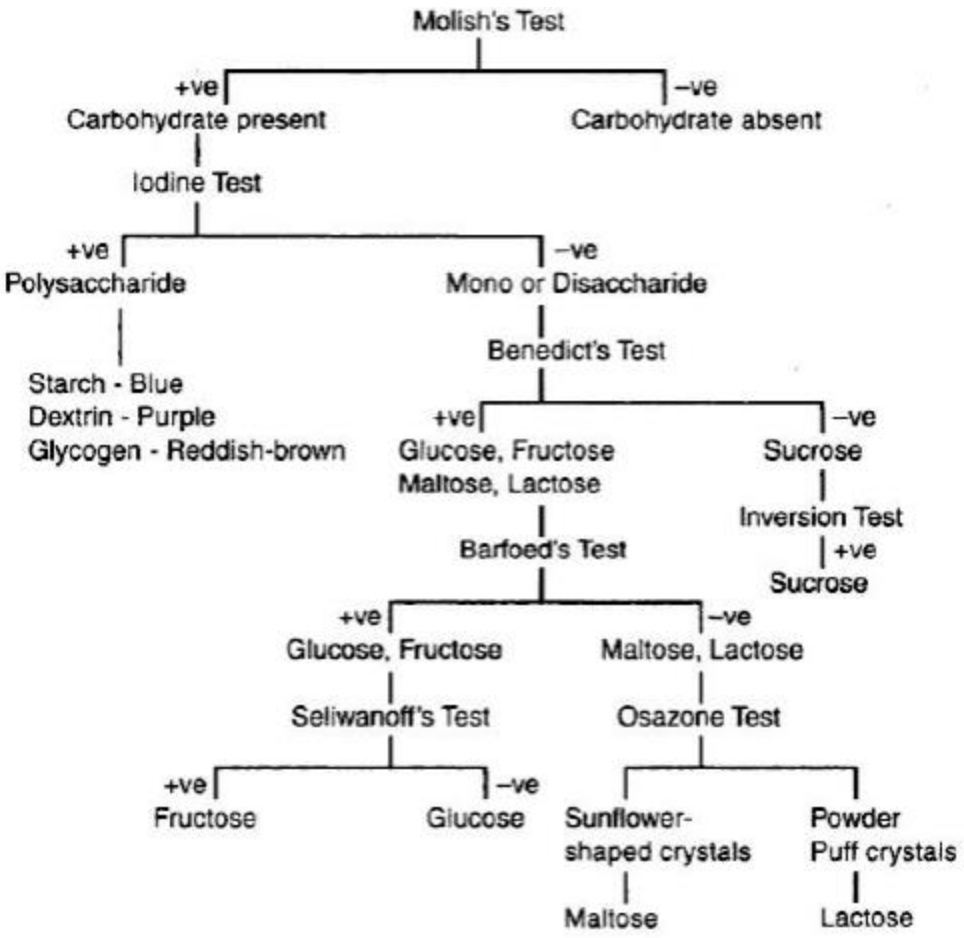


E. Seliwanoff's Test (Detects Keto Sugars like Fructose)

Principle: Ketohexoses react faster with Seliwanoff's reagent (resorcinol + HCl)

Clinical Relevance: Helps differentiate fructose from glucose (important in hereditary fructose intolerance)

Observation: Deep red color for fructose


Molish's Test
+ve
Carbohydrate present
–ve
Carbohydrate absent
Iodine Test
+ve
Polysaccharide
–ve
Mono or Disaccharide
Starch - Blue
Dextrin - Purple
Glycogen - Reddish-brown
Benedict's Test
+ve
Glucose, Fructose
Maltose, Lactose
–ve
Sucrose
Inversion Test
+ve
Sucrose
Barfoed's Test
+ve
Glucose, Fructose
–ve
Maltose, Lactose
Seliwanoff's Test
Osazone Test
+ve
Fructose
–ve
Glucose
Sunflower-shaped crystals
Maltose
Powder Puff crystals
Lactose