Lab4.

The reducing ability of carbohydrates

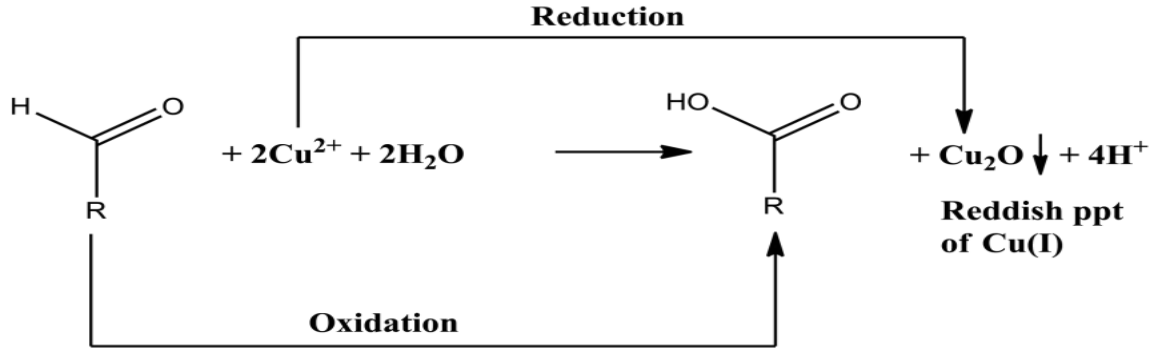
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Introduction

Monosaccharides	Disaccharides
• The simplest form of carbohydrates are called monosaccharides, which are soluble and sweet-tasting sugars. • They serve as monomeric building blocks for more complex carbohydrates. • The most common monosaccharide is glucose ($C_6H_{12}O_6$). • In eukaryotic cells, glucose plays an essential role as the main energy source in respiration and is crucial in the transport of sugars in the blood.	• Disaccharides, also called double sugars, consist of two monosaccharide units linked by a glycosidic bond. • Similar to monosaccharides, they are soluble in water. • Upon hydrolysis with acid or enzyme, a disaccharide yields two monosaccharide molecules. • Common examples include sucrose, lactose, and maltose.

Barfoed's Test

- Barfoed's test is a differential test used to distinguish between monosaccharides and disaccharides. It is based on the reducing ability of sugars. Monosaccharides give an early positive result, producing a red precipitate within 2–3 minutes. Disaccharides react more slowly (after 6–7 minutes) because they must first undergo acid-catalyzed hydrolysis before reducing the reagent. The Barfoed's reagent consists of copper(II) acetate dissolved in a dilute acetic acid solution.
- Principle of the Test : The principle is based on the reduction of cupric (Cu^{2+}) acetate to cuprous (Cu^{+}) oxide (Cu_2O), forming a brick-red precipitate.
  During the reaction, the aldehyde group of the sugar is oxidized to a carboxylic acid.
- Requirements and Tools : Sample solution of unknown carbohydrate , Test tubes , Pipette , Water bath Barfoed's reagent



Procedure

1. Take **1 mL** of the test sample in a clean, dry test tube.
2. Add **2 mL** of **Barfoed's reagent** to the tube.
3. Place the tube in a **boiling water bath** for **2 minutes**.
4. Remove and **allow to cool**.
5. Observe for the development of a **brick-red precipitate**.
6. Record the **time required** for color development.

Results Interpretation as shown in table 1 and figure 1

Table 1 : results of Barfoed's test.

Observation	Inference
Brick-red precipitate forms within 2–3 min	Positive for monosaccharide
Brick-red precipitate forms after 6–7 min	Positive for disaccharide (after hydrolysis)
No color change (remains blue)	Negative – Non-reducing sugar

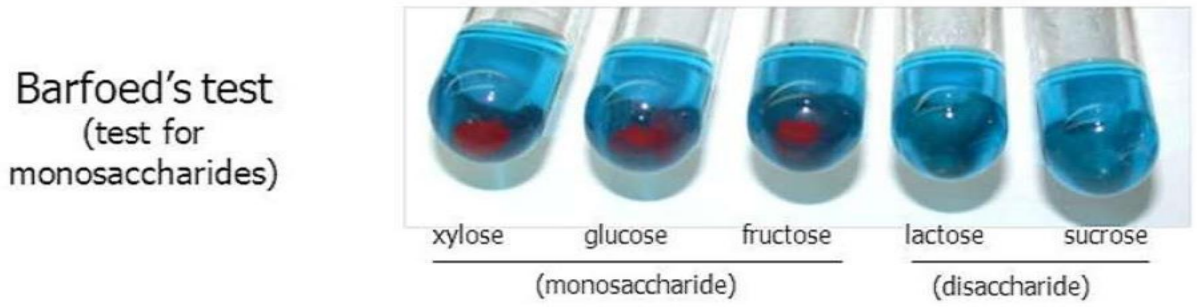


Figure 1 : results of Barfoed's test

Difference Between Barfoed's and Benedict's Tests

Feature	Barfoed's Test	Benedict's Test
Purpose	Differentiates mono- vs di-saccharides	Detects reducing sugars
Reagent Composition	$Cu(CH_3COO)_2$ in dilute acetic acid	$CuSO_4$, sodium citrate, sodium carbonate
pH	Acidic (~4.5)	Alkaline (~10)
Heating Time	2 minutes	5 minutes
Result Interpretation	Early reaction = monosaccharide	Any reduction = reducing sugar