



## EXPERIMENTS ON CARBOHYDRATES

**All Experiments:** Glucose, Fructose, Maltose, Lactose, Sucrose, Xylose, Starch are required.

### 1. Effect of Alkali on Carbohydrates

a. **Moore's Test:** A test for the presence of reducing sugar. Positive result produces a dark brown solution when put in a water bath. It is mainly based on the formation of yellow di-enol groups by the rearrangement between the carbon atoms 1 and 2 of the sugar by the effect of heat in the alkali medium.

- i. *Required chemicals:* Glucose and 10% NaOH solutions
- ii. *Procedure:* 2 ml of glucose solution put into a test tube and mixed with 1 ml of 10% NaOH solution and heated, the colour of the mixture becomes yellow. Then it turns into brown colour. At the end of the colour change, resin-like substances are formed. During this time, the caramel odour is felt. Strong reductive degradation products are formed during the experiment and these are called «Reductones».

### 2. Experiments Based on Reducing Properties of Carbohydrates

a. **Fehling's Test:** Sugars having free aldehyde or ketone groups have the ability to reduce heavy metal hydrates (Cu, Bi, Ag) by means of heat and effect in alkali medium. During the experiment, sugars are oxidized and give sugar acids (aldonic acids).

- i. *Required chemicals:* 0.2% glucose solution, Fehling A solution (69.38 g  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  is weighed, dissolved in a little water and completed with water to 1 litre), Fehling B solution (Dissolve 250 g NaOH and 346 g potassium tartrate to 1 litre of water), maltose, lactose and sucrose solution.
- ii. *Procedure:* To 1 mL of Fehling's solution A (aqueous solution of  $\text{CuSO}_4$ ) add 1 mL of Fehling solution B (solution of potassium tartrate). Then, add 2 mL of the sugar solution, mix well and boil. Try to see the red precipitate of cuprous oxide that forms at the

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end of the reaction. During boiling firstly yellow, then greenish, and finally brick red indicates a positive reaction. The red residue indicates that divalent copper ions ( $\text{Cu}^{+2}$ ) are reduced to a precious copper ( $\text{Cu}^+$ ).

**3. Reaction of carbohydrates in acid medium (Furfural Reactions of carbohydrates)**

- a. **Molisch Test:** It is a sensitive chemical test for all carbohydrates, and some compounds containing carbohydrates in a combined form, based on the dehydration of the carbohydrate by sulfuric acid to produce an aldehyde (either furfural or a derivative), which then condenses with the phenolic structure resulting in a red or purple-coloured compound. The test reagent dehydrates pentoses to form furfural and dehydrates hexoses to form 5-hydroxymethyl furfural. The furfurals further react with -naphthol present in the test reagent to produce a purple product.
  - i. *Required chemicals:* Molisch Reagent (1% solution of  $\alpha$ -naphthol in alcohol), 0.2% glucose solution (also sucrose, maltose and lactose solution).
  - ii. *Procedure:* 2 ml of 0.2% glucose solution is put into a test tube. Add about six drops of Molisch reagent. The tube is then inclined at 45 degrees and poured slowly into a tube containing 2 ml of concentrated sulfuric acid so that two layers form. A purple-violet colour on the contact surface of the liquids indicates a positive reaction. The assay can be repeated with sucrose, maltose and lactose solution.
  
- b. **Seliwanoff's Test:** Seliwanoff's test is a compound test which separates aldose and ketose sugars. This test depends on the rule that, when heated, ketones are more quickly dried out than aldoses. Keto sugars get dried out in the nearness of concentrated acids to yield



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furfurals or their subsidiaries which react with resorcinol in Seliwanoff reagent to yield a cherry-red hue complex as the positive result.

- i. Required chemicals:* Seliwanoff reagent (0.5 g of resorcin is dissolved in 330 ml of concentrated HCl and filled to a liter with distilled water), 1% fructose solution, 1% sucrose solution, glucose solution.
- ii. Procedure:* Take a test tube and add 5 ml of Seliwanoff's reagent. Now the material which is to be tested (1% fructose solution), pick it up, measure (5-6 drops) of it and pour it down in the test tube. Put the test tube incubation in a boiling water and then wait for the results. The experiment is repeated with sucrose and glucose solutions, and the results are compared.