GLUCOSE OXIDATION - SILVER MIROR

CHAPTER: SUGARS

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The purpose of this experiment is to the properties of glucose through its oxidation reactions which could be used as identification reactions of this sugar.

Theoretical aspects:

The glucose has a aldehyde group which could be oxidized by different oxidizing agents. The most common reagents which could oxidize this sugar are the very weak ones which are not attacking the rest of the molecule, transforming the aldohexose in a pentahydroxilic acid called *gluconic acid*. The Tollens reagent and the Fehling reagent are both very weak oxidizers but they give specific reactions with aldoses (especially with glucose). This specificity motivates the study of these two reactions in order to establish an identification method of glucose.

Materials, apparatus, chemicals:

Test tubes, glucose, Tollens reagent freshly prepared (silver nitrate, sodium hydroxide, ammonia), heating source

Safety precautions:

Sodium hydroxide is corrosive. Avoid the skin and eye contact with these reagents. Wear protective glasses and gloves. Silver nitrate causes burns and is a powerful oxidizing agent that may assist fire. Tollens reagent is very unstable if dry and also has been shown to explode if solutions are left for several hours. Concentrated ammonia is extremely damaging to eyes. Even contact with dilute ammonia solution can lead to serious eye damage Harmful if swallowed or inhaled and in contact with skin.

NaOH

$AgNO_3$

Tollens

NH_3

Experimental procedure:

First you have to prepare the Tollens reagent. This reagent should be used always in fresh form. DO NOT KEEP IT FOR DAYS! The preparation is made as follows. To a certain amount of 0,1M solution of $AgNO_3$ add a small amount of 1M NaOH solution. Then add drop wise some NH_3 solution until the medium will become colorless and crystal clear.

Then prepare a solution of glucose by disolving a pinch of this sugar in a few mL of water, in a very clean test tube or a round bottomed flask. Put a few mL of Tollens reagent in another test tube and warm up both solutions at aprox. 60 ºC. Then add the Tollens reagent to the glucose solution, mix it very well and allow standing.

Individual tasks:

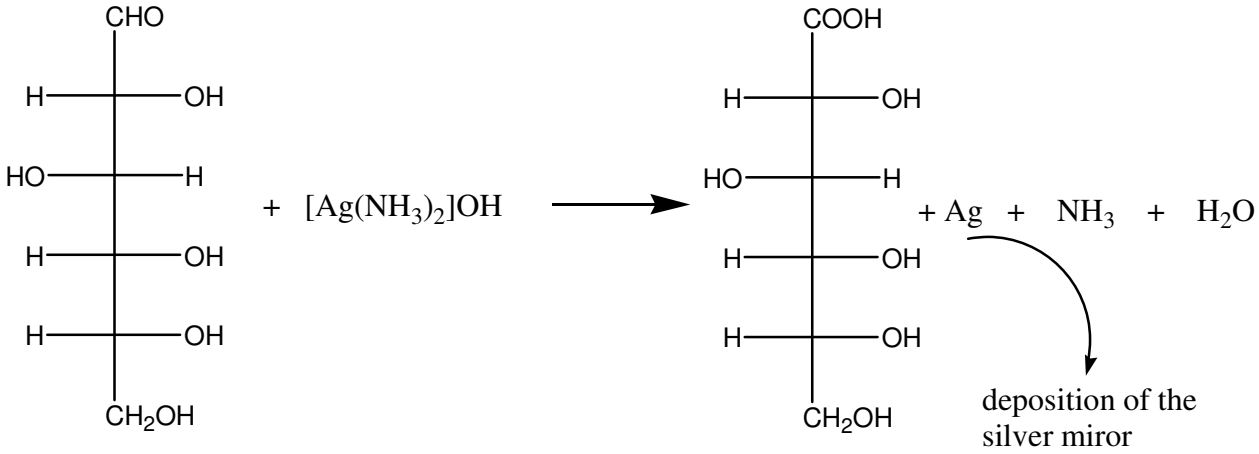
Describe the experiments carried out for preparing the Tollens reaction and the reduction of the glucose. Write down and establish the coefficients for the occured reactions. Describe the utility of this reaction.

Interpreting the results

The Tollens' test is important in carbohydrate chemistry, for proof of structure. The test is specific for reducing sugars. Fructose is also capable of reducing Tollens' solution, and is thus classified a "reducing sugar". Under alkaline conditions fructose is converted into glucose therefore the Tollens reaction is positive for fructose too even if this sugar is not a reducing one (it will transform itself in glucose which is a reducing sugar).

Explanation and conclusions:

The Tollens reagent is an oxidizer and the glucose is a reducing sugar because the presence of the aldehyde group. The glucose will be oxidized at the aldehyde end being transformed in *gluconic acid*. The reaction is as follows:



If the concentration of the solutions was high enough the reduced silver will be deposited as a silver mirror in the test tube. If the concentration is not very high a black color will appear in the solution, the typical color of the atomic silver. This reaction serves also as identification reaction of the glucose in biological liquids.

Waste disposal:

The solution from the Tollens reaction is **not** poured down the drain because of the toxicity of the silver salts. This solution should be collected in a container used for collecting silver waste.

References:

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