

# Acetic acid in vinegar



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The most common macromolecules found in living organisms are carbohydrates, lipids, proteins and nucleic acids. Briefly, the meaning of macromolecules is that they normally contain two or more molecules in them and their main functions are to store energy, information and much more. Most foods are known to be combinations of macromolecules. While some of these compounds can be detected by taste tests, many cannot. Scientists then use certain tests to determine the presence of macromolecules. To determine the type of macromolecules present in a certain type of food sample, various tests can be done.

The tests performed were, iodine testing for starch and glycogen, Benedict's test for reducing sugars, Schultz' solution for cellulose, Phloroglucinol to test for lignin, Xantoproitec test and Biuret's test for protein. And for lipid, Sudan 3 test and emulsion test was conducted. Depending on the test performed, certain results acquired, clearly identified the macromolecules present in each food sample. With the aid of the results from the lab, the unknown solution will also be determined?

## Starch

1. To test for starch, the starch test has been conducted with the use of dilute iodine. When a few drops of iodine solution was dripped into the test tube with starch solution, the iodine solution changes colour from yellow to dark blue. This determines the presence of starch. When starch is present, the iodine lodges itself in the helical structure of the polysaccharide chain to give it a black blue colour.

2. Dilute Iodine was dripped onto a thin slice of potato to test for the presence of starch. Dark blue colouration forms on the potato slice indicating the presence of starch. The Iodine solution traps itself in the helical structure of the polysaccharide to form dark blue colour.

3. To test for the presence of glucose, Benedict's solution was used to test for reducing sugars. Benedict's reagent is clear blue due to the copper ions in the reagent. When it is added to glucose and heated to boiling, the ions are reduced to  $\text{Cu}^+$  and then oxidized to form copper oxide ( $\text{Cu}_2\text{O}$ ). Copper oxide is a brownish-orange substance that is insoluble in water. Therefore, a positive reaction in a Benedict's test is the change of the clear light blue solution to an opaque orange-brown solution in a boiling water bath. This color change indicates the presence of Glucose in a given solution.

4. To test for non-reducing sugar which is sucrose, there was no reaction to the Benedict's reagent. This is because sucrose is not a reducing sugar as both its reducing ends are tied up to form bonds with fructose molecule hence it does not react. Sucrose solution is then hydrolyzed to form its monosaccharides with boiled with dilute hydrochloric acid. The monosaccharides are reducing sugars as they contain the aldehyde group. Neutralization of the mixture by sodium hydrogen carbonate is necessary as the reduction of the copper(II) ions will not take place in acidic conditions – of excess acid is present.

Benedict's Solution contains copper(II) sulphate, sodium carbonate and sodium citrate. The blue copper(II) ions from copper(II) sulphate are reduced to red copper(I) ions by the aldehyde groups in the reducing sugars. This

accounts for the colour changes observed. The red copper(I) oxide formed is insoluble in water and is precipitated out of solution. This accounts for the precipitate formed. As the concentration of reducing sugar increases, the nearer the final colour is to brick-red and the greater the precipitate formed.

5. Cellulose test is tested by using Schultz' solution.

Cotton is made up of cellulose which is a polysaccharide consisting of a linear chain of beta-glucose. Scultz' solution is used as it has the ability to stain cellulose. The yellow scultz' solution turns from yellow to purple indicating the presence of cellulose.

6. Lignin is found in lignified cell walls of sclerenchyma and xylem. Acidified phlocoglucinol is used to test for the presence of lignin as it will stain the lignin and turns it into blood red colour. The toothpick is made up of sclerechyma cells which have lignified all walls, so when it is dipped into the phlocoglucinol , it turns blood-red in colour.

7. Million's test is conducted to test for the presence of protein in the food sample. Million's reagent is used , the monomer of protein is amino acid trycosine(which contains a phenol group). When Million's reagent is added to the egg albumen and heated gently, white precipitate forms. It coagulates on heating and turns red.

8. Biuret test is conducted to test for the presence of protein. Biuret Reagent contains copper ions. Proteins and polypeptides contain peptide bonds which react with alkaline copper 2 alkaline copper 2 slphate solution producing violet complex.

9. To test for lipids, Sudan 3 test is conducted. When Sudan 3 is added to the test tube, a red stained oil layer separates on the surface of the water. The fat globules are stained by Sudan 3. They separate out because fat globules are less dense than water.

10. Ethanol-emulsion test is also used to test for the presence of lipids. A cloudy white suspension is formed when the test tube containing oil and ethanol is shaken vigorously. Lipids are immiscible with water. Tiny lipid droplets are formed in water which gives a cloudy white suspension.