Tests For Organic Compounds

The structures of cells are made up of many different chemical molecules. Most of the common molecules found in living things belong to four classes of carbon-containing molecules: carbohydrates, lipids, proteins, and nucleic acids. Cell metabolism involves the production and destruction of many types of molecules. In order to maintain life, cells metabolize compounds from the foods we eat. Metabolism is the sum total of all of the chemical reactions in your body. The metabolism includes catabolic reactions (compound building) and anabolic reactions (compound breaking).

Objectives

~ To determine the presence of starch by a chemical test
~ To analyze solutions for the presence of simple reducing sugars.
~ To analyze a sample of vegetable oil for the presence of lipids.
~ To analyze a sample of gelatin for the presence of protein.

Materials

vegetable oil	test tubes	wax marking pencil	tap water	
glucose solution	biuret regent	test-tube holder	droppers	brown paper
soluble starch solution	Benedict's solution	test-tube brush	hot plate	test-tube stoppers
2% gelatin solution	iodine solution	test-tube rack	1000 ml beaker	goggles and apron

Procedure (**Suggestions!!** **Start a water bath for Part B first...You don't have to do tests in order**)

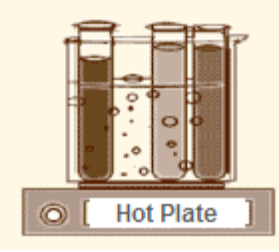
Part A. *Tests for Complex Carbohydrates (starch)*

Starch is a polysaccharide (a coiled polymer of glucose) that can be detected in a substance by using the indicator Iodine (iodine, potassium iodide, IKI). When iodine is applied to starch, it reacts with the coiled polymer and turns from brownish yellow to bluish black. Another polysaccharide is glycogen that is found in animals. When iodine is applied to glycogen it produces an intermediate color reaction.

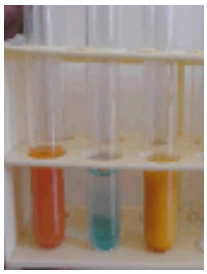
1. Put on goggles and an apron. Label five test tubes 1, 2, 3, 4 and 5. Place them in a test-tube rack.
2. Using a separate dropper for each solution, add 10 drops of soluble starch solution to test tube 1, 10 drops of glucose solution to test tube 2, 10 drops of sucrose to test tube 3, 10 drops of gelatin in test tube 4, and 10 drops of water to test tube 5. Record the color of each test tube's contents in *Table 1*.
3. Add 3 drops of iodine solution to each test tube. **CAUTION**: *if iodine is spilled, rinse with water and call your teacher immediately.*
4. Record in Table 1 the color of each test tube's contents after addition of the iodine.

5. Discard the contents of the test tubes according to your teacher's directions. Gently use a test-tube brush and soapy water to clean the test tubes and rinse with clean water.

Part B. *Test for Simple Reducing Sugars*



Benedict's solution tests for the presence of simple reducing sugars. This means you can detect monosaccharides and some disaccharides, but not polysaccharides. Thus, a color change may or may not occur when Benedict's solution is added to a carbohydrate and heated. These "simple sugars" are able to react with the copper ions in the Benedict's reagent. A change from blue to green, yellow, orange, or red occurs if a monosaccharide or some disaccharides are present. The most drastic changes occur with high concentrations of monosaccharides. The original blue color will remain after heating if a polysaccharide or some disaccharides are present.



1. For a water bath, heat 300 ml of water to boiling using med-high heat on the hot plate.
2. Label five test tubes 1, 2, 3, 4 and 5.
3. Using a separate dropper for each solution, add 10 drops of soluble starch solution to test tube 1, 10 drops of glucose solution to test tube 2, 10 drops of sucrose to test tube 3, 10 drops of gelatin to tube 4, and 10 drops of water to tube 5. Record the color of each test tube's contents in Table 2.
4. Add 20 drops of Benedict's solution to each tube and place them in a boiling water bath for 3 minutes.
5. Remove the test tubes from the water bath using a test-tube holder and place them in a test-tube rack to cool.

CAUTION: *Be careful not to burn yourself. If Benedict's solution is spilled, rinse with water and call your teacher immediately.*

6. Record the color of each tube's contents in *Table 2*.
7. Discard the contents of the test tubes according to your teacher's directions. Gently use a test-tube brush and soapy water to clean the test tubes and rinse with clean water.

Part C. *Tests for Lipids (Brown Paper Test)*

Lipids are nonpolar molecules with a variety of structures. They do not dissolve in water, which is a polar substance. Lipids include the fats, the oils, the sterols, and the waxes. Very common lipids are the triglyceride fats that are composed of glycerol and three chains of fatty acids. There are complicated tests to detect the presence of lipids, but one of the more uncomplicated tests that serves to detect the presence of fats is to use unglazed paper.

1. Place a drop of water on a piece of brown paper. In a <u>*separate*</u> spot on your brown paper, place a drop of oil. Allow the paper to dry for a few minutes. You may need to use a paper towel to dab off excess.
2. Hold the piece of paper up to the light. *If a semitransparent spot is evident, the sample contains lipids.* Record the appearance of the two spots in *Table 3*.

Part D. *Tests for Proteins*

Proteins are polymers of amino acids . When amino acids join through condensation reactions, peptide bonds are formed that link amino acids in long chains. An indicator solution called Biuret's reagent contains copper ions that react with peptide bonds only if there are more than four to six peptide bonds in the molecule. Therefore, free amino acids do not cause a reaction. When the reaction does occur, a violet color appears to indicate the presence of the protein.

1. Label five test tubes 1, 2, 3, 4 and 5.
2. Using separate droppers, add 30 drops of 2% gelatin solution to test tube 1, 30 drops of glucose solution to test tube 2, 30 drops of starch to test tube 3, 30 drops of sucrose to test tube 4, and 30 drops of water to test tube 5. Record the color of each tube's contents in Table 4.
3. Add 10 drops of biruet reagent to each test tube. **CAUTION**: *Biuret reagent is extremely caustic to the skin and clothing. If biuret reagent spills, rinse with water and call your teacher immediately.*
4. Record in *Table 4* the color of each tube's contents after adding to violet color.
5. Discard the contents of the test tubes according to your teacher's directions. Gently use a test-tube brush and soapy water to clean the test tubes and rinse with clean water.
6. Fill in the last column of all five tables with the correct interpretation of the test results.

Part E. *Tests for Known Substances*

You will now need to complete a series of tests on three known substance to determine if they are carbohydrates, lipids or proteins. Complete each of the tests on the four known substances and record your results in table 5. The substances to be tested are milk, potato, onion and amino acids.

Organic Compounds Lab Analysis Name(s):

Table 1.

Test for Complex Carbohydrates (using iodine)				
test tube	Substance	Color Before	Color After	Starch (+/-)
1	Starch			
2	Glucose			
3	Sucrose			
4	gelatin			
5	water			

Table 2.

Test for Reducing Sugars (using Benedict's Solution)				
Test Tube	Substance	Color Pre-boiling	Color Post-boiling	Reducing Sugar (+/-)
1	Starch			
2	Glucose			
3	Sucrose			
4	Gelatin			
5	Water			

Table 3.

Brown Paper Test for Lipids		
Substance	Translucent ?	Lipids present (+/-)
water		
oil		

Table 4.

Test for Proteins (using Biuret Reagent)				
Test Tube	Substance	Color Before	Color After	Protein (+/-)
1	Gelatin			
2	Glucose			
3	Starch			
4	Sucrose			
5	Water			

Table 5

Test for Known Substances	
Substance Tested	Type of Molecule
Milk	
Potato	
Amino Acid	
Onion	

Analysis:
Your answers must be in complete sentences and must be thorough. An example of a question, a good answer and a poor answer are given below.

Question: Which solution was a starch? *Poor Answer*: Solution #2
Good Answer: Solution #2, potato juice, was a starch because when we added iodine the solution turned black.

1. What is used to test for the presence of
    a. starch-
    b. reducing sugars (mono & disaccharides)-
    c. protein-

2. Indicator solutions work by changing color. How can you tell by using each of the tests that you have a
    a. starch-
    b. reducing sugar-
    c. protein-

3. Why was water tested in each of the tests?

4. Biuret reagent will turn the skin a brownish-purple color. Why does this occur?

5. When greasy food is spilled, why is it difficult to clean with water alone?

6. How does Benedict's reagent detect the presence of monosaccharides chemically?

7. Monosaccharides are a simple sugar, while starch is a polysaccharide (larger molecule made up of many monosaccharides). What do the results show you about how onions and potatoes store carbohydrates differently?

8. Biuret's reagent reacts with the presence of proteins, but not amino acids. Why?