

Identification of Organic Compounds Lab

Introduction

All organic compounds contain the element carbon (C). Organic compounds usually also contain oxygen (O) or hydrogen (H) or both. They may also contain nitrogen (N) or other elements. Atoms of these elements are able to form covalent bonds with other atoms.

Structural formulas are used to illustrate the arrangement of these atoms, as well as the number and kinds of atoms. In a structural formula, each atom is represented by the symbol for its element. The lines between the atoms represent chemical bonds that hold one atom to another. Molecular models can also be used to represent organic molecules. These models aid in the understanding of how small molecules and individual atoms join to form larger molecules.

Carbohydrates, fats, and proteins are three major classes of organic compounds. The energy-rich carbohydrates include simple sugars and starches. Fats are concentrated sources of energy. Proteins are large molecules that are used in cell growth and maintenance.

Problem

What laboratory tests or indicators are used to identify the presence of some organic compounds? What are the molecular structures of some organic compounds?

Purpose

The purpose of this investigation is to gain an understanding of the structure of organic compounds by recognizing the atomic structure of carbohydrates, proteins, and lipids. In this investigation, you will also use the specific indicator tests to identify a simple sugar (glucose), starch, a protein, and a lipid.

Materials

6 Test tubes
Test tube clamp
Test-tube rack
Hot plate
400 mL beaker
50 mL beaker
Medicine dropper
Safety goggles
Safety apron
Hair clip or tie

Benedict's solution
Sodium hydroxide solution
Copper sulfate solution
Lugol's iodine solution
Sudan III or IV

Tap water

Food Samples:

Carbohydrates:
Starch (complex sugar)
Glucose (simple sugar)
Protein
Lipid
Vegetable oil

Pre-Lab

Prior to doing the lab activity use your textbook and notes to answer the pre-lab questions at the end of this lab activity. Failure to complete the pre-lab questions prior to lab day will result in you doing the lab after school on your own time.

Safety

Put on safety goggles and a laboratory apron. Observe proper laboratory procedures when using electrical equipment. Tie back loose hair and clothing when working with a hot plate and do not reach over the hot plate. Always use special caution when working with laboratory chemicals, as they may irritate the skin or stain skin and clothing. Never touch or taste any chemical unless instructed to do so. Wash your hands thoroughly if any of the chemicals touch your skin and after carrying out this lab. Clean up all spills with a wet towel and be sure to dry the area.

Procedure

Part A: Test for a Simple Sugar (Glucose)

1. Put on your lab apron and safety goggles. Place six test tubes in a test-tube rack. Place the rack on a piece of white paper. Label on the paper in front of the first test tube with the letter "G" for glucose. Label the second test tube with "CG" as it will serve as the control for the glucose test.
2. Half fill the 400 mL beaker with water and place it on the hot plate to prepare a hot-water bath. **CAUTION:** *Use extreme care when working with hot water. Do not let the water splash on your body and be careful not to get tangled in the hot plate cord and tip the beaker over.*
3. Add 10 drops (approx. 1 mL) of Benedict's solution to each of the two test tubes. **CAUTION:** *Use extreme care when handling Benedict's solution to avoid staining your skin and your clothing. Also, wash your hands after using it. Benedict's solution is poisonous.*
4. Add 10 drops of the glucose solution to the test tube labeled "G." Add 10 drops of water to the test tube labeled "CG". Note the appearance of the solution in each test tube. Record this information in Data Table 1 in the observation section.
5. Place both test tubes in the boiling hot water bath for several minutes. Keep your eye on the tubes and be careful to catch all the different colors that can be observed as the experimental tube begins to change color. Please record these colors in Data Table 1.
6. After 2 minutes, use the test tube clamps to remove the test tubes from the hot water bath. Place the test tubes in the test tube rack.

CAUTION: *Be careful when working with heated equipment or materials to avoid burns.*

Part B: Test for Starch

1. Label the paper in front of test tube 3 with the letter “S” for starch. Label the paper in front of test tube 4 with the letters “CS” as it will serve as the control tube for the starch test.
2. Add 10 drops of the starch solution to the test tube labeled “S.” Add 10 drops of water to the “CS” test tube. Note the appearance of the substance in each test tube. Record this information in Data Table 1.
3. Carefully add 10 drops of Lugol’s iodine solution to each test tube. Gently swirl each test tube. Observe the contents of each test tube. **CAUTION:** *Lugol’s iodine will stain the skin and clothing. Please wash the affected area with soap and water.* Record the appearance of each test tube in Data Table 1.

Part C: Test for Protein

1. Label the paper in front of test tube 5 with a “P” for protein. Label the paper in front of test tube 6 with the letters “CP” as it will serve as the control tube for the protein test.
2. Add 10 drops of the protein solution into the test tube labeled “P.” Add 10 drops of water to the “CP” test tube.
3. Next place 10 drops of copper sulfate solution and 5 drops of sodium hydroxide in each of the test tubes. **CAUTION:** *Be careful when using sodium hydroxide it is a corrosive and it will burn skin or clothing. Please wash with soap and water any area that comes in contact with this substance.* Gently swirl each of the test tubes. This mixture of substances creates a reagent known as **Biuret’s reagent**. This reagent is a common test used to determine the presence of proteins in a substance.
4. Note the appearance of the substance in each test tube. Record this information in Data Table 1.
5. Note: Clean out the six test tubes. Keep two of the test tubes for the lipid test in Part D.

Part D: Test for Oil or Fat (Lipid)

1. Draw two circles on a small piece of brown grocery bag paper, each about the size of a dime. Label the circles 1 and 2.
2. Place a drop of water in circle 1 and a drop of oil in circle 2. Wait 5 minutes and hold the paper up to the light. The presence of a translucent spot in circle 2 is a positive test for oil, a fat, or a lipid.
3. A more accurate test for oil or fat is to add 10 drops of oil to a test tube that you will label with the letter "O" for oil. Then to a second test tube you will add 10 drops of water and you will label it with the letters "CO". As it will serve as the control for the lipid test.
4. Next add 10 drops of Sudan III or IV to each of the test tubes. **CAUTION:** *Sudan III or IV will stain the skin and clothing. Please wash the affected area with soap and water.* Gently swirl the two test tubes. The presence of a lipid is indicated by a pink color in the experimental tube.
5. Note the appearance of the substance in each test tube. Record this information in Data Table 1.

Name _____ Date _____ Period ____ CN ____

Pre – Lab Questions (10 pts.)

1. Which type of bonds hold the atoms of organic macromolecules together?
2. Which elements are found in a carbohydrate?
3. Simple sugars and starch belong to which class of organic macromolecules?
4. Which elements are always found in a protein molecule?
5. Which element is sometimes found in a protein molecule?
6. Which elements are found in the structure of a lipid?
7. Which monomers are used to create a lipid?
8. From a molecular standpoint how are lipids and carbohydrates alike?
9. From a molecular standpoint how do lipids and carbohydrates differ?
10. How are the functions of lipids and carbohydrates similar?

Observations (25 pts.)

Data Table 1

Organic Compound	Indicator Test	Description of Control Test Tube Before	Description of Result of the Test
1. Glucose			
2. Starch			
3. Protein			
4. Lipid	Brown paper test		
5. Lipid			

Analysis and Conclusions

1. In each analysis two samples are tested, one with the food sample and one with just water. What is the purpose of testing a sample with water and not the food sample?
2. Which of the tests require heating of the reagent with the sample in a water bath?
3. Which substance is detected by using Benedict's solution? _____
4. What is the color sequence for a positive test for a simple sugar?
5. Which of the tests is used to find the presence of proteins? _____
6. What color is indicative of a positive test for the presence of a protein? _____
7. Which substance(s) is detected with Lugol's iodine solution? _____
8. What is the positive color change when Lugol's is used as an indicator? _____
9. What is the color change for a positive test using Sudan III or IV? _____
10. Describe how to use a piece of brown paper to determine if a substance is a lipid.