

McMush Lab: Testing for the Presence of Macromolecules

BACKGROUND

Carbohydrates, lipids, proteins, and nucleic acids are organic molecules found in every living organism. These macromolecules are large carbon based structures. The macromolecules are assembled by joining several smaller units, called monomers, together through a chemical reaction called condensation. The resulting polymer can be disassembled through the complimentary process called hydrolysis.

Carbohydrates are made of carbon, hydrogen and oxygen atoms. In the carbohydrate there are two hydrogen atoms for every one oxygen atom present. The monomers for carbohydrates are referred to as monosaccharides. When many monosaccharides are chained together the resulting molecule is called a polysaccharide. Carbohydrates are used by living organisms as an important source of energy. Examples of carbohydrates include glucose, fructose, sucrose, galactose, ribose, deoxyribose, cellulose and chitin.

Lipids are also made of carbon, hydrogen and oxygen but the ratio of carbon, hydrogen, and oxygen is not 1:2:1. Instead, lipids have a much higher number of carbons and hydrogens with few oxygen atoms present. The nonpolar bonds that form between the carbon and hydrogen atoms of a lipid cause them to be hydrophobic, or water-repellent, molecules. This explains why water and oil do not mix. The large number of carbon to hydrogen bonds also serves to make lipids energy rich storage molecules. One gram of lipid stores twice as much energy as one gram of a carbohydrate. Lipids from animals are referred to as fats and are solids at room temperature, while those found in plants are referred to as oils which are liquids at room temperature. Fats and oils are made of smaller units called triglycerides which are composed of a glycerol and three fatty acid molecules. One important relative of true lipids are the phospholipids. Phospholipids differ in structure from regular lipids in that phospholipids are made of a glycerol and two fatty acids joined by a phosphate group. This arrangement makes phospholipid molecules have both hydrophilic and hydrophobic regions. This feature makes phospholipids an ideal structural component of the plasma membrane of cells. Steroids are another significant group of lipids. They differ slightly in structure because the carbon atoms are arranged in four rings. Examples of steroids include cholesterol, estrogen, testosterone and morphine.

Proteins are composed of amino acids which are composed of atoms of carbon, hydrogen, oxygen and nitrogen. Proteins serve as the major building blocks of organisms. Proteins are large complex molecules that combine to form various components of living organisms such as muscle fibers, enzymes, and hemoglobin. Proteins are made of unique combinations of the twenty amino acid monomers. A string of amino acid monomers joined together by peptide bonds is called a polypeptide.

PURPOSE

This lab activity provides an opportunity for the development of skills involved in chemically testing for the presence of the carbohydrates, lipids and proteins found in food samples. Once familiar with the detection techniques, you will apply those techniques to a slurry that has been made by blending a complete Happy Meal. Using the skills that you have developed you should be able to determine which organic compounds are present in the slurry.

PRE-LAB REQUIREMENTS (in your lab book)

1. Write the lab purpose. You can write word for word or summarize.
2. Summarize the procedures for the four tests described below (sugars, polysaccharides, lipids and proteins). Include enough detail to perform the lab using only your lab book as a guide. Write the procedure in table like this:

PROCEDURE	EXPLANATION
1. SUGARS a. Blah blah blah b. Blah blah blah	Leave this part blank for now...
2. Polysaccharides a. Blah blah blah b. Blah blah blah	

3. Create data tables in which you will record your results for each test. Be sure each table has a title and labeled column headings

SAFETY INFORMATION:

1. Goggles Must Be Worn at All Times.
2. Iodine is poisonous and can stain clothing.
3. Biuret reagent contains sodium hydroxide. If you get the solution on your skin, wash immediately with water.

MATERIALS:

McDonald's Happy Meal McMush slurry
Sugar solution
Cornstarch solution
Gelatin solution
Oil
Beakers or plastic cups
Benedict's Solution

6-8 test tubes
graduated cylinder
hot water bath
2 test tube holders
Biuret Reagent
Lugol's Iodine
Brown paper

PROCEDURE – CARBOHYDRATES

PART 1: TESTING FOR SUGARS

Benedict's solution can be used to detect the presence of monosaccharides. In the presence of a monosaccharide, Benedict's solution will change color from blue to orange when heated.

1. Add 5mL of sugar solution to one test tube and 5mL of water to another.
2. Add 3 mL of Benedict's solution to each test tube. Place the tubes in a beaker of hot water for five minutes. Use test tube clamps to hold hot test tubes.
3. Record your results for the positive and negative control for the monosaccharide test.
4. Wash out test tubes with soap and water after they have cooled.
5. Using the Benedict's solution test, determine whether or not the McMush slurry contains any monosaccharides. Record your results.

PART 2: TESTING FOR POLYSACCHARIDES

Lugol's iodine solution can be used to test for the presence of the polysaccharides (starch.) In the presence of starch, the Lugol's solution will change color from brown to a dark blue/black.

1. Add 5 mL of cornstarch solution to one test tube and 5mL of water to another.
2. Add 5 drops of Lugol's iodine to each test tube. Observe the change in color.
3. Record your results for the positive and negative control for the starch test.
4. Wash out your test tubes with soap and water.
5. Using the Lugol's solution, determine whether or not the McMush slurry contains starch. Record your results.

PROCEDURE – LIPIDS

1. Place a drop of oil and a drop of water onto separate spots of a piece of brown paper.
2. Rub off any excess fluid with a paper towel.
3. Wait 10 to 15 minutes for the drops to dry completely. Use a fan if necessary.
4. Hold the paper up to the light or window. Record your results for the positive and negative control for the lipid test.
5. Determine whether or not the McMush slurry contains lipids. Record your results.

PROCEDURE – PROTEIN

Biuret's reagent can be used to test for the presence of protein. Biuret's reagent will change color from yellow to blue-violet in the presence of protein.

1. Place 5 mL of the gelatin solution into a test tube. Add 10 drops of Biuret's reagent. The gelatin is a protein-rich solution and will test positive for the presence of protein.
2. Rinse out your test tube and record your results for the protein test.
3. Repeat steps 1 and 2 with water instead of gelatin solution as a negative control.
4. Using the Biuret's test for protein, test the McMush slurry to determine whether or not protein is present. Record your findings.

QUESTIONS

1. Why test known positive and negatives?
2. What portion of the Happy Meal may have provided each of the macromolecules tested?
3. In paragraph form, discuss what EACH of your observations mean in regards to the McMush.