Name _____ Date _____

Testing for Nutrients

Lab 6

Background

Substances in food that can be used by an organism for energy or for growth and repair are called nutrients. Nutrients include carbohydrates, proteins, fats, minerals, and vitamins. Cells of all organisms are composed of these nutrients and water. There are several chemical tests that can be used to determine which nutrients, if any, are present in a substance. You will use some of these tests in this activity.

Objectives

In this activity you will:

1. Learn how to test substances for the presence of carbohydrates, proteins, and fats.
2. Perform nutrient tests on several foods to determine which nutrients are present.

Materials

Pyrex test tubes
test tube rack
test tube holder
10-mL graduated cylinders
glass stirring rods
hot plate
5% glucose solution
Benedict's solution
egg albumen solution
biuret reagent in dropper bottle
pieces of potato, bread, carrot, onion, walnut, apple, and cheese
scalpel or single-edge razor blade
plastic funnel
glass-marking pencil
paper towels
boiling-water bath
pipettes
dry cornstarch
Lugol's solution in dropper bottle
salad oil
squares of unglazed brown paper
beakers
ruler
water

Procedures and Observations

PART I. TESTING FOR CARBOHYDRATES

Starches and sugars belong to the group of organic compounds called carbohydrates. Starch molecules are composed of many simple sugar molecules linked together. Starch molecules and simple sugar molecules have different chemical behaviors. For this reason, different chemical *reagents,* or testing agents, are used to test for starch and for simple sugars.

A solution of iodine, *Lugol's iodine solution,* is the reagent used to test for the presence of starch. Lugol's solution is yellow-brown. However, it reacts chemically with starch to form a blue-black substance called iodide of starch.

1. With a glass-marking pencil, label one clean test tube *S* for starch. Pour dry cornstarch into the test tube until there is 1 cm of cornstarch in the tube. Then add water to the test tube, to a depth of 3 cm.
2. Mix the starch and water by stirring them carefully with a glass stirring rod. Then set the test tube in a test tube rack.

   a. *What color is the mixture of starch and water?*

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3. Label another clean test tube *C* for control. Pour water into the test tube to a depth of 3 cm. Set it in the test tube rack.
4. Observe the color of Lugol's iodine solution.

   b. *What color is Lugol's iodine solution?*

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5. Add 1 drop of Lugol's solution to the starch and water mixture. Do not stir the mixture. **CAUTION:** *Use care when using Lugol's solution to avoid staining hands and clothing.*

   c. *What color is the mixture around the drop of Lugol's solution?*

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6. Stir the mixture with the stirring rod. Then observe it.

   d. *What color is the mixture after stirring?*

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7. Add 5 more drops of Lugol's solution to the mixture. Then stir it thoroughly. Observe the color.

   e. *What is the color of the mixture?*

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8. Add 1 drop of Lugol's solution to the control test tube. Do not stir it.

   f. *What color is the water around the drop of Lugol's solution?*

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9. Stir the solution with a clean glass stirring rod. Observe it.

   g. *What color is the solution?*

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10. Add 5 more drops of Lugol's solution. Stir it, and then observe it.

    h. *What color is the solution?*

Benedict's solution, a clear blue solution of sodium and copper salts, is used to test for the presence of simple sugars. In the presence of simple sugars, Benedict's solution changes color to green, yellow, and brick red, depending on the amount of sugar.

11. Label a clean test tube *G* for glucose. Add the initials of a person in your group. Using a graduated cylinder, pour 5 mL of the 5% glucose solution into the test tube. Then set it in the test tube rack.

12. Label another clean test tube *C* for control. Add the initials of a person in your group. Using a clean graduated cylinder, pour 5 mL of water into the test tube. Set it in the test tube rack.
13. Use a clean graduated cylinder to add 3 mL of Benedict's solution to each test tube. Mix the contents of each tube by carefully swirling them.

i. *What color is the solution in tube G?*

_____

j. *What color is the solution in tube C?*

_____

14. Carefully place both test tubes in a boiling water bath for 3 minutes. During the heating, observe the contents of each tube for any color changes.
15. At the end of 3 minutes, remove your test tubes with a test tube holder and place them in the test tube rack. **CAUTION:** *Avoid getting splashed with hot water. Never touch hot test tubes with your bare hands.* Observe the colors of the solutions.

k. *Describe what happened to the color of the solution in tube G.*

_____

l. *Describe what happened to the color of the solution in tube C.*

_____

PART II. TESTING FOR PROTEINS

Biuret reagent, a blue solution, is used to test for the presence of proteins in a substance. In the presence of protein, biuret reagent changes color to pink-purple.

1. Label a clean test tube *P* for protein. Pour 5 mL of egg albumen solution into the test tube. Set it in the test tube rack.

a. *What color is the egg albumen solution?*

_____

2. Label another clean test tube *C* for control. Add 5 mL of water to the test tube. Set it in the test tube rack.
3. Observe the color of biuret reagent.

b. *Record the color of biuret reagent.*

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4. **CAUTION:** *Biuret reagent is caustic and can harm skin and clothing. Handle with care.* Add 1 drop of biuret reagent to tube P. Swirl the contents of the tube to mix them. Then continue to add drops, one at a time, and mix by swirling, until you have added 10 drops. Watch closely for a color change.

c. *Describe what happened to the color of the solution.*

5. Add 1 drop of biuret reagent to tube C. Swirl the contents of the tube to mix them. Then continue to add drops, one at a time, and mix by swirling, until you have added 10 drops. Watch for a color change.

d. *Describe what happened to the color of the solution.*

PART III. TESTING FOR FATS

The presence of fats in a substance can be detected by using unglazed *brown paper.* Fats leave an oily, translucent smear when touched to brown paper.

1. Using a pipette, place 1 drop of salad oil on a square of unglazed brown paper. With a pencil, label the spot "oil."
2. Place 1 drop of water on the same piece of brown paper, about 2 cm below the drop of oil. Label the spot "water."
3. Set the piece of paper aside until the water evaporates.
4. When the water has evaporated, observe the brown paper.

a. *Are the two spots different? If so, describe how.*

5. Hold the paper up to light and look at the oil spot.

b. *Is the oil spot translucent? That is, can you see light through it?*

PART IV. TESTING FOR FOOD NUTRIENTS

Keep your food samples on paper towels, numbered according to their positions in Table 1. Wash your hands after handling each sample, to avoid transferring food particles from one food to another.

1. Divide each food sample into the number of parts needed for the tests indicated in Table 1. Note that some foods are not to be tested for all nutrients.

2. Number six depressions in a spot plate 1 to 6. If you do not have a spot plate, number six positions on a paper towel. Then, using a scalpel or single-edge razor blade, chop up one sample of each food to be tested into tiny pieces and put them in the proper place. CAUTION: Use care to avoid cutting yourself.
3. Add a few drops of Lugol's solution to each food sample, in order to test for starch. Observe the samples for any color changes indicating a positive result for starch.

a. *Record your observations in Table 1. If a food sample shows a positive reaction for starch, place a plus sign (+) in the proper space. If a food sample shows a negative reaction, place a minus sign (–) in the proper space.*

4. Number five Pyrex test tubes 1, 2, 3, 4, and 5. Then add the initials of a person in your group to each. Set them in the test tube rack.

Testing for Nutrients (continued)

5. Using a scalpel or single-edge razor, scrape, chop up, or crush each food sample to be tested into tiny pieces. Then place each crushed food sample in the proper test tube.

Table 1. Nutrient Tests

Nutrients Tested for	Foods Tested						
	[1] Carrot	[2] Bread	[3] Potato	[4] Apple	[5] Onion	[6] Walnut	[7] Cheese
starch							
simple sugars							
proteins							
fats							

6. Add 3 mL of water to each test tube. Then add 3 mL of Benedict's solution to each tube, to test for simple sugars. Swirl the contents to mix them. Place the test tubes in the boiling-water bath for 3 minutes.
7. At the end of 3 minutes, remove your test tubes from the boiling-water bath with test tube holders, and place them in the test tube rack. Observe them for an indication of the presence of simple sugars.

   b. *Record your observations about the presence of simple sugars in each food sample in Table 1.*

8. Number seven test tubes 1 to 7. Place them in the test tube rack.
9. Crush each food sample separately, as in Step 5, and transfer the samples to the proper test tubes. Then add 3 mL of water to each tube and gently swirl the contents to mix them.
10. Add biuret reagent 1 drop a time to each test tube to test for proteins. Watch the samples as you continue to add drops until there is a color change or until you have added 10 drops.

    c. *Record your observations about the presence of proteins in each food sample in Table 1.*

11. Number seven squares of brown paper 1 to 7.
12. Rub each solid food sample on the proper piece of brown paper. When the squares have dried, observe them for the presence of fats.

    d. *Record your observations about the presence of fats in each food sample in Table 1.*

13. Clean up your work area. **CAUTION:** *Dispose of the biuret reagent solution carefully, according to your teacher's direction.*

Analysis and Interpretations

1. In Parts I, II, III, and IV, why did you apply each test to water?

_____

2. Name the reagent or testing material used to detect the presence of the following:

   a. simple sugar _____

   b. protein _____

   c. starch _____

   d. fats _____

3. In each of the chemical tests you performed, how did you know when a positive reaction took place?

_____

_____

_____

_____

4. Did any of the results in this laboratory exercise surprise you? If so, which ones?

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For Further Investigation

1. You have learned that nutrients in the foods you eat are used in building cells and supplying energy. In other words, "you are what you eat." keep a list of everything you eat for 3 days. Determine which foods contain what percentage of proteins, carbohydrates, and fats.
2. What are the current recommended amounts of protein, carbohydrates, and fats for a person your age? Recommendations change frequently, as more is learned about the impact of various substances on the body. Obtain the current recommendations of the American Heart Association or the American Cancer Society. Compare your list of foods from Question 1 to the recommended list.
3. Use reference materials to find out what problems are caused by eating a high-fat diet. Summarize your findings in a list. How much fat is in the snacks you usually eat? Using a brownpaper grocery bag, you can easily test for fats at home. Make a list of those foods which contain fat.