**Identifying Biological Macromolecules in Food**

# Introduction:

Biochemists have developed standard tests to determine the presence of the most abundant macromolecules made by cells: carbohydrates (sugars, starches), lipids (fats), and proteins. In this investigation, your group will conduct some of these standard tests to identify the presence of sugar, starch, lipid, and protein in known samples. You will then use the same tests to analyze different food samples for the presence of these macromolecules. The class test result of various foods will then be combined and analyzed.

A **positive control** is a test that is designed to give the desired outcome of the experiment provided that all the reagents and equipment are functioning properly. It is used to define a positive test result.

A **negative control** is a test that is designed to not give the desired outcome of the experiment. It is used to define a negative result.

Purpose:

To identify the compounds present in various foods and how the concentrations vary

# Materials:

* Safety goggles
* Safety gloves (not latex)
* Benedict’s solution
* Biuret Reagent
* 10% NaOH
* Starch suspension
* Glucose solution
* Lugol’s Iodine
* Albumin (Egg White)
* 400 ml Beaker
* Graduated cylinder
* Hot plate
* Eye dropper
* 8 test tubes
* Test tube holder
* Test tube rack
* Mortar and pestle
* Paper towels
* Hair dryer
* Food Samples provided by your instructor (listed by letter)

FOOD SAMPLES IN THIS LAB:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Caution: wear safety goggles and gloves. Biuret reagent is toxic and NaOH is corrosive. DO NOT LET THESE SOLUTIONS COME IN CONTACT WITH YOUR EYES, SKIN, or CLOTHING. Use tongs to remove the test tubes from the hot water bath.***

# Procedure:

Part A: Establishing Positive and Negative Controls

**Benedict’s Test for Sugars**

1. Prepare a water bath by placing roughly 300 ml of water into a 400 ml beaker and placing the beaker on a hot plate. Bring the temperature to near boiling (simmer).
2. Use a clean graduated cylinder to measure and add 3 ml of water to a test tube and label it “Sugar Control”.
3. Use a clean graduated cylinder to measure and add 3 ml of the glucose solution into another test tube and label it “Glucose Solution”.
4. Use a clean graduated cylinder to measure and add 3 ml of Benedict’s Solution to the test tubes labelled “Sugar Control” and “Glucose Solution”.
5. Place the two test tubes into the heated water bath for 2 minutes. Once the reaction is complete, use test tube tongs to remove the test tubes from the water bath to cool. Observe the differences between the two test tubes.
6. Record your observations in the data table.

**Biuret Test for Proteins**

1. Use a clean graduated cylinder to measure and add 3 ml of water to a test tube and label it “Protein Control”.
2. Use a clean graduated cylinder to measure and add 3 ml of the glucose solution into another test tube and label it “Albumin Solution”.
3. To each of “Protein Control” and “Albumin Solution” add 10 drops of NaOH, followed by 7 drops of Biuret Reagent. Observe the differences between the two test tubes.
4. Record your observations in the data table.

**Iodine Test for Starch**

1. Use a clean graduated cylinder to measure and add 3 ml of water to a test tube and label it “Starch Control”.
2. Use a clean graduated cylinder to measure and add 3ml of the starch solution to another test tube and label it “Starch Suspension”.
3. Add 3 drops of Lugol’s Iodine solution to the test tubes labelled “Starch Control” and “Starch Suspension”. Observe the differences between the two test tubes.
4. Record your observations in the data table.

**Paper Test for Lipids**

1. Use a clean graduated cylinder to measure and add 3 ml of water to a test tube and label it “Lipid Control”.
2. Use a clean graduated cylinder to measure and add 3 ml of vegetable oil and 3 ml of water to another test tube and label it “Oil Suspension”.
3. Place 2 or 3 drops of “Lipid Control” and 2 or 3 drops of “Oil Suspension” on a piece of brown paper towel. Using a hair dryer, dry the regions of the paper towel subjected to the suspensions and wait until they are relatively dry to the touch. Pick up the paper towel and hold it up to the light in the classroom, and observe the differences seen between the two areas.
4. Record your observations in the data table.

**DISPOSE OF TEST TUBE CONTENTS IN THE WASTE CONTAINERS PROVIDED AND CLEAN AND RINSE TUBES.**

Part B: Testing for the Presence of Biochemical Macromolecules in Foods

Use the procedures outlined above to test solutions of the foods provided for sugar, starch, protein and lipid respectively. Test four different foods. Mix a small amount of food sample with 3mL of distilled water in the test tube. Label the test tubes. It is suggested that you conduct this part of the procedure by test rather than by food. Record the foods tested and the results in the chart.

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# Results

**Testing Biological Macromolecules in Foods**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Tube Contents** | **STARCH TEST** | **SUGAR TEST** | **PROTEIN TEST** | **LIPID TEST** |
| **Positive Control** |  |  |  |  |
| **Negative Control** |  |  |  |  |
| **Food:** |  |  |  |  |
| **Food:** |  |  |  |  |
| **Food:** |  |  |  |  |
| **Food:** |  |  |  |  |

(4 marks)

# Discussion/Conclusion:

1. Discuss the results that indicate a positive result when testing for sugar, starch, protein and lipids, respectively. (4 marks)
2. Describe the biological macromolecules present in each of the foods tested and support with descriptions of positive test results. (8 marks)

# Analysis Questions:

1. Apple juice tests positive with both the Benedict’s solution and Iodine solution. Do the sugars in apple juice need to be broken down by your digestive system before they can be utilized as an energy source for your body? Explain. (3 marks)
2. What conclusion could you make if a positive test for any of the macromolecules occurred in a test tube containing only distilled water? (1 mark)
3. Which part of each macromolecule do you think the indicators interact with to give a positive result? (4 marks)

|  |  |  |
| --- | --- | --- |
| Macromolecule | Indicator | Part of the Molecule |
| Sugar |  |  |
| Starch |  |  |
| Protein |  |  |
| Lipid |  |  |

1. Given that most consumers do not have access to the chemicals or materials that you did, how could knowledge of these nutrient contents benefit the average shopper? (2 marks)
2. Relate the macromolecules tested in this lab to the nutrition label provided. Indicate the number of grams of each of the four macromolecules that are present in this food sample. (4 marks)
3. Starch is digested into sugars by the enzyme amylase. Describe how the activity of amylase could be tested. (3 marks)