Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Macromolecule Lab: A Lesson in Urinalysis

**Purpose**

The purpose of this exercise is to determine how to use chemical indicators to verify the presence of monosaccharides and polysaccharides, proteins, and lipids in several known substances.[[1]](#endnote-1)

**Background**

Urine can contain important information about a patient’s (human or animal) health status. A test called a urinalysis, or “UA”, is done to check for infections of the urinary tract or for the presence of blood, glucose, or protein in the urine.

The composition of urine varies depending on diet and activity. Urine is about 95% water, but it also contains urea and uric acid. Sometimes traces of amino acids can be found in urine, as well as a variety of electrolytes. In this activity, you will be analyzing a “patient’s” urine for the presence of carbohydrates, proteins, or lipids.

**Procedure:**

**Materials**

* Have biology text books readily available, with reference to section on polysaccharides. The following book references may be of use: *Modern Biology,* Holt (Ch 3); *Biology*, McDougal Littell (Ch 2); *Biology*, Prentice Hall (Ch 2).

**Part I**

Protein Test Station

1. Test tubes
2. Protein solution
3. Biuret solution
4. Dropper
5. Supplies to clean and dry test tubes

Fat Test Station

1. Test tubes
2. Vegetable oil
3. Sudan III solution
4. Dropper
5. Supplies to clean and dry test tubes

Monosaccharide Test Station

1. Test tubes
2. Monosaccharide solution
3. Benedict’s solution
4. Dropper
5. Hot water bath
6. Test tube holder
7. Supplies to clean and dry test tubes

Polysaccharide Test Station

1. Well plate
2. Starch solution
3. Iodine solution
4. Dropper
5. Supplies to clean and dry test tubes

Part II

1. All materials from Step I *except* for known solutions (Protein, lipid, monosaccharide, starch).
2. Urine samples\*

*\*Teachers refer to “teacher’s notes” for urine recipes.*

**C:\Users\Angela\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\DRP2N1IJ\MCj04242300000[1].wmfSequence of Steps**

Complete pre-lab questions below

1. Distinguish between a mono-, di-, and polysaccharide. Provide an example for each.
2. List the four classes of lipids.
3. What are the monomers of protein, and what element do they contain that carbohydrates and lipids do not?
4. Explain why you have to test for the presence of these macromolecules in *known* substances first?

**Part I: Testing Known Substances**

In the first part of this lab, you will need to determine how to use chemical indicators to verify the presence of monosaccharides and polysaccharides, proteins, and lipids in several known substances. Your results in this section will allow you to carry out tests on a “patient’s” urine samples to determine the presence of any of the above known substances.

Visit each of the stations set up in the classroom. Follow all instructions carefully and make detailed observations in the data chart to assist you in Part II.

|  |  |  |
| --- | --- | --- |
| Macromolecule | Chemical Indicator | Observations for a Positive Test |
| Monosaccharide |  |  |
| Polysaccharide |  |  |
| Protein |  |  |
| Fat |  |  |

Test for Protein Using Biuret Solution

1. Go to the Protein Test station
2. Locate a test tube, the protein solution, and the Biuret solution.
3. Shake the protein solution. Then add 1-2 drops into the test tube.
4. Now, add 2-3 drops of Biuret solution. Swirl the solutions together.
5. Record the change in color that is seen.
6. Replace all materials. Clean out your test tube using soap, water, and a test tube brush. Place your test tube into the rack to dry.

Test for Fat using Sudan III solution

1. Go to the Fat Test station

2. Obtain a test tube, the vegetable oil, and the Sudan III solution.

3. Add 10 drops of vegetable oil to the test tube.

4. Add 10 drops of water to the test tube.

5. Now, add 2-3 drops of Sudan III to the test tube. Swirl the solutions together.

6. The red Sudan III solution should make the fat appear. Record what you see.

7. Replace all materials. Clean out your test tube using soap, water, and a test tube brush. Place your test tube into the rack to dry.

Test for Monosaccharides using Benedict’s solution

1. Go to the Monosaccharide Test station.
2. Locate a test tube, a test tube holder, the monosaccharide solution, and the Benedict’s solution.
3. Add 4-5 drops of the monosaccharide solution to the test tube.
4. Now, add 4-5 drops of the Benedict’s solution. Swirl the solutions together.
5. Carefully place your test tube into the hot water bath using the test tube holder. (Caution: water is HOT!)
6. Record the change in color that is seen (green indicates a low concentration of monosaccharides – brick red indicates a high concentration). Also, note how long it took for the color to change.
7. Replace all materials. Clean out your test tube using soap, water, and a test tube brush. Place your test tube into the rack to dry.

Test for Polysaccharides using Gram’s Iodine

1. Go to the polysaccharide test station.
2. Locate a white well plate, the starch solution, and the Iodine solution.
3. Shake the starch solution. Then add 1-2 drops into the well plate.
4. Now, add 1-2 drops of the Iodine solution.
5. Record the change in color that is seen.
6. Replace all materials. Clean out your well plate using soap and water. Place your well plate on the paper towel to dry.

**Part II: Testing Urine Samples**

Repeat all steps from Part I, only this time use your patient’s urine sample instead of the known solutions.

|  |  |  |
| --- | --- | --- |
| Urine Sample #: | | |
| Macromolecule | Chemical Indicator | Present (+)/Absent (-) |
| Monosaccharide |  |  |
| Polysaccharide |  |  |
| Protein |  |  |
| Fat |  |  |

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**Post-Lab Questions**

1. List the macromolecule(s) present in your patient’s urine.

2. Explain why *sucrose* would not test positively with Benedict’s solution.

3. Starch and cellulose are examples of polysaccharides. Use your book to find 2 more examples of polysaccharides and their functions.

4. For the following urine samples, evaluate the results and indicate which macromolecules are present.

Patient #5150: Purple-black iodine, green Benedict’s solution, blue Biuret, red, oily Sudan.

Patient #0560: Light brown iodine, red Benedict’s solution, lavender Biuret, red, watery Sudan.

**Teacher’s Notes:**

Synthetic Urine Recipe

*Each student group needs about 10 mL of a sample for testing. These recipes make about 60 mL of each sample.*

Stock Urine:

* 160mL water
* Yellow food coloring
* 2g NaCl

Urine from Patient #H 987

(High glucose)

* 40mL apple juice
* 20mL stock urine

Urine from Patient #L 623

(High protein)

* 60mL stock urine
* 5mL egg albumin

Urine from Patient #P 552

(High glucose & protein)

* 40mL apple juice
* 20mL stock urine
* 5mL egg albumin

Urine from Patient #M 340

(High protein & High starch – contaminated sample!)

* 50mL stock urine
* 5mL egg albumin
* 5mL starch

1. Niesen, Lorilee (2008).Macromolecule Lab; A Lesson in Urinalysis. *Maxwell High School Ag Department*. [↑](#endnote-ref-1)