Lactose Lab

Background

Lactose intolerance is a problem for many individuals. Drinking milk, eating cheese or other dairy products can cause a great deal of discomfort in the form of gas, bloating, and/or diarrhea. Lactose is a disaccharide made up of two sugars, glucose and galactose. Lactase is an enzyme that binds to lactose and breaks the bonds between the two sugars. Without lactase the bacteria in the gut ferment lactose, causing gas.

Most people and animals make lactase as infants. This allows them to process mother's milk. However, for many, lactase is no longer produced after nursing. It appears that lactose intolerance is more prevalent in certain cultures where dairy animals were not raised and milk was not a source of protein.

People who are lactose intolerant tend to avoid dairy products and this can be troublesome since these foods are high in proteins and essential nutrients like vitamins A and D, magnesium, calcium, riboflavin, and potassium. However, there is a solution and that is to take lactase in liquid or pill form before consuming dairy products. In this lab you will investigate the effectiveness of Lactaid and the amount of glucose in milk and other milk substitutes.

Class: Biology
Grades: 9-10
Unit: Macromolecules-Biochemistry
Topic: Lactose Lab
Duration of Lesson: 60 minutes

General Objectives:

- Students will be able to discuss what causes lactose intolerance.
- Students will be able to explain and discuss lactose intolerance from a cultural standpoint.

Specific Objectives:

Students will be able to:

- Read and follow laboratory protocol.

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- Recognize and discuss the purpose of controls, independent and dependent variables in lab.
- Interpret the effectiveness of Lactex (Lactase) using glucose test strips and mathematical calculations.
- Graph results.

Massachusetts State Standards

- S1S1, S1S3, S1S4
- 1.3
- 4.1

Methods/Lesson Procedure:

1. Review macromolecules
2. Discuss lactose intolerance-the cause
3. Discuss lactose intolerance from an evolutionary standpoint.
4. Explain the lab procedure.
5. Students perform procedure.

Day 1-Materials:
LCD, key clicker, laptop, glucose test strips, lactaid dissolved in liquid, cow milk, soy milk, rice milk, distilled water, 12 well plate, glucose solution, acid solution, pipets or droppers.

Assignment: complete lab table and graph.

Assessment: Each student group will work cooperatively to complete their lab and turn in a lab showing understanding.

Exploring Enzymes through Lactex ®

You are a scientist at a company called Pharmex. Recently a new treatment for lactose intolerance, Lactex®, has been developed. In order to verify the activity of Lactex® the enzyme must be tested on different milks which contain sugars, to verify that it only works on lactose. If the enzyme has additional activities on other sugars, it may not be approved for use by the FDA. Three milk samples will be tested: cow, soy, and rice.

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Your job is to determine if Lactex® only works on lactose and if it will stand up to the acidity of the stomach.

Milk is 87% water and contains fat, proteins, and carbohydrates. The primary carbohydrate in milk is the disaccharide Lactose, made from two monosaccharides: glucose and galactose. Other common disaccharides are sucrose (made from glucose and fructose) and maltose (made from two glucose molecules). Sucrose is ordinary table sugar refined from sugar cane or sugar beets.

Some questions to be answered in the lab write-up.
1. Do all 'milks' contain the same sugars?
2. Which 'milks' should lactose work on? How will you know if it has worked?
3. What will you use as a control(s)? Why?
4.What are the independent and dependent variables?

Materials:
12 well plate
Milks
Glucose test strips
Glucose solution
Water
Lactex®
Acid solution

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Procedure:
It may be useful to put the 12 well plate on a piece of white paper and write what you are adding to each well above or next to the well.
You will be using glucose test strips to measure the amount of glucose in the milk samples before and after you add the enzyme Lactex®. To use, dip the test strip into the well with your sample. Try not to touch the ends of the strips and don't remove them from the brown plastic bags until you are almost ready to label and use them. This allows for a better reading.

1. Add 3 drops each of cow milk to wells 1 and 5.
2. Add 3 drops each of soy milk to wells 2 and 6.
3. Add 3 drops each of rice milk to wells 3 and 7.
4. Add 3 drops of glucose solution to well 4 and 8.
5. Add 3 drops of water to wells 1, 2, 3 and 4.
6. Add 3 drops of Lactex® to wells 5, 6, 7, and 8.
7. Add 3 drops of acid soultion to well 8.

Figure 1. 12 well plate

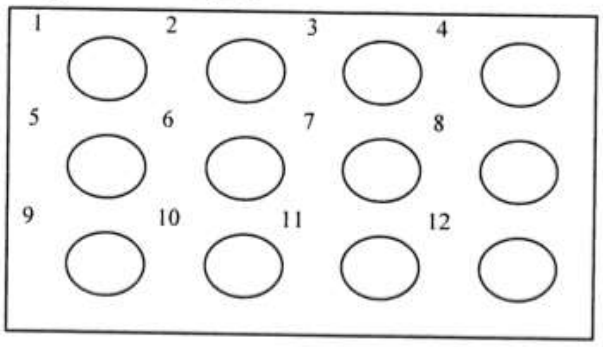

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Table 1.

Milk	Water		LACTEX		Difference (mg/dL)
	Color	Amount (mg/dL)	Color	Amount (mg/dL)	
Cow					
Soy					
Rice					

8. Wait at least 5 minutes. Label your test strips with the well number while you wait.
9. One at a time, dip your test strip into a well, wait 30 seconds and record the color in table 1.
10. After all the strips have been dipped and the color recorded, write the amount of glucose for that color.
11. Subtract the amount of glucose in the water columns from the amount of glucose in the Lactex columns, and put this value in the last column in table 1.
12. After all the data has been recorded, clean up your work area and materials.

Results and Conclusions:
Graph your data for each milk and write a conclusion discussing your results.

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