

Low Budget Biology 3: Lactase Enzyme Lab Teacher Prep

Purpose: this lab will examine the specificity of an enzyme to a specific substrate. Students will observe what happens when the enzyme is denatured.

Introduction:

Student Information:

Lactose, the sugar found in milk, is a disaccharide composed of glucose and galactose (both six sided sugars). Sucrose, ordinary table sugar, is also a disaccharide composed of fructose and glucose. Glucose is a six sided sugar and fructose is a five sided sugar.

Lactase is an enzyme that breaks lactose down into galactose and glucose. Lactase can be purchased in pill form by people who are lactose intolerant. These people lack the enzyme, lactase, and cannot break down the sugar lactose into its component parts.

Although lactose is similar to sucrose, lactase will break down only lactose- due to the shape of the sugar.

In this lab, you will see lactase break lactose down into galactose and glucose. You will also observe what happens if the shape of lactase is changed due to heating.

Notes:

Denaturing the enzyme was very difficult. We had to boil the enzyme (placing a test tube with the enzyme in a beaker of boiling water) for thirty minutes.

We thought about lowering the pH of the enzyme solution, but commercial lactase is swallowed and works in the stomach-- so lowering the pH was not really an option for.

We experimented by boiling the lactase for 5,15,15...minutes. Thirty minutes worked for us. We suggest that you try boiling the enzyme before the lab, adding some milk (source of lactose) and test for glucose. If glucose is present, boil the lactase for a longer period of time.

You can approach the enzyme specificity in two different ways:

- 1) Why didn't the sucrose break down in the presence of lactase?
- 2) Why didn't the lactose break down in the presence of boiled lactase?

This lab is an uncomplicated introduction to enzyme reactions.

Materials:

Lactase Tablet: These can be bought in any drug store or grocery store.

15 ml of Milk: Any milk will work.

Water: Used for dissolving the lactase tablet, dissolving the sucrose and boiling the lactase.

Sucrose: 5 grams per group.

100 ml Graduated Cylinder/10 ml Graduated Cylinder: Measuring water and enzyme amounts.

3 400 ml Beakers: Used for dissolving the lactase tablet, dissolving the sucrose and boiling the lactase.

5 Test Tubes: These tubes hold the different solution mixtures.

Test Tube Rack: Hold the test tubes.

Marking Pencil: Mark the test tubes so that confusion does not occur.
Clock:

Hot Plate with a Pyrex Test Tube: For denaturing the enzyme.

Glucose Test Strips: These strips can be found in any drugstore.

Stirring Rod: Helps to mix up the lactase tablet in the water.

Lactase Enzyme Lab

Purpose: to observe the breakdown of lactose, and only lactose, with the enzyme lactase.

Introduction:

Lactose, the sugar found in milk, is a disaccharide composed of glucose and galactose (both six sided sugars). Sucrose, ordinary table sugar, is also a disaccharide composed of fructose and glucose. Glucose is a six sided sugar and fructose is a five sided sugar.

Lactase is an enzyme that breaks down lactose into galactose and glucose. Lactase can be purchased in pill form by people who are lactose intolerant. These people lack the enzyme lactase and cannot break down the sugar lactose into its component parts.

Although lactose is similar to sucrose, lactase will break down only lactose- due to the shape of the sugar.

In this lab, you will see lactase break down lactose into galactose and glucose. We will also observe what happens if the shape of lactase is changed due to heating.

Materials:

- Lactase Tablet
- 15 ml of Skim Milk
- Water
- Sucrose
- 100 ml Graduated Cylinder
- 10 ml Graduated Cylinder
- 3 400 ml Beakers
- 5 test tubes
- Test tube rack
- Marking pencil
- Clock
- Hot Plate with a pyrex test tube
- Glucose test strips
- Stirring Rod

Procedures:

Solution Preparation:

- 1) Enzyme Solution: Add 1 lactase tablet to 200 ml of water. Stir until the tablet has dissolved.
- 2) Skim Milk: this solution contains the lactose.
- 3) Sucrose Solution: Add 5 grams of sugar to 100 ml of water. Stir until the sugar has dissolved.
- 4) Denatured Enzyme Solution:
 - a) Place 20 ml of Enzyme Solution into a pyrex test tube.
 - b) Add 200 ml of water to a 400 ml pyrex beaker.
 - c) Place the test tube in the beaker (gently laying the testtube so it rests on the side of the beaker.)

- d) Place the beaker and test tube on the hot plate.
- e) Boil the water in the beaker for 30 minutes.
- f) Let the solution cool to room temperature.

Lab Procedures:

- 1) Gather the materials.
- 2) Label the test tubes with the following labels:
 - A) Test tube with skim milk and enzyme solution.
 - B) Test tube with skim milk and water.
 - C) Test tube with skim milk and denatured enzyme solution.
 - D) Test tube with sucrose solution and enzyme solution.
 - E) Test tube with sucrose solution and water.
- 3) In test tube A add 2 ml of skim milk and 1 ml of enzyme solution.
- 4) Time for 2 minutes and test for glucose with the glucose test tape. Record this data in table 1. If there was glucose present mark a '+' in the table. If glucose was absent, mark a '-' in the table.
- 5) In test tube B add 2 ml of skim milk and 1 ml of water.
- 6) Repeat step 4.
- 7) In test tube C add 2 ml of skim milk and 1 ml of denatured enzyme solution.
- 8) Repeat step 4.
- 9) In test tube D add 2 ml of the sucrose solution and 1 ml of enzyme solution.
- 10) Repeat step 4.
- 11) In test tube E add 2 ml of the sucrose solution and 1 ml of water.
- 12) Repeat steps 4.

Results: You can make this into a table 6 rows by 2 columns: In the second column, record if the glucose test is positive or negative.

Table 1: Glucose presence in the following solutions.

Type of Solution	Positive or negative Glucose Result
Test tube A: Milk and Enzyme Solution	
Test tube B: Milk and Water	
Test tube C: Milk and Denatured Enzyme Solution	
Test Tube D: Sucrose Solution and Enzyme Solution.	
Test Tube E: Sucrose Solution and Water.	

Conclusion/Questions:

- 1) Diagram and describe the Lactose and Lactase reaction.

- 2) Why did the enzyme react to lactose but not to sucrose?

3) What happened when the enzyme was boiled?

4) Another way to affect the enzyme is by lowering the pH of the solution. However, lactase is suppose to be able to work in the stomach. Would lowering the pH of the enzyme solution affect the enzyme? Why or why not?

5) What type of reaction is this? Dehydration or Hydrolysis?