Food Explorations Lab II:

Magnificent Microbes

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, you will use bacterial fermentation to produce yogurt. Fat content, sugar content (lactose), and temperature will be the variables tested.

Lab Objectives

In this lab, you will learn how to…

1. Identify environmental conditions (temperature) and nutritional factors (i.e. sugar and fat) that encourages the growth of bacteria.
2. Explain the role of bacteria in yogurt production.
3. Describe fermentation and its purpose for an organism.
4. Explain the importance of an "active" culture for yogurt production.
5. Compare and contrast the effects of good and bad bacteria in food.

Lab Safety: Before beginning ANY investigation you should put on your safety goggles and apron. Always wash your hands following completion of an investigation. When handling food, you should also wash your hands prior to beginning an investigation.

Lab Question

Which of the following milk types will produce the most yogurt?

Lactose-Free Milk (warm storage)

Skim Milk (warm storage)

Whole Milk (cold storage)

Whole Milk (warm storage)

Predictions: I predict _____ will produce the most yogurt because…

Observations of Bacterial Fermentation

MATERIALS

1 Styrofoam cup
1 black permanent marker
1 paper cup containing plain yogurt (active culture)
1 cup heated milk (assigned by teacher)
1 thermometer
Aluminum foil (1 square)
1 tablespoon
1 liquid measuring cup
safety goggles
Aprons (optional)

PROCEDURE

DAY 1

Your teacher will assign you a milk type. Record your assignment below.

My Milk Assignment: _____

1. Label your Styrofoam cup - "Lactose-Free - Warm", "Skim Milk-Warm", or "Whole Milk – Warm".
2. Using a measuring cup, obtain 1 cup of your assigned heated milk (175˚ F) from your teacher: 1 cup Lactose-Free Milk, 1 cup Skim Milk, or 1 cup Whole Milk.
3. Pour the milk into your Styrofoam cup.
4. Using your thermometer, let the cup of milk cool to 120˚ F.
5. Add 1 tablespoon of yogurt to the cup.
6. Record observations (texture, color, odor) for your assigned milk in Table A under the "BEFORE Incubation" column.
7. Share your milk type with the other groups. Be sure to record your observations (texture, color, and odor) for the two milk types you were not assigned in Table A under the "BEFORE Incubation" column.
8. Cover your Styrofoam cup with aluminum foil and place it inside the warm cooler. Leave the cup in the warm cooler overnight.

Your teacher has prepared warm samples of the whole milk. These samples will be placed in cold storage so comparisons of yogurt production can be made for both warm and cold temperatures.

DAY 2

9. On Day 2, record your observations (texture, color, and odor) of each yogurt in Table A under the "AFTER Incubation" column. Use a spoon to stir your yogurt type. Comment on the consistency and amount of excess liquid for each yogurt type.
10. Share your milk type with the other groups. Be sure to record your observations (texture, color, and odor) for the two milk types you were not assigned in Table A under the "AFTER Incubation" column.

Table A: Milk Incubation Observations

Milk	BEFORE Incubation	AFTER Incubation
Lactose-Free Milk		**Warm storage:** Small amount of liquid on top Thick, but less so compared to skim and whole milk
Skim Milk		**Warm storage:** Very little liquid on top Medium thickness (between lactose-free and whole milk)
Whole Milk		**Cold storage:** No yogurt formed Still produced liquid
		Warm storage: No liquid on top Very Thick

Conclusion:

1. Which milk type produced the most yogurt? Why?

The whole milk in warm storage produced the most yogurt. This happened because fermentation requires warm temperatures. More fat makes a thicker product.

2. For each variable tested, explain its importance in the production of yogurt.

a. Temperature

The heating process promotes fermentation and helps the yogurt develop the desired consistency, flavor, and acidity. Once the desired consistency has been reached, the fermentation process is stopped. The yogurt can then be chilled or heated. Chilling allows the active culture to stay alive. If the yogurt is heated, the cultures are destroyed.

b. Lactose

When milk is fermented with bacteria, the sugar in milk, lactose, turns into lactic acid, which causes the milk to curdle and thicken.

c. Fat

The fat content of milk determines the thickness of the yogurt. The more fat, the thicker the yogurt. For example, yogurt made with whole milk is thicker than yogurt made with skim milk.

3. Explain the necessity of fermentation for the bacteria used to produce yogurt.

Fermentation is the breakdown of carbohydrates (sugars), like lactose. When milk is fermented with bacteria, it will make certain dairy products, like yogurt. This can be initiated with the addition of bacteria, yeast, or mold. Yogurt is made by mixing two types of bacteria with milk. Once bacteria is added to milk, the mixture is warmed to promote fermentation. This will help develop the desired consistency, flavor, and acidity. Once the desired consistency has been reached, the fermentation process is stopped. The yogurt can then be chilled or heated. Chilling allows the bacterial culture or active culture to stay alive. If the yogurt is heated, the cultures are destroyed.

4. Does lactose-free milk contain sugar? Support your answer.

Yes, lactose-free milk still contains the sugar lactose. The lactase enzyme is added to lactose-free (lactaid) milk to make it easily digested by lactose intolerant individuals. I can also tell that lactose-free milk still contains sugar by looking at the nutrition facts label.

5. Summarize the ingredients and environmental conditions needed to make yogurt.

To make yogurt you need:

Bacteria, mold, or yeast

Milk

Warm temperatures

Incubator

6. Describe active cultures and explain how they are maintained.

Active cultures are microorganisms that are alive. They must be kept in moderate temperatures and not heated or cooled to extremes.

7. Infer what would happen if yogurt not containing "active cultures" were used in this lab activity.

Yogurt would not form because you need live cultures for fermentation.

8. Compare and contrast the effects of good and bad bacteria in food.

Bacteria can be harmful in raw foods such as poultry because they can cause foodborne illness. Bacteria can be good in foods such as yogurt because they help maintain and/or restore normal intestinal bacteria.

Student Investigations Lab Extension

Directions to Use a Microscope

1. Plug the microscope in (if applicable) and turn it on.
2. Adjust the magnification to the lowest power.
3. Make sure the stage is lowered all the way and place the slide on the microscope stage. Slowly raise the stage using the coarse focus knob (large knob) so you can see the object clearly through the ocular lens. Do not let the slide touch the objective lens.
4. Using the fine focus knob (small knob), adjust the focus so the object looks clear.
5. If the object is too dark or too bright, you can adjust the diaphragm until you can see all the details.
6. Once the object is in focus, you may change to higher powers. However, be sure the lens does not hit the slide.

View Yogurt Bacteria under a Microscope:

1. Obtain a sample of yogurt with active cultures from your teacher or use a sample of yogurt from the *Food Explorations II* investigation.
2. Make a wet mount slide:
   a. Place a drop of water on a clean slide.
   b. Place a small amount of yogurt on the drop and cover with cover slip.
3. Observe using the microscope under 4X power and then 10X power.
4. Draw your observations in high power (10X).
5. In the box on page 118, draw the bacteria. What shape are the bacteria?

Bacteria Drawing