Food Explorations Lab III:

Maintaining Mass

STUDENT LAB INVESTIGATIONS

Name: _____

Lab Overview

In this investigation, you will make qualitative and quantitative observations as you test three possible methods of making curds and whey. You will determine if your measurements support the Law of Conservation of Mass.

Lab Objectives

In this lab, you will learn how to…

1. Determine methods that can be used to form curds and whey from milk.

2. Explain the Law of Conservation of Mass using quantitative observations.

3. Describe important environments for cheese-making.

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 treatments will cause milk to curdle? *You may choose more than one.*

Heat Vinegar Baking Soda

Predictions: I predict _____ will cause milk to curdle because…

Observation of Curdling Proteins under Varying Conditions

MATERIALS

2% milk (for the class)
1 cup containing 1 tbsp baking soda
3 plastic spoons
1 triple beam balance
1 black permanent marker
safety goggles
1 cup containing ½ cup vinegar
1 liquid measuring cup
1 small strainer (very thin mesh)
4 Styrofoam cups
1 medium bowl
Aprons (optional)

PROCEDURE

Before you begin your part of the lab investigation, your teacher will demonstrate how to find the mass of coagulated proteins after milk curdles when exposed to heat. Record the data your teacher determines from the demonstration in Table B.

1. Using the black permanent marker label the empty cups as follows:

   a. 1 Styrofoam cup "Milk with Vinegar"

   b. 1 Styrofoam cup "Milk with Baking Soda"

   c. 1 Styrofoam cup "Curds"

   d. 1 Styrofoam cup "Whey"

2. Using the triple beam balance, mass each of the labeled cups and write their masses below:

Cup	Mass in Grams
Milk with Vinegar	_____ g
Milk with Baking Soda	_____ g
Curds	_____ g
Whey	_____ g

3. Using the liquid measuring cup, obtain 1 cup of 2% milk from the teacher. Pour the milk into the cup labeled "Milk and Vinegar". Using the triple beam balance, mass the cup with the milk in it and write the new mass below.

"Milk with Vinegar" cup plus 1 cup Milk =	**_____ g**

4. Subtract the Mass of "Milk with Vinegar" empty cup from the Mass of "Milk with Vinegar" cup with the Milk to get the mass of the milk alone. Record this mass in Table B on page 125 under the column "Uncoagulated Milk".

Mass of "Milk with Vinegar" cup plus 1 cup Milk	**– Mass of "Milk with Vinegar" cup**	**= Mass of Milk for Vinegar treatment**
_____ g	**– _____ g**	**_____ g**

5. Using the liquid measuring cup, obtain another 1 cup of 2% milk from the teacher. Repeat step 4 for the cup labeled "Milk with Baking Soda".

Mass of "Milk with Baking Soda" cup plus 1 cup Milk	**– Mass of "Milk with Baking Soda" cup**	**= Mass of Milk for Baking Soda treatment**
_____ g	**– _____ g**	**_____ g**

6. Record descriptions of the milk before adding the vinegar and baking soda in Table A under the column labeled "Milk BEFORE Treatment." *DO NOT smell or taste this substance.*

7. Using the triple beam balance, measure the mass of the cup with vinegar provided by the teacher.

Mass of cup and vinegar =	**_____ g**

8. Add the vinegar just massed to the "Milk with Vinegar" cup. While one team member stirs the sample with a plastic spoon, another team member should mass the now empty cup that the vinegar was in. Calculate the mass of the vinegar used:

Mass of cup and vinegar	**– Mass of cup**	**= Mass of vinegar**
_____ g	**– _____ g**	**_____ g**

9. Record the mass of vinegar in Table B under the treatment column.

10. Observe the milk and vinegar mixture. Describe your observations in Table A under the column labeled "Milk AFTER Treatment."

11. Repeat steps 7 through 10 for the cup containing baking soda. Be sure to add the baking soda to the "Milk with Baking Soda" after you mass the cup containing the baking soda.

Mass of cup and Baking Soda	– Mass of cup	= Mass of Baking Soda treatment
_____ g	– _____ g	_____ g

12. Record the mass of baking soda in Table B under the treatment column. Describe your observations in Table A.

13. Select the cup that formed the most curds and whey. Follow these steps to determine the amount of curds and whey that were formed:

STEP 1: Place the strainer over a medium bowl and pour the selected mixture into the strainer. The strainer will catch any coagulated proteins. Using a plastic spoon, scrape the coagulated proteins out of the strainer and place them in the clean Styrofoam cup labeled "curds" measured in #2.

STEP 2: Place the small Styrofoam cup containing the milk proteins that you just scraped from the strainer on your balance and find its mass. The coagulated proteins are called **curd proteins**. Calculate the mass of the curd proteins and write it in Table B under the column labeled "Curd Protein."

Mass of "Curds" cup and Curds	– Mass of "Curds" cup	= Mass of Curds
_____ g	– _____ g	_____ g

STEP 3: The leftover fluid in your bowl is called **whey protein**. Pour the liquid whey protein into the Styrofoam cup labeled "Whey" and find its mass. Calculate and record the mass of the whey in Table B under the column labeled "Whey Protein."

Mass of "Whey" cup and Whey	– Mass of "Whey" cup	= Mass of Whey
_____ g	– _____ g	_____ g

Table A: Coagulation Observations

Milk Type	Treatment	Milk BEFORE Treatment	Milk AFTER Treatment
2% Milk	Vinegar	White & milky	A lot of coagulation You can clearly see whey and curds
	Baking Soda	White & milky	No difference – still white & milky

Table B: Coagulation Measurements

Milk Type	Treatment (grams)		Uncoagulated Milk (grams)	Curd Protein (grams)	Whey Protein (grams)
2% Milk	Vinegar	200g	210g	150g	250g
	Baking Soda	200g	210g	0g	400g
	Heat	200g	210g	100g	300g

TEACHER'S NOTE: Numbers in the tables are estimates only. The values your students obtain may vary.

Conclusion:

1. Explain how your original response compared to the actual results of the investigation.

Student responses will vary.

2. Describe any treatment(s) that did not produce curds and whey. Explain why.

Baking soda did not produce curds and whey. This did not happen because baking soda is a base and it does not provide the acid or heat needed to form curds.

3. Compare the total mass of the uncoagulated milk and its treatment to the total mass of the curds and whey produced. Explain any differences.

Heated:

There were less curds and more whey compared to the vinegar treatment.

Vinegar (acidic):

There were more curds and less whey when compared to the heated treatment

Baking Soda (basic):

No curds formed.

4. Which type of treatment produced the most curdling: Heated, acidic, or basic environments?

Acidic

5. Based on your investigation, which two environments are important in the cheese-making process? Why?

Heat and acidity are important. Heat allows the particles to separate more readily and acidity causes the protein (casein) to clump together and curdle.

Student Investigations Lab Extension

As a class, discuss the observations of each group and complete Table C.

TABLE C. Observations of Milk Types and Treatment Effects

MILK TYPE	TREATMENT TYPE		
	High Heat (teacher demo)	Vinegar	Baking Soda
2% Milk	_____ grams	Group 1: _____ grams	Group 1: _____ grams
		Group 2: _____ grams	Group 2: _____ grams
		Group 3: _____ grams	Group 3: _____ grams
		Class Averages	
		_____ grams	_____ grams

1. Predict what would happen if you use lemon juice as a non-heat treatment. Explain why.

   Lemon juice would produce curdles over time. The lemon juice will create an acidic environment, but because the milk is not heated, it will take more time for the particles to move.

2. As a class, discuss instances in which curdling might be a desirable outcome. List a few examples below.

   Cottage cheese