

Dairy Delights

Grade Level: 4-6

Approximate Length of Activity: One class period

Objectives

Teacher

1. Give students a general understanding of product technology and its importance to our food system over the years.
2. Explain why cheese making is a technological process and assist the students in a cheese-making activity.

Students

1. Describe the process of cheese making from cow to store.
2. Gain a general understanding of product technology.
3. Relate the history of cheese making to cheese making today.

Michigan Content Standards: (Science) S.I.P.E.1: S.IP.04.11; S.IP.04.12; S.IP.04.14; S.IP.04.15; **S.IA.E.1:** S.IA.04.12; S.IA.04.13; **S.RS.E.1:** S.RS.04.11; S.RS.04.15; S.RS.04.16; S.RS.04.17; S.RS.04.19; **P.CM.E.1:** P.CM.04.11; **S.IP.M.1:** S.IP.05.11; S.IP.05.13; S.IP.06.11; S.IP.06.13; **S.RS.M.1:** S.RS.05.12; S.RS.05.15; S.RS.05.16; S.RS.05.19; S.RS.06.12; S.RS.06.14; S.RS.06.15; S.RS.06.18; S.RS.06.19

Introduction

Cheese making, one of the earliest forms of biotechnology, involves chemical reactions that cause curd formation from liquid milk. To make cheese, living organisms (bacteria and fungi) are added to the milk. During their growth, the organisms metabolize the curd, creating chemical changes that result in cheeses of different textures and tastes such as Swiss cheese and Bleu cheese. The types of cheeses are determined by the type of milk, amount of fat in the milk, coagulation methods, cutting, cooking, curd formation, and the amount of salt added.

Production of cheese starts with a dairy cow giving birth. Following birth, a dairy cow is able to produce milk. Dairy cows are milked two to three times a day. With the help of humans, their milk travels from the milking machine to the cooling tank. A refrigerated truck goes to the dairy farm everyday to transport the milk to a cheese factory or dairy plant. The milk is pumped into a storage silo at the cheese factory, then tested to make sure it is clean and wholesome. The milk is cooled then pumped into a stainless steel vat where starter cultures are added. The starter is stirred through the milk with mechanical paddles. Rennet, a liquid enzyme, is added to the milk as a thickener. After 30 minutes, curds form from the milk. Knives cut the curd into small cubes and a clear liquid called whey oozes from them. The cheese is put on a finishing table and the whey drains from the curds. Curds knit into a solid mass as they rest. Next, the curds are cut and fed through a cheese mill. The mill cuts the curds again and puts them in a mixer with hot water. This causes the curds to melt so they can be placed in forms or molds. After the cheese forms it is placed in a salt brine bath to develop flavor. When the processing is completed, the cheese is wrapped and packaged.

Did you know farmers discovered biotechnology thousands of years ago? About 8,000 B.C., the first farmers decided to stay in one place and grow certain plants. Since then, people have continued to produce better, safer food to support themselves and the world. Around 1,800 B.C., people first used bacteria to create new and different foods. When bacteria grows in certain foods, such as cheese, it causes desirable flavors and textures. In 1845 a group of Swiss immigrants settled in Wisconsin and started manufacturing cheese. In 1880, there were 3,923 dairy factories in the United States that made 216 million pounds of cheese that year alone.

In the activity below, classrooms use an enzyme called chymosin to break bonds in milk and form curds. Chymosin is extracted, purified, and concentrated from microorganisms that carry gene coding for chymosin.

Materials Needed

- Whole milk
- Buttermilk
- Mixing bowl and spoon
- Small plastic disposable cups
- Medicine dropper
- Measuring cups and spoons
- Wooden popsicle sticks
- Gauze or cheesecloth
- Slow cooker
- Timer
- Thermometer
- Cheese Kits (5 mg. of chymosin can be purchased from Sigma Chemical (800) 325- 3010, or on the Web at www.sigmaaldrich.com . When purchasing, request product #R4879.

Activity Outline

Handy Information:

- Salt can be added to milk or the mixture before the experiment for a better tasting cheese, or salt the curds individually after the cheese is made.
- Wooden popsicle sticks can be used for this experiment or coffee stir sticks are also a good choice. Small plastic cups can be used to warm the milk.
- If the cups of milk are already poured, one cheese sample takes five minutes to make.

1. Divide the children into small groups to take turns doing this activity.
2. Prepare milk mixture of three parts milk to one part buttermilk.
3. Mix the milk and buttermilk in a bowl or container.
4. Pour two teaspoons milk mixture per student in a disposable cup.
5. Prepare water bath by putting about two or three inches of warm tap water in a slow cooker adjusting the temperature to 41C (106°F).
6. When the water is warm enough, have students hold their cups just below the water line in the slow cooker to warm the milk and swirl gently for one minute. Be careful not to get any water in the experiment cup.
7. Add one drop of diluted chymosin and swirl the cup gently for about ten seconds to mix. Put the cup back into the slow cooker. Hold the cup in the slow cooker to incubate. (The less movement the better for the rest of the experiment.)
8. Hold the cup in the slow cooker pot for about 30 seconds. Tilt the cup. What do you see? Is the milk getting thicker? It should be. Timing is not critical, but it is better to lengthen rather than shorten incubation.
9. Put the cup back in the slow cooker and hold for 60 more seconds. Tilt the cup after 30 seconds and again after one minute to check for thickening, the milk should look like thick yogurt. If it is still liquid, add one more drop of enzyme. If it looks like curdled milk proceed to the next step.
10. Keeping the cup in the slow cooker and using the wooden popsicle stick, draw a tic-tac-toe pattern in the bottom of the cup. The mixture should look like unstirred yogurt. You will not see the cuts you made until further incubation. Do not cut it further.
11. After 30 more seconds, look to see if the cuts are visible. A liquid should be forming where you cut the curd with the wooden popsicle stick.
12. Gently stir the curd with the wooden popsicle stick and put the cup back into the slow cooker for an additional 30 seconds. The thick white part is the curd and the watery liquid is the whey. If students do not see where the cuts were made at this point, incubate a little longer. The longer the sample is left in the water bath, the firmer the curd becomes and the more whey is excreted. This timing is another source of variability.
13. Instruct students to hold one hand over a wastebasket or sink. Make a pocket of the gauze in their hands and pour the mixture into the pocket, letting the whey drain from the cheese curd.
14. Twist the top of the gauze closed and gently squeeze the bottom to strain the whey.
15. Students can eat the cheese curd. They have just made cottage cheese.

Discussion Questions

1. Can you describe the process of cheese-making from cow to store?
2. Since cheese-making is a biotechnological process, and has been around for a long time, is biotechnology new? (Students should realize that biotechnology has been going on for a long time, although the scientific processes were not understood.)

Related Activities

1. Try different types of cheese and compare their different tastes and textures.
2. Research cheese production in the United States. How many dairy cows are used for this? How much cheese does Michigan produce each year? How much cheese do other states produce?

Resources

1. The Michigan Farm Bureau has an educational magazine geared for kids called "Ag Mag. The Dairy Ag Mag" focuses on dairy topics such as dairy cows, milking, dairy nutrition, ice cream, cheese, butter and career information. Contact Michigan Farm Bureau's, Promotion and Education Department, to obtain copies for your classroom at (800) 292-2680, ext. 3202.
2. Extra Cheese, Please! Mozzarella's Journey from Cow to Pizza by Chris Peterson.
3. United Dairy Industry of Michigan can give you free information and packets for the kids with stickers, snacks, and pencils. (800) 241-MILK (6455) or check out the Web site at www.udim.org.