

# A Milk-Curdling Activity



Chemistry

Food Science

Proteins

Enzymes

## Science Film Festival Films

 [Checker Tobi - The Milk Check](#)

## Learning Goals

- To learn how to curdle milk and what happens when milk curdles.
- To understand what role enzymes play in curdling milk.

## Explanation of Scientific Principles

Milk is liquid, but it can clump or curdle when it undergoes a chemical process. This process is called coagulation. Milk contains a lot of proteins, which are mostly whey and casein. Casein is poorly soluble, but it can form spherical structures called micelles which allow them to suspend in water as they were soluble. However, the micelles are easily broken down by acid or enzyme. This can cause the casein to come out of the solution and then clumps or curdles.

Lemon juice is very acidic. When it is added to the milk, the milk clumps almost instantly. Heating the lemon juice does not affect its acidity, when it is added to the milk, the same reaction should occur. Pineapple juice is not acidic enough to break the micelles. But the milk still clumps. This is because the enzyme bromelain breaks down the micelles. It takes time for the enzyme to work, so the milk takes a few minutes before it clumps. This enzyme is deactivated when heated. Therefore, heated pineapple juice cannot cause the milk to curdle.

## Explanation of Connection to the Film

A part of the film shows the processes for making dairy products such as cheese and yogurt. They all start with milk curdling. This experiment shows that acid and enzymes can curdle the milk.

## Materials

- Milk
- Lemon (fresh)
- Pineapple (fresh)
- Lemon squeezer
- Food grater, juicer or blender
- Teaspoon
- Tablespoon
- Knife
- Cutting board
- Two pieces of cheesecloth or cotton fabric
- 10 small transparent and microwavable cups (that each hold about two ounces)
- Paper towels
- Microwave
- Permanent marker
- Adult helper
- Workspace that can tolerate spills
- Timer (optional)

## Preparation

- 1 Mark four of the small cups with the labels “pineapple juice,” “pineapple juice (heated),” “lemon juice,” and “lemon juice (heated).”
- 2 Take a fresh pineapple and (with the help of an adult) cut off the rind on a cutting board. Only use about one fifth of the pineapple. Cut the flesh in smaller pieces and grate it. Alternatively, you can use a juicer or blender. Then, place the grated fruit in a piece of cheesecloth and squeeze at least one teaspoon of juice into each cup that is labeled with “pineapple juice.”
- 3 Put the cup labeled “pineapple juice (heated)” into the microwave and heat it just long enough to get it boiling (about 10 to 20 seconds). When it starts to boil, carefully take it out of the microwave and let it cool down.
- 4 Take a fresh lemon and use the lemon squeezer to make lemon juice. Add at least one teaspoon of juice into each cup labeled with “lemon juice.”
- 5 Again, put the cup labeled “lemon juice (heated)” into the microwave and heat it for 10 to 20 seconds. Once it starts boiling, carefully take it out and let it cool down.

# A Milk-Curdling Activity

1

**Have the children look at the cup labeled “1”. It should contain one tablespoon of milk.**

Ask: How does the milk look? What happens if you gently swirl the milk in the cup? Do you notice anything unusual?

3

**Take the second cup of milk and this time add one teaspoon of the heated lemon juice.**

Ask: Do you see the same reaction happening as before? How does the milk change? Is the reaction as fast as the previous one?

5

**To the fourth cup of milk add a teaspoon of heated pineapple juice and swirl the cup slightly. Again, observe the cup for about five minutes.**

Ask: Do you get a similar result again or is it different? If yes, how is it different? What do you think happened? Can you explain your observations?

8

**If you want (and only if you used clean materials!), you can taste a little bit of the whey and curd.**

Ask: Does it taste similar to milk? Is it sweet, sour, creamy or salty? Does it remind you of a particular food?

2

**Use a clean teaspoon to add one teaspoon of the freshly squeezed lemon juice to the milk in cup “1”. Swirl the cup slightly.**

Ask: Does the milk change when you add the lemon juice? If yes, does the change occur immediately or after awhile? When you swirl the cup a little bit, what do you observe at the wall of the cup?

4

**Use the third cup of milk, and with a clean teaspoon add one teaspoon of pineapple juice to the milk. Observe what is happening for about five minutes.**

Ask: Does the milk curdle with pineapple juice? Is the reaction fast or slow compared with that of the lemon juice?

6

**Choose the cup with milk that gave the greatest amount of curd. Then, place the second cheesecloth over the cup labeled “whey” and carefully pour the curdled milk mixture onto the cloth. Fold the cloth over the curdled milk and squeeze the liquid from the mixture into the cup.**

Ask: Do you see a lot of liquid coming out of the cheesecloth? What does the liquid look like? Is it clear, does it have a color or does it still look like milk? What do you think the liquid is?

## Preparation

6

**Label four of the remaining cups “1” to “4”. Fill each of these cups with about one tablespoon of milk.**

7

**Label the last two cups “curd” and “whey.”**