Yogurt & Microorganisms

Description:

Making yogurt is a tasty and interactive way to learn about helpful microorganisms in the food supply. This demonstration lesson with lecture, uses powdered milk and requires no cooking. It's prefect for a classroom.

Grade Level: 6-12

Essential Skills: 3, 9

NGSS: MS-LS1-7, MS-LS2-2, HS-LS1-7

Time: 2 class periods

Materials: 2 1/3 cups of instant, whole, unflavored powdered milk (recommend Nestle's Nindo brand for a creamy flavorful yogurt); 4 cups hot tap water (45-50 °C or 110-120 °F); 1/4 cup room temperature plain yogurt (use yogurt with active cultures and no additives); whisk; mixing bowl; 2 quart size glass jars with lids, insulated cooler; meat thermometer; additional containers with lids such as half gallon milk containers.

Vocabulary:

Live and active cultures refers to the living organisms, Lactobacillus bulgaricus and Streptococcus thermophilus, that convert pasteurized milk to yogurt during fermentation. Milk is pasteurized before culturing to remove any harmful bacteria.

Lactose is a sugar found mostly in milk. Lactose makes up around 2 - 8% of milk (by weight).

Coagulation in yogurt making happens when the inoculated milk acidifies the sugars enough to cause thickening of the proteins, making yogurt.

AITC Resources:

Lesson Plans:

Physical Changes of Matter and Ice Cream

Yogurt History:

Cultured milk products have been eaten since 2,000 BC. Yogurt is thought to have developed in Central Asia and was probably fermented spontaneously, likely by bacteria residing inside goatskin bags. People discovered when milk was left in a warm place, it thickened and developed a tart flavor. More importantly, yogurt kept longer than fresh milk. See page 2 for more background on yogurt and fermenting foods.

Directions:

1) Begin by reviewing the history of yogurt and fermenting foods with students. Support material to develop a lecture is on page 2.

2) Next, prep the insulated cooler which will become the incubator for this demonstration. To do this, pre-warm the incubator by filling it with containers of very hot tap water. Leave enough space for the two jars of yogurt mix. Show students how you made the incubation unit and explain how it will hold the heat while the milk and microbes work to make yogurt. Use a meat thermometer to check the temperature of the incubator prior to loading the yogurt mix. It should be 100-115° F. **Important:** Time and temperature are major factors in successfully making yogurt and keeping the microbes healthy. Handle the yogurt with care. It will not thicken properly if it cools or is shaken during incubation.

3) Next, show students the yogurt ingredients. Then add the powdered milk and hot tap water (110-120° F) into a deep mixing bowl. Whisk it until fully dissolved. Measure the water temperature with the thermometer. Next, add the plain yogurt with active cultures (the starter) and mix until well blended. Work quickly so the mixture does not cool.

4) Pour the mixture into the quart sized jars, cover with lids, place in the incubator and close the lid. Let it sit undisturbed for 6-8 hours. During incubation the bacteria multiplies, ingests the milk sugar (lactose), thickens the milk and turns it into yogurt.

5) After incubation the yogurt will have set up. Refrigerate it until the next class. Then show students the finished yogurt and have them do a taste test between commercial plain yogurt and what the class made. Record findings (sweet, bitter, lumpy, smooth, etc.). Expand this lesson by further exploring fermented foods and the role of microbes and fermentation the food supply.

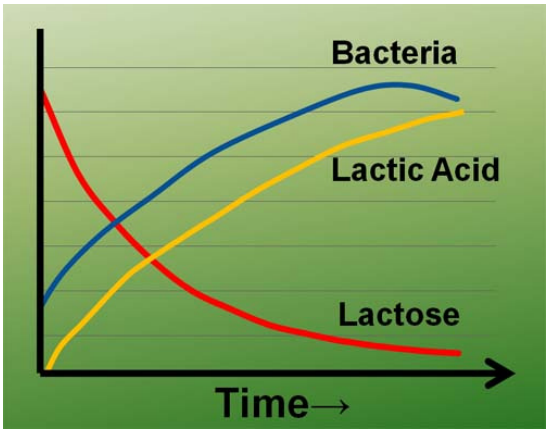
The temperature of the hot tap water used in yogurt mixture and incubator containers should be 110 - 120 °F.

Quickly whisk the yogurt mixture and pour into jars so it does not cool down.

Preheat the incubator/cooler with containers filled with hot tap water.

After 6-8 hours the yogurt should have set up and be thick and creamy.

" A cup of low-fat yogurt contains 448 mg. of calcium - 34% of the daily requirements for school-aged children."

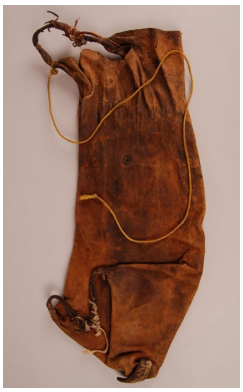


What is Yogurt?

Yogurt or *yoghurt* is the most popular fermented milk product in the world. It is made by fermenting milk using bacteria cultures. When the lactose in the milk is fermented using these bacteria, it produces lactic acid, which in turn acts on milk protein to give yogurt its thicker texture and characteristic tangy taste. The benefit of having a fermented milk product is that few other potentially harmful microorganisms can grow in yogurt's acidic environment. Thus yogurt can be stored safely longer than milk.

Worldwide cow's milk is most commonly used to make yogurt, but it can be made from the milk of water buffalo, goats, sheep, horses, camels and yaks. In the U.S. yogurt is typically produced using two bacterial cultures *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Sometimes *L. acidophilus* or a lactose-fermenting yeast is also added. These bacteria cultures are *thermophilic*, meaning they are active and thrive at higher temperatures (113 °F - 252 °F). Once the bacteria are added to the warm milk, they start to consume the milk sugars and begin fermentation, much like yeast in bread. Yogurt made with these active bacterial cultures produces lactase, the enzyme that allows humans to digest lactose. Consequently, yogurt can often be tolerated by people who are lactose intolerant. Using whole, powdered milk, as was used in the lesson, is the easiest method for making yogurt. Another method is slowly heating milk until almost boiling, then cooling it down. Heating the milk kills native bacteria which can compete with the introduced cultures. Heating the milk alters the structure of the milk protein, casein, a key to thick, firm yogurt. The slow heating process also results in evaporation and concentrates the milk, further helping the yogurt to thicken. Many yogurt manufacturers simulate this evaporation step by adding powdered milk or other thickeners.

In the U.S. yogurt is typically sweeten, but worldwide it is more often used with savory flavors. For cultures where yogurt has been used for thousands of years, it is integrated into all aspects of their food. Yogurt is the base for making many foods including yogurt cheese (*labneh*), condiments (*tsatsiki* or *raita*), even a yogurt-based soda in the middle east called *doogh*.



Middle eastern goat skin bag used to hold water and goats milk.

Yogurt History

Yogurt originated in Central Asia around 6,000 BC when humans began milking domesticated animals. It is believed the milk was stored in goatskin bags made from stomachs. These contained bacteria which curdled the milk when left in a warm place, essentially making yogurt. Not only did the milk keep longer as yogurt, it is believed people preferred the taste and continued the practice. Yogurt spread from Central Asia to the Middle East and Europe and the U.S. Today, it is known and consumed in almost all parts of the world.

Yogurt appears in many ancient texts including ancient Indian scripts, the Bible and historic texts by Pliny and Homer. The Mongol warrior Genghis Khan is said to have encouraged drinking yogurt made from horse milk called *kumis*. Mongols of all levels of society consumed the beverage, but it was of particular importance to the warriors. The warriors would take their horse herds with them as they traveled and always have a supply of kumis. Khan is said to have believed it keep warriors healthy and made them brave facing their enemies.

Historical records show in a 16th century Turkish doctor saved the life of King Francis I by treating him with yogurt made from goat's milk. The king suffered from intestinal illness and was apparently cured by yogurt. This brought a new surge in the popularity of yogurt as a health food, though at the time no one understood how the yogurt worked. In the 20th century a Russian scientist, Elie Metchnikoff studied the health benefits of fermented milk and determined the bacteria in cultured milk products like yogurt reduced the amount of "bad" bacteria in the gut and increased the "good" bacteria that aided digestion.

Turkish immigrants brought yogurt to North America in the 1700s, but it didn't catch on with the general population. The first industrialized production of yogurt is attributed to Isaac Carasso in 1919 in Barcelona – his company "Danone" was named for his son, "Little Daniel". In 1940s Daniel Carasso, the son of Danone founder started a small yogurt factory in the Bronx, New York – the company is now called Dannon in the United States. Yogurt with fruit on the bottom was first introduced in 1947 by Dannon.

The popularity of yogurt soared in the 1950s and 60s with the boom of the health food culture. Now yogurt of many types including kefir, Greek style yogurt, Swiss and fruit yogurts can be found at almost any grocery store.