

Let's Eat: Exploring Food Science

Making Yogurt Lab

How does plant-based yogurt compare to animal-based yogurt?

Teacher Background

Yogurt is created from the fermentation of **lactose** (milk sugar) by bacterial enzymes. This process is anaerobic, meaning that it occurs in the absence of oxygen. Lactose is a compound sugar, made up of the two simple sugars glucose and galactose. During the making of yogurt, the lactose is broken down by the lactase enzyme (provided by bacteria) into these two components (Refer to Figure 1). Further processing of glucose and galactose results in the end products of lactic acid and acetaldehyde. The production of **lactic acid** and **acetaldehyde** lowers the pH of the milk, causing it to have a sour, tart taste. The lower pH also affects the casein (milk protein), causing it to coagulate and precipitate, forming the solid curd that makes up yogurt. The leftover watery liquid is the whey. The two bacteria most commonly used to make yogurt are *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.

Starting Reagents

End Products



Figure 1. Enzymatic reaction in yogurt production.

Lactobacillus bulgaricus and *Streptococcus thermophilus* are not the only bacteria that can convert lactose into lactic acid. Fresh milk begins acquiring microbes from the very moment it leaves the cow. Milking equipment, people processing the milk, even bacteria in the air can all contaminate milk. To prevent the milk from going bad, all milk sold at the grocery store is pasteurized. Pasteurization is the process in which milk is heated for a certain length of time to kill *most* of the microorganisms that might be present. The U.S. Public Health Service guidelines say that heating milk at 62.8°C (145°F) for 30 minutes or 71.7°C (161°F) for 15 seconds meets pasteurization standards. These standards are based on the amount of heat necessary to kill most of the bacteria that are commonly found in milk. Of course, once you open a container of milk, it can contain or acquire a mix of bacterial species that can ferment milk in an undesirable fashion. Therefore, before you start making yogurt, it is necessary to heat the milk so that the only bacteria it contains are the ones we will add! Adding specific bacteria is called using a “starter culture”.

Soy yogurt is made by fermenting soy milk with friendly bacteria, mainly *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The process is similar to the production of yogurt from cow milk. The sugars are fermented by the bacteria into lactic acid, which causes the formation of the characteristic curd. The acid lowers the pH of the yogurt to about 4.0 and restricts the growth of food poisoning bacteria. The bacteria produce lactase which breaks down the lactose in dairy milk. Soy milk does not contain lactose but contains other sugars such as stachyose and raffinose. Soy yogurt contains natural probiotics: the two soy sugars, stachyose and raffinose, act as probiotics and stimulate the growth of Bifidobacterium in the large intestine.

Students will create yogurt from soymilk and whole dairy milk to compare the flavor and texture. Students may choose other plant-based milks to compare to other animal-based milks as well.

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