Souring milk

Make yogurt from yogurt

Materials

1 quart milk
4 tablespoons of yogurt – ingredients should only be milk and live active cultures
pot
hot plate or stove
cups
hot water bath – some way to keep cups warm
thermometer

To do and notice

1. Heat the milk over medium heat until it reaches 180°F (82°C). Stir the milk as it heats to make sure it doesn't scald on the bottom of the pot.
2. Take the milk off the heat, and let it cool to 110-115°F (43-46°C). You can do this in a sink full of ice water to speed things up.
3. Thoroughly mix in the prepared yogurt.
4. Make a hot water bath in a bin or cooler that will keep the yogurt insulated at 110-115°F (43-46°C).
5. Portion the milk/yogurt mixture into small cups, and place them in the bath for 8-12 hours. If you don't have to share, you can place the whole amount in a container and make a giant batch. Strain through cheesecloth if you like thicker yogurt.
6. Eat and repeat.

What's going on?

Yogurt is the product that results from the bacterial fermentation of milk. When you buy yogurt that contains "live active cultures", it means there are still living bacteria present inside. By feeding these bacteria and keeping them at their optimal temperature, they will eat and divide and process the milk into yogurt. These cultures are made up of a general class of bacteria called lactic acid bacteria. The ones used in yogurt-making metabolize lactose (a form of sugar present almost exclusively in milk) for energy and create lactic acid as a waste product. This acid helps give yogurt its texture and tangy flavor. In addition, since the lactose is used up during fermentation, the final yogurt tastes less sweet than the original milk.

Milk is made of proteins, carbohydrates (in the form of lactose), fat, and water. When you heat it up in the first step, the proteins denature from their tightly coiled state into relaxed chains. The temperature needed for this is too high for bacteria to survive, so this has the added benefit of sterilizing your milk. The milk is then cooled to the optimal temperature for the yogurt bacteria to undergo metabolism. Adding a lot of acid would precipitate the protein chains into clumps, but since the bacteria produce lactic acid gradually, proteins coagulate slowly into a network of chains. This network is able to trap liquid inside, and the end product is a smooth gel that gets firmer over time. Even though the bacteria divide fairly quickly, it takes several hours for them

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to work through the entire quantity of milk. Longer fermentation times will give a tangier and stronger flavored yogurt since more metabolism will have occurred. Straining the final gel results in an even denser yogurt as it physically separates the solid curds from the liquid whey. The amount of fat in the milk doesn't really participate in this process, but will affect the overall texture and flavor of the final product.

Going Further

If you have access to a compound microscope, it is fun to look at yogurt bacteria at high magnification. Make a wet mount with a tiny toothpick amount of yogurt and a drop of water. Under 400x, you can see individual bacteria swimming around. My store-bought yogurt contains these species: *Streptococcus thermophilus, Lactobacillus delbrueckii* subsp. *bulgaricus*, *Lactobacillus acidophilus*, *Bifidobacterium*, and *Lactobacillus casei.*

The first two are the main yogurt makers and work in synergy to digest lactose and produce lactic acid. They work so well together because they each make a waste product that the other uses for metabolism and are both thermophilic bacteria who grow best at 40-45°C. The other three strains work better at temperatures closer to human body temperature (37°C). They are often added as probiotics since they are already present in different parts of your body. As the temperature and pH of the yogurt changes, different species are able to metabolize at better or worse rates, and the end result is a unique flavor profile of everyone's waste.

In general, these bacteria come in two main shapes, with the lactobacillus having an oblong rod shape and the streptococcus, which means Greek for "twisted berry", like little spheres. After they divide they can still be attached to each other, so sometimes these look like beads in a chain.

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