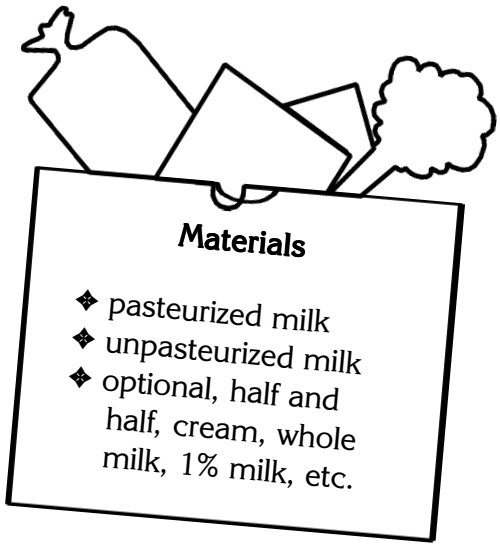
Sour Milk



Pasteurization is a heat treatment performed at the processing plant which destroys harmful bacteria without affecting the quality of the milk. Milk may be pasteurized using a low heat method (145° F, 63° C for 30 minutes) or a high heat method (162° F, 72° C for 15 seconds). Pasteurization does not kill all bacteria contained in raw milk, but it does kill those *pathogens* that may cause disease. Bacteria that remain after pasteurization eventually cause milk to sour (spoil). Pasteurization inactivates enzymes and destroys yeasts, molds, and other bacteria.

Bacterial populations in milk are a direct indication of milk quality. Processing plants check the milk before they load it into a truck, again before the truck is unloaded at the processing plant, in the storage tank at the processing plant, before it is pasteurized, and after it is pasteurized. Milk lots are also tested daily for 10 days after they are bottled. There are two tests used primarily. The first test checks the concentration of microorganisms in raw and pasteurized milk. The second test checks and detects viable and dead microorganisms.

Bacterial Growth in Milk

In both pasteurized and raw milk, various microorganisms succeed one another as the chemical environment of the milk changes. The microbes themselves bring about these changes. The stages of microbial growth are *Streptococcus*, then *Lactobacillus*, then yeasts and molds, and finally *Bacillus.*

Streptococci convert the milk sugar (lactose) to lactic acid. The acidity of the milk increases to the point where further *streptococci* growth is inhibited. *Lactobacilli* then begin to grow and convert the remaining lactose into lactic acid. Acidity increases further until *Lactobacilli* growth is suppressed. The lactic acid sours the milk and curdles *(coagulates)* the milk protein. Yeasts and molds grow well in this acid environment, and they convert acid into non-acid products. Finally, bacilli multiply in the environment where protein is the only nutrient available.

Bacilli convert protein into ammonia products, and the pH rises. These bacteria also digest the remaining protein through enzymatic action. The odor of spoiled milk becomes apparent once this has happened. Microbial activity causes changes in the pH of the milk. Fluctuations in pH are due to fermentation and putrefaction (decomposition) process.

Procedure

1. Pour one cup of pasteurized milk into two beakers or a glass. Cover one container with plastic wrap.

2. Pour one cup of unpasteurized milk into two beakers or a glass. Cover one container with plastic wrap. If you are unable to get unpasteurized milk from a local dairy, add one teaspoon of hay infusion, to doctor the sample with bacteria. (Hay infusion is made by steeping in warm water a small amount of grass or alfalfa hay. The proportion of hay to water should be enough to produce a color similar to that of strong green tea.)

3. Place the containers where the samples will be warm, preferably near a window (warmer conditions will speed bacterial growth).

4. Your microbes should begin to spoil the samples in a few days. Your nose and the consistency of the milk will tell you when you are ready to begin making some conclusions about the experiment.

Going further…

1. Compare the spoilage rate and bacterial growth in milk samples of varying fat content, such as 2%, whipping cream, and half-and-half.
2. Compare pasteurized and unpasteurized milk samples with regard to bacterial populations during a 14-day period. Compare refrigerated and non-refrigerated samples.
3. Study and discuss the numerous contibutions of Louis Pasteur. (See a good reference book on Louis Pasteur in the Appendix.)