

Milk enzymes and microbial enzymes degrade fat, protein, and carbohydrates to different degrees, producing a complex mixture of compounds we call cheese. Bacteria and fungi are living organisms, and as they grow the chemical changes they make as they metabolize milk result in cheeses of different textures and tastes, for example, Swiss cheese and blue cheese.

Scientists discovered that the enzyme rennin (produced in calf stomach lining cells) would coagulate the protein (casein) in milk, forming curds and whey. Because the enzyme reacts with a protein, the enzyme is called a *protease*. Now, through biotechnology, the gene from the calf stomach cell which makes the cell produce the enzyme rennin is removed and inserted into a bacteria or yeast cell. This causes the organism to produce the enzyme.

In cheese, coagulation is done through several steps

1. Bacteria convert lactose to lactic acid (same as in yogurt). Allowing the bacteria to work for 30 minutes creates an acid environment. If enough time passed, this acid would eventually coagulate the protein.
2. Instead of waiting for this, cheese makers use an enzyme called rennet.
 - Rennet is found naturally in the fourth stomach of cows.
 - Rennet can be man-made to copy the natural rennet works by altering protein so that it is no longer soluble in water (coagulates it).
 - Rennet works best at 90° and in an acid environment. Therefore, bacteria is added first, to create that acid environment, and then rennet is added.

If you would like to make cheese with an active culture there are several kits available. Two procedures follow for making cheese in a crock pot. Kits are available from Utah AITC. Both “slow” bacterial cheese and



biotech cheese kits, that make two crock pots of cottage cheese, are available for \$10 and \$2 respectively from Utah AITC. Other cheese kits can be purchased from a variety of cheesemaking companies (New England Cheesemaking Company, 413-628-3808, <http://cheesemaking.com>) and science supply companies. Here are two experiments. You may also be able to order material over the Internet or find the ingredients locally.

