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Milk Glue

Objective: Applying knowledge of protein denaturing, we will make "casein" glue by curdling the milk with an acid.

Materials: Skim milk, vinegar (5-7% acetic acid), 1000 mL glass beaker or pan for heating, Sodium bicarbonate (baking soda, a base), container for glue, strainer or cheesecloth, and food coloring (optional)

Background: There are various ways that proteins can be denatured. Temperature, pH, metal ions, etc. may denature a protein. In the process of making cheese, a microorganism is used that lowers the pH, which in turn causes the milk to curd. Then an enzyme called rennet is used to cause the curds to coagulate or clump together. Next time you eat cheese or custard, look on the package for the word "rennet". Naturally when milk sours forming curds, it is due to the action of bacteria found in the milk.

Milk is about 3% casein. Casein is a protein made of carbon, hydrogen, oxygen, sulfur, and phosphorus. Besides food products, casein can be used in a variety of non-food products, such as combs, buttons, glue, paints, plastics, and many more.

Procedure:

1. Put 500 mL (approximately 1 pint or 2 cups) of skim milk and 75 mL (approximately 6 tablespoons) of vinegar in the beaker or pan.
2. Heat slowly and stir continuously.
3. When it begins to curdle, remove from heat and continue stirring until curdling stops.
4. Let the curds settle to the bottom. The top liquid portion is called the whey.
5. Pour off the whey. Pour the curds into a strainer or cheesecloth and press as much liquid out as possible.
6. Put the curds in a container. Add 50 mL (approximately ¼ cup) of water and approximately 30 g (level tablespoon) of sodium bicarbonate. You will see some bubbles. This is a carbon dioxide releasing reaction between the remaining vinegar and the sodium bicarbonate.
7. You now have glue. You may now add a small amount of food coloring to your glue if you wish.
8. Test your glue by pasting two pieces of paper together. Let it dry thoroughly and then see if you can separate the sheets of paper.

Questions:

1. The curds in sour milk consist of what major protein?

2. How is cheese making different from milk souring?

3. List some other foods that contain proteins that may be used in other non-food products.