SEE PRE-LAB
EXTRACTION AND FILTRATION

Casein Glue

OBJECTIVES

- ***Recognize*** **the structure of a protein.**
- ***Predict*** **and** ***observe*** **the result of acidifying milk.**
- ***Prepare*** **and** ***test*** **a casein glue.**
- ***Deduce*** **the charge distribution in proteins as determined by pH.**

MATERIALS

- **100 mL graduated cylinder**
- **250 mL beaker**
- **250 mL Erlenmeyer flask**
- **funnel**
- **glass stirring rod**
- **hot plate**
- **medicine dropper**
- **baking soda, $NaHCO_3$**
- **nonfat milk**
- **paper**
- **paper towel**
- **thermometer**
- **white vinegar**
- **wooden splints, 2**

BACKGROUND

Cow's milk contains averages of 4.4% fat, 3.8% protein, and 4.9% lactose. At the normal pH of milk, 6.3 to 6.6, the protein remains dispersed because it has a net negative charge due to the dissociation of the carboxylic acid group, as shown in Figure A below. As the pH is lowered by the addition of an acid, the protein acquires a net charge of zero, as shown in Figure B. After the protein loses its negative charge, it can no longer remain in solution, and it coagulates into an insoluble mass. The precipitated protein is known as casein and has a molecular mass between 75 000 and 375 000 amu. The pH at which the net charge on a protein becomes zero is called the isoelectric pH. For casein, the isoelectric pH is 4.6.

$H_2N-\boxed{\text{protein}}-COO^-$ $^+H_3N-\boxed{\text{protein}}-COO^-$

FIGURE A FIGURE B

In this experiment, you will coagulate the protein in milk by adding acetic acid. The casein can then be separated from the remaining solution by filtration. This process is known as separating the curds from the whey. The excess acid in the curds can be neutralized by the addition of sodium hydrogen carbonate, $NaHCO_3$. The product of this reaction is casein glue. Do not eat or drink any materials or products of this lab.

SAFETY

For review of safety, please see **Safety in the Chemistry Laboratory** in the front of your book.