Lab – Analysis of Milk

Purpose: To identify the percentages of protein, water and carbohydrates within a sample of skim (nonfat) milk.

Procedure:

Part 1: Determining the amount of protein

1) Read all directions and make a data table or list of all the measurements needed.
2) Mass an empty beaker. Obtain 50 mL of skim milk. Record the mass of the beaker and the milk.
3) Heat the milk to about 40 ^{o}C using a burner.
4) Measure out 4.0 mL of 1.0 M $HC_2H_3O_2$ and add it slowly to the milk, with stirring. Use a spatula to stir the mixture. The protein should clump.
5) Weigh a small piece of cheesecloth. Weigh the largest beaker you have. Record.
6) Have one person in the group hold the cheesecloth over the large beaker. After all the acid has been added, remove the protein with a spatula. Place the protein on the piece of cheesecloth, not letting the cheesecloth fall into the beaker. Then, pour the remaining liquid through the cheesecloth (as you would a filter) to get the rest of the protein out. If you need to rinse with a little distilled water to get all the protein out, you can.
7) When all the protein has been removed from the milk, wrap the protein in the cheesecloth and squeeze out the excess water into the beaker. Unfold, place on a watch glass and allow the protein to dry overnight.
8) Weigh and record the mass of cheesecloth and the protein. Record.

Part 2: Determining the amount of water and carbohydrates

9) Heat the filtrate (liquid) gently with a burner, making sure the milk does not burn or boil over.
10) Continue to boil the mixture until almost all of the water is gone. When the material looks almost dry, turn off the heat. This should prevent scorching of the milk sugar. Allow the rest of the lactose to dry overnight in the beaker to form lactose crystals.
11) Weigh and record the mass of the beaker and the lactose. Record.

Data Table/List:

Calculations:

1) Determine the mass and percent of protein in the milk. Use the initial mass of the milk as a baseline.

2) Determine the mass and percent of water in the milk.

3) Assuming that all that is left from the end of part 2 is the carbohydrates, determine the mass and percent of carbohydrates in the milk.

4) A serving of milk is 240 mL. The density of skim milk is 1.033 g/mL. What is the mass of one serving of skim milk.

5) Using your percentages and the mass of one serving, calculate the total number of Calories in a serving on skim milk.

6) A serving of skim milk provides 83 Calories. Determine your percent error for this lab.

7) Whole milk is different from skim milk in that the fat has been removed in skim milk. The percent of fat in whole milk is 3.7%. In a glass of whole milk, the water percent would be reduced by this amount. Determine the mass of fat in whole milk, and the number of additional calories whole milk would provide.

Questions:

1) How would your calculated percentages be affected (relative to the true percentage) if

a) filter paper were used instead of cheesecloth?

b) you did not heat the mixture long enough in part 2?

c) you added too much $HC_2H_3O_2$ to the mixture?

2) Would you expect the same calculated percentage if the procedure were scaled up to use 100 mL of milk and sufficient acetic acid? Why or why not?

3) Is it a safe assumption to maintain that all that is left in the mixture after part 3 is the carbohydrates? Why or why not?

4) In raw milk (milk that has not been homogenized – straight from the cow), the insoluble fat will separate out as cream, which has a density of 0.998 g/mL. Explain a process we could add to this procedure to get the percent of fat in raw milk.

Conclusion: