3: DENATURING PROTEINS

Time: 1.5 h

Evaluated criteria: Analysis, Evaluation, Communication

Objective: To experiment with different methods the denaturing of the proteins found in egg white (albumin) and milk (casein).

Background information: Proteins are large molecules made up of small amino acids. Proteins are held in a natural shape due to the interaction of side groups on the amino acids from one part of the molecule to another area of the molecule. These interactions may be hydrogen bonds or disulfide bonds. We can denature the proteins by disrupting the H-bonds that are within the structure. When this happens the overall shape of the protein changes and new properties can be observed. The shape of a protein is associated with food processing properties, such as solubility, gel formation, and enzyme activity.

In the egg whites the albumin will change from clear to white. We will explore how the following denature egg albumin as well as milk casein.

- Heat – done by cooking
- Acids & bases – can form ions on some side groups of amino acids
- Organic compounds – form their own hydrogen bonds with the amino acids
- Heavy metals – react with disulfide bonds

Materials:

- Warm water bath at 100 ºC
- 6 test tubes
- 1 100mL beaker
- A dropper
- A scale
- A weighing boat
- 2 raw eggs
- NaCl (Sodium Chloride-Table Salt)
- $NaHCO_3$ (Sodium Bicarbonate – Baking Soda)
- Lemon juice OR vinegar
- Isopropyl Alcohol
- 5 mL of milk
- Stirring rod

Method:

*Procedure for Egg Albumin Denaturation***:**

Denaturation by Heat

1. Place 300 mL of water in a 400 mL beaker, place on the stand and heat to boiling.
2. Separate 2 egg whites by placing the egg whites in a plastic cup. Discard the egg yolk. Note: The clarity of the egg white this is your baseline or control.
3. Transfer approximately 5ml (1 tablespoon) of egg white into 1 test tube for heating.
4. Place the test tube in the boiling water and allow to "cook" till egg turns white.
5. Record your observations in a data table.

Denaturation by Ionic Compound (NaCl –Table Salt)

1. Add about 5mL of egg white to a test tube.
2. Add 2 grams of NaCl (table salt) to the test tube containing the egg white and stir.
3. Keep adding the NaCl gram by gram until you notice a change in the egg white.
4. Record your observations in a data table.

Denaturation by Base (Sodium Bicarbonate-Baking Powder)

1. Add about 5mL of egg white to a test tube.
2. Add 2g of $NaHCO_3$ (Sodium Bicarbonate – Baking Powder) to the test tube containing the egg white and stir.
3. Keep adding the $NaHCO_3$ gram by gram until you notice a change in the egg white.
4. Record your observation in the data table.

Denaturation by Acid (Lemon Juice or Vinegar)

1. Add about 5mL of egg white to a test tube
2. Add approximately 5 ml of lemon juice or vinegar to the test tube containing the egg white and stir.
3. Record your observation in the data table.

Denaturation by Organic Solvent (Rubbing Alcohol-Isopropyl Alcohol CH_3-CH(OH)-CH_3)

1. Add about 5mL of egg white to a test tube
2. Add 1 Teaspoon (5ml) rubbing alcohol to test tube containing egg white and stir.
3. Record your observation in the data table.

Procedure for Milk (Casein) Denaturation:

1. Place 10 ml of milk into a test tube.
2. Place 1 Teaspoon (5ml) of Lemon Juice or vinegar in the test tube and stir.
3. Record your observation in the data table.

Data process:
Present the all your detailed observations in a well organised table.

Conclusion and evaluation:
Do research and explain (always referring to your sources) with scientific explanations what has happened in each of the denaturing processes you experimented with. Evaluate the method and analyse the strengths and weaknesses of the experiment. Propose some improvements.