

## How Proteins are Affected by Temperature and pH

Egg white is a concentrated protein solution. What happens to an egg when it is cooked? It solidifies, but why? Can anything else cause similar changes?

Egg whites solidify most likely due to a condensation reaction, binding amino acids together into primary structure. A similar process happens in cells when amino acids are put together through condensation reactions.

Add one or two drops of egg white into a test tube. Then add 2 ml. of 80° C water to the tube. Shake lightly and observe.

When egg whites are submerged in 95°C water, the egg white quickly solidifies, turns to white from yellow, and floats. The "cooked" egg whites appear flakey.

Then place one or two drops of egg white into a test tube which contains about 2mL of 3M HCl. Observe. When egg whites are submerged in HCl<sub>(aq)</sub>, the egg white appears solid, white, and is floating.

Can you explain any similarities or differences between the reaction of the egg white with the HCl and with the hot water?

These similarities are most likely due to water's heat forcing a condensation reaction of the amino acids in the egg whites, bonding the H and OH groups on the ends of amino acids. The HCl<sub>(aq)</sub> will remove the OH from one end of the amino acids to form water and will allow amino acids to bond together through a mock condensation reaction.

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Saliva contains an enzyme called amylase which digests starch. Amylase is active at the pH in the mouth. (almost neutral)

Add 10 drops of one percent starch solution to each of two test tubes. Add 2 drops of (2M) HCl to one of the tubes. Collect a few milliliters of saliva in a 50mL beaker and add a few drops to each of the test tubes.

Test the pH of each tube with hydron paper. Wait ten minutes. Add 1 drop of iodine test solution to each tube. Take note of the results. Do you think amylase is active in the stomach after food is swallowed? Why?

Test tube with HCl<sub>(aq)</sub>: Very dark brown (almost black) and precipitate forming. Hydron paper is a dark purple.

Test tube without HCl<sub>(aq)</sub>: Light green color. Hydron paper is much lighter than that in HCl<sub>(aq)</sub> test tube.

Amylase is probably not active in the stomach because from the experiment, it was determined that the test tube with HCl<sub>(aq)</sub>, amylase, and starch contained more starch, as denoted by the color change when adding IKI, compared to the test tube without HCl and only amylase and starch. This phenomenon is most likely because the amylase digested the starch that was added in the test tube without HCl<sub>(aq)</sub> and therefore had a lower starch concentration, but in the test tube with HCl<sub>(aq)</sub> the amylase did not digest the starch due to the low pH.