

Protein—The functional and chemical properties 2.2.1

Key words:

Amino acids: individual building block for protein molecules

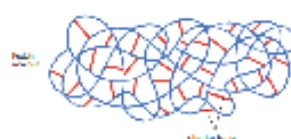
Chemical bonds: bonds that hold large protein molecules together in compact, folded bundles

Denaturation: the chemical bonds have broken and the protein molecule has unfolded and changed shape

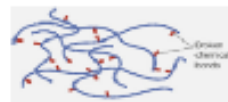
Coagulation: the joining together of lots of denatured protein molecules, which changes the appearance and texture of the food

Gluten: a protein that is formed from two separate proteins called glutenin and gliadin when liquid is added to flour to make a dough

Chemical structure: • Protein molecules are very big. • Made up of long chains of amino acids and formed into long bundles held together with chemical bonds.



Denaturation: Protein molecules can easily be denatured. This means that the chemical bonds holding the protein molecule bundle together can be broken, which makes the protein molecule bundle unfold and change shape like this: These can be broken by:



- Heating e.g. frying an egg
- Mechanical agitation e.g. whisking egg whites for meringue. This happens because egg-white protein can stretch and hold approximately 7 times its own volume of air when whisked. Whisking produces a gas-in-liquid foam, which becomes more stable as sugar is added. When baked, the proteins denature and water from them is driven out so the foam sets.
- Adding acid e.g. lemon juice/tomato juice added to raw meat to tenderise (marinate it) Lemons contain acids. Acids
- Adding acid e.g. lemon juice to milk proteins: the acids denature proteins in the condensed milk and cream and make them coagulate, which thickens and sets the mixture.
- Air bubbles e.g. formed in meringue
- Salt, for example, adding salt to poached eggs.

Coagulation:

- Denatured protein molecules unfold and start to join other denatured protein molecules nearby until they form a large mass. The denatured protein molecules are larger and take up more space than they used to. Because of this, they knock into other denatured protein molecules and start to join together in large groups – this is called coagulation.
- As protein foods are prepared and cooked, they change texture + become more solid (set) e.g. meat, fish, and eggs.
- Denatured protein molecules unfold and join up with other ones to form big groups – they coagulate
- As they coagulate, they trap air and water and this changes the colour, texture and flavour of the food.

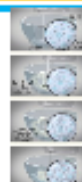


Eggs

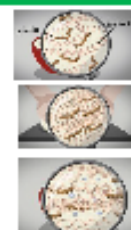
- The egg white change from transparent to opaque white and the whole egg has changed from a liquid food to a solid food when heated. • Egg white proteins begin to coagulate at 60°C; the egg yolk coagulates at 70°C. • Due to their ability to coagulate, the proteins in eggs are used in some recipes to hold and bind together other ingredients, for example, vegetables in a quiche flin, a breadcrumb or batter coating on the outside of some fried fish, the ingredients of a fish cake or beef burger. • If a food containing protein is overcooked, the coagulated protein molecules tighten up and squeeze out the water they were holding. This is called syneresis and is why overcooked meat or fish is dry and chewy, and why overcooked scrambled egg becomes rubbery and watery.



How foams are formed: Egg-white protein can stretch and hold approximately 7 times its own volume of air when whisked. The action of whisking denatures the protein. Whisking produces a gas-in-liquid foam, which becomes more stable as sugar is added. The denatured proteins coagulate and surround air bubble. When baked, the proteins denature and water from them is driven out so the foam sets



How gluten is formed: Gluten (in wheat flour) gives the right texture for bread making. Gluten is a protein that is formed from two separate proteins called glutenin and gliadin when liquid is added to make a dough. A gluten network is formed. The dough is kneaded and gluten gives bread dough elasticity = shrinking back when you stop stretching and shaping. This is because, long gluten molecules are coiled and bend in different places along their length. The gluten stretches and traps CO₂ bubbles produced by yeast and then sets (or coagulates) when baked.



Fault finding:

Scrambled egg has become rubbery and watery: Egg contains protein and water. If cooked at too high a temperature or too quickly, the proteins will denature and coagulate too quickly so that instead of trapping the water molecules, they will squeeze the water out, and the coagulated protein will become tough and rubbery in texture.

Grilled meat is hard and dry: • The meat contains protein in the form of muscle fibres. It contains fat and water. If grilled at too high a temperature, or too close to grill elements or flames, or for too long, the proteins will denature and coagulate very quickly. The coagulated protein molecules will tighten up and the water will be squeezed out as this happens. If too much is lost through evaporation, the meat will become dry and the tightened protein will make the meat hard.

