Protein—as a macro nutrient

Key Words

Amino acids—the 'building blocks' that join together to make protein molecules

Essential amino acids—amino acids the body cannot make by itself and must get ready made from foods

Biological value—the number of essential amino acids that a protein food has

Protein complementation – eating different LBV protein foods together in order to get all the essential amino acids the body needs

Protein alternatives - manufactured food products, with a high protein content

What is it and what is it made of? - a macronutrient found in animal and plant food. Made up of 'building blocks' called amino acids

Amino acids: there are 20 in total. 10 are essential for the growth of children; 8 are essential for adults

High Biological Value (HBV) proteins contain all the 10 essential amino acids (EAA).

Low Biological Value (LBV) proteins are missing one or more essential amino acids (EAAs).

Functions in the body.

- Growth and repair
- Repair of the body when it is injured
- Giving the body energy (if it does not have enough carbohydrate and fats)
- Also needed for hormones (for growth and reproduction), enzymes (e.g. to digest food) and antibodies (to fight infection)

LBV proteins do not contain all the essential amino acids we need but if you eat a mixture of them the missing essential amino acids in one may be provided by one of the others. This is called

Protein complementation. If you put two LBV foods together in a meal, the EAAs missing in one will be provided by the other – they complement each other. Beans and bread are both LBV protein foods so, as beans on toast, they are a good example of protein complementation. Other examples are: Pitta bread and hummus, baked beans on toast, bean and rice salad (not with soya beans), peanut butter on toast, bulgur and bean salad (not with soya beans) and vegetable satay and rice.



Effects of deficiency

Children will not grow properly and may never reach full height

Hair loss (hair is made of protein. People can live without hair so if protein is deficient the body will use it for more important body needs.

Nails and skin in poor condition

Easily develop infections due to weakened immune system

Not able to digest food properly

Specific groups:

Pre-school children need protein for rapid growth.

Children ages 5—12 are growing in 'spurts'

Vegetarians

Need to make sure they mix their LBV protein foods

Vegans—eat no animals or animal products and rely on plant based protein foods

Convalescing from illness or injury —need protein to repair damaged cells, repair wounds

Sources:

HBV foods: meat, poultry, cheese, soya beans, milk, quinoa, eggs, fish., yogurt, quark, soya beans, quinoa.

LBV foods: peas, beans, nuts, lentils, cereals (rice, oats, barley, rye, millet, sorghum) and cereal products (bread, pasta), seeds and gelatine.

Protein alternatives are manufactured food products, with a high protein content, e.g. mycoprotein (Quorn), tofu, TVP and tempeh. They are used instead of meat in meals.

Useful to people who have decided to change from eating meat to a vegetarian diet as often made to look like meat or chicken, so they can help someone get used to not eating meat as they become fully vegetarian. Can be made into similar meals such as stir fries, pies, curries and burgers. They do not have much flavour on their own but easily take up the flavours of other ingredients.

Effects of excess: Too much nitrogen in the body is dangerous. The liver and kidneys have to work harder to remove it. This puts them under stress and could harm them.

Amount needed for different life stages

0.75g of protein is needed per 1 kg of body weight. Some groups need more than others e.g. teenagers (boys in particular) and breastfeeding women.

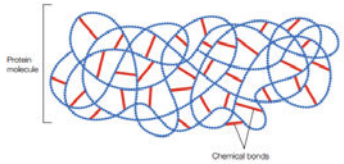
All **teenagers** need protein for growth, repair of body and energy. • Hormones (for growth and reproduction), enzymes and antibodies (to fight infection) are made from protein – teenagers need more of these as their body changes from a child to an adult. • Muscles made of protein – males are usually more muscular and taller than females, so need more protein.

Breast feeding women:• Protein is essential for growth and development of baby. • Breast milk provides protein. • Mother needs enough protein for her own body plus extra for the baby.

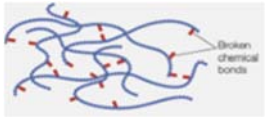
Protein—The functional and chemical properties

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.

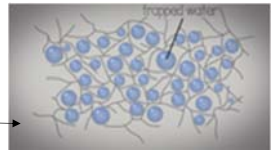


Denaturation: Protein molecules can easily be denatured. This means that the chemical bonds holding the protein molecule bundle together can be broken, which makes the protein molecule bundle unfold and change shape like this: These can be broken by:



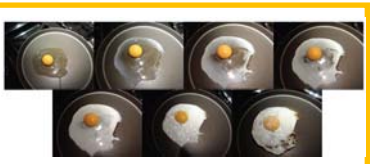
• Heating e.g. frying an egg
• Mechanical agitation e.g. whisking egg whites for meringue. This happens because egg-white protein can stretch and hold approximately 7 times its own volume of air when whisked. Whisking produces a gas-in-liquid foam, which becomes more stable as sugar is added. When baked, 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 →



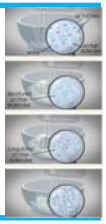
Coagulation:
• Denatured protein molecules unfold and start to join other denatured protein molecules nearby until they form a large mass. The denatured protein molecules are larger and take up more space than they used to. Because of this, they knock into other denatured protein molecules and start 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

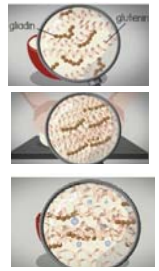


• The egg white change from transparent to opaque white and the whole egg has changed from a liquid food to a solid food when heated. • Egg white proteins begin to coagulate at 60°C; the egg yolk coagulates at 70°C. • Due to their ability to coagulate, the proteins in eggs are used in some recipes to hold and bind together other ingredients, for example, vegetables in a quiche flan, 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.