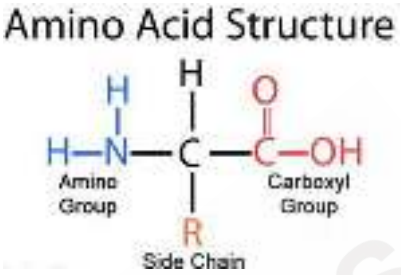
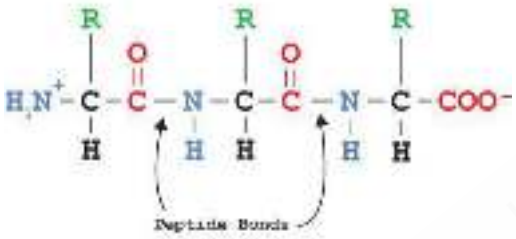
PROTEINS

A) Basic Structure and Properties:

Basic Structure: Proteins are made up of amino acids which are organic acids with a carboxyl group (COOH) and amino group attached to a carbon atom. R is the functional group which differentiates one amino acid from another.





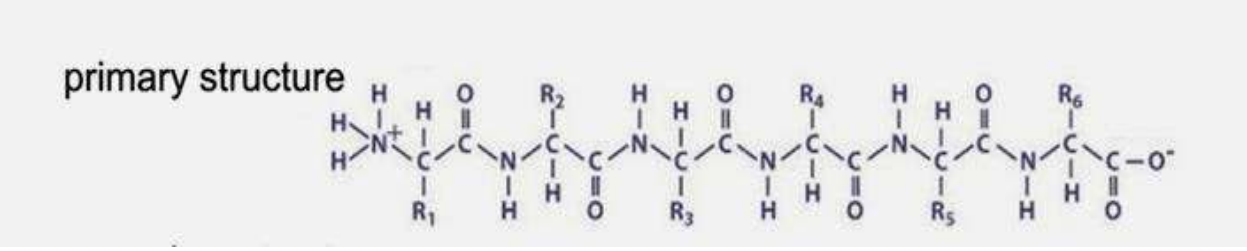
Peptide linkage: The carbon of the carboxyl group of one amino acid combines with the nitrogen group or amino group of another amino acid with the loss of one molecule of water. This bond which unites the two amino acids is called a peptide bond.

Protein molecules are polypeptides being made up of repeating units of –C-C-N- group which forms the backbone of the protein.

Composition: Proteins, like fats and CHO's, contain carbon, hydrogen and oxygen. In addition they contain about 16% nitrogen, which distinguishes the proteins from CHO's and fats.

Proteins are more complex and larger molecules than CHO's and fats. Some proteins contain sulphur, phosphorus, iron and other minerals also.

Primary Structure of Protein



Properties of Proteins

Proteins are synthesized from amino acids, which contain a basic and an acidic group. The presence of these basic and acidic group. The presence of these basic and acidic group in the constituent amino acids of proteins is responsible for their amphoteric nature. The ability of proteins to act as an acid or a base is referred to as its amphoteric nature. The amphoteric nature of proteins is very important from biological point of view, as it prevents sudden change of PH in the body. In food mixtures, these groups help to bind ions and change the texture, volume and appearance of the product.

Denaturation: When proteins are exposed to heat, light and/or change of pH, structural changes occur. These changes in structure of proteins are known as denaturation. It leads to change in solubility of proteins. It may be reversible, if conditions which cause it are mild, but mostly the changes which occur are irreversible.

Coagulation: Proteins coagulate on exposure to heat and/or change of pH. All proteins are firstly denatured and then coagulated by heat. The coagulation occurs between 65 degree celcius and 90 degree celcius. Coagulation means curdling, formation of a mass, congealing or solidifying. For example, when egg is boiled or scrambled, the egg proteins coagulate and a solid mass if formed

from raw egg, which is a fluid. When milk is incubated with curd, the liquid milk is transformed to curd, due to coagulation of milk protein by the lactic acid formed.

Hydration of Proteins: Proteins can form hydrates with water. This reaction is very important in food science. The protein molecule contains a number of groups, which contain a pair of unshared electrons and are therefore capable of attracting and binding the hydrogen of a molecule of water. The water molecule which has been bound, attracts another molecule of water and thus aggregates of water can build up around each polar group on the protein molecule. The extent of hydration of a protein dispersion depends on concentration of protein, the pH, the temperature and the presence of other substances, which combine with water.

Gelatin when placed in cold water swells due to hydration. If it is heated, it dissolves. When cooled, it solidifies again. Thus the water is held in the network of swollen gelatin particles. Gelatin is useful as a gelling agent, a whipping agent in foam and as a clearing agent in fruit juices, due to this property.

B) Type of Proteins Based on Their Origin (Plant/Animal)

Proteins are classified into 2 types for the study of nutrition point.

1. **Complete Proteins:** These proteins contain all the essential amino acids in sufficient quantity and ratio to supply the body's needs. They support life even if supplied as the sole source of

protein. These proteins are of animal origin, examples are milk, meat, poultry products and fish. The quality of these proteins is much superior to those of incomplete proteins.

2. **Incomplete Proteins**: These proteins are deficient in one or more of the essential amino acids and therefore they do not support life on their own. All plant sources of proteins, i.e, vegetables, fruits, cereals, pulses, nuts and oil seeds, contains proteins incomplete to varying degrees. If 2 sources of incomplete proteins are combined in the same meal, the resulting protein may be of better quality. Example: Khichdi, kheer

GELATIN is the only animal protein which is an incomplete protein. It lacks 3 essential amino acids namely tryptophan, voline and isoleucine and has a small amount of leucine.

C) Effect of Heat on Proteins

1. Denaturation

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65 degree celcius and 90 degree celcius. Coagulation means curdling, formation of a mass, congealing or solidifying. For example, when egg is boiled or scrambled, the egg proteins coagulate and a solid mass if formed from raw egg, which is a fluid. When milk is incubated with curd, the liquid milk is transformed to curd, due to coagulation of milk protein by the lactic acid formed.

D)Functional Properties of Proteins

1. **Emulsification:** Proteins act as emulsifying agents, because of their amphoteric nature.

For example, in preparation of mayonnaise, eggs act as emulsifying agent.

{**Emulsifying Agent:** Emulsion is dispersion of one liquid in another liquid. An emulsion is a heterognous system made up of two phases. A substance which stabilizes an emulsion is known as an emulsifying agent.}

2. **Gelation:** The changes that occur in preparation such as stiffening of an egg, meat and milk cookery depends on gel formation. A gel displays the property of rigidity. A classic example is that of gelatin gel, which forms with as low a concentration as 1%. When colloidal dispersions of large molecules are cooled, the viscosity increases and the mass attains same rigidity. This point is called gel point. Egg custard, gelatin gel, khandavi, kharvas, puddings etc are excellent examples of this phenomenon.
3. **Foamability:** Protein acts as foaming agent. Formation of foam is necessary in some food preparations. Proteins when beaten are able to hold in air, and thus improve the texture and feel of the food. Ice- cream and lemon meringue are excellent examples of this property.

The multipurpose functional properties of proteins in foods may be modified to suit the requirements of enhanced nutritional value and flavor, taste and textural characteristics in processed foods. Modification of proteins by chemical and enzymatic methods is gaining importance as the modified proteins exhibit better features compared to native proteins. Protein modifications for food processing aims at:

- Blocking undesirable reactions such as Millard Reaction.
- Improving the nutritional value by increasing digestibility of the food fortifying food with essential nutrients and inactivating toxic or undesirable constituents.
- Improving physical properties such as whippability, foam stability, solubility and texture.

E) <u>Commercial Uses of Proteins in Different Food Preparations</u>

The major role of protein in food preparation includes the ability of proteins to:

1. Form foams
2. Bind water and forms viscous sols and gels
3. Get coagulated by heat
4. Exhibit emulsifying properties
5. Show enzymatic activity

<u>Gelatin:</u> Gelatin is a partially degraded protein prepared from collagen. It contains a large proportion of amino acids which have a great affinity for water. The long thin fibres of gelatin help in forming firm gels at low temperatures.

Egg gels: Egg white proteins are denatured by heat and get coagulated. The transparent viscous sol of egg white turns white and opaque and form a gel with water trapped inside.

Cake: No sodium bicarbonate is used in sponge and angel cakes as these are foam cakes. The properties of egg, sugar and water to cake flour is high.

Confectionary items: Bread is made from wheat, which is milled into flour. Wheat flour from hard wheat is higher in protein and is used for bread making. When flour and water are kneaded together, the gluten complex starts foaming and elastic dough is formed. On application of heat,
the gluten coagulates and forms a fairly rigid cellular structure. The gluten matrix thus forms the foundation of the structure of all bakery products. Excessive mixing of the dough can weaken the gluten structure.

Meringues: These are egg white foams with sugar incorporated into it. Soft meringues are used for topping basked Alaska, cream and chocolate pies. Hard meringues are used to make macaroons or as a base for pie fillings.

Soufflés: It contains milk, grated cheese, eggs, salt, butter and flour. In the case of soufflé, a very thick white sauce is made. Egg yolk is blended in it followed by grated cheese. The white sauce should be hot enough to cause fat in cheese to melt.

Custard : An egg custard is prepared using one egg, a cup of milk, a tbsp of sugar and a pinch of salt. Milk is heated and added to beaten egg along with sugar and salt. In egg custards, the egg protein ovalbumin gets denatured by heat and unites to form a network in which liquid milk is trapped to form a fragile gel.

Soups and curries: Thickening agent. [bind water(flour) and form viscous sols and gels