# UNIT 3: MACRO NUTRIENTS

## PROTEINS

Protein is the basic material of every living cell. It is the only nutrient that can make new cells and rebuild tissues. Therefore, an adequate amount of protein in the diet is essential for normal growth and development and the maintenance of health.

## Introduction

- Proteins are large, complex, organic compounds made up of carbon, hydrogen, oxygen, and nitrogen. The presence of nitrogen distinguishes proteins from carbohydrates and fats. Apart from nitrogen, elements such as sulphur, phosphorus, copper, and iron are also found in some proteins.
- They are composed of one or more chains of amino acids.
- Proteins are fundamental components of all living cells and include many substances, such as enzymes, hormones, and antibodies that are necessary for the proper functioning of an organism.
- They are essential in the diet of animals for the growth and repair of tissue and can be obtained from foods such as meat, fish, eggs, milk, and legumes.

## Basic Structure of a Protein

Proteins are made up of hundreds or thousands of smaller units called amino acids, which are attached in long chains.

20 different types of amino acids can be combined to make a protein. 9 are essential and 11 are non-essential.

The sequence of amino acids determines each protein's unique 3-dimensional structure and its specific function.

The bond which unites the two amino acids is called a peptide bond.

An amino acid has:

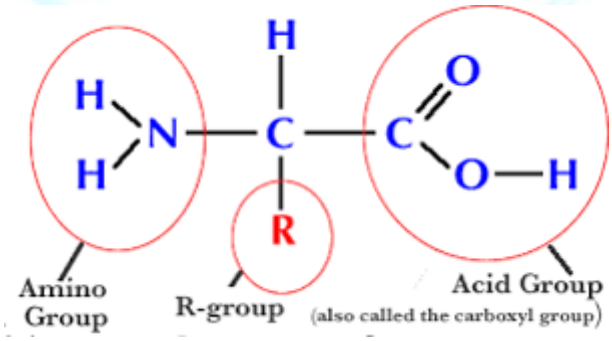
1 carboxyl group (COOH)

1 amino group or nitrogen group (NH2)

1 hydrogen (H)

And 1 functional group (R)

NH2CHRCOOH.



## Amino Acids

The term amino acid is short for α-amino [alpha-amino] carboxylic acid. Amino acids play central roles both as building blocks of proteins and as intermediates in metabolism. The 20 amino acids that are found within proteins convey a vast array of chemical versatility.

## Essential Amino Acids

Those amino acids which cannot be synthesized in sufficient amounts by the body and must be provided by the diet are called essential amino acids. The human adult requires eight essential amino acids while growing children require ten essential amino acids. Essential amino acids are indispensable to life.

- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine
- Histidine (for children)
- Arginine (for children)

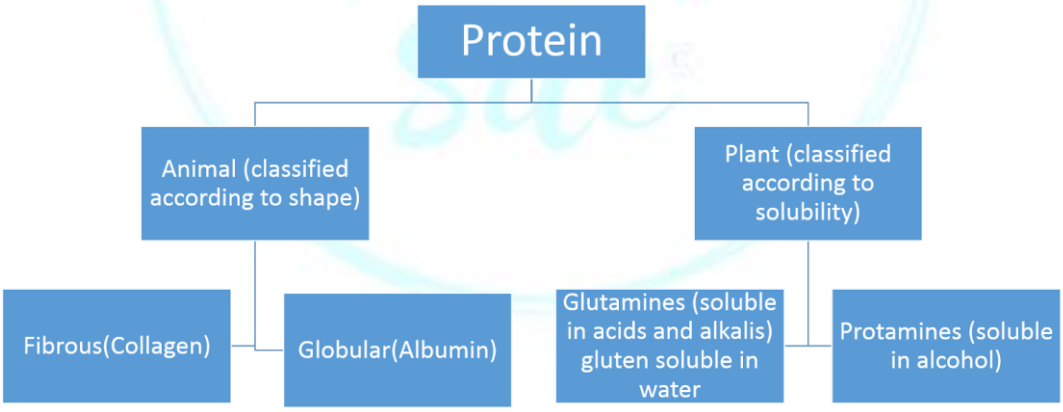
## Non-essential Amino Acids

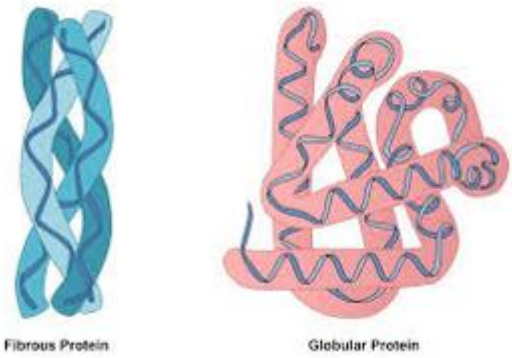
Non-essential amino acids do not mean that these amino acids are not required by the body. They are termed non-essential because they are not dietary essentials. If they are lacking in the diet, they can be synthesized by the body from other amino acids.

- Alanine
- Asparagine
- Aspartic Acid
- Cysteine
- Glutamine
- Glycine
- Hydroxylysine
- Hydroxyproline
- Proline
- Serine
- Tyrosine

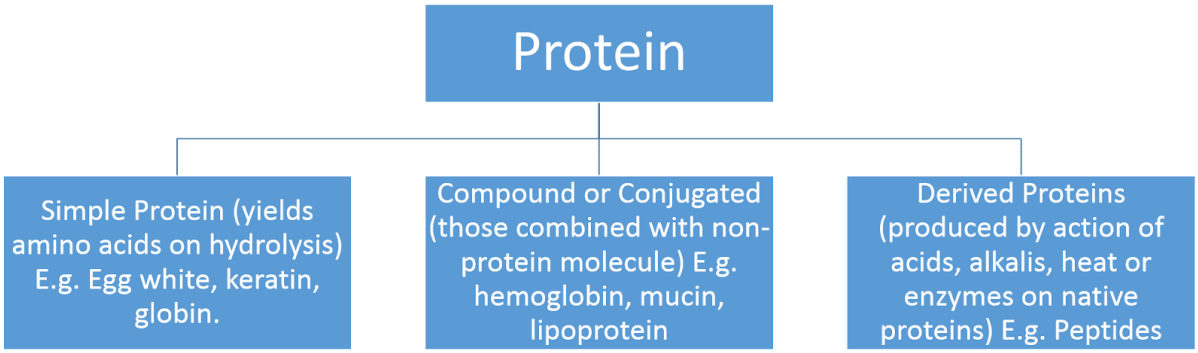
## Classification of Protein

Based on origin:

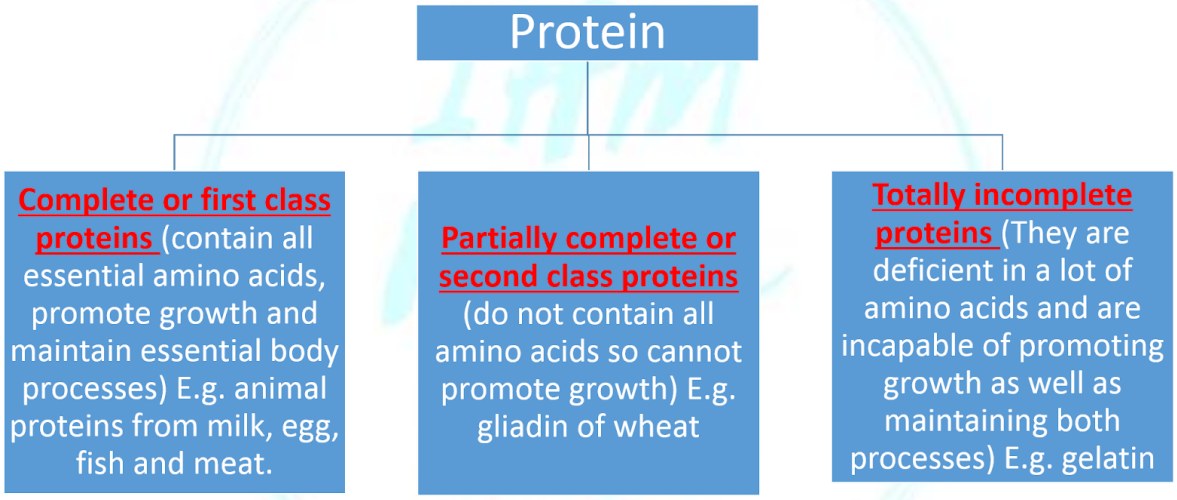


Based on characterization:




Based on Function:




## Dietary Sources of Proteins

Proteins are present in both plant and animal foods.

### *Animal food sources:*

Animal food sources provide the highest quality or complete proteins such as eggs, milk and milk products (cheese, paneer, mawa, milk powder, curds, condensed milk), meat, fish, shellfish, poultry, and organ meat.

*Plant food sources:*

Pulses, especially soya bean (43% protein) and its products such as soya milk textured vegetable proteins: nuts and oilseeds-groundnuts and gingelly seeds are important sources of protein in the Indian diet.

Cereals contain 6-12% partially complete proteins and as they form bulk of the diet, they contribute significantly to the protein content.

Vegetables contain a small percentage of good quality protein (approx 1-3 percent).

Fruits do not contribute to the protein content of the diet.

## Functions of Proteins

Proteins perform three main functions

1. Structural function
2. Regulatory function
3. Energy

### Structural function

*Growth:*

The primary function of food protein is the synthesis of body cells. Proteins are the major constituent of muscles, organs, endocrine glands, and collagen. Collagen is the main structural protein of bones, tendons, ligaments, skin, blood vessels, and connective tissue. All enzymes and some hormones, e.g., insulin is made up of proteins. Proteins are required for the formation and growth of all these substances. During periods of rapid growth, additional proteins are needed for the synthesis of body components.

*Maintenance:*

Protein is required by all age groups for the continuous maintenance of all the cells in the body. Cells have a varying life span and proteins are needed to replace the old or worn-out cells.

## Regulatory function

All amino acids from food protein are used for growth and maintenance. Certain amino acids and proteins have highly specialized functions in the regulation of body process and protection against disease.

Some of the regulatory functions are as follows:

- Haemoglobin, an iron-containing protein in the red blood cells, performs an important role by transporting oxygen to the tissue cells.
- Plasma proteins maintain water balance and regulate the osmotic pressure in the body.
- Antibodies that are proteinaceous perform a protective function by increasing the body's resistance to disease.
- All enzymes and some hormones, e.g. insulin is made up of protein. The hormone insulin regulates blood sugar levels. Enzymes act as specific catalysts to the metabolic processes in the body.
- Some amino acids have specific functions, e.g. tryptophan serves as a precursor for niacin, a complex vitamin. The amino acid tyrosine in combination with iodine forms the hormone thyroxine.

## Energy

Like carbohydrates, proteins also provide 4 kcal/g when broken down in the body. If the diet does not supply adequate calories from carbohydrates and fats, the proteins from the diet will be oxidized to meet the energy needs of the body. Protein is used by the body as a source of energy only when no other source of energy is available.

## Methods of improving protein quality

- Animal protein contains all essential amino acids in correct proportions and amounts and is good quality proteins. Four essential amino acids are in short supply in plant proteins. They are lysine, methionine, threonine, and tryptophan. Proteins in plant foods are generally deficient in one or two essential amino acids. Cereals are poor in lysine and pulses are poor in methionine.
- Protein will be synthesized only when all amino acids, which form the protein, are present simultaneously. Vegetable proteins are partially complete proteins. These two points should be kept in mind while improving the protein quality of a meal.

The protein quality of a mainly vegetarian diet can be improved in the following ways.

- By including a small quantity of complete protein food in every meal. Complete protein foods such as milk, curds, paneer, cheese, buttermilk, and eggs could be used in small quantities in various preparations instead of including it in one meal only, e.g. cereal and milk, egg or cheese sandwiches, French toast, raita, curd rice, or buttermilk at all meals in place of bowl of curd in one meal.
- Correct mixtures of plant foods could provide all essential amino acids in suitable proportions and amounts. Cereal and pulse

combinations will complement each other as cereals provide methionine, which is lacking in pulses, and pulses provide lysine, which is lacking in cereals, when cereal and pulses are consumed together in the same meal, e.g. missie roti, Thalipeeth, Puran Poli, idli, and Rajma Chawal. This is possible because the same amino acids are not missing from all plant foods.

- Synthetic amino acids may be added to processed foods to compensate for the amino acid deficient in them, e.g., lysine enriched bread. Textured vegetable proteins are used successfully to improve protein quality and reduce the cost of protein-rich foods.
- When plant proteins are consumed with a small quantity of animal protein, the quality of the mixture is likely to be as effective as if the only animal protein has been consumed. A good rule while planning menus would be to include some animal proteins at each meal instead of concentrating it all in one meal.

## Whey Protein

- Whey protein is a mixture of proteins isolated from whey, which is the liquid part of milk that separates during cheese production.
- Milk contains two main types of protein: casein (80%) and whey (20%).
- Whey is found in the watery portion of milk. When cheese is produced, the fatty parts of the milk coagulate and the whey is separated from it as a by-product.
- If you've ever opened a yogurt container to see liquid floating on top — that's whey. Cheesemakers used to discard it before they discovered its commercial value.
- After being separated during cheese production, whey goes through various processing steps to become what people

generally recognize as whey protein — a powder that is added to shakes, meal replacements, and protein bars.

- Whey protein doesn't taste very good on its own, which is why it's usually flavoured. Chocolate, vanilla and strawberry-flavoured powders are popular.
- It's important to read the ingredients list, as some products may have unhealthy additives like refined sugar.
- Taking whey protein is a convenient way to add 25–50 grams of protein on top of your daily intake.
- This can be important for bodybuilders and gym enthusiasts, as well as people who need to lose weight or are simply lacking protein in their diet.

## Soy Protein

- Soybeans are among the best sources of plant-based protein.
- The protein content of soybeans ranges from 36 to 56% of the dry weight.
- One cup of boiled soybeans (172 g) contains around 29 grams of protein.
- The nutritional value of soy protein is good, although the quality is not quite as high as animal protein.
- The main types of protein in soybeans are glycinin and conglycinin, which make up approximately 80% of the total protein content. These proteins may trigger allergic reactions in some people.
- Consumption of soy protein has been linked with a modest decrease in cholesterol levels.