

CHEMICAL STRUCTURE OF PEPTIDES, POLYPEPTIDES AND PROTEINS

Proteins consist of amino acids which are characterized by the -
CH(NH₂)COOH substructure.

Nitrogen and two hydrogens comprise the amino group,
-NH₂,

and the acid entity is the carboxyl group,
-COOH.

Amino acids link to each other when the carboxyl group of one molecule reacts with the amino group of another molecule, creating a peptide bond

-C(=O)NH- and releasing a molecule of water (H₂O).


Amino acids are the basic building blocks of enzymes, hormones, proteins, and body tissues.




A **peptide** is a compound consisting of 2 or more amino acids.

Oligopeptides have 10 or fewer amino acids.

Polypeptides and **proteins** are chains of 10 or more amino acids, but peptides consisting of more than 50 amino acids are classified as proteins.







In the animal kingdom, peptides and proteins regulate metabolism and provide structural support.


The cells and the organs of our body are controlled by peptide hormones


Insufficient protein in the diet may prevent the body from producing adequate levels of peptide hormones and structural proteins to sustain normal bodily functions.





Individual amino acids serve as neurotransmitters and modulators of various physiological processes, while proteins catalyze most chemical reactions in the body, regulate gene expression, regulate the immune system, form the major constituents of muscle, and are the main structural elements of cells.



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- Deficiency of good quality protein in the diet may contribute to seemingly unrelated symptoms such as sexual dysfunction, blood pressure problems, fatigue, obesity, diabetes, frequent infections, digestive problems, and bone mass loss leading to osteoporosis.
 - Severe restriction of dietary protein causes kwashiorkor which is a form of malnutrition characterized by loss of muscle mass, growth failure, and decreased immunity.

Types of proteins

- Allergies are generally caused by the effect of foreign proteins on our body.
- Proteins that are ingested are broken down into smaller peptides and amino acids by digestive enzymes called "proteases".
- Allergies to foods may be caused by the inability of the body to digest specific proteins.
- Cooking denatures (inactivates) dietary proteins and facilitates their digestion.
- Allergies or poisoning may also be caused by exposure to proteins that bypass the digestive system by inhalation, absorption through mucous tissues, or injection by bites or stings.
- Spider and snake venoms contain proteins that have a variety of neurotoxic, proteolytic, and hemolytic effects.

Structural Proteins

- Many structures of the body are formed from protein. **Hair** and **nails** are made of **keratins** which are long protein chains containing a high percentage (15%-17%) of the amino acid cysteine. Keratins are also components of animal claws, horns, feathers, scales, and hooves.
- **Collagen** is the most common protein in the body and comprises approximately 20-30% of all body proteins. It is found in tendons, ligaments, and many tissues that serve structural or mechanical functions. Collagen consists of amino acid sequences that coil into a triple helical structure to form very strong fibers. Glycine and proline account for about 50% of the amino acids in collagen.

- **Gelatin** is produced by boiling collagen for a long time until it becomes water soluble and gummy.
- **Tooth enamel** and **bones** consist of a protein matrix (mostly collagen) with dispersed crystals of minerals such as apatite, which is a phosphate of calcium.
- **Muscle** tissue consists of approximately 65% **actin** and **myosin**, which are the contractile proteins that enable muscle movement.
- **Casein** is a nutritive phosphorus-containing protein present in milk. It makes up approximately 80% of the protein in milk and contains all the common amino acids.

Classification

- Proteins may be classified into three main groups according to their shape, solubility and chemical composition.
- **(a) Fibrous proteins**
- Fibrous proteins insoluble animal proteins which are generally very resistant to digestive enzyme breakdown. Fibrous proteins exist as elongated filamentous chains. Examples of fibrous proteins include the collagens (main proteins of connective tissue), elastin (present in elastic tissues such as arteries and tendons), and keratin (present in elastic tissues such as arteries and tendons), and keratin (present in hair, nails, wool and hooves of mammals).

b) Globular proteins

- Globular proteins include all enzymes, antigens and hormone proteins.
- Globular proteins can be further subdivided into albumins (water soluble, heat-coagulable proteins which occur in eggs, milk, blood and many plants); globulins (insoluble or sparingly soluble in water, and present in eggs, milk, and blood, and serve as the main protein reserve in plant seeds); and histones (basic proteins of low molecular weight, water soluble, occur in the cell nucleus associated with deoxyribose).

c) Conjugated proteins

- Conjugated proteins these are proteins which yield non-protein groups as well as amino acids on hydrolysis.
- Examples include the
 - Phosphoproteins (casein of milk, phosvitin of egg yolk),
 - glycoproteins (mucous secretions),
 - Lipoproteins (cell membranes),
 - Chromoproteins (haemoglobin, haemocyanin, cytochrome, flavoproteins), and
 - Nucleoproteins (combination of proteins with nucleic acids present in the cell nucleus).

Protein function

The function of proteins may be summarized as follows:

- To repair worn or wasted tissue (tissue repair and maintenance) and to rebuild new tissue (as new protein and growth).
- Dietary protein may be catabolized as a source of energy, or may serve as a substrate for the formation of tissue carbohydrates or lipids.
- Dietary protein is required within the animal's body for the formation of hormones, enzymes and a wide variety of other biologically important substances such as antibodies and haemoglobin.

Protein requirements

- The study of dietary nutrient requirements in fishes and shrimp has been almost entirely based on studies comparable to those conducted with terrestrial farm animals.
- It follows therefore that almost all the available information on the dietary nutrient requirements of aquaculture species is derived from laboratory based feeding trials; the animals being kept in a controlled environment at high density and having no access to natural food organisms.