

7.1: What are proteins?

Learning Objectives

- Define proteins and understand their classification and the importance of their structure in their functions.

Proteins

Proteins are bio-polymers containing one or more polymer chains composed of amino acid monomers linked together by amide bonds, i.e., proteins are polyamide biochemicals.

Classification of proteins based on their functions

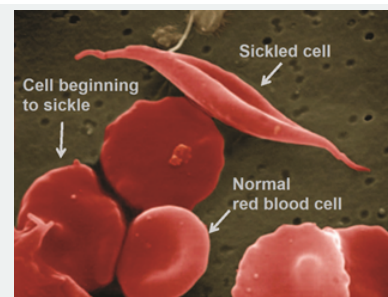
Proteins are considered the most abundant biochemicals that perform various functions in living things. The major types of proteins, classified according to their role in biochemical systems, are the following.

- Structural:** Structural proteins are the primary structural materials in animals. For example, collagen constitutes tendons and cartilage, and keratin comprises hair, skin, wool, and nails.
- Contractile:** These proteins are responsible for movements; e.g., myosin and actin are proteins responsible for the contraction of muscles.
- Transport:** These proteins move the molecules in the body. For example, hemoglobin transports oxygen, and lipoproteins carry lipids.
- Storage:** They store nutrients or essential chemicals, e.g., casein in milk and ovalbumin in eggs store nutrients, and ferritin stores iron in the spleen and liver.
- Hormones:** These proteins regulate metabolism and the nervous system; e.g., insulin regulates blood glucose levels, and growth hormones regulate growth.
- Enzymes:** They catalyze biochemical reactions in the body of living things, e.g., sucrase catalyzes the hydrolysis of sucrose, and digestive enzymes like trypsin catalyze the hydrolysis of proteins.
- Protection:** These proteins protect living things, e.g., antibodies destroy harmful foreign substances, and fibrinogen coagulates blood when needed to avoid blood loss through injuries.

Importance of protein structure

Many proteins are present in living things' bodies to perform different functions. For example, the human body contains about 100,000 different proteins. The structure of proteins, i.e., the exact sequence of amino acids and how they fold and interact with other protein molecules in the physiological environment, is critically important for their functions. For example, hemoglobin in red blood cells is needed to transport oxygen. It comprises more than 800 amino acids arranged in a specific sequence. Sickle cell anemia is caused by a change of one out of more than 800 amino acids in hemoglobin. It causes red blood cells to change from regular rounded shapes to sickle shapes, as shown in the figure to the right, which can not function properly and causes other medical problems.

To understand the proteins, their functions, and their malfunction, it is essential to understand the structure and properties of amino acids and proteins described in the next section. Proteins have levels of structures, i.e., i) primary -the sequence of amino acids, ii) secondary -the folding of sections of the protein chains, iii) tertiary -the overall shape of the protein polymer, and iv) quaternary -a combination of more than one proteins in a unit which is described in a later section.



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