

DEFINITIONS, CLASSIFICATIONS AND THE BIOLOGICAL FUNCTIONS OF AMINO ACIDS

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ABOUT THE STUDY

Amino acids, often referred to as the "building blocks of life" are fundamental molecules that play a central role in the structure and function of living organisms. These versatile compounds serve as the foundation for the creation of proteins, which are essential for the myriad processes that sustain life. This article delves into the definition, classification and examples of amino acids, unraveling their significance in the intricate tapestry of biological molecules.

Definition of amino acids

Amino acids are organic compounds that serve as the basic units of proteins. Structurally, they consist of an amino group (NH_2), a carboxyl group (COOH), a hydrogen atom (H), and a side chain (R group), all attached to a central carbon atom (C_α). The variation in the side chain gives each amino acid its unique identity and properties. The term "amino" reflects the presence of the amino group and "acid" denotes the carboxyl group, which imparts an acidic nature to these molecules. There are 20 standard amino acids commonly found in proteins, each with distinct chemical properties and functions.

Classification of amino acids

Amino acids can be classified based on the properties of their side chains, specifically whether the side chain is nonpolar, polar, or electrically charged. This classification influences their behavior in biological systems.

Nonpolar amino acids: Nonpolar amino acids have hydrophobic side chains, meaning they tend to avoid water and are often found buried within the interior of proteins. Examples include glycine, alanine, valine, leucine and isoleucine. These amino acids contribute to the stability of protein structures by forming hydrophobic interactions.

Polar amino acids: Polar amino acids have hydrophilic side chains, making them water-attracting. Serine, threonine, cysteine, and tyrosine are examples of polar amino acids. They often participate in hydrogen bonding and contribute to the solubility of proteins in aqueous environments.

Positively charged (basic) amino acids: Amino acids with positively charged side chains are basic in nature and often interact with negatively charged molecules. Examples include lysine, arginine and histidine. These amino acids are crucial for enzyme catalysis and the stabilization of certain protein structures.

Negatively charged amino acids: Amino acids with negatively charged side chains are acidic and can form salt bridges with positively charged molecules. Aspartic acid and glutamic acid are examples of acidic amino acids. They play roles in enzyme catalysis and protein-protein interactions.

Essential and non-essential amino acids

Amino acids are further categorized based on whether they are essential or non-essential for the human body.

Essential amino acids: Essential amino acids are those that the body cannot synthesize on its own, and thus, they must be obtained from the diet. Examples include leucine, isoleucine, valine, lysine, methionine, threonine, tryptophan, phenylalanine and histidine. These amino acids are crucial for protein synthesis and overall health.

Non-Essential amino acids: Non-essential amino acids can be synthesized within the body, and dietary intake is not necessarily required. Examples include alanine, asparagine, aspartic acid, cysteine, glutamine, glutamic acid, glycine, proline, serine, and tyrosine. While non-essential, their availability impacts various physiological processes.

Biological functions of amino acids

Amino acids are the foundation of proteins, and proteins, in turn, are involved in virtually every aspect of cellular structure and function. The biological functions of amino acids extend beyond protein synthesis.

Protein synthesis: Amino acids are linked together through peptide bonds to form polypeptide chains, which ultimately fold into functional proteins. The sequence of amino acids in a protein dictates its unique structure and function.

Enzyme catalysis: Many enzymes, which are biological catalysts are proteins composed of amino acids. The specific arrangement of amino acids in the active site of enzymes allows them to facilitate and accelerate chemical reactions in living organisms.

Cellular signaling: Some amino acids, such as tyrosine, serve as precursors for signaling molecules like neurotransmitters and hormones. For example, dopamine and epinephrine are derived from tyrosine and play crucial roles in neuronal signaling and the stress response.

Immune response: Amino acids contribute to the synthesis of immune-related molecules, such as antibodies. These molecules play a key role in the immune system's ability to recognize and neutralize pathogens.

Metabolism and energy production: Amino acids can be converted into energy through various metabolic pathways. During times of energy deficiency, amino acids can be catabolized to generate ATP, the primary energy currency of cells.

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