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AMINO ACIDS

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ABSTRACT

This article provides a comprehensive analysis of the chemical structure, classification, and biological functions of amino acids, the fundamental building blocks of proteins. The study examines the mechanisms of peptide bond formation and the unique properties of amino acids determined by their variable side chains (R-groups). Furthermore, the paper highlights the metabolic significance of essential and non-essential amino acids in the human body, the pathological conditions arising from their deficiencies, and their diagnostic importance in modern medicine. The findings demonstrate that maintaining amino acid balance is crucial not only for physical development but also for the regulation of hormonal and neurochemical processes.

Keywords

amino acids, peptide bond, metabolism, protein biosynthesis, R-groups, enzymatic activity.

INTRODUCTION:

Among the substances that form the molecular basis of life, amino acids hold a unique position. They are not only the structural building blocks of proteins but also regulators of all metabolic processes within the organism. Almost all hormones, enzymes, and immune system cells in the human body are composed of specific sequences of amino acids. With the advancement of modern medicine and molecular biology, studying the role of amino acids in transmitting genetic information and the diseases resulting from their deficiency has become a pressing issue. This article provides an in-depth analysis of the chemical properties of amino acids and their significance in clinical medicine.

MATERIALS AND METHODS:

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This research work is based on theoretical analyses focused on studying the biological and chemical properties of amino acids. Scientific publications from the last decade, molecular biology textbooks, and international articles from databases such as PubMed, Google Scholar, and Scopus were used as research materials. During the study, comparative-analytical, systematic approach, and inductive logic methods were employed. The classification of amino acids and their metabolic pathways were examined based on the principles of biochemical modeling.

RESULTS:

As a result of the study, the multifunctional roles of amino acids in the human body were identified in the following areas:

1. **Structural Analysis:** The formation of polypeptide chains through peptide bonds determines the primary structure of proteins. The chemical diversity of R-groups (hydrophobic, hydrophilic, charged) was confirmed as the key factor in shaping the spatial configuration of proteins.

2. **Metabolic Significance:** Out of 20 standard amino acids, 9 (valine, leucine, isoleucine, etc.) were categorized as essential; their deficiency leads to the cessation of protein biosynthesis and a decline in immune function.

3. **Biochemical Catalysis:** It was observed that functional groups within amino acids allow enzymes' active sites to bind with substrates and accelerate chemical reactions by 10^6 to 10^{12} times.

DISCUSSION:

The research results indicate that amino acids are not merely "building blocks" but hold a central position in maintaining the body's homeostasis. Specifically, the chemical diversity of R-groups enables proteins to form complex configurations, allowing them to perform specific biological functions (e.g., oxygen transport or hormonal signaling).

From a clinical perspective, a deficiency in essential amino acids is directly linked to growth retardation in children and a decline in cognitive functions in adults. For instance, a deficiency in Tryptophan negatively impacts the synthesis of the hormone serotonin, leading to insomnia and depressive states. Furthermore, in modern nanomedicine, amino acid-based biosensors are yielding revolutionary results in the early detection of diseases. This confirms that an in-depth study of amino acid metabolism is a priority not only for theoretical biology but also for practical healthcare.

CONCLUSION:

The conducted studies demonstrate that amino acids are the molecular foundation of life, performing multifaceted roles within biological systems. The radical groups (R-groups) of amino acids are the essential elements that ensure the specific conformation and functional activity of proteins. As analyzed in this paper, the polypeptide chains formed through peptide bonds guarantee the stability of vital processes. Furthermore, it was identified that disturbances in amino acid balance during metabolism lead to serious pathological conditions. In conclusion, a profound understanding of amino acid biochemistry is of fundamental importance in developing

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modern diagnostics and effective treatment methods. Future research should focus on further expanding the study of amino acids' potential within genetic engineering and nanomedicine.

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