

ENZYMES AND THEIR ROLE IN LIVING ORGANISMS

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Abstract. *This scientific article discusses the biological significance of enzymes, their functions in living organisms, and their role in metabolic processes. Enzymes are of great importance as biological catalysts that accelerate biochemical reactions occurring in the organism. The article provides detailed information about the structure, properties, classification, mechanism of action, and application of enzymes in medicine, the food industry, and biotechnology. In addition, scientific analyses are presented regarding the role of enzymes in maintaining human health and diseases associated with enzyme deficiency.*

Keywords: *enzyme, biological catalyst, protein, metabolism, biochemical reaction, enzymatic activity, metabolic process, substrate, active site, enzymology.*

Introduction

All vital processes occurring in living organisms are carried out on the basis of complex biochemical reactions. These reactions are necessary for the normal functioning of the organism and take place continuously in cells. However, most biochemical reactions proceed very slowly under ordinary conditions or may not occur at all. Therefore, living organisms contain special biological catalysts — enzymes — which increase the rate of reactions by thousands or even millions of times.

Enzymes are complex organic substances that are mainly protein in nature. They are formed in living cells and play an important role in regulating metabolic processes. By participating in reactions, enzymes reduce the activation energy of the reaction and thereby increase its rate. For this reason, enzymes are considered one of the essential biological substances for the life of all living organisms [1].

The science that studies enzymes is called enzymology. Today, enzymology remains one of the important scientific fields in biology, medicine, pharmacy, and biotechnology. With the help of enzymes, many practical processes are carried out, such as the production of food products, preparation of medicines, diagnosis and treatment of diseases.

Enzymes are biological catalysts that regulate all chemical reactions in living organisms.

They are synthesized in cells and act on specific substrates with a high degree of selectivity. Each enzyme catalyzes a specific reaction. Therefore, enzymes possess high specificity [2].

Most enzymes consist of proteins, while some enzymes also contain additional components — cofactors or coenzymes. Cofactors may consist of metal ions, such as iron, magnesium, zinc, and copper ions. Coenzymes, on the other hand, are derivatives of vitamins.

Enzymes have the following main properties:

1. High catalytic activity.
2. Specificity.
3. Sensitivity to temperature and environmental pH.
4. Remaining unchanged at the end of the reaction.
5. Strong effect even in small amounts.

The names of enzymes are usually determined according to the substrate they catalyze or the type of reaction. Most enzyme names end with the suffix “-ase”. For example, lactase, amylase, lipase, and protease.

The International Union of Biochemistry classifies enzymes into six main classes according to the type of reactions they catalyze:

1. **Oxidoreductases.** These enzymes catalyze oxidation-reduction reactions. Examples include dehydrogenase and oxidase enzymes.
2. **Transferases.** These enzymes transfer functional groups from one molecule to another.
3. **Hydrolases.** These enzymes break down complex substances with the help of water. For example, lipase breaks down fats, while amylase breaks down starch.
4. **Lyases.** These enzymes break chemical bonds without hydrolysis or form new bonds.
5. **Isomerases.** These enzymes form isomeric forms of molecules.
6. **Ligases.** These enzymes participate in the synthesis of complex compounds and use ATP energy [3].

This classification of enzymes is of great importance in studying their biological functions.

Enzymes have a complex three-dimensional structure, and their functional part is called the active site. The active site is the region where the substrate binds, and the chemical reaction takes place exactly in this area.

The interaction between enzyme and substrate is explained by the “lock and key” model.

According to this theory, the active site of an enzyme corresponds only to a specific substrate.

The Role of Enzymes in Living Organisms

Enzymes play an important role at all stages of an organism’s life activity. They participate in metabolism, energy production, respiration, digestion, cell division, and immune system function.

1. Role in the digestive process

In the digestive system, enzymes break down nutrients into simple compounds. For example:

- Amylase breaks down starch into glucose.
- Pepsin breaks down proteins into amino acids.
- Lipase breaks down fats into glycerol and fatty acids.

If these enzymes are deficient in the organism, digestive processes are disrupted.

2. Role in energy metabolism

Energy production in cells cannot occur without enzymes. Many enzymes participate in glycolysis, the Krebs cycle, and oxidative phosphorylation.

3. Role in respiration

Enzymes in the respiratory chain ensure the production of energy with the help of oxygen.

4. Role in the immune system

Some enzymes protect the organism from harmful microorganisms. For example, the enzyme lysozyme breaks down the cell wall of bacteria.

5. Role in genetic processes

The synthesis of DNA and RNA also occurs with the help of enzymes. DNA polymerase and RNA polymerase enzymes play an important role in the transmission of hereditary information [4].

In modern medicine, enzymes are widely used. Enzymes are important tools in diagnosis and treatment.

Role in Diagnosis

The amount of certain enzymes in the blood helps to identify diseases. For example:

- ALT and AST enzymes are used to assess liver function.
- Amylase is used to diagnose pancreatitis.
- Creatine phosphokinase is used in the diagnosis of heart diseases.

Role in Treatment

Enzyme preparations are used in diseases of the digestive system. For example, the drug pancreatin is recommended in cases of pancreatic insufficiency [5].

Conclusion

Enzymes are biological catalysts necessary for the normal life activity of living organisms.

They accelerate all biochemical reactions occurring in the organism and ensure the balance of metabolic processes. Enzymes have high specificity and act on certain substrates. Their activity depends on temperature, pH, and other factors.

The importance of enzymes in biology and medicine is very great. They are widely used in disease diagnosis, treatment, food production, and biotechnological processes. As a result of the development of modern science and technology, new properties of enzymes are being studied, and the scope of their practical application is expanding.

Therefore, the in-depth study of enzymes is considered one of the important scientific directions for the development of biology, medicine, and biotechnology.

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