ENZYMES: DEFINITION, STRUCTURE, FUNCTION AND EXAMPLES

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1. Introduction

For living cells to function efficiently and effectively, bodies contain enzymes that accelerate biochemical reactions necessary in life processes. Life processes include nutrition, reproduction, respiration, excretion, locomotion (movement), irritability (sensitivity), and growth. They are vital for body energy, health, building, and maintenance for survival and perpetuation.

Enzymes are biological polymers that catalyze biochemical reactions in cells (www.toppr.com). They hasten metabolic reactions. Their catalytic function enables critical life processes in body cells. They help speed up conversion of substrates into metabolic products.

Enzymes are essential substances without which life cycles would not be completed. Subsequent sections substantiate this statement of vitality of enzymes through critical analysis of their structure and functions with emphasis on the specificity characteristic of enzymes.

2. Definition, Structure and Function of Enzymes

2.1. Definition of Enzyme

Enzymes are biological catalysts (www.byjus.com). Catalysts are substances which enhance the speed of chemical reactions and remain unchanged at the end of reactions. An enzyme is a proteinous substance which accelerates the rate of biochemical reactions in body living cells and remains unchanged in quantity, structure, and composition at the end of the reaction.

2.2. Structure of Enzymes

Enzymes are made up of amino acids linked in characteristic fashion by non-protein components known as co-factors. It is a linear chain of amino acids that gives rise to a three-dimensional specific structure (www.ncbi.nim.gov). The structure imparts specificity of the enzyme's activity. Only sections situated next to binding sites are involved in catalysis.

The catalytic and binding sites together make up the enzyme's active site. High temperature and/or extreme pH can denature the enzyme. Such conditions change the enzyme's shape, which in turn alters shapes of active sites. It impends substrates from binding to it, losing enzyme activity.

The structure of enzymes contains co-factors, which include i) cations that form loose bonds with active sites; ii) coenzymes that bond with enzymes only during catalysis; and iii) prosthetic groups that, tightly, bond with enzymes at all times (www.toppr.com).

2.3. Function of Enzymes

Enzymes are involved in all life processes to facilitate breathing, building muscles, nerve functions and excretion. They are extremely specific to substrates. The exact structure and active sites decide on specificity for substrate molecules.

The catalytic reactants don't undergo chemical change with ease due to energy barriers, which require extra energy to overcome in order to reach the transition state. This extra energy is called Activation Energy, which the enzyme provides. The enzyme, thus, helps reduce activation energy of substrate molecules to carry forward the reaction.

2.3.1 Mode of Enzyme Reaction

The basic mechanism begins with binding of the substrate to the active site. Thus, enzymes offer hollow spaces where catalytic reactions take place. The substrate with opposite charge fits into binding spaces in the manner the key fits into the lock, *the lock and key hypothesis*.

The active sites are of definite shapes and functional groups to which substrate molecules bind to form an enzyme-substrate complexes (intermediates). The intermediate reacts with the second substrate to form the product. Then, the enzyme detaches from the product. The enzyme remains unchanged in quantity, structure and composition ready to offer the same active sites for other substrates for the catalytic cycle to continue until the reaction is completed.

. When active sites and substrates are not exact fits, *induced fit hypothesis* applies to enable catalytic reactions (www.byjus.com). The active site changes shape as it gets closer to the substrate, enabling the substrate to fit exactly into the site. Once fully locked into the exact position, catalysis begins.

2.3.2. Critical Function of Enzymes

Enzymes are analogous to field surfaces in sports arena where players (substrates) face each other in the match (reaction). Specificity of an enzyme may be akin to specific disciplines in sports whereby disciplines are substrates while sports are life processes. Prosthetic co-factors are, tightly, tied to enzymes to, maybe, demarcate borders of playing surfaces. Cations act as portable goal posts while coenzymes act as referees who only come to control the match (reaction) and leave. Without enzymes, there would be no playgrounds for body cell metabolic reactions.

2.4. Examples of Enzymes

Examples of enzymes are common in beverage and food industries where enzymes in yeast aid fermentation of sugars. Fermentation gives texture and taste to products. Nutrition is critical for body building, maintenance and health. It provides specific substrates that correspond with types of enzymes in the digestive system. The digestive system provides examples of enzymes with specificity to food types (substrates). It originates in the mouth and stretches through oesophagus, stomach, small intestines, large intestines, and ends with rectum.

Other vital organs that support digestion include teeth (chewing), tongue (mixing), salivary glands (salivary amylase production), liver (bile production), and pancreas (production of carbohydrases, proteases and lipases).

Digestive enzymes are carbohydrases for catalysis of carbohydrates; proteases for catalysis of proteins and lipases for catalysis of fats & oils. Salivary amylase (ptyalin) catalyzes starch (substrate 1) into maltose (intermediate). Then, maltase catalyzes maltose into glucose (product).

Catalysis of proteins and fats & oils happens in the stomach and small intestines. Proteases catalyze proteins into intermediates and into amino acids. Pepsin catalyzes proteins into peptides, which trypsin catalyzes into amino acids. But milk sugar is catalyzed into lactose, which lactase catalyzes into galactose & glucose. Lipases catalyze fats & oils into fatty acids and glycerol.

3. Conclusion

Enzymes are essential catalysts in metabolic reactions without which life cycles in organisms cannot be completed. They offer active sites for catalysis of body cell biochemical reactions. Enzymes display extreme specificity on substrates to respect borders of active sites, controlled by prosthetic co-factors. This characteristic is enhanced by cations and coenzymes which operate like goal posts and referees in catalysis respectively. Enzymes are proteins and run the risk of being denatured under high temperatures and extreme pH levels.

Sources

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