**Enzymes: Definition, Examples, Functions, and Structure**

Name

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**Introduction**

Notably, chemical reactions constitute an essential aspect of the various biological processes that support the lives of animals and plants. Accordingly, researchers have established that biochemical reactions in living organisms require catalysts to initiate and sustain life processes. In this regard, the concept of enzymes emerged in modern biology and medicine to understand and interpret the functions of different biochemical processes in living organisms. Enzymes are a class of proteins that play a crucial role in cellular metabolism by effectively reducing the activation energy (Ea) required for catalyzing chemical reactions involving biomolecules. Certain enzymes can significantly decrease the activation energy required for cellular reactions to the extent that they can effectively reverse them. Enzymes facilitate chemical processes without undergoing any alteration, analogous to the process of energy oxidation upon utilization. The paper critically evaluates enzymes, pondering their functions and structural differences.

**Discussion**

According to Tyzack et al. (2017), enzymes, which serve as biological catalysts, exhibit a remarkable degree of specificity by facilitating a singular chemical reaction or a set of closely related reactions. The particular nature of an enzyme is determined by its precise structure and the characteristics of its active site. In a similar dimension, Copeland (2023) asserts that substrate molecules bind to the active region of an enzyme. At the outset, substrates form associations with enzymes through noncovalent reactions, encompassing ionic, hydrogen bonding, and hydrophobic interactions. As such, Tyzack et al. (2017) affirm that enzymes expedite the progression toward equilibrium by reducing the biochemical processes and activation energy more effectively than non-catalyzed reactions. Prokaryotic as well as eukaryotic cells commonly employ allosteric regulation as a mechanism to respond to internal cellular fluctuations effectively.

**Examples of Enzymes**

In the past, enzymes were designated with names corresponding to the individuals responsible for their discovery. Through additional research, the classification process has evolved to become more comprehensive.

Enzymes are categorized into six distinct functional categories, as the International Union of Biochemists (IUB) outlines. This classification system is based on the specific type of reaction that enzymes facilitate through catalysis. As such, Chapman et al. (2018) found six distinct categories of enzymes: oxidoreductases, hydrolases, transferases, lyases, ligases, and isomerases. Prokaryotic and eukaryotic cells commonly employ allosteric regulation to respond to changes in intracellular condit*i*ons effectively.

**Oxidoreductases**

Oxidoreductases represent a category of enzymes responsible for facilitating oxidoreduction processes. Oxidoreductases facilitate the electron transfer process from a specific molecule, known as the oxidant, to a separate molecule, referred to as the reductant. As such, the enzymes facilitate reactions that resemble the formula: A– + B → A + B–, wherein A represents the oxidizing agent, and B denotes the reducing agent (Farhadi et al., 2017). Oxidoreductases encompass two distinct enzymatic classes, namely oxidases and dehydrogenases. Oxidases are a class of enzymes that participate in redox reactions where molecular oxygen serves as the terminal electron acceptor, either for hydrogen or electrons. Dehydrating enzymes are a class of proteins that facilitate the oxidation of a substrate through the transfer of hydrogen ions to the recipient, which can be a flavin enzyme or a NAD+/NADP+ (Lei et al., 2017). Additional examples of oxidoreductases encompass oxygenases, hydroxylases, and reductases, peroxidases. The latter are typically found within peroxisomes, facilitating the enzymatic reduction of hydrogen peroxide. Oxygenases are enzymes that facilitate the incorporation of oxygen derived from oxygen molecules into the substrates of organic matter. Reductases are enzymes that facilitate reduction reactions. In a majority of instances, reductases possess the ability to function as oxidases.

**Transferases**

Transferases exist as a class of enzymes that facilitate the movement of specific functional categories from one molecular structure to a different molecule through catalytic activity (Bhatia & Bhatia, 2018). One illustrative instance involves acyl transferases, which serve as catalysts for the movement of acyl groups. Another example involves peptidyl transferase. During protein biosynthesis, an enzyme facilitates the movement of amino from the transfer RNA (tRNA) compounds from one region to another. Transferases catalyze the nucleophilic substitution process responsible for moving functional compounds such as methyl, glycosyl, acyl, hydroxymethyl, phosphate, sulfate, formal, and alkyl (Tyzack et al., 2017). They have minimal utility in manufacturing. Glycosyltransferases are utilized to produce oligosaccharides, a typical commercial application of transferases. Cellular identification and communication rely heavily on oligosaccharides and polysaccharides, two naturally occurring molecules. The use of glucokinase constitutes another case in point.

**Hydrolase**

Hydrolases are a class of enzymes that function as biochemical catalysts, utilizing water to cleave chemical bonds, thereby facilitating the fragmentation of larger molecules into smaller ones (Chapman et al., 2018). Several examples of hydrolase enzymes commonly found in biological systems include esterases, such as lipases, glycosidases, nucleosidases, phosphatases, and peptidases.

Esterases catalyze the hydrolysis of ester bonds present in lipids, while phosphatases catalyze the removal of phosphate groups from molecules (Farhadi et al., 2017). One instance of a pivotal esterase involves acetylcholine esterase, which converts the neuronal impulse into the acetate group after the hydrolysis of the neurotransmitter into acetic and choline acid by the hydrolase. Acetic acid holds significant metabolic importance within the human body, serving as a vital intermediary for various biochemical reactions, including glycolysis (Lei et al., 2016). Lipases refer to enzymes that catalyze the hydrolysis of glycerides. Glycosidases are proteins that catalyze the cleavage of sugar molecules from carbohydrates, while peptidases are enzymes that facilitate the hydrolysis of peptide bonds. Nucleosidases are enzymes that catalyze the hydrolysis of nucleotide bonds.

Bhatia and Bhatia (2018) believe hydrolase enzymes play a crucial role in the human body due to their inherent degradative properties. Lipases play a significant role in the hydrolysis of lipids, facilitating the conversion of complex molecules such as fats, lipoproteins, and other macromolecules into simpler constituents, namely glycerol and fatty acids. Moreover, fatty acids and various other tiny molecules are utilized in biological systems for synthesis and as a means of energy production.

Other examples of enzymes include cofactors, ligases, isomerases, and lyases. Cofactors involve non-proteinous substances that often react with enzymes. Isomerases are known to catalyze the process of isomer compound formation. For instance, phosphoglucomutase speeds up the reactions that lead to the formation of glucose phosphates.

**Examples of real-life application**

Enzymes have a significant influence on various aspects of daily life. An illustration of this can be seen in the utilization of enzymes within laundry detergents, which aid in the degradation of proteins responsible for staining alongside the inclusion of lipases that facilitate the dissolution of fatty stains (Copeland, 2023). Cryotolerant and thermotolerant enzymes exhibit functionality within extreme temperature ranges, rendering them valuable for industrial applications necessitating high temperatures or bioremediation procedures that transpire in harsh environments, such as the Arctic.

Enzymes play a crucial role in the food and beverage industry by facilitating the conversion of starch into sugar, thereby enabling the production of sweeteners derived from alternative sources besides sugarcane. Enzymes play a crucial role in the clothing industry by mitigating impurities in cotton and minimizing the reliance on potentially hazardous chemicals employed in the leather treatment procedure (Tyzack et al., 2017). In addition, the plastics industry persistently explores strategies for leveraging enzymes to develop renewable materials.

**Structures of Enzymes**

Enzymes consist of a polypeptide chain composed of amino acids, which ultimately adopt a three-dimensional conformation. The arrangement of amino acids determines the conformation, which subsequently determines the enzyme's catalytic function (Bhatia & Bhatia, 2018). When subjected to elevated temperatures, the enzyme undergoes structural denaturation, leading to a decline in enzymatic activity, a phenomenon commonly linked to changes in temperature.

Enzymes, in comparison to their substrates, generally exhibit a larger size, displaying a range of dimensions from sixty-two residues of ammonia to an average of Two thousand five hundred residues, as observed in the case of fatty acid synthase (Chapman et al., 2018). The catalytic process primarily involves a limited portion of the structure located close to the binding regions. A digestive enzyme's active region comprises both the site of catalytic activity and the binding site (Farhadi et al., 2017). A limited quantity of ribozymes are present that function as RNA-dependent enzymatic catalysts in biological systems. It forms complex interactions with proteins.

Ina recent study, Copeland (2023) maintains that enzymes consist of numerous amino compounds that are interconnected in a specific manner, resulting in diverse enzyme structures. Enzyme chains undergo a process of folding, forming distinct shapes that confer upon the enzyme's distinctive chemical characteristics. Enzymes typically possess a cofactor, which is a non-protein constituent.

**Conclusion**

Enzymes are protein molecules composed of amino acids covalently bonded in one or several polypeptide chain structures. "primary structure" refers to the specific arrangement of amino acids within a polypeptide chain. Consequently, this factor plays a crucial role in determining the enzyme's three-dimensional conformation, which encompasses the configuration of its active site. The classification of enzymes encompasses six primary categories, namely oxidoreductases, hydrolases, transferases, lyases, ligases, and isomerases. Each category performs a broad range of reactions yet catalyzes numerous distinct reactions within its respective category. Typically, these enzymes exhibit high specificity, selectively binding particular substrates to facilitate specific biochemical reactions. Enzymes play a crucial role in expediting metabolic reactions, as their absence would significantly prolong the duration of these reactions, rendering them insufficiently rapid to support the sustenance of life. Hence, enzymes exhibit distinct characteristics, encompassing specific functionalities and molecular configurations.

**References**

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