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RESEARCH ARTICLE

ROLE OF ENZYMES

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INTRODUCTION

Enzymes are proteins with highly specialized catalytic functions, produced by all living organisms. Enzymes are responsible for many essential biochemical reactions in microorganisms, plants, animals, and human beings. Although like all other proteins, enzymes are composed of proteins formed by long linear chains of amino acids linked by peptide bonds, but they differ in function in that they have the unique ability to facilitate biochemical reactions without undergoing change themselves. Enzymes are essential for all metabolic processes, but are not alive. They are produced by cells, but they are not viruses or bacteria and they cannot reproduce by themselves; they are therefore "alive" even though not biologically active, in determined conditions of pH, temperature, liquor composition and so on.

Naming Of Enzyme

The first Enzyme Commission, in its report in 1961, devised a system for classification of enzymes that also serves as a basis for assigning code numbers to them.

These code numbers, prefixed by EC, which are now widely in use, contain four elements separated by points, with the following meaning
(i) The first number shows to which of the
six main divisions (classes) the enzyme belongs,
(ii) The second figure indicates the subclass,
(iii) The third figure gives the sub-subclass,
(iv) The fourth figure is the serial number of the enzyme in its sub-subclass.

The subclasses and sub-subclasses are formed according to principles. By adding a suffix "-ase" to the root name of the substrate molecule it is acting upon enzymes are commonly named.

Some Of The Enzymes Used In Industrial Processes

1. Class- Oxidoreductases
Enzymes- catalases, glucose oxidases, laccases
2. Class- Transferases
Enzymes- Fructosyl transferases, glucosyl transferases
3. Class- Hydrolases
Enzymes- amylases, cellulases, lipases, mannanases, pectinases, phytases, proteases, pullulanases, xylanases
4. Class- Lyases
Enzymes- Pectate lyases, Alpha- acetolactate decarboxylases
5. Class- Isomerases
Enzymes- Glucose Isomerases

ENZYME COMPOSITION

Cofactors
Coenzymes
Enzyme Inhibitors
Active site and substrate

Cofactors

The activity of an enzyme depends on a specific protein chain. In many cases, the enzyme consists of the protein and a combination of one or more parts called cofactors. Some enzymes do not need any additional components to show full activity. However, others require non-protein molecules called cofactors to be bound for activity.

Cofactors can be either inorganic e.g., metal ions or organic compounds e.g., flavin. These molecules transfer chemical groups between enzymes. These tightly bound molecules are usually found in the active site and are involved in catalysis.

Coenzyme

Coenzymes are small organic molecules that can be loosely or tightly bound to an enzyme. Coenzymes transport chemical groups from one enzyme to another. Since coenzymes are chemically changed as a consequence of enzyme action, it is useful to consider coenzymes to be a special class of substrates, or second substrates, which are common to many different enzymes. Coenzymes are habitually continuously regenerated and their concentrations maintained at a steady level inside the cell.

Enzyme Inhibitors

Enzyme reaction rates can be decreased by various types of enzyme inhibitors. Enzyme inhibitors are molecules that interact in some way with the enzyme to prevent it from working in the normal manner. Some of the inhibitors types are as follows: Nonspecific Inhibitors, Specific Inhibitors, Competitive Inhibitors, Non competitive Inhibitors, Irreversible Inhibitors.

Example for an inhibitor, Methanol poisoning occurs because methanol is oxidized to formaldehyde and formic acid which harass the optic nerve causing blindness. Ethanol is given as a remedy for methanol poisoning because ethanol competitively

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inhibits the oxidation of methanol. Ethanol is oxidized in preference to methanol and consequently, the oxidation of methanol is slowed down so that the toxic by-products do not have a chance to accumulate.

Active Site and Substrate

The overall enzyme contains a specific geometric shape called the **active site**, where the reaction takes place. The molecule acted upon is called the substrate.

Enzyme Mechanism

Enzymes are natural protein molecules. The fundamental mechanism by which enzymes catalyze chemical reaction begins with the binding of the substrate to the active site on the enzyme. The active site is the specific region of the enzyme which combines with the substrate. The binding of the substrate to the enzyme causes changes in the distribution of electrons in the chemical bonds of the substrate and ultimately causes the reactions that lead to the formation of products. The products are released from the enzyme surface to regenerate the enzyme for another reaction cycle.

The active site has a unique geometric shape that is complementary to the geometric shape of a substrate molecule, similar to the fit of puzzle pieces. This means that enzymes specifically react with only one or a very few similar compounds. Some mechanism of enzyme is explained below:

Lock and Key Theory

The precise action of an enzyme was first postulated in 1894 by Emil Fischer among a single substrate can be explained using a Lock and Key analogy. In this analogy, the lock is the enzyme and the key is the substrate. The correct substrate fits for the active site (key hole) of the enzyme. Only the correctly sized key (substrate) fits into the key hole (active site) of the lock (enzyme).

Smaller keys, larger keys, or incorrectly positioned teeth on keys (incorrectly shaped or sized substrate molecules) do not fit into the lock (enzyme). Only the correctly shaped key opens a particular lock. This is illustrated in graphic on the left.

Induced Fit Theory

Not all experimental evidence can be adequately explained by using the lock and key theory. For this reason, a modification called the induced-fit theory has been proposed.

The induced-fit theory assumes that the substrate plays a role in determining the final shape of the enzyme and that the enzyme is partially flexible. It explains why certain compounds can bind to the enzyme but do not react because the enzyme has been distorted too much. Other molecules may be too small to induce the proper alignment and therefore cannot react. Only the proper substrate is accomplished of inducing the proper alignment of the active site.

Enzyme Uses

Enzymes play a diversified role in many aspects of everyday life including aiding in digestion, the production of food and several industrial applications. Enzymes are nature's catalyst. Humankind has used them for thousands of years to carry out important chemical reactions for making products such as cheese, beer, and wine. Bread and yogurt also owe their flavor and texture to a range of enzyme producing organisms that were domesticated many years ago.

Types of Enzyme Available

Enzymes are categorized according to the compounds they act upon. Some of the most common include; proteases which break down proteins, cellulases which break down cellulose, lipases which split fats (lipids) into glycerol and fatty acids, and amylases which break down starch into simple sugars.

Functions of Enzyme

They work to make reactions go faster in digestive and metabolic (energy related) processes. They are called 'catalysts' because they speed up the reaction by lowering the amount of energy needed to get the reaction started.

Enzymes basically just facilitate a reaction. Enzymes are proteins with "active sites" (areas on which reactions can occur). Enzymes bring substrates (reactants) together onto the active sites in order to help them react. The enzyme is not used up in the reaction and can be used continuously for many reactions.

Enzymes are used to lower the "activation energy" of a reaction (amount of energy required to start a reaction).

Amylase breaks down starch into glucose (sugar).

Protease breaks down protein into amino acid.

Lipase breaks lipids down into fatty acids and Glycerol.

Application of Enzyme in Textile Wet Processing/ Dyeing Industry

Enzyme is a living organism. Humankind has used enzymes for thousands of years to carry out important chemical reactions for making products such as cheese, beer, and wine. Bread and yogurt also owe their flavor and texture to a range of enzyme producing organisms that were domesticated many years ago.

From the beginning of nineties till today, the biggest development of modern enzymology is made in the textile segment with the introduction of:

Cellulase for bio-finishing cellulosic fabrics and garments,
Catalase for elimination of hydrogen peroxide after bleaching,
Amylase for desizing processes,
Pectinase for bioscouring of raw cotton,
Protease for the treatment of wool and silk
Laccase for oxidation of dyes such as indigo

Other Industrial Applications

Enzymes are used in the chemical industry and other industrial applications when extremely specific catalysts are required. However, enzymes in general are limited in the number of reactions they have evolved to catalyze and also by their lack of stability in organic solvents and at high temperatures. The efforts have begun to be successful, and a few enzymes have now been designed "from scratch" to catalyze reactions that do not occur in nature.

Example: In paper industry amylases, Xylanases, Cellulases and ligninases were used for degrade of starch to lower viscosity, aiding sizing and coating paper. Xylanases reduces the bleach required for decolorizing; cellulases smooth fibers, enhance water drainage, and promote ink removal; lipases reduce pitch and lignin-degrading enzymes remove lignin to soften paper.

Catalase is also used in the textile industry, removing hydrogen peroxide from fabrics to make sure the material is peroxide-free.

A biological detergent is a laundry detergent that contains enzymes harvested from micro-organisms such as bacteria adapted to live in hot springs. The enzymes in biological detergents enable effective cleaning at lower temperatures than required by normal detergents, but are denatured at higher temperatures—about 50 °C is recommended. A biological detergent can contain α-amylase, a cellulase, a protease and a lipase.

Industrial Enzymes and the Environment

Enzymes can often replace chemicals or processes that present safety or environmental issues. For example, enzymes can:

Replace acids in the starch processing industry and alkalis or oxidizing agents in fabric desizing
In tanneries reduce the use of sulfide
Replace pumice stones for stonewashing jeans

Allow for more complete digestion of animal feed leading to less animal waste Remove stains from fabrics.

Clothes can be washed at lower temperatures, thus saving energy.

In starch, paper and textile processing, less hazardous chemicals only required if enzymes are used.

Enzymes can be used instead of chlorine bleach for removing stains on cloth. The use of enzymes also allows the level of surfactants to be reduced and permits the cleaning of clothes in the absence of phosphates.

CONCLUSION

Enzyme is a highly efficient catalyst in biochemical reactions. It not only works efficiently and rapidly, they are also biodegradable. They are highly efficient in increasing the reaction rate of biochemical process otherwise it proceed very slowly, or in some cases, not at all. This type of catalytic capability makes enzymes unique. Enzymes also contribute to safer working conditions through elimination of chemical treatments during production processes. As an upshot, protein engineering is a vigorous area of research and engaged in the attempts to create new enzymes with novel possessions, either through balanced design or in advancement.

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