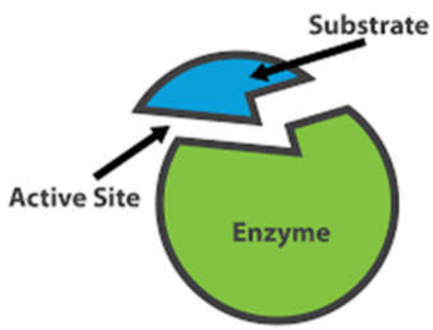
Enzymes

Enzymes are biological molecules that significantly speed up the rate of virtually all the chemical reactions take place within the cell. They are vital for life and serve a wide range of important functions in the body some enzymes break large molecules into smaller pieces that are more easily absorbed by body

Examples

The enzyme glucosidase converts sugar maltose into two glucose sugars



Components of enzymes

Enzymes are proteins and And biological catalyst

Catalyst

Catalyst accelerate the chemical reaction

Substrate

The molecules upon which enzymes may act called substrates.

Product

The enzyme converts the substrate into different molecules called products Almost all metabolic processes in the cell need enzyme catalysis in order to occur at a rate fast enough to sustain life.

Metabolic Pathways

It depends on the enzymes to catalyse individual steps

Enzymology

The study of enzymes is known as enzymology.

Pseudo enzyme analysis

It is a feeling recently grown of recognising that during evolution some enzyme have lost the ability to carry out biological catalyzes which often reflected in their Amino acid sequence and unusual pseudo catalytic properties

Reaction rate

Enzymes increase reaction rate by lowering the activation energy.

Activation energy

The energy required to start a chemical reaction is called activation energy. Chemically in enzymes are like any catalyst and are not consumed in chemical reaction nor do they alter. The AC librium of reaction is differ from other catalysts by being much more specific.

Inhibitors

Inhibitors are the molecules that decrease in line activity means enzyme activity affected.

Ec3Activators

Activated are the molecules that increase the enzyme activity some enzymes are used commercially for the synthesis of antibiotics

Historical Background

Berzillum in 1836 used the term catalyst. first enzyme extracted by yeast. This enzyme is named zymase. James sumner Firstly isolated the enzyme and catalase it this enzyme was grease.

Naming conversions

An enzyme name is often drive from its substrate are chemical reaction it catalyzed with the word ending ase for example lactase , DNA polymerase

International Union of Biochemistry (IUOB)

It development in nomenclature for enzyme the EC numbers each enzyme is described by a sequence of numbers preceded by EC which stands for

Types by Enzyme Commission

The first number broadly classifies the enzyme based on its mechanism.

The top-level classification of enzymes is given below.

Ec1

Oxidoreductase Catalyse oxidation-reduction reactions

Ec2

Transferases transfer to a functional group like methyl are phosphate groups.

Ec3

Hydrolases catalyse the hydrolysis of various bonds.

Ec4

Lyases Cleave various bonds by means other than hydrolysis and oxidation.

Ec5

Isomerases catalyse isomerization changes within a single molecule.

Ec6

Ligases Union two molecules with covalent bonds. The sections are subdivided by other features such as substrate products and Chemical mechanism. An enzyme is fully specified by four numerical designations

Examples

Hexokinase is transparent that adds phosphate groups to hexose sugars molecules containing an alcohol group.

Ribozymes

Small number of RNA based biological catalysts are called ribozymes. It can act alone in a complex whose protein is the most common of these is ribosome which is a complex of protein and catalytic RNA components.

Mechanism of enzymes

Mechanism of enzyme action

The basic mechanism by which enzymes catalyze chemical reactions begins with the binding of the substrate (or substrates) 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.

Substrate binding

Enzymes must buy their substrate before they can catalyse any chemical reaction enzymes are usually very specific as to state they bite and then the chemical reaction is catalyzed.

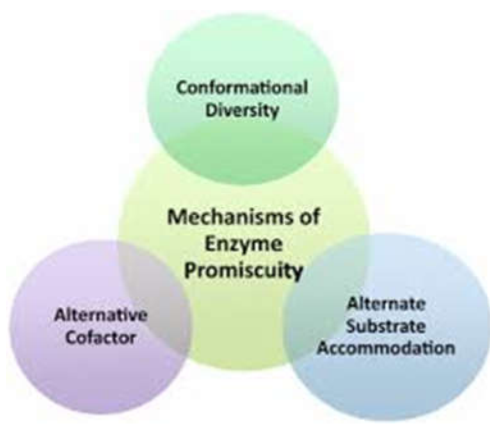
SpecifiCity

Specificity Is achieved by binding pockets with complementary shape charge and hydrophilic or hydrophobic characteristics to substrate some enzymes showing the highest specificity and accuracy are involved in the copying and expression of genome some of these enzymes have proofreading mechanisms.

an enzyme such as DNA polymerase catalyzes a reaction in the first step and then checks that the product is correct in a second step.

Enzymes promiscuity

Some enzymes display enzymes promiscuity having broad specificity and acting on a range of different physiological e relevant substrates. enzyme used as small side activities which arose naturally which Bidar starting point for evolutionary selection of new functions .



Two types of model represents the specificity of enzymes

These are two types of models,

- *Lock and key model*
- *Induced fit model*

Lock and key model

In 1894 Emil Fishcher proposed that the enzyme and substrate to that specific complementary geometric shapes fit exactly into 1 and other.

This model explains in rhyme specificity but fails to explain the stabilization half transition state that enzymes achieve.

Induced fit model

In 1958 Daniel koshland suggested modifications to lock and key model, since enzymes are rather flexible structures their active size is continually reshaped by interactions with substrate as substrate interactions with enzymes.

As a result the substrate doesn't simply bind two rigid active sites the amino acid side chains that make up the active sites are molded into precise positions that enable the enzyme to perform its catalytic function.

the substrate molecule also changes shape slightly as it enters the active site; the active site continues to change until the substrate it's completely bound.

Nature of Active Site and Substrate Interaction:

Enzymes have varying degrees of specificity. Some enzymes have absolute specificity for one substrate and no others, while other enzymes react with substrates with similar functional groups, side chains, or positions on a chain. The least specific enzymes catalyze a reaction at a particular chemical bond regardless of other structural features.

Much experimental work is devoted to gaining an understanding of the nature of the active site in an enzyme. Since enzymes are proteins, the nature of amino acid side chains in the vicinity of the active site is important. The specific amino acid side chains have been determined for many enzymes.

The active site for carboxypeptidase A will be used to illustrate the principles involved as shown in the graphic on the left.

The substrate (space filling gray,blue red) can interact with the active site through opposite charges, hydrogen bonding (shown in yellow), hydrophobic non-polar interaction, and coordinate covalent bonding to the metal ion activator as shown in magenta. The numbers behind the amino acids indicate the sequence position of the amino acid in the protein. The white lines represent the wire frames of the other amino acids in the enzyme.

The carbonyl bond is activated by interaction with the Zn ions. This leads to the addition of -OH from water to the carbonyl to produce an acid and the ultimate rupture of the C-N bond.

Dynamics

Enzymes are not rigid ,static structures

Enzymes are not rigid static structures instead they have Complex internal dynamic motion that is the movement of parts of enzyme structures such as individual amino acids residing groups of residues forming loop re1 and entire protein domain.

Example

Dihydrofolate reductase Are associated with the substrate binding catalyst is to factory release and product release steps of catalytic cycle consistent with catalytic resonance theory.

Substrate presentation

It is a process where the enzyme is sequestered away from its substrate. enzymes can be sequestrated to plasma membranes away from substrate in cytosol.

The enzyme is released and mixes with its substrate. alternatively the enzyme can be sequestrated near its substrate to activate the enzyme.

Example

Enzymes can be soluble and upon activation bind to A lipid in plasma membrane and then act upon molecules in plasma membrane.

Coenzymes and cofactors

Small organic molecules can be loosely bound to an enzyme. It transports chemical groups from one enzyme to another .

Characteristics of enzymes

- *Enzymes speed up chemical reactions.*
- *they are required in minute amounts.*
- *they are highly specific in their actions.*
- *they are affected by temperature.*
- *they are affected by pH.*
- *some catalyse reversible reactions*
- *some require coenzymes.*
- *they are inhibited by inhibitors*
- *They function in reverse*

Enzyme speed up chemical reaction

Enzymes speed up the extraction by lowering the activation energy needed for reaction to start.

Enzymes required in minutes amounts

Enzymes are only present in small amounts in the cell since they are next altered during their reactions enzymes are highly specific for their substrate; there is one specific enzyme for each specific chemical reaction.

Enzyme specific in their actions

Because enzymes use binding energy to reduce the activation energy of reaction, they obtain their specificity towards their substrate because of their structure.Enzymes only catalyze one kind of substance and cannot function For many substrates. The term is called one enzyme and one substrate.

Enzymes are affected by temperature

The rate of an enzyme catalysed reaction increases as temperature rises but up to a certain temperature . the increase in temperature above the optimum level can denature the enzyme

Enzymes are affected by pH

High and low PH value generally results in complete loss of activity for most enzymes.

Reversible reaction

Enzyme catalysed biochemical reactions .Enzyme and chemical catalyst increases the rate of a chemical reaction in both directions forward and reverse.

Enzyme required coenzymes

Enzymes are proteins coenzymes are small non protein molecules. Coenzyme Hold and atom are groups of atoms allowing enzymes to work.

Enzymes are inhibited by inhibitors

Inhibitor is a molecule that binds to an enzyme and decreases its activity. The binding of an inhibitor can stop a substrate from entering the enzyme active site under the enzyme from catalysing its reaction.

They function in reverse

It means the enzyme does not determine the direction of rotation. but it only functions in accelerating the reaction rate till it reaches equilibrium. The enzyme also functions in substrate synthesis as sub stars breaking down reaction.