

Enzymes

Enzymes are globular proteins. They are also called biological catalysts as they speed up chemical reactions. Thus, substrates are converted into products faster.

Active Site

The site present in enzymes where the substrate binds and forms the enzyme-substrate complex.

The R group present in the enzyme reacts with the substrate to ensure maximum binding.

Activation Energy

The additional amount of energy required to convert substrate into product.

The enzyme speeds up a chemical reaction by lowering the activation energy.

Types Of Enzymes

There are two types of enzymes based on the site where they perform their actions.

1) Intracellular

Enzymes which are present inside the cell are called intracellular.

2) Extracellular

Enzymes which are present outside the cell.

Enzyme Specificity:

Key And Lock Model

According to the key and lock model, the shape of the active site of the enzyme and substrate are complementary.

They fit with each other completely to form a complex.

It works like a key and lock. As only the right key can fit in the lock. In the same way, only the right substrate can fit into the enzyme.

This shows the specific nature of enzymes.

Induce Fit Model

According to induce fit model the shape of the active site of the enzyme and substrate are not complementary to each other.

Instead when the substrate is present the active site continuously shapes itself so that the substrate can fit into it.

Thus, the enzyme adjusts itself like gloves on hands. This model is currently more acceptable.

Investigating Progress Of Enzyme Catalysed Reaction

Progress of reactions catalyzed by the enzyme can be followed by two methods:

- 1) Rate of formation of product

2) Rate of disappearance of substrate

Factors

Different factors can affect enzyme action. This includes:

1. Temperature
2. pH
3. Substrate concentration
4. Enzyme concentration
5. Inhibitor concentration

Mechanism

When enzymes are added to the solution of substrate they collide with each other. With time substrate concentration decreases thus, no collision also decreases. This results in a decrease in the rate of reaction.

Thus, the rate is fastest at the start of reaction because the numbers of substrates are maximum.

Temperature

When temperature increases a no of effective collision a increases rate of reaction increases.

At optimal temperature enzyme activity is maximum.

After this, the H bonds holding enzyme molecule together start breaking. Thus, the enzyme denatures.

This distorts the shape of the active site of enzyme à decrease enzyme-substrate collision à rate of reaction decreases.

Most of the enzymes work at an optimal temperature of 37degree C.

Effect Of pH

Enzymes maintain their normal structure at a very narrow range of pH. This is called an optimal pH.

Optimal pH:

Optimal pH is the pH at which enzymes activity is maximum.

Most enzymes work at an optimal pH of 7-7.45.

After this, the bonds holding enzyme molecules start breaking. Thus, enzyme activity decreases.

Effect Of Enzyme Concentration:

When there are more substrates than enzyme limiting factor is enzyme concentration:

Increasing enzyme concentration increases the chances of effective collision thus the rate of reaction increases.

But, increasing enzyme concentration after a certain point does not affect the rate of reaction. Now, the substrate concentration is less.

Effect Of Substrate Concentration:

When there are more enzymes than substrate:

Limiting factor is substrate concentration:

Increasing substrate concentration → increases the rate of collision → thus the rate of reaction is increased.

But the rate will increase up to a certain point then there will be no effect on the rate of reaction because now enzymes are more than the substrate.

Effect Of Inhibitor Concentration

Inhibitors

Inhibitors are molecules that inhibit enzyme action.

Competitive Inhibitors

They have the same shape as the substrate.

Binds with the enzyme at the active site thus, preventing the substrate from it.

Increasing the concentration of the substrate can reverse inhibition.

Non Competitive Inhibitors

They do not have the same shape as the substrate.

Binds with the enzyme at a site other than active site and changes the shape of the enzyme and its active site.

Increasing concentration of the substrate cannot reverse inhibition.

Michaelis Menton Equation

$$V_0 = V_{MAX} \frac{[S]}{K_M + [S]}$$

It relates the rate of enzymatic reaction with the concentration of substrate present.

Here,

V_{max} is the maximum rate of reaction that can be achieved at maximum substrate concentration.

K_m is called as Michaelis constant. It is the inverse of affinity. Thus, it is the measure of affinity or enzyme-substrate binding. If k_m is low affinity is high that is less amount of substrate is required to reach the maximum rate.

Immobilizing An Enzyme In Alginate

Enzymes have a lot of commercial importance as well. They are used in industries on a large scale to speed up chemical reactions.

The problem is it is very expensive to use a new enzyme every time. For that reason, most industrialists prefer reusing the same enzymes.

But, it is very difficult to separate the enzyme product complex due to its small size. That is why enzymes are immobilized for reuse.

Immobilizing enzymes means they are attached to an inert substance such as calcium alginate. Thus, during the reaction enzyme keeps attached to sodium alginate and do not mix with the product. Then it is easily removed from the product.