Enzymes

Enzymes are a proteins that synthesized by living cells and act as biological catalysts that speed up biochemical reactions without appearing in the net final equation.

Substrates:- a reactants in biochemical reaction upon which enzymes act to give product.

Characteristics of Enzymes

1. They enter the biochemical reaction in small quantity without changing in its chemical structure.

2. Catalysis occurs in a region within the enzyme known as the active site.

3. Enzymes convert the substrate to product in high efficient with high reaction rates where the rates of enzymatically catalyzed reactions are typically 10^6 to 10^{12} greater than those un catalyzed reactions.

4. Enzymes have a greater degree of specificity as compared to the chemical catalysts; that is, enzymatic reactions rarely have side products.

5. The catalytic activity of many enzymes depends on the presence of small non-protein molecules inside them termed ***cofactors***. Cofactors can be subdivided into two groups: *metals ions* (Cu^{+2}, Fe^{+2}, Ni^{+2}…etc.) *and small organic molecules* called **coenzyme**. For example the enzyme carbonic anhydrase requires Zn^{+2} for its activity. Enzyme without its

cofactor is called an ***apoenzyme*** (inactive enzyme); the complete active enzyme is called a ***holoenzyme***.

Apoenzyme + cofactor = holoenzyme

Enzyme unit (or activity):- amount of enzyme which convert one Micro-mole (10^{-6} mole) of substrate to product in one minute under determined measurement condition.

Turnover number:- The number of moles of the substrate that converted to the product per one mole of the enzyme in one minute.

Specific activity:- enzyme units per milligram of protein. It consider a measure of the enzyme purity, thus increases with purification.

Factors affecting the rate of enzyme-catalyzed reactions

1. **Enzyme concentration**

As the concentration of the enzyme is increased, the velocity of the reaction proportionately increases.

2. **Substrate concentration**

Increase in the substrate concentration gradually increases the velocity of enzyme reaction within the limited range of substrate levels.

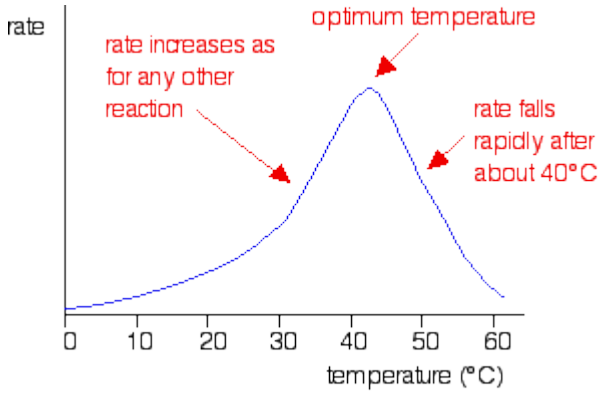
3. **Effect of product concentration**

The accumulation of reaction products generally decreases the enzyme velocity For certain enzymes, the products combine with the active site of enzyme and form a loose complex and, thus, inhibit the enzyme activity.

4. Effect of Temperature

Velocity of an enzyme reaction increases with increase in temperature up to a maximum and then declines.

The optimum temperature for most of the enzymes is between 35°C–40°C. In general, when the enzymes are exposed to a temperature above 50°C, **denaturation** leading to derangement in the native (tertiary) structure of the protein and active site are seen. Majority of the enzymes become inactive at higher temperature (above 70°C).



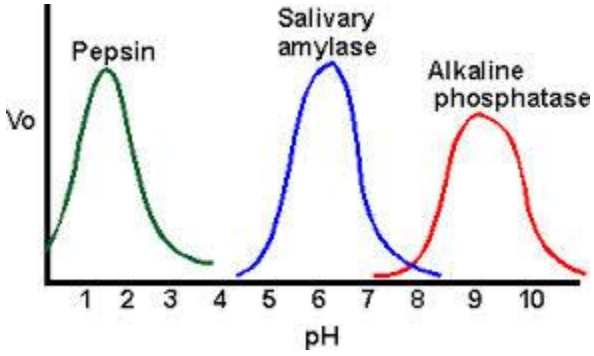
5. Effect of pH

Increase in the hydrogen ion concentration (pH) considerably influences the enzyme activity

Each enzyme has an optimum pH at which the velocity is maximum. Below and above this pH, the enzyme activity is much lower and at extreme pH, the enzyme becomes totally inactive.

Most of the enzymes of higher organisms show optimum activity around neutral pH (6-8). There are, however, many exceptions like pepsin (1-2), acid phosphatase (4-5) and alkaline phosphatase (10-11)

Hydrogen ions influence the enzyme activity by altering the ionic charges on the amino acids (particularly at the active site), substrate, ES complex



6. Effect presence of inhibitors or activators
7. Time
8. Light and radiation

Enzyme Classification

Enzymes can be classified into six distinct classes. These are:

1) Hydrolases: Enzymes that hydrolyze substrates.
2) Isomerases: Enzymes involved in isomerization reactions.
3) Ligases: Enzymes involved in condensation reactions using nucleoside di- and triphosphates as an energy source. These enzymes are often called synthetases. Another class of ligases which use derivatives of nucleotides (UDP-a-D-glucose) are known as synthases.
4) Lyases: Enzymes that promote addition to double bonds.
5) Oxidoreductases: Enzymes involved in redox reactions.
6) Transferases: Enzymes that catalyze group transfer reactions