Enzymes: Definition, Mechanisms and Classification | Microbiology

In this article we will discuss about:- 1. Definition of Enzymes 2. Mechanism of Enzyme Action 3. Enzyme Kinetics 4. Allosteric Enzymes 5. Classification 6. Components.

Definition of Enzymes:

Enzymes are highly specialized proteins which act as catalyst of biological system. Louis Pasteur was the first to recognize the importance of enzymes while studying the fermentation process and denoted it as "ferment"-an integral part of living cells.

It was Edward Buchner who in 1897 extracted the enzyme from yeast cells, responsible for fermentation of sugar to alcohol. In 1926, James B. Sumner isolated and crystallized urease and also postulated that all enzymes are proteins. Today we know, this is true but with exception of Ribozymes which is a catalytic RNA.

Enzymes are the large globular proteins with molecular weight ranging from 13,000 to millions Dalton. The catalytic efficiency of an enzyme depends upon its three dimensional conformation.

Moreover, these biocatalysts are highly specific for the reaction as well as other conditions e.g. each enzyme has its own optimum pH, temperature, etc. for maximum perfor-mance. Some enzymes require an additional moiety known as cofactors for their biological activity.

Mechanism of Enzyme Action:

Enzyme is active in catalytic action of biochemical reaction. They act on substrate and forms a complex after interactions with the enzyme is called active center. The enzyme and substrate forms a complex at the active centre.

This binding action makes both enzyme and substrate stable. The interaction between substrate and enzyme may be either ionic bonds and hydrogen bonds or Van der Waal forces. The active sites of enzyme have some special groups such as NH_2 COOH, -SH etc. which bind the substrate though above bonds to form a transitional (intermediate) compound called enzyme-substrate complex (ES).

This reaction is exergonic and releases some energy which raises energy level of the substrate molecule.

Thus, activating the substrate molecule and the phenomenon is known as activation energy or energy of activation as shown in Fig. 12.10:

Types of Mechanisms of Enzymes:

There are two types of mechanisms involved to explain substrate-enzyme complex formation; lock and key theory (template model), and induced-fit theory.

(i) Lock and Key Theory:

Emil Fischer (1894) explained the specific action of an enzyme with a single substrate using a theory of Lock and Key analog (Fig. 12.11). According to this theory, reaction of sub-state and enzyme is analogous to lock and key.

Enzyme is analogous to key, where the geometrical configuration of socket is fixed. Similarly substrate has also got fixed geo-metrical configuration like that of key. A particular lock can be opened or closed by a particular key. According to the particular substrate can be found at active site of particular enzyme forming substrate-enzyme complex.

Enzyme-substrate complex remains in tight fitting and active sites of enzymes are complementary to substrate molecules. Subsequently, enzyme-substrate complexes result in the transformation of substrate into the product formation due to activity of reaction sites.

Since product has lower free energy, it is released. Enzymes are fixed to receive another molecule of substrate and thus enzyme activity continues. In this analogy, the lock is the substrate and the key is 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 as shown in Fig. 12.11:

(ii) Induced Fit Theory:

In 1958, Koshland modified the Fischer's model for the formation of an enzyme-substrate complex to explain the enzyme property more efficiently.