Enzymology

DATE / / PAGE 1

⇒ Basics of Enzymology :-

The term enzyme was coined by Eduard Buchner (1897), which literally means 'in yeast'.

Definition:-

a substance produced by a living organism which acts as a catalyst to bring about a specific biochemical reaction.

- All the enzymes are mostly proteins consisting of one or more polypeptides held together by non-covalent bonds.
- However, some RNA molecules have been found to act as biocatalysts, called ribozymes.

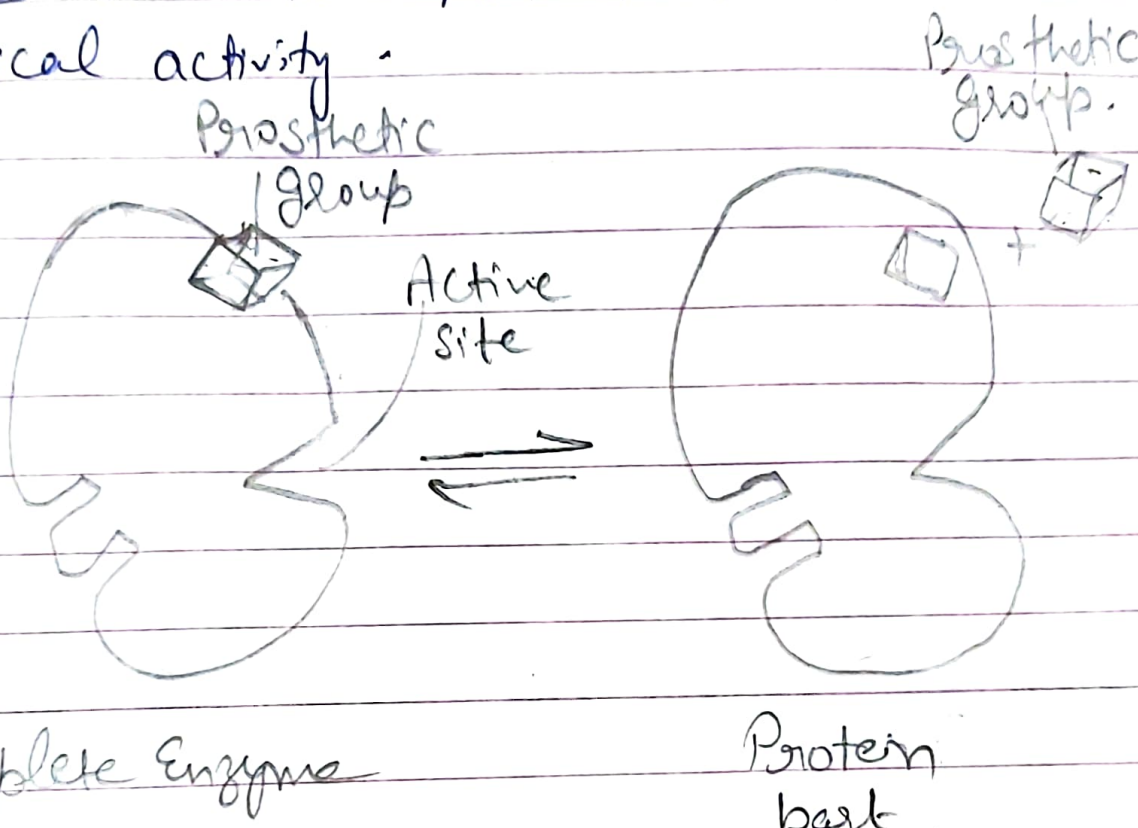
⇒ Structure and Composition of Enzymes :-

The enzymes consist of following structures:-

1) Protein part or Apoenzyme :-

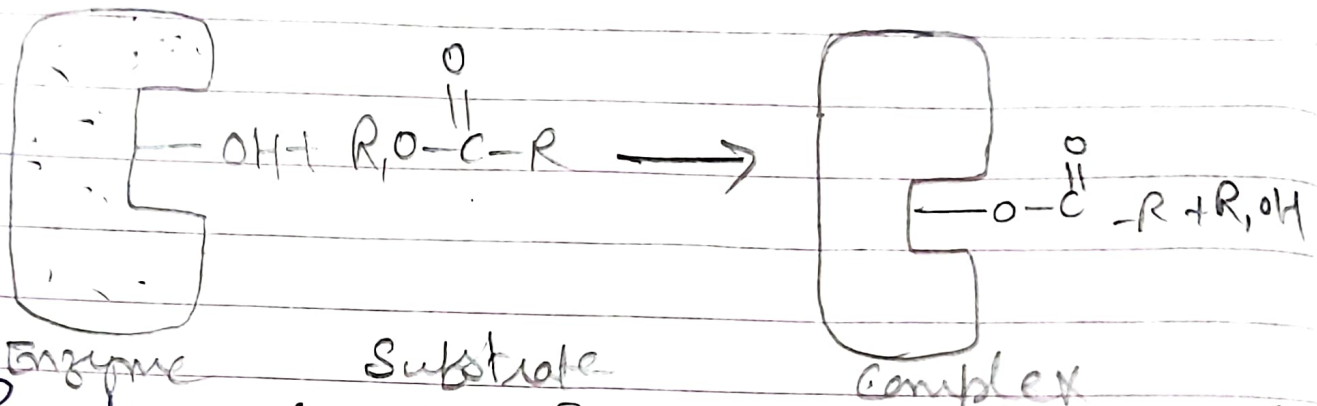
- Apoenzyme contitute the major portion of an enzyme.

- The specific sequence of amino acids in a protein molecule provides specific nature of enzymes which is important for their biological activity.



2) Active site :- The substrate physically comes in contact with the specific site in protein molecule.
- The surface of folded protein posses specific binding site known as active site.
- The active site may thus be defined as that particular part of the protein which binds

to the substrate to form an enzyme substrate complex.



3.) Prosthetic Group :- Eg: Enzyme Substrate Complex

- Many enzymes require the presence of an essential non-protein part for efficient performance of their function.
- The non-protein part which is tightly bound to enzymes is termed as 'Prosthetic group'.
- The simple prosthetic groups are metalic ions, such as Cu, Zn, Mn, Mo etc.

4.) Co-enzymes and Co-factors :-

- The non-protein part, when tightly bound to apoenzyme, is called prosthetic group but

if it is not tightly bound, it is known as coenzyme or cofactor.
- Since these substances are intimately concerned with the overall reactions, they are termed as co-factors or Co-enzymes.

e.g. Some of the co-enzymes are:-
Coenzyme I or NAD, Biotin, Ascorbic acid or Vitamin C etc.

⇒ Properties of Enzymes:-

1) Catalytic Properties:- All the enzymes act as biological catalysts.
- It is effective in very small amounts.
- It is usually unchanged in the reaction.
- It speeds up the reaction.

2) Reversibility of Action:- Many enzymes hasten the reversible biological reactions in either direction i.e. forward or backward, depending upon the availability of suitable energy sources.

3) Specificity of Enzymes :-

- Enzymes are highly specific in nature.
- That means a particular enzyme can catalyse only a particular type of reaction.
- These molecules are "genetically" informed to catalyse on or a few specific reactions.
  e.g. the enzyme fumarate hydrolase acts only on fumarate.

4) Sensitiveness to heat :-

- Many enzymes are inactivated or denatured by moderate heat (i.e. 60°C to 70°C).
- Early denaturation occurs by heat when these are in moist conditions.
- Due to this property enzymes are said to be thermobile.

5) Inhibition of enzyme by poisons :-

All enzymes posses active site which participate in the biochemical reaction. The substrate combines with the active site to form enzyme - substrate complex to activate the reaction.

If the active sites of an enzyme are blocked or inactivated by some chemical compounds, the activity of enzymes will be inhibed. Such chemical substances or agents which inactivate the enzyme are known as "enzyme poisons" or inhibitors.

6.) Colloidal Properties of enzymes :-

- The enzymes are large molecules of very hight molecular weight.
- Size of these molecules is measured in the range of colloidal particles.
- The enzymes are dispersed in the dispersion medium of protoplasm and show all the colloidal properties.

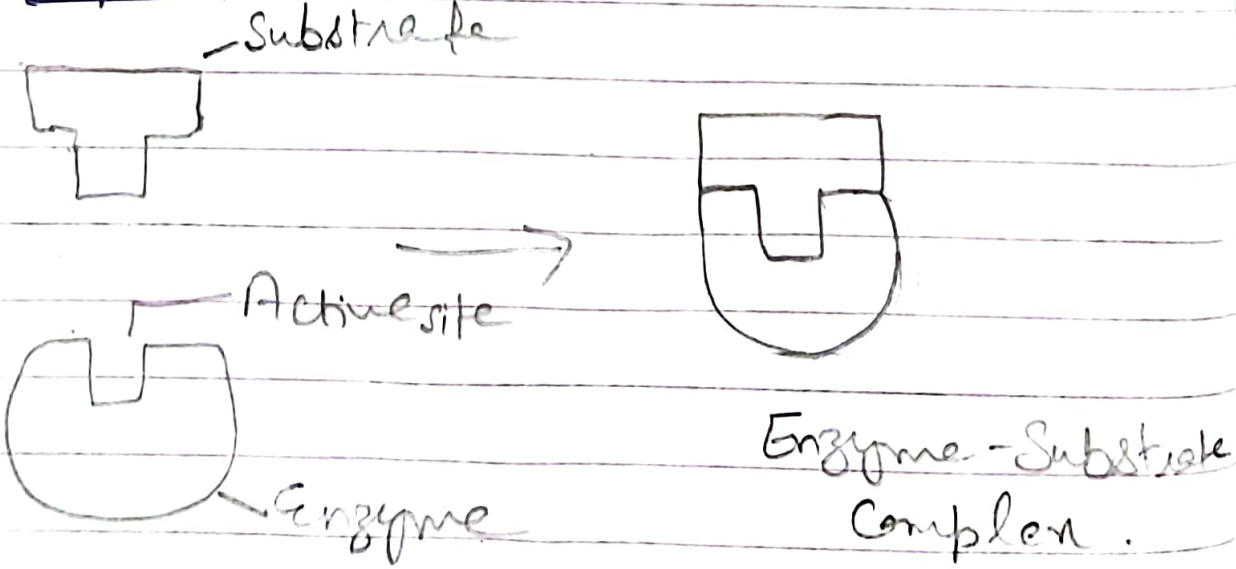
⇒ Mode of Enzyme Action :-

Two theories have been put foward to explain mode of enzyme Action.

1.) The lock + key theory.
2.) The induced fit theory.

1.) Lock and key theory :-

- Fisher has developed a lock and key theory to describe the mode of action of the enzyme.
- If the right enzyme fits into the appropriate substrate, the reaction will occur, otherwise it would not.
- Enzyme shape provides surface configuration that can fit with the other molecules.
- The molecule on which the enzymes act are known as substrates of enzymes.
- After fitting the new product which is formed is called, Enzyme Substrate Complex.



Lock and key model for enzyme action

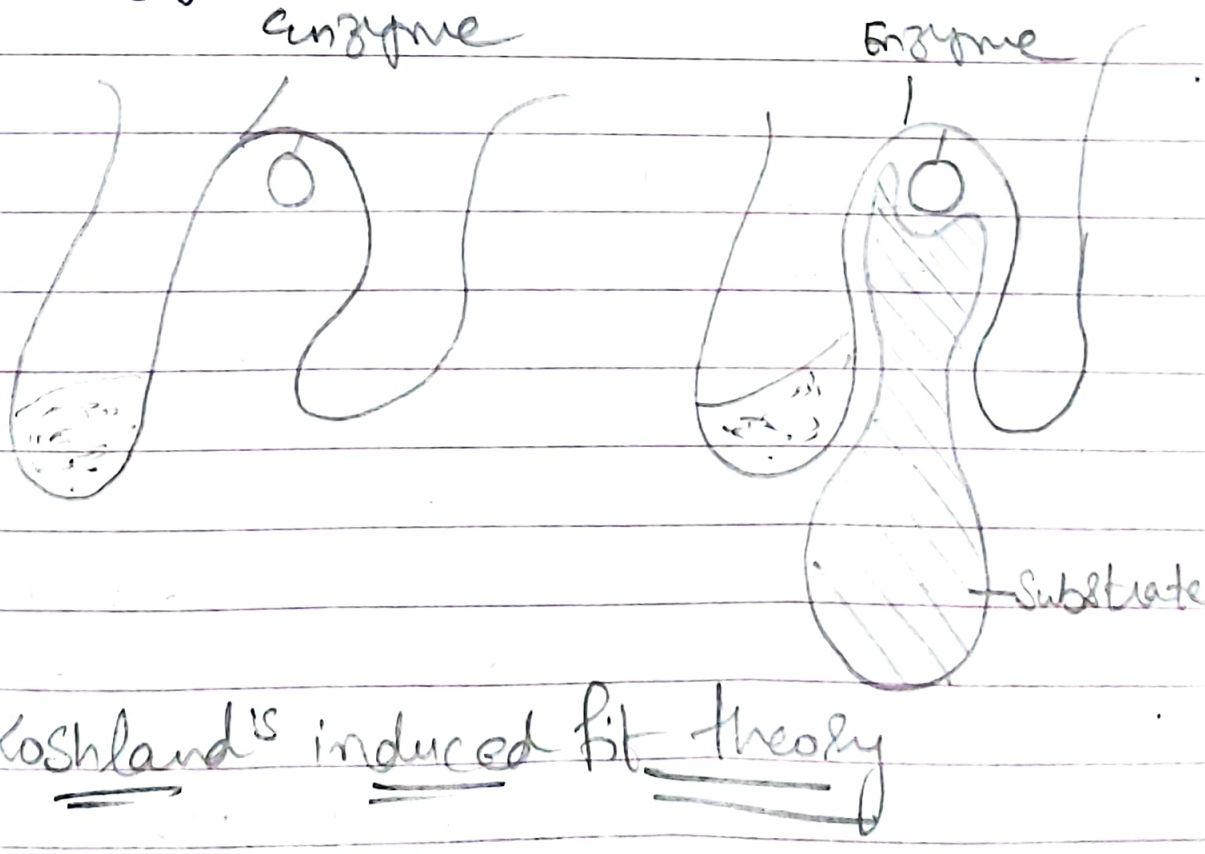
2.) Induced fit theory:-

- This theory was purposed by Koshland (1959).
- It has been demonstrated that:-

a.) The geometry of enzyme protein is altered considerable when the substrate fits into the active site.

b.) A proper orientation of catalytic groups is required for enzyme action. This orientation is induced by substrate.

In this way, a perfect 'hand and glove' relationship is achieved between the enzyme and the substrate.



Koshland's induced fit theory

⇒ Factors Influencing Rate of Enzyme Activity:-

1) **Enzyme and substrate concentration:-** In most of the cases the rate of an enzyme catalysed reaction increases with increasing concentration of enzyme.

2) **Temperature:-** A rise in temperature increases the rate of catalysis by increasing the kinetic energy of substrate and enzyme molecules.

3) **Hydrogen ion concentration (pH):-** Each enzyme is catalytically active within a limited range of pH. Some enzymes are active in acidic pH, some are active in alkaline pH while still others require neutral pH.

4) **Reaction product:-** Accumulation of reaction products inhibits the enzymic activity and with this the reverse reaction can occur. Accumulation of reaction products may sometimes cause denaturation of enzymes.