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Biochemistry & Clinical Pathology
Chapter 6 : Enzymes

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Chapter 6
Enzymes

→ The specific type of proteins that catalyse (increase the rate of) chemical reactions in living cells are called enzymes.

Or

→ Enzymes are catalysts(a thing that causes changes) that catalyse the chemical reaction.

Properties of Enzymes

- Enzymes increase the rate of reaction
- They are unstable
- Their activity can be decreased or enzymes can be destroyed by variety of condition like temperature, changes in PH
- Enzymes are complex macromolecules with high molecular weight
- All enzymes are protein except the group of catalytic of RNA

IUB (International Union of Biochemistry)and MB (molecular Biology)

Classification

1) **Oxidoreductases :** These type of enzymes involve in oxidation(loss of electron) reduction(gain of electron) example s dehydrogenases , oxidases.
2) **Transferases :** These type of enzymes involve in transferring of chemical group such as alcohol, carboxyl , sulphate , phosphate, aldehyde, ketone . example transaminases , kinases.
3) **Hydrolyses :** These type of enzymes involve in breaking of different bonds .Examples Lipase , peptidase , glycosidase.
4) **Lyases :** These type of enzymes involve addition or removal of the elements of water (hydrogen, oxygen), ammonia (nitrogen, hydrogen), or carbon dioxide (carbon, oxygen) at double bonds. For example, decarboxylases remove carbon dioxide from amino acids and dehydrases remove water.
5) **Isomerases :** These type of enzymes are involve in isomerization reaction (Isomerization is a process in which one isomer is formed from another. An isomer is any of the two or more forms of a molecule with the same chemical formula but with a different stereochemical arrangement of the atoms).
6) **Ligases :** These type of enzymes involve in biding or joining of two molecules together. e.g. Synthetases , carboxylases.

Factors Affecting Enzymes Activity

- **Temperature :** Enzymes have optimal temperatures at which they function best. An increase in temperature can increase enzyme activity, but excessive heat can denature the enzyme, rendering it inactive.
- **pH :** Enzymes have optimal pH levels at which they function best. A change in pH can affect the shape of the enzyme, making it unable to bind to its substrate, and therefore less active.
- **Substrate concentration :** As the concentration of substrate increases, the rate of enzymecatalyzed reactions also increases, up to a point. Beyond that point, the enzymes become saturated and the reaction rate levels off.
- **Enzyme concentration :** Increasing the amount of enzyme present will increase the rate of the reaction, up to a point. Beyond that point, the reaction rate levels off.
- **Inhibitors :** Compounds that bind to enzymes and prevent them from functioning properly are called inhibitors. They can be competitive or non-competitive, and can be reversible or irreversible.
- **Co-factors :** Many enzymes require small, non-protein molecules, called cofactors, to function. Cofactors can be metal ions or organic molecules, and if they are not present, the enzyme will not function

Mechanism of Action of Enzymes

Step 1 : The enzyme attracts the substrate to its active site and becomes Enzyme - Substrate comple .

E + S → ES complex

Step 2 : a process called catalysis occurs

Step 3 : Now The enzyme release the Substrate and now substrate is called Product (p) .

ES → E + P

There are two models which explained the Mechanism of action of enzyme :

1. Lock and Key Hypothesis (Emil Fisher)
2. Induced fit Hypothesis (Koshland)

Enzyme Inhibitors

→ The agents which prevent or decrease the action of Enzymes are called Enzyme inhibitors :

Types of Enzyme Inhibitors

- **Reversible / competitive Inhibitors :** This type of Inhibitors have structural similarity with substrate , and bind at the active site of enzymes and inhibit the action of enzyme . If the concentration of Substrate increase then the inhibition is reversed.
- **Non - Competitive or Irreversible Inhibitors :** This type of Inhibitors bind with functional group other than the active site , and inhibit the action of enzymes for ever . If the concentration of Substrate increase then the inhibition does not reverse.

Therapeutic and Pharmaceutical Importance of Enzymes

Therapeutic Importance

- Trypsin ,is used to treat Inflammation
- Streptokinase are used to treat thrombosis
- Lysozyme is used as antibiotic
- Urokinase is used to dissolve blood clots

Pharmaceutical Importance

- Enzymes (used in manufacturing of drugs)
- Glucose isomerase is used for production of High fructose syrup
- Penicillin acylase is used in production of penicillin
- Amylase is used for diagnosis of Pancreatitis .(inflammation of pancreas , in which serum amylase level increase)