**ENZYMES**

**Enzymes** are protein molecules in cells which work as biological catalysts. **Enzymes** speed up chemical reactions in the body, but do not get used up in the process, therefore can be used over and over again. Almost all biochemical reactions in living things need **enzymes**.

**Enzymes** are biological molecules (typically proteins) that significantly speed up the rate of virtually all of the chemical reactions that take place within cells. They are vital for life and serve a wide range of important **functions** in the body, such as aiding in digestion and metabolism.

They may be simple or conjugated proteins. The relatively lower molecular weight non proteinoid prosthetic group of enzymes is called co-enzyme.

**Coenzymes** are small molecules. They cannot by themselves catalyze a reaction but they can help enzymes to do so. In technical terms, **coenzymes** are organic non protein molecules that bind with the protein molecule (apoenzyme) to form the active enzyme (holoenzyme). Both the **coenzyme** and the **apoenzyme** must be present for the overall activity of the enzyme. The coenzymes may be composed of heterocyclic ring systems. For example vitamins of the B group act as coenzymes for several enzymes. In fact, the apoenzyme is catalytically inactive by itself, but its activity can be restored by the addition of coenzyme. There are many metalloprotein enzymes in which the metal ions bonded either to the apoenzyme or to the coenzyme are known as enzyme activators.

**Chemical nature enzymes**

 Analysis of enzymes as so that all enzymes so far are proteins. They belong to either simple, globular or conjugated globular class of proteins. On the basis of chemical composition enzymes can be divided into three classes namely, (1) simple globular protein (2) globular metalloprotein (3) globular protein or metalloproteins attached to the prosthetic (non protein) group called coenzyme. For example, pepsin is an example of simple globular protein. Ascorbic acid oxidase is a globular metalloprotein; transaminase is a globular protein attached to a prosthetic group and catalyse is a globular metalloprotein containing porphyrin prosthetic group.

**Characteristics**

1. Most of the enzymes are colourless solids, but some are yellow, green or Brown.
2. They are mostly soluble in water or dilute salt solutions.
3. They are colloidal in nature and do not pass through dialysing membranes, although the prosthetic groups of enzymes or Coenzymes can be easily separated by dialysis from the proteinoid part or apoenzyme.
4. They usually contain C,H,N and S although phosphorus and metallic ions are also present occasionally.
5. They have high molecular weights.
6. As catalyst they are effective in very small amounts.
7. Most of the enzymes get inactivated, presumably through denaturation, when heated above 80 degree centigrade.
8. They show an extraordinary specificity of action. They may be specific for particular substrate or a particular type of reaction.
9. Enzyme actions are greatly influenced by pH variations. Optimum pH for most the enzyme actions is about 7.
10. Enzyme actions are usually carried out in dilute solution, as high concentration of the solution of the subtract renders the enzymes inactive.

**Functions of Coenzymes:**

Coenzymes may be considered as special activators that can be removed reversibly from the protein part of the enzyme and are necessary for the activity of the enzyme. They play an important role in metabolic functions of the body. They are mostly found in the vitamin B complex. Some major coenzymes and their function are illustrated below:

1. Nicotinamide-adenine dinucleotides (NAD): This cofactor is found in two forms in cells: **NAD**+ is an oxidizing agent – it accepts electrons from other molecules and becomes reduced. This reaction forms NADH, which can then be used as a reducing agent to donate electrons. These electron transfer reactions are the main function of NAD.
2. Flavin mononucleotides (FMN): It is a biomolecule produced from riboflavin (vitamin B2) by the enzyme riboflavin kinase and functions as the prosthetic group of various oxidoreductases, including NADH dehydrogenase, as well as cofactor in biological blue-light photoreceptors.
3. Flavin adenine dinucleotide (FAD): FAD is a redox-active coenzyme associated with various proteins, which is involved with several important enzymatic reactions in metabolism. A flavoprotein is a protein that contains a flavin group, this may be in the form of FAD or flavin mononucleotide (FMN)
4. Adenosine triphosphate (ATP): ATP synthase is an enzyme that creates the **energy storage** molecule adenosine triphosphate (ATP). ATP is the most commonly used "**energy** currency" of cells for all organisms.
5. Tetrahydrofolic acid (THF): Tetrahydrofolic acid is a cofactor in many reactions, especially in the **synthesis** (or anabolism) of amino acids and nucleic acids.
6. Thiamine pyrophosphate(TPP): **functions** as a coenzyme in the metabolism of carbohydrates, lipids, and branched-chain amino acids.

Some of these coenzymes with specific reactions are given below

1. Nikotin adenine dinucleotides (NAD) as hydrogen acceptor

 CH₃CH₂OH ----[NAD]→ CH₃CH=O + NADH + H\*

1. Flavin adenine dinucleotide (FAD) also acts as hydrogen acceptor from the substrate or reduced product can also give hydrogen to the substrate. Thus in the presence of specific apoenzyme this can effect oxidation reduction reactions.

 FAD + 2H ⇄ FADH₂