ENZYMES: Classification and its importance:

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CLASSIFICATION OF ENZYMES:

Firstly Enzymes were classified into two broad categories:

(i) Hydrolysing:

Catalysing hydrolysis of larger molecules into smaller ones, e.g., carbohydrates or amylases, proteases, lipases, esterases, phosphorylases, amidases. Digestive enzymes are hydrolysing in nature. They are often grouped into three types— proteolytic, amylolytic and lipolytic,

(ii) Desmolysing:

Catalysing reactions other than hyrolysis, e.g., aldolases, dehydrogenases, oxidases, peroxidases, catalases, carboxylases, etc.

The **modem system of enzyme classification** was introduced by International Union of Biochemistry **(IUB)** in 1961. It groups enzymes into the following six categories.

1. Oxidoreductases

- Catalyze oxidation-reduction reactions where electrons are transferred.

- These electrons are usually in the form of hydride ions or hydrogen atoms.
- The most common name used is a dehydrogenase and sometimes reductase is used.
- An oxidase is referred to when the oxygen atom is the acceptor.

2.Transferases

- Catalyze group transfer reactions.
- The transfer occurs from one molecule that will be the donor to another molecule that will be the acceptor.
- Most of the time, the donor is a cofactor that is charged with the group about to be transferred.
- Example: Hexokinase used in glycolysis.

3.Hydrolases

- Catalyze reactions that involve hydrolysis.
- It usually involves the transfer of functional groups to water.
- When the hydrolase acts on amide, glycosyl, peptide, ester, or other bonds, they not only catalyze the hydrolytic removal of a group from the substrate but also a transfer of the group to an acceptor compound
- For example: Chymotrypsin.

4. **Lyases**

- Catalyze reactions where functional groups are added to break double bonds in molecules or the reverse where double bonds are formed by the removal of functional groups.
- For example: Fructose bisphosphate aldolase used in converting fructose 1,6-bisphospate to G3P and DHAP by cutting C-C bond.

5. **Isomerases**

- Catalyze reactions that transfer functional groups within a molecule so that isomeric forms are produced.
- These enzymes allow for structural or geometric changes within a compound.
- For example: phosphoglucose isomerase for converting glucose 6-phosphate to fructose 6-phosphate. Moving chemical group inside same substrate.

6.Ligases

- They are involved in catalysis where two substrates are ligated and the formation of carbon-carbon, carbon-sulfide, carbon-nitrogen, and carbon-oxygen bonds due to condensation reactions.
- These reactions are coupled to the cleavage of ATP.

Chemical Nature of Enzymes:

All enzymes are globular proteins with the exception of recently discovered RNA enzymes. Some enzymes may additionally contain a non-protein group. Accordingly there are two types of enzymes, simple and conjugate.

Simple Enzyme:

It is an enzyme which is wholly made up of protein. Active site is formed by specific grouping of its own amino acids. Additional substance or group is absent, e.g., pepsin, trypsin, urease.

Conjugate Enzyme:

It is an enzyme which is formed of two parts— a protein part called apoenzyme (e.g., flavoprotein) and a nonprotein part named cofactor. The complete conjugate enzyme, consisting of an apoenzyme and a cofactor, is called holoenzyme. Active site is formed jointly by apoenzyme and cofactor.

Cofactor is small, heat stable and dialysable part of conjugate enzyme. It may be inorganic or organic in nature. Organic cofactors are of two types, coenzymes and prosthetic group enzymes .

Coenzymes are easily separable non-protein organic cofactors. Coenzyme requires two Apo enzymes, one for picking up the group and the second for transferring the group, e.g., NAD^+, $NADP^+$, CoA.

Prosthetic groups are non-protein organic cofactors firmly attached to apoenzymes, e.g., heme (=haem), biotin, pyridoxal phosphate. Heme (= haem) is iron containing prosthetic group in cytochromes, haemoglobin, myoglobin, catalase and peroxidase. Prosthetic group requires a single apoenzyme for picking up the group and transferring the same.

The last two cause breakdown of hydrogen peroxide to water and oxygen. FMN and FAD are considered prosthetic groups by some workers while others consider them to be coenzymes.

Both coenzyme and prosthetic group take part in group transfer reactions.

Biological Importance of Enzymes:

(i) Thousands of chemical reactions are taking place in the body of a living organism. All of them are mediated by enzymes,

(ii) Enzymes are specialised catalysts that operate at biological temperatures,

(iii) Enzyme mediated reactions do not require harsh treatment,

(iv) They are pH specific so that reactions requiring different pH operate in different parts of the body,

(v) As they operate under favourable conditions, enzymes force the organisms to live under favourable environment,

(vi) Enzymes are highly regulated. Their formation is controlled by separate genes. Activation and repression of genes allow certain enzymes to be functional or non-functional in cells.

Economic Importance of Enzymes:

i. ELISA:
It is enzyme based detection of diseases like AIDS.

ii. Endonucleases:
They are enzymes used in breaking DNA at specific sites. DNA fragments are employed in genetic engineering.

iii. Alcoholic Beverages:
Enzyme complex zymase obtained from yeast is used in brewing or fermentation of alcoholic drinks.

iv. Detergents:
They contain protease for brighter washing of clothes and amylase for dish washing.

v. Baby Foods:
Trypsin is added to partially pre-digest baby foods.

vi. Streptokinase:
The enzyme is used in clearing blood clots inside blood vessels.

vii. Digestive Aids:
Diastase and other enzymes are used regularly by patients with deficient digestive juices.

viii. Cheese:
Rennet or rennin tablets are used for preparation of cheese. Lactase and lipase are employed to provide proper consistency and flavour to cheese.

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