SNS COLLEGE OF TECHNOLOGY

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COIMBATORE-641 035, TAMIL NADU

DEPARTMENT OF FOOD TECHNOLOGY

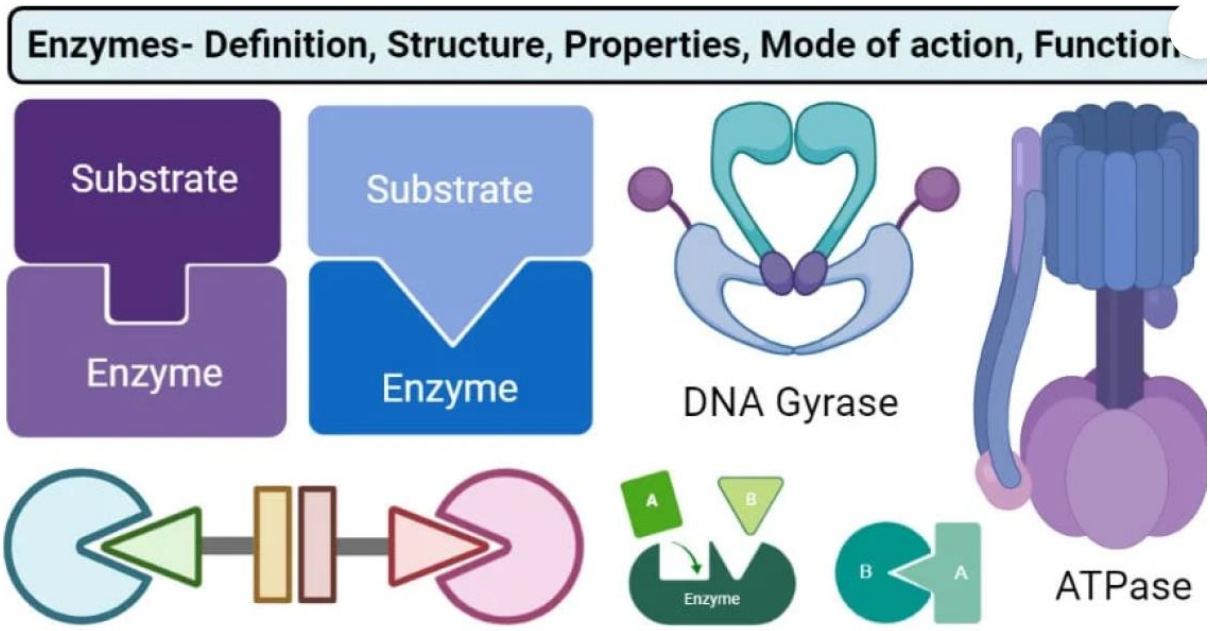
23FTT204- BIOCHEMISTRY & NUTRITION

UNIT V – ENZYMES

Introduction, classification and nomenclature of enzymes.

An enzyme is a protein biomolecule that acts as a biocatalyst by regulating the rate of various metabolic reactions without itself being altered in the process.

- The name 'enzyme' literally means 'in yeast', and this was referred to denote one of the most important reactions involved in the production of ethyl alcohol and carbon-dioxide through the agency of an enzyme zymase, present in yeast.
- Enzymes are biological catalysts that catalyze more than 5000 different biochemical reactions taking place in all living organisms.
- However, these are different from other catalysts which are chemical and can last indefinitely. Enzymes are proteins that are prone to damage and inactivation.
- Enzymes are also highly specific and usually act on a specific substrate of specific reactions.



1. Intracellular enzymes

- The enzymes that act within the cells in which they are produced are called intracellular enzymes or endoenzymes.
- As these enzymes catalyze most of the metabolic reactions of the cell, they are also referred to as metabolic enzymes.
- Most of the enzymes in plants and animals are intracellular enzymes or endoenzymes.
- Intracellular enzymes usually break down large polymers into smaller chains of monomers.
- All intracellular enzymes undergo intracellular digestion during cell death.

2. Extracellular enzymes
    - The enzymes which are liberated by living cells and catalyze useful reactions outside the cell but within its environment are known as extracellular enzymes or exoenzymes.
    - Exoenzymes act chiefly as digestive enzymes, catalyzing the breakdown of complex macromolecules to simpler polymers or monomers, which can then be readily absorbed by the cell.
    - These mostly act at the end of polymers to break down their monomers one at a time.
    - Exoenzymes are enzymes found in bacteria, fungi, and some insectivores like Drosera and Nepenthes.
    - Extracellular enzymes, unlike intracellular enzymes, undergo external digestion during cell death.

Nomenclature of Enzymes:

Many enzymes are named by adding the suffix '-ase' to the name of their substrate. Example. Urease is the enzyme that catalyzes the hydrolysis of urea, and fructose-1,6-bisphosphatase hydrolyzes fructose-1,6-bisphosphate. However, other enzymes, such as trypsin and chymotrypsin, have names that do not denote their substrate. Some enzymes have several alternative names.

To rationalize enzyme names, a system of enzyme nomenclature has been internationally agreed. This system places all enzymes into one of six major classes based on the type of reaction catalyzed. Each enzyme is then uniquely identified with a four-digit classification number.

Example: Trypsin has the Enzyme Commission (EC) number 3.4.21.4, where

1. the first number (3) denotes that it is a hydrolase

2. the second number (4) that it is a protease that hydrolyzes peptide bonds

3. the third number (21) that it is a serine protease with a critical serine

4. residue at the active site, and

5. the fourth number (4) indicates that it was the fourth enzyme to be assigned to

this class.

For comparison, chymotrypsin has the EC number 3.4.21.1, and elastase 3.4.21.36.

Classification of Enzymes

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.