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Topic: Enzymes - classification & Nomenclature

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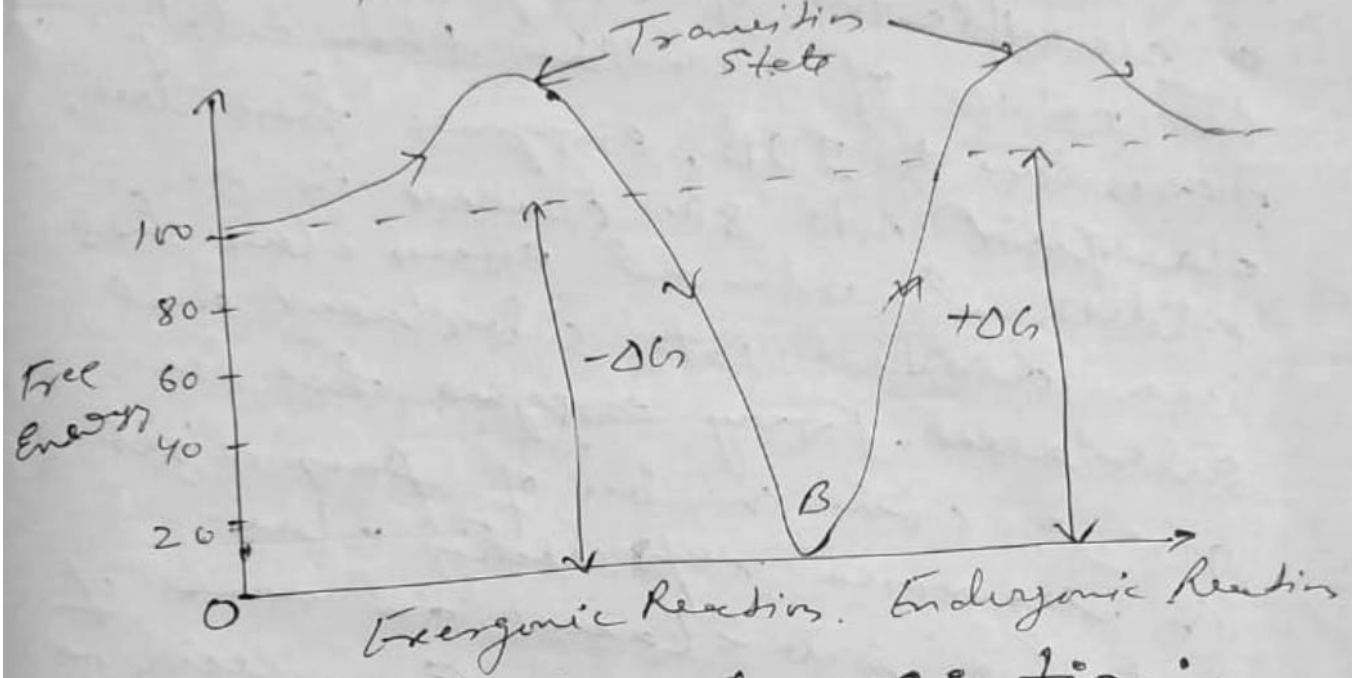
Enzymes: classification & Nomenclature

Introduction - Action of saliva on conversion of starch into sugars and act action of gastric juice on digestion of meat gave birth to the idea of the presence of catalysts in biological syetem. These biological catalysts were named as 'Enzymes' by Louise Pasteur (1860). However, it was **Edward Buchner** (1897), who first extracted the enzymes from yeast. But J.B. Sumner (1926) was the first to prepare a crystalline form of enzyme **Urease** from Jack beans and proved that the enzyme was a protein. Enzymes, like protein, are of high molecular weight (MW 12,000 to 1 million). They are composed of two to eight subunits or polypeptide chains. The activity of enzyme require characteristic

primary, secondary and tertiary nature of the protein.

Enzyme Action: For certain substrates to undergo chemical reaction, they have to be provided with enough of free energy to attain an activated state called transition state: This energy of activation acts as energy barrier and in its absence reaction fails to occur. Energy barrier is of different magnitude in different reactions. If energy barrier is low, large number of molecules will be in activated state which means that the reaction rate is fast. Conversely, if the energy barrier is higher, smaller number of molecules is in activated state and thus the reaction is slower. When an enzyme acts over a substrate, it combines with the substrate forming a transition state. (Enzyme-substrate complex) of lower free energy of activation. Enzyme, thus, creates an alternative pathway by which energy barrier is lowered, that is, required free energy of activation is diminished. H_2O_2 requires 18,000 cal/mol of free energy for activation, but in the presence of the enzyme catalase the free energy required is just 2,000 cal/mol. Likewise

hydrolysis of casein in the presence of H^+ ions requires 20,600 Cal/mol of activation energy, but in the presence of trypsin, the required energy of activation is only 12,000 Cal/mol.



Nomenclature & classification :-

Enzymes are mostly named by putting suffix -ase after the name of the substrate they act upon, namely urease, lipase, protease, glucose-6-phosphatase, and so on. Some of the names are very specific, such as glucose-6-phosphate dehydrogenase and glucose-6-phosphatase and some are even optically specific such as L+ β-hydroxyacyl coA dehydrogenase. Though even now trivial names such as pepsin and trypsin are still in use, with the discovery of about 2,000 enzyme. it has become imperative to devise a method of

of classifying enzymes to avoid anti. ambiguity in nomenclature.

Enzyme Commission of the International Union of Biochemistry (IUB) has adopted a classification of enzymes based on the nature of reaction they catalyse. According to IUB, enzymes have been classified into six classes in an established order and every class has been divided into subclasses and subclasses. Every enzyme has been given a code number of four digit in sequence representing class, subclass, sub-class and name of the enzyme. Enzyme Commission of IUB has classified enzymes into 6 classes, each being grouped further into 4-21 subclasses.

1. Oxidoreductases → They catalyse oxidation of a substrate (A) with simultaneous reduction of another substrate (B)

$$AH + B \xrightarrow{\text{oxidoreductase}} A + B\cdot H$$

The substrate undergoing oxidation or reduction may possess different groups such as CH-OH, CH=CH, C=O, CH-NH2 and C=NH. Subclasses are the following:—

A. Oxidoreductases acting on CH-OH.

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B. Oxidoreductaes acting on $=C=O$.
C. Oxidoreductaes acting on $-CH=CH-$
D. Oxidoreductaes acting on $-CH-NH_2$.
E. Oxidoreductaes acting on $-CH=NH$.

2. Transferaes :- Enzymes that catalyse the transfer of different groups other than hydrogen from one substrate to the other.

Subclaees of transferaes are following:-

A. Transferaes transferring one carbon ;
E.c Acetyl coA choline-O-acetyl transferaes. (choline-acyl transferaes)
B. Transferaes transferring aldehyde or Ketone group.
C. Transferaes transferring acyl group.
D. Transferaes transferring glucosyl groups
E. Transferaes transferring phosphate group.
F. Transferaes transferring sulfur-containing group.

3. Hydrolaes :- These enzymes bring about hydrolytic cleavage of different bonds grouped under different subclaees.

Subclaees of Hydrolaes are -
A. Hydrolaes hydrolyzing ester bond.

B. Hydrolases hydrolyzing glycoside bond.
C. Hydrolases hydrolyzing peptide bond.
D. Hydrolases hydrolyzing C-N bond other than peptide bond.
E. Hydrolases hydrolyzing acid anhydride.

4. Lyases - They catalyze removal of atoms or groups of atoms from substrate by non-hydrolytic process thereby leaving double bond.
Subclasses of lyases are -
A Lyases cleaving >C=C< bond.
B. Lyases cleaving >C=O bond.
C. Lyases cleaving >C=N bond.

5. Isomerases - These enzymes bring about Inter-conversion of different isomers, that is geometric; optical or positional isomers.
Subclasses of Isomerases are -
A. Racemases.
B. Cis-trans isomerase.
C. Interconversion of aldoloses and Ketoses.

6. Ligases - They are enzymes catalyzing bond formation at the expense of ATP.
Subclasses of ligases are -
A Ligation of C-O bond

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