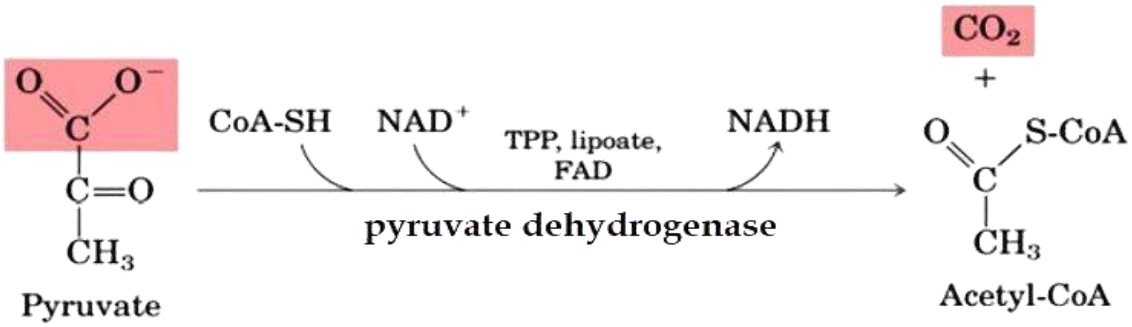
Enzymes

Classification of Enzymes:-

According to the International Union of Biochemists (I U B) enzymes are divided into six functional classes and are classified based on the type of reaction in which they are used to catalyze. and enzymes were often named by the suffix (ase)to the name of substrate as mentioned before. For example Maltase enzyme found in saliva; breaks the sugar maltose into glucose.

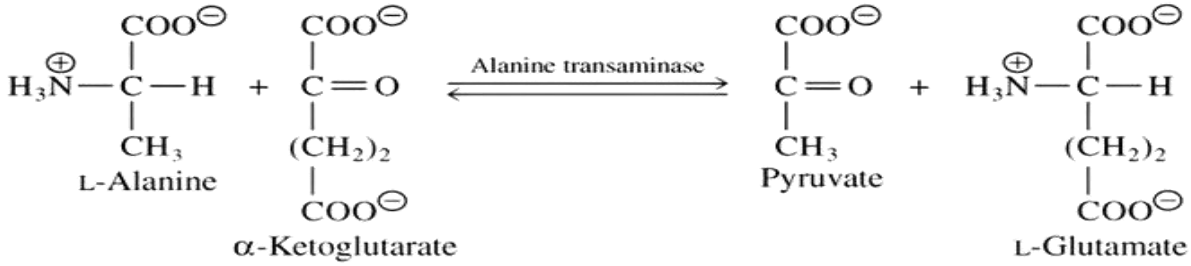
1. Oxido-reductases :- these catalyze oxidation and reduction reactions. for example, pyruvate dehydrogenase, which catalyzes the oxidation of pyruvate to acetyl coenzyme A.

$$A_{red} + B_{ox} \rightleftharpoons A_{ox} + B_{red}$$



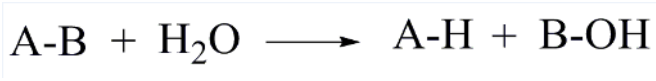
2. Transferases :-these catalyze the transfer of a chemical group from one compound to another. for example, is a transaminase, which transfers an amino group from one molecule to another.

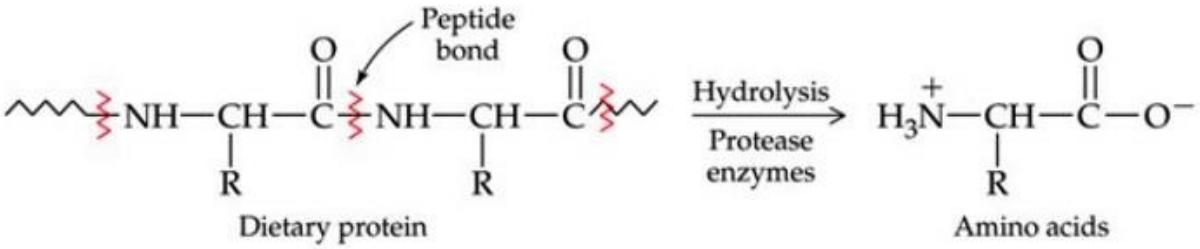
$$A\text{-}B + C \longrightarrow A + B\text{-}C$$



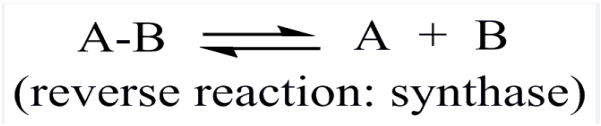
Enzymes

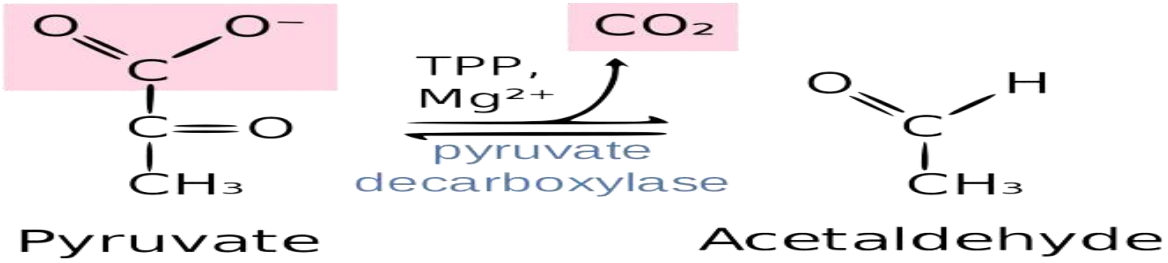
3. Hydrolases :- they catalyze the hydrolysis of a bond. for example, the enzyme pepsin hydrolyzes peptide bonds in proteins.



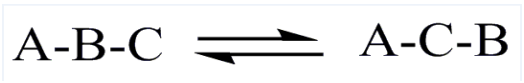


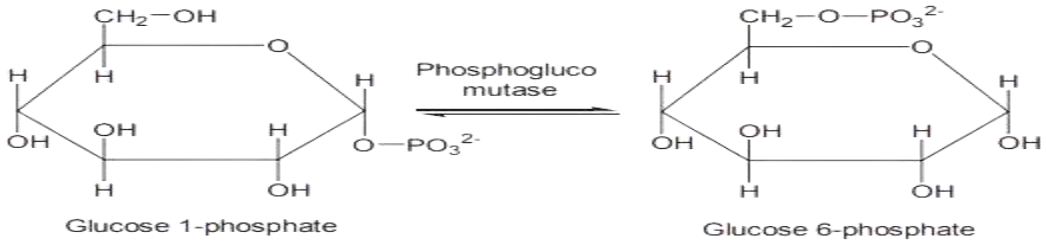
4. Lyases :- enzyme that catalyzes the breaking (an elimination reaction) of various chemical bonds by means other than hydrolysis , often forming a new double bond . for example, pyruvate decarboxylase.





5. Isomerases :- they catalyze the formation of an isomer of a compound. for example, phosphoglucomutase catalyzes the conversion of glucose-1-phosphate to glucose-6-phosphate (transfer of a phosphate group from one position to another in the same compound).





Enzymes

6. Ligases :- they catalyze to joining of two molecules with the cleavage of pyrophosphate bond of ATP or a similar compound. For example, DNA ligase catalyzes the joining of two fragments of DNA by forming a phosphodiester bond.

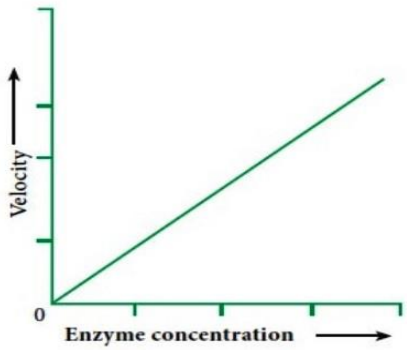
$$A + B + ATP \longrightarrow A\text{-}B + ADP + P_i$$

Factors affecting on velocity of Enzymes reactions:-

Different enzymes show different responses to change of enzyme and substrate concentration, temperature, and pH. Enzymes responses to these factors give us valuable clues as to show enzyme function in living cells.

A. Enzyme Concentration:-

The rate of an enzyme catalyzed reaction is directly proportional to the concentration of the enzyme .when the concentration of the enzyme is increased, the velocity of the reaction proportionately increases .this property of enzyme is used to determine the activities of serum enzymes in the diagnosis of diseases.

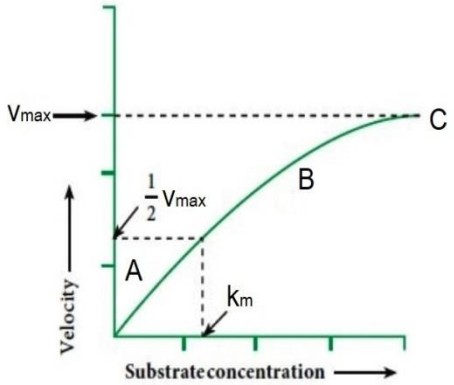


Effect of the enzyme concentration

Enzymes

B. Substrate Concentration :-

Increase in the substrate concentration gradually increases the velocity of enzyme reaction within the limited range of substrate levels.



Effect of the Substrate Concentration

In the above graph, shows three distinct phases.

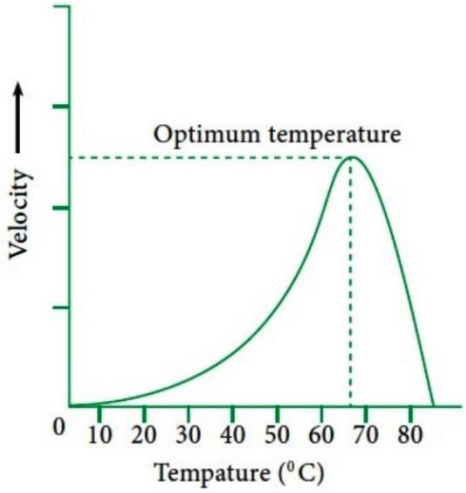
1. In the first phase (A), the velocity of the reaction is directly proportional to the substrate concentration.
2. In the second phase (B), the substrate concentration is not directly proportional to the enzyme activity.
3. In the third phase (C), the velocity remains constant and does not change with increase in the substrate concentration.

C. Temperature:-

Velocity of an enzyme reaction increases with increase in temperature up to a maximum and then declines. A bell-shaped curve is usually.

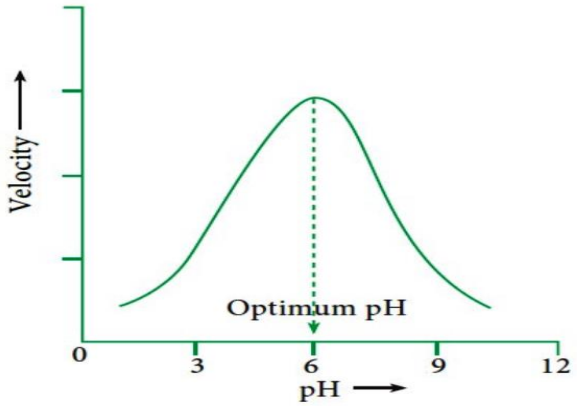
The optimum temperature for most of the enzymes is between 40°C-45°C. In general, when the enzymes are exposed to a temperature above 50°C, denaturation leading to derangement in the native (tertiary) structure of the protein and active site are seen. Majority of the enzymes become inactive at higher temperature (above 70°C).

Enzymes



Effect of the Temperature

D. PH:- Increase in the hydrogen ion concentration (pH) considerably influences the enzyme activity and a bell-shaped curve is normally obtained . Each enzyme has an optimum pH at which the velocity is maximum. most of the enzymes of higher organisms show optimum activity around neutral pH (6-8). There are many exceptions like pepsin (1-2), acid phosphatase (4-5) and alkaline phosphatase (10-11) for optimum pH.



Effect of the PH

Enzymes

- **Enzyme kinetics and K_m value:**

The enzyme (E) and substrate (S) combine with each other to form an unstable enzyme-substrate complex (ES) for the formation of product (P).

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_3} E + P$$

Here k_1, k_2 and k_3 represent the velocity constants for the respective reactions, as indicated by arrows.

Km, the Michaelis-Menten constant, is given by the formula.

$$K_m \frac{k_2 + k_3}{k_1}$$

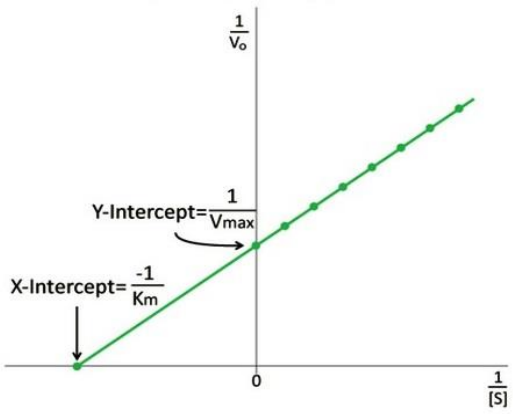
Km or the Michaelis-Menten constant is defined as the substrate concentration (expressed in moles/L) to produce half-maximum velocity in an enzyme catalyzed reaction.
Km value is a constant and a characteristic feature of a given enzyme. It is a representative for measuring the strength of ES complex. a low Km value indicates a strong affinity between enzyme and substrate, while a high Km value reflects a weak affinity between them
The Michaelis-Menten equation:-describes how reaction velocity varies with substrate concentration.

$$V_o = \frac{V_{max}[S]}{K_m + [S]}$$

Where,
V_0 = the initial velocity of the reaction.
V_{max} = the maximal rate of the reaction.
[S] = the concentration of the substrate.
K_m = the Michaelis-Menten constant (substrate concentration at half V_{max})

The Lineweaver-Burk plot:-

If $1/V_0$ is plotted versus 1/[S] straight line is obtained this plot , the Lineweaver-Burk plot can be used to calculate k_m and V_{max} as well as determine the mechanism of action of enzyme inhibitor the equation describing the Lineweaver-Burk plot is .



The Lineweaver-Burk Plot