Department of Microbiology
B.D. College, Patna-1
BSC. Part I IMB "Enzyme Kinetics"
Biochemistry
By Deepak Kumar

Enzyme Kinetics:- Enzyme Kinetics is the study of chemical reaction that are catalysed by enzymes. The rate of reaction is measured and the effects of different condition of reaction are investigated.

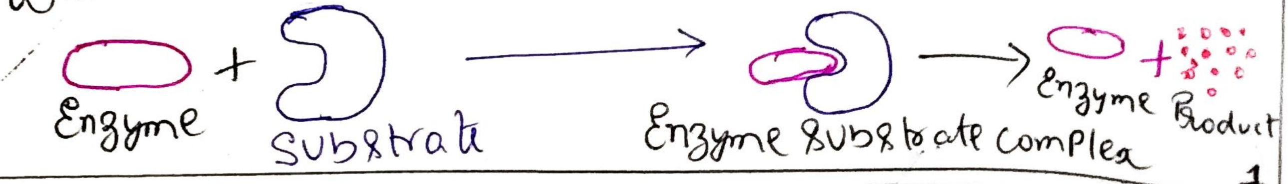
Importance:-

Enzymes are biological catalysts which increases the rate of reaction without taking part in it.

⇒ Enzyme are substrate specific and form an enzyme-substrate complex before forming a product.

⇒ Kinetics is the study of Rate of Reaction. that means rate of formation of product

⇒ Enzyme has a high affinity for the transition state as the substrate binds it quickly form the transition state as Enzyme-Substrate complex and which results in the formation of Products.



B.D. College

$$E + S \underset{K_{-1}}{\overset{K_1}{\rightleftharpoons}} ES \xrightarrow{K_2} E + P$$

Where K_1, K_{-1} and K_2 represent the rate constant for the individuals.

During Equilibrium State:- Based on Michalis-Menton Assumption.

Rate of formation :- According to first order reaction

$$K_1 [E][S] \rightarrow (1)$$

where K_1 is rate constant

[ ] – concentration

Rate of Breakdown.

$$K_{-1} [ES] \rightarrow (2)$$

During equilibrium state:-

Rate of formation = Rate of Breakdown

$$K_1 [E][S] = K_{-1} [ES]$$

$$\frac{[E][S]}{[ES]} = \frac{K_{-1}}{K_1} \quad \left(\because \frac{K_{-1}}{K_1} = K_S \right]$$

(K_S is Dissociation constant)

$$\frac{[E][S]}{[ES]} = K_S \rightarrow (3)$$

[Eo] = Total concentration of Enzyme

[E] = Concentration of free enzyme

[Es] - Concentration of Bound Enzyme.

$$[E_0] = [E] + [ES]$$

$$[E] = [E_0] - [ES] \quad \text{---(4)}$$

Putting the value of $[E]$ in eq -(3) we get

$$\frac{[E][S]}{[ES]} = K_S$$

$$\Rightarrow \frac{\{[E_0] - [ES]\}[S]}{[ES]} = K_S$$

$$\Rightarrow \{[E_0] - [ES]\}[S] = K_S[ES]$$

$$\Rightarrow [E_0][S] - [ES][S] = K_S[ES]$$

$$\Rightarrow [E_0][S] = K_S[ES] + [ES][S]$$

$$\Rightarrow [E_0][S] = [ES]\{K_S + [S]\}$$

$$\boxed{[ES] = \frac{[E_0][S]}{K_S + [S]}} \rightarrow 5$$

This governs / controls the rate of formation of Product.

$$\because V_0 = K_2[ES]$$

$$[ES] = \frac{V_0}{K_2}$$

$K_2 \rightarrow$ Rate concentration of formation of Product

Putting the value of $[ES]$ in eq (5) we get

$$\frac{V_0}{K_2} = \frac{[E_0][S]}{K_s + [S]}$$

$$V_0 = \frac{K_2 [E_0][S]}{K_s + [S]} \rightarrow (6)$$

When [S] is very high; all the enzyme present as [ES] and V_0 reaches V_{max}

$$V_{max} = K_2 [E_0] \rightarrow (7)$$

Putting the value of V_{max} in eq (6)

$$\therefore \boxed{V_0 = \frac{V_{max} [S]}{K_s + [S]}}$$

Significance of M-M Equation:-

⇒ One enzyme binds with single substrate and it is substrate specific.

⇒ Formation of single intermediate product