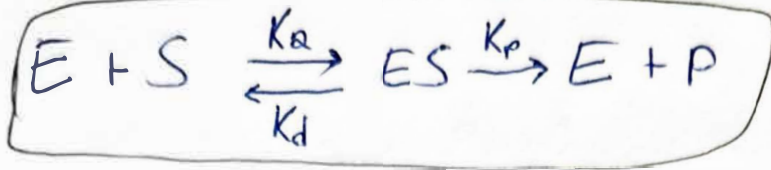


MICHAELIS-MENTEN



↳ Rate of Product formation: $\frac{d[P]}{dt} = k_p [ES]$

↳ Rate of Complex formation: $\frac{d[ES]}{dt} = k_a [E][S]$

↳ Rate of Complex breakdown: $\frac{d([E][S])}{dt} + \frac{d[P]}{dt} = (k_d + k_p) [ES]$
(complex separation)

⇒ At steady state the complex breakdown ≡ enzymatic reaction

$$\frac{d([E][S])}{dt} + \frac{d[P]}{dt} = \frac{d[ES]}{dt}$$

$$(k_d + k_p) [ES] = k_a [E][S]$$

→ $[ES] = \frac{k_a}{k_d + k_p} \cdot [E][S]$
concentration of the complex

K_M = Michaelis-Menten constant

$$K_M = \left(\frac{k_a}{k_d + k_p} \right)^{-1}$$

→ it shows how efficient is the enzyme.

→ Let's now consider $[E_0]$ as initial concentration of total enzyme

↳ enzyme "still" available will be: $([E_0] - [ES]) = [E]$

↳ We can re-write the concentration of the complex:

before $\rightarrow [ES] = \frac{[E][S]}{K_M}$

now $\rightarrow [ES] = \frac{([E_0] - [ES])[S]}{K_M} \rightarrow [ES] = [E_0] \cdot \frac{[S]}{[S] + K_M}$
we can rewrite as \rightarrow

How ??

Demonstration:

$$[ES] = \frac{([E_0] - [ES])[S]}{K_M} = \frac{[E_0][S]}{K_M} - \frac{[ES][S]}{K_M}$$

$$\rightarrow [ES] + \frac{[ES][S]}{K_M} = \frac{[E_0][S]}{K_M}$$

$$[ES] \left(1 + \frac{[S]}{K_M}\right) = \frac{[E_0][S]}{K_M} \rightarrow [ES] \left(\frac{K_M + [S]}{K_M}\right) = \frac{[E_0][S]}{K_M}$$

$$\rightarrow [ES] (K_M + [S]) = [E_0][S] \Rightarrow [ES] = [E_0] \frac{[S]}{[S] + K_M} \checkmark$$

• Now, let's think in terms of VELOCITY V

\rightarrow Velocity of $[P]$ production $\rightarrow V = \frac{d[P]}{dt} \rightarrow V_{max} = K_p [E_0]$

Recall: $\frac{d[P]}{dt} = K_p [ES]$ and $[ES] = [E_0] \cdot \frac{[S]}{[S] + K_M}$

$$\rightarrow \frac{d[P]}{dt} = \underbrace{K_p [E_0]}_{V_{max}} \frac{[S]}{[S] + K_M} \Rightarrow V = V_{max} \frac{[S]}{[S] + K_M}$$

Michaelis-Menten Equation