Michaeles Menton Derivation

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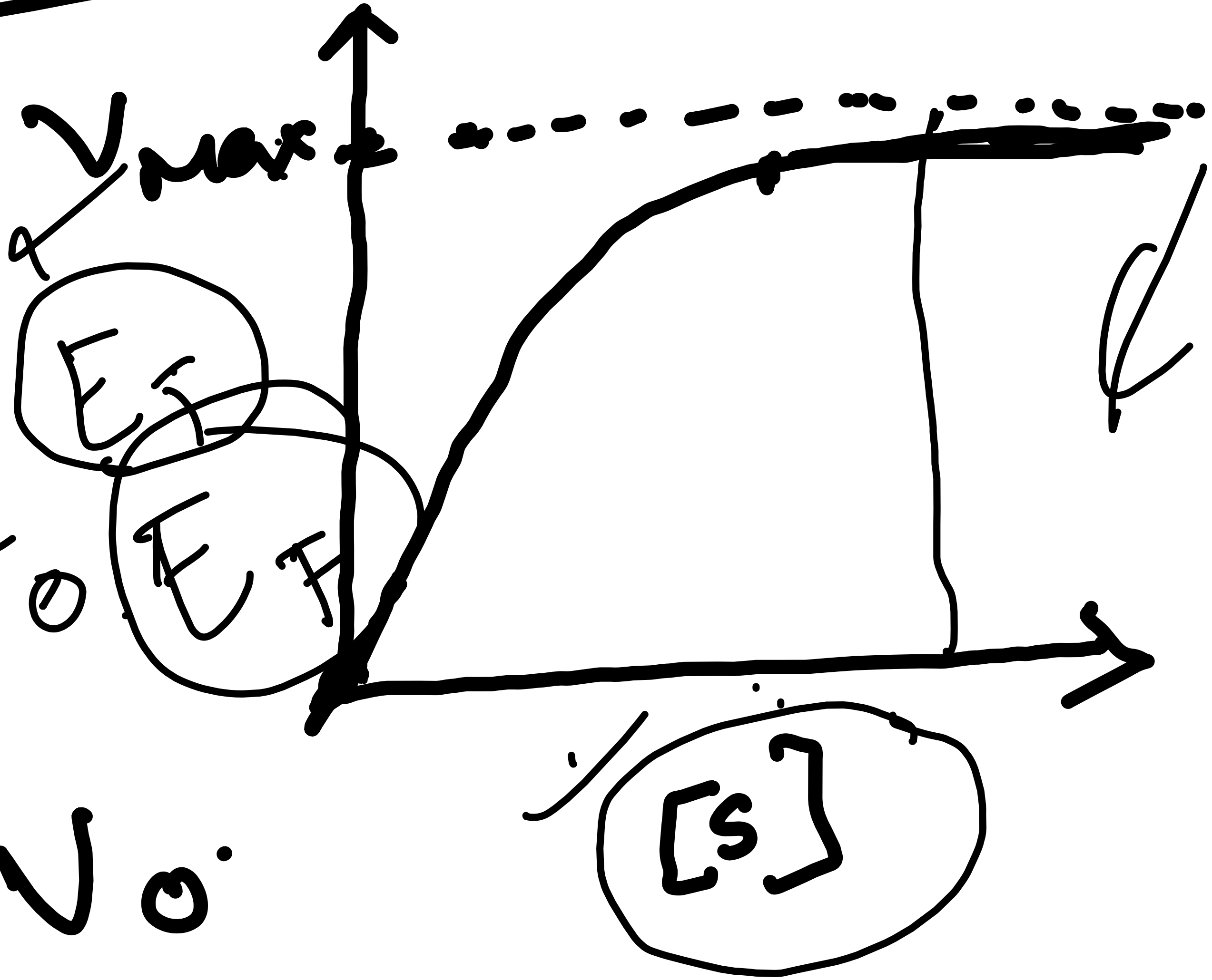
Enzyme Kinetics

E + S

ES



V

E

S

ES

Vo

- co-enz
- Enzymes
- active site
- Substrate
- Enz-S complex
- Lock & Key
- Induced fit

$$E + S \underset{K_2}{\overset{K_1}{\rightleftharpoons}} ES \underset{K_4}{\overset{K_3}{\rightleftharpoons}} E + P \quad \text{--- (1)}$$

$$V_0 = K_3 [ES] \quad \text{---- (2)}$$

$$[ES] = [E]_T \text{ at } V_{max}$$

$$V_{max} = K_3 [E]_T \quad \text{---- (3)}$$

At steady state → equilibrium

- Rate of formation of ES = $K_1 [E][S]$
- Rate of consumption of ES = $K_2 [ES] + K_3 [ES]$

R of consumption of ES = Rate of formation of ES

$$K_2 [ES] + K_3 [ES] = K_1 [E][S] \quad \text{--- (4)}$$

$$\frac{K_2 + K_3}{K_1} = \frac{[E][S]}{[ES]} \quad \text{--- (5)}$$

$$KM = \frac{K_2 + K_3}{K_1} \quad \text{--- (6)}$$

$K_M \rightarrow$ Michaelis constant.

- express [E] in terms of [ES] & $[E]_T$

$$[E] = [E]_T - [ES] \quad \text{---} \quad (7)$$

- Subs (6) & (7) eq. (5)

$$K_M = \frac{([E]_T - [ES])[S]}{[ES]} \quad \text{---} \quad (8)$$

$$* \; K_M = \frac{([E_T] - [ES])[S]}{[ES]}$$

$$\Rightarrow [ES] K_M = [E_T][S] - [ES][S]$$

$$\Rightarrow [ES] K_M + [ES][S] = [E_T][S]$$

$$\Rightarrow [ES](K_M + [S]) = [E_T][S]$$

$$\Rightarrow [ES] = \frac{[E_T][S]}{K_M + [S]} \quad \text{---} \quad (9)$$

$$[ES] = \frac{[E]_T [S]}{K_M + [S]} \quad \text{-----} \quad (9)$$

Subs (9) in (2)

$$V_0 = \frac{K_3 [E]_T [S]}{K_M + [S]} \quad \text{----} \quad (10)$$

Subs eq (3) in eq (10)

$$V_0 = \frac{V_{Max} [S]}{K_M + [S]} \rightarrow \text{MM eq}$$