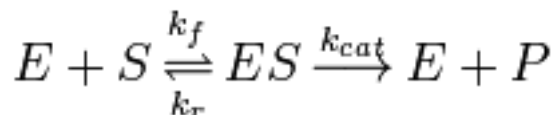


Michaelis-Menten enzymkinetik

http://en.wikipedia.org/wiki/Michaelis%E2%80%93Menten_kinetics

Formler:



$$[E] + [ES] = [E]_0$$

$$K_m = \frac{k_r + k_{cat}}{k_f}$$

$$K_d = k_r / k_f$$

$$V_{max} = k_{cat}[E]_0$$

Differentialligningssystem:

$$\begin{aligned} d[S]/dt &= -k_f [E][S] + k_r [ES] \\ d[E]/dt &= -k_f [E][S] + k_r [ES] + k_{cat} [ES] \\ d[ES]/dt &= +k_f [E][S] - k_r [ES] - k_{cat} [ES] \\ d[P]/dt &= +k_{cat} [ES] \end{aligned}$$

1) Ligevægts approksimation:

$$k_f [E][S] = k_r [ES]$$

2) Kvasi-steady-state approksimation:

$$k_f [E][S] = k_r [ES] + k_{cat} [ES]$$

Udledning af formler:

1) Ligevægts approksimation:

$$[E] + [ES] = [E]_0 \Leftrightarrow [E] = [E]_0 - [ES]$$

indsættes i:

$$k_f [E] \cdot [S] = k_r \cdot [ES]$$

Og får hermed:

$$k_f ([E]_0 - [ES]) \cdot [S] = k_r \cdot [ES] \Leftrightarrow k_f [E]_0 \cdot [S] - k_f [S] \cdot [ES] = k_r \cdot [ES] \Leftrightarrow k_f [E]_0 \cdot [S] = k_f [S] \cdot [ES] + k_r \cdot [ES] \Leftrightarrow$$

$$k_f [E]_0 \cdot [S] = (k_f [S] + k_r) \cdot [ES] \Leftrightarrow [ES] = \frac{k_f [E]_0 \cdot [S]}{k_f [S] + k_r} \Leftrightarrow [ES] = \frac{[E]_0 \cdot [S]}{\frac{k_r}{k_f} + [S]} \Leftrightarrow$$

$$\underline{\underline{[ES] = \frac{[E]_0 \cdot [S]}{K_d + [S]}}}$$

Fra differentialligningssystemet har vi:

$$\frac{d[P]}{dt} = + k_{cat} \cdot [ES]$$

derfor gælder

$$\underline{\underline{v = \frac{d[P]}{dt} = k_{cat} \cdot \frac{[E]_0 \cdot [S]}{K_d + [S]} = \frac{k_{cat} \cdot [E]_0 \cdot [S]}{K_d + [S]} = \frac{V_{max} \cdot [S]}{K_d + [S]}}}$$

Følgende formel er hermed udledt:

$$v = d[P]/dt = \frac{V_{max} [S]}{K_d + [S]}$$

2) Kvasi-steady-state approksimation:

$$[E] + [ES] = [E]_0 \Leftrightarrow [E] = [E]_0 - [ES]$$

indsættes i:

$$k_f [E] \cdot [S] = k_r \cdot [ES] + k_{cat} \cdot [ES]$$

Og får hermed:

$$k_f ([E]_0 - [ES]) \cdot [S] = k_r \cdot [ES] + k_{cat} \cdot [ES] \Leftrightarrow k_f [E]_0 \cdot [S] - k_f [S] \cdot [ES] = k_r \cdot [ES] + k_{cat} \cdot [ES] \Leftrightarrow k_f [E]_0 \cdot [S] = k_f [S] \cdot [ES] + k_r \cdot [ES] + k_{cat} \cdot [ES] \Leftrightarrow$$

$$k_f [E]_0 \cdot [S] = (k_f [S] + k_r + k_{cat}) \cdot [ES] \Leftrightarrow [ES] = \frac{k_f [E]_0 \cdot [S]}{k_f [S] + k_r + k_{cat}} \Leftrightarrow [ES] = \frac{[E]_0 \cdot [S]}{\frac{k_r + k_{cat}}{k_f} + [S]} \Leftrightarrow \underline{\underline{[ES] = \frac{[E]_0 \cdot [S]}{K_m + [S]}}}$$

Fra differentialligningssystemet har vi:

$$\frac{d[P]}{dt} = + k_{cat} \cdot [ES]$$

derfor gælder

$$\underline{\underline{v = \frac{d[P]}{dt} = k_{cat} \cdot \frac{[E]_0 \cdot [S]}{K_m + [S]} = \frac{k_{cat} \cdot [E]_0 \cdot [S]}{K_m + [S]} = \frac{V_{max} \cdot [S]}{K_m + [S]}}}$$

Følgende formel er hermed udledt:

$$v = d[P]/dt = \frac{V_{\max}[S]}{K_m + [S]}$$