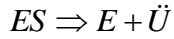
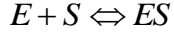


Enzim İnhibisyonu**Tersinmez İnhibisyon**

Tersinmez inhibitör (enzim zehirleri) etkisini, enzimin aktif grubunu kimyasal değişime uğratarak gösterir.

Yarışmalı İnhibisyon (Competitive Inhibition): Substrat ile inhibitör aynı aktif konum için yarışır.



Yaklaşık yataşkın koşul varsayımı:

$$\frac{dC_{ES}}{dt} = 0 ; \quad \frac{dC_{EI}}{dt} = 0 ; \quad r = k_2 C_{ES}$$

$$\frac{dC_{ES}}{dt} = k_1 C_E C_S - k_{-1} C_{ES} - k_2 C_{ES} = 0$$

$$C_{ES} = \frac{k_1}{k_{-1} + k_2} C_E C_S \quad C_{ES} = \frac{C_E C_S}{Km}$$

$$\frac{dC_{EI}}{dt} = k_i C_E C_I - k_{-i} C_{EI} = 0$$

$$C_{EI} = \frac{k_i}{k_{-i}} C_E C_I \quad C_{EI} = \frac{C_E C_I}{Ki}$$

Enzim için: $C_{Eo} = C_E + C_{ES} + C_{EI}$

$$C_{Eo} = C_E + \frac{C_E C_I}{Ki} + \frac{C_E C_S}{Km}$$

$$C_E = \frac{C_{Eo}}{1 + \frac{C_S}{Km} + \frac{C_I}{Ki}}$$

C_{ES} de yerine konursa:

$$C_{ES} = \frac{C_S}{Km} \times \frac{C_{Eo}}{1 + \frac{C_S}{Km} + \frac{C_I}{Ki}}$$

$$C_{ES} = \frac{C_S C_{Eo}}{Km + C_S + \frac{Km}{Ki} C_I}$$

$$\text{Tepkime hız ifadesi: } r = k_2 C_{ES} = \frac{k_2 C_{Eo} C_S}{C_S + Km(1 + \frac{C_I}{Ki})}$$

$$r = \frac{r_{\max} C_S}{C_S + Km(1 + \frac{C_I}{K_i})}$$

MM denklemini doğrusallaştırılırsa: $\frac{1}{r} = \frac{Km}{r_{\max}} (1 + \frac{C_I}{K_i}) \frac{1}{C_S} + \frac{1}{r_{\max}}$

$(\frac{1}{r}; \frac{1}{C_S})$ grafiğinde $egim = \frac{Km}{r_{\max}} (1 + \frac{C_I}{K_i})$ $kayma = \frac{1}{r_{\max}}$

Yarışmasız İnhibisyon (Noncompetitive İnhibition)



MM yaklaşımı ile:

Enzim için: $C_{Eo} = C_E + C_{ES} + C_{EI} + C_{ESI}$

Denge sabitlerinden: $C_{ES} = \frac{C_E C_S}{K_S}$

$$C_{EI} = \frac{C_E C_I}{K_i}$$

$$C_{ESI} = \frac{C_{ES} C_I}{K_i} = \frac{C_E C_S C_I}{K_i K_S}$$

$$C_{Eo} = C_E + \frac{C_E C_S}{K_S} + \frac{C_E C_I}{K_i} + \frac{C_E C_S C_I}{K_i K_S}$$

$$C_{Eo} = C_E (1 + \frac{C_S}{K_S} + \frac{C_I}{K_i} + \frac{C_S C_I}{K_i K_S})$$

$$C_E = \frac{C_{Eo}}{(1 + \frac{C_S}{K_S} + \frac{C_I}{K_i} + \frac{C_S C_I}{K_i K_S})}$$

$$C_{ES} = \frac{C_S}{K_S} \times \frac{C_{Eo}}{(1 + \frac{C_S}{K_S} + \frac{C_I}{K_i} + \frac{C_S C_I}{K_i K_S})}$$

$$C_{ES} = \frac{C_{Eo} C_S}{(K_S + C_S + \frac{C_I K_S}{K_i} + \frac{C_S C_I}{K_i})}$$

$$r = k_2 C_{ES} = \frac{k_2 C_E C_S}{K_S \left(1 + \frac{C_I}{K_i}\right) + C_S \left(1 + \frac{C_I}{K_i}\right)}$$

$$r = \frac{C_S r_{\max}}{(K_S + C_S) \left(1 + \frac{C_I}{K_i}\right)}$$

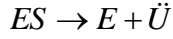
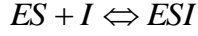
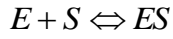
$$K_S = \frac{k_{-1}}{k_1} \quad K_m = \frac{k_{-1} + k_2}{k_1} \quad k_2 \ll k_{-1} \Rightarrow K_m = K_S$$

$$r = \frac{C_S r_{\max}}{(K_m + C_S) \left(1 + \frac{C_I}{K_i}\right)}$$

$$\frac{1}{r} = \frac{K_m}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right) \frac{1}{C_S} + \frac{1}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right)$$

Bu $\left(\frac{1}{r}; \frac{1}{C_S}\right)$ grafiğinde $egim = \frac{K_m}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right)$ ve $kayma = \frac{1}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right)$ olur.

Sınırlı Yarışmalı (Yarışmalı Olmayan) İnhibisyon



Yaklaşık yatışkın koşul varsayımı:

$$\frac{dC_{ES}}{dt} = 0 \quad \frac{dC_{ESI}}{dt} = 0 \quad r = k_2 C_{ES}$$

$$\frac{dC_{ES}}{dt} = k_1 C_E C_S - k_{-1} C_{ES} - k_i C_{ES} C_I + k_{-i} C_{ESI} - k_2 C_{ES} = 0$$

$$C_{ES} = \frac{k_1 C_E C_S + k_{-i} C_{ESI}}{(k_{-1} + k_i C_I + k_2)}$$

$$\frac{dC_{ESI}}{dt} = k_i C_{ES} C_I - k_{-i} C_{ESI} = 0$$

$$C_{ESI} = \frac{C_{ES} C_I}{(k_{-i} / k_i)}$$

C_{ES} 'de yerine konursa:

$$C_{ES} = \frac{k_1 C_E C_S + k_{-i} \frac{C_{ES} C_I}{(k_{-i} / k_i)}}{(k_{-1} + k_i C_I + k_2)}$$

$$[(k_{-1} + k_2 + k_i C_I) - k_i C_I] C_{ES} = k_1 C_E C_S$$

$$C_{ES} = \frac{k_1 C_E C_S}{(k_{-1} + k_2)}$$

$$C_{ESI} = \frac{C_I}{K_i} x \frac{k_1 C_E C_S}{(k_{-1} + k_2)}$$

Enzim için: $C_{Eo} = C_E + C_{ES} + C_{ESI}$

$$C_{Eo} = C_E + \frac{k_1 C_S}{(k_{-1} + k_2)} C_E + \frac{k_1 C_I C_S}{K_i (k_{-1} + k_2)} C_E$$

$$C_E = \frac{C_{Eo}}{1 + \frac{k_1 C_S}{(k_{-1} + k_2)} + \frac{k_1 C_I C_S}{K_i (k_{-1} + k_2)}}$$

C_{ES} 'de yerine konursa:

$$C_{ES} = \frac{k_1}{(k_{-1} + k_2)} x \frac{C_{Eo}}{1 + \frac{k_1 C_S}{(k_{-1} + k_2)} + \frac{k_1 C_I C_S}{K_i (k_{-1} + k_2)}}$$

$$C_{ES} = \frac{C_{Eo} C_S}{\frac{k_{-1} + k_2}{k_1} + C_S + \frac{C_I C_S}{K_i}}$$

$$C_{ES} = \frac{C_{Eo} C_S}{K_m + C_S + \frac{C_I C_S}{K_i}}$$

Tepkime hız ifadesi: $r = k_2 C_{ES}$ $r = \frac{k_2 C_{Eo} C_S}{K_m + C_S + \frac{C_I C_S}{K_i}}$ $r = \frac{r_{\max} C_S}{K_m + C_S \left(1 + \frac{C_I}{K_i}\right)}$

Denklem doğrusallaştırılırsa:

$$\frac{1}{r} = \frac{K_m}{r_{\max}} \frac{1}{C_S} + \frac{1}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right)$$

Bu $\left(\frac{1}{r}; \frac{1}{C_S}\right)$ grafiğinde $egim = \frac{K_m}{r_{\max}}$ ve $kayma = \frac{1}{r_{\max}} \left(1 + \frac{C_I}{K_i}\right)$ olan doğru denklemdir.

Kaynak:

1. Bailey JE and Ollis DF, 1986. Biochemical Engineering Fundamentals, McGraw Hill, 2.baskı, NY
2. Shuler, ML and Kargı F, 2001. Bioprocess Engineering: Basic Concepts, 2. Baskı, Prentice Hall, NJ