Enzyme Kinetics

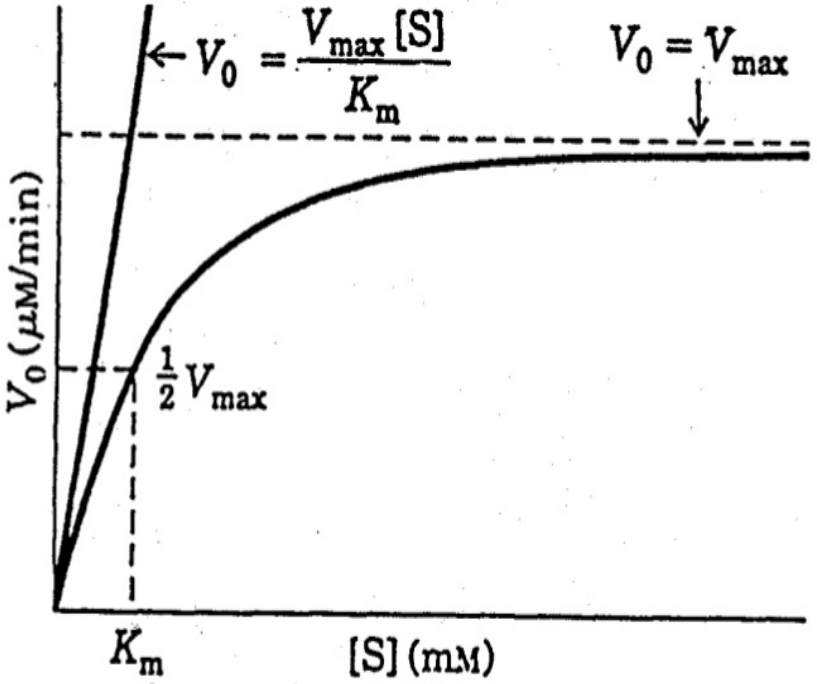
Questions and answers

2nd year undergraduates- Biology
2018-2019

أ.م. د. زهراء سالم محسن

Michaelis-Menten equation

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$



V_0= initial velocity
Vmax= maximum velocity
[S]= substrate concentration
Km= Michaelis constant= [S] when the velocity of the reaction is ½ V max

Q3 An enzyme hydrolyzed a substrate concentration of 0.03 mmol/L ,the initial velocity was $1.5x10^{-3}$ mmol/L.min^{-1} and the maximum velocity was 4.5x10-3 mmol/L.min^{-1} . Calculate the km value.

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$S1 = 0.03$

$V_{o1} = 1.5*10\text{-}3$

$Vmax = 4.5*10\text{-}3$

$Km = ?$

$$1.5*10^{-3} = \frac{4.5*10^{-3} * 0.03}{Km + 0.03}$$

$$Km + 0.03 = \frac{4.5*10^{-3} * 0.03}{1.5*10^{-3}}$$

$$Km + 0.03 = 0.135*10^{-3} / 1.5*10^{-3}$$

$$Km + 0.03 = 0.09$$

$$Km = 0.06$$

Q1 Urease enzyme hydrolyzed urea at [S]= 0.03 mmol/L with a *Km* value of around 0.06 mmol/L. The initial velocity observed was $1.5x10^{-3}$ mmol/L.min-1 . Calculate the maximum velocity of the enzymatic reaction

Solution

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

S1= 0.03

Km= 0.06

V_{o1}= 1.5*10-3

V_{max}=?

$$1.5*10^{-3} = \frac{Vmax* 0.03}{0.06 + 0.03}$$

$$Vmax = 1.5*10^{-3} * 3$$

$$=4.5*10^{-3}$$

Q2 An enzyme with a Km of 0.06 mmol/L hydrolyzed a substrate of a concentration 0.03 mmol/L. The initial velocity of the reaction was 0.0015 mmol/L.min $^{-1}$. Calculate the substrate concentration which gives an initial velocity of 0.003 mmol/L.min^{-1} .

Solution

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

$S1 = 0.03$

$Km = 0.06$

$V_{o1} = 1.5*10\text{-}3$

$V_{02} = 3 \ *10\text{-}3$

$S_2 = ?$

$1.5*10^{-3} = Vmax* \frac{0.03}{0.06 + 0.03}$

$3*10^{-3} = \frac{4.5*10^{-3} * S_2}{0.06 + S_2}$

$Vmax = 1.5*10^{-3} * 3$

$=4.5*10^{-3}$

S2= 0.12 mmol/L

Q1 Urease enzyme hydrolyzed urea at [S]= 0.03 mmol/L with a *Km* value of around 0.06 mmol/L. The initial velocity observed was $1.5x10^{-3}$ mmol/L.min-1 . Calculate the initial velocity of the enzymatic reaction when using [S]= 0.12 mmol/L.

Solution

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

S1= 0.03

Km= 0.06

V_{o1}= 1.5*10-3

S_2=0.12

V_{02}=?

$$1.5*10^{-3} = \frac{Vmax* 0.03}{0.06 + 0.03}$$

$$V_{o2} = \frac{4.5*10^{-3} * 0.12}{0.06 + 0.12}$$

$Vmax = 1.5*10^{-3} * 3$

$=4.5*10^{-3}$

$V_{02} = 3*10^{-3}$

Q3 An enzyme hydrolyzed a substrate concentration of 0.03 mmol/L ,the initial velocity was $1.5x10^{-3}$ mmol/L.min^{-1} and the maximum velocity was 4.5x10-3 mmol/L.min^{-1} . Calculate the substrate concentration that gives a velocity of $3x10^{-3}$ mmol/L.min-1 .

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$

S_1= 0.03
V_{o1}= 1.5*10-3
Vmax= 4.5*10-3
V_{02}= 3 *10-3
S_2 =?

1. Use the Michaelis-Menton Equation to calculate the missing values of [S] given below if V_{max} = 5 mmol/min. Plot [S] versus V . Draw line parallel to the x-axis at V_{max} and extend your plotted line to show its approach to V_{max}.

[S] (mM)	V (mmol/min)
10	1.2
$[S]_1$	1.7
$[S]_2$	2.1
$[S]_3$	2.2
$[S]_4$	2.5

$$v_0 = \frac{V_{max}[S]}{K_m + [S]}$$