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Mathematical functions of the rate of enzymatic reaction with temperature, concentration of substrate and concentration of enzyme are proved that the divide differences are symmetrical in all their arguments

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Abstract

In this research paper, I used mathematical functions of the rate of enzymatic reaction for proving the divide differences are symmetrical in all their argument. The concentration of substrate is the limiting factor, as the substrate concentration increases, the Enzyme reaction rate increases. Assuming a sufficient concentration of substrate is available, increasing Enzyme concentration will increase the enzymatic reaction rate. The rise in Temperature accelerates an Enzyme reaction but at the same time causes inactivation of the protein. At certain Temperature known as the optimum Temperature the activity is maximum. Temperature, concentration of substrate and concentration of enzyme are increased the rate of enzymatic reaction at a limit which is called optimum limit. I take their values in mathematical form where "n" is optimum limit.

Keywords: *Concentration of enzyme, Concentration of substrate, Divide differences, Mathematical functions, rate of enzymatic reaction, Temperature.*

1 Introduction

Mathematical functions of the rate of enzymatic reaction with temperature, concentration of substrate and concentration of enzyme are $V = f(E)$, $V = f(S)$ and $V = f(T)$ [1]. These mathematical functions are show that "the concentration of substrate is the limiting factor, as the substrate concentration increases, the Enzyme reaction rate increases. Assuming a sufficient concentration of substrate is available, increasing Enzyme concentration will increase the rate of enzymatic reaction. Temperature, concentration of substrate and concentration of enzyme are increased the rate of enzymatic reaction at a limit which is called optimum limit [2]-[5]." Divide differences are symmetrical in all their arguments [6].

2 Divide differences are symmetrical with $V = f(T)$

If $(T_0,V_0),(T_1,V_1).....(T_n,V_n)$ denoted the values of the function where V is the rate of enzymatic reaction with Temperature then $\frac{V_1-V_0}{T_1-T_0}$ $\frac{V_2-V_1}{T_2-T_1}$, $\frac{V_3-V_2}{T_3-T_2}$, $\frac{V_4-V_3}{T_4-T_3}$,…, $\frac{V_n-V_{n-1}}{T_n-T_{n-1}}$ are called the divide differences of T. We know that the first divide difference with two arguments T_0,T_1 is given by

$$f(T_0,T_1)=\frac{f(T_1)-f(T_0)}{T_1-T_0}$$

$$f(T_0,T_1)=\frac{f(T_0)}{T_0-T_1}+\frac{f(T_1)}{T_1-T_0}$$

Again second difference with three arguments T_0,T_1,T_2 is given by

$$f(T_0,T_1,T_2)=\frac{f(T_1,T_2)-f(T_0,T_1)}{T_2-T_0}$$

$$f(T_0,T_1,T_2)=\frac{f(T_0,T_1)}{T_0-T_2}+\frac{f(T_1,T_2)}{T_2-T_0}$$

$$f(T_0,T_1,T_2)=\left[f(T_0,T_1)-f(T_1,T_2)\right]\frac{1}{T_0-T_2}$$

$$f(T_0,T_1,T_2)=\left[\frac{f(T_1)-f(T_0)}{T_1-T_0}-\frac{f(T_2)-f(T_1)}{T_2-T_1}\right]\frac{1}{T_0-T_2}$$

$$f(T_0,T_1,T_2)=\left[\frac{f(T_0)}{T_1-T_0}-\frac{f(T_0)}{T_1-T_0}+\frac{f(T_1)}{T_2-T_1}-\frac{f(T_2)}{T_2-T_1}\right]\frac{1}{T_0-T_2}$$

$$f(T_0,T_1,T_2)=\frac{f(T_0)}{(T_0-T_1)(T_0-T_2)}-\frac{f(T_1)}{(T_1-T_0)(T_1-T_2)}+\frac{f(T_1)}{(T_1-T_0)(T_2-T_1)}$$

Similarly

$$f(T_0,T_1,T_2,T_3)=\frac{f(T_0)}{(T_0-T_1)(T_0-T_2)(T_0-T_2)}+\frac{f(T_1)}{(T_1-T_0)(T_1-T_2)(T_1-T_2)}+\frac{f(T_2)}{(T_2-T_0)(T_2-T_1)(T_2-T_3)}+\frac{f(T_3)}{(T_3-T_0)(T_3-T_1)(T_3-T_2)}$$

And in general

$$f(T_0,T_1,T_2,...,T_n)=\frac{f(T_0)}{(T_0-T_1)(T_0-T_2)...(T_0-T_n)}+\frac{f(T_1)}{(T_1-T_0)(T_1-T_2)...(T_1-T_n)}+...+\frac{f(T_n)}{(T_n-T_0)(T_n-T_1)...(T_n-T_{n-1})}$$

3 Divide differences are symmetrical with $V=f(S)$

If $(S_0,V_0),(S_1,V_1)...(S_n,V_n)$ denoted the values of the function where V is the rate of enzymatic reaction with concentration of substrate then $\frac{V_1-V_0}{S_1-S_0}$ $\frac{V_2-V_1}{S_2-S_1}$, $\frac{V_3-V_2}{S_3-S_2}$, $\frac{V_4-V_3}{S_4-S_3}$,…, $\frac{V_n-V_{n-1}}{S_n-S_{n-1}}$ are called the divide differences of S . We know that the first divide difference with two arguments S_0,S_1 is given by

$$f(S_0,S_1)=\frac{f(S_1)-f(S_0)}{S_1-S_0}$$

$$f(S_0,S_1)=\frac{f(S_0)}{S_0-S_1}+\frac{f(S_1)}{S_1-S_0}$$

Again second difference with three arguments S_0,S_1,S_2 is given by

$$f(S_0,S_1,S_2)=\frac{f(S_1,S_2)-f(S_0,S_1)}{S_2-S_0}$$

$$f(S_0,S_1,S_2)=\frac{f(S_0,S_1)}{S_0-S_2}+\frac{f(S_1,S_2)}{S_2-S_0}$$

$$f(S_0,S_1,S_2)=\left[f(S_0,S_1)-f(S_1,S_2)\right]\frac{1}{S_0-S_2}$$

$$f(S_0,S_1,S_2)=\left[\frac{f(S_1)-f(S_0)}{S_1-S_0}-\frac{f(S_2)-f(S_1)}{S_2-S_1}\right]\frac{1}{S_0-S_2}$$

$$f(S_0,S_1,S_2)=\left[\frac{f(S_0)}{S_1-S_0}-\frac{f(S_0)}{S_1-S_0}+\frac{f(S_1)}{S_2-S_1}-\frac{f(S_2)}{S_2-S_1}\right]\frac{1}{S_0-S_2}$$

$$f(S_0,S_1,S_2)=\frac{f(S_0)}{(S_0-S_1)(S_0-S_2)}-\frac{f(S_1)}{(S_1-S_0)(S_1-S_2)}+\frac{f(S_1)}{(S_1-S_0)(S_2-S_1)}$$

Similarly

$$f(S_0,S_1,S_2,S_3)=\frac{f(S_0)}{(S_0-S_1)(S_0-S_2)(S_0-S_2)}+\frac{f(S_1)}{(S_1-S_0)(S_1-S_2)(S_1-S_2)}+\frac{f(S_2)}{(S_2-S_0)(S_2-S_1)(S_2-S_3)}+\frac{f(S_3)}{(S_3-S_0)(S_3-S_1)(S_3-S_2)}$$

And in general

$$f(S_0,S_1,...,S_n)=\frac{f(S_0)}{(S_0-S_1)(S_0-S_2)..(S_0-S_n)}+\frac{f(S_1)}{(S_1-S_0)(S_1-S_2)..(S_1-S_n)}+...+\frac{f(S_n)}{(S_n-S_0)(S_n-S_1)..(S_n-S_{n-1})}$$

4 Divide differences are symmetrical with $V=f(E)$

If $(E_0,V_0),(E_1,V_1)...(E_n,V_n)$ denoted the values of the function where V is the rate of enzymatic reaction with concentration of enzyme then $\frac{V_1-V_0}{E_1-E_0}$ $\frac{V_2-V_1}{E_2-E_1}$, $\frac{V_3-V_2}{E_3-E_2}$, $\frac{V_4-V_3}{E_4-E_3}$,..., $\frac{V_n-V_{n-1}}{E_n-E_{n-1}}$ are called the divide differences of E . We know that the first divide difference with two arguments E_0,E_1 is given by

$$f(E_0,E_1)=\frac{f(E_1)-f(E_0)}{E_1-E_0}$$

$$f(E_0,E_1)=\frac{f(E_0)}{E_0-E_1}+\frac{f(E_1)}{E_1-E_0}$$

Again second difference with three arguments E_0,E_1,E_2 is given by

$$f(E_0,E_1,E_2)=\frac{f(E_1,E_2)-f(E_0,E_1)}{E_2-E_0}$$

$$f(E_0,E_1,E_2)=\frac{f(E_0,E_1)}{E_0-E_2}+\frac{f(E_1,E_2)}{E_2-E_0}$$

$$f(E_0,E_1,E_2)=\left[f(E_0,E_1)-f(E_1,E_2)\right]\frac{1}{E_0-E_2}$$

$$f(E_0,E_1,E_2)=\left[\frac{f(E_1)-f(E_0)}{E_1-E_0}-\frac{f(E_2)-f(E_1)}{E_2-E_1}\right]\frac{1}{E_0-E_2}$$

$$f(E_0,E_1,E_2)=\left[\frac{f(E_0)}{E_1-E_0}-\frac{f(E_0)}{E_1-E_0}+\frac{f(E_1)}{E_2-E_1}-\frac{f(E_2)}{E_2-E_1}\right]\frac{1}{E_0-E_2}$$

$$f(E_0,E_1,E_2)=\frac{f(E_0)}{(E_0-E_1)(E_0-E_2)}-\frac{f(E_1)}{(E_1-E_0)(E_1-E_2)}+\frac{f(E_1)}{(E_1-E_0)(E_2-E_1)}$$

Similarly

$$f(E_0,E_1,E_2,E_3)=\frac{f(E_0)}{(E_0-E_1)(E_0-E_2)(E_0-E_2)}+\frac{f(E_1)}{(E_1-E_0)(E_1-E_2)(E_1-E_2)}+\frac{f(E_2)}{(E_2-E_0)(E_2-E_1)(E_2-E_3)}+\frac{f(E_3)}{(E_3-E_0)(E_3-E_1)(E_3-E_2)}$$

And in general

$$f(E_0,E_1,...,E_n)=\frac{f(E_0)}{(E_0-E_1)(E_0-E_2)...(E_0-E_n)}+\frac{f(E_1)}{(E_1-E_0)(E_1-E_2)...(E_1-E_n)}+...+\frac{f(E_n)}{(E_n-E_0)(E_n-E_1)...(E_n-E_{n-1})}$$

5 Conclusion

Conclusively it can be stated that mathematical functions of the rate of enzymatic reaction are proved the divide differences are symmetrical in all their arguments with temperature, concentration of substrate and concentration of enzyme. Mathematical functions are worked in $\boldsymbol{n}$ limit which is optimum limit.

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