Competitive Inhibition

Competitive inhibition is a type of inhibition which reduces the effectiveness of enzymes at catalyzing reactions. Most types of competitive inhibition are reversible, meaning that the enzyme is not permanently altered in any way. In this process, the substrate competes with the inhibitor to bind to the active site. Thus, by increasing the amount of substrate, the inhibiting complex can be overcome. Inhibition does not affect Vmax, because adding more substrate will allow the reaction to occur at the non-inhibited maximum rate (this is where the substrate out-competes the inhibitor). However, inhibition does increase Km, the substrate concentration at one-half of Vmax, because it takes more substrate to reach Vmax or one-half Vmax.



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Reversible Inhibition

Driving in Reverse

Most examples of competitive inhibition are reversible, meaning that the enzyme is not permanently altered and the inhibition process is reversible.

Constant Vmax

Single Vmax finish line

In competitive inhibition, the Vmax stays the same, because the inhibitor does not alter the enzyme's ability to act on the substrate. The competitive inhibitor only competes with the substrate for binding to the active site.

Substrate Competes With Inhibitor For The Active Site

Sub and Inhibit-officer Competing for the Action-clapperboard

In this type of inhibition, the inhibitor and substrate are competing to bind to the active site of the enzyme. This means that the inhibitor-enzyme complex is weak, because a substrate can outcompete it.

Inhibition Increases Km

Inhibit-officer with Large Kim

The substrate concentration at half of Vmax is Km. Km increases with competitive inhibition, because more substrate is needed to out-compete the inhibitors for binding to the active site. Thus, in order to reach Vmax (or half Vmax), the substrate concentration must be higher, thus a larger Km.

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