Non-Competitive Inhibition

Non-competitive inhibition is a type of inhibition that reduces the effectiveness of enzymes at catalyzing reactions. It is a subset of reversible inhibition, which means that the enzyme is not permanently altered in any way. The substrate does not compete with the inhibitor for binding to the active site, which means the substrate is often free to bind to the active site. The inhibitor binds to a separate site known as the allosteric site, and it has a strong enzyme-inhibitor complex because it is not competing with the substrate for binding. Km remains constant because this inhibition does not affect substrate binding, and adding more substrate will not affect the reaction kinetics. Regardless of how much additional substrate is added, the enzyme will still be less effective. This is because the enzyme has a different conformational form, called a conformational shift. In this form it is less effective at converting substrate to product in the active site. Because it is less effective, it has a lower Vmax. The inhibited reaction has a lower maximum rate because of the ineffectiveness of the enzyme.

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Characteristics

Reversible Inhibition
Cars driving in Reverse
Non-competitive inhibition is a type of reversible inhibition because the enzyme is not permanently altered. In this type of inhibition, product formation is prevented for a limited time.

Substrate Freely Binds The Active Site
Sub Holding Action-clapperboard
The substrate can freely bind the active site in non-competitive inhibition. This is because the inhibitor is not attempting to bind the active site for the substrate that normally binds the enzyme.

Inhibitor Strongly Binds Allosteric Site
Inhibit-officer Strongly-grabbing Aloe-plant
The inhibitor binds a separate site known as the allosteric site, and changes the ability of the enzyme to catalyze transformation of the substrate to the product. This enzyme-inhibitor complex is strong because it is not competing with the substrate for binding.

Km Constant
Same-size Kim
In non-competitive inhibition, Km is constant (concentration of substrate at one-half Vmax) because adding more substrate will not affect the reaction kinetics. The binding of the substrate is not affected.

Enzyme Has Different Conformational Form
Enzyme Low-rider-car
Though the enzyme is not permanently altered, it does change conformation while the inhibitor is bound, preventing the enzyme from catalyzing the transformation from substrate to product.

Low Vmax
Low Vmax speed limit sign
Though Km remains unchanged, non-competitive inhibition results in a lower Vmax, which is a lower maximum rate of reaction. This is because the enzyme is less able to convert the substrate into product at the active site and can no longer function as well as an uninhibited enzyme.