

Enzyme Inhibitors and Classification of Enzyme Inhibition



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Enzyme Inhibitors and Classes of Enzyme Inhibition is an important topic in Biochemistry and biochemistry is a branch of the mainstream of chemistry. Enzyme Inhibitors and Classification of Enzyme Inhibition is useful to study the reaction rate of Enzyme.

Enzyme Inhibitors:

Enzyme inhibitors (here, we denote the enzyme inhibitors by **I**) are molecular agents that interfere with catalysis to slowing or halting enzymatic reactions. They give trouble to the fitting process of substrates into the enzyme's active site.

Enzyme Inhibition

To understand the process of enzyme inhibition process as well as the enzyme inhibitor, we consider an enzyme (denoted as **E**), a substrate (denoted as **S**). The substrate **S** is undergoing a chemical reaction catalyzed by the enzyme **E** to produce a product **P**. So the chemical reaction is represented as-



But when The inhibitors are interfering with the catalytic process of the enzyme then the inhibitor instead of substrate binds with the enzyme to form an enzyme-inhibitor. So the enzyme can not perform as a catalyst anymore.



here,

- E = Enzyme
- S= Substrate
- I= Inhibitors
- P = Product

Examples of inhibitors include *toxins, poisons, pesticides, and antibiotics*.

Classes of Enzyme Inhibition:

There are two kinds of enzyme inhibition-

- a. Reversible Inhibition and
- b. Irreversible Inhibition.

Reversible Inhibition

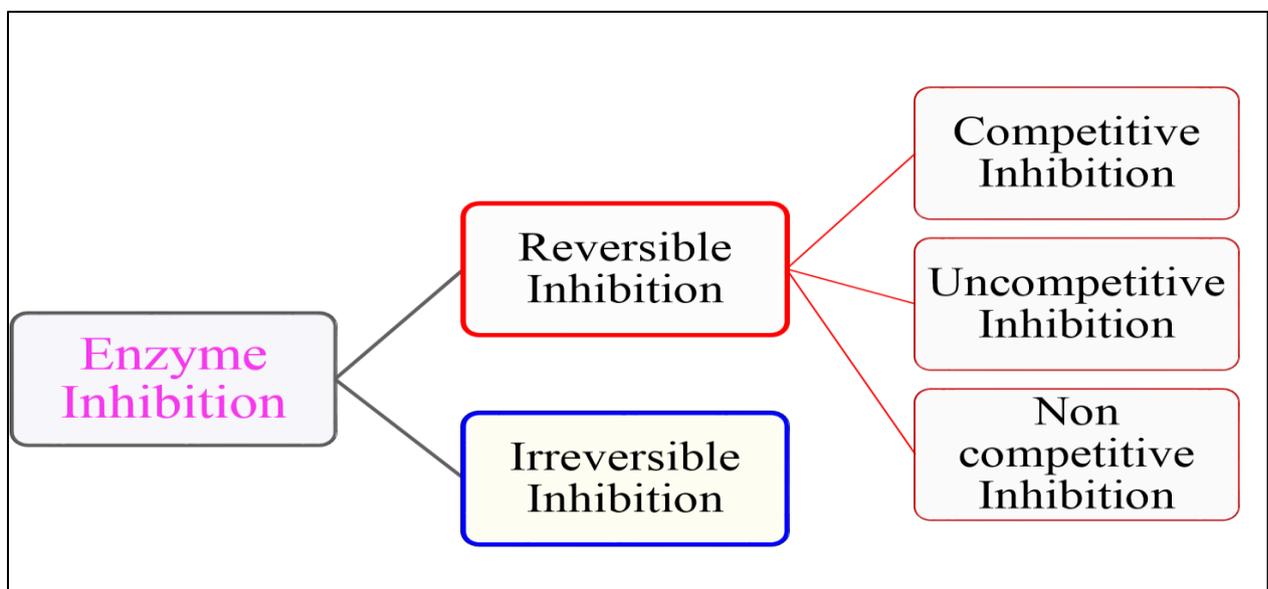
The reversible inhibition process inhibitor substance or agent bind with the active site of an enzyme by a weak bond such as hydrogen bond, hydrophobic interactions, rather than a covalent bond. Generally, the reversible inhibitors do not allow the reaction to occur when binds with the enzyme. But this inhibitor can easily be removed by dilution or dialysis.

Irreversible Inhibition

The inhibitor attaches to the active site of the enzyme by a covalent bond so that it can't be removed from the active site. That means the inhibitors attach permanently to the enzyme. This kind of inhibitor consists of functional groups.

Again there are three kinds of **Reversible Inhibition** —

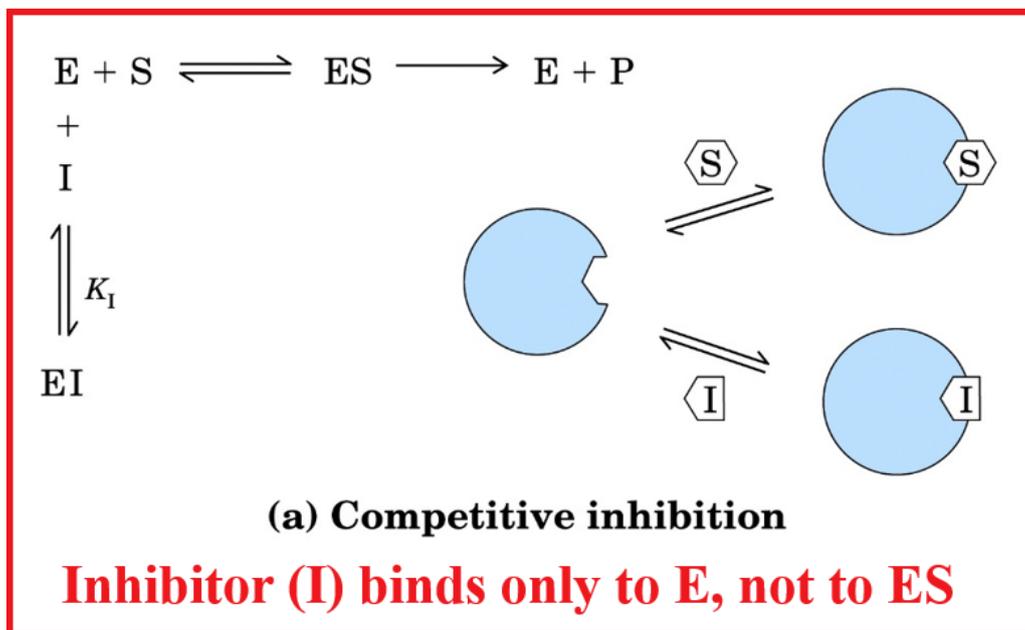
- i. Competitive Inhibition
- ii. Uncompetitive Inhibition and
- iii. Non-competitive Inhibition.



Classes of Reversible Inhibition:

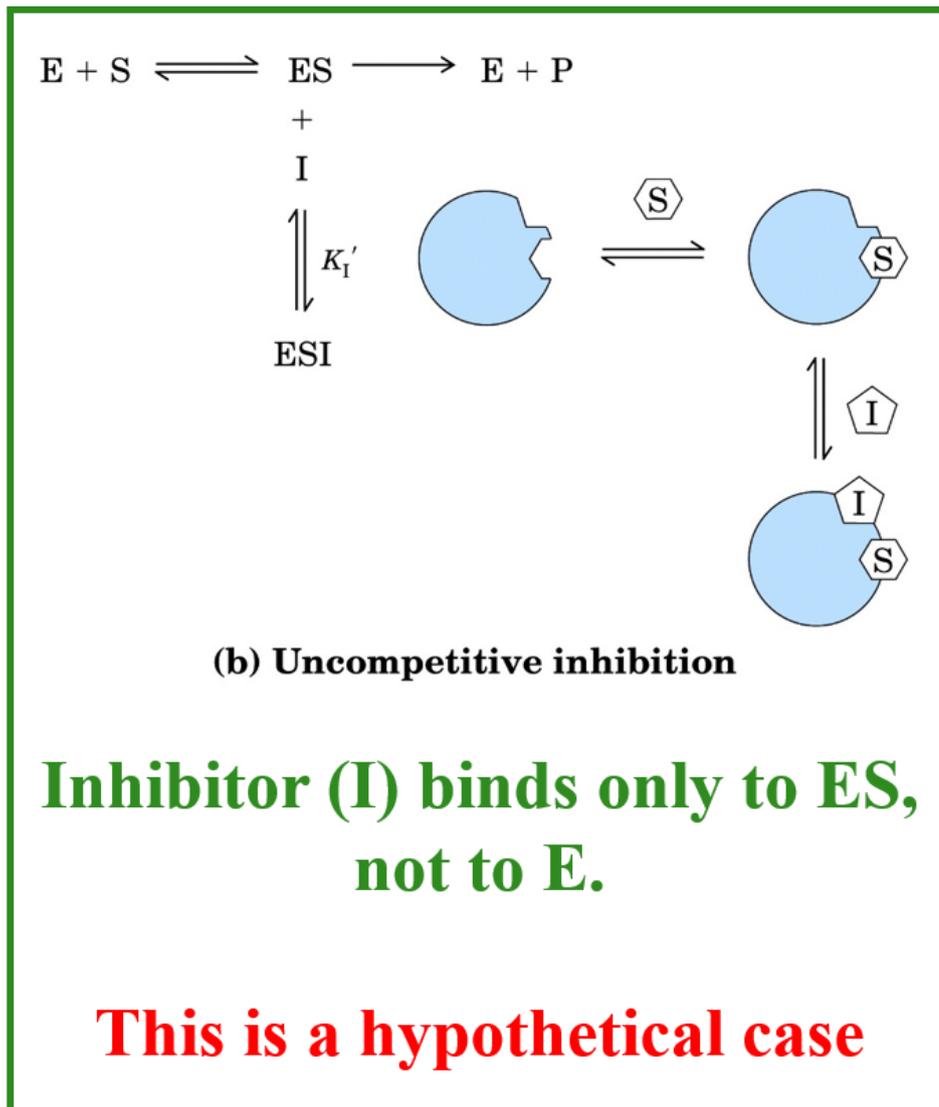
- i. **Competitive Inhibition:** Inhibitor (I) binds only to Enzymes (E), but not to the enzyme-Substrate complex (ES) and inhibits the Enzymes (E) to function is known as the Competitive Inhibition. It is a real kind of Inhibition. A competitive inhibitor is

reversible and has a structure like a substrate to fit the active site of the enzyme. So Competitive inhibitor competes with the substrate for the active site of the enzymes. Once It fits with the active site of an Enzyme then it makes an Enzyme-Inhibitor complex (EI), the Substrate can't bind with the Enzyme. So the Inhibition takes place. But it is a reversible process so the Enzyme-Inhibitor complex (EI) can breaks down under specific conditions and again enzyme becomes functional.

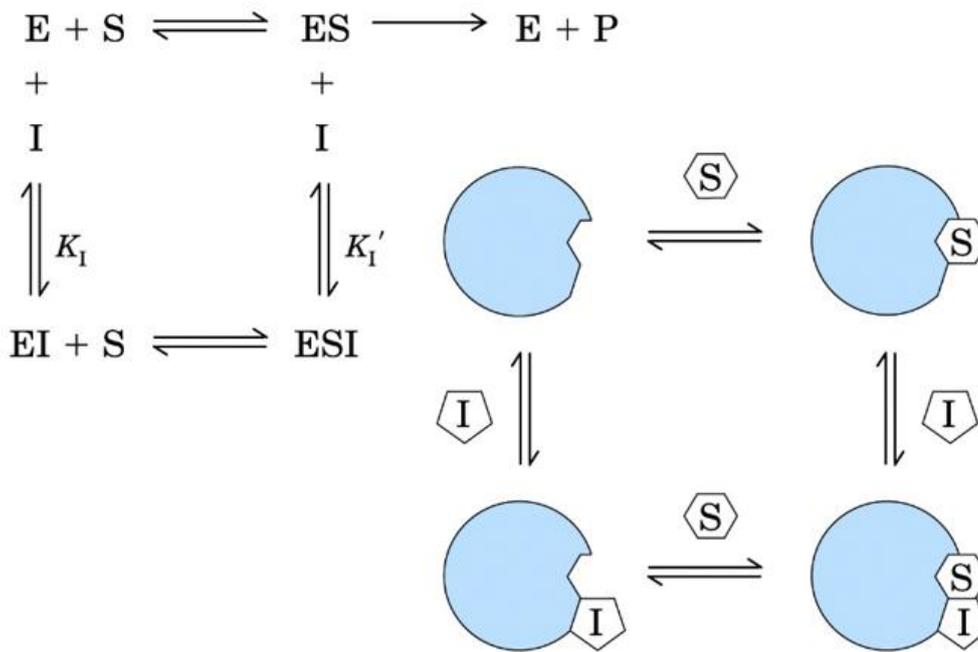


- ii. **Uncompetitive Inhibition:** Inhibitor (I) binds only to Enzyme-Substrate complex (ES), not directly to Enzymes (E), and inhibits the enzymes to function is known as the Uncompetitive Inhibition. This is a hypothetical situation for a true enzyme that has

never been documented, but which makes a helpful contrast to competitive inhibition.



- iii. **Noncompetitive Inhibition:** Inhibitor (I) binds to both the Enzymes (E) and the Enzyme-Substrate complex (ES) and hence inhibits the Enzymes (E) to function is known as the Noncompetitive Inhibition. In this case, the Inhibitor binds with the Enzymes as well as the Enzyme-Substrate complex (ES). So the enzymes can't be functional anymore. But this process also reversible so the enzyme can be functional again dilution or dialysis. Hence the reaction rate is affected by the inhibitors

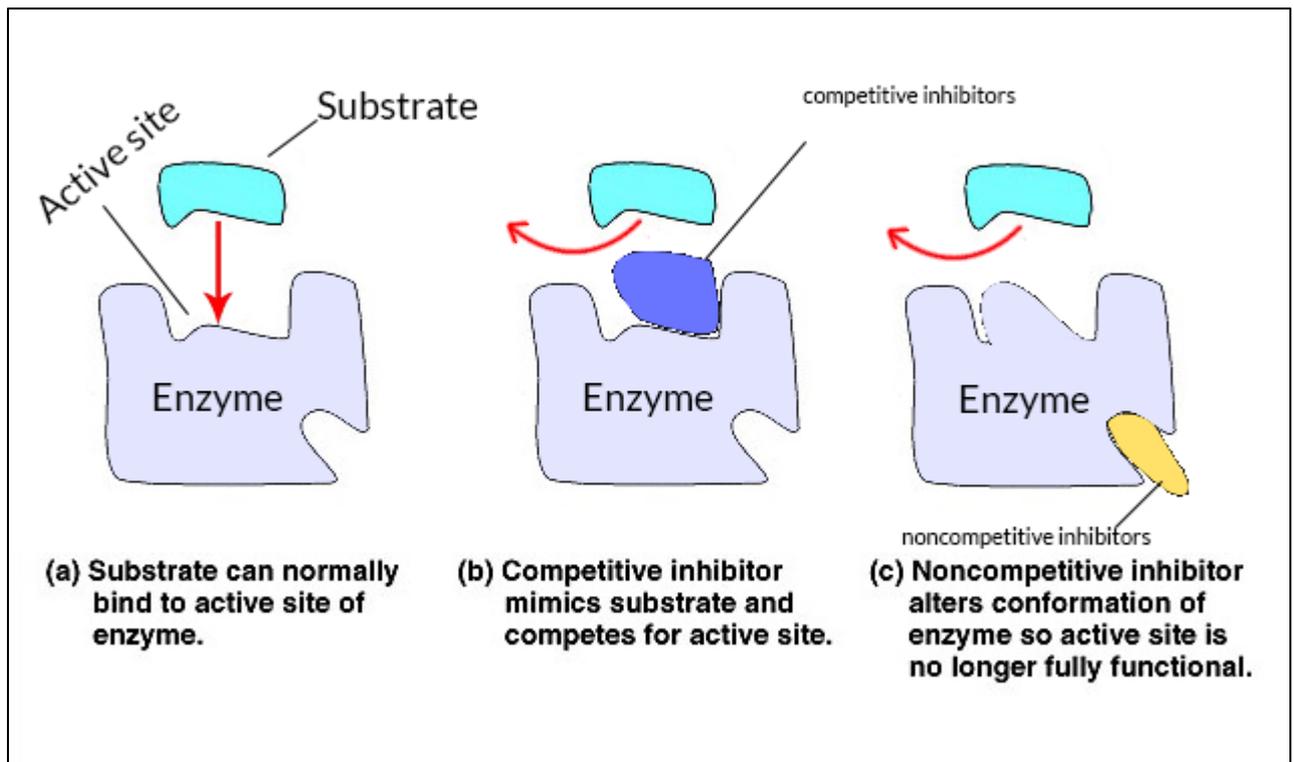


(c) Mixed inhibition

Inhibitor (I) binds to E and to ES

Classes of Reversible Inhibition in brief

Competitive Inhibition	Uncompetitive Inhibition	Non-competitive Inhibition
Inhibitor (I) binds only to Enzymes (E)	Inhibitor (I) binds only to Enzyme-Substrate complex (ES)	Inhibitor (I) binds to both the Enzymes (E) and the Enzyme-Substrate complex (ES)



Enzyme Inhibition (Mechanism)

	▶ Competitive	▣ Non-competitive	◀ Uncompetitive
Cartoon Guide	<p>Substrate Inhibitor Compete for active site</p>	<p>Different site</p>	
Equation and Description	$E + S \rightleftharpoons ES \rightarrow E + P$ $+ I$ $\downarrow \uparrow$ EI	$E + S \rightleftharpoons ES \rightarrow E + P$ $+ I \quad + I$ $\downarrow \uparrow \quad \downarrow \uparrow$ $EI + S \rightarrow EIS$	$E + S \rightleftharpoons ES \rightarrow E + P$ $+ I$ $\downarrow \uparrow$ EIS
Equation and Description	[I] binds to free [E] only, and competes with [S]; increasing [S] overcomes inhibition by [I].	[I] binds to free [E] or [ES] complex; Increasing [S] can not overcome [I] inhibition.	[I] binds to [ES] complex only, increasing [S] favors the inhibition by [I].