**ENZYMES**

**&**

**MECHANISM OF ENZYME ACTION**

CONTENTS
 Chemistry

 Classification
 Mechanism

of Enzyme Action
 Enzyme Kinetics
 Inhibition
 Activation
 Specifi...Introduction


Enzymes are biological catalysts that speed
up the rate of the biochemical reaction.



Most enzymes are ...

STRUCTURE OF ENZYMES


The active site of an enzyme is the region that binds
substrates, co-factors and prosthetic groups...ACTIVE SITE
o

Active site can be further divided into:
Active Site

Binding Site

Catalytic Site

It chooses the substrat...

CO-FACTORS
o

Co-factor is the non protein molecule which carries out
chemical reactions that can not be performed by stan...INORGANIC CO-FACTORS
These are the inorganic molecules required for the proper
activity of enzymes.
Examples:
++
Enzyme ca...

TYPES OF ORGANIC CO-FACTORS
Prosthetic Group
o

A prosthetic group is a
tightly bound organic cofactor e.g. Flavins, heme
...Types of co-factors

Continued…



An enzyme with it‟s co-factor removed is designated as
apoenzyme.



The complete com...SUBSTRATE


The reactant in biochemical reaction is termed as substrate.



When a substrate binds to an enzyme it forms...SITES OF ENZYME SYNTHESIS
o

Enzymes are synthesized by ribosomes which are attached to
the rough endoplasmic reticulum.

...INTRACELLULAR AND
EXTRACELLULAR ENZYMES
o

o

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

o

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Intracellular enzymes are synthesized and retained in the cell
fo...CHARACTERISTICS






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



Enzymes speed up the reaction by lowering the activation
energy of the reaction.
Their pr...

NOMENCLATURE OF ENZYMES
o

o

o

o

An enzyme is named according to the name of the substrate it
catalyses.
Some enzymes w...

EXAMPLES
substrate

enzymes

products

lactose

lactase

glucose + galactose

maltose

maltase

Glucose

cellulose

cellul...

CLASSIFICATION OF ENZYMES


A systematic classification of enzymes has been developed by
International Enzyme Commission....

Continued……..

Classification of enzymes
ENZYME CLASS

REACTION TYPE

EXAMPLES

Oxidoreductases

Reduction-oxidation
(redo...

MECHANISM OF ENZYME ACTION


The catalytic efficiency of enzymes is explained by two
perspectives:

Thermodynamic
changes...

THERMODYNAMIC CHANGES


All chemical reactions have energy barriers between reactants
and products.



The difference in...

THERMODYNAMIC CHANGES


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







Only a few substances cross the activation barrier and change
into products.
That i...

THERMO-DYNAMIC CHANGES
OVERVIEW

 

PROCESSES AT THE ACTIVE SITE
Covalent
catalysis
Acid base
catalysis

Catalysis
by strain
Catalysis
by
proximity

 

COVALENT CATALYSIS
o

Enzymes form covalent linkages with substrate forming
transient enzyme-substrate complex with very l...

ACID-BASE CATALYSIS


Mostly undertaken by oxido- reductases enzyme.



Mostly at the active site, histdine is present w...

CATALYSIS BY PROXIMITY


In this catalysis molecules must come in bond forming
distance.



When enzyme binds:
A region ...

CATALYSIS BY BOND STRAIN







Mostly undertaken by lyases.
The enzyme-substrate binding causes reorientation of the
...

LOCK AND KEY MODEL





Proposed by EMIL FISCHER in 1894.
Lock and key hypothesis assumes the active site of an
enzymes...

INDUCED FIT MODEL




More recent studies have revealed that the process is much
more likely to involve an induced fit m...

INDUCED FIT MODEL

32

 

ENZYMES KINETICS

 

INTRODUCTION
“It is a branch of biochemistry in which we study the rate of
enzyme catalyzed reactions.”


Kinetic analysi...

RATES OF REACTION AND THEIR
DEPENDENCE ON ACTIVATION ENERGY
Activation Energy (Ea):
“The least amount of energy needed for...

RATES OF REACTION AND THEIR
DEPENDENCE ON ACTIVATION ENERGY
Activation Energy (Ea):
“The least amount of energy needed for...

ENZYMES LOWER THE ACTIVATION ENERGY OF A

Energy levels of molecules

REACTION

Initial energy state
of substrates

Activa...

KINETICS OF ENZYMES CATALYSIS


Enzymes catalysis:

“ It is an increase in the rate of reaction with the help of
enzyme(a...

FACTORS AFFECTING RATE OF
ENZYME CATALYZED REACTIONS
Temperature
 Hydrogen ion concentration(pH)
 Substrate concentratio...

EFFECT OF TEMPERATURE









Raising the temperature increases the rate of enzyme
catalyzed reaction by increasing ...

Temperature

5- 40oC
Increase in Activity

Rate of Reaction

40oC - denatures

0
<5oC - inactive

10

20

30

40

50

60

 

EFFECT OF PH






Rate of almost all enzymes catalyzed reactions depends on
pH
Most enzymes exhibit optimal activity a...

PH AFFECTS THE FORMATION OF HYDROGEN BONDS
AND SULPHUR BRIDGES IN PROTEINS AND SO AFFECTS
SHAPE.
trypsin

arginase

Rate o...

MICHAELIS-MENTEN MODEL & EFFECTS OF
SUBSTRATE CONCENTRATION


Michaelis-Menten Model:
“According to this model the enzyme...

MICHAELIS-MENTEN EQUATION


Michaelis-Menten Equation:

“It is an equation which describes how reaction velocity varies
w...

ASSUMPTIONS FOR MICHAELIS-MENTEN
EQUATION






Following assumptions are made in deriving the MichaelisMenten equatio...

SUBSTRATE CONCENTRATION

 

SUBSTRATE CONCENTRATION

 

PHARMACEUTICAL IMPORTANCE


Enzymes are virtually involved in all physiological processes
which makes them the targets of...

INHIBITION
o

The prevention of an enzyme process as a result of interaction of
inhibitors with the enzyme.

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INHIBITORS...

TYPES OF INHIBITION
Inhibition

Reversible

Competitive

Uncompetitive

Irreversible

Mixed

Noncompetitive

 

REVERSIBLE INHIBITION
o

It is an inhibition of enzyme activity in which the inhibiting
molecular entity can associate and...

COMPETITIVE INHIBITION


In this type of inhibition, the inhibitors compete with the
substrate for the active site. Forma...

EXAMPLES OF COMPETITIVE INHIBITION


Statin Drug As Example Of Competitive Inhibition:



Statin drugs such as lipitor c...

UNCOMPETITIVE INHIBITION


In this type of inhibition, inhibitor does not compete with the
substrate for the active site ...

EXAMPLES OF UNCOMPETITIVE
INHIBITION


Drugs to treat cases of poisoning by methanol or ethylene
glycol act as uncompetit...

MIXED INHIBITION
o

o

In this type of inhibition both E.I and E.S.I complexes are
formed.
Both complexes are catalyticall...

IRREVERSIBLE INHIBITION





This type of inhibition involves the covalent attachment of the inhibitor
to the enzyme.
T...

EXAMPLES OF IRREVERSIBLE
INHIBITION


Aspirin which targets and covalently modifies a key enzyme
involved in inflammation...

ACTIVATION


Activation is defined as the conversion of an inactive form of
an enzyme to active form which processes the ...

ACTIVATION BY CO FACTORS


Many enzymes are activated by co-factors.

Examples:




DNA polymerase is a holoenzyme that...

CONVERSION OF AN ENZYME
PRECURSOR


Specific proteolysis is a common method of activating
enzymes and other proteins in b...

ZYMOGEN ACTIVATION BY
PROTEOLYTIC CLEAVAGE

 

ENZYME SPECIFICITY




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Enzymes are highly specific in nature, interacting with one or
few substrates and catalyzing o...

TYPES OF ENZYME SPECIFICITY


Enzymes show different degrees of specificity:



Bond specificity.
Group specificity.
Abs...

BOND SPECIFICITY




In this type, enzyme acts on substrates that are similar in
structure and contain the same type of ...

GROUP SPECIFICITY


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In this type of specificity, the enzyme is specific not only to the
type of bond but also to the s...

SUBSTRATE SPECIFICITY






In this type of specificity ,the enzymes acts only on one
substrate
Example :
Uricase ,whic...

OPTICAL / STEREO-SPECIFICITY






In this type of specificity , the enzyme is not specific to
substrate but also to it...

DUAL SPECIFICITY





There are two types of dual specificity.
The enzyme may act on one substrate by two different
rea...

DUAL SPECIFICITY


The enzyme may act on two substrates by one reaction type

•

Example:
Xanthine oxidase enzyme acts on...