ENZYMES

Department of Biochemistry

- **Enzymes,**
  - Enzymes are biological catalysts in living organisms, .
  - They increase the speed of the reactions by decreasing the activation energy.
  - They don't effect reaction equilibrium constants and thermodinamics of the reaction.
  - All enzymes are protein structures except a small group of catalytic RNA molecules called ribozymes.
  - They exhibit different forms of specifity (absolute specifity, bound specifity, stereochemical specifity, group specifity).
  - They can still have activity after isolation from biological milieu.
  - Their MWs range between 10000-2000000.
  - They increase the rate of reactions more than 10^9 fold.

How do enzymes effect the parameters below?

- Activation energy

- Stabilization of the transition state

- Free energy change (ΔG-Free Gibbs Energy change of the reaction)

Enzymes-Basic Concepts

The molecules upon which enzymes may act are called **substrates**. Enzymes bind to their substrates from a special region called **active site**.

A **cofactor** is a non-protein chemical compound or metallic ion that is required for an enzyme's biological activity. Organic cofactors are usually made from vitamins and called **coenzymes**. In some cases, both coenzymes and cofactors are required for the activity. A catalytically active enzyme consisting of an apoenzyme combined with its cofactor is called **holoenzyme**. The protein part of an enzyme without the cofactor is called **apoenzyme**. Enzymes that differ in amino acid sequence but catalyze the same reaction are called **isozymes (isoenzymes).**

Enzymes-Basic Concepts

A coenzyme that is tightly or even covalently bound is called a **prosthetic group**. Flavins, Heme group in cytochrome c and biotin are examples of a prosthetic group.

•Enzyme-Substrate Binding Models

• Lock and key model →→ The fit between the substrate and active site of the enzyme is very specific like that of a lock and key.

•Induced fit model →→ The active site of the enzyme may change in order to fit the substrate molecule.

SPECIFITY OF ENZYMES

- Enzymes are highly specific biocatalysts that can only interact with one or several substrates and catalyze only one type of reaction.

- Some enzymes exhibit stereospecificity.

Classification of Enzymes

An enzyme has two names. The first one is the recommended name for daily use. The second is the more systematic full name that is used when the enzyme is to be identified in case of uncertainty.

1. Recommended name: Generally, the names of the most commonly used enzymes are obtained by adding a suffix (such as urease, glucosidase) to the end of the substrate used in that reaction. However, there are also enzyme names (pepsin, trypsin, etc.) that do not give an idea about the reaction they catalyze.

2. Systematic name: According to this nomenclature, enzymes are divided into 6 classes.

Classification of Enzymes

- International Union of Biochemistry and Molecular Biology (**IUBMB**) suggested a classification for enzymes which classify enzymes in 6 main groups.

Classification of Enzymes

1- Oxidoreductases:

They catalyze the transfer of hydrogen or oxygen atoms

- Dehydrogenases
- Oxidases
- Reductases
- Peroxidases
- Catalase
- Oxygenases
- Hydroxylases

Classification of Enzymes

2- Transferases

They catalyse the transfer of groups having C-, N- or P- groups.

- Transaldolase and transketolase
- Acyl, methyl, glucosyl ve phosphoryl transferases
- Kinases
- Phosphomutases

Classification of Enzymes

3- Hydrolases

They catalyse the hydrolytic cleavage of bonds.

- Esterases
- Glucosidases
- Peptidases
- Phosphatases
- Tyolases
- Phospholipases
- Amidases
- Deaminases
- Ribonucleases

Classification of Enzymes

4- Lyases

They catalyse the cleavage of C-C, C-S ve C-N bonds.

- Decarboxylases
- Aldolases
- Hydratases
- Dehydratases
- Synthases
- Lyases

Classification of Enzymes

5- Isomerases

They catalyse the rasemization reactions of optical or geometrical isomers.

- Rasemases
- Epimerases
- İzomerases
- Mutases

Classification of Enzymes

6- Lygases

They catalyse formation of bonds between C and O, S, N coupled to ATP and GTP hydrolysis.

- Synthethases
- Carboxylases