Enzymes

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Enzymes

Biochemistry: Biochemistry broadly deals with the chemistry of life and living processes .the scope of biochemistry is as vast as life itself. Every aspect of life-birth, growth, reproduction, aging and death, involves biochemistry. For that matter, every

moment of life is packed with hundreds of biochemical reactions. Biochemistry is the most rapidly developing and most innovative subject in medicine; these include the application of biochemistry in the laboratory for the diagnosis of diseases.

Enzymes: are proteins that act as catalysts, compounds that increase the velocity or the rate of chemical reactions without itself undergoing any change in the overall process. In addition to increasing the speed of reactions, enzymes provide a means for regulating the rate of metabolic pathways in the body.

Differences between enzymes and chemical catalysts

a.Enzymes are proteins.

b. Enzymes are highly specific and produce only the expected products from the given reactants, or substrates (i.e., there are no .(side reactions

c. Enzymes may show a high specificity toward one substrate or .exhibit a broad specificity, using more than one substrate

d. Enzymes usually function within a moderate pH and temperature range.

Enzyme binding sites: An enzyme binds the **substrates** of the reaction and converts them to **products**. The substrates are bound to specific

substrate binding sites on the enzyme called active sit. The spatial geometry required for all the interactions between the substrate and the enzyme makes each enzyme **selective** for its substrates and ensures that only specific products are formed. (Enzymes act with highly specificity on specific types of molecules ((substrate)). **E + S = ES complex**).

- Enzymes act under mild conditions (pH and temperature).
- Enzymes found in large number within the cells, and that's make the cells act like a complex chemical machine.

➢ THE ENZYME-CATALYZED REACTION

- Enzymes, in general, provide speed, specificity, and regulatory control to reactions in the body. Enzyme-catalyzed reactions have three basic steps:
- (**1**) binding of substrate: **E + S ⇿ ES** complex
- (**2**) conversion of bound substrate to bound product: **ES ⇿ EP**
- (**3**) release of product : **EP ⇿ E + P**
- An enzyme binds the substrates of the reaction it catalyzes and brings them together at the right orientation to react. The enzyme then participates in the making and breaking of bonds required for product formation, releases the products, and returns to its original state once the reaction is completed.

Enzymes do **not** invent new reactions; they simply make reactions occur **faster**. The catalytic power of an enzyme (the rate of the catalyzed reaction divided by the rate of the un catalyzed reaction) is usually in the range of 10^6 to 10^{14}.

Without the catalytic power of enzymes, reactions such as those involved in nerve conduction, heart contraction, and digestion of food would occur too slowly for life to exist.

Each enzyme usually catalyzes a specific biochemical reaction. The ability of an enzyme to select just one substrate and distinguish this substrate from a group of very similar compounds is referred to as **specificity**. The enzyme converts this substrate to just one product. The specificity, as well as the speed, of enzyme catalyzed reactions results from the unique sequence of specific amino acids that form the three-dimensional structure of the enzyme.

Enzymes have varying degrees of specificity for substrates

Enzymes may recognize and catalyze:

- a single substrate
- a group of similar substrates
- a particular type of bond

Table 21.2 Types of Enzyme Specificity

Type	Reaction Type	Example
Absolute	Catalyze one type of reaction for a single substrate	Urease catalyzes only the hydrolysis of urea
Group	Catalyze one type of reaction for similar substrates	Hexokinase adds a phosphate group to hexoses
Linkage	Catalyze one type of reaction for a specific type of bond	Chymotrypsin catalyzes the hydrolysis of peptide bonds

➢ Chemical nature and properties of enzymes

1- All the enzymes are invariably proteins.

2- Each enzyme has its own tertiary structure and specific conformation which is very essential for its catalytic activity.

3- The functional unit of the enzyme is known as **holoenzyme** which is often made up of **apoenzyme** (the protein part) and a **coenzyme** (non-protein organic part).

Holoenzyme → Apoenzyme + Coenzyme

(Active enzyme) (Protein part) (Non-protein part)

4- The word monomeric enzyme is used if it is made up of a single polypeptide e.g. ribonuclease , trypsin. Some of the enzymes which possess more than one polypeptide (subunit) chain are known as oligomeric enzymes e.g. lactate dehydrogenase, aspartate transcarbamoylase etc.

☒ Nomenclature of enzymes

In the early days, the enzymes were given names by their discoverers in an arbitrary manner. For example, the names **pepsin**, **trypsin** and **chymotrypsin** convey no information about the function of the enzyme or the nature of the substrate on which they act.

- The **suffix-ase** was added to the substrate for naming the enzymes e.g. lipase acts on lipids; nuclease on nucleic acids; lactase on lactose etc , the **suffix – ase** also can be added to the name of the reaction that the enzyme react e.g. Oxidases , decarboxylases , dehydrogenases etc .

Example of enzyme

Enzyme	Role
Pepsin	Stomach enzyme used to break protein down into peptides. Works at very acidic pH (1.5).
Proteases	Digestive enzymes which act on proteins in the digestive system
Amylases	A family of enzymes which assist in the breakdown of carbohydrates
Lipases	A family of enzymes which breakdown lipids

Enzymatic reactions divided in to 6 major classes and each have (Table 1) subclasses.

- ✓ The additional information that required to express the nature of the enzymatic reaction .
- ✓ Each enzyme has a specific code number called **Enzymatic code** (EC) that identified each of class , subclass , sub-subclass , and the last number refers to the name of enzyme itself . e.g.// **2.7.1.1** [ATP: D-hexose- 6- phosphotransferase]

In that **2** refers to the class (transferase) .

7 refers to the subclass (transfer a phosphate group) .

1 refers to the sub-subclass (refers that alcohol act like phosphate acceptor) .

1 refers to the enzyme (hexoxinase) .

Which is the enzyme that help in the transferring of **phosphate** group from ATP to the hydroxyl group on the **6th** carbon atom of glucose.