Course BSH-122

Credit-3(2+1)

Enzymes, Properties and Functions

Lecture-2

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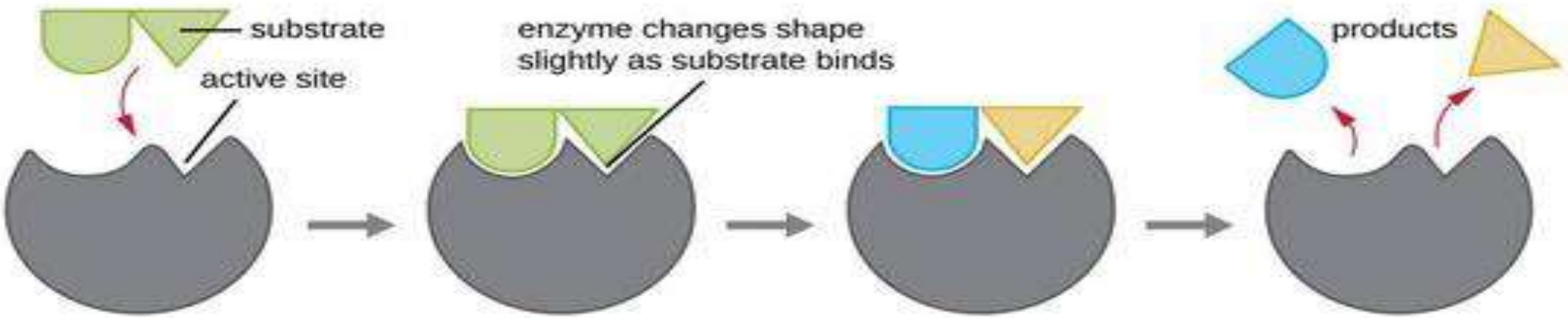
- Enzymes catalyze only those substrates which fit perfectly on the active site of that enzyme.
- Most enzymes are far larger than the substrates molecules that act on and the active site is usually a very small portion of the enzyme, between 3 and 12 amino acids. The remaining amino acids which make the bulk of the enzyme, function to maintain the correct globular shape of the enzyme.
- Once the product is formed, they no longer fit into the active site and escape into surrounding medium.
- According to lock and key model, enzymes behave as rigid molecules. However, most enzymes are globular and are flexible with varying shape.

INDUCED FIT MODEL



INDUCED FIT MODEL

- In 1959, Koshland suggested a modification to the ‘Lock and Key’ hypothesis which is known as ‘Induced fit’hypothesis.
- Working from evidence that suggested that some enzymes and their active site are more flexible. To this, he proposed that the active site can modify its shape as the substrate interact with the enzyme.

- The amino acids which make up the active site are moulded into precise shape which enable the enzyme to perform its catalytic function most efficiently.
- For instance, a suitable analogy to describe Induced fit model would be that of a hand changing the shape of the glove as the individual put on the glove. Therefore in this case, glove is the active site of enzyme and the hand is substrate.
- However, in some cases, the substrate molecules changes slightly as it enters the active site before bindinG

Properties Of Enzymes Can Be Classified Into:

1.Physical properties

2.Chemical Properties

3.General properties

1.Physical properties

1.Physically enzymes behave as colloids or as substance of high molecular weight.

2.Enzymes are destroyed or inactivated at temperature below the boiling point of water.

3.At 60 degrees Celsius most enzymes in liquid medium are inactivated.

4.Dried enzymes extract can endure temperature 100 degree Celsius to 120 degrees Celsius or even higher. Thus enzymes are thermos-labile.

5.There is always a specific temperature of optimum activity of every enzyme, which usually ranges from 25 degrees Celsius to 45 degrees Celsius. Enzymatic action is highest at 37 degrees Celsius and enzymes become inactive when temperature rises above 60 degrees Celsius.

2. Chemical Properties Of Enzymes

1. Catalytic Property
2. Specificity
3. Reversibility
4. Sensitiveness to heat and temperature and pH

1. Catalytic Property

- Enzymes have extra-ordinary catalytic power. They are active in very small quantities. A small amount of enzyme is enough to convert a large quantity of substrate. The enzymes remain unchanged after the reaction.
- The turnover number of enzymes ranges from 0.5 to 600000. Turn over number is the number of substrate molecules converted by one molecule of enzymes per second when its active site is saturated with substrate.

2. Specificity

Enzymes are very specific in their action. Particular enzymes act on particular substrates only. Enzymes are also specific to a particular type of reaction. In some rare cases, the specificity may not be too strong. Enzymes show different types of specificity as follows:

1.Bond Specificity: It is also called as relative specificity. Here the enzymes are specific for a bond. eg; peptidase is specific or peptide bond, lipase is specific for ester bond in a lipid.

2.Group Specificity: It is also called structural specificity. Here the enzymes are specific for a group. eg; pepsin hydrolyse the peptide bonds in with the amino group belongs to aromatic amino acids.

3.Substrate Specificity: It is also called absolute specificity. Here the enzyme acts only on a particular substrate. eg; arginase acts only on arginine; carbonic anhydrase acts only on carbonic acid.

4.Optical Specificity: It is also called stereo-specificity. This is the highest specificity shown by an enzyme. Here the enzymes are specific not only to the substrate but also to its optical configuration. e.g. L amino acid oxidase acts only L-amino acids, not on D-amino acids. Similarly, the alpha-amylase act only on alpha-14 glycosidic linkage of starch and glycogen. It is not able to hydrolyse the beta-14 glycosidic linkage of cellulose.

5.Co-factor Specificity: This shows that enzymes are not only specific to the substrate but also specific to its co-factors.

3. Reversibility

Most of the enzymes catalysed reactions are reversible. The reversibility of the reaction depends upon the requirements of the cell. In some cases, there are separate enzymes for forward and reverse reaction. Some enzyme-catalysed reactions are not reversible.

4. Sensitiveness to heat and temperature and pH

- Enzymes are very sensitive to heat and temperature.
- They are thermolabile.
- The maximum activity of Associate in Nursing protein is at traditional temperature.
- The correct temperature for the utmost activity is termed optimum temperature. Enzymes will be inactive at very low temperatures; this is the reason for preserving food and vegetables in the refrigerator.

- The enzymatic activity increases with the increase in temperature up to a certain level. At higher temperature (60-70 degree Celsius), the enzyme is destroyed or denatured.
- Do you know an enzymes active at very high temperature? It is Taq-Polymerase used in PCR reactions. The optimum temperature for it is 75 to 80 degrees Celsius.

- The optimum pH of most endo-enzyme is pH 7.0 (neutral pH).
- However, digestive enzymes can function at different pH. For example, salivary amylase act best at pH 6.8, pepsin act best at pH2 etc.
- Any fluctuation in pH scale from the optimum causes ionization of R-groups of amino acids that decrease the protein activity.
- Sometime a change in pH causes the reverse reaction, e.g. at pH 7.0 phosphorylase break down starch into glucose 1- phosphate while at pH5 the reverse reaction occurs.

3.General properties

- Enzymes initiate and accelerate the rate of biochemical reaction.
- The activity of enzymes depends upon the acidity of medium (pH specific). Each catalyst is most active at a specific pH. For example, pH 2 for pepsin, pH 8.5 for trypsin. Most intracellular enzymes function at near neutral pH.
- Enzymes can accelerate the reaction in either direction.
- All enzymes possess active sites which participate in the biochemical reactions.
- Enzymes are very unstable compounds mostly soluble in water, dilute glycerol, NaCl and dilute alcohol.

- Enzymes act actively at optimum temperature.
- All enzymes are protein in nature but all proteins may not be an enzyme.
- Enzymes lower the energy of activation of the substance molecule so the biochemical reaction can take place at normal body temperature which is 37 degrees Celsius.

Functions of enzymes

The enzymes perform a number of functions in our bodies. These include:

1.Enzymes help in signal transduction. The most common enzyme used in the process includes protein kinase that catalyzes the phosphorylation of proteins.

2.They break down large molecules into smaller substances that can be easily absorbed by the body.

3.They help in generating energy in the body. ATP synthase is the enzyme involved in the synthesis of energy.

4.Enzymes are responsible for the movement of ions across the plasma membrane.

5.Enzymes perform a number of biochemical reactions, including oxidation, reduction, hydrolysis, etc. to eliminate the non-nutritive substances from the body.

6.They function to reorganize the internal structure of the cell to regulate cellular activities.

Application of enzymes

- There are approximately 1300 different enzymes found in human cells, which include amylase, pepsin, trypsin, pancreatic lipase, ribonuclease and deoxyribonuclease.
- All these enzymes are involved in the different chemical processes such as the breakdown of large starch molecules, proteins, fats and other nucleic acids.
- Enzymes are very useful catalysts in many different industrial processes, which includes:

1. Food processing industries
2. Pharmaceutical industries
3. Textile industries

THANK YOU