**ENZYMES**

**Introduction**

Enzymes are a very important component in cells. They are macromolecular compounds that serve as biological catalysts. Their purpose is to fasten biological chemical reactions so that they can occur in rates that are fast enough to sustain life (Tymoczko, 2002). For instance, carbonic anhydrase is an enzyme present in cells such as the erythrocytes. The purpose of this enzyme is to catalyze the conversion of carbon dioxide and water to weak carbonic acid and also the dissociation of weak carbonic acid to carbon dioxide and water (Badger & Price, 1994) in the lungs. This fastens the transport of carbon dioxide for elimination in the lungs. If this reaction was slow, there would be metabolic acidosis due to accumulation of weak carbonic acid. The chemical reactions catalyzed by enzymes have three components. This are the actual enzyme, the substrates and the products.

**Structure of Enzymes**

Enzymes have a primary, secondary and tertiary structure. With regards to their primary structure, various enzymes are made up of amino acids that are linked together by peptide bonds which are a type of covalent bonds. The binding of different amino acids via these bonds results in a linear chain referred to as a polypeptide or protein. These amino acids are arranged in a particular order. This order is determined by the DNA sequence that encodes for the sequence in the corresponding gene. The amino acid sequence is the one that specifies the structure of the enzyme (Anfinsen, 1973) and is the one responsible for the determination of the catalytic activity of the enzyme. This is what differentiates it from other enzymes.

Amino acids have amino groups and carboxyl group. The hydrogen present in the amino group and the oxygen present in the carboxyl group have the ability to bind together. Hydrogen bond is responsible for binding of these groups. Amino acids in the same chain can interact with each other. If this interaction occurs, the protein chain can fold up on itself in different ways to form two secondary structures depending on the on how it has folded. The protein may fold on itself to form a beta sheet. With regards to beta sheets, there may be two forms of the sheet. This is dependent on the direction of the chain of the protein. A parallel sheet may be formed if the proteins have remained in the same direction. If there is an alternation between every fold, the resultant sheet is termed as an anti-parallel sheet.

Within the structure of all enzymes, there is a region called an active site. This region is special in that it has particular shape and functional groups whose whole purpose is to bind to the substrate’s reacting molecules. This region has a few numbers of amino acids whose function is to catalyze the reaction. The active site binds to the substrate molecules through non-covalent interactions. These include hydrogen bonding, hydrophobic interactions, electrostatic interactions and van de Waals interactions.

In order for a chemical reaction to occur, a certain amount of energy should be available in the chemical system to allow the potential reactants to undergo the chemical reaction. This energy is referred to as the activation energy. It is at times referred to the minimum amount of energy necessary to start a chemical reaction. The purpose of enzymes is to act as catalysts and lower the activation energy making it easier for the reaction to take place more easily. (Radzika & Wolfenden, 1995)

**The Lock and Key Hypotheses**

This theory was first postulated in 1894 by Emil Fischer to explain the working mechanism of enzymes. In this analogy, the key is the substrate molecules whereas the lock is the enzyme. This theory stated that only the appropriately shaped key which in this case referred to the substrate fits in the key hole of the lock which represents the enzyme.

**Induced Fit Model**

Due to the inability of the lock and key hypothesis being able to explain all experimental evidence, the induced fit model was introduced. This theory suggested that the enzyme has the ability to change its shape partially. The change of shape is induced by the substrate. It does this by aligning the enzyme properly so as to access the active site for the process catalyzing the reaction to begin. This gives an explanation as to why other compounds bind to particular enzymes but no reaction takes place.

**External Factors Affecting Enzyme Activity**

**Temperature**

Temperature is an important external factor that dictates how efficiently enzymes will work. Enzymes are proteins in nature. When subjected to very higher temperatures they are denatured. This is because high temperatures destroy the enzymes bonds and distorts its structure hindering its ability to catalyze the reaction.

**pH**

This refers to the concentration of hydrogen ions. The cause of the loss of enzyme activity is the loss of the shape of the structure. The appropriate structure is mediated by no-covalent interaction. Certain levels of pH interfere with these interactions and in most cases the distortion occurs if the levels are extreme.

**Substrate Concentration**

 The concentration of the substrate is an important external factor determining the enzyme activity. A higher concentration of substrates means that more enzymes are activated in accordance with the lock and key hypotheses. This means that a lower concentration of enzyme means less substrate are available for activation of the substrate.

**References**

Anfinsen, C., 1973. Principles that govern the folding of protein chains. *Science,* 181(4096), pp. 223-30.

Badger, M. & Price, G., 1994. The role of carbonic anhdrase in photosynthesis. *Annu.Rev. Plant Pysiology,* Volume 45, pp. 369-392.

Murtaza, M., n.d. *BIOChem riview.* [Online]
Available at: biochemriview.weebly.com/enzymes.html

Radzika, A. & Wolfenden, R., 1995. A proficient enzyme. *Science,* Volume 267, p. 5194.

Tymoczko, C., 2002. *Biochemistry.* 5th ed. San Fransisco: W.H Freeman.