Examining the enzyme amylase and its uses science essay

A catalyst is a substance used to speed up a particular reaction and remain unchanged at the end of the reaction. Reactions that are sped up by catalysts can range from making sure maximum ammonia is obtained in industries to making sure that every starch particle in our bodies has been broken down during digestion. Looking at enzymes, enzymes can be defined as biological catalysts they speed up metabolic reactions that are taking part in living organisms. Enzymes are protein in nature and are made up of globular proteins. This gives them a precise 3D shape that has hydrophilic R groups on the outside that make them soluble. Enzymes come from microorganisms, plants or animals. An enzymes features include an active site which is a depression in the enzyme to which a molecule (substrate) can bind and be broken down into two or more products. The shape of the active site is what determines what substrates can fit and substrates are required to fit perfectly in an enzyme for them to be broken down. Therefore an enzyme will act on only one type of a specific substrate molecule. Enzymes also reduce the activation energy this is the initial amount of energy that is required to increase the rate of a particular reaction. The rate of a reaction of an enzyme depends on how many enzyme molecules there are, how many substrate molecules there are and the speed that the enzyme is able to convert this substrate into a product. However the rate of reactions of enzymes does not always run smoothly it is affected by: enzyme concentration, substrate concentration, pH, enzyme cofactors, temperature and enzyme inhibitors. Enzymes tend to denature when exposed to high temperature that is higher than 40â °C because of their protein nature they are then destroyed. They also work faster at a pH of around 7 that is a

neutral pH with few exceptions. Eg. Enzymes in the stomach that work within the presence of hydrochloric acid (1, 2)

Introduction to enzymes in industries.....

Enzymes play multiple roles in industries and many industries have now turned to enzyme technology. The advantage in using enzymes is that they can catalyse the different chemical reactions, they are specific so therefore they can give pure products, and they work efficiently. Such factors play leading roles in the pharmaceutical, food and agricultural industries. When using enzymes in industries microorganisms are preferably used as the source rather than plants or animal. This is because companies find that " they can be grown economically in bulk fermenters controlled conditions, they can be genetically engineered relatively easily, and mutant varieties can relatively easily be produced to improve performance and their production rate can be altered to suit the demand." When several enzymes are required to be used in more than one reaction to made a product then the enzymes are isolated and the specific enzyme is chosen for the reaction. Pure enzymes can also be used and in some cases enzymes can be used as they are without having to purify them eg. fruit juice production and meat tenderization. Industries have also found another way of using enzymes that enables them to reduce the cost of the process and also be able to re-use the enzyme after that reaction. They do this by immobilizing the enzyme. This means that the enzyme gets strapped to a solid support then put in the reaction so therefore after the enzyme has broken down that reaction it can be retrieved from the mixture. Immobilizing an enzyme also makes it more stable as it disables the enzyme to denature as a result of pH or temperature

changes. Such enzymes are mostly used in the process for making sweeteners in the USA and fruitdrinks in Japan. (1, 2)

AMYLASE

This is a digestive enzyme that plays an important role in our bodies and also in the food industry, textile and pharmaceutical industry. Amylase comes in different forms that are determined by the way in which their glycosidic bonds are attached. There is the Alpha-amylase, Beta-amylases and Gluco-amylases these include gamma-amylases and amyloglucosidases . (3, 7)

Below are the primary-quaternary structures of amylase.

Primary Structure Secondary Structure

Quatenary Structure Tertiary Structure

The enzyme amylase is mainly used as a digestive enzyme. The reaction that is being broken down in the presence of amylase is the breaking down of long chain carbohydrates (polysaccharides such as starch) into disaccharides (maltose) and then monosaccharides (glucose). (3, 5, 6)

In industries amylase is used in the following ways: In brewing and fermentation the amylase that is present in wheat breakdown the starch into fermentable sugars. They catalyze maize or potato starch to syrups in numerous reactions to syrups that contain sugars that can then be used in making sweets, or ice cream. In baked goods they pre-digest the starch that increases the performance of yeast and increases the yield of the product. In textile industry they are used to breakdown starched clothes for them to be

dyed after the starch has been used as a stiffening agent to design the cotton fibres. In washing and cleaning, amylase is used to dissolve starch stains. For sizing of paper. ” to increase diastase in flour.” Used in babyfoods. Amylase also takes out starch during jelly production. In fruit juices they remove the lees that has starch. (3, 7, 4)

The sources of amylase is animals, plants, and microorganisms. In animals amylase is made in the salivary glands and pancreas. In plants amylase can be found in barley malt and in microorganisms they are found in the fungus Aspergillus oryzae. (1)

Amylase can be produced by fungul and bacterial cultures. Of these 2 a bacterial culture shows more of an advantage as they display stability in temperature than amylase from fungul cultures. In the bacterial culture the amylase is produced by genetically modified microorganisms these are different types of bacillus. The amylase that is produced by fungul cultures are not genetically modified but once when they were genetically modified Trichoderma was used. (7)

A cofactor is a substance that must be attached to the active site before a substrate can be able to bind and enable the enzyme to work properly. These come in the form of an ion or a molecule. The cofactor of amylase is calcium ions (1, 6,)

An inhibitor is another molecule (other than a substrate) that is very similar to a substrate that takes over the active site and therefore reduces the rate of activity of that enzyme. Inhibitors can be classified as competitive inhibitors and non-competitive inhibitors. The competitive inhibitors are the

ones that temporarily bind the active site but can be reversed and overcome by increasing the concentration of the substrate whereas the non-competitive inhibitors are permanent and they destroy the catalytic activity of the enzyme. An inhibitor of amylase is phaseolamin. (1, 6, 4)

The problem with using amylase is that when used in the brewery industry when boiling wort enzyme gets denatured by the boiling and breaking down starch to dextrins by fermentable sugars does not happen. When amylase mixed with other enzymes is used to overcome indigestion it may cause drowsiness, dizziness, blurred vision or lightheadedness.