The application of enzymes in industry and medicine essay sample

Enzymes are biological catalysts that lower the activation energy for a reaction to take place. Enzymes have many advantageous qualities that allow them to be used in industry and medicine:

* Enzymes are not used up in reactions; each molecule repeatedly carries out the same process. This makes enzyme technology very efficient as enzymes can be reused.

* They have specificity. One type of enzyme will decompose one substrate into a particular product therefore there is no wastage of resources.

* Enzymes are biodegradable; therefore there is little pollution in this industry.

* Enzymes function at moderate temperatures, pressure and pH so energy is saved.

Until recently most biotechnology involved whole organisms therefore many enzyme pathways were involved but now isolated enzymes can be used. There is still a lot of biotechnology taking place using whole organisms though e. g. yeast used in baking and alcohol production.

When whole organisms are used in industrial methods, some of the substrate is converted to biomass for growth of the organism, but in usage of isolated enzymes there isn’t a waste of substrate. Industry cannot afford wastefulness. Also, in using a single enzyme, no other reactions other than the necessary one can take place and the conditions specified for the necessary reaction can be provided easily without affecting the rest of the organism. In the extraction process it will also be easier to isolate the single

product formed if the enzyme is extra-cellular. The enzymes simply need to be filtered off and the product will be ready for use.

In some cases, micro-organisms are preferred as the source of enzymes. They have many advantages:

* They produce more enzyme molecules in relation to their mass than other organisms.

* The yield can be increased by means of strain selection, mutation and optimisation of growth conditions.

* They can be grown in laboratories and are not influenced by climate.

* They occupy a great variety of habitats and extremes of pH and temperature.

In using micro-organisms several factors have to be considered. Nutritional requirements must be simple, they must not produce toxins, they must not be pathogenic and it is advantageous if they have a high growth rate.

Fermentation is a term often restricted to the action of specific enzymes, called ferments, produced by minute organisms such as moulds, bacteria, and yeast. This term, in actual fact, is defined by “ the chemical changes in organic substances produced by the action of enzymes”. Therefore the word “ fermentation” could be used to describe enzyme technology. Probably, the most important type of “ fermentation” as scientists use the term, is alcoholic fermentation. The enzymes: diastase, zymase and invertase break down starch by hydrolysis into complex sugars, then simple sugars, and

finally alcohol. Hemicellulases such as amyloglucosidase can then be used to break down sugars again to produce low-calorie beer which is now more desirable in the industry.

Isolated enzymes can be used in food manufacture and have been for many years. One example of which is cheese manufacture. After the lactic acid bacteria in the milk converts the lactose to lactic acid by the use of the enzyme lactase, curd and whey begin to separate and the process is encouraged by the addition of the enzyme rennet. Rennet is found in the stomach of milk-drinking mammals. To obtain rennet for cheese making it is usually extracted from the lining of the stomach of a calf, dried as a powder, then dissolved in water as required.

As there are a rapid increasing number of vegetarians in the world, the enzyme chymosin is being more widely used. It is produced by genetically engineered Escherichia coli. The enzymes are very similar and so the difference in taste and texture of the resulting cheeses is negligible. Lipases can also be used in cheese manufacture as they ripen the cheese. These enzymes come from the mould growing in the cheese e. g. from the mould Pennicillium roquefortii.

Surprisingly, enzymes are used in leather manufacture. Most types of skin are treated with a “ bating” material consisting of enzymes of trypsin. It is treated in this way to give a smoother grain and render the skin soft and flexible for clothing e. g. gloves.

In medicine, organisms can be used to treat patients by enzyme action or by use of isolated enzymes. The use of maggots for healing wounds is now a

popular method of treatment in hospitals. Sterile maggots are placed in a dressing and then placed on the patient’s wound. These maggots excrete digestive enzymes to digest the dead material in the wound and then absorb the products into their body. This is a type of extra-cellular digestion and has proved very successful in medicine. Isolated enzymes such as trypsin are also used to clean wounds.

Biosensors are also a vital part of medicine nowadays. They can be used to recognise molecules very specifically, when enzymes are used for these purposes they are known as probes or sensors. One example is a sensor for heroin in a patient’s bloodstream. Two enzymes, Rhodococcus and Pseudomonas, can break down the drug. When fixed onto a strip of gel together with a dye, a change in colour appears when the enzymes are active.

Rhodococcus breaks down heroin to morphine and then Pseudomonas breaks down the morphine and by doing so a chemical change occurs which causes the colourless dye to turn red. When samples of unknown substances are placed on the gel or blood plasma, the presence or lack of presence of heroin can be detected. This drug is illegal and therefore these enzymes have great potential.

Some animal feed industries have formed from the waste products of agricultural forestry. Most wood waste is not very useful as it contains lignocellulose and few organisms can break this down to form useful products but lignases from Sporotrichum pulverulentum make cellulose

available for animal feed as they can break down the waste lignocellulose to useful products.

Biological washing powders are so called because they contain biological enzymes. These enzymes can break down organic stains on the clothing being washed and therefore remove stubborn stains from the clothes. These enzymes are mainly proteases and are very valuable digestive enzymes.