The use of enzymes in medicine

Enzymes are biological catalysts, which speed up the rate of a chemical reaction. They speed up the reaction by lowering the activation energy required to begin the reaction. Enzymes work at their optimum rates in specific temperatures and pH ranges. Enzymes are globular proteins with a tertiary structure, which determines the shape of its active site so they can only fit to one substrate molecule. When the active site of an enzyme and a substrate bind together, an enzyme- substrate complex is formed. As enzymes are never used up in a reaction this allows them to have several applications particularly in medicine.

Enzymes can be used to detect specific changes, their properties allow them to be used in medicine for analysing, diagnosing and treating purposes.

The most common use of enzymes in medicine is in biosensors. The biosensor used to detect diabetes is the most generic example of a commercial biosensor. Diabetes is a disorder when individuals are unable to produce enough insulin, which breaks down glucose. Biosensors can be used as medical analytical reagents to test the concentration of glucose in urine for diabetes. 'A test strip is used which contains a chemical indicator called toluidine and the enzyme glucose oxidase.'

The test trip is put into a urine sample and a colour change occurs. Using a colour chart the concentration of glucose in the urine sample can be determined. The colour change arises because the enzyme glucose oxidase converts the glucose into gluconic acid and hydrogen peroxide. This means the changes in colour take place due the combination of hydrogen peroxide and toluidine.

Genetic engineering and recombinant DNA technology is a recent development in science and technology, yet has proved to be very successful in treating various disorders. However without restriction enzymes or also know as restriction endonuclease there would be not be recombinant DNA technology, this shows how vital enzymes are to medicine. The enzyme has proved to be successful in helping people with diabetes and lack the protein insulin, haemophiliacs who lack the protein factor VIII, which allows blood to clot and also sufferers of cystic fibrosis.

Scientists have been able to extract useful genes from the DNA with the help of restriction enzymes from donor cells. 'Restriction enzymes are proteins that cut DNA molecules at precise sites to produce clearly defined fragments. It is this precision that allows chosen genes to be cut away from other genes so that they can be isolated'. (Ashall, 1994). The genes are then inserted into vectors, found in bacteria. The bacterium replicates itself to produces load of copies of the useful gene. This shows restriction enzymes are a very useful tool for molecular biology and are as much a part of DNA technology research as a saw is to carpentry.

Restriction enzymes have not just proved to be beneficial in disorders lacking certain proteins but also proved to cure skin cancer. In 2004 a miracle took place for Mark Origer of Wisconsin. Mark had been diagnosed with skin cancer and was soon going to die. However a few months later his tumours had gone and he was now free from cancer. It was genetic engineering that saved his life and in particular restriction enzymes. Cells were taken from his body, and new genes were inserted using the enzyme creating T-cells, which could recognise and destroy the cancerous cells, they

were then reinserted into his body. 'The modified cells survived and thrived, and slowly destroyed his tumours.' (New Scientist, 24 February 2007).

A four-year-old girl, Ashanthi DeSilva was born with a rare genetic disease where there was a deficiency of an enzyme called adenosine deaminase. This meant she lacked a healthy immune system and was vulnerable to all germs. 'Doctors removed the white blood cells from her body; let them grew and were then modified by inserting the missing gene and then inserted back into her bloodstream with the help of restriction enzymes in order to splice the DNA at specific precise points'. Tests showed that the therapy has strengthened her immune system and no longer has long periods of illnesses. The operation shows that due to the enzyme restriction endonuclease doctors were able to create a miracle for Ashanthi and her family, as without which she may rarely have survived to adulthood.

Enzymes can be used to diagnose whether the liver been damaged by alcohol or drugs. It identifies liver diseases especially cirrhosis and hepatitis. 'When the organ is damaged an enzyme called alanine aminotransferase is released into the bloodstream'. When the blood is tested it will prove if the liver is damaged.

In order to reduce the amount of heart muscle damaged from a heart attack an enzyme called streptokinase is entered into the veins immediately after a heart attack. The enzyme stimulates extra production of plasmin. 'Plasmin is produced in the blood to break down fibrin, which is the major constituent of blood clots, therefore dissolving clots in the arteries of the heart wall'.

Using enzymes especially in genetic engineering has caused many moral and ethical issues to rise and in particular religions being concerned about 'playing God'. However enzymes have been used and are being used at present in medicine related applications whether it is to analyse or diagnose medical disorders or treat illnesses. Enzymes have helped to save many lives, and a large number of people are thankful to them without even knowing about them. The potential of scientific technology has not yet reached and the rate at which science and technology is developing currently, many more enzymes will be discovered which will probably end up helping in curing miraculous diseases. The above enzymes are just some from the list but will end up being trendsetters to many more enzymes.

References

https://h2g2. com/edited_entry/A3328355

http://www. wsws. org/articles/1999/apr1999/canc-a28. shtml

http://www. webmd. com/digestive-disorders/Alanine-Aminotransferase-ALT