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DEPARTMENT: PHARMACOLOGY

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COURSE TITLE: INTRODUCTION TO BIOTECHNOLOGY

QUESTION: Discuss In Details the Aspects of Medical Biotechnology

ANSWERS

Medical biotechnology is the use of living cells and cell materials to research and produce pharmaceutical and diagnostic products that help treat and prevent human diseases. ..The medical biotechnology field has helped bring to market microbial pesticides, insect-resistant crops, and environmental clean-up techniques.

Medical Biotechnology is also the use of living cells and other cell materials for the purpose of bettering the health of humans. Essentially, it is used for finding cures as well as getting rid of and preventing diseases. The science involved includes the use of these tools for the purpose of research to find different or more efficient ways of maintaining human health, understanding pathogen, and understanding the human cell biology.

Here, the technique is used to produce pharmaceutical drugs as well as other chemicals to combat diseases. It involves the study of bacteria, plant and animal cells to first understand the way they function at a fundamental level.

It heavily involves the study of DNA (Deoxyribonucleic acid) to get to know how to manipulate the genetic makeup of cells to increase the production of beneficial characteristics that humans might find useful such as the production of insulin. The field usually leads to the development of new drugs and treatments, novel to the field.

Examples

Vaccines

Vaccines are chemicals that stimulate the body's immune system to better fight pathogens when they attack the body. They achieve this by inserting attenuated (weakened) versions of the disease into the body's bloodstream. This causes the body to react as if it was under attack from the non-attenuated version of the disease. The body combats the weakened pathogens and through the process takes note of the cell structure of the pathogens and has some cell 'remember' the disease and store away the information within the body.

When the individual becomes exposed to the actual disease, the body of the individual immediately recognizes it and quickly forms a defense against it since it already has some information on it. This translates to quicker healing and less time being symptomatic.

The attenuated disease pathogens are extracted using biotechnological techniques such as growing the antigenic proteins in genetically engineered crops. An example is the development of an anti-lymphoma vaccine using genetically engineered tobacco plants made to exhibit RNA (A similar chemical to DNA) from malignant (actively cancerous) B-cells.

Antibiotics

Strides have been made in the development of antibiotics that combat pathogens for humans. Many plants are grown and genetically engineered to produce the antibodies. The method is more cost effective than using cells or extracting these antibodies from animals as the plants can produce these anti bodies in larger quantities.

Biotechnology Applications in Medicine

The Recombinant DNA (rDNA) technology. This biotechnology application is very important in healthcare because it allows for the mass production of safe and more effective medicines. It also prevents undesirable immune responses which are common with medical products from non-human sources. Currently, about 30 recombinant therapeutics have been approved for human use worldwide, and 12 of these are presently being marketed in India. Let's take a look at some of the applications.

1) Genetically Engineered Insulin

Earlier, diabetes was treated using insulin from the pancreas of slaughtered pigs and cattle. Do you think this insulin causes any side-effects in humans? Yes! Insulin from animal sources induces allergies and other unwanted immune reactions in humans. This is why there was a need to isolate human insulin. Is there a way to do this? What if we can use bacteria to produce human insulin? Not only can we grow bacteria in large amounts, but we can also mass-produce human insulin. Insulin consists of two short, polypeptide chains – chain A and B, linked via disulfide bridges. Insulin is produced as a 'prohormone' in mammals (including humans). This prohormone has an extra peptide, the C peptide, which needs to be removed to give rise to mature insulin.

Maturation of Insulin.

The major challenge while generating human insulin is to assemble insulin into its mature form. An American company called 'Eli Lilly' overcame this hurdle in 1983. They prepared two DNA sequences that correspond to the A and B chains of human insulin. They then incorporated these sequences into plasmids of E. coli to generate insulin chains. Further, they produced the chains separately, extracted and combined them by creating disulfide bonds to give rise to human insulin.

2) Gene Therapy

It is a well-known application of Biotechnology in Medicine. The impressive thing about gene therapy is that it holds the highly sophisticated and outstanding key to genetic diseases Apart from that, it is also used for treating diseases by inserting a correct and normal gene for your inactive or defective gene. If a child is born with a genetic defect, is there a way to correct that defect? Yes, there is, with gene therapy! Gene therapy is a biotechnology application involving a collection of methods that can correct a gene defect in a child or an embryo. It involves inserting a normal gene into the person's cells or tissues to compensate for the non-functional gene. Let's understand how this works. In 1990, the first clinical gene therapy was applied to treat a 4-year old girl with a deficiency in the enzyme adenosine deaminase (ADA). This disorder is due to the lack of the gene for ADA, which is an enzyme important for the function of the immune system. Bone marrow transplantation helps cure this disorder in some cases. Enzyme replacement therapy, which involves injecting the patient with functional ADA, is also effective in some cases. However, both these procedures are not completely curative.

In gene therapy, blood lymphocytes of the patient are grown in a culture outside the body. Subsequently, a functional ADA cDNA is incorporated into these lymphocytes and re-introduced into the patient. This alleviates the symptoms of the disorder. However, the patient requires periodic infusions of these genetically-engineered lymphocytes, since these cells are not immortal. A permanent cure for this could be to introduce the gene producing ADA from marrow cells into cells at early embryonic stages of life.

3) Molecular Diagnosis

We all know that early diagnosis of a disease is important to effectively treat the disease. Early detection is not possible using conventional methods like serum and urine analysis. Let's look at some biotechnology applications that help in early diagnosis of diseases.

i) Polymerase Chain Reaction (PCR)

Normally, we can detect a pathogen (bacteria, virus etc.) only when the disease symptoms start to appear. However, by this time, the pathogen concentration in the body is very high! Is there a way to detect pathogens at initial stages of the disease when their concentrations are low?

Yes, using a technique called PCR. PCR involves amplification of the nucleic acid in the pathogen allowing us to detect the pathogen at very low concentration. Today, we use PCR routinely to detect HIV in suspected AIDS patients and to detect gene mutations in suspected cancer patients.

4) Genetic testing

It is one of the heredity techniques used for ending various genetic diseases and other genetic related problems in carrier screening, parents, and sex. It is the best technique that uses suitable DNA probes that have a better sequence similar to mutated sequences. Most significantly, genetic testing is used for recognizing illegal individuals. Along with this, many people opt for genetic testing to examine the parenthood.

5) Biopharmaceutical

The biopharmaceutical is another most significant and most important application of biotechnology. The combination of drugs does not concern any chemicals. Nevertheless, microorganisms are completed it possible for expanding them. The proteins and their large molecules are the most significant sources of this biopharmaceutical application. They can attack some hidden mechanisms or functionalities of your disease. Apart from that, it also wipes out the bugs.

Currently, most of the scientists are frustrating for expanding the biopharmaceutical drugs that are treated against various diseases including heart diseases, hepatitis, and cancer.

These are the useful applications of Biotechnology in medicine that makes biotechnology as the most significant part of human life. Additionally, they influence all aspects of good human health. It not only offers advanced medical devices but also plays a vital role in avoiding various health problems.

The advances and Trends in biotechnology develop lots of new and useful technologies that are resulted in the quality production of various biological variations and genetic processes. The new technologies help to produce lots of biochemically-defined sources of medical significance.

The best thing about the biotechnology field is that it creates a massive potential for the healthcare and pharmaceutical industries.