ATOMIC ENERGY CENTRAL SCHOOL 4

MUMBAI

UNIT IX

CHAPTER 12

BIOTEHNOLOGY AND ITS APPLICATION

SYNOPSIS

MODULE – 2/3

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TOPICS TO BE COVERED

- Biotechnological Applications in the field of Medicine

GENETICALLY ENGINEERED INSULIN

- BY rDNA TECHNOLOGY

GENE THERAPY

- REPLACING DEFECTIVE GENE BY HEALTHY GENE

MOLECULAR DIAGNOSIS

Biotechnological Applications in the field of Medicine

- The rDNA technology processes have made great impact in the area healthcare by mass production of safe and more effective therapeutic drugs.

- There are 30 recombinants therapeutics all over world approved for human use.
- Out of these 12 are marketed in India.

Diabetes which became a global pandemic led to extraction of insulin from slaughtered animals like pig and cattle. But this insulin was slightly different from human insulin and caused allergies in humans.

In the early 1920s **Frederick Banting** and **Charles Best** discovered insulin under the directorship of **John Macleod** at the University of Toronto. With the help of **James Collip** Insulin was purified, making it available for the successful treatment of diabetes. Banting and **Macleod** earned a Nobel Prize for their work in 1923.

Structure of Human Insulin

- Human Insulin is made up of 51 amino acids arranged in two polypeptide chains.
- A has 21 amino acids and B has 30 amino acids.
- The two polypeptide chains are interconnected by two disulphide bridges.
- A disulphide linkage also occurs in A chain.
- The hormone develops from a storage product proinsulin has 3 chains– A, B and C.
- C chain has 33 amino acids which is removed prior to insulin formation.
- In 1983, Eli Lily an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and

introduced them in plasmids of *E. coli* to produce insulin chains.

- Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form human insulin (humulin).

Steps involved in insulin production by rDNA technology:

- Isolation of Donor or DNA segment
- Formation of rDNA
- Production of multiple copies of rDNA
- Introduction of rDNA in recipient organisms
- Screening of the transformed cells

- Dr Saran Narang, a scientist of Indian origin, working in Ottawa, Canada was involved in cloning of insulin gene.

Gene Therapy

It is a technique of genetic engineering to replace a faulty gene by a normal healthy functional gene.

TYPES OF GENE THERAPY:

- Germline Gene Therapy
- Somatic cell Gene Therapy

The diseases for which the Gene Therapy will be used:

- SCID
- Duchenne Muscular Dystrophy

- Cystic Fibrosis

➢ The first clinical gene therapy was given in 1990 to a 4 year old girl with adenosine deaminase (ADA) deficiency. The enzyme is very important for the function of immune system. Disorder is caused due to deletion of the gene for adenosine deaminase. These patients do not have functional T-lymphocytes.

➢ T-lymphocytes are extracted from the bone marrow of the patient and are cultured outside the body.

➢ Functional ADA cDNA (a retroviral vector) is then introduced into these lymphocytes, which are reinjected into the bone marrow of the patient.

The patient requires periodic infusions of such genetically engineered lymphocytes as these cells do not remain alive always. But if injected at early embryonic stages it may be a permanent cure.

Molecular Diagnosis

- rDNA, PCR, ELISA are some of the techniques where early diagnosis of an infection is possible.

Here, rDNA is Recombinant DNA technology

PCR is Polymerase Chain Reaction

ELISA is Enzyme Linked Immuno-sorbent Assay.

- Very low concentrations of bacteria or virus can be detected by amplification of their

nucleic acid by PCR. This is used in the suspected cases of AIDS and cancer.

- ELISA is based on the principle of antigen and antibody interaction.

ACKNOWLEDGEMENT

The following text books were referred to complete the synopsis:

1. Text book of NCERT Class – XII
2. Truman's Elementary Biology Part – 2
3. MT Biology Today
4. MTG at your fingertips
5. Wikipedia