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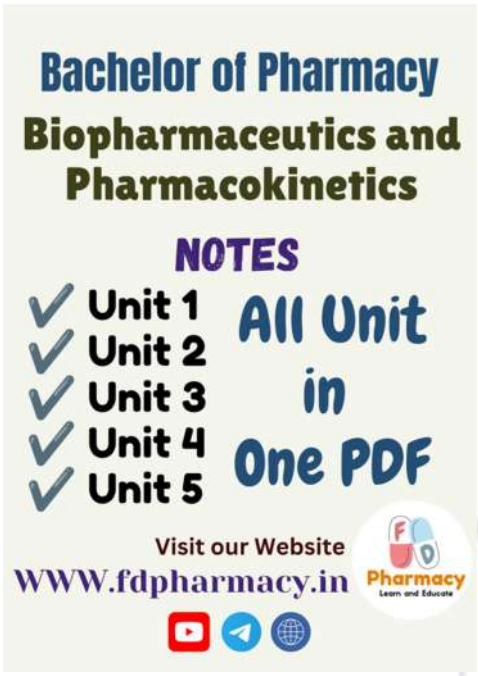
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PHARMACEUTICAL BIOTECHNOLOGY

UNIT 2

TOPIC :

- b) Recombinant DNA technology. Application of genetic engineering in medicine.

Recombinant DNA Technology (rDNA Technology)

- Recombinant DNA (rDNA) technology is a technique in which DNA molecules from different sources are combined to form a new DNA molecule called recombinant DNA.
- It involves insertion of a desired gene into a vector and transferring it into a host organism for replication and expression.

Simple meaning:

"Combining DNA from different organisms to produce useful products."

Principle of Recombinant DNA Technology

The principle is based on:

- Isolation of desired DNA
- Cutting DNA using restriction enzymes
- Joining DNA fragments using DNA ligase
- Transfer of recombinant DNA into host cells
- Multiplication and expression of inserted gene

Tools Used in Recombinant DNA Technology

1. Restriction Endonucleases

- Molecular scissors
- Cut DNA at specific recognition sites

Examples:

- EcoRI
- HindIII
- BamHI

2. DNA Ligase

- Molecular glue
- Joins DNA fragments together

Example:

- T4 DNA ligase

3. Cloning Vectors

DNA carriers used to transfer foreign DNA.

Examples:

- Plasmids
- Bacteriophages
- Cosmids
- BAC
- YAC

4. Host Organism

Organisms where recombinant DNA is introduced.

Examples:

- *Escherichia coli (E. coli)*
- Yeast
- Animal cells

Steps in Recombinant DNA Technology

Step 1: Isolation of Genetic Material

- Desired DNA is isolated from donor cells.

Step 2: Cutting DNA

- Restriction enzymes cut donor DNA and vector DNA at specific sites.

Step 3: Formation of Recombinant DNA

- DNA ligase joins foreign DNA with vector DNA.

Result:

- Foreign DNA + Vector DNA → Recombinant DNA

Step 4: Introduction into Host Cell

➢ Recombinant DNA is introduced into host cells.

Methods:

- Transformation
- Transfection
- Electroporation

Step 5: Selection of Recombinants

- Cells carrying recombinant DNA are selected using marker genes.

Example:

- Antibiotic resistance markers

Step 6: Cloning and Expression

- Host cells multiply and produce desired proteins.

Applications of Recombinant DNA Technology

1. Production of Therapeutic Proteins

Examples:

- Human insulin
- Growth hormone
- Interferons

2. Vaccine Production

Used to produce recombinant vaccines.

Example:

- Hepatitis B vaccine

3. Gene Therapy

Replacement of defective genes to treat diseases.

4. Diagnosis of Genetic Disorders

Helps detect inherited diseases.

5. Agriculture

Development of genetically modified crops.

6. Research Applications

Used in molecular biology and genetic studies.

Advantages of Recombinant DNA Technology

- Large-scale protein production
- High specificity
- Improved disease treatment
- Better diagnostic methods
- Development of vaccines

Limitations

- Expensive process
- Ethical concerns
- Risk of unintended genetic changes

Application of Genetic Engineering in Medicine

- Genetic engineering is the modification of genetic material of an organism to obtain desired characteristics.
- It uses recombinant DNA technology to alter genes for medical purposes.

Applications in Medicine

1. Production of Human Insulin

Genetically engineered bacteria produce human insulin.

Advantages:

- Large quantity production
- High purity
- Reduced allergic reactions

2. Production of Human Growth Hormone (HGH)

- Used to treat growth hormone deficiency.

3. Vaccine Production

Genetic engineering helps produce safer vaccines.

Examples:

- Hepatitis B vaccine
- Recombinant vaccines

4. Gene Therapy

Defective genes are replaced with normal genes.

Diseases treated:

- Hemophilia
- Cystic fibrosis
- Severe combined immunodeficiency (SCID)

5. Production of Interferons

Interferons are proteins used against:

- Viral infections
- Certain cancers

6. Production of Monoclonal Antibodies

Used in:

- Cancer treatment
- Autoimmune disorders
- Diagnostic tests

7. Production of Clotting Factors

Genetically engineered clotting factors treat:

- Hemophilia A
- Hemophilia B

8. Molecular Diagnosis

Used to detect:

- Genetic disorders
- Infectious diseases
- Cancer markers

9. Personalized Medicine

Treatment is designed according to patient's genetic profile.

10. Drug Development

Helps discover and manufacture new medicines.

Advantages of Genetic Engineering in Medicine

- Better treatment options
- Early disease diagnosis
- Production of safer drugs
- Reduced side effects
- Improved vaccine production