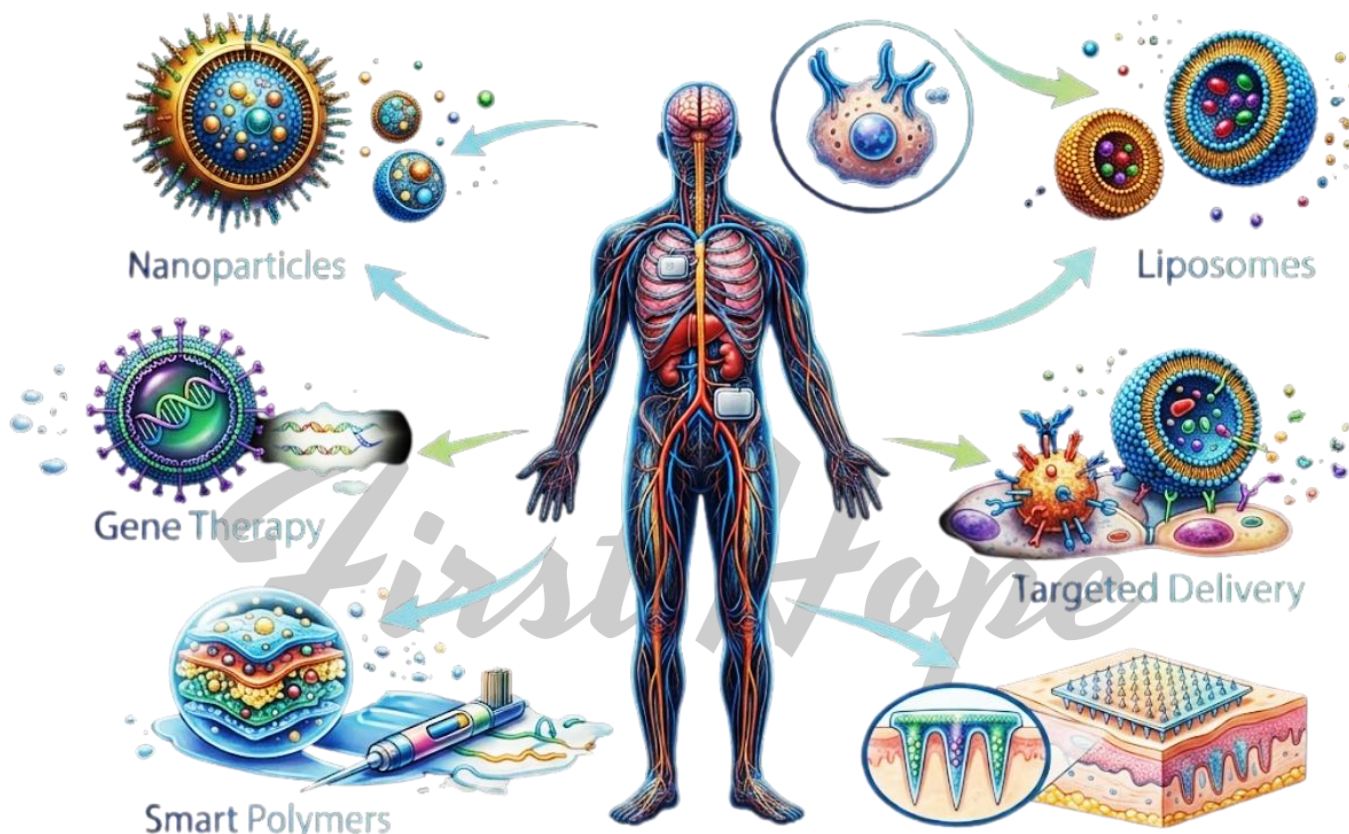


Biotechnology in Drug Delivery Systems

Biotechnology in Drug Delivery Systems – Overview and Concept

Definition

- Biotechnology in drug delivery involves the use of biological systems, living cells, or biological molecules to develop and deliver drugs more effectively in the body.



Basic Concept

- Instead of relying only on chemical drugs, biotechnology uses:
 - Proteins
 - Genes (DNA)
 - Antibodies
 - Cells

Why Biotechnology is Important in Drug Delivery

- Many modern drugs are biological in nature, such as:
 - Proteins (e.g., insulin)
 - Antibodies
 - Genes

- **Traditional drug delivery methods are often ineffective because these drugs are:**
 - Unstable
 - Easily degraded (enzymes, environment)
 - Large (poor absorption)
- **Biotechnology enables:**
 - Target-specific action
 - Personalized medicine
 - Use of molecules that mimic natural biological processes

Key Features

- **High specificity** → Targets only diseased cells
- **High potency** → Effective at low doses
- **Complex structure** → Requires specialized delivery systems

Major Areas in Biotechnology for Drug Delivery

1. Recombinant DNA Technology

- Produces therapeutic proteins by genetic engineering
- Example: production of insulin

2. Monoclonal Antibodies

- Highly specific targeting agents
- Bind to specific antigens on diseased cells

3. Gene Therapy

- Treats diseases at the **genetic level**
- Involves delivery of functional genes into cells

Applications in Drug Delivery

- Targeted cancer therapy
- Gene therapy for genetic disorders
- Vaccines (including mRNA vaccines)
- Hormone replacement therapy (e.g., insulin)

Advantages

- High specificity (reduced side effects)
- Personalized treatment approaches
- Improved therapeutic outcomes

- Ability to treat previously untreatable diseases

Challenges

- Stability issues (sensitive to environment)
- High production cost
- Complex manufacturing processes
- Delivery barriers (enzymes, immune system)
- Storage and transport requirements
- Possible immune reactions

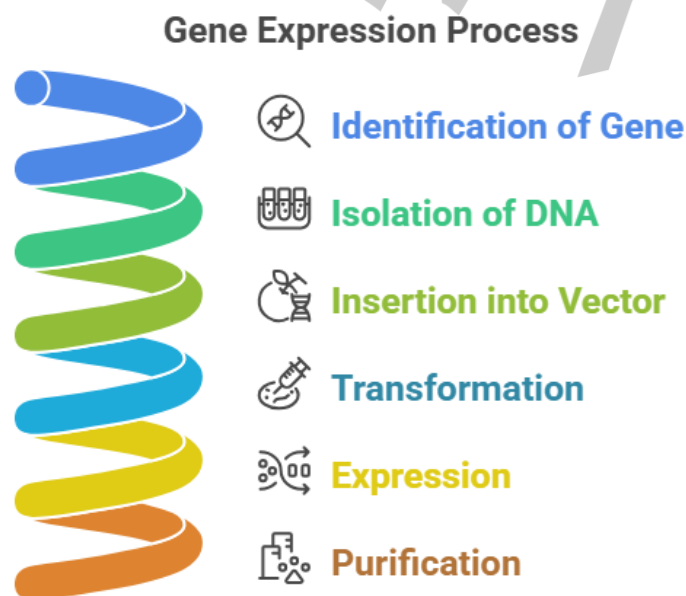
Recombinant DNA Technology in Drug Delivery Systems

- Recombinant DNA (rDNA) technology involves combining DNA from different sources to produce desired proteins or therapeutic agents.

Basic concept:

- A specific gene is identified and isolated
- It is inserted into a host organism (like bacteria)
- The host produces the desired protein in large amounts

Steps involved:



A. Identification of gene

- Select gene responsible for desired protein (e.g., insulin gene)

B. Isolation of DNA

- DNA is cut using restriction enzymes

C. Insertion into vector

- Gene is inserted into a vector (carrier DNA)
- **Common vectors:**
 - Plasmids
 - Viruses

D. Transformation

- Vector introduced into host cell (e.g., E. coli)

E. Expression

- Host cells produce the protein

F. Purification

- Protein is extracted and purified for therapeutic use

Applications in drug delivery

- **Production of therapeutic proteins:**
 - Insulin
 - Growth hormone
 - Interferons
- **Used in targeted delivery systems:**
 - Proteins act as drugs or targeting agents

Role in drug delivery systems:

- Enables large-scale production of biologics
- **Allows modification of proteins to improve:**
 - Stability
 - Half-life
 - Targeting ability

Advantages:

- High purity and specificity
- Large-scale production
- Reduced risk of contamination compared to animal sources

Limitations:

- Complex manufacturing process
- Risk of immune reactions
- Requires strict quality control



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