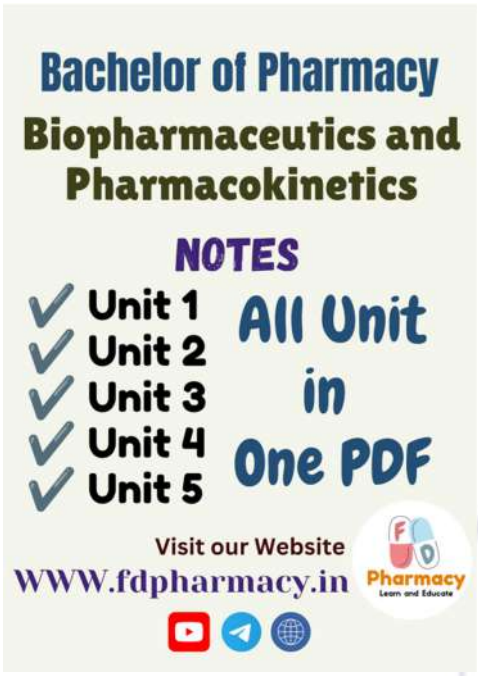
WELCOME

TO


Bachelor of Pharmacy
Biopharmaceutics and Pharmacokinetics
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate


Bachelor of Pharmacy
Herbal Drug Technology
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate


Bachelor of Pharmacy
Pharmaceutical Biotechnology
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate


Bachelor of Pharmacy
Medicinal Chemistry III
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate


Bachelor of Pharmacy
Pharmacology III
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate


Bachelor of Pharmacy
Quality Assurance
NOTES
Unit 1
Unit 2
Unit 3
Unit 4
Unit 5
All Unit in One PDF
Visit our Website
WWW.fdpharmacy.in
Pharmacy
Learn and Educate

PHARMACEUTICAL BIOTECHNOLOGY

UNIT 4

TOPIC :

- d) Introduction to Microbial biotransformation and applications.

Microbial Biotransformation

- Microbial biotransformation is the chemical modification of substances by microorganisms such as bacteria, fungi, and yeast through the action of their enzymes.
- In simple words, microorganisms convert one chemical compound into another through biochemical reactions.
- Microbial biotransformation is widely used in the pharmaceutical industry, biotechnology, food industry, agriculture, and environmental management.

Definition

- Microbial biotransformation is a biological process in which microorganisms convert a substrate into a structurally modified product using enzymatic reactions.

Importance of Microbial Biotransformation

1. Produces useful pharmaceutical products.
2. Eco-friendly and environmentally safe process.
3. Highly specific reactions with fewer by-products.
4. Operates under mild temperature and pH conditions.
5. Used in production of steroids, antibiotics, vitamins, and hormones.
6. Reduces manufacturing costs.
7. Provides high product yield and purity.

Types of Biotransformation Reactions

1. Oxidation Reaction

- Oxidation involves the addition of oxygen or removal of hydrogen from a compound.

Example

Ethanol → Acetaldehyde

Microorganism: Acetobacter species

Applications

- Vinegar production
- Pharmaceutical synthesis
- Industrial fermentation

2. Reduction Reaction

- Reduction involves the addition of hydrogen or removal of oxygen from a compound.

Example

Acetaldehyde → Ethanol

Microorganism: Saccharomyces cerevisiae (Yeast)

Applications

- Alcohol fermentation
- Pharmaceutical industry
- Chemical manufacturing

3. Hydrolysis Reaction

→ Hydrolysis is the breakdown of complex molecules into simpler molecules by the addition of water.

Example

Starch → Glucose

Microorganism: Bacillus species

Applications

- Food industry
- Fermentation processes
- Production of sugars

4. Hydroxylation Reaction

- Hydroxylation involves the introduction of a hydroxyl group (–OH) into a molecule.

Example

Progesterone → 11α-Hydroxyprogesterone

Microorganism: Rhizopus nigricans

Applications

- Steroid drug production
- Corticosteroid synthesis
- Pharmaceutical industry

5. Dehydrogenation Reaction

- Dehydrogenation involves the removal of hydrogen atoms from a compound.

Example

Succinate → Fumarate

Microorganism: Pseudomonas species

Applications

- Metabolic studies
- Industrial bioprocesses
- Chemical synthesis

6. Methylation Reaction

- Methylation involves the addition of a methyl group ($-CH_3$) to a compound.

Example

Catechol → Guaiacol

Microorganism: Aspergillus species

Applications

- Drug synthesis
- Production of aromatic compounds
- Biotechnology

7. Demethylation Reaction

- Demethylation involves the removal of a methyl group ($-CH_3$) from a compound.

Example

Caffeine → Theophylline

Microorganism: Pseudomonas putida

Applications

- Drug metabolism studies
- Pharmaceutical research
- Biodegradation processes

8. Isomerization Reaction

- Isomerization is the conversion of one isomer into another isomer.

Example

Glucose → Fructose

Microorganism: Streptomyces species

Applications

- High-fructose corn syrup production
- Food industry
- Industrial biotechnology

9. Acetylation Reaction

- Acetylation involves the addition of an acetyl group (CH_3CO) to a compound.

Example

Sulfonamide → Acetyl Sulfonamide

Applications

- Drug metabolism
- Pharmaceutical manufacturing
- Chemical modification of drugs

10. Esterification Reaction

- Esterification is the reaction between an acid and an alcohol to form an ester.

Example

Organic Acid + Alcohol → Ester

Microorganism: Saccharomyces cerevisiae

Applications

- Flavor production
- Perfume industry
- Food processing

Sources of Biocatalysts

Biocatalysts are biological agents that catalyze biotransformation reactions.

1. Growing Cells

- Growing cells are actively dividing microbial cells that perform biotransformation during their growth phase.

Characteristics

- Continuous enzyme production.
- High metabolic activity.
- Suitable for large-scale fermentation.

Example

- Production of antibiotics by Penicillium species.

2. Non-Growing Cells

- Non-growing cells are resting microbial cells that do not divide but still possess active enzymes.

Characteristics

- Stable enzyme activity.
- Useful for specific reactions.
- Lower nutrient requirements.

Example

- Steroid transformation by resting bacterial cells.

3. Immobilized Cells

- Immobilized cells are microbial cells attached to or trapped within a solid support while retaining their catalytic activity.

Advantages

- Reusable.
- Easy separation from products.
- Increased stability.
- Continuous production possible.

Example

- Ethanol production using immobilized yeast cells.

4. Immobilized Enzymes

- Immobilized enzymes are enzymes fixed onto insoluble support materials while maintaining catalytic activity.

Advantages

- Reusable.
- High stability.
- Cost-effective.
- Easy product purification.

Example

- Immobilized glucose isomerase used in high-fructose corn syrup production.

Applications of Microbial Biotransformation

1. Pharmaceutical Industry

Steroid Conversion

- Production of corticosteroids.
- Synthesis of steroid hormones.

Antibiotic Modification

- Improvement of antibiotic activity.
- Development of new antibiotics.

Vitamin Synthesis

- Production of vitamins and vitamin precursors.

2. Environmental Applications

Biodegradation of Pollutants

- Breakdown of harmful chemicals.
- Removal of environmental contaminants.

Wastewater Treatment

- Removal of organic waste.
- Reduction of water pollution.

Detoxification

- Conversion of toxic compounds into harmless substances.

3. Food Industry

Fermentation

- Production of alcoholic beverages.
- Production of fermented foods.

Flavor Production

- Generation of natural flavors and fragrances.

Organic Acid Production

- Citric acid
- Lactic acid
- Acetic acid

4. Agriculture

Pesticide Degradation

- Breakdown of harmful pesticide residues.

Biofertilizer Production

- Enhancement of soil fertility.
- Promotion of plant growth.

Advantages of Microbial Biotransformation

1. Environmentally friendly.
2. High specificity and selectivity.
3. Low energy requirements.
4. Cost-effective process.
5. Produces fewer unwanted by-products.
6. Suitable for large-scale industrial production.