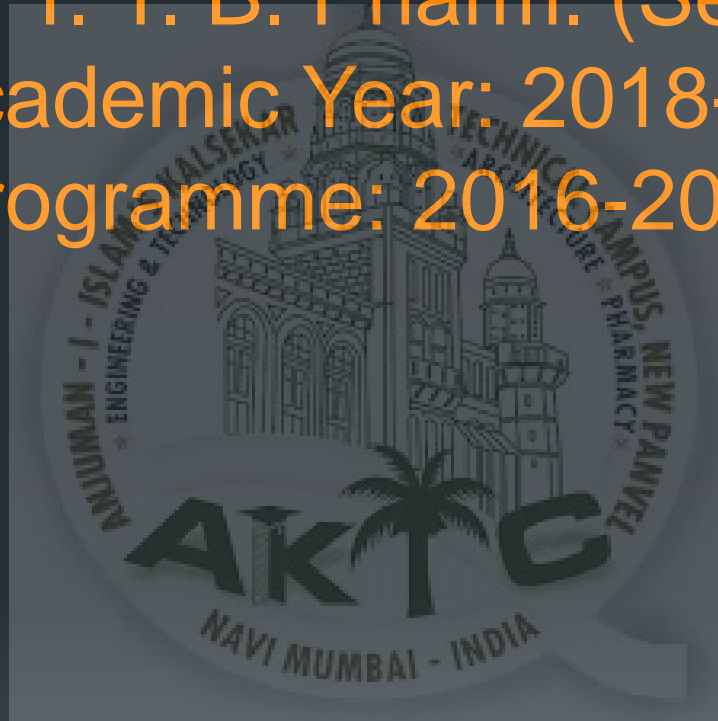
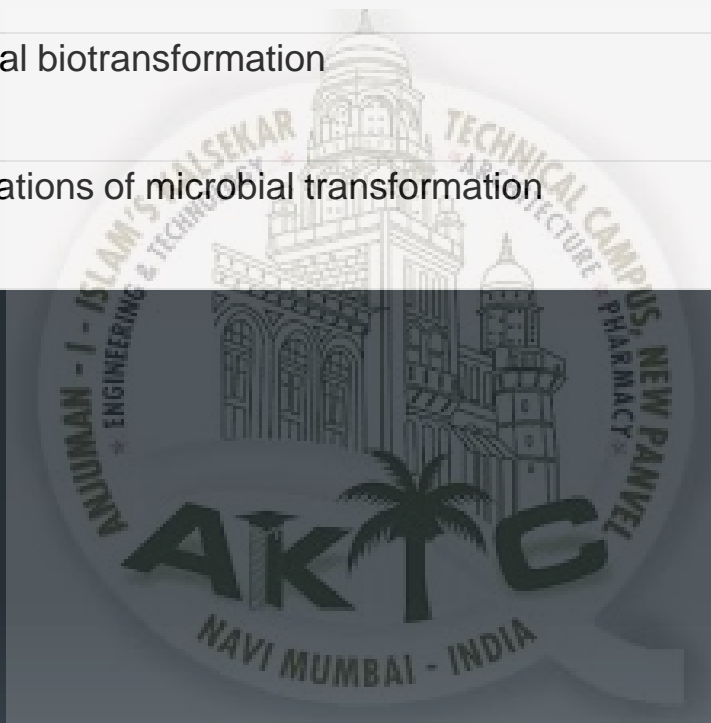


Topic: Microbial Biotransformation
Subject: Pharmaceutical Biotechnology
Class: T. Y. B. Pharm. (Sem.- V)
Academic Year: 2018-19
Programme: 2016-2020



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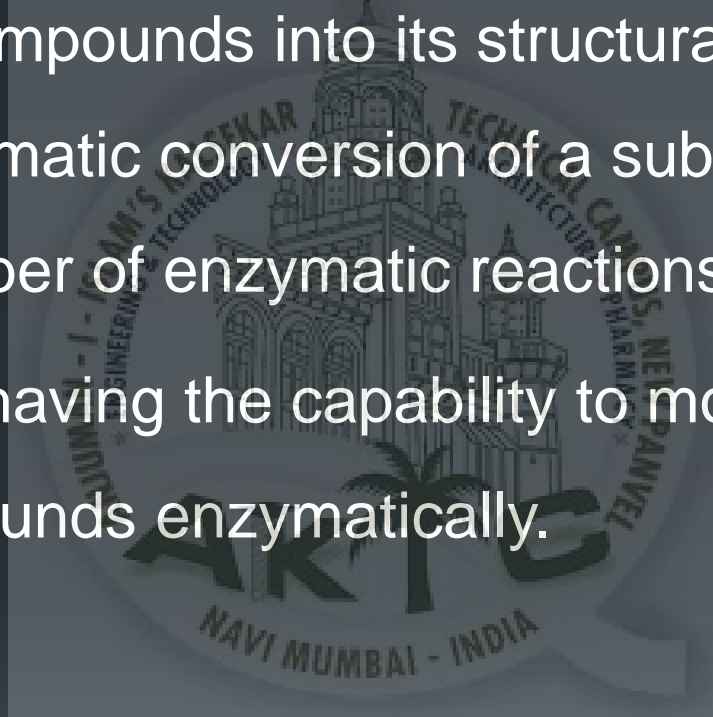
	Topic Learning Outcomes	COs	BL
	1 Explain the microbial biotransformation	CO4	L2
	2 Discuss the applications of microbial transformation	CO4	L2



- Definition:

Biotransformation is a process in which microorganisms convert organic compounds into its structurally related products i.e., enzymatic conversion of a substrate into product with a limited number of enzymatic reactions.

- Microorganisms having the capability to modify a wide range of organic compounds enzymatically.



- **Advantages of Biotransformation:**
- When the production of a particular compound is either difficult or costly by chemical methods then biotransformation is useful.
- It is useful in chemical reactions in which substrate specificity, stereo specificity and mixed reactions.
- The environmental pollution due to biotransformation is negligible.
- It is easy to apply recombinant DNA technology to make desired improvements in microbes involved in biotransformation.
- Due to limited number of reactions, easy to scale-up the processes.

■ Types of Reactions involved in biotransformation:

Many types of chemical reactions like oxidation, reduction, hydrolysis, condensation, isomerization, formation new C-C bonds, synthesis of chiral compounds and reversal of hydrolytic reactions. Biotransformation involve more than one type of reaction.

1. Oxidation Tryptophan to 5-Hydroxytryptophan using *B. subtilis*
2. Reduction Benzaldehyde to Benzyl alcohol using *S. cerevisiae*
3. Hydrolysis Anhydrotetracycline to Tetracycline using *Streptomyces aureofaciens*
4. Condensation Streptomycin to Streptomycin phosphate using *Streptomyces*

■ Sources of Biocatalysts and Techniques for Biotransformation:

growing cells, resting cells, killed cells, immobilized cells, cell-free extracts, enzymes and immobilized enzymes can be used for biotransformation.

■ Product Recovery in Biotransformation:

The desired products obtained by biotransformation are extracellular. The product may be either soluble or suspended state can be recovered by employing commonly used techniques by precipitation by salts, extraction with solvents etc.

■ Limitations:

low yields or process is expensive or market itself is limited.

■ APPLICATIONS:

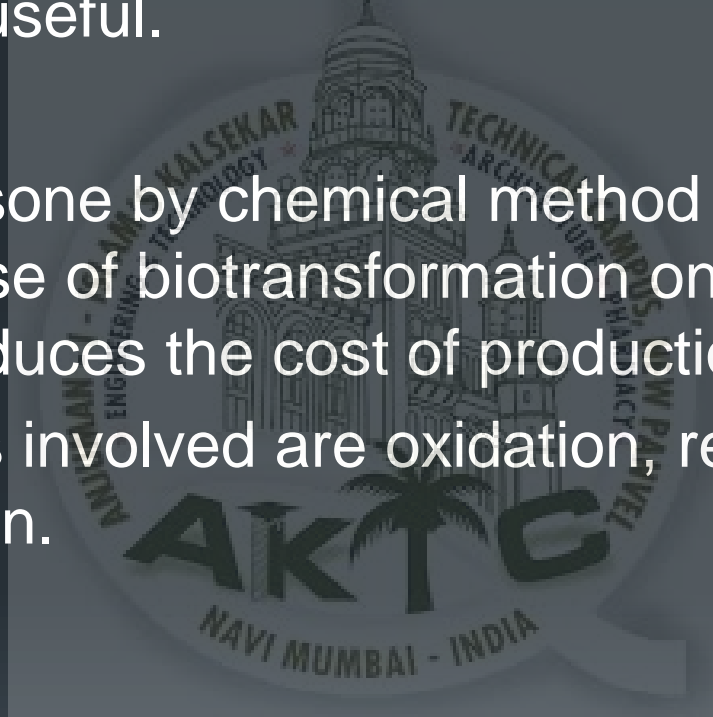
1) Biotransformation of steroids:

- Steroids having a wide range of functions.
- Therapeutically useful.

e.g. Cortisone.

To produce cortisone by chemical method 37 reactions are required but in case of biotransformation only 11 reactions are required which reduces the cost of production.

Types of reactions involved are oxidation, reduction, hydrolysis and ester formation.





Stigmasterol



Chemical reactions

Progesterone



Rhizopus nigricans

11 α -Hydroxyprogesterone

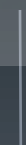


Chemical reactions

Hydrocortisone
(Cortisol)

Corynebacterium simplex

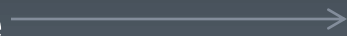
Prednisolone



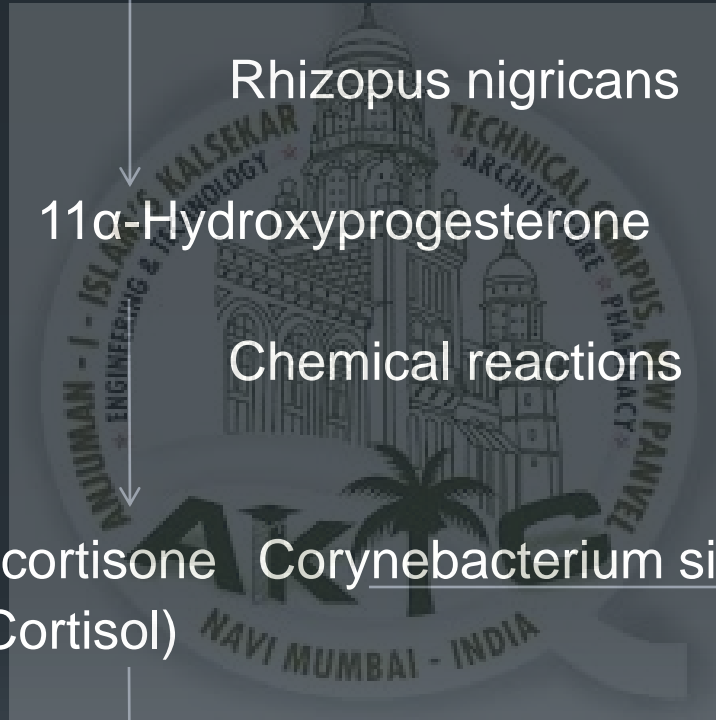
Chemical reactions

Corynebacterium simplex

Cortisone



Prednisone



- Biotransformation of cholesterol:
- ^{IR@AIKTC} Certain commercially important steroids can directly produced from cholesterol by biotransformation.



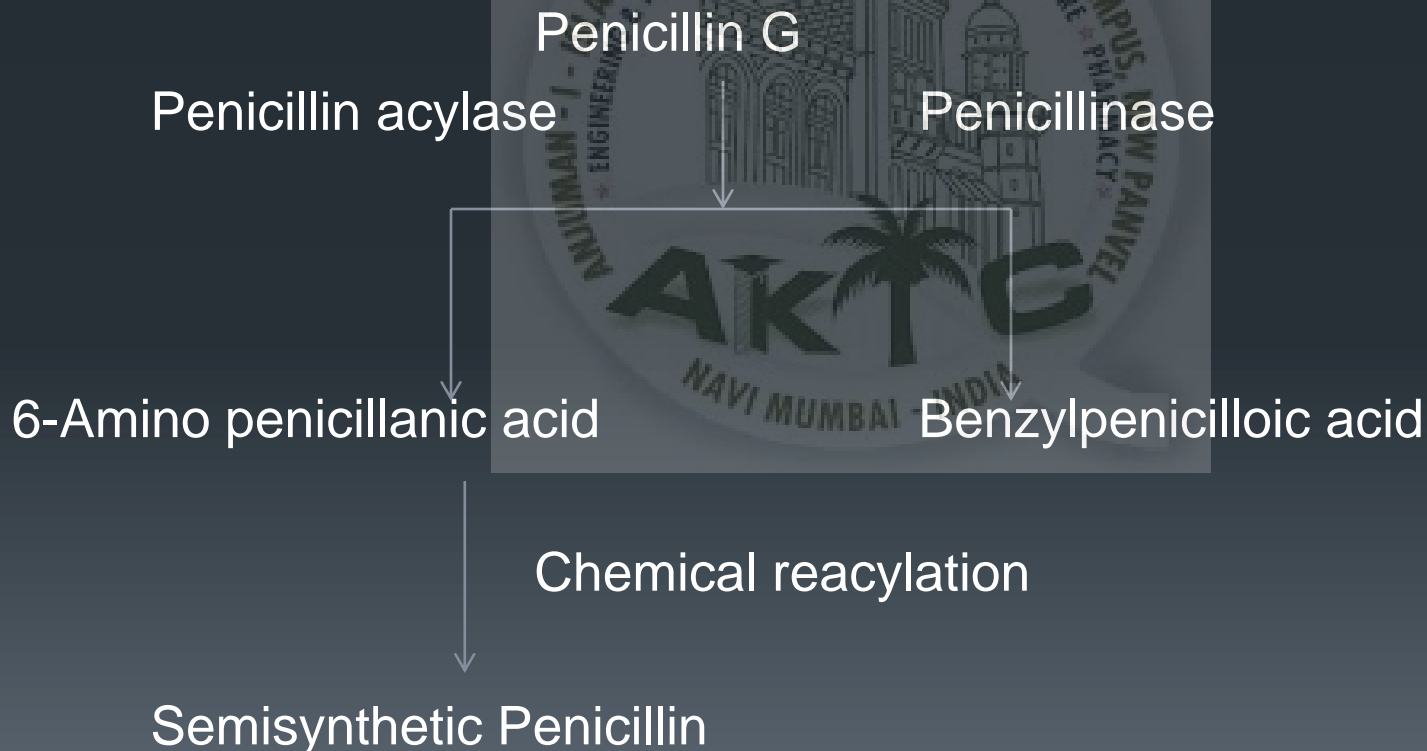
2) Biotransformation of Antibiotics:

- Direct Biotransformation:

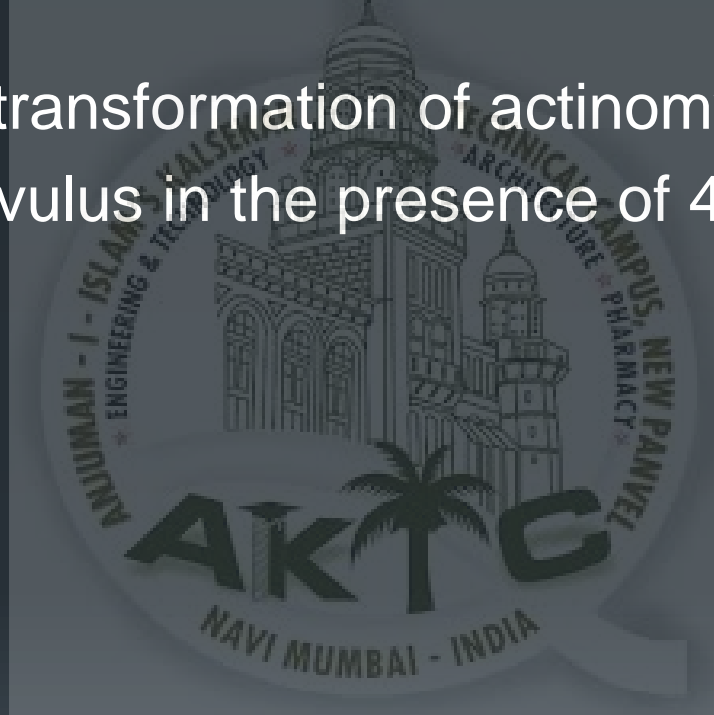
By direct biotransformation reactions like acylation, deacylation, phosphorylation, adenylation etc., microbes

- produces the desired products.

- example Biotransformation of Penicillin G:



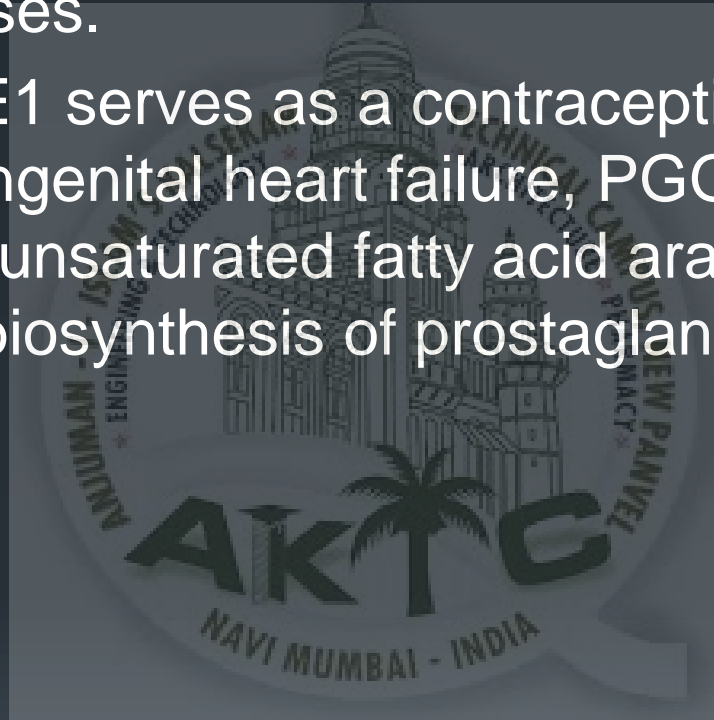
- Indirect Biotransformations:
- The biosynthetic processes of antibiotics can be controlled by the addition of certain inhibitors or modified substrates to the medium.
- For example Biotransformation of actinomycins by streptomyces parvulus in the presence of 4-methyl-proline.



3) BIOTRANSFORMATION OF ARACHIDONIC ACID TO PROSTAGLANDINS:

Prostaglandins are important for pharmaceutical and therapeutic purposes.

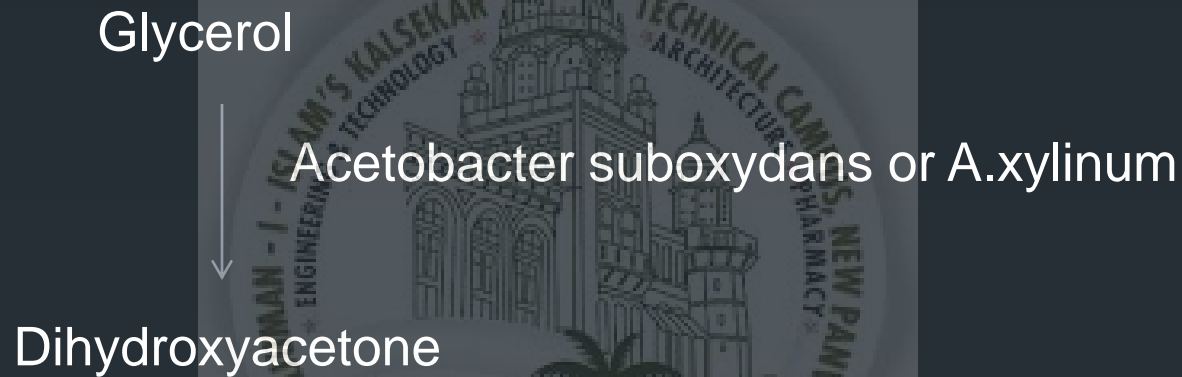
For example PGE₁ serves as a contraceptive, PGG₁ is used in treatment of congenital heart failure, PGG₂ for relieving labour pains. The unsaturated fatty acid arachidonic acid is the precursor for the biosynthesis of prostaglandins.



4) BIOTRANSFORMATION OF GLYCEROL TO DIHYDROXYACETONE:

Dihydroxyacetone is used in cosmetics and suntan lotions.

Certain acetic acid bacteria can convert glycerol to dihydroxyacetone.



References:

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- B. D. Singh, Biotechnology
- K. Sambamurthy, Ashutosh Kar; Pharmaceutical Biotechnology Fundamentals and Applications
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- S S Kori, M A Halkai, Pharmaceutical Biotechnology Fundamentals and Applications



Review questions to ensure attainment of TLOs/ Cos

1. Define Microbial Biotransformation.
2. Give the applications of Biotransformation.

