



**BP 605 T. Pharmaceutical Biotechnology (Theory)**

# **Introduction to Microbial biotransformation and applications**

**Dr Chandresh Sharma**

Assistant Professor

Department of Biotechnology

Chhatrapati Shahu Ji Maharaj University, Kanpur



# Overview

Introduction and Definition

Microbial biotransformation

Applications



# BIOTRANSFORMATION

- ✓ Biotransformations are **structural modifications in a chemical compound** by **organisms /enzyme systems** that lead to the formation of **molecules with relatively greater polarity**.
- ✓ This mechanism has been developed by **microbes to acclimatize to environmental changes** and it is useful in a wide range of biotechnological processes.
- ✓ The most **significant aspect** of biotransformation is that it **maintains the original carbon skeleton** after obtaining the products.



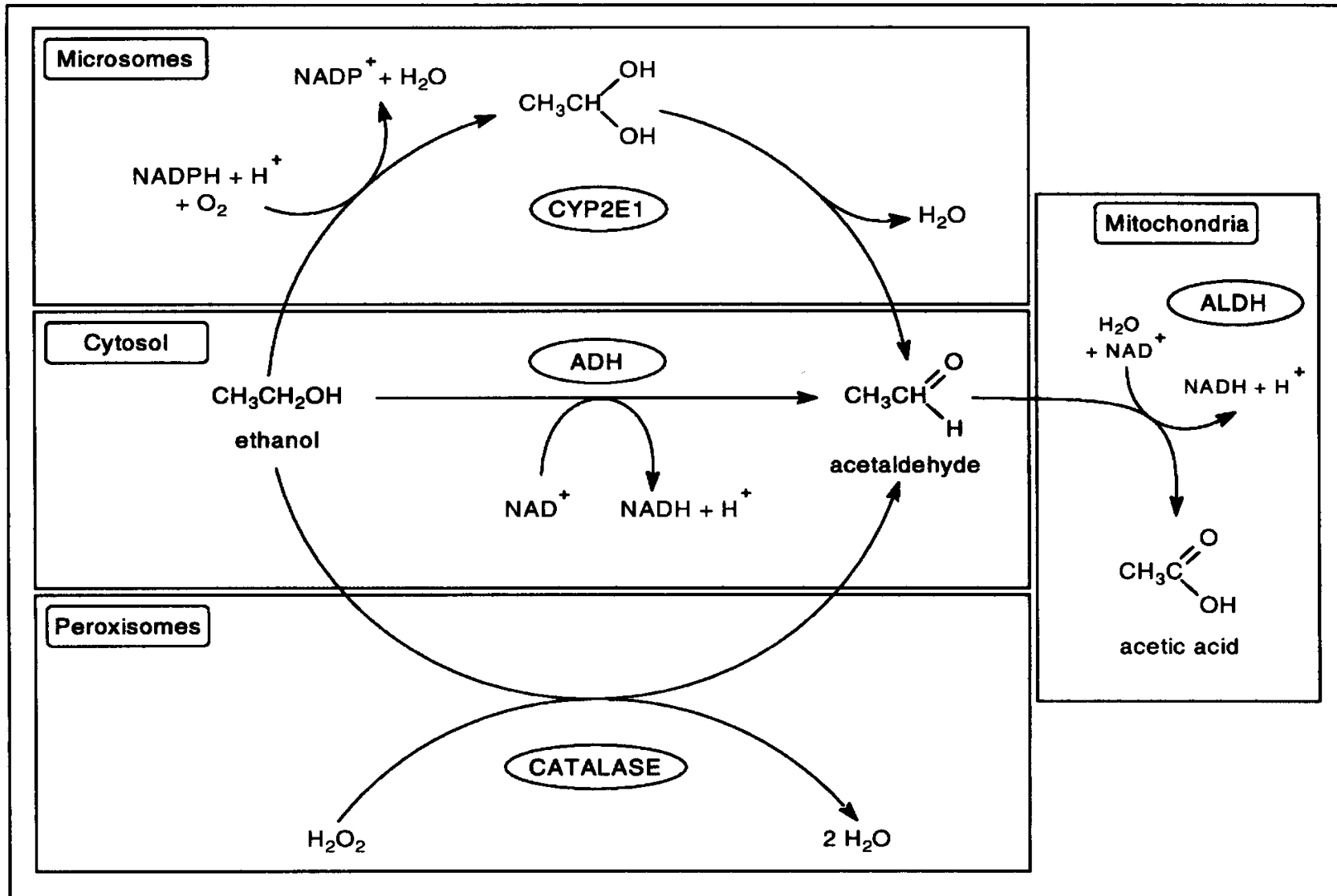
# TYPES OF BIOTRANSFORMATION

Biotransformation is of two types:

- 1. Enzymatic:** Microsomal biotransformation is caused by **enzymes present within the lipophilic membranes of smooth endoplasmic reticulum.**
- 2. Nonenzymatic:** **Non-Microsomal Biotransformation** involves the **enzymes which are present within the mitochondria.**



# TYPES OF BIOTRANSFORMATION





# BIOTRANSFORMATION REACTION

**Any structural change in a molecule**

- ✓ **Phase I** - creates site for phase II reaction
  - Oxidation (adds O) e.g. microsomes
  - Reduction
  - Hydrolysis (e.g. by plasma esterases)
  - Others
- ✓ **Phase II** - couples group to existing (or phase I formed) conjugation site
  - Glucuronide (with glucuronic acid)
  - Sulphate
  - Others



# Microbial cells are ideal choice for biotransformation

**Microbial cells are ideal choice for biotransformation due to certain reasons like:**

- I. Surface-volume ratio:** Microbial biotransformation has **high surface-volume ratio**.
- II. Growth Rate:** Higher growth rate of microbial cells reduces the time of biomass transformation.
- III. Metabolism Rate:** Higher rate of the metabolism in microbes leads to efficient transformation of substrate.
- IV. Sterility:** It is easier to maintain sterile conditions when microbes are used



# APPLICATIONS OF MICROBIAL BIOTRANSFORMATION

- ✓ Transformation of steroids and sterols.
- ✓ Transformation of Pollutants.
- ✓ Transformation of Non-Steroid Compounds.
- ✓ Transformation of Antibiotics.
- ✓ Transformation of Pesticides.
- ✓ Petroleum Biotransformation.





# **GENETIC ORGANIZATION OF EUKARYOTES AND PROKARYOTES**



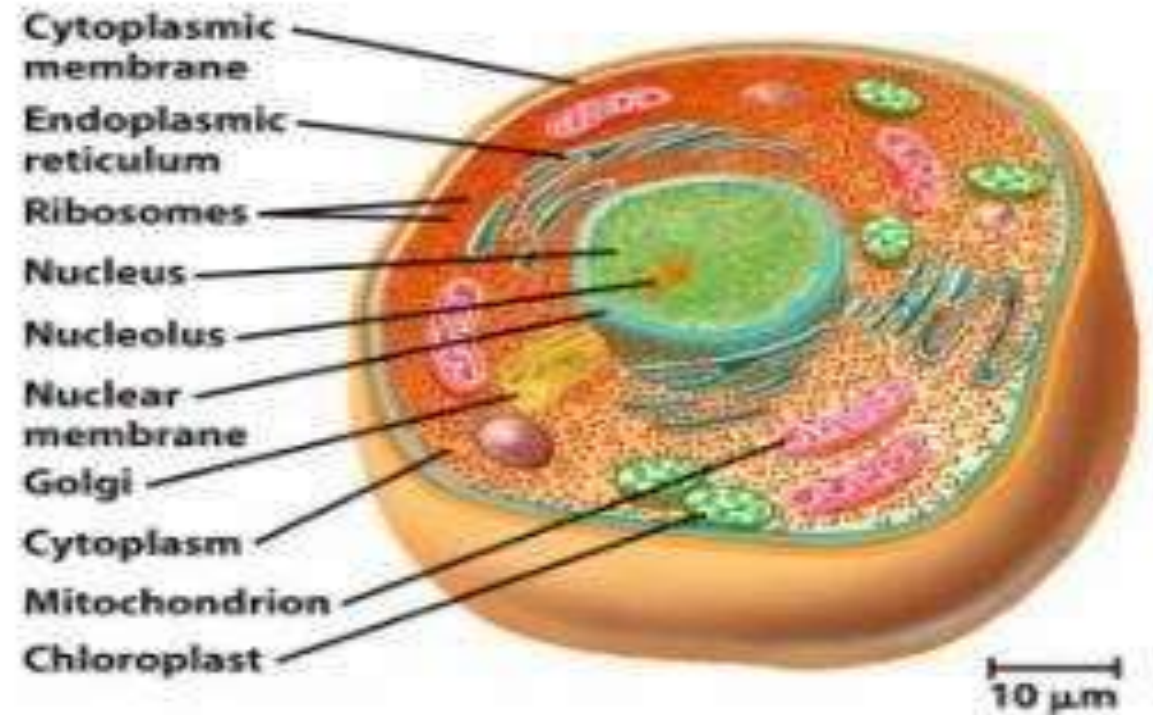
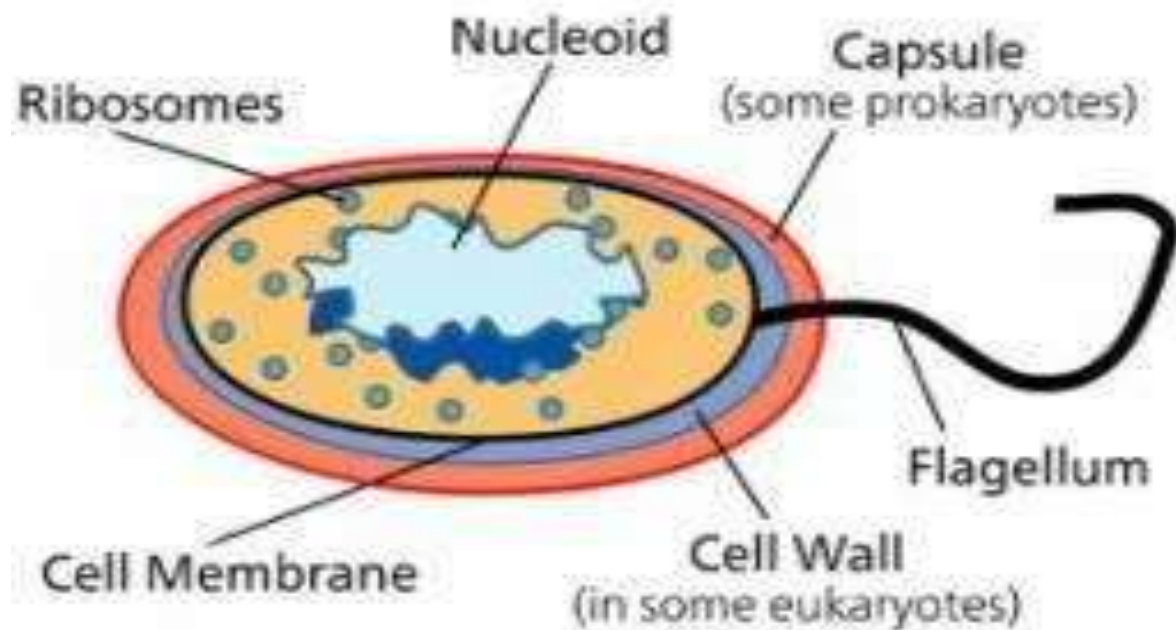
# EUKARYOTES AND PROKARYOTES

- ✓ **Prokaryotes** are organisms made up of cells that lack a cell nucleus or any membrane-encased organelles.
- ✓ **Eukaryotes** are organisms made up of cells that possess a membrane-bound nucleus that holds genetic material as well as membrane-bound organelles.



# DIFFERENCE BETWEEN EUKARYOTES AND PROKARYOTES

## Prokaryotes vs Eukaryotes





# Prokaryotic vs. eukaryotic genomes

<b>Prokaryotic</b>	<b>Eukaryotic</b>
No-nonsense genomes – nearly all coding	Lots of noncoding regions (introns, intergenic regions)
Frequent horizontal gene transfer (HGT)	Less frequent HGT
Circular genome plus plasmids	Distinct linear chromosomes
Operons	More dispersed regulation
Streamlined genomes, few repetitive elements	Abundant repetitive elements
Very rapidly evolving in both sequence and structure	More conservative mode of evolution
Very large population sizes ( $10^9$ - $10^{10}$ )	Smaller population sizes ( $\sim 10^3 - 10^4$ )



# Acknowledgement

## Pharmaceutical Biotechnology

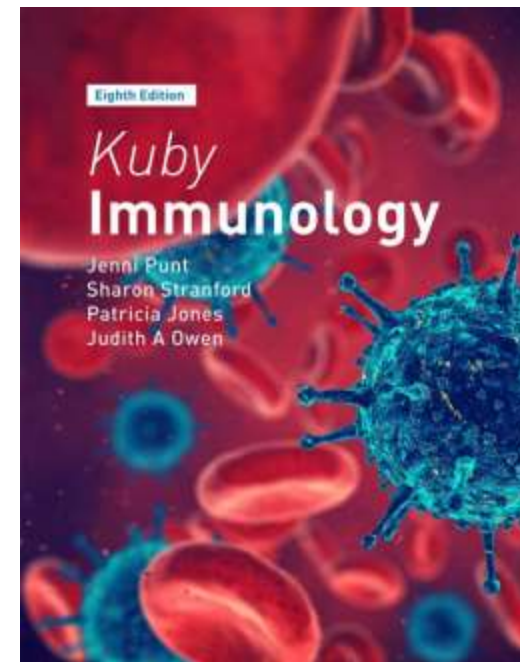
Concepts and Applications:

Gary Walsh

*University of Limerick, Republic of Ireland*



John Wiley & Sons, Ltd



For Query

**Pearson Education Inc.**

[chandreshsharma@csjmu.ac.in](mailto:chandreshsharma@csjmu.ac.in); [sharmac3001@gmail.com](mailto:sharmac3001@gmail.com)