

Fermentation technology

Fermentation Technology and Its Applications

- Fermentation technology is the use of **microorganisms (bacteria, fungi, and yeast)** under controlled conditions to produce useful products such as food, medicines, enzymes, and chemicals.

Basic Concept

- Microorganisms grow and multiply using nutrients
- During growth, they produce metabolic by-products
- These products are collected and used for various purposes
- **Fermentation can be carried out in:**
 - Liquid medium (Submerged fermentation)
 - Solid substrates (Solid-state fermentation)

Types of Fermentation



1. Based on Mode of Operation

A. Batch Fermentation

- All nutrients are added at the beginning
- Process runs for a fixed time

B. Continuous Fermentation

- Fresh nutrients are continuously added
- Products are continuously removed

C. Fed-Batch Fermentation

- Nutrients are added in intervals during the process

2. Based on Physical State

A. Submerged Fermentation (SmF)

- Microorganisms grow in liquid nutrient medium
- Widely used in industrial production
- Easier to control pH, temperature, and oxygen

B. Solid-State Fermentation (SSF)

- Microorganisms grow on solid materials without free-flowing water
- Commonly used for fungi and some bacteria
- Suitable for enzyme production

Important Factors Affecting Fermentation

- Temperature
- pH
- Oxygen supply (aeration)
- Nutrient composition (carbon, nitrogen sources)
- Agitation (mixing)
- Sterility

Major Applications of Fermentation Technology:

A. Food Industry

- Production of bread, yogurt, cheese, vinegar, and alcoholic beverages
- Improves taste, texture, and shelf life

B. Pharmaceutical Industry

- Production of antibiotics (e.g., penicillin)
- Vaccines and hormones
- Vitamins (e.g., Vitamin B12)

C. Agriculture

- Biofertilizers (e.g., Rhizobium)
- Biopesticides
- Silage production (animal feed)

D. Industrial Products

- Organic acids (citric acid, lactic acid)
- Solvents (ethanol, acetone)
- Biofuels

E. Environmental Applications

- Waste treatment and recycling
- Bioremediation (removal of pollutants)

Advantages of Fermentation Technology

- Large-scale production possible
- Independent of climatic conditions
- Consistent quality
- Cost-effective for many products

Limitations

- Risk of contamination
- Requires strict control
- Downstream processing can be expensive

Production of Ergot Alkaloids

Definition

- **Ergot** alkaloids are a group of complex secondary metabolites mainly produced by the fungus *Claviceps purpurea*.
- These compounds are **pharmacologically important** and widely used in medicine.

Introduction / Natural Source and Problem

- Naturally produced when the fungus infects rye and other cereals
- Forms hard structures called ergots
- Field production is unreliable and unsafe due to contamination risks
- Therefore, fermentation technology is used for controlled and safe production.

Microorganism Used

- *Claviceps purpurea*
- Other species: *Claviceps fusiformis*

Types of Ergot Alkaloids

1. Ergometrine (Ergonovine)

- Used to control postpartum hemorrhage

2. Ergotamine

- Used in migraine treatment

3. Ergocristine, Ergocryptine

- Used in neurological disorders

Fermentation Process

A. Inoculum Preparation

- Pure culture of fungus is grown

B. Fermentation Medium

- Contains carbon source (glucose, sucrose)
- Nitrogen source (ammonium salts)
- Minerals and growth factors

C. Cultivation Conditions

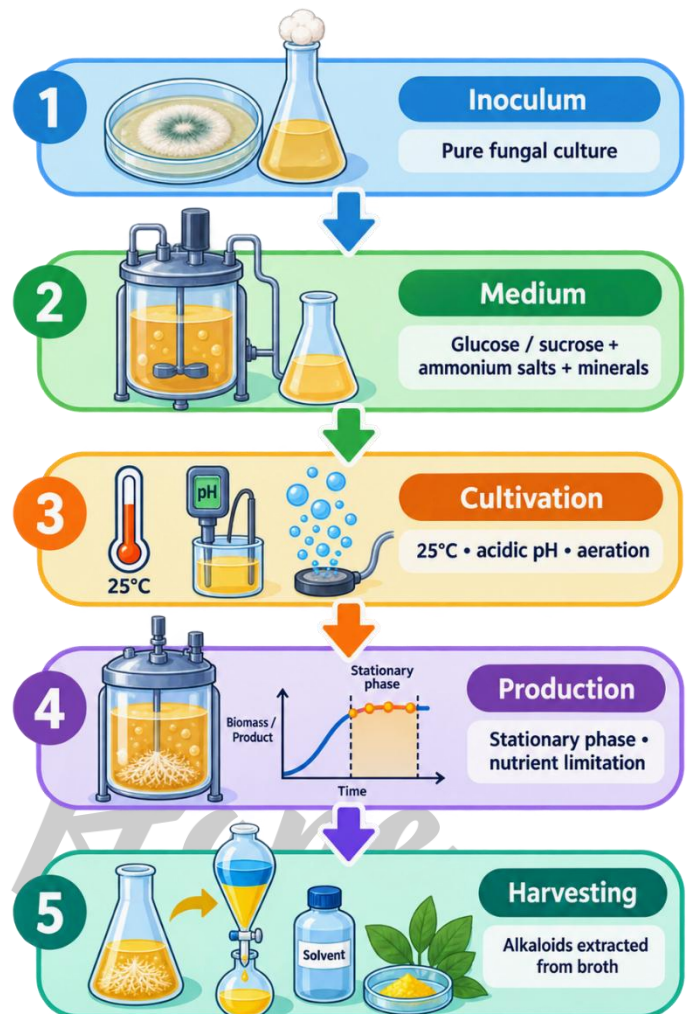
- Temperature: around 25°C
- pH: slightly acidic
- Aeration: essential for growth and alkaloid production

D. Production Phase

- Alkaloids are produced during stationary phase
- Requires controlled nutrient limitation

E. Harvesting

- Alkaloids extracted from broth using solvents



Factors Affecting Production

- Carbon and nitrogen ratio
- Phosphate levels
- Oxygen supply
- Strain selection

Advantages of Fermentation Production

- Safer than field cultivation
- Higher yield
- Controlled conditions
- Possibility of strain improvement

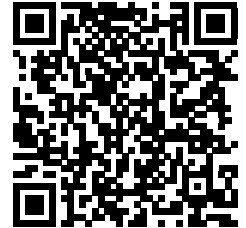


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