



UNIT V – TOPIC 4

Role of Technologies

Definition:

Fermentation is a metabolic process in which microorganisms convert **organic substrates** (like sugars) into **alcohol, acids, or gases**, typically under **anaerobic conditions**.

1. Types of Fermenters (Bioreactors)

Type	Description	Applications
1. Batch Fermenter	<ul style="list-style-type: none">- Closed system- All nutrients added at start- No additions/removals during process	<ul style="list-style-type: none">- Antibiotics (penicillin)- Yogurt production
2. Fed-Batch	<ul style="list-style-type: none">- Semi-open system- Nutrients added periodically- Products removed at end	<ul style="list-style-type: none">- Baker's yeast- Recombinant proteins
3. Continuous	<ul style="list-style-type: none">- Open system- Fresh medium continuously added- Product continuously removed	<ul style="list-style-type: none">- Ethanol fuel- Wastewater treatment
4. Solid-State	<ul style="list-style-type: none">- No free water- Substrate acts as support (e.g., rice bran)	<ul style="list-style-type: none">- Tempeh- Koji (soy sauce/miso)
5. Airlift	<ul style="list-style-type: none">- Gas bubbles provide mixing- No mechanical agitator	<ul style="list-style-type: none">- Single-cell proteins- Vinegar
6. Photobioreactor	<ul style="list-style-type: none">- Uses light energy- For photosynthetic microbes	<ul style="list-style-type: none">- Algae biofuels- Spirulina



2. Benefits of Fermentation

A. Nutritional Benefits

✓ Enhances digestibility:

- Breaks down anti-nutrients (e.g., phytic acid in sourdough)

✓ Increases bioavailability:

- Fermented dairy improves calcium absorption

✓ Produces nutrients:

- Vitamin B12 (in tempeh), K2 (in natto)

B. Health Benefits

✓ Probiotics: Live cultures support gut microbiome (e.g., kefir, kimchi)

✓ Detoxification:

- Reduces aflatoxins in grains
- Lowers cyanide in cassava

C. Food Preservation

✓ Extends shelf life via:

- Acid production (lactic acid in sauerkraut)
- Alcohol production (wine/beer)
- Antimicrobial compounds (bacteriocins)

D. Economic/Environmental Benefits

♻️ Upcycling: Uses agri-waste (e.g., whey → biogas)

□ Value addition: Cheap raw materials → premium products (soy → tempeh)

□ Sustainable: Lower energy than thermal processing

E. Flavor Enhancement

- Develops umami (soy sauce), tanginess (yogurt), complexity (cheese)