



UNIT V – TOPIC 5

Role of Technologies

Why Control Fermentation?

- Ensure **product consistency**
 - Enhance **safety** by inhibiting pathogens
 - Improve **flavor, texture, and shelf life**
 - Maximize **yield** of desired metabolites
 - Prevent **undesirable microbial growth**
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□ Key Parameters for Controlling Fermentation

1. Temperature

- Most fermentations occur between **20°C and 45°C**.
 - **Too low**: Slows microbial growth.
 - **Too high**: Can kill microbes or promote spoilage organisms.
 - **Example**: Yogurt fermentation is controlled at ~42°C for optimal lactic acid production.
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2. pH

- Microorganisms have optimal pH ranges (e.g., Lactobacillus: pH 4.0–6.5).
 - Low pH helps inhibit spoilage organisms.
 - Buffers (like phosphate) or pH adjustments (acid/base addition) are used.
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3. Oxygen Availability

- **Aerobic vs. Anaerobic conditions**:
 - **Yeast** for bread: aerobic for CO₂, anaerobic for alcohol.
 - **Lactic acid bacteria**: Mostly anaerobic.
- Controlled using sealed systems, sparging, or agitation.



4. Substrate Concentration

- Adequate nutrients (sugars, proteins) are necessary.
- Overload can lead to off-flavors or inhibition.
- Starter cultures are often added for controlled fermentation.

5. Inoculum Type and Size

- Use of **starter cultures** ensures specific and safe microbial growth.
- Higher inoculum = faster fermentation and less contamination risk.

6. Time

- Each fermentation has an **optimal duration**.
- Under- or over-fermentation can affect taste, texture, and safety.

☐ Technological Controls

✓ Use of Starter Cultures

- Selected strains with desired traits.
- Outcompete wild microbes, ensure repeatability.

✓ Automated Fermenters

- Monitor and control temperature, pH, oxygen, agitation in real time.

✓ Preservatives and Inhibitors

- Salt, sugar, or acids used to control microbial environment.

✓ Hygiene and Sanitation

- Cleaning equipment and environment prevents unwanted microbial contamination.



□ Examples of Controlled Fermentations

Product	Microbe	Controlled Parameter
Yogurt	<i>Lactobacillus, Streptococcus</i>	Temp: ~42°C, pH ~4.5
Bread	<i>Saccharomyces cerevisiae</i>	Temp: 25–30°C, anaerobic
Wine	<i>Saccharomyces cerevisiae</i>	Temp: 15–25°C, limited O ₂
Sauerkraut	<i>Lactobacillus</i> spp.	Salt concentration, pH, anaerobic
Kombucha	Yeast + acetic acid bacteria	Temp: 20–30°C, aerobic