

Microbe Growth in Fermenter

Types of Micro-organisms

Microbes are found across all 3 domains of life.

1. Bacteria
2. Archaea
3. Eukaryotes

Why use Microbes in culture

1. Adaptability
2. Ease of cultivation
3. Speed of growth.

Microbes use a **wide variety of substrates** for metabolism and produce a **range of products** from their metabolic pathways.

Growth Media Components

1. **Energy source** (light for photosynthetic organisms/ chemical substrates e.g. glucose).
2. **Raw materials** for biosynthesis
Some micro-organisms produce all the complex molecules required for biosynthesis
Others requires these raw materials to be added.

Fatty Acids

Amino Acids

Vitamins

Culture Conditions

1. Sterility to prevent contamination by microbes.

Why prevent contamination?

1. This reduces competition with the desired micro-organisms for nutrients.
2. Reduce the risk of spoilage of the product.

HOW? Steam and filters.

2. Temperature to keep enzymes at optimum

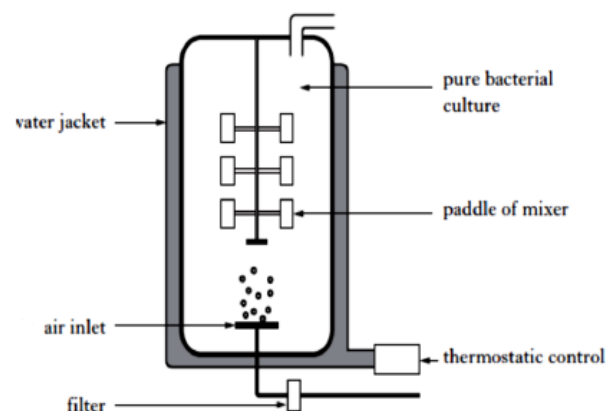
HOW? Water jacket and thermostat.

3. Oxygen concentration for aerobic respiration

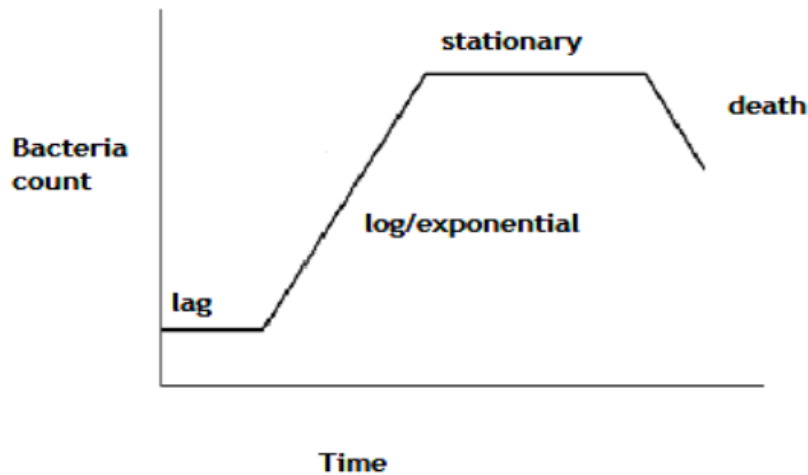
HOW? Air inlet and paddles for aeration.

4. pH to keep enzymes at optimum

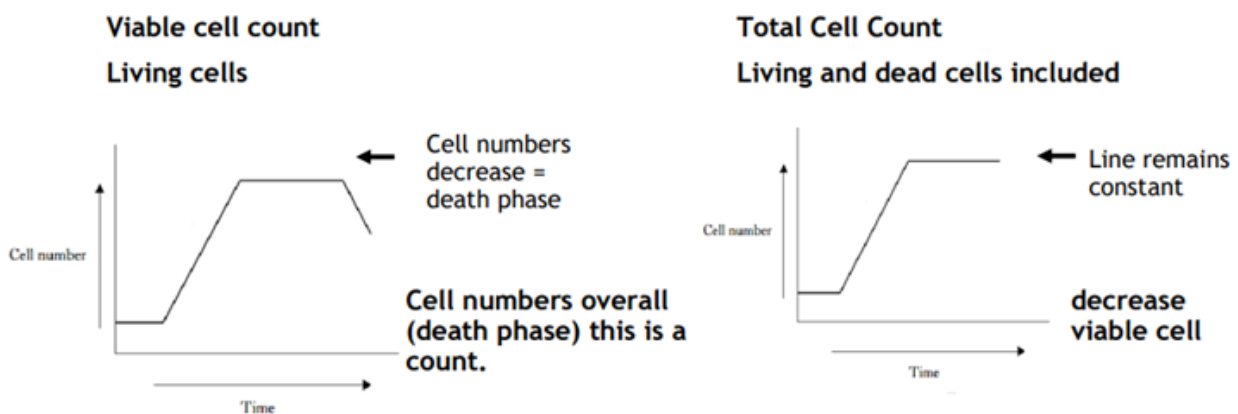
HOW? Use of buffers.



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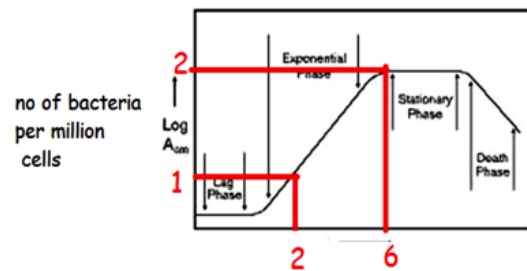
1. **Lag** (no cell growth)
Enzymes are being induced to metabolise substrate.
2. **Log/Exponential** (rapid growth)
Most rapid growth due to plentiful nutrients.
3. **Stationary**
Nutrients running out in the culture media and toxic metabolites start to be **produced**
Secondary metabolites are produced e.g. antibiotics are produced to outcompete other bacteria which confers an ecological advantage to microbes in the wild.
4. **Death phase**
Toxic metabolites **accumulate** OR **lack of nutrients** in the culture
The prove that cells are viable is that a death phase can occur.



Generation Time/ Semi-logarithmic Scales

Calculating Mean Doubling Time from graphs

The mean doubling time of bacteria aka the mean generation time occurs during the rapid growth of the log/exponential phase.



1 million cells - 2 hours
 2 million cells - 6 hrs
 Doubling time = 4 hrs

Semi Log Graph Paper

In Semi Log graph paper, the Y axis starts at 1 and the lines do not go up evenly.

Semi Log paper is needed as the growth is too big to fit on normal graph paper.

Example

The following diagram shows semi log paper and the viable cell count every 2 minutes after exposure to a disinfectant designed to kill bacteria.

