

Growth of Bacteria

Summary of what you are going to learn in this lecture

- Appropriate conditions of moisture, pH, temperature, osmotic pressure, atmosphere and nutrients are required for bacterial growth.
- Bacteria increase in number by binary fission.
- The generation time, that is, the length of time required for a single bacterial cell to yield two daughter cells, is influenced by both genetic and nutritional factors.
- *Escherichia coli*, a common enteric organism, has a generation time of approximately 20 minutes under optimal nutritional conditions.
- Bacterial pathogens have generation times ranging from 30 minutes to 20 hours.
- Long-term preservation of microorganisms usually involves freezing procedures.
- Heat treatment or chemicals can be used to inactivate bacteria.

Bacterial Growth

- The normal reproductive method of bacteria is **binary fission**, in which a single cell divides into two identical cells.
- The time required for a cell to divide or a population to double is known as **the generation time**.
- ***Escherichia coli***, a common enteric organism, has a generation time of approximately **20 minutes**.

Logarithmic Growth of Bacterial Populations

- Bacterial division occurs according to a **logarithmic progression** (two cells, four cells, eight cells, and so on).

Phases of Growth

Lag phase

- There is little or no change in the number of cells, but metabolic activity is high.

Log phase

- The bacteria multiply at the fastest rate possible under the conditions provided.

Stationary phase

- There is an equilibrium between cell division and death.

Death phase

- The number of deaths exceeds the number of new cells formed.

Measurement of Bacterial Growth

Direct Methods

- Plate counts following serial dilution
- Pour Plate and Spread Plate Method
- Filtration
- The Most Probable Number (MPN) Method
- Direct Microscopic Count

Indirect Methods

- Turbidity
- Metabolic Activity
- Dry Weight

Nutrients Required for Bacterial Growth

- Bacteria acquire nutrients from their environment.
- Most are chemoheterotrophs, using organic chemicals as sources of energy and carbon.
- Small molecules may be metabolized rapidly or utilized to synthesize macromolecules.
- Nutrient media (Agars and broths) for the isolation of pathogenic bacteria are formulated to supply particular growth factors for specific groups of organisms.
- Most bacteria require **carbon** and **nitrogen** in relatively large amounts.
- In culture media, **peptones are usually the main source of nitrogen**. Peptones, which are **mixtures of peptides and amino acids** obtained by the **digestion of meat and other sources of protein**, frequently supply other essential nutrients such as **phosphate, sulphate, potassium, magnesium, calcium** and **iron**.
- Phosphates are essential for the production of nucleic acids and molecules containing energy-rich bonds.
- Sulphates are required for the synthesis of sulphur-containing amino acids, and magnesium, potassium, calcium and iron are important co-factors for certain enzymes.
- **Trace elements** and certain growth factors such as **vitamins** are also essential for bacterial growth.

References

1. Quinn PJ, Markey BK, Leonard FC, FitzPatrick ES, & Fanning S (2011). *Veterinary Microbiology and Microbial Disease*. 2nd Ed., Wiley-Blackwell.
2. Tortora GJ, Funke BR, Case CL (2019). *Microbiology, An Introduction*. 13rd Edition, Pearson Education Inc.