

Microbial Growth

CLS 212: Medical Microbiology

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Factors Affecting Microbial Growth

- There are some factors that affect and control the growth of microorganisms around us, in hospitals, in the laboratory, and in industrial settings. **These factors are:**

1. Availability of Nutrients
2. Moisture
3. Temperature
4. pH
5. Osmotic Pressure and Salinity
6. Atmospheric Pressure
7. Gaseous Atmosphere

Availability of Nutrients

- Nutrients are crucial for microorganisms to survive in the environment.
- These nutrients are **chemicals** that can be broken into essential elements like: carbon, oxygen, hydrogen, nitrogen, sodium, potassium, calcium, iron, ext... which are required for growth.

Moisture

- All organisms on planet need **water** for their metabolic processes and most will die if moisture is too little.
- Some bacteria and parasites can stay dormant in endospores and cysts until moisture is available for their growth.

Temperature

- Microorganisms have **optimum temperature** required for growth, this temperature depends on their enzymes.
- The temperature (which ranges from minimum to maximum growth temp.) is different from one organism to another.
- Microorganisms can be classified according to their preferred temp. into:
 1. **Thermophiles:** microorganisms that grow best at high temp. 45-80°C (heat lover) **e.g.** organisms living in hot springs, archaea,...
 2. **Mesophiles:** microorganisms that grow best at moderate temp. 15-40°C **e.g.** Normal Flora, most bacteria.
 3. **Psychrophiles:** microorganisms that grow best at low temp. -15-10°C (cold lover) **e.g.** Bread Mold.

pH

- Most microorganisms prefer a neutral or slightly alkaline growth medium pH 7-7.4.
- **Some microorganisms like acidic or alkaline environments so are classified into:**
 1. **Acidophiles:** microorganisms that grow best in acidic media pH 2-5 **e.g.** Fungi.
 2. **Alkaliphiles:** microorganisms that grow best in alkaline media pH 8.5-11 **e.g.** *Vibrio cholera* (the only alkaliphilic human pathogen).

Osmotic Pressure and Salinity

- Most microorganisms prefer to live in **isotonic solutions** (solutions where the concentration of the solute is equal to that of normal cells found in it) thus no osmotic pressure is exerted.
- **Hypotonic solutions** will cause microbial cells to swell then burst (die).
- **Hypertonic solutions** will cause microbial cells to shrink (inhibiting growth).
- Some microorganisms are **halophilic** i.e prefer salt environment to grow (salt lovers) **e.g.** microorganisms living in the Dead Sea.

Atmospheric Pressure

- Most bacteria live at normal atmospheric pressure (14.7 psi) and are not affected by minor changes in it.
- Some like very high atmospheric pressure (**Barophiles**) like in oil wells and deep oceans.

Gaseous Atmosphere

- Microorganisms can be classified according to the requirement of oxygen to survive into:
- **Aerobes:** require 20-22% O₂.
- **Anaerobes:** will die in the presence of O₂.
- **Microaerophiles:** require 5% only of O₂.
- Some microorganisms are **Capnophiles** i.e. require 5-10% of **CO₂** for their growth.

Bacterial Growth Curve

1. **Lag Phase:** where the bacteria absorb nutrients, synthesize enzymes, and prepare for division. **There is no increase in bacterial number in this phase.**
2. **Log Phase (logarithmic growth phase):** where rapid multiplication occurs causing **very high increase in the number of bacteria.**
3. **Stationary Phase:** where the nutrients in the media decrease and the toxic waste resulting from bacterial metabolism increases. As a result, the multiplication is slowing down. **The number of dividing bacteria equals the number of dead bacteria.**
4. **Death Phase:** where overcrowding occurs and the bacteria are dying very rapidly because of lack of nutrients and accumulation of toxic waste. **Very few bacteria will remain alive in this stage.**

