Department of biology

2025-2026

((MICROBIOLOGY))

Stage (2)

LEC- ((8))

Control of Microbial Growth

By

Asst. Lecturer ALI ALAWADI

Control of microbial growth

- The rate of microbial growth and death influenced by a number of environmental parameters. Some agents destroy all forms of microbes, whereas other agents only inhibit their growth. A nutrient may be essential for growth in low concatenation; it may be Toxic at higher concentration.
- A number of inhibitory chemicals are employed for the control of microbial growth.
- The principal reasons for microbial control are:

  1- To prevent transmission of disease and infection.

  2- To prevent decomposition and spoilage.

  3- To prevent contamination of materials used in pure culture work in laboratories.

❖ Microorganisms can be inhibited or destroyed by physical or by chemical agents.

Antimicrobial agents are classified according to their application and action into:

1. **Biocide:** A general term describing a chemical agent, usually broad spectrum that inactivates M.O.

2. **Bacteriostatic:** a chemical agent is able to inhibit bacterial multiplication.
3. **Bacteriocidal:** a chemical agent is able to kill bacteria.
4. **Sterilization:** a physical or chemical process that completely destroys or removes all microbial life, including spores.
5. **Disinfectants**: can be either germicides or microstatic agents that kill or prevent the growth of pathogenic M.O but not necessarily the spores and are applied only to inanimate.
6. **Antiseptic:** a substance that destroys or inhibit the growth of M.O in or on living tissue.
7. **Antimicrobial agent:** Chemical that kills M.O or prevent the growth of M.O.

Microbicidal and Microbiostatic agents act by:

1. **Destruction by:**
   i. Heat (boilers, ovens).
   ii. Chemical agent(disinfectants).
   iii. Radiation (X-ray, UV light).
   iv. Mechanical agents (crushing, scattering by ultrasonic vibrations).
2. **Removal (especially bacteria) by:**

i. Filtering

ii. High-speed centrifugation

3. **inhibition by:**

i. Low temperature (refrigeration, dry ice)

ii. Desiccation.

iii. Freeze-drying.

iv. High osmotic pressure.

v. Chemical and drugs such as:

a. Dyes: eosin, methylene blue and crystal violet.

b. Chemotherapeutic drugs such as: antibiotics.

Types of cell damage:

1. Denaturation and coagulation of protein and enzymes
2. Damage of cell wall or prevent the formation of cell wall.
3. Damage the permeability of cytoplasmic membrane.
4. Prevent the synthesis of protein and nucleic acids
5. Interfere with the activity of enzymes.

A- physical parameters:

1. **Temperature (heat):** it influences the rates of chemical reactions and the proteins, thereby affecting the rates of

enzymatic activities. The higher the temperature above the maximal growth temperature the higher the death rate for that M.O Higher temperature can be used to kill M.O and it used to sterilize materials.

Sterilization by heat can be divided into:

A. **Moist heat**

B. **Dry heat**

A. Moist heat: moisture at elevated temperature causes the coagulation of macromolecules. Moist heat at temperature of 40-80C, applied for 30 min is sufficient to kill vegetative bacteria, virus and fungi but not bacterial spores. they exposed to steam at 121C and 15-pound inch pressure for 15 min. in autoclave, which will kill all M.O including endospores.

B. Dry heat: It is a process that dehydrates the cell, causing solutes precipitation and oxidation of macromolecules rather than their coagulation. Dry heat is used in the range of 160-180C for 1-2 hr. it is generally used for sterilization of certain glassware.

Pasteurization: destroys vegetative pathogens but does not affect many on the M.O that spoil milk.

2. **Filteration:** it is a common technique for separating different sizes, but it is also useful for sterilization.

3. **Radiation:** it is used for controlling growth can be characterized as either nonionizing such as ultraviolet (UV) light (which is absorbed by DNA at wavelength 240280. it has low penetrability and is used primarily for irradiation of air and flats, also it can be used in hospitals)
4. Osmotic pressure.
5. PH: acidic (2-6), alkaline (8-above), neutral.(7.5-6.5)
6. Drying: It ceases of metabolism in cells because of unavailable humidity.
7. Lyophiliation (freeze-drying) is a more practical way of preserving M.O for storage. The principle of lyophilization is that the culture is dried in a glass vial while in the frozen state by removing the water through a process called sublimation. That is water is removed from the frozen as a vapour by using a high vacuum system.
8. Surface tension: it affects the permeability of cytoplasmic membrane, which led to leak the components of the cell outside.

B- Chemical agents:

Compounds have the ability to kill or prevent growth or metabolism of M.O.

Typical properties must found in these chemical agents are:

1- Antimicrobial activity.

2- Solubility.

3- Stability.

4- Non-toxic to human and animal and should be extremely toxic to M.O at room temperature.

5- Homogenicity.

6- Acting only with M.O and not with other organic compound Capacity to penetrate into M.O cell.

7- Non-corrosive and non-staining to human.

8- Have a good smell.

9- Detergent capacities.

10- Availability.

The major antimicrobial chemical agent is:

1. **Phenol (carbolic acid) and phenol derivatives:** it can be used as a disinfectant for organic matter or at high concentration. Phenol inactivates important enzyme system in the cell and denatures cell proteins.

2. **Alcohols:** are capable of killing vegetative forms of bacteria and fungi but are inactive against spores. They are more effective at concentration between 60-90%. Alcohols also act as proteins denaturants and lipid solvents and exert their activity on microbial membranes as well as the lipid envelope of viruses. They are also dehydrating agents.

3. **Halogens:** The halogens chlorine, bromine, fluorine, and iodine are very strong oxidizing agents. They inactivate proteins by oxidizing sulfuryl groups.
4. **Dyes:** such as crystal violet.
5. **Ammonia:** it has an affect mainly on gram-positive bacteria.
6. **Quaternary ammonium compounds:** the bactericidal effect is high against gram positive and also quite active against gram negative bacteria.
7. **Acids and alkalines:** the killing action of mineral acids such as HCl, and H2SO4 is a function of the degree of dissociation of the final hydrogen ion concentration. Alkalies action is dependent on dissociation and the resulting concentration of hydroxyl ions.
8. **Gaseous:** it is highly flammable even in low concentration therefore it mixed with CO2 because of its power to penetrate, it is used to sterilize large packages, bundles of cloths, and even certain plastics. The mode of action is alkylation reaction with organic compounds such as enzymes and other proteins.
9. **Antibiotics:** major chemotherapeutic agents based on mechanism of action:
    1. Inhibitors of cell membrane function: they change permeability of the microbial cell, such as nystatin.

2. Inhibitors of cell wall synthesis: such as penicillins and cephalosporins.
3. Inhibitors of nucleic acids synthesis: such as rifampin.
4. Inhibitors of protein synthesis: there is many drugs used today that are classified as inhibitors of protein synthesis and in most instances, they exhibit greater affinity for bacterial ribosomes. The major inhibitors or protein synthesis are tetracycline.