جامعة الانبار

كلية: الصيدلة

قسم: العلوم المختبرية السريرية

اسم المادة باللغة العربية: الاحياء المجهرية

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عنوان المحاضرة باللغة العربية: التعقيم والتطهير

عنوان المحاضرة باللغة الإنكليزية: **STERILIZATION AND DISINFECTION**

STERILIZATION AND DISINFECTION

Introduction

Why we need Sterilization?

- Microorganisms capable of causing infection are constantly present in the external environment and on the human body.
- Microorganisms are responsible for contamination and infection.
- The aim of sterilization is to remove or destroy them from materials or from surfaces

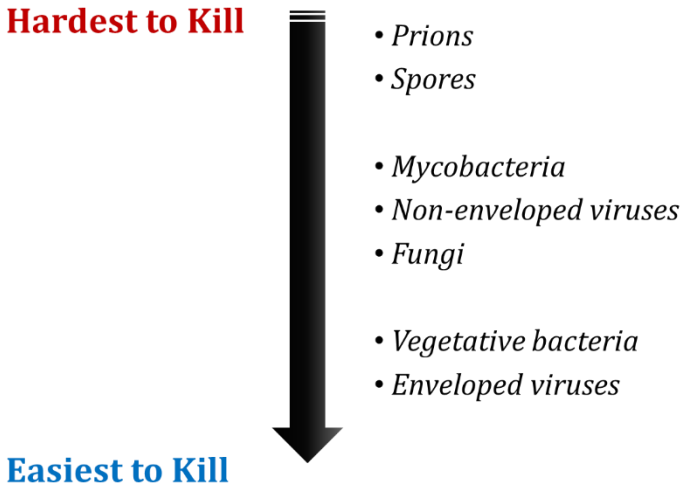
Sterilization

Sterilization is a process that eliminates or kills all forms of microbial life, including transmissible agents (such as fungi, viruses, bacteria including spore forms) present on a surface, contained in a fluid, a medication, or in a compound such as biological culture media.

Disinfection

Reducing the number of pathogens or organisms capable of producing infections (but not spores) to a level that is no longer cause diseases.

Order of resistance



Values used in sterilization

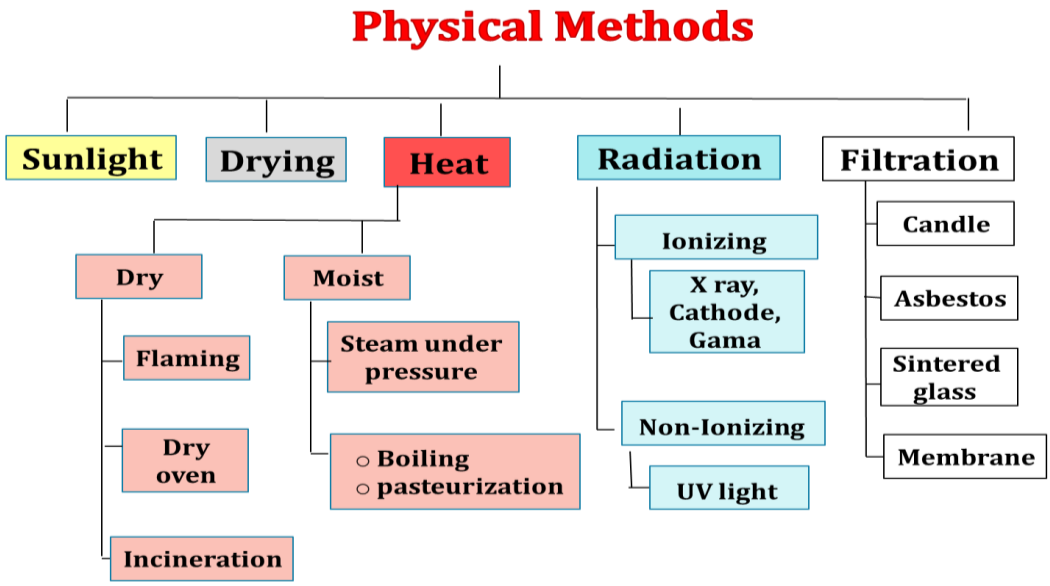
- ***Thermal Death Point:*** The lowest temperature that kills all microorganisms in a liquid suspension in 10 minutes.
- ***F value:*** the number of minutes required to kill a known population of microorganisms under specified conditions.
- ***Decimal reduction (D) value:*** The time required to reduce the survivors of microorganisms by 90%.

Basic Terminologies

- ***Bactericidal agents:*** An agent that kills bacteria. Most do not kill Endospores.
- ***Bacteriostatic agents:*** An agent that inhibits the growth of bacteria, but does not necessarily kill them.
- ***Sporicidal agents:*** An agent that kills spores.
- ***Antibiotics:*** are substances produced by one microbe that inhibits or kills another microbe.
- ***Antiseptics:*** microbicide agents harmless enough to be applied to the skin and mucous membrane such as alcohols, iodine solution and detergents.
- ***Asepsis:*** term used to indicate the prevention of infection by inhibiting the growth of bacteria in wounds or tissues.
- ***Decontamination:*** article or area free from contaminants that include microbial, chemical, radioactive and other hazards.
- ***Sanitize:*** Removal of pathogens from inanimate objects by mechanical or chemical cleaning

Methods of Sterilization

- Physical Methods
- Chemical Methods



1. Sunlight:

- **Action primarily due to UV rays however, effects vary places**
- **Bacteria in water are readily destroyed by sunlight.**

2. Drying:

- **Moisture is essential for growth of bacteria.**
- **Drying in air has deleterious effect on many bacteria.**
- **However, spores are unaffected.**

3. Heat (Dry and moist)

- Heat is considered to be the most reliable method of sterilization of objects that can stand with heat.

A. Dry Heat:

Causes denaturation of proteins and oxidative damage. Techniques include:

- ***Flaming***

common uses: bacterial loops, needle and spatula.

- ***Hot Air oven*** (160°C/2hrs or 170°C/1hrs)
- common uses: glassware and metallic instruments.

- ***Incineration:*** This is a method of destroying contaminated material by burning them in incinerator.
- common uses: animal carcasses, pathological material, disposable labs' materials and contaminated clothes.

B. Moist Heat:

Moist heat is more efficient in contrast to dry heat; it causes coagulation and denaturation of proteins.

Techniques include:

- ***Pasteurization*** (At temperature 63°C for 30 minutes or 72°C for 15 minutes): Food (dairy) Industry. Kills most vegetative bacterial cells including pathogens such as *Staphylococci, streptococci* and *Mycobacterium tuberculosis.*
- ***Boiling*** (At temperature 100°C): 30 minutes of boiling kills microbial pathogens and vegetative forms of bacteria but may not kill bacterial endospores.
- ***Intermittent boiling (tyndallization)*** (At temperature 100°C): three time at 30 minutes intervals of boiling, followed by periods of cooling kill bacterial endospores.
- ***Autoclave*** (At temperature 121°C under 15 bar pressure for 15 minutes):

Principle: Water boils when its vapor pressure equals the surrounding atmosphere. Thus, when pressure inside closed vessels increases, the temperature at which water boils increases too.

- kills all forms of life including bacterial endospores. Used to sterilize pharmaceutical products, culture media, surgical instrument and cotton.

Autoclave

4. Radiation

- There are 2 types of Radiation:

A. Non-ionizing:

UV Radiation it has a germicidal effect on microorganisms.

• Common uses: Surface disinfection, in hospitals, operating theater and laboratories.

B. Ionizing: 2 types:

(Electron beam): Common uses: sterilization of instruments such as syringes, gloves, dressing packs, foods and pharmaceuticals.

(Gamma rays): Common uses: sterilization of disposable petri dishes, plastic syringes, antibiotics, vitamins, and hormones.

5. Filtrations

- Helps to remove bacteria from heat labile liquids.
- commonly uses: for heat labile pharmaceuticals and protein solutions in medicinal drug processing (such as those containing proteins like large molecule drug products, serum, enzymes, sugars, toxins).

Types of filters:

- *Candle filters:* Used for purification of water for industrial and drinking purposes.
- *Asbestos filters:* Disposable, single-used disc used to filtered *alkaline liquids*.
- *Sintered glass filters:* used when we have small amount of liquid like carbohydrate to be added to culture media.
- *Membrane filters*: Made of cellulose esters or other polymers. Used to filtered water and preparation of sterile liquid.

Chemical Methods:

A. (Gases):

- ***Ethylene oxide gas***: to sterilize heat –sensitive objects
  - Common uses: medical and pharmaceutical products, plastic containers

- ***Hydrogen Peroxide Gas Plasma:*** Highly reactive/charged particles from hydrogen peroxide generated under vacuum
  - Common uses: used to sterilize heat- and moisture-sensitive items like some plastics, and electrical/electronic devices.

- ***Fumigation***: release of hydrogen peroxide, chlorine dioxide gas or possibly ozone in sealed rooms

- Common uses: For rooms contaminated with some pathogens such as *MRSA* and *Clostridium difficile*

B. liquids:

- ***Formaldehyde (35%):*** is a broad-spectrum germicide for bacteria, fungi, and viruses. The mechanism of action of formaldehyde is based on protein denaturation.
  - Common uses: Sterilization of instruments.

- ***Phenols:*** Synthetic phenolic compounds have broad-spectrum disinfecting action including a tuberculosis kill.
  - Common uses: surface disinfection

- ***Alcohols***. Like Ethanol (80%), Propanol (60%), and Isopropanol (70%). Alcohols are quite effective against bacteria and fungi, less so against viruses. They do not kill bacterial spores.
  - Common uses: surgical and hygienic disinfection of the skin and hands.

- ***Halogens:*** Chlorine, Iodine. halogens denatures proteins by binding to free amino groups.
  - Common uses: Chlorine is used to disinfect drinking water and swimming-pool water. Iodine used to disinfect skin and small wounds.

Sterilization Vs Disinfection

Sterilization	*Disinfection*
❖ Total destruction of all microorganisms (pathogenic or not).	❖ Minimize the numbers of microorganisms but does not eliminate them completely.
❖ Highly effective methods like chemicals, heat, filtration and radiation.	❖ Moderate effective methods like detergents, halogenes, alcohols and pasterization.
❖ Kill the bacteria and their spores.	❖ Does not kill the bacterial spores.
❖ Used in surgical operation and various labs.	❖ Commonly used in daily life.