

Sterilization

Sterilization: refers to any process that eliminates or kills all forms of life (referring to microorganisms such as bacteria, fungi, viruses, spores) that present in a specific surfaces, objects or fluids, food or biological culture media. Sterilization can be achieved through various means, including heat, chemicals, irradiation, high pressure, and filtration. Sterilization is distinct from **disinfection, sanitization, and pasteurization**, in that those methods reduce rather than eliminate all forms of life and biological agents present. After sterilization, an object is referred to as being sterile or aseptic.

***Disinfectants:** any chemicals that used to kill microorganisms on **nonliving** surfaces or objects.

***Antiseptics:** any chemicals that used to kill microorganisms on the **skin**.

Sterilization include many agents that act by different concepts as follows:

1. Physical agents

The physical agents act either by **heat, radiation** or by removing microorganisms through **filtration**.

Heat energy kills by denaturing proteins, and can be applied in three ways in the form of :

a. Moist heat that include:

❖ **autoclaving (heat under pressure)** is the most used method of sterilization, because bacterial spores are resistant to boiling they must be exposed to a higher temperature; this cannot be achieved unless the pressure is increased. For this purpose, an autoclave chamber is used

in which steam, at a pressure of 15 lb/in², reaches a temperature of 121°C and is held at that temperature for 15 to 20 minutes.

- ❖ **Boiling water:** using of heating water to a high temperature (100°C) to kill most of the pathogenic microorganisms, particularly viruses and bacteria causing waterborne diseases. To increase the efficiency of boiling water in killing germs, the water must boil for at least 20 minutes, then used. Boiling water can kill vegetative bacterial cells, but not kill the spores.
- **Bacterial Spores:** are a dehydrated and inactive metabolically dormant forms of bacteria exhibit minimal metabolism and respiration, as well as reduced enzyme production. Spores represent a mechanism of bacterial resistance to unsuitable environmental conditions to protect themselves against ecological degrading agents. It can stay viable for long time in dust or any environment. Under favorable conditions, spores can germinate into the vegetative cells.

b. Dry heat that include:

- ❖ **Hot air:** by using the **oven**, its first method of sterilization and is a longer process than moist heat sterilization, requires temperatures in the range of 180°C-200°C for 2 hours. This process is used for glassware and steel objects.
- ❖ **Flaming:** is used to inoculate loops and straight-wires in bacteriology labs for streaking. Leaving the loop in the flame of burner until it glows red ensures that any infectious agent is inactivated. This is commonly used for small metal or glass objects, but not for large objects.
- ❖ **Incineration:** is a waste treatment process that involves the combustion of organic substances contained in waste materials. This

method also burns any organism to ash. It is used to sterilize medical and biohazardous waste.

❖ **Pasteurization:** it is used for milk, consists of heating the product to 62°C for 30 minutes followed by rapid cooling. This is sufficient to kill the vegetative cells of the milk-borne pathogens, but not to sterilize the milk. This method used for juices also.

2. Radiation: two types of radiation used to kill microorganisms, **Ultraviolet light(UV)** and **X-rays**.

Radiations, such as ultraviolet light and X-radiation, is often used to sterilize heat-sensitive items and killed by damaging DNA. It only disinfects surfaces.

3. Filtration: is a method of sterilizing certain fluids (e.g., those with heat-sensitive components), that damaged by heat, irradiation or chemical sterilization, such as drugs solutions, can be sterilized by microfiltration using membrane filters. This method is commonly used for heat labile pharmaceuticals, protein and sugars solutions in medicinal drug processing and intra-venous solutions.

2. Chemical agents: act by one of the three mechanisms against microorganisms:

a. Disruption of germs cell membrane

❖ **Ethanol Alcohol:** is widely used to clean the skin before immunization or venipuncture. It acts mainly by disorganizing the lipid structure in membranes, also it denatures proteins as well. Ethanol requires the presence of water for maximal activity (i.e., it is far more effective at 70% than at 100%).

❖ **Detergents** and **phenols** these compounds interact with the lipid in bacterial cell membranes , leading to destruction of these cells.

b. Modification of germs proteins

❖ **Chlorine:** is used as a disinfectant to purify the water supply and to treat swimming pools. It is also the active component of **hypochlorite (bleach, Clorox)**, which is used as a disinfectant in the home and in hospitals.

❖ **Iodine:** is the most effective skin antiseptic used in medical practice and should be used prior to obtaining a blood culture and installing intravenous catheters.

c. Modification of germs nucleic acids

a variety of dyes not only stain microorganisms, but also inhibit their growth. One of these is **crystal violet (gentian violet)**, which is used as a skin antiseptic.

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