STERILIZATION

Definition-

Sterilization is the process of freeing an article, a surface or a medium of all microorganisms- both in vegetative and in spore states- by removing or killing them.

Disinfection- Disinfection means destruction of all pathogenic organisms capable of causing infection.

In contrast to sterilization, disinfection does not affect the spore states of organisms.

Types-

There are two methods of sterilization

1- Physical methods

2- Chemical methods

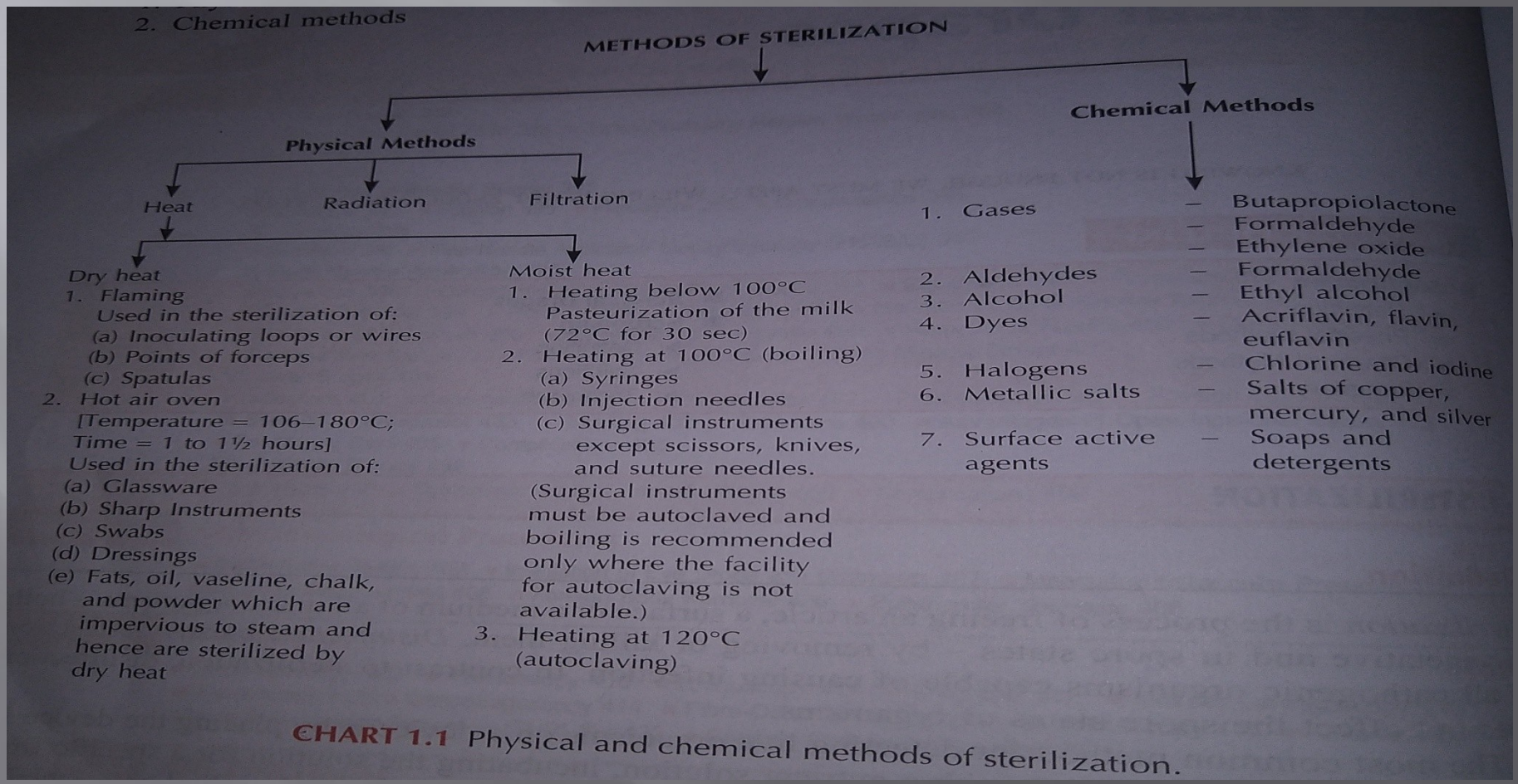

CHART 1.1 Physical and chemical methods of sterilization.

1- Physical methods-

Hot Air Oven-

Principle-

Hot air oven is an electrical device used for sterilization utilizing dry heat.

Temperature - 100 ° c

Time - 1 hour

Uses - for sterilization of:

- glassware
- forceps
- scissors
- Scalpels
- syringes
- liquid paraffin
- Dusting powder
- fat/grease

Remarks-

- Glassware should be perfectly dry before placing in the oven.
- After sterilization, oven must be allowed to cool down for 2 hours before door is opened.
- Articles should be arranged in such a manner that free circulation of air is possible.

Moist Heat (Boiling)-

Principle-

Immersion in boiling water (100 ° c) for 10 minutes kills most of the pathogenic organisms. This is the commonly used methods for disinfecting (not sterilization) instruments.

Advantages

- It is a simple method.
- It is economical.

Disadvantages-

- Certain bacteria, viruses, and spores are resistant to boiling.
- This method cannot be used for sterilizing sharp instruments which are damaged by heat and moisture.

Remarks-

- The article should be fully dipped in water.
- The article is put in water only after the boiling points has been reached.
- The glass articles are first wrapped in linen, put in cold water, and then brought to boil.
- When boiling is in process, do not put the instruments in water.
- Do not use this methods for sharp instruments.
- Always keep the lid of the container closed.

Autoclaving-

- It is most common method used for sterilizing surgical instruments.
- It is accomplishes sterilization dependably without damage to most of the instruments.
- Autoclaving can be done by a single-drum autoclave, two-drum vertical autoclave, or very large autoclaving machines.

Principle-

- During autoclaving, sterilization occurs by saturated steam produced under desired pressure.
- In an autoclave, water boils when its vapour pressure equals the pressure of surrounding atmosphere.
- When water is boiled at increased pressure inside a closed vessel, the boiling point of water increases and so is the temperature of the steam produced.
- Saturated steam has better penetrating power.
- When steam comes in contact with a cooler surface, it is condenses into water and gives up its latent heat to that surface leading to sterilization.

Temperature: 120 °c

Pressure: 20 Ibs per square inch

Times: 20 minutes

Uses: for sterilization of:

- surgical instrument
- syringes and needles
- linen including gowns
- masks
- abdominal swabs and dressing

The autoclave sterilizer-

Autoclave is the name given to a sterilizer that utilizes saturated steam under pressure.

The steam is used in the autoclave for the following reasons:

- When the steam is held in a closed container, it is compressed and the temperature rise above the boiling points.
- The steam is able to penetrate porous materials rapidly.

Process-

- The steam first introduced into the outer chamber until the desired temperature is reached.
- At this point, the steam is turned into the inner chamber, which is packed with articles to be sterilized.
- Initially, when the air enters into the inner chamber, it comes out forcibly through the valves.
- It is kept flowing into the inner chamber till the desired temperature is reached.
- It is very important to note the temperature (120°C), pressure (20psi), and times (20minutes).
- The air needs to be removed from the sterilizer since it prevents contact of the steam and the materials to be sterilized.
- At the end of the sterilization time, the steam supply is stopped, but the door is not opened till the pressure becomes zero and the temperature reaches 100°c.

Remarks-

- While autoclaving, the following points should be kept in mind:
- The air in the autoclave is poor conductor of heat; therefore it must be displaced by steam.
- When one sees a continuous jet of steam escaping out of autoclave, the air may be considered displaced, and the steam outlet should then be closed properly.
- Steam and air tend to move in a vertical direction. This movement quicker and thereby penetration of steam into the material will also be better if the articles are placed vertically in the autoclave.
- Materials inside the drums must be packed loosely because tight packing obstruct the efficient penetration of steam.
- Materials that take a long time for sterilization must be placed in the upper part of the chamber since steam penetration starts earlier in the upper part than in lower part.
- Thus towels, linens, gowns, etc, should be placed in upper part while metal instruments should be placed in the lower part.

- The articles should be left in the autoclave for a short duration after the procedure is over in order to dry the materials.
- Each article has its own physical and chemical properties, and therefore, has its own requirement for complete sterilization as follows:
- Metal instruments (unwrapped): 20 minutes
- Syringes (unwrapped): 20 minutes
- Metal instruments (wrapped), trays(wrapped),Threads (linen, silk, nylon), and metal wires: 30 minutes
- Rubber gloves and catheters: 20 minutes
- Linen, towels, gowns, dressing, gauze, cotton, etc: 45 min

Radiation-

There are two methods involving radiations:

1. Nonionizing radiations

a) Infrared: used for rapid mass sterilization of syringe.

b) Ultraviolet (sunlight): used for disinfecting enclosed areas such as entryways, hospital wards, operation rooms, etc.

2. Ionizing radiation method: it involves X-ray, gamma rays, and cosmic rays.

c) which are highly lethal to DNA and other vital cell constituents.

d) Gamma rays are used for sterilizing plastic syringes, swabs, catheters, suture materials, and surgical instruments.

e) Other products sterilized by gamma rays include IV sets, blood donor transfusion sets, scalp vein sets, eye droppers, paraffin gauze surgical -blade , ready-to-use surgical kits, ophthalmic ointments, heart valve etc.

Advantage-

- Instruments like disposable syringes, catheters, sharp instruments etc, which cannot withstand heat, can be sterilized this method.
- Instruments that are covered in plastic packs or aluminium foils can be sterilized by this methods.

Disadvantages-

- Since radiations travel in a straight line and do not penetrate, only the surface of an object in straight line is irradiated.
- The bacteria in shadows remain unaffected.
- Ultraviolet radiations do not penetrate glass.
- Prolonged exposure to UV rays causes conjunctival damage; this, however, can be prevented wearing dark glasses.
- Radiation methods are injurious to skin and underlying tissues.
- These methods are expensive.

Filtration-

- Filtration through several different types of filters including the modern membrane filters (Millipore filters) is an efficient way to removing larger particles and bacteria from liquids (e.g. Human serum albumin).
- That this may not be exactly equivalent to sterilization as viruses; especially the ones with smaller size pass through such filters.

Types of filters

- Earthenware candles
- Asbestos disc filter
- Sintered glass filter
- Collodion filter

2- Chemical Methods –

Chemical disinfectants-

- The chemical substances, known as disinfectants, are antimicrobial agents that are applied to objects to destroy or inactivate pathogenic organism. This process is called disinfection.
- Sanitizers are substances that reduce the number of microorganisms to a safe level, but are less capable of killing pathogenic bacteria than disinfectants.
- The stronger the chemical, the lesser the time required for disinfection.
- Commonly used disinfectants are phenol, Lysol, formalin, Dettol, alcohol, and oxidizing Agents ($KMnO_4$, ozone, iodine).

Principle

- A chemical disinfectant acts by coagulation or changing the composition of protein, so that the latter no longer exists in the same form.

Advantage-

- This method is used to sterilize instruments which are damaged by heat and metallic objects prone to corrosion.
- It is an easy and fast-acting method.

Disadvantage-

- Disinfectants often cannot destroy spores.
- They are injurious to skin and can be corrosive to articles.

Remarks-

- The disinfectant chosen should destroy pathogens.
- The article should be fully submerged into it for sufficient time.
- The disinfectants should not be injurious to skin and articles.
- Before dipping the article into the disinfectant, free it from organic material.

The choice of disinfectant depend upon the following:

- The types of article, e.g. Metal, rubber or linen
- Strength of the agents: Lysol requires 1:20 dilution, while carbolic acid requires 1:40 dilution.
- The times required for disinfection.
- The cost of chemical etc.

Gas sterilization (Fumigation)

- Ethylene oxide gas is employed as a sterilizing agents in specially designed chambers in which temperature and humidity can be controlled, and which air can be evacuated.
- An exposure period of 3-6 hours is needed.
- Other gases employed for sterilization are formaldehyde and β-propiolactone.

Uses-

- It is used for the sterilization of delicate surgical instruments with optical lenses, plastic parts of heart-lungs machines and respirators, disposable syringes, blankets, pillows, and mattresses.

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Precautions

- The gas dissolves plastic, rubber, fabric, and leather.
- Chemical burns may occur when materials treated with ethylene oxide are applied to the tissues.
- The dissolved chemical escapes from materials when they are exposed to air, and a minimum of 24 hours of aeration is necessary to ensure the removal of gas from sterilized articles.

Disadvantages-

- Ethylene oxide has a pungent smell.
- It is an irritant to eye, mucus membrane, and skin.


Thanks