Sterilization and Disinfection

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Decontamination : Procedures involve the destruction or removal of .contaminants.

Contaminants: Contaminants are defined as microbes present at a .given place and time that are undesirable or unwanted.

Sterilization: The process of destroying all forms of microbial life on an object or in a material , including endospores (most resistant form)and viruses.

Bactericide: is a chemical that destroys bacteria.

Bacteriostatic: agents inhibit or prevent the growth of bacteria in tissues .or on other objects in the environment.

Germicide: is a chemical that will kill any pathogenic microorganisms.
Disinfection: a physical or chemical process that destroys vegetative .pathogens but not bacterial endospores.

Sanitization: is any chemical technique that removes microorganism to ."safe "levels standards.

Antisepsis: Chemicals applied to body surfaces to destroy or inhibit .vegetative pathogens.

Factors influence of antimicrobial agents work:

1.Exposure time to the agent..

2.Numbers of microbes present.

3.Relative resistance of microbes(example

endospores vs. vegetative forms).

4.Activity of the agents(microbicidal microbistatic).

How antimicrobial agents work: their modes of action?

1.Agents affect cell wall synthesis.

2. **“** “ membrane permeability.

3. “ “ protein and nucleic acid synthesis and function.

Microbial control methods:

➢ Physical methods:

1.Heat :

A.Dry heat :.

1. Red heat. It is used to sterilize metalic objects by holding them in flame till they are red hot .e.g. inoculating wires ,needles , scalpels , forceps etc.

2.Flaming . The article is passed over flame without it to become red hot e.g. mouth of culture tubes , glass slides.

3.Incineration . This is excellent method for rapidly destroying material e.g. animal carcasses ,pathological material etc.

4.Hot air oven. Sterilization by hot air oven requires temperature of 150c to180c. We can sterilize all glass , petri dishes , test tubes , flask ,liquid paraffin ,dusting powder , etc.

Killing by dry heat is due to:

1.Protein denaturation.

2.Oxidative damage.

3.Toxic effect of elevated levels of electrolytes.

B. Moist heat :

The lethal effect of moist heat is denaturation and coagulation of protein Moist heat including :

1.Pasteurization(Disinfection): subject liquids to temperatures below 100c and is used to lower the microbial load in liquids.

2.Boiling :boiling water can be used to destroy vegetative pathogens.

3. Tyndallization . This is the process by which medium is placed at 100 ^{o}C in flowing steam for 30 min. each on 3 successive day. The mechanism under lying this method is vegetative cell are destroyed at 100 ^{o}C and remaining spore which germinate during storage interval are killed on subsequent heating.

4. Autoclave(sterilization).

In this apparatus material for sterilization are exposed to 121 ^{o}C for 15-20 min. At 15 pounds per sequare inch . Autoclave is used for culture media, etc.

The factors influencing sterilization by heat are:

1.Nature of heat(dry or moist).

2.Temprature and time.

3.Number of organisms present.

4.Whether organism has sporing capacity.

5.Type of material from which is to be eradicated

C. Cold temperatures: (refrigeration and freezing)are microbistatic and are commonly used to preserve food , media, and cultures.

D. Drying and desiccation: drying and desiccation lead to (often temporary) metabolic inhibition by reducing water in the cell.

2.Radiation

- Radiation : cold sterilization, which works by introducing mutations into the DNA of target cells.

- Radiation include:

a.Ionizing radiation, such as gamma rays and X-rays,has deep penetrating power and works by causing breaks in the DNA of **target** organisms. They are useful for the sterilization of disposable material like, cut gut , disposable syringes,etc.

b.Nonionizing radiation uses ultraviolet waves with very little penetrating power and works by creating dimers between adjacent pyrimidine. ,which interferes with replication.

- **Sunlight(UV).** It possesses appreciable bacteriological activity . This is one of the natural methods of sterilization in cases of water in tanks , river and lakes….

Ultraviolet lamps are used in:

- Killing of microorganism.
- Prevention of air borne infection in operation theatre , public places and bacteriological laboratories

4.Filtration: involves the physical removal of microbes by passing a gas or liquid through a fine filter, and can be to sterilize air as well as heat –sensetive liquids.

5. Ultrasonic and sonic vibrations. They are bactericidal causing mechanical agitation and rupture of bacteria.

➢ Chemical methods:

- Chemicals are divided into disinfectants ,antiseptics, sterilants ,sanitizers ,and degermers based on their level of effectiveness and the surfaces to which they are applied.
- Antimicrobial chemicals are found as solids ,gases and liquids. Liquids can be either aqueous(water based)or tinctures(alcohol based).

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Chemical methods include:

1.Halogens:

a.Chlorine: is used as chlorine gas ,hypochlorites,and chloramines. All work by disrupting disulfide bonds and given adequate time ,are sporicidal.

b.Iodin: is found both as free iodine(I_2)and iodophores (iodine bound to organic polymers such as soap).Iodine has a mode of action similar to chlorine and is also spor h time icidal, given enough time.

2.Phenolics:are chemical based on phenol (sterilizing surgical instruments, killing culture accidentally split in the laboratory(3% solution).Disrupting cell membranes and,precipetatinproteins.They are bactericidal,fungicidal,and viricidal,but not sporicidal.

3. Chlorhexidine:is a surfactant and protein denaturant with broad microbicidal properties, although it is not sporicidal. Solutions of chlorhexidine are used as skin degerming agents for preoperative scrubs, skin cleaning, and burns.

4. Ethyle and isopropyl alcohol, in concentration of 50% to 90% are useful for microbial control.

- Alcohols act as surfactants,dessolving membrane lipids and coagulating proteins of vegetative bacterial cells and fungi. They are not sporicidal.

5. Hydrogen peroxide: produces highly reactive hydroxyl-free radicals that damage protein and DNA while also decomposing to O2 gas, which is toxic to anaerobes. Strong solutions of H_2O_2 are sporicidal.

6. Detergent and soaps:

a.Cationic detergents known as quaternary ammonium compounds, act as surfactants that alter the membrane permeability of some bacteria and fungi.There are not sporicidal.

soaps have little microbicidal activity but rather function by removing grease and soil that contain microbes.

6.Heavy metals: Solutions of silver and mercury kill vegetative cells(but not spores) in exceedingly low concentrations(oligodynamic action) by inactivating proteins.

7. Aldehydes such as glutaraldehyde and formaldehyde kill microbes by alkylating protein and DNA molecules.

8.Gas and aerosols such as ethylene oxide ,propylene oxide ,and chlorine dioxide are strong alkylating agents, all of which are sporicidal.

9.Dyes(Gentian violet and malachite green etc. are active against Gram positive bacteria), acides and alkalis can also inhibit or destroy microbes.

References

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