Lecture -1

Disinfectants

Paper – IC 404A / CSM 404 A
Unit -IV
Petrochemicals, Oils & Soaps

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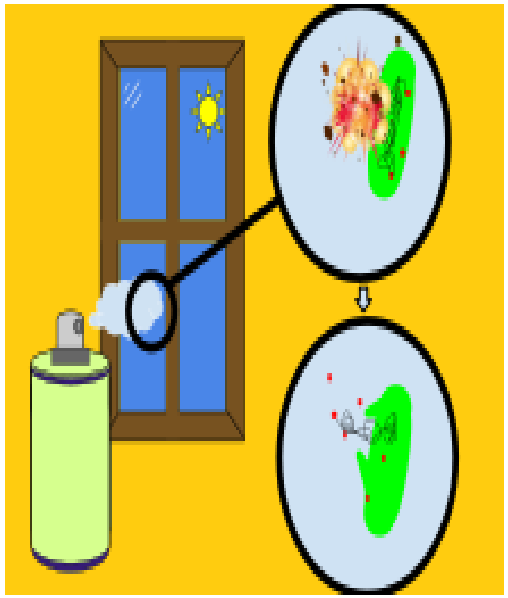
Introduction

- Disinfection is the process of destruction or removal of micro- organisms and reducing them to the level not harmful to health.
- Disinfection generally kills the sensitive vegetative cells but not heat resistant endospores.
- If the object is inanimate (lifeless), such as working area, dishes, benches, etc. the chemical agent is known as disinfectants. However if the object is animate (living) such as human body tissue, the chemical is known as antiseptic.
- Disinfectants are usually bactericidal but occasionally they may be bacteriostatic.

- An **ideal disinfectant** should have following properties :

  - Broad spectrum
  - Non toxic
  - Fast acting
  - Odourless
  - Surface compatibility
  - Economical
  - Easy to use
  - Soluble and miscibility
  - Not affected by the physical factors
  - Stable on storage

- In *wastewater treatment*, a disinfection step with *chlorine, ultra-violet (UV) radiation* or *ozonation* can be included as tertiary treatment to remove pathogens from wastewater. An alternative term used in the sanitation sector for disinfection of waste streams, sewage sludge or fecal sludge is sanitisation or sanitization.



Terminology

- **Sepsis:** Bacterial contamination.
- **Asepsis:** Absence of significant contamination.
- **Antisepsis:** Chemical destruction of vegetative pathogens on living tissue.
- **Sanitization:** Lowering microbial counts on eating and drinking utensils to safe level.
- **Bactericidal:** Chemical agents capable of killing bacteria.
- **Virucidal:** Chemical agents capable of killing virus.
- **Fungicidal:** Chemical agents capable of killing Fungi.
- **Sporicidal:** Chemical agents capable of killing Spores.
- **Bacteriostatic:** Chemical agents that inhibit the growth of bacteria but do not necessarily kill them.

Levels of resistance of microbes to disinfectants

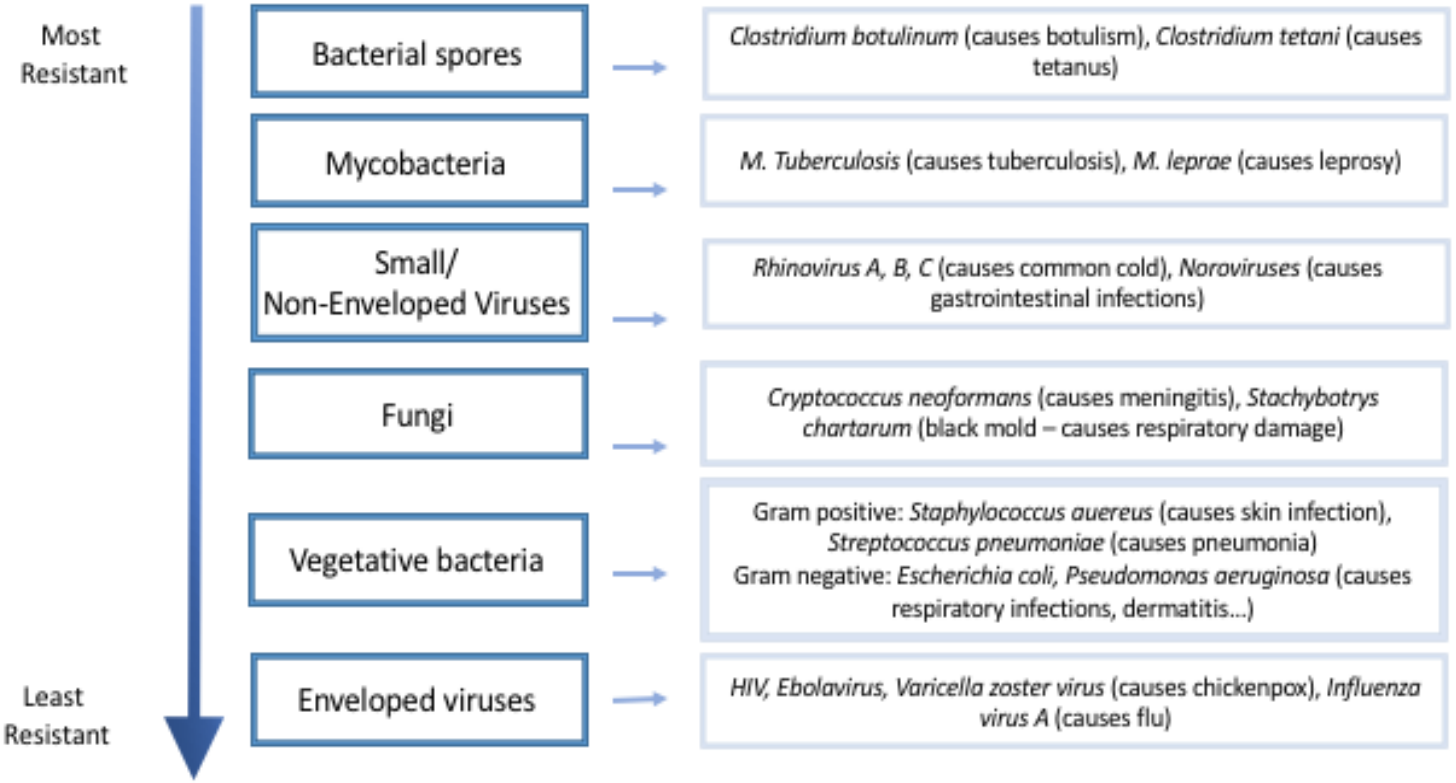


Figure 1: Level of resistance of different microbes to disinfectants. Bacterial spores, which are able to form endospores with coats that are highly resistant to environment stresses, have the highest level of resistance, followed by mycobacteria, which have a protective waxy outer coat. Small/non-enveloped viruses lack a protective envelope but have a protein viral capsid that has some resistance to environmental stresses. Vegetative bacteria include both gram negative and gram positive bacteria; gram negative bacteria are more resistant to disinfectants due to a double membrane. Enveloped viruses are least resistant because the lipid envelope is easily compromised by most disinfectants, exposing the core of the microbe.

Properties of Disinfectant

- A perfect disinfectant would also offer complete and full microbiological sterilisation, without harming humans and useful form of life, be inexpensive, and noncorrosive.
- The choice of disinfectant to be used depends on the particular situation. Some disinfectants have a wide spectrum (kill many different types of microorganisms), while others kill a smaller range of disease-causing organisms.
- Most modern household disinfectants contain **denatonium,** an exceptionally bitter substance added to discourage ingestion, as a safety measure. Those that are used indoors should never be mixed with other cleaning products as chemical reactions can occur.

Mode of action of Disinfectants

- Alteration of membrane permeability.
- Damage to protein.
- Rupture of cell membrane.
- Damage to nucleic acids.
- Interfere with metabolic pathway.

Factors affecting disinfection

- Concentration of disinfectant
- Temperature
- Time of contact
- pH of environment
- Surface tension
- Formulation of disinfectant
- Chemical structure of disinfectant
- Types and number of micro-organisms present
- Interfering substances in the environment
- Potentiation , synergism, and antagonism of disinfactants.

Evaluation of Anti-microbial agents & Disinfectants Techniques

Methods used for evaluation of Disinfectants:

- Tube dilution and agar plate method.
- Cup plate method or Cylinder plate method.
- Ditch- Plate method.
- Gradient plate technique.
- **Phenol coefficient method**. (Rideal-Walker test)

Phenol Coefficient Method

➢Phenol coefficient test is suitable for testing disinfectants miscible with water and which exert their antimicrobial action in manner similar to that of phenol

* Test Organism: *Salmonella typhi*
* Standard disinfectant: Phenol

➢Different dilutions of the test disinfectants and phenol are prepared and 5ml of each dilution is inoculated with 0.5 ml broth culture of the organisms for 24 hr.

➢ All tubes (disinfectants + organisms and phenol + organisms)are placed in 17.50C water bath.

➢ Subcultures of each reaction mixture are taken and transferred to 5ml sterile broth after 2.5, 5, 7.5 and 10 min.

➢The broth tubes are incubated at 370C for 48 to 72 hr and are examined for presence or absence of growth.

Table 17.2 : Determination of Rideal-Walker coefficient

Disinfectant	Dilution	Time interval for sub-culture (min.)			
		2.5	5	7.5	10
Test disinfectant	1 : 1000	+	–	–	–
	1 : 2000	+	+	–	–
	1 : 3000	+	+	+	–
	1 : 4000	+	+	+	+
Phenol	1 : 80	+	–	–	–
	1 : 100	+	+	–	–
	1 : 120	+	+	+	–
	1 : 140	+	+	+	+

(+ = growth; – = no growth)

$$\text{R.W. coefficient} = \frac{\text{Dilution of disinfectant killing in 7.5 but not in 5 min.}}{\text{Dilution of phenol killing in 7.5 but not in 5 min.}}$$

$$= \frac{2000}{100}$$

$$= 20$$

- If a **phenol coefficient or Rideal-Walker coefficient** of a given test disinfectant is **1**, it means that disinfectant has **same effectiveness** as phenol.
- If a phenol coefficient or Rideal-Walker coefficient of a given test disinfectant is **less than 1**, it means that **disinfectant is less effective than phenol.**
- If a phenol coefficient or Rideal-Walker coefficient of a given test disinfectant **is more than 1**, it means that **disinfectant is more effective than phenol.**
- If the **phenol coefficient of the test disinfectant is 20 it means that the disinfectant is 20 times more active than phenol.**