

Disinfection – chemical

- **Inactivated by organic matter**
- **Use appropriate disinfectant for given situation**
- **Correct concentrations**
- **Mode of action**

Chemical Agents in Microbial Control

- Desirable chemical for disinfection
- Rapid action in low concentrations
- Soluble in water or alcohol (tincture)
- Broad-spectrum and nontoxic
- Penetrates surface with persistence
- Resists inactivation
- Non-corrosive, non-staining
- Sanitize, deodorize, cheap, available

Factors that Affect Germicidal Activity of Chemicals

- Concentration of agent
- • Time of exposure
- • Presence of organic material
- • Nature of organisms to be removed

Chemical means of achieving decontamination

- ...phenol and its derivatives;
- ...alcohols;
- ...halides;
- ...aldehydes;
- ...quaternary ammonium compounds;
- ...chloroform;
- ...ethylene oxide;
- ...heavy metal ions;
- ...dyes.

Phenolic disinfectants

- **Black and white fluids – Jeyes fluid**
- **Clear soluble phenolics – Stericol**
- **Broad spectrum**
- **Good fungicidal activity**
- **Poor viral and spore activity**
- **inexpensive**
- **Good use for environmental decontamination**

Not readily inactivated by organic matter
Hard water inactivation

Alcohols

- **Methanol Ethanol Isopropanol**
- **Good bacterial and fungal activity**
- **Variable viracidal activity**
- **Rapid action**
- **Readily inactivated by organic matter**
- **Flammable**

Chlorine based disinfectants

- **Hypochlorites – Chlorox, Domestos, Milton**
- **NaDCC compounds
(Dichloroisocyanurates) – Presept and
Actichlor**

Chlorine based disinfectants are:

- **Active against viruses and spores**
- **Good fungicidal and bactericidal activity**
- **Poor Mycobacterial activity**
- **Inactivated by organic matter**
- **Corrosive**
- **Unstable**

Halides/Halogens

- Halides are very powerful oxidising agents
- **chlorine** and **iodine**.
 - rapid germicidal action,
 - inactivated in the presence of organic matter.
 - highly irritant to humans.
- **Chlorine** is used in low concentrations to prevent
 - **sodium hypochlorite - household bleach**
- **Iodine**
 - **iodophores**

- • **Iodines - betadine**
- • **QAC's –**
- • **Aldehydes - gluteraldehyde**

Skin disinfection

- • **Liquid soap and water**
- • **Alcohol, chlorhexidine, iodine**

Miscellaneous

- **SOUND WAVES**
 - Ultrasonic-High frequency waves
 - Disrupts cells
 - Sonicator--removes microbes by cavitation
- **FILTRATION**
 - Sterilize liquids that can't be heated
 - HEPA filter for air
 - Pore size determines removal

- Chemical Groups
- Halogens
- Phenolics
- Chlorhexidine
- Alcohols
- Hydrogen peroxide
- Detergents
- Heavy metals
- Aldehydes
- Gases
- Dyes
- Acids and alkalis

- Denature proteins
- Chlorine
- Sanitizers
- Iodine
- Tincture, skin antiseptic
- Iodophors
- Iodine and PVA (polyvinyl alcohol)
- Time release effect
- Eg Betadine → Povidone Iodine

PHENOLIC COMPOUNDS

- Damages cell membrane, protein
 - Phenol
 - Carboic acid--poisonous
 - Bisphenols
 - Hexachlorophene
- Skin antiseptic--time release effect
- Amphyl, Triclosan

Phenol and its derivatives:

- 'gold standard'
- Phenol acts
 - by causing **cell disruption**
 - **denaturing proteins.**
- It is highly **corrosive** and **toxic** to humans

ALCOHOLS

- Dissolves membranes
- Ethyl and isopropyl
- Good against vegetative cells
- Evaporation diminishes contact time

Alcohols:

- Alcohols such as methanol, ethanol and isopropanol dehydrate cells, disrupt membranes and cause coagulation of protein.
- A **70% (v/v) aqueous solution** is **more effective** at killing microbes than absolute alcohols.
- Because the primary cidal effect of alcohols is membrane disruption, bacterial **endospores** and many viruses are **unaffected by alcohols**.

Aldehydes:

- Aldehydes denature **nucleic acids** and **proteins**
 - lethal
 - **glutaraldehyde** and **formaldehyde**,
 - inactivated in the presence of organic matter.

ALDEHYDES

- Denature proteins
- Glutaraldehyde
 - Cidex--used to disinfect endoscopes, fiber optics, dental
- Formaldehyde
 - Used to disinfect some surgical instruments and dialysis machines
- TOXIC

Quaternary ammonium compounds

- Organically substituted ammonium compounds such as **cetrimide** and **benzalkonium chloride**
- cationic detergents.
- widely used as disinfectants for domestic use and in hospitals.

GASES

- Affect DNA
- Ethylene oxide (ETO)
 - Alkylating agent--carcinogenic
 - Used in chemiclave (gas autoclave)
- Chlorine dioxide
 - Treatment of drinking water,
 - wastewater, food processing
 - equipment, medical waste
 - Decontaminant—anthrax 2001

GASES 2

- Propylene oxide
 - Less toxic—breaks down
- Betapropiolactone
 - Highly toxic--rooms, bone grafts,
 - inactivate viruses in vaccines
- GASES
 - Better than ETO for foods (nuts, powders, starches, spices)

Chloroform

- **Chloroform** is an organic solvent that **disrupts membranes**. It has **no direct clinical applications** as a disinfectant, but can be used in the laboratory to sterilise items and some solutions.

Ethylene oxide

- Very few gases are able to kill microbes
- It is a **highly effective disinfectant**, capable of **killing spores** rapidly.
- Its cidal activity is enhanced by the presence of moisture.
- It can be used to sterilise bulky items and very delicate instruments
- cost & flammability preclude widespread use.

HEAVY METALS

- (Hg, Ag, Au, Cu, As, Zn)
- Denature proteins
- Toxic, allergens, inactivated by
- inorganic substances
- Mercury compounds
- Thimersol--preservative
- Mercurochrome, merthiolate

Heavy metal ions

- Most heavy metal ion preparations are now considered **too toxic** for routine use.
- **Silver sulphadiazine** is used topically to help to prevent colonisation and infection of **burn tissues**.

HYDROGEN PEROXIDE (OXIDIZING AGENTS)

- Highly reactive—damaging to cells
- Somewhat unstable
- Inactivated by catalase
- 35% H_2O_2 and 35% peracetic acid
- Powerful sterilants, endoscopes
- Ozone (O_3)—sterilize air, water,
- industrial air conditioners

CHLORHEXIDINE

- Surfactant, denatures protein
- Chlorine + 2 phenolic rings
- Hibiclens, Hibitane
- Skin antiseptic--time release effect
- Mild, low toxicity, rapid action

DETERGENTS (SURFACTANTS)

- Damages cell membrane
- Cationic most effective
- Quaternary ammonium compounds
 - (quats)—sanitizes
- Anionic have limited microbicidal activity
- Soaps
- Mechanical removal of microbes

DYES

- Aniline dyes
- Crystal violet
- Malachite green
- Used in solutions for skin infections
- Also used in veterinary ointments

ACIDS AND ALKALIS

- Denature proteins
- Caustic, corrosive, hazardous
- Acids primarily used as food preservatives
- Ammonium hydroxide used in detergents and cleansers as deodorizing agent

Dyes used for disinfection

- **Acridine dyes**

- bactericidal because of their interaction with bacterial nucleic acids.
- They may be used topically as antiseptics to treat mild burns