Control of Microbial Growth

Microbiology

Unit-II

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Objectives

- Define Key words
- Discuss Physical and Chemical microbial control method
- Discuss the importance of microbial control
- Discuss Broad Spectrum & Narrow Spectrum Antibiotics

Key Terms

Sterilization: The destruction of all forms of microbial life (including endospores) by physical or chemical method.

Disinfection: Reducing the number of pathogenic microorganisms to the point where they no longer cause diseases. Usually involves the removal of **vegetative** pathogens.

Disinfectant: An agent applied to inanimate objects to be disinfected.

Antiseptic: A chemical agent applied to skin or living tissues to limit microbial growth.

- **Sanitization**: Treatment of food-handling equipment used to meet public health standards and minimize chances of disease transmission. E.g: Soap & hot water.
- **Sepsis:** (Gk word: decay or putrid.) The presence of bacterial contamination IN A BLOOD ETC.
- **Asepsis:** The absence of bacterial contamination.
- **Aseptic techniques:** used to prevent microbial contamination of any clinical procedure and products of pharmaceutical and food industry to keep standards.
- **Macrobiotics :** a diet that relating and consists of whole cereals and grains supplements especially, with beans and vegetables .

Microbiacidal : is any biocidal components or substance whose purpose is to reduce the infectivity of microbes such as virus and bacteria

Antibiotics : A medicine (the manufacturing form od a drug) such is pencilline etc that's inhibits the growth of or destroys micro organisms .

Bacteriostatic Agent: (stasis: to stop)

An agent that inhibits the growth of bacteria.

Germicide: An agent that kills certain microorganisms.

- **Bactericide**: An agent that kills bacteria.
- **Virucide**: An agent that inactivates viruses.
- **Fungicide:** An agent that kills fungi.
- **Sporicide**: An agent that kills bacterial endospores and fungal spores.

Physical Methods of Microbial Control

HEAT:

Dry Heat:

Direct Flaming: Used to sterilize inoculating loops OR SMEAR LOOPS and needles.

- **Incineration**: Effective way to sterilize disposable items (paper cups, dressings) and biological waste.

Filtration: Removal of microbes by passage of a liquid or air through a screen like material with small pores. Used to sterilize heat sensitive materials like vaccines, enzymes, antibiotics, and some culture media.

Physical Methods of Microbial Control

Moist Heat: Kills microorganisms by **coagulating** their proteins.

In general, moist heat is much more effective than dry heat.

- **Boiling:** Heat to 100°C or more. It Kills vegetative forms of bacterial pathogens, almost all viruses, and fungi and their spores within 10 minutes or less. Endospores and some viruses are not destroyed quickly. However brief boiling will kill most pathogens.

Physical Methods of Microbial Control

Moist Heat:

Reliable sterilization with moist heat requires temperatures above that of boiling water.

- Example of moist heat is **Autoclave,** a Chamber which is filled with hot steam under pressure. This is a Preferred method of sterilization for non-heat-sensitive materials in which temperature of steam reaches **121ºC** at **15** psi pressure.

Physical Methods of Microbial Control

Moist Heat (Continued):

- **Pasteurization:** It is used to reduce microbes responsible for spoilage of beer, milk, wine, juices, etc.
  - **Classic Method of Pasteurization**: Milk is heated to 62^{o}C for 30 minutes.
  - **High Temperature Short Time Pasteurization (HTST):** Milk is exposed to 72^{o}C for 15 seconds.
  - **Ultra High Temperature Pasteurization (UHT):** Milk is treated at 140^{o}C for 3 seconds and then cooled very quickly in a vacuum chamber.
  - **Advantage**: Milk can be stored at room temperature for several months.

Physical Methods of Microbial Control

Refrigeration: Temperatures from 0 to 7°C. It exerts bacteriostatic effect. Reduces metabolic rate of most microbes so they cannot reproduce or produce toxins.

- **Freezing**: Items are protected by stopping the growth of microbes at temperatures below 0°C.
- **Lyophilization:** (Greek, and means "made solvent-loving“). Lyophilization, commonly known as freeze-drying, is a way of freezing and then drying something in a vacuum.

Cells and some foods are preserved in this way.

Physical Methods of Microbial

Desiccation: It is the process of removal of water. In the absence of water, microbes cannot grow or reproduce, but some may remain viable for years. After water becomes available, they start growing again.

Physical Methods of Microbial Control

Osmotic Pressure: The use of high concentrations of salts and sugars in foods is used to increase the osmotic pressure and create a hypertonic environment.

Note:

Yeasts and molds are resistant to high osmotic pressures.

Staphylococci spp. that live on skin are fairly resistant to high osmotic pressure.

Physical Methods of Microbial Control

Radiation: different types of radiation kill microbes:

1. **Ionizing Radiation:** Gamma rays, X rays, electron beams, or higher energy rays. Have short wavelengths (less than 1 nanometer).

Used to sterilize pharmaceuticals and disposable medical supplies. Food industry is interested in using ionizing radiation.

Disadvantages: Penetrates human tissues. May cause genetic mutations in humans.

Physical Methods of Microbial Control

2. Ultraviolet light (Nonionizing Radiation):
Wavelength is longer than 1 nanometer. Damages DNA.

Used to disinfect operating rooms, nurseries, cafeterias.

Disadvantages: Damages skin, eyes. Doesn't penetrate glass, and cloth.

Chemical Methods of Microbial Control

- **Phenol** (carbolic acid): was first used by Lister as a disinfectant.
- Destroys plasma membrane and denatures proteins.
- Rarely used today because it is a skin irritant and has strong odor.
- **Advantages**: Stable, persist for long times after applied, and remain active in the presence of organic compounds.

Chemical Methods of Microbial Control

Halogens: Effective alone or in compounds.

A. Iodine:

- **Tincture of iodine** denatures proteins.
- It Stains skin and clothes.

B. Chlorine:

- Used to disinfect drinking water, pools, and sewage.
- Chlorine is easily inactivated by organic materials.
- When mixed in water, forms hypochlorous acid:

$$Cl_2 + H_2O \text{ ------> } H^+ + Cl^- + HOCl$$

Hypochlorous acid

Chemical Methods of Control

Types of Disinfectants

Alcohols:

- Kill most bacteria, fungi, but not endospores.
- Act by denaturing proteins and disrupting cell membranes.
- Evaporate, leaving no residue.
- Used to mechanically wipe microbes off skin before injections or blood drawing.
- Not good for open wounds, because cause proteins to coagulate.

Chemical Methods of Control

Types of Disinfectants

Heavy Metals:

- Heavy metals and their compounds are microbicidal.
- Include copper, selenium, mercury, silver, and zinc.
- The property of heavy metal to exert biocidal effect is called **Oligodynamic action.**

A. Silver:

- 1% silver nitrate used to protect infants against gonorrheal eye infections until recently.

B. Copper

- Copper sulfate is used to kill algae in pools and fish tanks.

Chemical Methods of Control

Types of Disinfectants

C. Selenium

- Kills fungi and their spores. Used for fungal infections.
- Also used in dandruff shampoos.

D. Zinc

- Zinc chloride is used in mouthwashes.
- Zinc oxide is used as antifungal agent in paints.

Chemical Methods of Control

Types of Disinfectants

Oxidizing Agents:

A. Ozone:

- It is Used to disinfect water.
- Helps neutralize unpleasant tastes and odors.
- More effective killing agent than chlorine,

Chemical Methods of Control

Types of Disinfectants

B. Hydrogen Peroxide:

- Used as an antiseptic.
- Not good for open wounds because quickly broken down by catalase enzyme present in human cells.
- Effective in disinfection of inanimate objects.
- Sporicidal at higher temperatures.
- Used by food industry and to disinfect contact lenses.

C. Benzoyl Peroxide:

- Used in acne medications.(CREAMS ,JELLS,AND LOTIONS)

Importance of Control of Microbial Growth

Control of microbial growth means to kill or inhibit the growth of microorganisms. Control of growth usually involves the use of physical or chemical agents which either kill or prevent the growth of microorganisms.

The control of microbial growth is necessary in many practical situations, and significant advances in medicine, agriculture, and food science have been made through the study of microbiology.

Importance of Microbial Control (Cont…)

Microbial control is very important in the following different aspects.

*Controls infectious diseases.

*Minimizes cross and nosocomial infections

*Prevents surgical complications

*Decreases morbidity and mortality

*Prevents food from spoilage

*Food can be preserved for months

*Improves and ensures the safety of agricultural products

*Ensures the provision of safe drinking water to public

Difference b/w broad Spectrum /Narrow Spectrum Antibiotics

Narrow Spectrum Antibiotics

These are active against a selected group of bacterial types. Narrow spectrum antibiotics are used for the specific infection when the causative organism is known and will not kill as many of the normal microorganisms in the body as the broad spectrum antibiotics. So, It has less ability to cause superinfection. These cause less resistance of the bacteria as it will deal with only specific bacteria.

Examples include **Azithromycin** (a azalide, a subclass of macrolide antibiotic), **Clarithromycin, erythromycin**

Broad Spectrum Antibiotics

The term **broad-spectrum antibiotic** can refer to an antibiotic that acts on the two major bacterial groups, gram-positive and gram-negative, or any antibiotic that acts against a wide range of disease-causing bacteria.

These medications are used when a bacterial infection is suspected but the group of bacteria is unknown (also called empiric therapy) or when infection with multiple groups of bacteria is suspected.
Although powerful, broad-spectrum antibiotics pose specific risks, particularly the disruption of native, normal bacteria and the development of antimicrobial resistance. An example of a commonly used broad-spectrum antibiotic is ampicillin.

Examples of broad Spectrum Antibiotics

Aminoglycosides (except for **streptomycin**)
Ampicillin.
Amoxicillin.
Amoxicillin/clavulanic acid (**Augmentin**)
Carbapenems (e.g. **imipenem**)
Piperacillin/tazobactam.
Quinolones (e.g. **ciprofloxacin**)
Tetracyclines.

THE END

THANK YOU STUDENTS