4.1: An Overview to Control of Microorganisms

Define the following:

a. selective toxicity
b. broad spectrum antibiotic
c. narrow spectrum antibiotic
d. antibiotic
e. chemotherapeutic synthetic drug
f. cidal
g. static
h. sterilization
i. disinfection
j. disinfectant
k. antiseptic
l. physical agent

Control of microorganisms is essential in order to prevent the transmission of diseases and infection, stop decomposition and spoilage, and prevent unwanted microbial contamination. Microorganisms are controlled by means of physical agents and chemical agents. Physical agents include such methods of control as high or low temperature, desiccation, osmotic pressure, radiation, and filtration. Control by chemical agents refers to the use of disinfectants, antiseptics, antibiotics, and chemotherapeutic antimicrobial chemicals.

In this unit we will concentrate on the chemical control of microbial growth with a special emphasis on the antibiotics and chemotherapeutic antimicrobial chemicals used in treating bacterial infections. Control of microorganisms by means of
physical agents will be covered in Lab 18 and control by means of disinfectants, antiseptics, and sanitizers will be discussed in Lab 19.

The basis of chemotherapeutic control of bacteria is selective toxicity. Selective toxicity means that the chemical being used should inhibit or kill the intended pathogen without seriously harming the host. A broad spectrum agent is one generally effective against a variety of Gram-positive and Gram-negative bacteria; a narrow spectrum agent generally works against just Gram-positives, Gram-negatives, or only a few bacteria. As mentioned above, such agents may be cidal or static in their action. A cidal agent kills the organism while a static agent inhibits the organism's growth long enough for body defenses to remove it.

There are two categories of antimicrobial chemotherapeutic agents: antibiotics and synthetic drugs. Antibiotics are metabolic products of one microorganism that inhibit or kill other microorganisms. Chemotherapeutic synthetic drugs are antimicrobial drugs synthesized by chemical procedures in the laboratory. Many of today's antibiotics are now actually semi-synthetic and some are even made synthetically.

Antibiotics are metabolic products of one microorganism that inhibit or kill other microorganisms. Why then do bacteria produce antibiotics? There is growing support for multiple actions for microbial antibiotic production:

- If produced in large enough amounts, antibiotics may be used as a weapon to inhibit or kill other microbes in the vicinity to reduce competition for food.
- Antibiotics produced in sublethal quantities may function as interspecies quorum sensing molecules enabling a number of different bacteria to form within a common biofilm where metabolic end products of one organism may serve as a substrate for another. All the organisms are protected within the same biofilm.
- Antibiotics produced in sublethal quantities may function as interspecies quorum sensing molecules enabling some bacteria to manipulate others to become motile and swim away thus reducing the competition for food.
- Antibiotics action may result in the degradation of bacterial cell walls or DNA and these products can act as cues that trigger other bacteria to produce a protective biofilm.
- Antibiotics produced in sublethal quantities may trigger intraspecies quorum sensing. Exposure to low concentrations of an antibiotic may trigger bacteria to produce quorum sensing molecules that trigger the population to produce a protective biofilm. The biofilm then protects the population from greater concentrations of the antibiotic.

Summary

1. Physical control includes such methods of control as high or low temperature, desiccation, osmotic pressure, radiation, and filtration.
2. Chemical control refers to the use of disinfectants, antiseptics, antibiotics, and chemotherapeutic antimicrobial chemicals.
3. Sterilization is the process of destroying all living organisms and viruses.
4. Disinfection is the elimination of microorganisms, but not necessarily endospores, from inanimate objects or surfaces.
5. Decontamination is the treatment of an object or inanimate surface to make it safe to handle.
6. A disinfectant is an agent used to disinfect inanimate objects but generally too toxic to use on human tissues.
7. An antiseptic is an agent that kills or inhibits growth of microbes but is safe to use on human tissue.
8. A sanitizer is an agent that reduces microbial numbers to a safe level.
9. An antibiotic is a metabolic product produced by one microorganism that inhibits or kills other microorganisms.
10. Synthetic chemicals that can be used therapeutically.
11. An agent that is cidal in action kills microorganisms.
12. An agent that is static in action inhibits the growth of microorganisms.
13. Selective toxicity means that the chemical being used should inhibit or kill the intended pathogen without seriously harming the host.
14. A broad spectrum agent is one generally effective against a variety of Gram-positive and Gram-negative bacteria.
15. A narrow spectrum agent generally works against just Gram-positives, Gram-negatives, or only a few bacteria.

**Glossary**

Basic terms used in discussing the control of microorganisms include:

1. **Sterilization**
   Sterilization is the process of destroying all living organisms and viruses. A sterile object is one free of all life forms, including bacterial endospores, as well as viruses.

2. **Disinfection**
   Disinfection is the elimination of microorganisms, but not necessarily endospores, from inanimate objects or surfaces.

3. **Decontamination**
   Decontamination is the treatment of an object or inanimate surface to make it safe to handle.

4. **Disinfectant**
   A disinfectant is an agent used to disinfect inanimate objects but generally too toxic to use on human tissues.

5. **Antiseptic**
   An antiseptic is an agent that kills or inhibits growth of microbes but is safe to use on human tissue.

6. **Sanitizer**
   A sanitizer is an agent that reduces microbial numbers to a safe level.

7. **Antibiotic**
   An antibiotic is a metabolic product produced by one microorganism that inhibits or kills other microorganisms.

8. **Chemotherapeutic synthetic drugs**
   Synthetic chemicals that can be used therapeutically.

9. **Cidal**
   An agent that is cidal in action will kill microorganisms and viruses.

10. **Static**
    An agent that is static in action will inhibit the growth of microorganisms.
Contributors and Attributions

- Dr. Gary Kaiser (COMMUNITY COLLEGE OF BALTIMORE COUNTY, CATONSVILLE CAMPUS)