Chapter 5: Control of Microbial Growth

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Terms:

- **Sterile:** completely free of all viable microbes; an absolute term
- **Sterilization:** destruction or removal of all microbes through physical or chemical means
- **Sterilant:** a chemical that destroys all microbes
- **Disinfectant:** a chemical that destroys many microbes
- **Decontamination:** treatment used to reduce the number of pathogens to a level considered safe
- **Sanitation:** the process that substantially reduces the microbial population to meet accepted health standards
- **Antiseptic:** disinfectant non-toxic enough to be used on skin
- **Aseptic technique:** procedures that minimize the chance of unwanted microbes being accidentally introduced
- **Pasteurization:** brief heat treatment that reduces the number of spoilage organisms and destroys disease-causing microbes
- **Germicide:** kills microbes
- **Preservation:** process of inhibiting microbial growth to delay spoilage
- **Bactericidal:** kills bacteria
- **Bacteriostatic:** prevents the growth of—but does not kill—bacteria
- **Decimal reduction time (D-value):** time required for 90% of the organisms to be killed under specific conditions

Things to know:

- Basic principles and terms associated with microbial growth control
- What to consider when choosing a method and why
- The different *physical* methods for killing microbes and basics of how each work (types of heat, pressure, filtration, radiation)
- 4 levels of *chemical* germicide potency
- What to consider when choosing a chemical method of microbial control
- 10 classes of germicidal chemicals (examples, pros, cons, and uses)
- Rising concerns about germicide resistance and toxicity
- Different methods of preservation

1. History
    a. **Joseph Lister**
        i. Inspired by Pasteur's work wondered if "minute organisms" might be responsible for causing infection
        ii. Provided additional support for germ theory
        iii. Began sterilizing instruments and maintaining a clean operating environment
    b. Prior to the late 19th century, minor surgeries were risky for the patient to develop fatal infections
        i. Proper hand washing and gloves were not standard
        ii. Did not understand that airborne microbes could infect open wounds
    c. Modern hospitals:
        i. Use strict procedures to avoid microbial contamination
        ii. Most surgeries can be performed with relative safety
    d. Control of microbial growth is important in
        i. Preserving food and other goods
        ii. Control practices in research labs
        iii. Public spaces and utilities need to ensure safe levels of microbes (drinking water, waste water, air filtration)

2. **5.1 Approaches to Control**
    a. Basic principles
        i. **Sterilization:** removal of *all* microorganisms
            1. Includes endospores and viruses (not prions)
        ii. **Disinfection**: elimination of *most* or all pathogens
            1. Some microbes may remain
        iii. **Disinfectants**: used on *inanimate* objects
        iv. **Antiseptics:** used on *living tissues*
        v. **Pasteurization:** brief heating to reduce the number of spoilage organisms by destroying pathogens
            1. For foods and inanimate objects
            2. **Pasteur** found that brief heating beer and wine prevented the growth of most microorganisms that cause food spoilage
            3. Different levels of pasteurization (72-138 C)
        vi. **Decontamination:** reduces pathogens to levels that are considered *safe to handle*
        vii. **Sanitation:** process that substantially reduces microbial population of *meet accepted health standards*
            1. Not a specific level of control, vague term
        viii. **Preservation:** *delay spoilage* of foods and other perishable products by adjusting conditions or adding **bacteriostatic** (growth-inhibiting) preservatives

b. Situational considerations: different situations need different levels of microbial growth control
    i. Daily life
        1. **Washing and scrubbing** with soaps and detergents
            a. *Mechanical* cleaning
        2. **Refrigeration:** preservation
    ii. Hospitals and healthcare facilities
        1. Important due to healthcare associated infections
        2. Patients are susceptible to infection
        3. Pathogens are everywhere
        4. Instruments must be **sterilized** to avoid infection
        5. **Prions** are a new concern; difficult to destroy
    iii. Microbiology laboratory
        1. Rigorous methods of control: **sterilization** and **disinfection**
        2. Must eliminate microbial contamination to experimental samples and the environment
        3. Careful treatment before (sterile media) and after (sterilize cultures, waste)
        4. **Aseptic techniques** are used to prevent contamination of samples, self, and laboratory
        5. CDC guidelines for labs working with microbes
            a. BSL-1: microbes not known to cause disease
            b. BSL-4: microbes for which no vaccine/treatment exists
                i. BSL = biosafety level
    iv. Food production
        1. Perishables retain quality longer when contaminating microbes are destroyed, removed, or inhibited
        2. **Heat treatment** is common and reliable but can alter flavour and appearance of products
        3. **Irradiation**: approved to treat certain foods
        4. **Chemical additives:** prevent spoilage, FDA regulates them because of toxicity risk
        5. Facilities must keep surfaces clean and free of microbes
    v. Water treatment
        1. Goal: ensure that drinking water is free of pathogens
        2. Chlorine was traditionally used to disinfect water
            a. It forms **disinfection byproducts (DBPs)** when reacting with naturally occurring chemicals
            b. DBPs are linked with long-term health risks
        3. Some organisms are resistant to chemical disinfectants
            a. *C. parvum* which causes diarrhea
        4. Regulations require facilities to minimize DBPs and *C. parvum* in treated water
        5. Filtration, UV, or ozone is often used