



Food Microbiology

I. Introduction

The history of food microbiology is closely linked to fundamental discoveries in microbiology and humanity's practical need to preserve and consume food safely. It can be divided into four major periods.

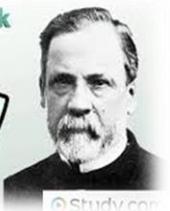
I.1. The empirical era: before the discovery of microbes (antiquity - 17th century)

- **Practices without scientific understanding:** People used empirical methods to preserve food and prevent its "rotting" or "spoilage."
- **Common techniques:** Drying, salting, smoking, fermentation (for bread, beer, wine, cheese, yogurt) and preservation in honey or vinegar.
- **Observation:** It was known that certain processes transformed food beneficially (fermentation) while others made it dangerous (rotting, poisoning), but the existence of the responsible microorganisms was entirely unknown.

I.2. The era of fundamental discoveries: the invention of the microscope and the "war of the generations" (17th - 19th century)

- **Antoni van Leeuwenhoek (1676):** By perfecting the microscope, he was the first to observe "animalcules" (bacteria and yeasts) in pepper water and later in beer. He opened the door to an invisible world.
- **"Spontaneous generation" vs "Biogenesis":** For centuries, it was believed that life (maggots, molds) could arise spontaneously from non-living matter.
 - **Francesco Redi (1668)** refuted this idea for maggots.
 - **Louis Pasteur (1850s-1860s)** delivered the final blow to this theory with his famous swan-neck flask experiment, proving that microorganisms came from the air and were responsible for fermentation and spoilage.

Swan-Necked Flask



- **Louis Pasteur (Father of modern microbiology):**
 - **Pasteurization (1864):** He developed the process of moderate heating (pasteurization) to destroy pathogens and undesirable yeasts in wine and beer, and later in milk. This was a major advance for food safety.

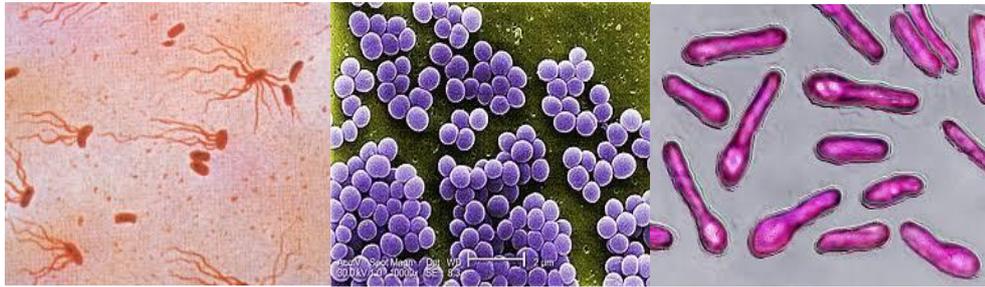
I.3. The era of pathogens and prevention: the golden age of microbiology (late 19th - early 20th century)

This period saw the identification of specific pathogenic bacteria and the establishment of food safety principles.

- **Robert Koch (1870s-1880s):** He established "Koch's Postulates," a set of criteria to prove that a specific bacterium causes a specific disease.

- **Identification of the first foodborne pathogens:**

- *Salmonella typhi* (typhoid fever) by Karl Joseph Eberth (1880).
- *Staphylococcus aureus* by Friedrich Julius Rosenbach (1884).
- *Clostridium botulinum* (botulism) and its toxin by Emile van Ermengem (1895).



Salmonella typhi

Staphylococcus aureus

Clostridium botulinum

- **Elie Metchnikoff (1908):** He studied lactic acid bacteria and proposed the idea of probiotics, linking the consumption of yogurt (with *Lactobacillus*) to longevity.

I.4. The modern era: control, safety, and regulation (20th century - present)

The focus is on prevention, understanding growth mechanisms, and implementing rigorous control systems.

- **Development of preservation systems:** Emergence of freezing, irradiation, and modified atmosphere packaging.
- **Hazard Analysis Critical Control Point (HACCP - 1960s):** Designed by NASA to ensure the safety of astronauts' food, HACCP became the most widespread food safety management system in the world. It is a preventive and systematic approach.
- **Molecular biology and genomics (late 20th - 21st century):**
 - Use of molecular biology techniques (PCR, sequencing) to rapidly detect and identify pathogens.
 - Study of the food microbiome to understand and improve fermentations and prevent spoilage.
 - Traceability and rapid investigation of foodborne disease outbreaks.
- **Focus on viruses and parasites:** Better understanding of the role of viruses (Norovirus, Hepatitis A) and parasites (*Cyclospora*, *Toxoplasma*) in foodborne illnesses.

Note* : HACCP is a systematic, preventive approach to food safety. Instead of just checking the final product for problems, HACCP is a process that:

- **Identifies** potential hazards (biological, chemical, or physical) that could make food unsafe.
- **Puts controls in place** at specific points in the production process where those hazards can be prevented, eliminated, or reduced to safe levels.
- **Monitors** those control points continuously to ensure everything is working.

Think of it as a proactive plan to build safety into the food-making process from start to finish, rather than reacting to problems after they happen.