



EDO UNIVERSITY, IYAMHO
Department of Microbiology

MCB 411: Food Microbiology I

Instructor: *Mr. Arthur C. Okafor.*

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Lecture Period and Venue: Thursday 9:00am – 11:00am, ML 1.

Office hours: Tuesday, 1pm - 4pm, Thursday, 1pm - 4pm, Friday, 8am – 1pm.

Office: New Faculty of Science Block, Rm B2.

Description: This course is designed to give the students a deep knowledge of the role of microorganisms in foods: beginning with milestones in food microbiology; microorganisms important in foods, various sources of contamination of food; Principles of food spoilage including factors affecting microbial growth and activity in foods. Principles of food preservation with detailed study on various preservation methods. and conclude with contamination, spoilage and preservation of specific food.

Prerequisites: Students should have thorough knowledge of **General Microbiology, Introductory Genetics and Cell Physiology, Microbial genetics, Microbiological Techniques, Microbial Ecology, Mycology, Bacteriology and Soil Microbiology** courses offered in 200 Level and 300 Level.

Learning outcomes: At the completion of this course, students are expected to:

- (i) Recognize the features of various microorganisms important in food and their roles.
- (ii) Be able to trace various sources of contamination of foods.
- (iii) Understand the principles of food spoilage and preservation.
- (iv) Be acquainted with various preservation methods

Assignments: There shall be a minimum of 3 assignments throughout the course in addition to a Mid-Term test and a Final Exam. Completed assignments must be submitted at the beginning of the lecture periods on the due dates. Assignments are organized and structured to serve as supplementary materials for the midterm test and final exam.

Grading: I will assign 10% of this class grade to assignments, 10% for participation in oral presentations, 10% for the midterm test and 70% for the final exam. The Final exam is comprehensive.

***Recommended Textbooks:**

- (1.) NESTER'S MICROBIOLOGY by Nester *et al.* 5th Edition. Jaypee Publishers.
- (2.) BROCK BIOLOGY OF MICROORGANISMS by Madigan *et al.*, 14th Edition. Pearson Education Inc.
- (3.) FUNDAMENTAL FOOD MICROBIOLOGY by Bibek Ray and Arun Bhunia. 4th Edition. CRC Press.
- (4.) MODERN FOOD MICROBIOLOGY by James M. Jay. 6th Edition. An Aspen Publication.

*The recommended textbooks above also serve as references from which this lecture note was compiled.

Lectures: Below is a description of the contents.

MILESTONES AND DEVELOPMENTS IN FOOD MICROBIOLOGY

The knowledge of the presence and role of microorganisms in foods came before the introduction of microbiology as a science. Generally, the era may be divided into the 'food-gathering' period and the 'food-producing' period. During the food-gathering period, humans were probably carnivorous, with plant foods coming into their diet later in this period. It is also during this period that foods were first cooked. This period covers the time from human origin over 1 million years ago up to 8,000 years ago. The food-producing period dates from about 8,000 to 10,000 years ago and also includes the present time. As agriculture and animal husbandry were adopted by the early civilizations, food supply became available in abundance during the growing seasons. Preservation of foods became important for uniform supply of food around the year. It is presumed that the problems of spoilage and food poisoning were encountered early in this period.

With the advent of prepared foods, the problems of disease transmission by foods and of faster spoilage caused by improper storage made their appearance. Spoilage of prepared foods apparently dates from around 6000 BC. The first boiler pots are thought to have originated in the Near East about 8,000 years ago. The arts of cereal cookery, brewing, and food storage were either started at about this time or stimulated by this new development. The first evidence of beer manufacturing has been traced to ancient Babylonia as far back as 7000 BC. The Sumerians of about 3000 BC are believed to have been the first great livestock breeders and dairymen and were among the first to make butter. Milk, butter, and cheese were used by the Egyptians as early as 3000 BC. Between 3000 BC and 1200 BC, the Jews used salt from the Dead Sea in the preservation of various foods. The Chinese and Greeks used salted fish in their diet, and the Greeks are credited with passing this practice on to the Romans, whose diet included pickled meats. Wines are known

to have been prepared by the Assyrians by 3500 BC. Fermented sausages were prepared and consumed by the ancient Babylonians and the people of ancient China as far back as 1500 BC. Another method of food preservation that apparently arose during this time was the use of oils such as olive and sesame. Jensen has pointed out that the use of oils leads to high incidences of staphylococcal food poisoning. The Romans excelled in the preservation of meats other than beef by around 1000 BC and are known to have used snow to pack prawns and other perishables, according to Seneca. The practice of smoking meats as a form of preservation is presumed to have emerged sometime during this period, as did the making of cheese and wines. It is doubtful whether people at this time understood the nature of these newly found preservation techniques. It is also doubtful whether the role of foods in the transmission of disease or the danger of eating meat from infected animals was recognized.

Little progress was made toward understanding the nature of food poisoning and food spoilage between the time of the birth of Christ and AD 1100. Ergot poisoning (caused by *Claviceps purpurea*, a fungus that grows on rye and other grains) caused many deaths during the Middle Ages. Over 40,000 deaths due to ergot poisoning were recorded in France alone in AD 943, but it was not known that the toxin of this disease was produced by a fungus. The involvement of invisible organisms in many diseases in humans was suspected as early as the thirteenth century by Roger Bacon. Athanasius Kircher, a monk, as early as 1658 examined decaying bodies, meat, milk, and other substances and saw what he referred to as "worms" invisible to the naked eye. He is perhaps the first person to suggest the role of microorganisms in spoiling foods. However, Kircher's descriptions lacked precision and his observations did not receive wide acceptance.

Since the time of the Greeks, the emergence of maggots from dead bodies and spoiled flesh was thought to be due to spontaneous generation (i.e. the generation of some form of life from non-living objects). This theory had many powerful followers among the educated and elite classes. The advocates of the spontaneous generation theory argued that the animalcules could not regenerate by themselves (biogenesis), but they were present in different things only through abiogenesis (spontaneous generation). In 1765, Lazzaro Spallanzani in an attempt to disprove the doctrine of the spontaneous generation of life, performed an experiment. He showed that beef broth that had been boiled for an hour and sealed remained sterile and did not spoil. However, he did not convince the proponents of the theory because they believed that his treatment excluded oxygen, which they felt

was vital to spontaneous generation. In 1837, Theodore Schwann showed that heated infusions remained sterile in the presence of air, which he supplied by passing it through heated coils into the infusion. Although both of these men demonstrated the idea of the heat preservation of foods, neither took advantage of his findings with respect to application.

The event that led to the discovery of canning had its beginnings in 1795, when the French government offered a prize of 12,000 francs for the discovery of a practical method of food preservation. In 1809, a Parisian confectioner, François (Nicholas) Appert, succeeded in preserving meats in glass bottles that had been kept in boiling water for varying periods of time. This discovery was made public in 1810, when Appert was issued a patent for his process. Not being a scientist, Appert was probably unaware of the long-range significance of his discovery or why it worked. This, of course, was the **beginning of canning** as it is known and practiced today. This event occurred some years before Louis Pasteur demonstrated the role of microorganisms in the spoilage of French wines, a development that gave rise to the rediscovery of bacteria. Antony van Leeuwenhoek in the Netherlands had examined bacteria through a microscope and described them in 1683, but it is unlikely that Appert was aware of this development, as he was not a scientist and Leeuwenhoek's report was not available in French.

The first person to appreciate and understand **the presence and role of microorganisms in food** was Louis Pasteur. In 1837, he showed that the souring of milk was caused by microorganisms, and in about 1860 he used heat for the first time to destroy undesirable organisms in wine and beer. This process is now known as **pasteurization**. Finally, in 1861, Louis Pasteur demonstrated that, in boiled infusion, bacteria could grow only if the infusions were contaminated with bacteria carried by dust particles in air. His careful and controlled studies proved that bacteria were able to reproduce (biogenesis) and life could not originate by spontaneous generation. John Tyndall, in 1870, showed that boiled infusion could be stored in dust-free air in a box without microbial growth. The major developments of ideas on the possible roles of microorganisms in foods and their scientific proof were initiated by Pasteur in the 1870s, followed by many other scientists before the end of the nineteenth century. This paved the way for the establishment of early food microbiology in the twentieth century.

ASSIGNMENT

- 1) State with dates the contributions of the following scientists to the development of food microbiology:
(a) Peter Durand, (b) Grimwade, (c) Elie Metchnikoff, (d) Esty and Meyer, (e) John Snow,
(f) Cienkowski, (g) Tyndall, (h) Harry Russell, (i) Marie von Ermengem.

- 2) Briefly highlight what a food microbiology student is expected to know.

