

College of Applied Medical Sciences

Department of Environmental Health

*Introduction to Food Safety and
Microbiology*

Lecture 4



FOOD MICROBIOLOGY

Food microbiology is the study of the microorganisms that inhabit, create, study of microorganisms causing food or contaminate food, including the spoilage.

"Good" bacteria, however, such as probiotics, are becoming increasingly important in food science.

In addition, microorganisms are essential for the production of foods such as cheese, yogurt, bread, beer, wine and, other fermented foods.

Type and sources of food pollutant

1-Pollutants reach the food during the growing , harvesting , like stones and dust , minerals , insects and their remnants .

2-Pollutants reach the food during the manufacturing and trading process , as residuals glass , bone and mineral , timber , electrical wiring , grease, rust and paint residue .

3-Pollutants reach the food during the packaging and distribution process , such as insects , thread , hair, stones and metals .

Microorganisms in food

1-Food spoliage

2-Food preservation

3-Food-borne Illness

4-Fermented Foods

***Factors affecting microbial growth in food**

1-Composition and PH

2-presence and availability of water

3-oxidation-reduction potential

4-altered by cooking

5-physical structure

6-presence of antimicrobial substances

7-Temperature

lower temperatures retard microbial growth

1-PH

-pH is a term used to describe the acidity or alkalinity of a solution. At pH 7, there is an equal amount of acid (hydrogen ion: H⁺) and alkali (hydroxyl ion: OH⁻), so the solution is “neutral”.

pH values below 7 are acidic, while those above 7 are alkaline.

-pH has a profound effect on the growth of microorganisms. Most bacteria grow best at about pH 7 and grow poorly or not at all below pH 4. Yeasts and molds, therefore, predominate in low pH foods where bacteria cannot compete.

-pH impacts make up of microbial community and therefore types of chemical reactions that occur when microbes grow in food.

The minimal pH minimal for growth of principal foodborne disease organisms

2-Water activity (aw) is a term describing the availability of water to microorganisms. It is only roughly related to percent moisture. Pure water has an aw of 1.00, and the atmosphere above the water in a closed container will have an **Equilibrium relative humidity (ERH)** of 100%. If we add an ounce of rocks to a quart of water in such a container, the ERH and the aw will not change. But if we add

an ounce of salt, the ERH will fall to about 98 % and the aw to 0.98. Rocks do not dissolve in water but salt does, thereby reducing the proportion of water that can enter the atmosphere. Likewise, the amount of water available to microorganisms present in the solution is reduced. Yet the percent moisture is the same in the container with rocks as it is in the container with, salt, namely, 98%.

Water availability

in general, lower water activity inhibits microbial growth

water activity lowered by 1-drying and 2- addition of salt sugar

osmophilic microorganisms (prefer high osmotic pressure)

Osmophilic organisms are microorganisms adapted to environments with high osmotic pressures, such as high sugar concentrations.

3-Physical structure

grinding and mixing increase surface area and distribute microbes

promotes microbial growth .outer skin of vegetables and fruits slows microbial growth .

4-Antimicrobial substances

1-coumarins – fruits and vegetables

2-lysozyme – cow's milk and eggs

3-aldehydic and phenolic compounds – herbs and spices

4-allicin – garlic

5-polyphenols – green and black teas

Food spoilage

results from growth of microbes in food alters food visibly and in other ways, rendering it unsuitable for consumption involves predictable succession of microbes different foods undergo different types of spoilage processes toxins are sometimes produced algal toxins may contaminate shellfish and finfish .

Toxins

-Ergotism:

toxic condition caused by growth of a fungus in grains

-Aflatoxins

carcinogens produced in fungus-infected grains and nut products

-Fumonisin

carcinogens produced in fungus-infected corn

Food Preservation

Removal of Microorganisms

1-usually achieved by filtration

-commonly used for water, beer, wine, juices, soft drinks, and other liquids

2-Low Temperature

-refrigeration at 5°C retards but does not stop microbial growth

-microorganisms can still cause spoilage with extended spoilage

-growth at temperatures below -10°C has been observed

3-Pasteurization

-kills pathogens and substantially reduces number of spoilage organisms

-different pasteurization procedures heat for different lengths of time

-shorter heating times result in improved flavor

4-Reduced water availability

-Drying

-Freeze-drying (lyophilization)

-Addition of high concentrations of solutes such as sugar or salt

5-Chemical-Based Preservation

-GRAS: (chemical agents “generally recognized as safe”)

-pH of food impacts effectiveness of chemical preservative

6-Radiation

A-ultraviolet (UV) radiation

-used for surfaces of food-handling equipment

-does not penetrate foods

B-radappertization

-use of ionizing radiation (gamma radiation) to extend shelf life or sterilize meat, seafoods, fruits, and vegetables

-kills microbes in moist foods by producing peroxides from water

-peroxides oxidize cellular constituents

Food-borne Illness

› **1-Food-Borne Infection**

› ingestion of microbes, followed by growth, tissue invasion, and/or release of toxins

› **2-Food-Borne Intoxications**

› ingestion of toxins in foods in which microbes have grown

› include staphylococcal food poisoning, botulism, *Clostridium perfringens* food poisoning, and *Bacillus cereus* food poisoning

Fermented Foods

› **Alcoholic Beverages**

- › Alcohol is produced from fermentation by the yeast
Saccharomyces cerevisiae

› Bread , Dairy Products , Other Fermented Foods

› **Bread**

- › involves growth of *Saccharomyces cerevisiae* (baker's yeast) under aerobic conditions
- › maximizes CO₂ production, which leavens bread
- › other microbes used to make special breads (e.g., sourdough bread)
- › can be spoiled by *Bacillus* species that produce ropiness

› **Cheese**

- › -Milk is treated with lactic acid bacteria and an enzyme called rennin that partially hydrolyses the protein and causes it to coagulate into “curds.” The liquid portion of the milk at this time is called “whey.”
- › -The whey is separated from the curds, and the curds are aged (“ripened”)
- › -Different microbes in the early and late stages of processing give rise to cheeses with different characteristics