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# FOOD PRESERVATION

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In the hunter-gatherer stage of human social evolution, people were probably hungry much of the time. When food was found, whether a ripe fruit or a moribund animal, it was likely to be eaten on the spot, thus obviating preservation. However, at least some of the time, even at that early stage, there were surely food surpluses (e.g., a whole tree ― or several ― loaded with ripe fruit, or a moribund mammoth); then the problems became: how long dare we stay here, how much food can we carry, and how long will it stay fit to eat? Surely some attempts were made to preserve food.

When people invented agriculture, their crop yields were largely seasonal, so preservation became a larger challenge ― protecting an investment of time and effort, and staying alive till the next harvest season. Food animals offered an attractive alternative, in that they could be fed things that were not fit for humans (e.g., grass), might offer sustained food production (eggs, milk), could travel with the family if relocation was needed (perhaps even carrying household goods), and could be killed and eaten for any reason, at any season of the year. Food of animal origin is generally more highly valued than vegetable matter, so preservation of animal foods has been attempted, with varying success, from those times until today.

Preservation is keeping food for human consumption by denying it to competitors such as:

- bacteria and fungi
- insects, rodents, and birds
- animals larger than people
- other people
- the internal combustion engine.

Preservation also entails delaying or preventing intrinsic deterioration processes in food, such as over-ripening or undesired dehydration.

Obviously, our focus in this lesson will be on microbiological preservation, from the standpoints of both quality and safety. Most preservation technology has been developed to sustain quality, but the safety impact is important, too. Preservation methods include one or more of the following:

- Physical processes
- Chemical treatments
- Biological processes

**Physical processes** include:

- Heating
- Cooling
- Drying
- Irradiation
- High hydrostatic pressure

Physical processes — heating

- Cooking: generally a final preparation step, but may be done in processing "ready-to-eat" foods; often involves boiling water or direct application of flame; cooking with oil or fat allows application of temperatures above 100°C
- Baking: oven temperatures often high, but internal temperature of food <100°C
- Below-boiling processes:
  - Blanching prepares food for further processing
  - Pasteurization kills microorganisms, including pathogens (except spore formers)
- Heat processes, prediction
  - *D*-value = time for a 10-fold reduction in microbial count
  - *z*-value = temperature change that will produce a 10-fold change in *D* value
- Above-boiling process: retorting attains "commercial sterility," but hermetic seal is required to maintain it
- Tyndallization — low-tech (noncommercial) heat sterilization procedure; boil medium (or food) on three successive days

Physical processes — cooling

- Refrigeration: seldom done with ice anymore; retards biological processes, as well as microbial growth
- Freezing: with water in solid state, microbial processes stop, but some enzymatic deterioration is still possible.

Physical processes — drying (ripe grains are generally dry enough to store without processing)

- Dehydration: evaporation or sublimation removes water that might be used by microbes, retards enzymatic processes (examples: chuño, viande séché)
- Addition of solute: binds water (examples: honey, salt pork)
- Physical processes — irradiation
  - Microwave: commercial processing, home food preparation
  - Ultraviolet: surface treatments, disinfection of water
  - Ionizing radiation — sources
    - Low doses (<1 kGy) — sprouting control, insects, *Trichinella*, protozoa?
    - Medium doses (1–10 kGy) — pasteurization
    - High doses (>10 kGy) — commercial sterilization, astronaut food

Physical processes — high hydrostatic pressure (600–700 MPa) applied to food, kills bacteria & viruses; processing applications still under development

**Chemical treatments** include:

- Acidification
- Enzyme treatments
- Application of antimicrobial additives

Chemical treatments — acidification

- Organic acids (e.g., acetic, lactic, propionic): strong antibacterial effects

- Mineral acids: prevention of botulism

Chemical treatments — enzyme treatments

Chemical treatments — antimicrobial additives
- Broad-spectrum: sulfites for wine preservation, etc.
- Targeted: nitrite for preventing botulism; nisin

**Biological processes** include:
- Controlled, spontaneous microbiological processes
- Microbiological processes using defined inocula

Biological processes — controlled (sauerkraut fermentation); spontaneous, uncontrolled fermentations

Biological processes — defined inocula
- Starter cultures: cheese and sausage
- Mold inoculation: blue cheese, surface-ripened cheese

**Summary**
- Preservation includes any means to keep food safe and fit to eat, has been practiced for a very long time.
- Physical processes, especially drying and heating, are probably the oldest.
- Pre-cooking, chemical preservation, high hydrostatic pressure, and irradiation are some of the preservation procedures of the future.
- Controlled and defined biological processes are an important part of the art of food science, but may also present some safety hazards if a science base is not established.

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