

Microbiology of Thermally Processed Foods

Microbiology - The study of small living organisms seen only by using a microscope.

Microorganisms of concern are molds, yeasts, and bacteria.

Bacterial spores are extremely resistant to heat, cold, and chemical agents while the vegetative cells are less resistant.

Oxygen Requirements of Bacteria:

- **Aerobes** – require oxygen to live
- **Anaerobes** – oxygen prevents growth
- **Facultative anaerobes** – tolerate presence or absence of oxygen

Moisture Requirements of Bacteria:

- The amount of moisture and its availability in a food are important factors for bacterial growth
- Measured by water activity - a_w
- Influenced by the addition of ingredients such as salt and sugar

Minimum a_w requirements for Bacterial Growth:

Most molds (e.g., <i>Aspergillus</i>)	0.75
Most yeasts	0.88
<i>C. botulinum</i>	0.93
<i>Staphylococcus aureus</i>	0.85
<i>Salmonella</i>	0.93

pH requirements for Bacterial Growth:

Microbial growth is generally greater at a neutral pH

Bacteria, yeast and molds have optimum, minimum and maximum pH for growth

pH														
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Acidity			Neutral					Alkalinity						

Temperature Requirements for Bacterial Growth:

Bacterial group names are based on optimum temperatures for growth:

- **Psychrotrophs** - Grow best at 58°F to 68°F; Can grow slowly at 40°F; Only *C. botulinum* Type E and non-proteolytic strains of types B and F are of concern in canned food.
- **Mesophiles** - Grow best 86°F to 98°F; Includes all microorganisms that affect food safety; *C. botulinum*—a sporeformer—is in this group
- **Thermophiles** - Optimum growth of obligate thermophiles occurs at 122°F to 150°F; Spores are very heat resistant; **No human pathogens.**

***Clostridium botulinum* - Pathogen of concern for canned meat and poultry products.**

Anaerobic, mesophilic sporeformer. The organism produces a deadly toxin. Botulism is the disease in humans. The organism is contained in soil and water throughout the world. Spores found everywhere, but vegetative form produces toxin. Spores survive unfavorable conditions such as acid environments and heat. Certain spores survive 5 to 10 hours in boiling water—212°F (100°C). Although the spores are heat resistant, the toxin can be inactivated by boiling temperatures.

Commercially sterile foods may contain viable microorganisms

- Spores of thermophilic bacteria survive commercial sterility processes
- Not harmful
- Do not grow under normal storage conditions
- May need to be destroyed for hot-vended items

Incipient spoilage- Microbial spoilage caused by too long of a delay between container closing and retorting.

Contamination After Processing - Leaker spoilage, generally due to inadequately formed seams, container damage, or cooling water contamination.

Inadequate Heat Processing - Inadequate heat process may lead to public health hazard.

Non Microbial Food Spoilage - Chemical action causing hydrogen swells or pin-holes
Overfilling of container gives the appearance of spoilage. Zero or low vacuum cans may appear to be spoiled.