



**COURSE TITLE: FOOD AND INDUSTRIAL MICROBIOLOGY**  
**COURSE NO. - DTM-321: CREDIT HRS-3 (2+1)**



**MICROBIAL SPOILAGE OF CANNED FOODS**

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# CANNED FOODS

- Canning is a method of preserving food in which the food contents are processed and sealed in an airtight container.
- Canning provides shelf life typically ranging from one to five years

## Steps of Canning

1. Packing the product into the container.
2. Hermetically sealing the container
3. Thermally processing for product and the container together.
4. Cooling
5. Storage.



# History of Canning

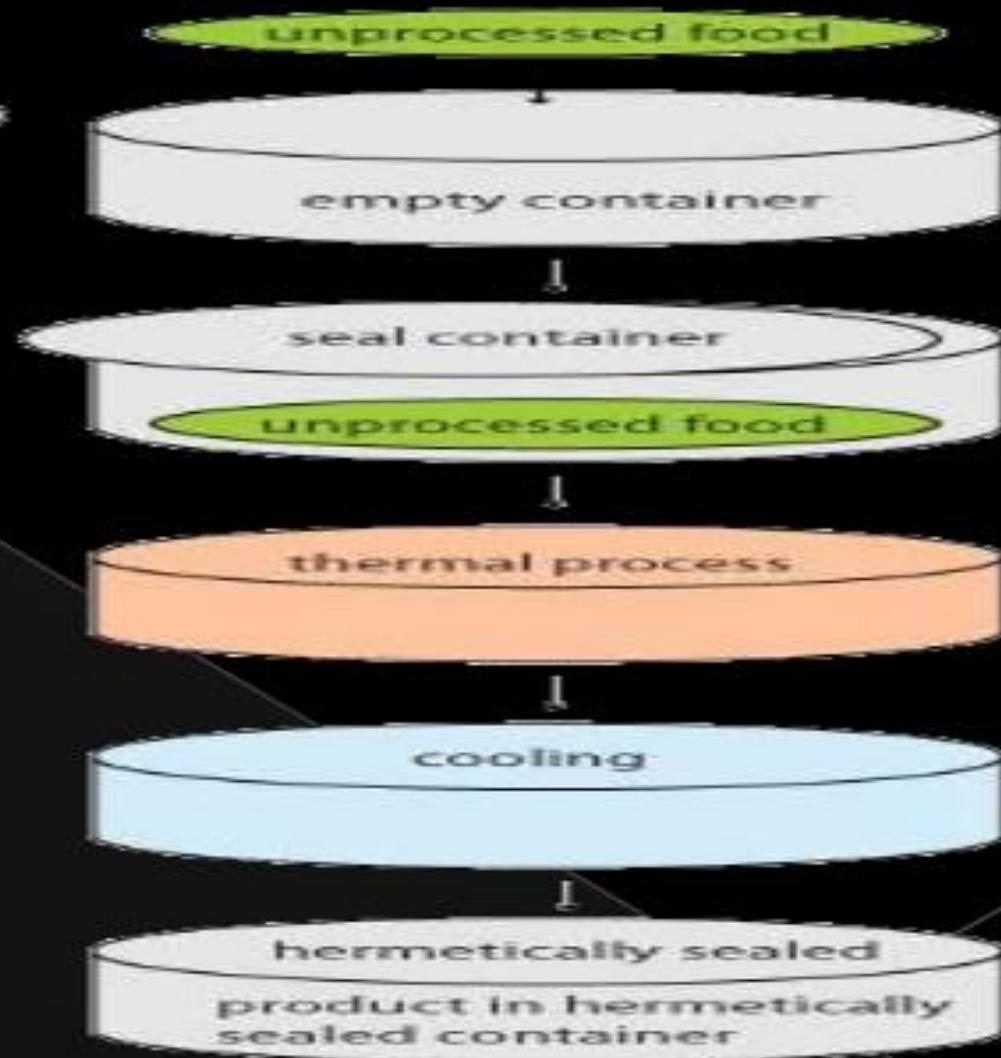
- The canning process was started dates back to the late 18th century in France when the Emperor Napoleon Bonaparte concerned about keeping his armies fed.
- Nicholas Appert was the scientist who conceived the idea of preserving food in bottles like alcoholic beverages.
- He showed that food without preservative will not spoil if it is sufficiently heated and sealed in an airtight container.



# Canning Process

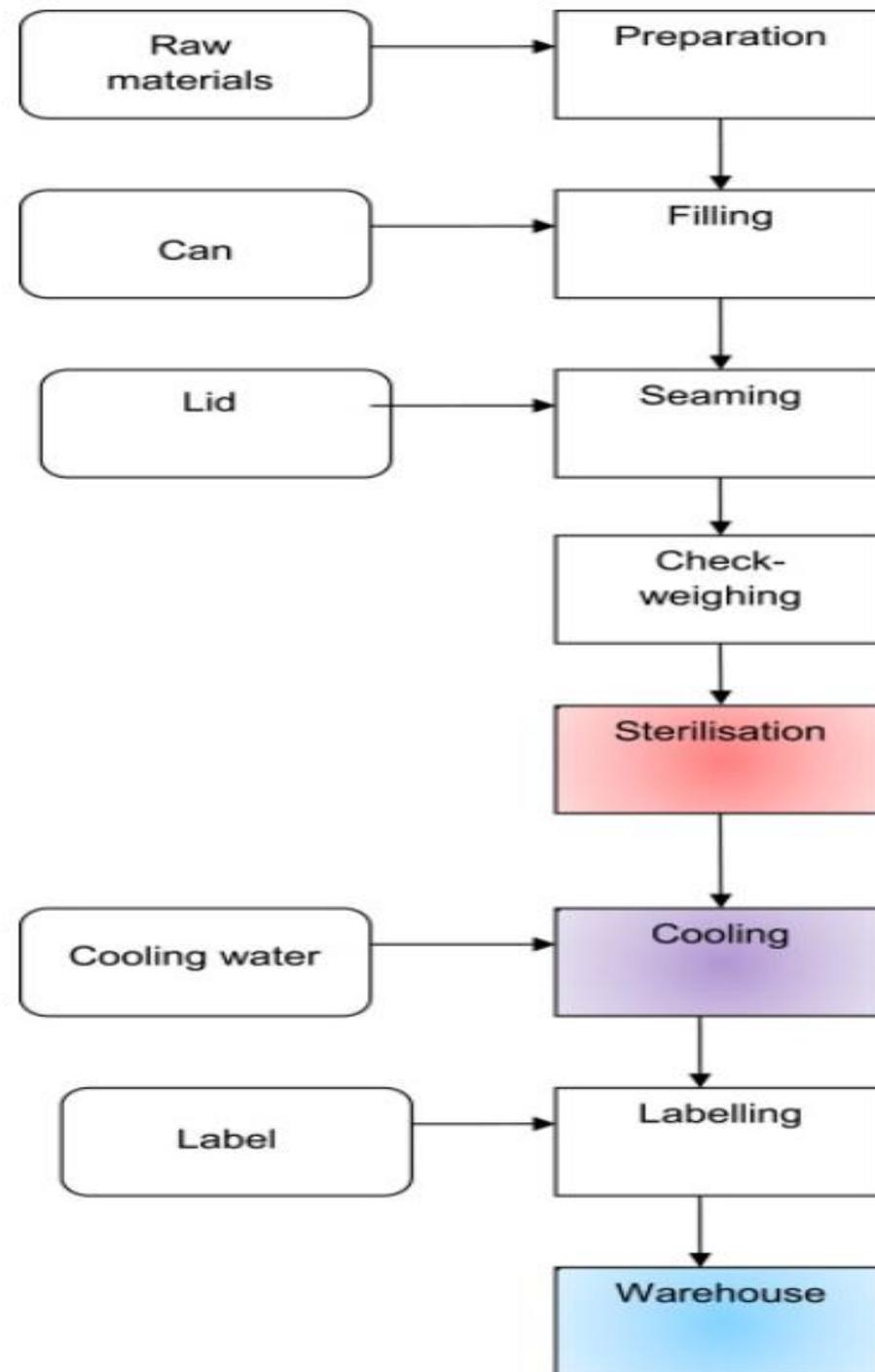


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## FLOW DIAGRAM CANNED FOODS

**Reduction**

**Recontamination**

**Growth**

Can showed swollen irregular appearance as contaminating microorganisms produce gas when they grow in a canned foods resulted to causes swelling of container, It is assumed that the product inside might be spoiled and sometimes they may explode from excessive internal pressure. Flexible or non-rigid containers will appear “ballooned.” If Can is leaky or rusty. The canned product smell putrid or alcoholic and discoloured while Syrup or juices showed turbid, cloudy, slimy or mouldy appearance.

**The steps in canning:** Packing the product into the container and then it is hermetically sealed. Hermetically sealed container is designed and intended to be secure against the entry of microorganisms. Thereafter sealing glass jars or metal cans is done.

Thermally processing the product and the container together.

□ High-Acid foods (jams, jellies, sauerkraut, kimchi, pickles, fermented vegetables,) are processed at 100°C in water bath canner considering to kill botulism bacteria in boiling water. Sometimes, botulinum spores can survive boiling temperature and can be eliminated by using higher temperatures than boiling water.

□ Low-Acid foods ( such as meat, poultry, fish and vegetable) must be processed at 116-121°C in Pressure canning process.

□ High-Acid foods (fruits, jams, jellies, sauerkraut, fermented vegetables, lemon juice) heated at 100°C in boiling water bath canner. The higher acidity level of the ingredients and the heat treatment given during processing safely preserves the food.

Cooling cans is immersed in cold water or let them to cool at room temperature from 12-24 hours. As the temperature of the product drops, a vacuum forms inside and pulls down the lid. This is often accompanied by a popping sound and happens within minutes after removing the jar from the water bath canner. Canned product should be stored in a cool , dry, dark place and it should not be stored where temperature extremes exist. Canned product can be used within one year without any change in its quality.

## Spoilage of canned food

Spoilage of can observed due to the biological or chemical reasons or a combination of both. The biological spoilage is primarily due to microbial growth while chemical spoilage is due to hydrogen produced by the action of acids in food and iron present in can. Sometimes, swelling of canned products observed and it is mainly due to high summer temperature.

**Hydrogen swell** is due to production of hydrogen gas in can because of action of acid of food and iron of canned products specially in acidic foods (canned fruits) and it is not related to fermentation or bacterial spoilage.

Canned products show varying degree of bulging and this problem is associated with Increase in storage temperature, higher acidity nature of food, presence of soluble sulphur and phosphorous compounds and internal surface lacquering of container.

## Sulphiding (Sulphur stinker spoilage)

This type of spoilage occurs in low acid foods and causative organism involved in this is *Desulfotomaculum nigrificans*. Spoilage cause discoloration inside the can showed pink to dark purple. Hydrogen sulphide formed as a result of breakdown of sulphur-containing proteins (liver, kidney) by organisms of clostridium group (*Cl. nigrificans* -sulphur stinker) with the odour resemble like rotted egg. Black discolouration observed because of H<sub>2</sub>S reaction with steel base of tin which produces iron sulphide and may lead to pitting.

## Thermophilic anaerobic (TA) spoilage

This type of spoilage is caused by thermophilic anaerobes which are not able to produce hydrogen sulfide. *Clostridium thermosaccharolyticum* is the main organism involved and produces acid and gas in foods showed sour or cheesy smell in spoiled food produces

# Soilage of canned food

## Chemical soilage

Hydrogen swell

Sulphiding

Rust&damage

## Biological soilage

incipient

leakage spoilage

inadequate thermal

**Growth of thermophilic  
microorganisms**

**Growth of acid-tolerant  
spore forming  
microorganisms**

## Various stages of spoilage in can

<b>Appearance of Can</b>	<b>Description</b>
Flat	This is normal stage of can where ends of can are slightly concave. At this stage partial vacuum exist in can. It maintains the condition even if dropped on solid surface.
Flipper	This appears flat but on dropping it on solid surface, either end can become convex. On applying pressure the can regains its shape.
Springer	It has both ends bulged but if pushed inside, one end remain concave but other flips out. This appearance describes slight pressure in the cans usually caused by poor exhaust, overfilling, denting or variation in temperature. Usually no gas production occurs.
Soft swell	The ends are bulged due to presence of gas in can but the ends can be pushed inside with light pressure.
Hard swell	This is stage where high gas pressure accumulates inside can and bulged ends cannot be pushed inside manually. Due to pressure the ends or side seam may buckle or distort. A very high pressure may lead to bursting of can through seam or ends.
Breather	This is a type of can which has minute leak allowing air movement into the can. It may not allow microbial entry into can.

## Spoilage by Non-Spore Formers

Presence of non-spore formers in cans indicates post processing contamination. The organisms which are heat resistant are generally found. These organisms are more prominent:

*Micrococcus Lactobacillus*

*Enterococcus Streptococcus thermophilus*

*Leuconostoc Microbacterium*

Presence of these organisms indicates leakage of container. Cooling water is one of the important source of contamination and coliforms may also gain entry into the can through these leakage and spoile the canned product.

## Spoilage by Mesophilic Spore formers

*Bacillus and Clostridium* are involved in this type of spoilage

## Characteristics of Mesophilic spore former spoilage in can

Spoilage type	Characteristic
Mesophilic <i>Clostridium</i> type	<ul style="list-style-type: none"><li>• Sugar fermenting species producing butyric acid involved e.g. <i>C. butyricum</i>, <i>C. pasteurinum</i></li><li>• Swelling of container due to CO<sub>2</sub> and Hydrogen</li><li>• Putrefactive species such as <i>C. sporogenes</i>, <i>C. putrefaciens</i>, <i>C. botulinum</i> too play role</li><li>• Decompose proteins and produce ammonia, indole, H<sub>2</sub>S, skatole</li><li>• Spoilage prevalent in foods processed at 100°C</li></ul>
Mesophilic <i>Bacillus</i> type	<ul style="list-style-type: none"><li>• <i>Bacillus</i> is most involved</li><li>• Problem more prominent in poorly evacuated cans</li><li>• Sea foods, meat, evaporated milk most affected</li><li>• <i>B. polymyxa</i> and <i>B. macerans</i> involved</li><li>• Entry of organism through leakage of cans</li></ul>

# Spoilage by Fungi

## **Yeasts**

Yeasts and their spores are not thermo tolerant, so they are not found in properly heat-treated cans. Their presence indicates faulty processing treatment or post processing contamination through leakage. Fermentative yeasts are more prominent and they often produce carbon dioxide and cause swelling of cans. Occasionally, film yeasts also showed growth on the surface of the canned food products.

## **Molds**

*Aspergillus* and *Penicillium* are common molds found responsible in spoiling canned food. They can grow even at high sugar concentration level and acidification during processing or storage prevents the growth of these molds. Some molds are resistant to normal heat treatment applied during processing and it is generally found in home made canned foods where heating and sealing is not done under total aseptic conditions.

## Health and Food safety aspects

The disease is caused by *C. botulinum* are the major concern which is an anaerobic and rod shaped bacteria able to grow at low pH - 4.6 with a long temperature range of 20 to 45°C. It also produces botulinal enterotoxins that cause severe neuromuscular condition known as botulism. The most common way of getting botulism is either by eating the contaminated foods or drinking the contaminated beverages. The patient may show blurred or double vision, vertigo, dry mouth, slurred speech, drooping eyelids, difficulty in swallowing and speaking, muscles weakness and the mortality rate is very high due to the respiratory and / or cardiac failure.



THANK YOU