Fish Preservation

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Preservation is the processing of food so that they can be stored for a longer time.

- Preservation of fish is done to prevent spoilage.
- Since fish is very perishable, it is therefore, necessary to preserve fish if not consumed or disposed immediately.

Fish preservation is the method of extending the shelf life of fish and other fishery products by applying the principles of chemistry, engineering and other branches of science in order to improve the quality of the products.

Some of the important reasons for preserving foods are

1. **To take care** of the excess produce
2. **Reaches areas** where the food item is not available
3. Makes **transportation and storage** of foods easier
4. **Preserving** Foods at Home

Method Of Fish Preservation

Fish Foods can be preserved by the following methods-

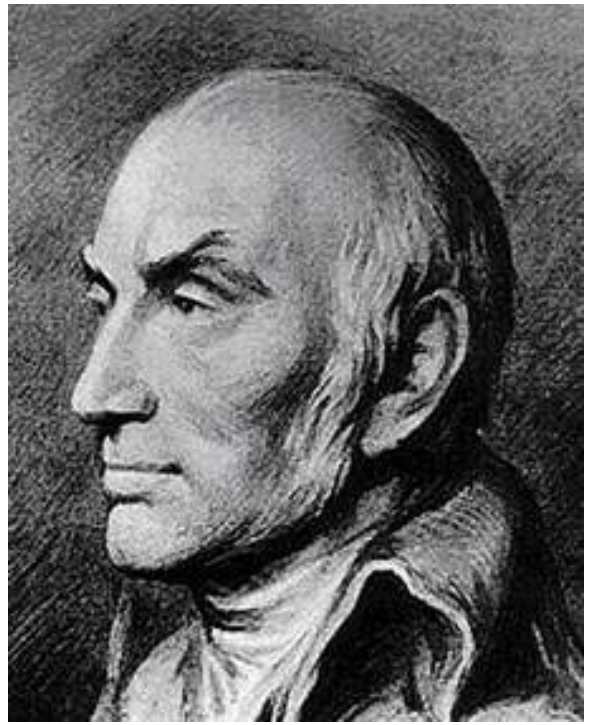
- Using **preservatives** (Canning and pickling)
- **Lowering temperature** (Chilling and freezing)
- **Increasing temperature** (Smoking)
- **Dehydration**
- **Salting**

Preservation by Canning

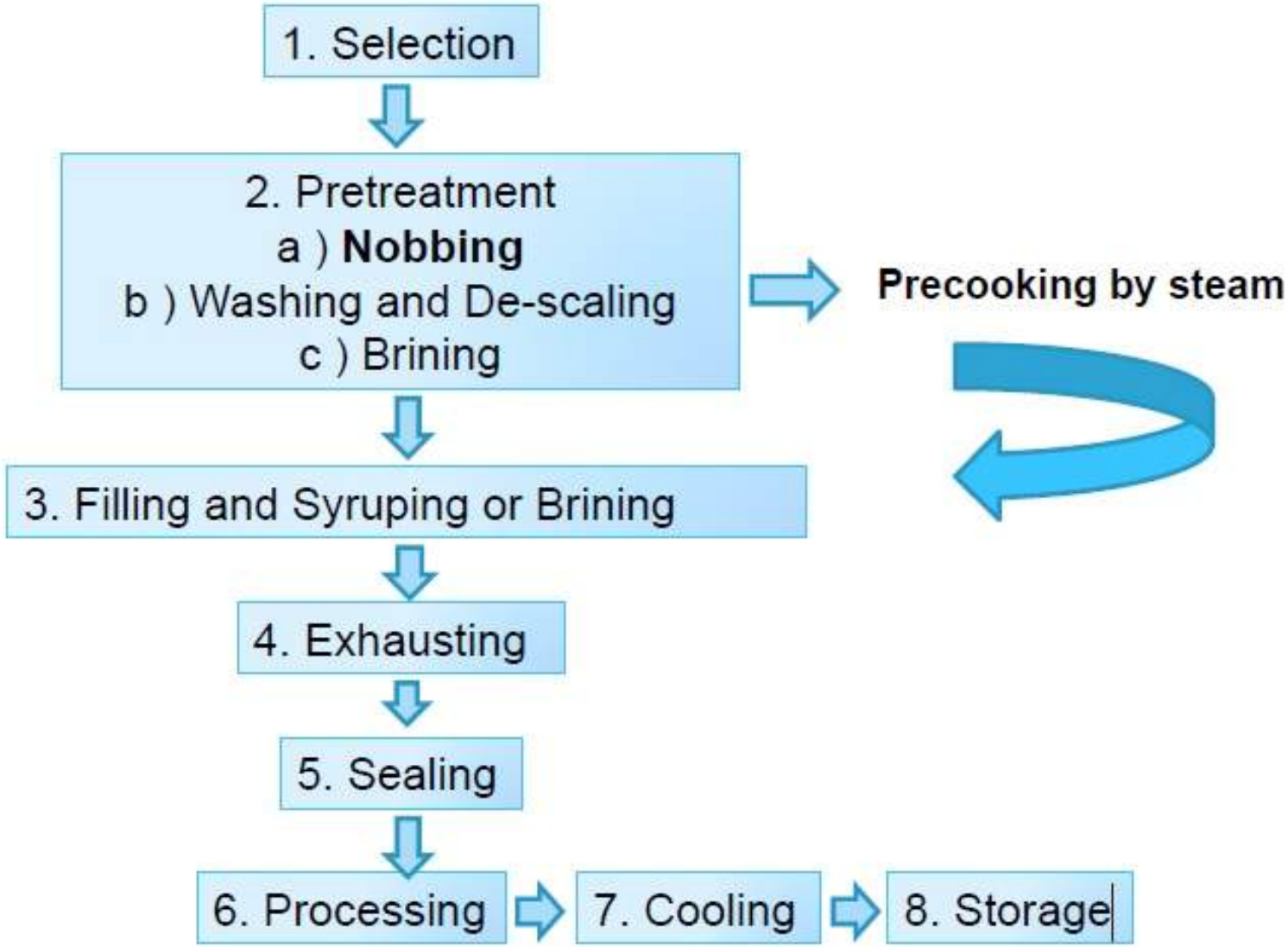
- **Canning** may be defined as the processing of fish by **heat treatment** in **hermetically sealed container** where sufficient degree of heat is required through **conduction and/or convection** to achieve commercial sterility in order to **kill** all sorts of **pathogenic microorganisms**.
- It is also known as the “Art of appertization” or “Appertizing”.
- **Objective of canning** is to yield a product that may be stored for a considerable time at the end of which it will still be interesting and safe to eat.
- **Principles of fish canning**
- Maintenance of commercial sterility
- Maintenance of appropriate heat
- Maintenance of bacteriological principles

History of Canning

- **Napoleon and the French government**, hoping to find an effective way to feed the troops, A prize of **12,000 francs** was offered to anyone who could **preserve foods** for a long time.
- **Nicolas Appert**, A **Parisian confectioner** and **chef discovered** that it was **heat** that kept the foods **spoilage free**. Thus he won the prize for his discovery (1810) and a new era of food preservation began.



The process of Fish canning



1. Selection of raw materials

- **Mature, pre-spawning** fish and **medium fatty fish** are better for canning.
- Eventually fish with the following characteristics are used for canning -
- Excess bone
- High fishy odor
- Fish with hard and farm muscle.
- Available E.g. Sardine, Tuna, Salmon, Herring etc.

2. Treatment before canning

a) Nobbing

b) Washing and de-scaling

c) Brining

a) Nobbing:

- This process of **removing head and gut** in one operation is called nobbing. In the case of larger fish, such as herring and pilchard, the head and gut are removed, but not the **roe or milt**.

2. Treatment before canning

b) Washing and de-scaling:

- **Removing scales** from the surface of a fish, especially from the outer surfaces of fish is known as **Descaling.**
- A fish **scale is a small rigid plate** that grows out of the skin of a fish.
- The skin of most fishes is covered with these protective scales.
- **After de- scaling**, the next operation is **removing of fins**, **viscera** from the raw materials and washing.
- **Nobbing releases blood** that must be removed because it causes **brown staining** in the processed fish.
- Washing also removes **surface slime** and **dirty materials** from fish.

2. Treatment before canning

c) Brining:

- The fish are immersed in a **concentrated solution of common salt** for a **predetermined length of time**.
- Salt is **absorbed by the flesh** and imparts a **desired flavor** to the finished products in which a salt content of about **2 % is acceptable.**

Pre-cooking

- Pre-cooking is usually carried out in **steam, water, oil, hot air or smoke**, or a combination of these.
- It serves a number of related **functions:**

¢ to partially **dehydrate the flesh** and prevent release of those fluids during retorting.

¢ to **remove natural oils**, some of which have a strong flavor.

¢ to **coagulate fish protein** and **loosen meat** from the frame.

¢ **cleanses** of fish and **reduces bacterial load**

¢ **expels the respiratory gasses** from tissues, thus helping to improve vacuum in can

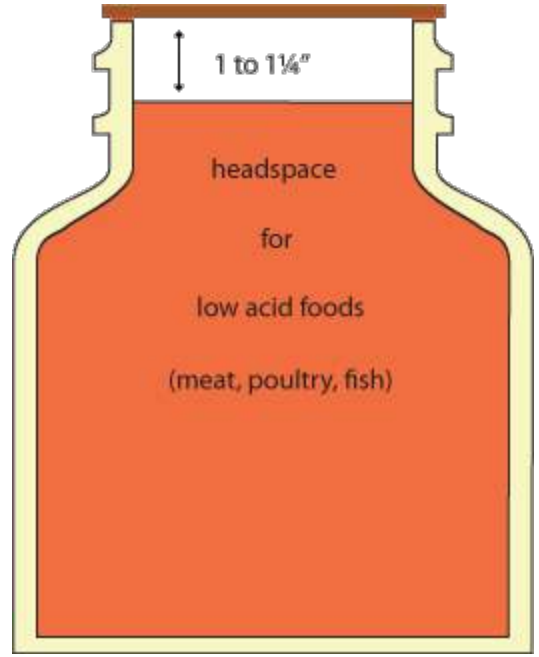
¢ **removes raw flavor** of fish

¢ to **develop desirable textural** and **flavor properties** and

¢ to make the flesh of **crustacea firm and aid their release from the shell.**

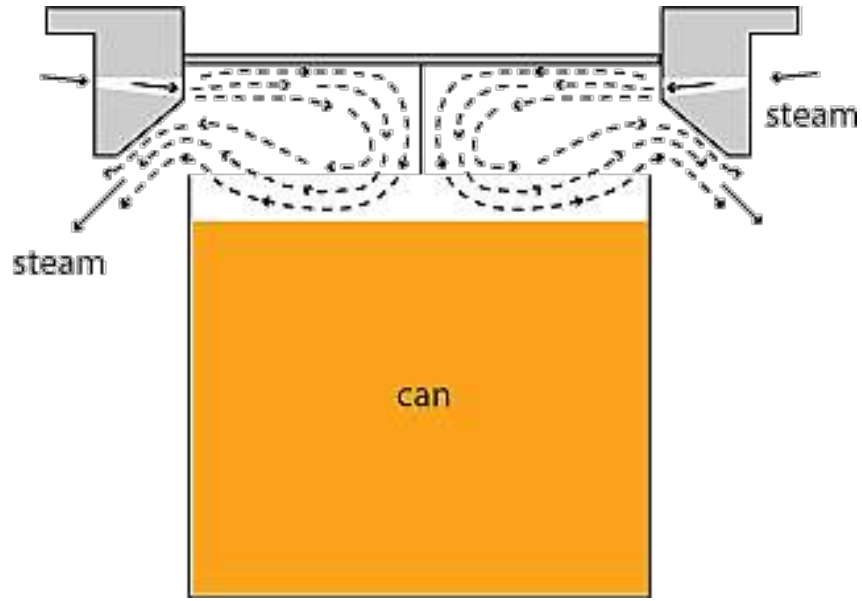
3. Filling the can

- The above treated fishes are **filled** in the can either by **manually or mechanically** usually a **small top space** is left which is also called **head space** and generally **filled with inert gas.**
- The fishes are **arranged inside** the can **as compact as possible**.
- Necessary **additives** (Salt, Tomato sauce, Starch, Sugar etc.) may be used to develop characteristics **flavor** and improve **keeping quality.**



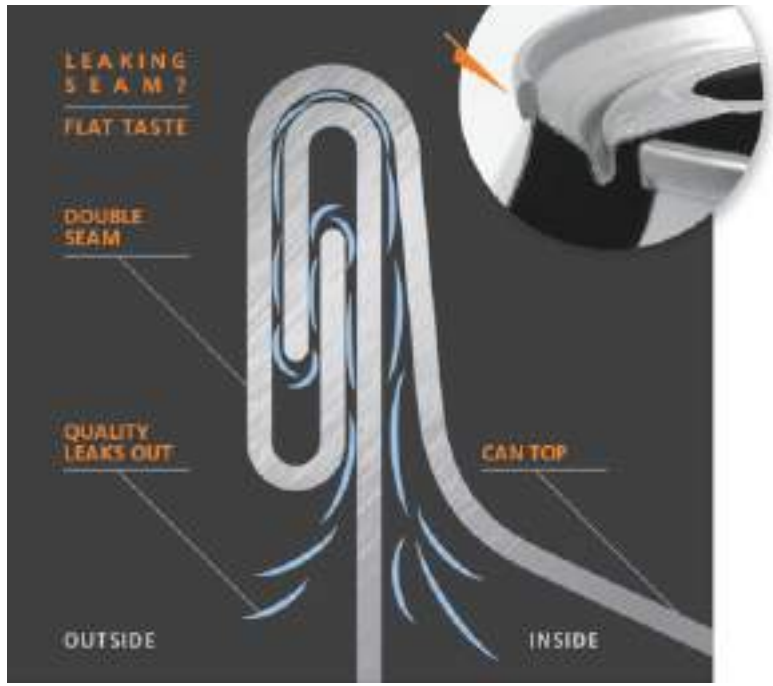
4. Exhausting

- The process of **removal of air** from cans is known as exhausting. Exhausting is done by the **application of heat.**
- Contents of the container are heated to **170° F, 77° C,** prior to sealing the container. As the contents contract during the cooling step, a vacuum is produced inside.
- Obtaining a vacuum by **injecting steam into headspace**. The steam **pushes the air out**, then the can is **immediately sealed**. When the **steam condenses**, a **vacuum is formed**.
- **The major advantages of exhausting are as:**
- **Corrosion of tin** plate is avoided.
- Minimizes the discoloration by **preventing oxidation.**
- Helps in better **retention** of vitamin particularly **Vit-c**
- **Reduces** the chemical reaction.
- **Preventing** development **excess pressure.**



5. Closing the can

- All fish cans are closed by the **double-seaming method** and the operation is usually called **seaming**.
- A **seal** must be achieved that will **prevent** passage of **contaminating material**, carried either **in air or water**, into the can after it has been sterilized.
- **Proper care** and **maintenance of seaming** is vital and its performance should be checked at frequent intervals throughout the working day.



6. Processing

¢ It is the **most important step** during the whole canning procedure.

¢ It is done for **predetermined time** at the **respective temperature**.

¢ Fish have a low acidity at levels where microbes can flourish.

¢ From a public safety point of view, foods with low acidity (a pH more than 4.6) need sterilization under high temperature (116-130 °C).

¢ Heat processing is done in a special instrument called **retort** and so the process is called **retorting.**

¢ The **total time** required to sterilize canned food is largely **depends on:**

- ¢ **Size** of can
- ¢ Processing **temperature**
- ¢ **Rate** of heat penetration at the center of the can.
- ¢ **pH** of the food
- ¢ The **type and number** of organisms present

7. Cooling

- Cooling is done as **quickly as possible** after retorting.
- Otherwise **off flavor** may produce because considerable changes may take place during heat processing

8. Labeling and boxing

- After cooling, cans of large fish such as herring and pilchards are **stored for a period of weeks before labeling.**
- Cans of **small fish** are usually **labeled directly**, since these are not so susceptible to damage.
- Ingenious machines are available for labeling **dingley cans**, and are capable of fixing the lid label, placing a key on this, and wrapping the whole in a **greaseproof wrapper**.
- Larger cans may have the **top label pasted on by hand**, and the **side label by machine.**
- Many canners label by hand, making use of female labor during off-season period.
- In recent years, the introduction of decorated lids has cut down the use of paper labels

Why Fish is Canned with Liquid?

¢ Heat transfer through the fish is by **conduction** and, therefore, **very slow;**

¢ At a processing temperature of **121°C**, it would take **6 hours** to raise the **centre temperature** of a 145.5 mm (diameter) by 168 mm (height) can from 10 to 100°C by conduction alone.

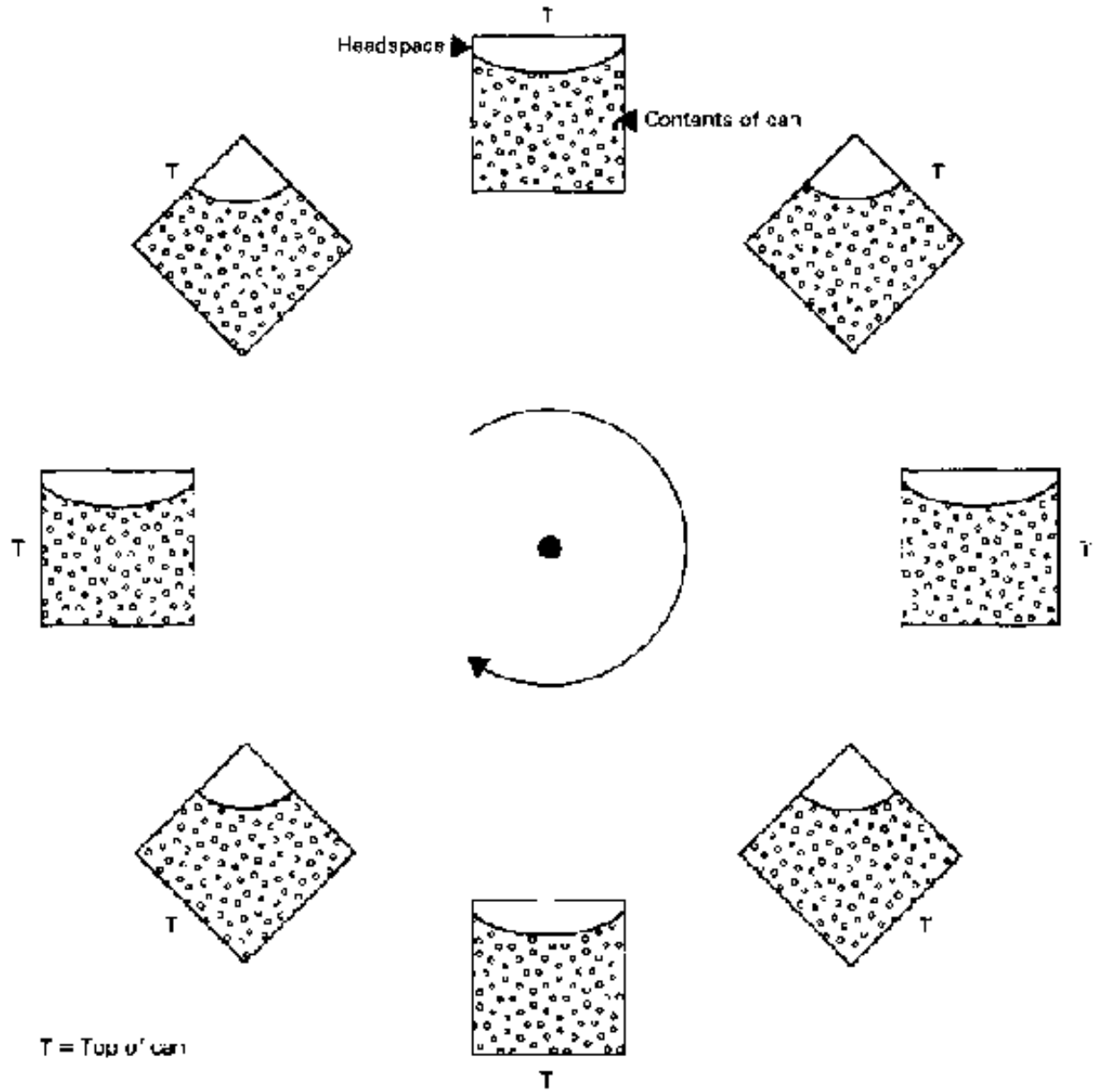
¢ In this time, the **fish nearest the walls** of the container would be **grossly overcooked.**

¢ **By comparison**, if ail the heat could be transferred by **convection**, in the same size can under the same conditions, it would only take **20 minutes** to achieve the same temperature rise at the can centre.

Rotary Retort in Fish Canning

- Most fish canners **increase in-can heat transfer rates** even further by processing the cans in a rotary retort.
- The movement of the **headspace bubble** during rotation forces an increase in **liquid movement** and, therefore, convection heat transfer.
- The fish are more **evenly cooked** throughout the can and, those **nearest the can** walls are **less likely to be overcooked**.

Movement of Headspace in Rotary Retort



Spoilage of the Can fish

- Canned fish may be spoiled or objectionable for the buyer due to any of the following causes-

1. Microbial spoilage
2. Chemical spoilage
3. Mechanical spoilage

- Production of **hydrogen** (hydrogen swell), CO2, browning, corrosion of cans due to chemical reactions.
- Liquefaction, gelation and discoloration due to enzymatic reactions are some examples of non microbial spoilage.

Microbial Spoilage

- Microbial spoilage is due **to 3 main** factors-

1. **Inadequate cooling** after heating or high-temperature storage, allowing germination and growth of thermophilic spore formers.
2. **Inadequate heating**, resulting in survival and growth of mesophilic microorganisms.
3. **Leakage in the cans**, allowing microbial contamination from outside following heat treatment and their growth.

Spoilage by Thermophilic spore formers

- Thermophilic sporeformers can cause **three types** of spoilage-

1. Flat sour spoilage
2. Thermophilic anaerob (TA) spoilage
3. Sulphide stinker spoilage

- **Flat sour spoilage**

In this spoilage the **cans do not swell** but the products become acidic because of germination (Spores begin to grow) and of facultative anaerobic ***Bac. Stearothermophilus.***

The organisms **produces acids without ga**s but with some off-flavor and cloudiness.

- **Thermophilic anaerob (TA) spoilage**

It is caused by the growth of **anaerobic *Clostridium Thermosaccharolyticum***

The production of large quantities of **H2 and CO2 gas** and swelling of cans are sour and cheesy odor.

Spoilage by Thermophilic spore formers

- **Sulfide stinker spoilage**
- This spoilage is caused by the **Gram- negative anaerobic** spore former ***Desulfotomaculum nigrificans***
- The spoilage is characterized by a flat container but **darkened** products with the **odor of rotten eggs** due to **H2S** produced by the bacterium.
- **H2S**, produced from the **sulfur containing amino acids**, dissolves in the liquid and **reacts with iron** to form **black color of iron sulfide.**

Spoilage due to insufficient heating

- Insufficient heat treatment results in the **survival** of mainly spores of ***Clostridium*** and some ***Bacillus spp.*** Following processing they **can germinate and grow** to cause spoilage.
- The most important **concern** is the growth of ***Clo. Botulinum*** and production of **toxins**
- Spoilage can be either from **breakdown of protein or carbohydrate.**

Spoilage due to container leakage

- **Damaged and leaky containers allow** different types of **microorganisms** to get inside from the environment after heating
- They can **grow in the food** and cause different types of spoilage, depending on the microbial typea.
- Contamination with pathogens will make the product **unsafe**

Special Problems Related to Fish Canning

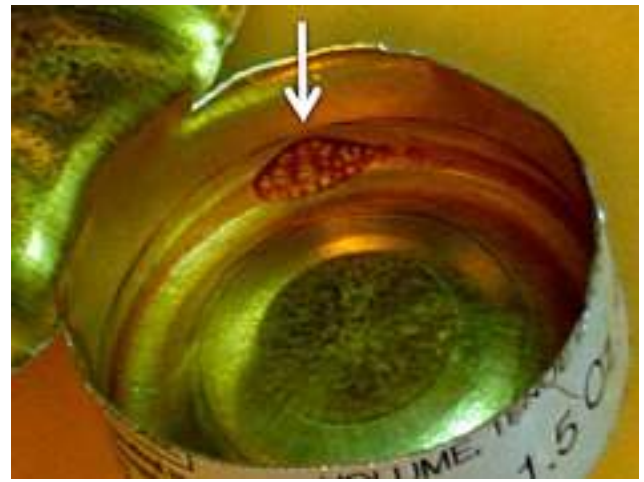
Sulphur staining:

¢ Fish proteins, and especially **crustacean and shellfish proteins**, are rich in **sulphur amino acids** which, on heat processing, **release hydrogen sulphide.**

¢ This can **react with iron** in the tinplate producing **black ferrous sulphide** (**'sulphur staining').**

¢ To **avoid** these unsightly black deposits, a special lacquer incorporating **zinc oxide or zinc carbonate** is used to **coat the internal can walls**.

¢ The **hydrogen sulphide** released now **reacts** preferentially with the **zinc oxide or carbonate** producing **white zinc sulphide** which remains embedded in the lacquer so that an **attractive** internal appearance is maintained.



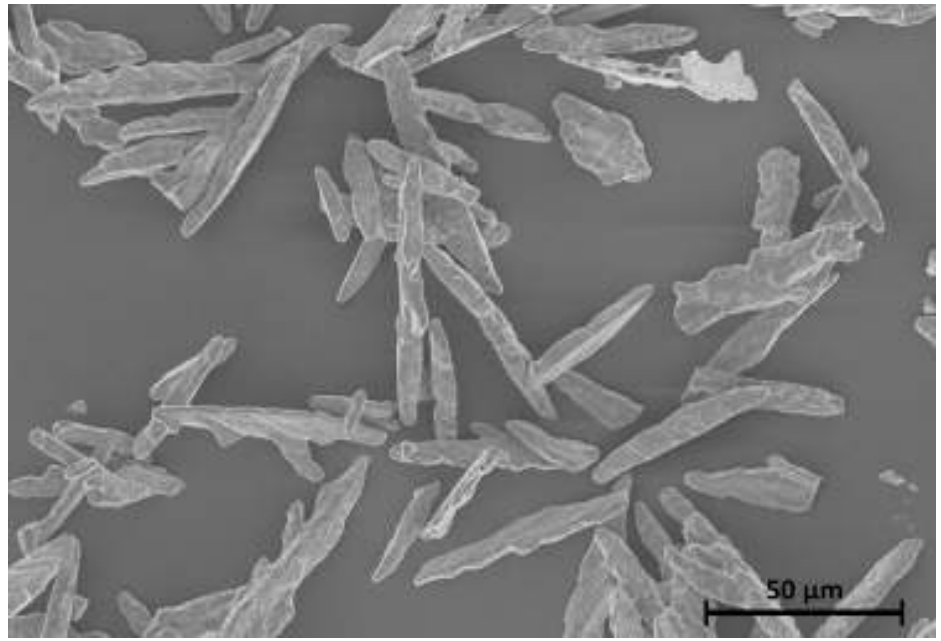
Special Problems Related to Fish Canning

- **Struvite formation**

¢ In some canned fish products**, glass-like crystals of calcium struvite** may form on **storage** and become the reason for many **'foreign body‘** complaints in canned fish.

¢ This phenomenon may be **avoided** by the addition of small amounts of **citric acid** to the product **prior to filling** and processing.

¢ **Citric acid complexes** available calcium ions, thus **preventing** them from **forming calcium struvite.**



Special Problems Related to Fish Canning

- **Curd and adhesion**
- Curd" is **precipitated protein** often found on the **top of canned fish** like **salmon** which is generally canned **without pre-cooking.**
- Curd is a **brine soluble protein** that **exudes and coagulates**.
- Use of **raw fish** which is **not very fresh**, as also **inadequate brining or pre-cooking** are some of the reasons found responsible for formation of curd in the can.
- Curd formation can be **prevented** by **cold blanching** the fish in **10-15 percent brine** for **20-30 minutes** followed by **washing**.

Special Problems Related to Fish Canning

- **Blue Discoloration**
- BD is usually associated with **crabmeat** (e.g. legs, claws etc.)
- The **copper** in the **haemocyanin** (Hemocyanins are **copper-containing respiratory pigments**) in the crab **reacts** with the **sulphur compounds** liberated during the thermal processing producing **blue copper sulphate.**
- This phenomenon becomes **evident** when the copper in the meat is **above 2%**
- Therefore, the important method to **prevent** this consists is **thoroughly bleeding** the meat followed by **washing** in running water so that **copper** is **reduced** below this **critical levels**.
- Using **chelating agent** in the brine can control discoloration in the meat.

Special Problems Related to Fish Canning

- **Honeycombing:**
- This phenomenon is observed in **canned tuna** meat processed from **stale raw materials**. The meat in such can resemble honeycombs.
- During **steaming,** the volume of **meat contracts** due to **removal of water** and **coagulation of protein**. **Coagulation** starts on the **surface**.
- When the water in the **inner parts evaporates** and **escapes as gas** or bubbles through the **soft**, **not yet the coagulated** parts, the g**elatinous part swell** like soup bubbles.
- The swelled gelatinous parts **solidify** after **cooling** and **exhibits** h**oneycomb appearance.**