

Chapter 10

Thermal processing of Fish

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Thermal processing also known as heat processing is commonly used processing method which helps in extending the shelf life of the food products with high safety level, convenience and a healthy product. Seafood as a whole food is highly nutritious. Benefits to human health associated with the consumption of seafood is well recognized for multiple bodily organs and physiological functions but their high perishable nature is a concern. Seafood undergoes spoilage due to autolytic, microbial action as well as oxidation of lipid. Proper handling and preservation is essential to maintain quality of fish. Heat processing is an age old preservation method practiced in many countries to extend the shelf life of food products. Heat treatment causes the destruction of microbes which increases the shelf life. There are number of thermal processing operations like- baking, blanching, canning, dehydration, extrusion, frying, pasteurization, sterilization, etc. All these operation serves various purposes and helps in manufacture of different food products.

Thermal processing is of utmost importance to low acid high water activity foods, where there are no hindrances to microbial growth. The proper delivery of heat is essential to cause the destruction of microbes to avoid food spoilage. In seafood's processing, thermal processing through canning (retort pouch processing) is a common approach. In canning, the food is preserved by application of heat in hermetically sealed cans (pouches). Hermetic sealing means- complete airtight sealing. This prevents contamination from outside. Heating at very high temperature ranging from 110 to 135°C for a desirable time helps in killing all the vegetative forms of microorganisms as well as most heat resistant microbial spores. The amount of time needed for processing is different for each food type depends on hurdles present in the food and heat transfer characteristics. In thermal processing of seafood products, heat processing is aimed for the destruction of spores of *Clostridium botulinum*. A number of thermally processed ready-to-eat (RTE) products are available on market shelf.

Advantages of thermal processing

- Preservation of food for longer duration
- Ready-to-eat (RTE) food products
- Production of safe foods
- Room temperature storage
- Easy process

Canning Process

The important operations in thermal processing are:

- Raw material preparation
- Blanching/ Precooking
- Filling into containers
- Addition of fill (brine/ oil/ gravy)
- Exhausting
- Seaming/ sealing
- Retorting (heat processing)
- Cooling
- Drying
- Labelling and storage

These operations have been briefly explained below:

Raw material preparation

Most of the fish found in our country are suitable for thermal processing. But appropriate care should be taken while selecting the fish.

- Only fresh fish should be processed- low microbial load
- Proper dressing and washing is very essential
 - ✓ Descaling- removal of scales
 - ✓ Beheading- removal of head
 - ✓ Degutting- removal of gut and visceral organs (liver, kidney, intestines)
 - ✓ Removal of fins, tails
 - ✓ Cutting into appropriate size

For shrimps- peeling (removal of outer shell) and deveining (removal of intestine) is done. Clams, mussels and oysters are depurated before picking the meat. These organisms are kept under starvation for 24 hours in water to reduce the microbiological load and improve the quality.

Blanching/ Pre-cooking

Cleaned and dressed fish is immersed in salt solution (2-5%). The blanching is done either in hot or cold brine depending upon the fish. The blanching gives firmness to the product. Shrimps are blanched in boiling brine solution. This gives them attractive red color. Sometimes, fish are precooked to remove water from them.

Functions of blanching:

- Firm texture of fish
- Reduction in bacterial load
- Inhibition of enzymatic reaction
- Shrinkage for better filling
- Removal of cellular gases

Filling into containers

The blanched material is filled in cans. The most popular are tin plated steel cans or OTS (Open top sanitary) cans. Inside of can is coated with lacquer. For fish, the lacquer is sulphur resistant (SR lacquered cans). This lacquer helps in prevention of black colour in canned fish products.

Sulphur(Aminoacids of fish) + Iron(Tincan) = Ironsulphide (black colour)

Usually cans are denoted by trade name. First digit represents diameter of can (in inches) and next two digits represent measurement in sixteenth of inches.

Apart from OTS cans, other container used in canning are: aluminium cans, tin free steel (TFS) cans, glass containers, retort pouches.

Table 1. Cans used in fish canning industry

Trade Name	Dimension	Overseam dimension
4 1/2 OZ prawn cans	301 x 203	77 x 56
8 oz prawn cans	301 x 206	77 x 60
1 lb. jam can	301 x 309	77 x 90
No.1 tall can	301 x 409	77 x 116
8 oz. tuna can	307 x 113	87 x 43

(Adapted from Vijayan, PK (2003) Canning Preservation of fish and Shell Fish)

Nowadays, retort pouch processing is very popular. The retort pouches are flexible in nature and they easily withstand high temperatures used during thermal processing. They also provide good barrier against moisture and gases. The most common retort pouch is 3 layered laminate. The 3 layers are joined with adhesive lamination. These three layers are:

- Polyester: Strength and abrasion resistance
- Aluminium foil: Barrier against moisture, gases and light
- Polypropylene/ polyethylene: Heat sealing

Addition of fill

The cans/ pouches are then filled with liquid medium i.e brine solution, oil, curry, gravy, sauce etc. The functions of liquid medium are:

- Acts as constituent of product
- Taste, flavor
- Helps in heat penetration

While filling with liquid medium a headspace of around 0.7-0.9 cm is left from the top of can. This helps in formation of vacuum in can.

Exhausting

Exhausting is removal of air from the cans/ pouches, before sealing. Removal of air is necessary because presence of air may cause undesirable stress on seams/ seals of the cans/ pouches. This may cause them to burst during the thermal processing. Other functions include:

- Less strain on seams/ seals
- Removal of oxygen- prevention of oxidation
- Helps in uniform heat transfer
- Helps in detection of spoilage

The exhausting is done by heating the product before filling and sealing it immediately. The exhausting temperature is 80--85°C. The exhausting can also be done by injecting the steam into the pouches. The steam takes away the air and vacuum develops upon condensation of steam.

Seaming/ sealing

Cans are sealed by double seaming technique. The retort pouches can be hot bar sealed or impulse sealed. To avoid seal defects in pouches, it is better to double seal them.

Thermal processing

The sealed cans/ pouches are heated for sufficient time to cause destruction of pathogenic micro-organisms and inactivate spoilage causing microbes. The temperature and duration of heat processing depends upon type of food and indicator organism.

For canned fish, *Clostridium botulinum*, is taken as indicator organism. Our aim is to reduce the spore of *Clostridium*. For this, the center of pack (called as cold point) should get a temperature of 121.1°C for 2.52 min. The thermal processing can be carried out by using steam retort or water immersion retort (Fig. 1.)

Cooling

After heat processing cans/ pouches are cooled to the room temperature. The cans/ pouches should be rapidly cooled. This will help in preventing the overcooking of the food material. Additionally, it helps in reducing the excessive strain on the seams of the cans. Water used for cooling should be clean.

Drying

The cans/ pouches are wiped and dried to remove water from the exterior surface. The water on external surface may cause corrosion upon storage.

Labeling and storage

The cans should be properly labelled as per the regulations. The cans/ pouches must not be stored while hot. This provides favorable conditions for thermophilic bacteria, which might have survived heat processing. The cans should be not stored at high humidity conditions. High humidity may induce rusting in cans. The product should not be stored at high temperatures as it may lead to the formation of hydrogen swells. The storage area should be clean, cool and dry.

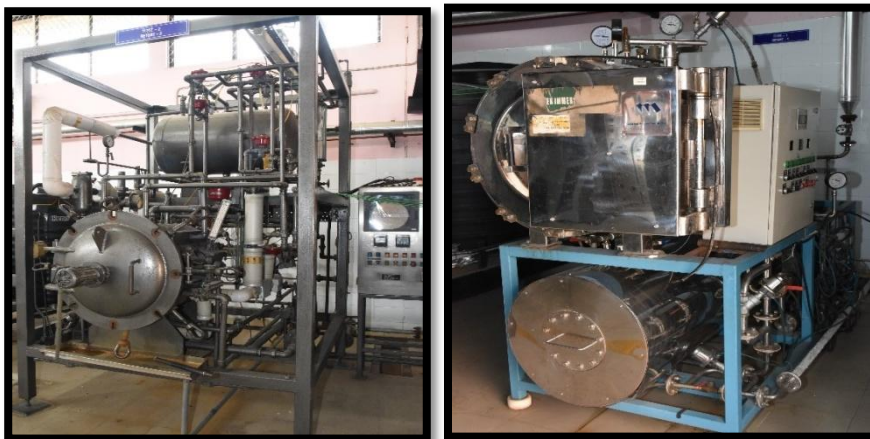


Fig. 1. Steam retort and water immersion retort used for heat processing