SEMESTER - V
C12T and DSE-2T
POST HARVEST TECHNOLOGY, FISH AND AQUACULTURE PRODUCTS AND BI-PRODUCTS

Smoking:

Smoking is one of the oldest methods of fish preservation developed in prehistoric period. In recent times smoking is used as a method of preservation with the incorporation of smoke flavour and development of colour. In under developed countries this method is used as a means of preservation only, while in developed countries this method is used to impart smoke flavour to the product since in these countries there are other sophisticated means of preservation of fish. Smoking is a method of preservation effected by the combination of drying, deposition of naturally produced chemicals resulting from thermal breakdown of wood and salting. All these three factors help in preservation of fish. Smoked fish is ready to eat and has great demand in western sophisticated markets. Smoking is also used as an intermediatory step in the preservation of canned smoked fish. Here before canning, fish is smoked to impart smoky flavour. Smoke is a good preservative since it contains bacteriocidal and antioxidant properties. Around 2% of the total world catch is used for preparing smoked fish all over the world. In India, "masmine" is prepared in Lakshadweep group of islands.

Different types of smoking

1. Hot smoking: In this type, the temperature should be maintained above 30oc and the normal range is 70-80oc. In hot smoking fish is completely cooked and consumer can take it without further cooking.

2. Cold smoking: In cold smoking temperature should be maintained below 30oc. Here meat will not be cooked and it is used to impart flavour in the meat. So it has to be cooked before consumption. This method is followed in temperate countries as temperature in these countries is very low.

3. Combined method of hot and cold smoking: Here fish is first smoked below 30oc for few hours and finally it is hot smoked.

4. Liquid smoking: Liquid smoking extract is prepared by dry distillation of wood and then it is concentrated to a particular degree and later it is used in proper dilution. Dilute smoke is concentrated, fishes are dipped into it for required time and then it is dried.

5. Electrostatic smoking: Here smoked particles are charged into an electrical field (usually positively charged) and at the same time fishes are negatively charged. The positively charged smoke particles are attached by the fish. It is a rapid process.

Chilled sea water:

It is also possible to cool seawater by mixing ice with it. These systems are usually referred to as chilled seawater (CSW) and can be extremely simple. A mixture of seawater and ice, usually 1:1 to 1:2 on a volume basis at the start, forms an ice slurry that has a temperature of about –1.5oC. In such ice slurry or chilled seawater (CSW), the heat transfer between the fish and the cold medium occurs by convection. Thus, the rate of chilling is higher than in ice. Ice and salt should be added to the slurry during chilling to compensate for the loss of ice due to melting and to maintain the salt concentration at about 3%. Agitation in tank prevents accumulation of the ice at the surface and formation of a large temperature difference between the upper and bottom part of the container. Furthermore, forced convection increases the rate of heat transfer.

The rate of chilling of fish in CSW is especially high in the range from ambient temperature to about 5oC, while below 5oC, it is not significantly higher than that in crushed ice. Thus, CSW is often used only for rapid initial chilling of highly valued fish onboard. Another use of CSW is for chilling and holding the catch onboard in insulated containers. The shelf life of ungutted fish kept in CSW containers is a few days longer than that of fish carefully chilled with flake ice. Furthermore, no textural damage occurs except for some loss of scales. In the case of small fatty fish, the CSW treatment offers some protection against rancidity. Compressed air or nitrogen is injected into the bottom of the tank to ensure rapid and even cooling, the gas flow rate should be 2-4kg/h at a pressure of about 35kN/m2. The contents should be agitated at least for 6 hours.

Chilled storage:

In general, two types of plastic fish boxes are used: stack-only and nest/stack boxes.

The handling rate is necessary to prevent quality loss because of delayed icing. Pre-chilling can be of advantage to compensate lack in handling rate.
Handling methods, which make it possible to guarantee that the icing procedure is sufficient to chill the fish to 0oC and maintain this temperature until landing.
The hold must be constructed in such a way, that safe and easy stacking of the boxes can take place.
Hold insulation of a relatively high quality should be considered. A small mechanical refrigeration plant can be of advantage. Air temperature in the hold should be +1o or -3oC.

Use of antimicrobial agents in ice and cold liquids

By ordinary method of icing, fish can be preserved for 10-12 days. However, studies have shown that use of antimicrobial agents in ice or cold liquids, enhance the shelf life of fish by 60 to 100%. The following antimicrobial agents were used.

a) Chlorine compounds

If liquid chlorine or bleaching powder is mixed with ice or cold liquids, shelf life of fish can be enhanced. If the cooling media (ice or chilled liquid) contains less than 30 ppm of chlorine, no damage is done to fish. However if the proportion is more than this, the fish gets acrid smell. Also due to oxidation, the colour of fish may change. By this method fish can be preserved for 18-20 days.

b)Antibiotics

By the use of antibiotics in ice or cold liquids, shelf life of chilled fish can be increased. Among the antibiotics, chlorotetracycline and oxytetracycline are important. These are powerful broad spectrum antibiotics and are very effective even at low concentrations. Antibiotics were used for chilling fish as follows.

By dip treatment in antibiotic solution and then chilling.

Incorporating antibiotic in water and then ice is prepared and used for chilling.

Icing:

Icing is the most prevalent method of preserving fish. Ideal icing involves packing crushed ice and fish alternatively in insulated boxes, in the fish to ice ratio of 1:1 (w/w). By this, the temperature of the fish is lowered to near 1 to 2°C in about 2-3 hrs (the melting of the ice needs 80 calories of heat/g and this heat is removed from the fish in contact with ice and hence, the fish get cooled). This lowering of temperature brings about

arrest of almost all enzymatic changes,
killing of about 50-60% of the mesophilic bacteria and
slowing down of the activities and growth of all other bacteria, which are cold-loving (psychrophilic) and cold-tolerant (psychrotrophic).

As a combined effect of all these three factors, the spoilage of fish is delayed to a considerable length of time in ice. During iced storage of fish, there is an initial drop of bacterial count due to the death of the cold sensitive mesophiles. The surviving cold tolerant bacteria, however, get adapted to growth in low temperature. Consequently, there is a gradual increase in population, which takes about 6 to 8 days to reach a count of one million per gram or above. By that time, the fish has reached the stage of incipient spoilage.

Qualitatively, there is a selection of bacterial flora during iced storage of fish. Irrespective of the composition of the initial flora, the Pseudomonas/ Alteromonas group emerges as the predominant group of bacteria at the time of spoilage. This is because most of the psychrotrophic bacteria capable of spoilage belong to these genera.

Spoilage of fish:

Spoilage of fish, post mortem, is mainly due to (1) oxidation, (2) autolysis and (3) bacteria. The major cause of spoilage of fish is bacteria, particularly in the case of marine fishes.

The flesh and body fluids of newly caught fish are free from bacteria (except when the fish has bacterial disease). The bacteria present on skin, adhering slime gills and intestine are normally saprophytic. Once the fish is dead, these bacteria invade the fish tissue.There are three main routes for this attack.

From the gills into the flesh through the vasculatory (circulatory) system.
Through the skin by penetration.
Through the peritoneal lining (from the intestinal cavity).

Invation of bacteria through the first and second routes is faster. Entry through the peritonial lining can take place only after perforation of stomach and intestinal walls, which normally takes longer time.

The fish muscle contains 15 to 18% protein. Bacteria attack the protein and break it down to peptides and amino acids. Initially, bacteria live and multiply in the fish tissue, utilizing the low molecular weight compounds like carbohydrates and amino acids present in small quantities in the muscle. Due to post-mortem enzymatic break down of the macromolecules in the muscle, enough low molecular weight compounds are formed, which serve as the food of bacteria. Subsequently bacteria elaborate proteolytic enzymes, which break down proteins to peptone, polypeptides, lower peptides and finally to amino acids. Bacteria will metabolize amino acids, in different ways leading to the production of odouriferous and foul smelling compounds like ammonia, hydrogen sulphide, mercaptans, indole, amines and organic acids.

When the fish is left in ambient temperature, which is usually 28 ±4°C, tropical fishes get spoiled within 6 to 12 hrs. depending on their size. In order to prevent such spoilage,

many methods are in practice. Drying, icing, freezing and use of chemicals are some of the usual methods. The basic principle involved in these methods of preservation of fish is to control the activities of the microorganisms.