

THE ROLE OF REFRIGERATION IN FISH PROCESSING INDUSTRY

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The annual catch of fish in India is in the neighbourhood of 1.3 million tons of which about 0.8 million is from the sea and the remaining from inland sources. Fish is one of the most perishable of the food materials. So it is imperative that proper precaution should be taken to prevent spoilage right from the time of landing itself.

It has been established that lowering the temperature of fish retards the activity of the enzymes and bacteria which bring about the spoilage. For short time storage, say upto a maximum of seven days, fish can be kept in a fresh condition by chilling with ice in the ratio of 1:1 with subsequent replenishment of ice. For long time storage fish has to be deep frozen. Frozen fish has been most popular because freezing retains the colour, flavour, texture and nutritive value of the fish to a greater extent than any other method used industrially at present. This is why we are able to earn bulk of foreign exchange through the sale of frozen prawn compared to canned and dried prawn and fish. Even in the canning industry, refrigeration has a very important role in so far as the fresh fish has to be preserved in sound condition until it is processed.

The very important aspect in freezing the fish is the rapidity at which fish is frozen. In other words, the rate of freezing has a profound influence on the quality of the product. It has been established by research findings that the freezing should be done as rapidly as possible for best results and the material should pass from 0°C to -5°C in a very short time, say within half

an hour. This is because the size of the ice crystals formed inside the tissue of fish depends upon the time taken for passage through this temperature zone. If the time taken is more, the size of the crystals formed will be bigger and undesirable qualities of the product will result. In commercial practice, a 25 mm block of fish should be frozen and its temperature brought to less than -18°C within 2½ hours.

The advantages of quick freezing can be summarized as follows:

1. It chills the product rapidly preventing bacterial spoilage.
2. It facilitates rapid handling of large quantities of product.
3. It makes utilization of automatic devices practicable, thus materially reducing handling costs.
4. It promotes maximum utilization of freezer space.
5. It produces a packed product of uniform appearance, with a minimum of voids or bulges.

Now we shall discuss the various types of freezers under use:

Sharp freezing: This is perhaps the oldest method of freezing fish commercially. In this, fish to be frozen are placed on shelves comprised of refrigerated pipe coils. Eventhough the heat transfer between the refrigerant in the pipes and the fish at the point of contact is relatively high, the overall heat transfer rate is quite low because an extensive surface area of the product is not in contact with the pipes and is cooled largely by the natural circulation of the air

within the freezer. So the use of the sharp freezer is limited to freezing round fish only.

Blast freezing: Blast freezers are generally small rooms or tunnels in which cold air is circulated by one or more fans over an evaporator and around the product to be frozen. Blast freezers are used for freezing such fishery products as shrimp, fish fillets, steaks, scallops, or breaded pre-cooked products packed in institutional size packages.

Plate freezing: In the multi-plate freezer, freezing is accomplished by refrigerant flowing through connected passage ways in the horizontal movable plates stacked in an insulated cabinet. Plate freezer is used extensively in the freezing of fishery products packed in consumer size cartons and in 5 lb institutional type cartons. Among packaged fishery products, frozen in the plate freezer, are fillets, steaks, shrimp, fish sticks, fish blocks and scallops. The plate freezer provides rapid and efficient freezing of fishery products and so it is becoming more and more popular.

Storage of frozen fish: Fishery products may undergo undesirable changes in flavour, odour, appearance and texture during frozen storage. These changes are attributable to dehydration, oxidation of the oils or pigments and enzyme activity in the flesh. The rate at which these changes occur depends on (i) the composition of the particular species of fish and (ii) the protection afforded to the product through the use of suitable packaging materials and glazing compounds.

Effect of composition on quality: Fish having a high oil content such as sardine, mackerel etc., have a comparatively short frozen storage life because of the development of rancidity due to the oxidation of the lipid fractions.

Effect of temperature on quality: Frozen fish must be kept at -18°C or lower in order to ensure adequate shelf-life.

Storage above -18°C , even for a comparatively short period of time, will result in rapid loss of quality. It is important, therefore, that frozen seafoods be kept at temperatures as close to -18°C as possible from the time frozen until they reach the consumer. Modern refrigeration plants are being operated at -24°C or lower to obtain the ideal conditions.

Effect of humidity on quality: A high relative humidity in the cold storage room will tend to reduce the evaporation of moisture from the product. The relative humidity of the air in the refrigerated room is directly affected by the temperature differences between the room cooling coils and the room temperature. An increase in this temperature differential results in decreased relative humidity and accelerated rate of moisture withdrawal from the frozen product. Likewise small temperature difference between the air and the evaporator cooling coil results in a high relative humidity and reduced moisture loss from the product. It is, therefore, important that the evaporator coils in the freezer be sized properly so that the desired high relative humidities can be obtained.

Effect of packaging and glazing on quality: Adequate packaging of fishery products is important to prevent dehydration and subsequent loss of quality. Similarly glazing should be done to prevent desiccation. Individual fish, frozen in the round or headed and eviscerated stage, cannot usually be suitably packaged, therefore, they must also be protected by a suitable, glazing compound. Glazing acts as a protective coating against the two main causes of deterioration during storage, viz., dehydration and oxidation.

Transportation: Conditions of temperature and humidity recommended for frozen storage should also be employed during transportation and marketing to minimize product quality loss. So refrigerated carriers

employing mechanical refrigeration or dry ice (solid carbon dioxide) should be used for the transportation of frozen foods. To minimize quality loss during transportation and marketing, the following procedures should be adhered to:

1. For long distance transportation, the temperature of refrigerated carriers should be maintained at -18°C .
2. Refrigerated carrier should be pre-cooled to at least -12°C before loading.
3. Frozen products should not be removed from the cold storage until the carrier is ready to be loaded.
4. Frozen fish should not be stacked

directly against floors or wall of carrier. Floor and wall racks or strips should be provided to permit air circulation around the entire load.

5. Product, when received at the retail store, should be put immediately into a -18°C storage room.
6. Display cases in retail stores should be continuously held at a temperature of -18°C or lower.

From the above, it is clear that refrigeration is playing a very important role in fish processing industry and the method of freezing preservation will continue for a long time even though the latest technique of freeze-drying is finding its use in modern industry.