

Current Trends in Fish Processing Technology

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Food processing occupies a position of major importance in the world food trade. In the past, studies on food preservation have been concentrated on developing new or improved products. At present and in the future, studies on food preservation are of more critical nature such as reducing post harvest losses, and developing new processes that optimize cost, nutritional quality, environmental impact and utilization of resources and energy.

Fish is a highly nutritious, protein rich food. The spoilage rate of fish is very high compared to most other meat products. Hence there exists a great need for more effective and more widely used methods for fish preservation so as to reduce the staggering amount of fish that is unnecessarily wasted. The aim of fish processing technology is to develop novel preservation methods to prevent undesirable changes in the nutritive value and sensory quality of the products. This is achieved by developing cost effective methods of preservation, which control growth of microorganisms, reduce undesirable changes in physical, chemical and sensory parameters and prevent contamination.

Preservation is achieved by physical, chemical and biological methods. Chemical methods of preservation involve addition of preservatives like salt, acids or exposure to smoke. Biological methods involve alcoholic or acid fermentations. Physical methods include heating, irradiation

(increase in energy level), chilling and freezing (decreasing temperature of products) and dehydration and freeze-drying (control of water content).

Among the methods mentioned above earlier, the most important for fish preservation are the physical methods. Some of these methods can completely stop growth of microorganisms and greatly retard the progress of many chemical reactions. But none of these methods can completely stop chemical and physical changes.

Chill storage

Chilled storage in different forms and styles and in different containers has been used in the case of fish and fish products for a long time. Modified atmosphere or controlled atmosphere storage by the application of CO₂ at concentrations ranging from 50-100% to fresh fish in chilled condition substantially increases the shelf life. This effect is explained largely on the basis that 20% or more CO₂ at 0°C effectively retards growth of bacteria responsible for spoilage of fresh fish.

Freezing preservation

Freezing is the most satisfactory method for long-term preservation of fish products. The advancements in the freezing of fish products are mainly in the technological aspects of freezing and also in the introduction of newer frozen products.

The form, style and nature of frozen products have undergone significant changes. Earlier mainly the raw materials were frozen and stored for marketing. At present the products style has changed to ready to cook or ready to warm type (finished) product. Many of the drawbacks in product formulation have been overcome and almost perfected. CIFT has also taken steps to formulate Indian cuisine from fish and succeeded in preparing a large number of products in frozen condition, which are ready for use. Processing of different types of coated products like fish fingers, fish cutlets, coated prawns, coated squid and cuttle fish, coated fillets and burgers have already been standardized.

The technological advancement in this area is commendable. Plate freezers and tunnel freezers are used earlier for freezing fish products while spiral freezers are extensively employed now. This type of freezers considerably reduces the space occupied by the freezers and also freezing time. A major modification in air blast freezing is the fluidized bed freezing. Fluidized bed freezing is successful for many kinds and sizes of unpackaged fish products. The best results are obtained with small and uniform sized products such as prawns and squid rings. Double contact plate freezers are used for freezing fish in orthorhombic packages. Semi automatic and automatic horizontal plate freezers have also been introduced. For freezing unpackaged fish products rotary drum type freezers are available. Liquid immersion freezers having aqueous solutions of freezants such as propylene glycol, glycerol, sodium chloride, calcium chloride and mixtures of sugar and salt can be used for rapid freezing, especially on-board fishing vessel

Liquid nitrogen and liquid or solid carbon dioxide are used for very rapid freezing (cryogenic freezing) of fish products. The rate of freezing obtained with cryogenic methods is much greater than that obtained with air blast or plate freezing and is only moderately greater than that obtained with fluidized bed or liquid immersion freezing. For e.g. shrimp freezes in about 9 min in a commercial liquid nitrogen freezer and in about 12 min in a fluidized bed freezer. Thaw exudates and damage to texture are very low in cryogenically frozen fish products. But liquid nitrogen freezers are not commercially used in India because of the high operation costs.

Thermal processing

Thermal processing (canning) involves several heating processes such as cooking, blanching, pasteurization and sterilization. The objective of thermal processing is to inactivate or destroy the microorganisms and the enzymes. At the same time, maximum retention of nutrients is also very important. In preliminary cooking and also in sterilization it is observed that high temperature and short time process favour nutrient retention without sacrificing the rate of destruction of microbial spores. The major problem is the retention of some of the heat resistant enzymes by this method.

Another area, which has undergone significant changes, is the thermal processing equipment or retorts. The still retort is the oldest type of equipment used in sterilization or thermal processing. In conventional system, the method consists of loading crates of containers into the retort, closing it and heating with steam. Improvement in the systems have centered on the mechanics of handling the containers. The recent development is the introduction

of a “crate less” container handling system. Continuous retorts have distinct advantages over batch type retorts like greater production rate, lower labour cost and higher rate of heat transfer. At least four types of continuous retort systems that use steam as heat transfer medium are in use.

Aseptic processing is another method of thermal processing but it is not applicable for fish products. Another area, which has undergone considerable transformation, is the development of new containers. Different types of materials are used now for making containers for canning. The main materials used are glass, tin plate, steel, aluminum and metal foils laminated with plastics. Cans made into different styles from metals like beaded cans, cemented side seam cans, two piece cans, drawn and wall ironed cans, drawn and redrawn cans and necked in cans are available. Easy open end cans and retortable pouches are recently introduced and have become very popular

Radiation preservation

A recent development in preservation of fish and fish products is the application of radiation. Radiation is applied to frozen fish products to reduce the microbial load. Other potential applications of radiation in fish processing technology are:

1. Sterilization of fish products in hermetically sealed containers.
2. Extension of shelf life of fish products distributed and stored at refrigerated temperature.
3. Treatment of water, sewage and fish processing wastes.

Major drawback in the application of irradiation to fish products are the

possibility of development of impaired flavour, texture and appearance. The development of off flavour in fish can be controlled by regulating the dose and applying radiation in the frozen state to the products.

Curing and Drying

Cured and dried fish represents fish products with low water activity. The water activity of fish products is reduced by drying, salting or salting and drying. The conventional method of drying is exposing fish with or without salting to sun by spreading over sand. Since this causes heavy contamination many a times, modifications have been made in sun drying to reduce contamination. Solar tent drying, drying on platforms or rack drying are the results of such attempts. By using the modified methods, the quality can be improved substantially by reducing contamination.

The above methods of drying cannot be used in adverse weather conditions. Mechanical driers have been developed to overcome this. When the quantity of fish to be dried is small or seasonal, batch driers are used. Kiln drier and cabinet or tray driers represent the important types of batch drying equipment. The modification in the batch type driers is the continuous hot air driers. They are operated by passing the material on a conveyor belt with co-current or counter current hot air flow. Other important types of driers are rotary driers, drum driers spray driers and osmotic driers. Though these driers are of not much use in drying of fish products, hydrolysed products can be dried using them.

Freeze dried products

Freeze dried fish products are prepared

by freezing the product and subliming the ice under low pressure. The structural changes in this type of drying are minimum and flavour is retained to the maximum. There are different types of freeze driers. Some of the important types are tray freeze drier, continuous belt freeze drier, continuous circular plate freeze drier and fluidized bed freeze driers. Extensive work in the field of freeze-drying is still underway and modified freeze-drying processes continuously appear in literature. Some of the process modifications include improved heat transfer using some vibrations and beds of alternate product layer and desiccant layer.

Smoked products

Smoking of fish products like curing is a very old method of preservation. In addition to preservation, smoke imparts a particular flavour to the product. Studies have revealed the various components present in smoke and their nature of action. The major smoke components include acids, phenols, carbonyls, alcohols and hydrocarbons.

Colour imparted to the fish by smoking is due to carbonyl amino reactions of the Maillard type. Appearance and texture of the smoked product are largely affected by the quality of raw material and process parameters. However, some smoke components such as formaldehyde have a toughening effect on the muscle protein. Phenols play an important role in the desirable characteristic flavour of smoked fish. Shelf life extension of smoked fish is due to a combination of lowered water activity and by the uptake of bactericidal and antioxidant components of wood smoke.

Carcinogenic substances like polynuclear aromatic hydrocarbons are deposited during smoking. The important among them is benzo-A-pyrene and it has been detected at low levels in smoked products. By process control, the quality of the smoked product can be improved considerably. Modifications have been made in the traditional smoke kiln. Sophisticated mechanical smoke kilns are now available.

Fish Products of Commerce

A large number of value added and diversified marine products both for export and internal market based on shrimp, lobster, squid, cuttlefish, bivalves, certain species of fish and minced fish have been identified. A brief description of such products is given below.

Individually quick frozen, products

Radical changes have taken place in the freezing of fish and fishery products over the years. An important improvement in freezing prawns is the shift from the conventional block frozen to the individually quick frozen products (IQF). With advent and spread of aquaculture for shrimp, in particular, individual quick-freezing has become very popular. Farmed prawn has the advantage of harvesting at a predetermined period and hence can be frozen in very fresh condition. Because of this, most of the farmed prawns are frozen as whole IQF. Lobsters, squid, cuttlefish and different varieties of finfish are also processed in the individually quick frozen style.

IQF products fetch better price than conventional block frozen products. The products have to be packed in attractive moisture proof containers and stored at

-30°C or below without fluctuation in storage temperature. Thermoform moulded trays have become accepted containers for IQF products. Some of the IQF products in demand are prawns in different forms such as whole, peeled and de-veined, cooked, headless shell-on, butterfly fan tail and round tail-on; whole cooked lobster, lobster tails and lobster meat; cuttlefish fillets, squid tubes and squid rings; boiled clam meat and skinless and boneless fillets of white lean fish.

Battered and breaded products

Battered and breaded products are those, which are coated with another foodstuff. In general, there are two types of coating viz batter and crumb. Regular shaped fish products such as fish sticks or fingers, mussels and minced fish products are used for production of battered and breaded products. These products packed in consumer packs after freezing are sold through super markets as ready to fry items. Such fried products find good acceptance in fast food outlets. Fish and prawn cutlets also can be classified under battered and breaded products.

Ready to serve fish products in retortable pouch

Ready to serve fish products viz. curry products, in retortable pouches are a recent innovation in ready to serve fish products for local market. The most common retortable pouch consists of a 3 ply laminated material. Generally it is poly ester/aluminium/cast polypropylene. Some of the products are mackerel curry, rohu curry, sardine curry, tuna curry, pomfret curry, prawn curry, seer fish moilee, pearl spot moilee, fried mussel, fish sausage, prawn kurma, prawn Manchurian, fried mussel and mussel masala. These products have a shelf life of more than one year at room temperature. As there is increasing demand in national and international market for ready to serve products the retort pouch technology will have a good future. Coated products and fish mince and mince-based products are also becoming popular now.

Fish processing technology is a continuously changing area. Tremendous modifications have taken place in the recent past, which helped to produce wholesome products with very high retention of nutritional quality. These developments do not sacrifice the sensory characteristics of the products but enhance their acceptability.