

Packaging for Fresh and Processed Marine Products

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Fresh fish is one of the most perishable of all foods. The rate of spoilage doubles with every 5.5°C rise in temperature. Dehydration, onset of autolysis and microbial growth cause fresh fish to spoil rapidly. Fish is moved through the various stages of storage, auction, processing and distribution in a variety of containers, many of which are lacking in good hygienic standards. If the fish are of poor quality to start with, the quality loss will be even more pronounced. The best package cannot improve the quality of the contents. The function of fish containers in general and fish boxes in particular is to make possible efficient and economic handling of fresh fish from catch to the retail market. These containers should protect fish from undesirable influences such as crushing, spoilage, environment pollution and pilferage. They should facilitate storage, effective chilling, internal and long distance transport, easy determination of quantities and display in wholesale and retail markets. These requirements should be met at the lowest possible cost. There are at least four important factors to be reckoned with where transportation of fresh fish is concerned. They are i) Method of preservation of fresh fish ii) Mode of transport iii) Containers for packing iv) Organisational/socio-economic factors.

Packaging of fresh fish

In India, the physical flow of fish for domestic trade indicates that about 50% of the catches is consumed within a distance of 40 kms, another 45% within 200 kms and balance 5% beyond 200 kms from the coastal line. In general, about 87.5% of the catch is consumed within the State and interstate flow is only 12.5%. The mode of transport is by and large by road and rail (through water-ways in Kerala and Gujarat to some extent)

and within the State, road transport, though costlier, is resorted to by the fishing trade, generally for distances upto 200 kms. Rail transport is adopted for smaller consignments and for long interstate distribution. Open lorries covered with tarpaulin and insulated/refrigerated trucks are used for longer distances while hand carts, bicycles, tempo vans etc. are used for short distance transport. While the fish sent by rail wagons are properly packed, in road transport, fish is despatched either in packed or unpacked condition. There is no fixed ratio of ice to fish used which varies according to the availability, cost and transit time. For shorter time intervals of 4 hours or less, no icing is done. Packaging of fresh, iced fish is probably the most neglected area under existing conditions in the country even though it calls for maximum attention due to the highly perishable nature of the commodity. Baskets made of split bamboo and similar plant materials are invariably used for packing fresh iced fish. After packing, they are wrapped in gunny outside and stitched. However, they have certain drawbacks. They do not possess adequate mechanical strength and get deformed under stacking. Sharp edges of bamboo are also known to cause bruises on the skin of fish. The first development work on the improvement of efficiency of bamboo baskets was undertaken at CIFT in the early 60's by providing additional lining of polythene and gunny or water resistant kraft paper, thereby enhancing the shelf life of iced fish by 50-80%. The second hand tea chests, commonly used in Veraval region of Gujarat, were provided with 2.5 cm thick foamed polystyrene slabs (in polythene sleeving) inside to improve their insulation value. These containers were found to be extremely beneficial for transport of fish over long distances of upto 60 hours duration. For short distance transportation of iced fish involving a journey of less than 16 hours duration, non returnable cheap containers may be used and for distances involving duration beyond 16 hours (upto 60 hours) insulated plywood boxes with 25 mm foamed polystyrene may be used. For long distance transport, packing the fish in the frozen state (at -18°C) in insulated plywood boxes is recommended so that at the receiving end they are received in thawed condition. A recent development at CIFT related to the packaging of iced fish is the development of an insulated corrugated plastic container which is the lightest of all packages available in the country for iced fish

transport. A package for holding 30 kgs of iced fish weighs less than 2 kgs and keeps chilled fish fresh for 60 hours. It is reusable for 5 trips and being of collapsible design and light weight, return of empty containers is very cheap.

Packaging of frozen seafoods

In recent times, seafood industry has emerged as one of the most important export oriented industries in India. India exports ninety varieties of seafood products to forty five countries all over the world, with Japan, USA and W. Europe sharing 95% of the total seafood exports. From among the variety of seafoods exported, frozen shrimps dominate the trade and account for about 72.75% of the total exports in terms of value. A suitable frozen fish package must be able to meet the following requirements:

1. Reduction in moisture loss, oxidation and change of odour and flavour.
2. Retention of volatile flavours
3. Flexibility to fit the contour of the food
4. Resistance to puncture, brittleness and deterioration at low temperature
5. Ease of filling

The conventional system of processing shrimps is to freeze in plate freezer in blocks of 2 kg or 5 lbs. These blocks of frozen shrimps are packed and exported to international markets as institutional packs. Most often, these frozen blocks are thawed out at the importer's end, reprocessed and packed in consumer packs. Paper board (duplex board) carton is the most important primary package used in the export of frozen seafoods. These cartons are given a wax coating to protect the contents from loss of moisture. Frozen blocks weighing 2 kg (usually) are packed in such cartons lined inside with 100/125 gauge low density polythene. Ten such cartons are in turn packed in 5 ply corrugated fibre board box which serves as shipping container. They are strapped with 12 mm wide high density polythene or polypropylene or rayon straps. The following specification has been recommended by CIFT for the packaging of frozen shrimp for export.

The quality requirements of the film when used as closely wrapping liner are indicated below:

Low Density Polyethylene (LDPE) - 100 gauge (0.025 mm)

High molecular weight high density polythene (HM-HDPE) - 60 gauge (0.015 mm)

Linear Low Density Polyethylene (LLDPE) - 60 gauge (0.015 mm)

When bags are used they should be made from one of the following films:

LDPE - 200 gauge (0.05 mm)

HM-HDPE - 120 gauge (0.03 mm)

LLDPE - 120 gauge (0.03 mm)

Overall migration of chemical constituents should be less than 50 mg/litre.

Unit Carton

It should be made from solid, white duplex board of chemical wood pulp and should be coated with wax on both sides. Low density polythene (20 gsm) can also be used for coating. The dimensions of the unit carton should suit the frozen product of 2 or 2.3 kg (net weight). There are no standards for duplex cartons for frozen shrimp for export. However, the minimum requirements are:

Grammage	:	300 gsm
Caliper	:	0.4 ± 0.02 mm
Wax content	:	10 gsm on each side

or

Polythene coating	:	20 gsm on each side
Ring stiffness	:	270 N
Bursting strength	:	400 Kpa
Cobb 30' Value	:	10 (max.)

For the purpose of inspection, the label indicating the code number and size grade has to be placed inside the carton. The code slip that is being used by the industry these days is made up of paper varying in thickness from 0.07 mm to 0.215 mm. Recently, complaints have been received from importers for re-processing and the mutilated fragments are estimated as filth. CIFT has developed a code slip based on 150 gauge polyester tracing sheet. This code slip is non mutilable and all the existing printing/writing done on the paper code slip can be done on the polyester tracing sheet code slip also.

Master Carton

The master cartons are generally made from corrugated fibre board. Bureau of Indian Standards has specified quality requirements of master carton (IS: 6715-1972). For 5 ply corrugated fibre board cartons, the following specifications are recommended by CIFT to hold 20-30 kg frozen shrimp for export -

Bursting strength	- 12 kg/cm ² (1200 Kpa)
Water proofness (Cobb 30' value)	- 120 (max.)
Wax coating on each side	- 20 gsm (minimum)
Grammage of liners & corrugating medium	- 140 ⁵ gsm
Type of flute	- A, B, C or any combination of these
Puncture resistance	- 200 beach units
Compression strength	- 350 kg (minimum)

The cartons used presently by the industry are almost cubical in shape (355 mm x 330 mm x 285 mm). The use of near-cubical corrugated box leads to instability in stacking. A corrugated fibre board carton holding 12 instead of 10 inner cartons would lead to a box of rectangular cross

section and result in better stacking. CIFT has worked out the design of a corrugated fibre board box to hold 12 nos. of unit cartons.

The growing trend is towards IQF shrimps in consumer packs. As the demand for shrimps in other countries is ever increasing, the time is ripe for the Indian exporters to add value to their product by processing shrimp as IQF product and packing in consumer packages rather than resorting to block freezing. Unlike in the case of block frozen shrimps, the IQF product presented to the consumer may not undergo processing or cooking at the time of serving; therefore it is very important that the product packed should be of very high quality and the package selected should be such that it retains the quality of the product till it reaches the consumer. Modern methods of processing and packaging should be incorporated for the value added products to enhance the consumer appeal so that the product can be competitive in the international markets. The major markets for IQF shrimps are Spain, Italy, U.K., U.S.A. and France.

In case of IQF shrimps the product is placed in the primary container/ pack along with the code slip and weighed. After weighing, the primary pack is closed and further packed in master carton for storage and transportation. The packaging systems are not standardised and vary from exporter to exporter. In general, the packaging system followed by the exporters is to pack the product in plastic film pouches (monofilms or co-extruded films) which may be printed or unprinted. At times, when printed, they are for the brand of the importer. The plastic bags are closed by heat sealing. The unit pouches (capacities of 500 g, 1 kg, 2 kg, 4 kg etc) may be either provided with unit/intermediate cartons or directly placed in master cartons. The unit/intermediate cartons are made from duplex board or 3 ply corrugated fibre board.

For IQF packaging, there are several limitations for the use of wax coating on the duplex board. In view of the relatively inferior quality of our duplex board, the use of poly-coated cartons can be of very great help functionally and enhances the aesthetic value of the pack. When lamination is given to the print surface, it will brighten the colours

appreciably and enhance the sales appeal of the package as a whole. Besides, there are many advantages in such a lamination as it prevents moisture affecting the board, etc. The most functional cost effective film will be a 10 micron Biaxially oriented polypropylene film. Care should be taken in selecting the right adhesive as well as curing process; otherwise there is a great risk of the laminate coming off, resulting in a poor pack. Some retail outlets in certain countries may also object to film lamination for ecological reasons, since the carton cannot be recycled into pulp without removing the film. In such cases the only alternative will be to use a moisture resistant varnish.

Two functional requirements of packing IQF shrimp are worth noting. IQF shrimps are less well protected than the glazed block frozen shrimp against dehydration on storage and oxidative rancidity. Therefore, good quality barrier material is needed in the form of sealed bag as the primary pack for IQF shrimp. The transit package must have good compression strength to bear weight without damage to the product. Compression strength should therefore be an item of specification for the transit package. A compression strength of 500 kg has been suggested as specification which might give reasonable safety.

CIFT has developed flexible packaging material for IQF shrimp based on 12 micron plain polyester laminated with 250 gauge low density polythene laminate for consumer packs to hold 100 to 200 g of the IQF product.

Packaging for dried fishery products

One fifth of India's fish catch is salted and dried for future consumption in the country and for export to our neighbouring countries. The packaging employed for this product is highly unsatisfactory, leaving much to be done, from the scientific and hygienic points of view. Baskets with braided coconut fibres or palmyrah leaves are the containers exclusively used for packing this product both for export and internal distribution. An overwrap with gunny fabric is given as reinforcement in the case of products meant for export and those which have to be transported over long distances inside

the country. These packages are however prone to easy entry of insects, rodents and other similar pests. The product is highly sensitive to changes *in relative humidity of the atmosphere and hence the packaging has to be sufficiently water vapour proof.*

Polyester-polythene laminated pouches have been found to be highly suitable for hygienic retail packaging of cured fish products. Gussetted type poly-lined gunny or HDPE woven sacks which can hold 50 kg of the dried fish have been found to possess good stackability, attractive and hygienic appearance and good acceptability.

Accelerated freeze dried prawns are in good demand *due to their superior quality in spite of higher cost of production.* AFD products weigh only 1/5th of fresh fish. The moisture content is generally below 2%. Hence, such dried material has to be packed in inert gas so as to exclude air and oxygen. *The packaging materials must have low oxygen and water vapour transmission rate in order to protect the materials from acidity and absorption of water.* Paper/aluminium foil/polythene laminates or metallised polyester laminated with polythene pouches are used for packing AFD products. In some cases, metal containers like tin cans have to be used as a protection against shock as the material is very brittle.

Packaging for heat-processed fish products

A suitable canned fish package should be hermetically sealable, thermally conductive and inexpensive without affecting the odour, flavour, texture, colour and food value of the contents. Sulphur resistant lacquered cans are generally used for fish products. Aluminium sheet is produced indigenously and cans made out of it work out to be cheaper than tin cans. Even though an imported aluminium can processing line was installed in a factory at Cochin in the 80s for demonstration purposes, somehow or the other it did not attract the private entrepreneurs so far and the technology still remains to be applied commercially in the country.

The main drawback of tin cans in our country is that the entire tin plate has to be imported at high cost. *Due to this reason, there is an imperative need to use aluminium can as an alternative packaging material*

for canning. Work carried out at CIFT revealed that the aluminium can indigenously developed is quite good for heat processed fish and fish based products. The other alternative packaging used for canning is the flexible packaging material. It is perhaps the most significant advancement in fish packaging since the development of the can and is made from a laminate of three materials viz. an outer layer of polyester or nylon for strength, a middle layer of aluminium foil as moisture, light and gas barrier and an inner layer of cast polypropylene as the heat seal and food contact material. It offers many advantages over conventional canned and frozen food packages to the food processor, distributor, retailer and consumer. Because of the high cost of the rigid cans, with the consequent breakdown of the canning industry, this new cheaper technology offer good potentialities for rapid development with the timely support of financing agencies. Studies carried out at CIFT reveal that fish packed in retortable pouches are highly acceptable to consumers in place of metal cans.

Currently, CIFT is undertaking extensive studies on the infrastructure of the packaging industries of India with a view to studying the feasibility of producing retortable pouches out of purely indigenous materials.

Packaging for fish based convenience foods

Frozen shrimp being the product of choice in the export markets, both fishing and processing industries became polarised towards catching, freezing and exporting of shrimp as its most engaging activity. The result was that nearly 90% of the fish catches of the country received an indifferent attitude from the industrialists. But, now a point of saturation/stagnation has been reached in the catches of prawns which remained stationary for the past several years. Nevertheless, the industry has been compelled to resort to diversification both from the point of view of catching and processing for its very survival. On the processing/preservation side, technologies have been developed for preparing several fish based convenience foods making use of many varieties of cheaper fishes which command less demand in the fresh fish markets. Different types of packaging materials developed at this Institute for such products are briefly discussed below.

1. Packaging for fish pickles

Prawn, mussel, seer and tuna meat pickles are some of the pickles which have become very popular not only inside the country but also outside, in nations like the middle east countries where conglomerations of Indian population are present. The conventional container for packing fish pickle is glass bottles which possess several plus points like rigidity, inertness, non-toxicity, durability and non-permeability to gases and moisture. But the disadvantages with glass containers are heaviness, brittleness, voluminous nature and high cost. Losses due to breakage during transportation are high. Glass containers with closures cost about 25-30% of the total cost of production of fish based pickles. CIFT has identified flexible packaging materials based on plain polyester laminated with LDPE-HDPE co-extruded film or nylon/surlyn or LD/BA/Nylon/BA/Primacore. In these flexible packaging materials, pickles can be kept for a period of 7 to 8 months at ambient temperature. The above packaging materials do not have any deleterious effect on the products and can be attractively fabricated as stand up packs with all details printed and hence can advantageously replace the conventional glass bottles. Flexible packaging materials are found to be cheaper than glass.

2. Packaging for frozen fish curry

One method of long term preservation of fish curries is to seal them in cans and heat process as in the usual canning process. The materials packed in cans and stored at room temperature showed slight metallic taste and softening of the meat pieces. Fish curry packed in polystyrene or polyvinyl chloride thermoformed containers and stored at $-20 \pm 2^{\circ}\text{C}$ had a shelf life of 26 weeks.

3. Packaging for fish soup powder

Fish soup powder contains partially hydrolysed proteins, carbohydrates, fat and several seasoning compounds including salt and is hygroscopic in nature. Proper packaging of this product assumes great importance in view of its hygroscopic character. Work in CIFT has revealed 12 micron plain polyester laminated with LDPE-HDPE co-extruded film

or 90-100 micron LD/BA/Nylon/BA/Primacore multilayer film to be suitable for long term storage of soup powder for upto 180 days.

4. Packaging for battered and breaded products

The most important class of value added marine products is battered and breaded products. Some of the products developed at this Institute are (a) battered and breaded peeled prawns (b) battered and breaded shrimp-fan tail (butterfly) (c) battered and breaded shrimp round tail (d) squid rings (e) stuffed squid.

From minced fish, products like (a) fish fingers (b) fish cutlets and (c) fish patties (burgers) can be prepared.

Conventional packaging materials like flexible plastic films alone are not suitable for these products as they provide little mechanical protection to the products and as a result the products get damaged or broken during handling and transportation. The thermoformed trays produced from food grade materials like polyvinyl chloride or high impact polystyrene are suitable for the packaging of battered and breaded products. For export, especially to European and U.S. markets where merchandising is mainly through super markets and departmental stores, thermoformed trays will prove beneficial. The trays are required for self service merchandising systems and constitute unit packs and the buyers in these countries are used to them.

5. Packaging for dry fish pickle

Fish pickles generally have high content of liquid gravy and so packing presents difficulty. Dry pickle having no liquid gravy will be more suitable for packing, transport and distribution. Fishes like anchoviella and white sardine (*Kowala coval*) are being dried and marketed. These fishes, if converted into dry pickle, will bring better returns. Nylon/Surylyn or LD/BA/Nylon BA/Primacore multilayer film were found to be ideal packaging materials for long storage upto 13 months at ambient temperature.