Chapter 14

Packaging of fish and fish products

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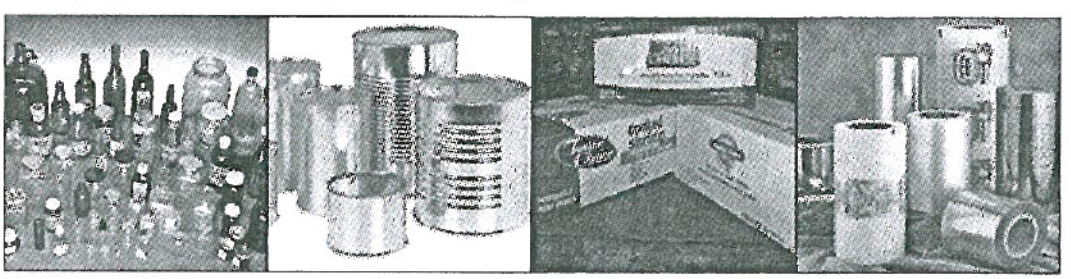
Food packaging like any other packaging is an external means of preservation of food during storage, transportation and distribution and has to be provided at the manufacturing/ production centre. Hence it forms an integral part of the product manufacture/production and has an important function in the distribution of foodstuffs. In today's consumer oriented economy, a package is an extremely vital link between the manufacturer of the product and the ultimate user. There is a great awareness among the consumers today regarding their right to obtain proper quality and a correct quantity of the product at a fair price in an aesthetic and hygienic package.

Unlike many other manufactured consumer products like leather, machineries, chemicals etc. the packaging needs of food and food products, and particularly fish, are very complex because of the intrinsic characteristics and the need to retain or preserve them while in the package.

Packaging materials widely used for food products are:



Glass containers | Metal cans | Paper products | Flexible films

Glass containers

Glass containers have been used for many centuries and still are one of the important paking material in food packaging. Glass is made from limestone, sand, soda ash and alumina. Physically it is a super cooled liquid of very high viscosity. Chemically it is a mixture of inorganic oxides.

Due to its certain properties, glass has its unique place in food packaging. It is strong, rigid and chemically inert. It does not appreciably deteriorate with age and is an excellent barrier to solids, liquids and gases, and gives excellent protection against odour and flavor contamination. The transparency of glass provides product visibility. Glass can also be moulded to variety of shapes and sizes. But it has the disadvantages like fragility, photo oxidation, heavier in weight etc. Glass containers include bottles, jars, tumblers and jugs.

Metal cans

Cans are traditionally used for heat sterilized products. Today there are several choices available: standard tin plate, light weight tin plate, double reduced tin plate, tin free steel and vacuum deposited aluminium on steel and aluminium. For food products packing they are coated inside to get desirable properties like acid resistance and sulphur resistance. But care has to be taken to avoid tainting of the lacquer. Metal cans are advantageous as packages because of superior strength, high speed manufacturing and easy filling and dosing. Disadvantages of metal cans are weight, difficulty in reclosing and disposal.

Paper

A very considerable portion of packaged foods is stored and distributed in packages made out of paper or paper based materials. Because of its low cost, easy availability and versatility, paper is likely to retain its predominant position in packaging industries. Paper is highly permeable to gases, vapours and moisture and loses its strength when wet. Ordinary paper is not grease and oil resistant, but can be made resistant by mechanical processes during manufacturing.

Paper board

Thicker paper is called as paper board. There is not a clear cut dividing line between the heaviest grade of paper and the lightest board. Moreover the lightest standard board is 0.19 mm thick and heavy papers are of 0.125 mm thickness. Paper boards are used for carton making.

Cellophanes

Cellophane was the first commercial film. Cellophane is manufactured from highly purified cellulose derived from bleached sulfite pulp. By incorporating various coatings and modifications, over 100 different grades of cellophane are available now.

Low Density Polyethylene (LDPE)

Most commonly used as it possesses qualities such as transparency, water vapour

impermeability, heat sealability, chemical inertness and low cost of production. Organic vapours, oxygen and carbon dioxide permeabilities are high and has poor grease barrier property. It resists temperature between –40°C to 85°C. Polyethylene (polythene, PE) is the material consumed in the largest quantity by the packaging industry.

High Density Polythene (HDPE)

HDPE resins are produced by low-pressure process. The density of the material is around 0.95 g/cm^3. HDPE possesses a much more linear structure than LDPE and has up to 90% crystallinity, compared with LDPE which exhibits crystallinities as low as 50%. It is stronger, thicker, less flexible and more brittle than low density polythene and has lower permeability to gases and moisture. It has a higher softening temperature (121°C) and can therefore be heat sterilized. High molecular weight high density polythene (HM-HDPE) has very good mechanical strength, less creep and better environmental stress crack resistance property.

Linear Low Density Polythene (LLDPE)

Linear low density polythene is low density polythene produced by a low pressure process. Normal low density polythene has many -C_5H_{11} side chains. These are absent in LLDPE, allowing the molecules to pack closer together to give a very tough resin. It is virtually free of long chain branches but does contain numerous short side chains. Generally the advantages of LLDPE over LDPE are improved chemical resistance, improved performance at both low and high temperatures, higher surface gloss, higher strength at a given density and a greater resistance to environmental stress cracking. LLDPE shows improved puncture resistance and tear strength. The superior properties of LLDPE have led to its use in new applications for polyethylene as well as the replacement of LDPE and HDPE in some areas.

Polypropylene

Polypropylene (PP) is produced by the polymerisation of propylene. All PP films have permeability about ¼ to ½ that of polyethylene. It is stronger, rigid and lighter than polyethylene.

Cast PP: It is extruded, non-oriented film and is characterized by good stiffness, grease and heat resistance and also has good moisture barrier. However, it is not a good gas barrier.

Oriented, Heat set (OPP): Orientation can be in one direction (unbalanced) or in two directions equally (balanced). The resulting film is characterized by good low temperature durability, high stiffness and excellent moisture vapour transmission rate. One drawback of OPP is its low tensile strength.

Coated PP: These newer types of PP are available as heat seal coated or saran (PVDC) coated. They are used when moisture and gas protection is necessary.

Composite PP: This has outer polyethylene plies around PP core. This material can be readily heat-sealed.

Practically all these materials have been in use for packaging different products providing satisfactory services. However, plastics which have a relatively recent origin, while offering several advantages over other packaging materials, have been presenting several problems as well for food products. Some of the chemical adjuvants used in the manufacture of plastic materials may be toxic in nature and may get transferred to the food when the package is in contact with the food material. However, plastics have the advantage that most of them possess excellent physical properties such as strength and toughness. They are light in weight and flexible, and also resistant to cracking. A wide range of polymers are now available for conversion into diverse type of plastic packaging materials. However, the requirements with a particular food may not be met with a simple material, as it may not possess all the desired properties. In such cases copolymers or laminates consisting of two or more layers of different polymers having different properties can be used.

Polystyrene

Polystyrene is manufactured from ethylene and benzene, which are cheap. The polymer is normally atactic and is thus completely amorphous because the bulky nature of the benzene rings prevents a close approach of the chains. While offering a reasonably good barrier to gases, it is a poor barrier to water vapour. New applications of polystyrene involve co-extrusion with barrier resins such as EVOH and Poly Vinylidene Chloride copolymer to produce thermoformed, wide mouthed containers for shelf stable food products and multi layer blow moulded bottles. To overcome the brittleness of polystyrene, synthetic rubbers can be incorporated at levels generally not exceeding 14% w/w. High impact polystyrene is an excellent material for thermoforming. Co-polymerisation with other polymers like acrylonitrile butadene improves the flexibility. It is used as a breathing film for packaging fresh produce. Since it is crystal clear and sparkling, it is used in blister packs and display cover. These materials have low heat sealability and often tend to stick to the jaws of heat sealer. Both impulse and adhesive sealings are satisfactory.

Polyester

Polyester can be produced by reacting ethylene glycol with terephthalic acid. Polyester film's outstanding properties as a food packaging material are its great tensile strength, low gas permeability, excellent chemical resistance, light weight, elasticity and stability over a wide range of temperature (-60° to 220°C). The later property has led to the use of PET for boil in the bag products which are frozen before use and as over bags where they are able to withstand cooking temperatures without decomposing.

Although many films can be metallized, polyester is the most commonly used one. Metallization results in a considerable improvement in barrier properties. Reduction in water vapour transmission rates by a factor of 40 and oxygen permeabilities by over 300 is normally obtained. A fast growing application for polyester is oven compatible trays for frozen food and prepared meals. They are preferable to foil trays for these applications because of their ability to be micro waved without the necessity for an outer board carton.

Polyamides (Nylon)

Polyamides are condensation products of diacids and diamine. The first polyamide produced was Nylon-6,6 made from adipic acid and hexamethylene diamine. Various grades of nylons are available. Nylon-6 is easy to handle and is abrasion-resistant. Nylon-11 and nylon-12 have superior barrier properties against oxygen and water and have lower heat seal temperatures. However, nylon-6,6 has a high melting point and hence, it is difficult to heat seal. Nylons are strong, tough, highly crystalline materials with high melting and softening points. High abrasion resistance and low gas permeability are other characteristic properties.

Polyvinyl Chloride (PVC)

The monomer is made by the addition of reaction between Acetylene and Hydrochloric acid. It must be plasticised to obtain the required flexibility and durability. Films with excellent gloss and transparency can be obtained provided that the correct stabilizer and plasticizer are used. Thin plasticized PVC film is widely used in supermarkets for the stretch wrapping of trays containing fresh red meat and produce. The relatively high water vapour transmission rate of PVC prevents condensation on the inside of the film. Oriented films are used for shrink-wrapping of produce and fresh meat. Unplasticized PVC as a rigid sheet material is thermoformed to produce a wide range of inserts from chocolate boxes to biscuit trays. Unplasticized PVC bottles have better clarity, oil resistance and barrier properties than those made from polyethylene. They have made extensive penetration into the market for a wide range of foods including fruit juices and edible oils.

Ionomers

If polythenes are made with co-polymerised acid groups they may be cross linked with zinc or sodium ions. The resulting resins marketed as Surlyn A displays excellent sealing property even when contaminated with fats and oils. It has low temperature resistance and hot-tack strength. Similarly ethylene-acrylic acid copolymers (primacor) are claimed to give high strength seals and good adhesion to other substrates.

Copolymers

When polythene resins are being manufactured, it is possible to mix other monomers with ethylene so that these are incorporated in the polymer molecules. These inclusions alter the characteristics of the polythene. Vinyl acetate is commonly used and the resulting ethylene vinyl acetate (EVA) copolymers display better sealing than modified polythene. Butyl acetate is incorporated with similar effects.

Aluminium foil

Aluminium foil is defined as a solid sheet section rolled to a thickness less than 0.006 inches. Aluminium has excellent properties like relectivity, emissivity, thermal conductivity, light weight, corrosion resistance, workability, grease and oil resistance, tastelessness and

odourlessness, heat and flame resistance, opacity and non-toxicity. Aluminium foil free from defects is a perfect moisture and oxygen barrier. In all flexible packaging applications using aluminium foil where good moisture and oxygen barrier properties are important, the foil is almost always combined with heat sealing media such as polythene or polypropylene. It is the cheapest material to use for the properties obtained. Foils of thickness 8 to 40 microns are generally used in food packaging. Foil as such is soft and susceptible for creasing. Hence, foil is generally used as an inner layer.

Packaging of fresh fish

Fresh fish is one of the most perishable of all foods. More than 20% of the fresh fish caught in many tropical and sub-tropical areas is wasted, with a large chunk lost in quality and value, occurring between harvest and fresh sale. Fish after catch will remain fresh only for a limited period of 4-6 hours, depending on the environmental conditions and the intrinsic nature of the fish. Chilling by mixing fish with ice is the cheapest and most efficient method of minimizing such wastage. Fish sold immediately in local markets may not need any special packaging. But a proper packaging to ensure better shelf life becomes essential when it has to be transported to distant localities for disposal. A suitable package for fresh fish should have the following properties:

- Provide a barrier against oxygen to reduce fat oxidation
- Keep the fish moist and prevent dehydration
- Retard chemical and bacterial spoilage
- Prevent permeation of external odours

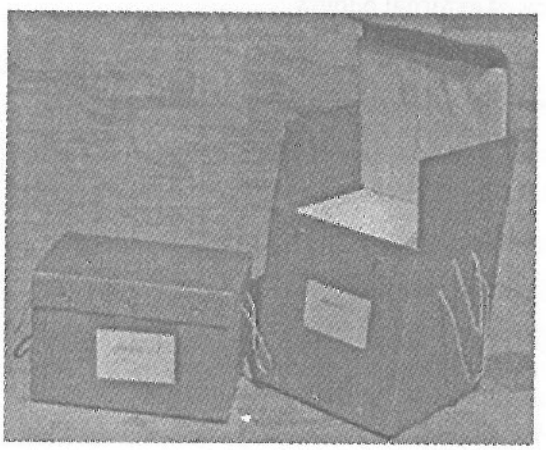
For bulk packaging

- The container should be sturdy enough to withstand the rigours of transit and travel by different modes
- Should be of light weight, hygienic and easily cleanable
- Should possess good insulation properties
- Should have good barrier properties
- Should be returnable or non-returnable on economic considerations

In India baskets made of split bamboo and similar plant materials are traditionally used for packing fresh iced fish. After packing they are wrapped in gunny outside and sewed. However, they do not possess adequate mechanical strength and get deformed under stacking. The porous surface of these containers tends to absorb water and accumulate slime, creating an ideal breeding ground for spoilage bacteria, which can contaminate fish held in them. Used tea chests provided with 2.5 cm thick foamed polystyrene (in polythene sleeving) slabs inside have been found extremely beneficial for transport of fish over long distances up to 60 hours duration. Materials such as aluminium, steel and fibreglass are

also used in the construction of insulated containers. Contamination of insulation layer with water drastically reduces insulation properties of the medium. A recent development is an insulated corrugated plastic container, which is the lightest of all packages available in the country for iced fish transport. It lasts for five trips and being of collapsible design and light weight, return of empty container is very easy. For cycle hawkers U shaped box (100 kg capacity) made of high molecular weight high density polythene is found ideal. Modern insulated containers are made of HDPE or polypropylene with polyurethane insulation sandwiched between the inner and outer walls of the double walled containers. They are durable and in normal use have a life span of over five years.

Modern insulated containers



Corrugated polypropylene box developed by CIFT for carrying fish on board.

Modified Atmosphere Packaging

Fresh fish is highly susceptible to spoilage from post mortem autolysis and microbial growth. The high ambient temperature of our country favours rapid growth of

microorganisms. Presently ice and mechanical refrigeration are the most common means of retarding microbial and biochemical spoilage in freshly caught seafood during distribution and marketing. However, as ice melts it tends to contaminate fish accelerating spoilage and reduces shelf life. Modified atmosphere packaging, a technologically viable method has been developed as a supplement to ice or mechanical refrigeration to reduce the losses and extend the storage life of fresh seafood products.

In modified atmosphere packaging air is replaced with different gas mixtures to regulate microbial activity and/or retard discolouration of the products. The proportion of each component gas is fixed when the mixture is introduced into the package; however, no control is exercised during storage. The composition of the gas mixture changes from its initial composition as a result of chemical, enzymatic and microbial activity of the product during storage. It is primarily the enrichment of Carbon dioxide in the storage atmosphere as a means of controlling microbial growth, which results in the extension of shelf life of products.

Carbon dioxide lowers the intra and extracellular pH of tissues and possibly that of microorganisms. Further it may affect the membrane potential of microorganisms and influence on the equilibrium of decarboxylating enzymes of microorganisms. The gases normally employed are Carbon dioxide, mixtures of Carbon dioxide and nitrogen, Carbon dioxide and oxygen and Carbon dioxide, oxygen and nitrogen with the sole objective to extend the shelf life of the product beyond that obtained in conventional refrigerated storages. Inhibition by Carbon dioxide manifests in an increased lag phase and a slower rate of growth of microorganisms during logorathmic phase. Inhibition by Carbon dioxide was found to be more effective when the product was stored at the lowest range of refrigerated temperatures. Packaging materials generally employed for this purpose are flexible films of nylon/surylyn laminates, PVC moulded trays laminated with polythene, polyester/low density polythene film etc. The use of high barrier film along with MAP that contains CO_2 effectively inhibits bacterial growth during refrigerated storage of packaged fresh fishery products.

The composition of the gas mixtures used for MAP of fresh fish varies, depending upon whether the fish in the package is lean or oily fish. For lean fish, a ratio of 30% oxygen, 40% Carbon dioxide, 30% nitrogen is recommended. Higher values of Carbon dioxide are used for fatty and oily fish with a comparable reduction in level of oxygen in the mixture leading to 40-60% nitrogen. By excluding oxygen, the development of oxidative rancidity in fatty fish is slowed. On the other hand, oxygen can inhibit the growth of strictly anaerobic bacteria like *Clostridium botulinum* although there is a very wide variation in the sensitivity of anaerobes to oxygen. It is also seen that inclusion of only some oxygen with nitrogen or Carbon dioxide will not prevent botulism with absolute certainty.

Packaging of frozen fish

Frozen shrimp is an important marine product. Conventionally shrimp is frozen as blocks of 2 kg each in duplex board carton lined with low density polythene and 10 such

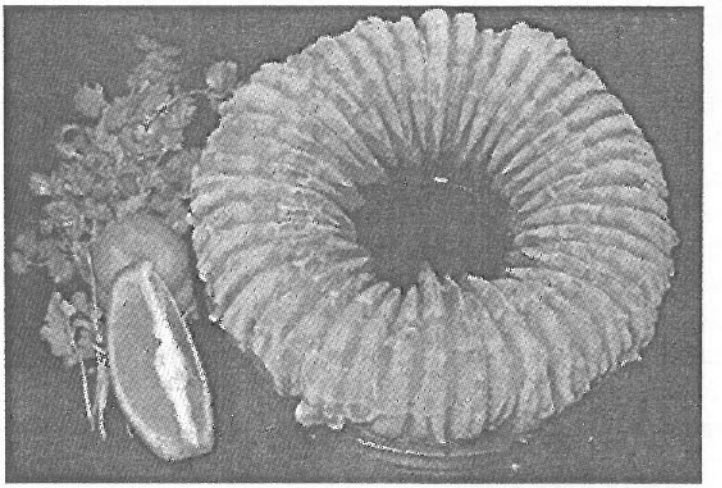
cartons are packed in a master carton made of 5 ply or 7 ply corrugated fibre board boxes. The shrimp is frozen with adequate glaze water and the frozen block is once again glazed in ice-cold water before final packing. As such the principal considerations in packaging requirement are adequate strength to withstand handling stress and strain and resistance to moisture.

There is great demand now, from the importing countries, for shrimp in individually quick frozen (IQF) form and in tune with this, modernization of the plant and machinery to process IQF shrimp is taking place at a rapid pace. IQF shrimp is a value added product as it fetches higher unit value compared to block frozen shrimp. Already a sizable portion of the shrimp is now processed in IQF form.

The packaging requirements of IQF shrimp vary considerably from those of block frozen shrimp. Greater demand for IQF shrimp is in consumer packs and not in bulk or institutional packs. In the case of block frozen shrimp, it being frozen with glaze and the block as such is once again glazed. The risks of moisture loss or oxidative reaction leading to flavour changes etc. are minimal. However, each shrimp in an IQF pack is remaining as a discrete piece which is vulnerable to several risks. Some of the essential characteristics desired out of a packaging material for IQF shrimp are:

1. Low water vapour transmission rate to reduce the risk of dehydration.
2. Low oxygen/gas permeability, thereby reducing the risk of oxidation and thus changes in odour and flavour, and retention of volatile flavours.
3. Flexibility to fix the contours of the food.
4. Resistance to puncture, brittleness and deterioration at low temperature and ease of filling.

IQF shrimp is filled in a primary container along with code slip and weighed. Instead of the code slip placed inside the pack along with shrimp, bar coding is nowadays adopted. After weighing, the primary pack is closed by heat sealing and further packed in master cartons for storage and transportation. In general the packaging system followed is to weigh the product into plastic film pouches (monofilm, co-extruded film or laminated pouches) of capacity varying from 500 g to 4 kg per pack depending upon agreement between the processor and purchaser. The unit pouches may be printed or not and may be provided with unit/intermediate cartons or directly packed in master cartons. The unit/intermediate cartons are made of duplex or 3 ply corrugated fibreboard. For IQF packaging there are several limitations in the use of wax coating on a duplex board and hence the preference is for corrugated fibreboard. However if and when duplex carton is used, in view of the relatively poor quality of the duplex board generally in use, it will be desirable to use laminated plastic film to the inside of the carton as well as to the surface print to improve the functional properties as well as aesthetic value of the pack. The most functionally effective film has been identified as 10 micron biaxially oriented polypropylene (BOPP).



IQF cooked shrimp packed in ring shaped thermoformed container.

One major functional requirement of shipping container/transit package for IQF shrimp is high compression strength to bear weight without damage to the product. It is very important that IQF shrimp should not be subjected to undue pressure during transit and storage. The stack weight should not increase pressure on the product in the cartons in the lower layers. This can be achieved only if master cartons do not yield to pressure and pass it on to the product inside. A compression strength of 500 kg is the minimum recommended specification which might give reasonable safety to the product. Cartons made of 5 or 7 ply corrugated fibre board satisfying the above requirements can be safely used.

Apart from shrimp in different styles, there are a few other products processed in IQF form for which similar packaging as discussed above can be used. The other major IQF products are cooked whole lobster, lobster tail, lobster meat, cuttle fish fillets, boiled clam meat and fish fillets from white lean fishes.

IQF shrimps in flexible films

Battered and Breaded Products

This forms an important class of value added products in convenience form. The battering and breading process increase the bulk of the product, thus reducing the cost element. A number of value added marine products both for export and internal markets can be prepared from shrimp, squids, cuttle fish, certain species of fish and minced meat from low priced fishes. The changes taking place during frozen storage of the value added products are desiccation, discoloration, development of rancidity etc. Application of proper packaging prevents/retards these changes and enhances shelf life. 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. Hence, thermoformed containers are commonly used for this purpose.

The thermoformed trays produced from food grade materials are suitable for the packaging of value added fishery products both for internal and export markets. Trays made of materials like PVC, HIP and HDPE are unaffected by low temperature of frozen storage and provide protection to the contents against dessication, oxidation etc. during prolonged storage.

Thermoformed trays used for packing value added fish products

Blanched breaded shrimp packed in thermoformed containers

Various value added battered and breaded fish products available in the market are battered and breaded peeled shrimp, battered and breaded shrimp, fantail (butterfly), battered and breaded shrimp round tail-on, battered and breaded squid rings, battered and breaded stuffed squid rings, battered and breaded stuffed squid, battered and breaded fish fillets, fish fingers, fish cutlets and fish patties (burgers).

Packaging of dried fishery products

The special function required of a suitable dried fish/product package are inertness, leak proofness, impermeability to oxygen and moisture and less transparent. Resistance to mechanical abrasion and puncture is another desired quality. One fifth of India's fish catch is salted and dried for internal consumption. The packaging employed is highly unsatisfactory leaving much to be desired from the scientific and hygienic points of view. Baskets improvised with braided coconut or palmirah leaves are the containers mainly used for packaging 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. These packages are however prone to easy entry of insects, rodents and other pests. The product being highly sensitive to changes in relative humidity, the packaging has to be sufficiently water vapour proof.

The bulk packaging materials commonly used in tropics are waxed corrugated cartons, deal wood or plywood boxes, bamboo baskets or gunny bags, dried palmirah or coconut palm leaves and multiwall paper sacks. Among different packaging materials studied, high density polythene woven gusseted bags laminated with 100 gauge low density polythene are found quite suitable for dried fish packaging. From the hygienic point of view HDPE is impervious to microbial and insect attack.

HDPE woven sack for bulk packaging of dry fish

The commonly used packaging materials for consumer packs of dry fish are low-density polythene or polypropylene. These materials are cheap, readily available and have good tearing and bursting strength. Disadvantages are high water vapour and gas transmission rate, proneness to puncture or damage from sharp spines and smell coming out. Shelf life is limited. Recent developments of cured fish packaging are the use of polyester polythene laminate pouches for consumer packaging.

Dry fish packed in consumer pack (laminated pouches)

Packaging of canned fish

A suitable canned fish package should be hermetically sealable, thermally conductive and inexpensive which should not affect the odour, flavour, texture, colour and food value of the contents. Sulphur resistant lacquered cans are generally used for fish products. Common materials used for manufacturing containers for fish products the world over are tinplate, aluminium and tin free steel (TFS). In India tin cans are traditional containers for canned fish and shell fish. Aluminium alloys are finding increasing use in can making in USA and UK. Over the years several improvements have been brought about in the can making technology including the can material. Many of these innovations are the results of searches for can materials which will be free of the major defects encountered with tinplate cans like corrosion and mechanical defects. Cans made of tin free steel, high tin fillet can, light tin coated steel can etc. have been experimented with, but the best promising alternative to tin plate has been considered as aluminium modified by alloying with magnesium, manganese etc. Aluminium offers several advantages over tin plate particularly owing to its light weight, corrosion resistance, easiness to open, recyclability of metal etc. The entire production of canned fish in India is at present in tin plate cans. However, almost the entire

quantity of the cans used for processing fish are made of imported tin plate. High cost of imported tin plate was one of the reasons for the collapse of the canned fish exports from India. Aluminium containers offer tremendous opportunities to take care of the packaging needs of food-based industries like canned fish. Indigenously developed aluminium can has been found quite good for heat processing fish and fish based products. The other developments include the introduction of drawn and wall ironed, drawn and redrawn, TFS, welded side seam cans. Another new material Litewel-N (LTW-N) is being marketed by a Japanese company for use in food and beverage cans.

Fish products in aluminium cans

Tuna in oil in TFS cans

Ready to serve fish products in retortable pouches

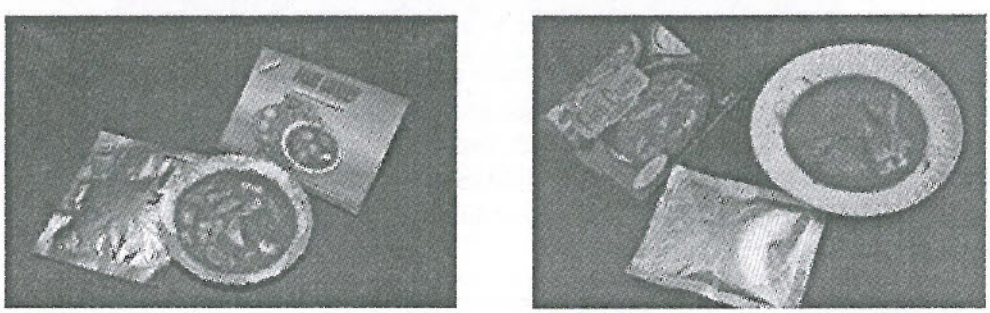
Retortable flexible containers are laminate structures that are thermally processed like a can, are shelf stable and have the convenience of frozen boil in the bag products. The material for flexible containers must provide superior barrier properties for a long shelf life, seal integrity, toughness and puncture resistance and must also withstand the rigors of thermal processing. Retortable flexible containers may be retort pouches or semi rigid containers.

The most common form of pouch consists of a three ply laminated material. Generally it is polyester/aluminium foil/cast polypropylene. The outer polyester film is 12 micron thick. It serves to protect the foil and to provide the laminate with strength and abrasion resistance. The core of aluminium foil is used to give the laminate the necessary water, gas, odour and light barrier properties. The foil thickness is normally 12 micron although 7, 9 and 15-micron foils are used. The primary function of the polypropylene inner ply is to provide the strong heat seals and good product resistance required in the retort pouch. The layer also helps to protect the foil and contributes to overall pack strength. The thickness of the cast polypropylene layer will depend to some extent on the nature of the product being packed. The three layers of the retortable material are combined by adhesive lamination.

Retort pouches with aluminium foil have the disadvantage of the product not being seen by the consumers before opening. In order to overcome this problem, nowadays see-

through pouches are being manufactured using laminates of polyester, polypropylene with silicon dioxide or aluminium oxide coatings, which not only give see through properties but also have very good barrier properties. Work carried out at CIFT has revealed that fish products packed and processed in these see through pouches have a shelf life of more than 18 months at ambient temperature storage. Now both opaque and see through pouches are easily available as they are being manufactured by many industries in India and are not expensive also.

The CIFT has successfully developed a suitable three layer configuration of flexible pouches which can perform the packaging function equally well as metal cans and is free from the disadvantages met with them. This is a retortable flexible pouch based on polyester/ aluminium foil/cast polypropylene. Now flexible pouches are manufactured in India employing the configuration developed by CIFT and this opened the way for commercialization of heat processed fish curry in flexible pouches. The fish curry remained in good condition for more than a year at ambient temperature storage (28±2°C). The advantages of these retort pouch processed products are that they need not be refrigerated and can be easily opened and served. Generally processing times can be reduced by as much as 50% as compared to a comparable sized can, jar, or other cylindrical container. There are also additional advantages which include reduced shipping costs and storage space for the empty containers. The pouch also has good shelf appeal and a growing acceptance by consumers.



Fish curry in retort pouches

The CIFT has standardised this technology for several ready to serve products in different regional recipes from many varieties of fish and shell fish from both marine and freshwater. These products will not only cater to the needs of local people but also to the ethnic Indian population residing in other parts of the world. This technology has already been transferred to four entrepreneurs in India, who are successfully producing and marketing different ready to serve fish products both in domestic and export markets.

Fish sausage

Fish sausage is a product identical to the popular pork sausage. Surimi is the base material, which is homogenised after mixing with several other ingredients. The

homogenised mass is stuffed in synthetic casings like Ryphan (Rubber hydrochloride) or Kurehalon (Vinylidene chloride). The casing is closed using metal rings after which it is heated in water at 85-90°C and then slowly cooled. After drying the surface the sausage is wrapped in cellophane laminated with polythene. Fish sausage is kept at refrigerator temperatures for retail; however when prolonged storage is needed it is better kept frozen. Duplex cartons lined with a plastic film are ideal for short-term storage, but when stored frozen, packaging suggested for block frozen shrimp can be considered suitable.

Accelerated Freeze Dried (AFD) Products

Application of the technique of freeze drying in fish preservation is a relatively recent development; however the process became very popular in spite of the high cost of production because of several other advantages associated with the products. These are practically devoid of moisture, its percentage generally being below 2. The products are very fragile and can easily undergo chemical reactions with air leading to oxidation, deterioration of colour, absorption of water etc. They are generally packed under an inert gas to exclude air and oxygen. Hence the main requirements in the packaging employed are low oxygen and water vapour transmission to protect the product from rancidity and absorption of moisture and sufficient mechanical strength to protect from shock. Paper/aluminium foil/polythene laminates or metallised polyester polythene laminated pouches are recommended for accelerated freeze dried products. In some cases metal containers like tin cans have to be used to protect the material from shock, as these products are very brittle.

Fish Pickles

Fish pickle is a value added item whose bulk is contributed by low value items like ginger, chilly, acetic acid etc. Generally low cost fish, clam meat, oyster meat etc. are the fish/shellfish components used in fish pickles. Conventionally glass bottles are used as containers, which offer properties like inertness, non-toxicity, durability, non-permeability to gases, moisture etc. But they are heavy, prone to break, voluminous and expensive. New flexible packaging materials developed for fish pickle is based on plain polyester laminated with LDPE-HDPE Co-extruded film or Nylon/Surlyn or LD/BA/Nylon/BA/Primacore. These are inert to the product, can be attractively fabricated as stand up packs and can be printed on the reverse side of the polyester film.

Fish Soup Powder

Fish soup powder is a speciality product containing partially hydrolysed fish, protein, carbohydrates, fat and several other seasonings including salt. The product is hygroscopic and hence the selection of the package assumes great significance. Appropriate package developed for such products are 12 micron plain polyester laminated with LDPE-HDPE co-extruded film or 90-100 micron LD/BA/Nylon/BA/Primacore multilayer film which ensure a safe storage of the product up to 180 days.