Packaging of Dried Fish

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Drying is a traditional method of preserving fish in our country. Though traditional, it is still widely practiced in developed and developing countries. This is perhaps the cheapest method of preservation, since no expensive technology is used. In India roughly 20 % of the fish caught is preserved by drying. Only a small portion of this is fit for human consumption. The rest are inferior quality sold at very low prices. Part of the dry fish are used for poultry and cattle feed and also for manure. Considerable quantities of dry fish are exported, mainly to Singapore, Sri Lanka and to the Middle East.

Drying and its importance

There are basically two methods of drying fish. The common one is the traditional sun drying by utilizing the atmospheric conditions like temperature, humidity and airflow. The other is by using artificial means like mechanical driers for removal of moisture from the fish under controlled conditions. Fish is conventionally dried on the beach and occasionally on coir mats, cement platforms, bamboo mats and jute sacks. The fish dried on the beach is contaminated with sand, filth and other foreign matters. The most hygienic method for drying fish is drying them on racks. This ensures circulation of air from both top and bottom and contamination of the product with sand or dust is avoided and a high quality product is assured.

In certain cases the wet fish treated with salt is not dried, the self brine formed after salting is drained and the fish is packed in Palmyrah leaf baskets or coconut leaf baskets and taken marketed. This method is particularly suitable for fatty fishes. In such fishes the fat gets oxidized on exposure to air. These products have moisture content of 50-55% and the salt content of around 25%. They are most susceptible to fungal attacks, bacterial degradation and putrefaction. They have only very short shelf life.

Spoilage of dry fish

Deteriorative changes in dry fish are mainly protein denaturation, browning, rancidity, insect infestation, sliming, microbial growth and loss of appearance and texture. These mainly occur due to improper handling and packaging. Hence a proper packaging system is necessary to retard the spoilage, and avoid contact of the dry fish with air and moisture.

Moulds and fungi

Fungus usually grows well on unsalted and salted dried fish, which has high moisture, content. In salted fish, yellow brown to brownish black or spots are seen on the fleshy parts caused by growth of halophilic mould called *Sporendonema epizoum*.

Rancidity

This is caused by the oxidation of fat. Rancidity is more pronounced in oil rich fishes like mackerel, sardine etc. The unsaturated fat in the fish reacts with the oxygen forming peroxides, which are further broken down into simple and odouriferous compounds like aldehydes, ketones and hydroxy acids, which impart

the characteristic odours. At this stage the colour of the fish changes to brown. This is known as rust. Fatty fishes continue to become more and more rancid during storage. Certain impurities in salt and traces of copper accelerate this. Rancidity reduces the nutritive value and consumer acceptance and is a serious problem in cured fatty fishes.

Pink /Red Halophiles

This type of spoilage is mainly due to the presence of halophilic bacteria (*Halobacterium salinarum*) from the salt. It is commonly found in tropical countries like India. Spoilage appears on the surface as slimy pink patches.

Insect Infestation

Spoilage due to insect infestation occurs during initial drying stages and during storage of the dried samples.This is mainly caused by blowflies belonging to family *Calliphoridae* and *Sancophaidaes*. The larva causes most of the damage by consuming dried flesh until the bones only remain.

Fragmentation

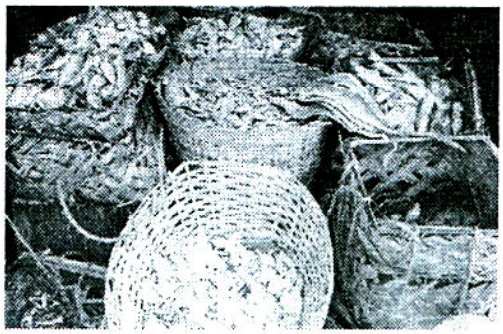
Denaturation and excess drying of fish results in breaking down of the fish during handling. Fish can become brittle and is liable to physical damage when handled roughly.

Functions of packaging

It is estimated that about one third of the dry fish manufactured in India is lost due to poor handling and processing techniques, packaging, and storage. Packaging of dry fish has many functions to serve for reducing these losses. The properties of a suitable packaging material are inertness, leak proofness, impermeability to water and oxygen and resistance to mechanical abrasion and puncture.

Packaging of dry fish

Traditionally, coconut leaf baskets, palmyrah leaf baskets, jute sacks and news paper baskets have been used for packing and transportation of dried fish. These containers only help in transportation of the fish. They do not protect or preserve the fish. The dry fish packed in such containers have a very short shelf life and is usually not of good quality. These fish are often found to be rancid or has mould growth. Since the packaging is permeable, the product absorbs moisture and gets soggy. It is seen that this fish is prone to attack by insects, rodents or other pests. The fish also arrive at the destination in an exposed condition. Hence these packaging materials afford least protection to the product. Plywood boxes and waxed corrugated cartons are also used for packing large quantities. Studies at Central Institute of Fisheries Technology have shown that high density polythene woven gusseted bags laminated with 100 gauge low density polythene is suitable for packaging dried fish. High Density Polyethylene (HDPE) is impervious to microbial and insect attack. HDPE is a material which will not spoil even if it gets wet. It is hard and translucent and has high tensile strength. Various packaging materials used in India for bulk packaging and their advantages and disadvantages are given in Table 1.



Dry fish packed in different traditional material

Table.1. Bulk packaging materials and their properties

Type	Merits	Demerits
Waxed corrugated cartons	Handy, light , hygienic and presentable	Very delicate Not foolproof against insects, rodents, moisture, breakage Costly
Dealwood or Plywood boxes	Compact and strong Larger quantities can be packed Handling , transportation and stacking are easy Can be reused Protection against damage	Comparatively heavy Cost is high Cheap wood not easily available
Bamboo baskets	Handy, light Not costly	Very delicate Not foolproof against insects, rodents, moisture, breakage
Gunny bag	Light ,handy, cheap , proof against breakage	Not foolproof against insects, rodents, moistureNot hygienic
Dried palmyrah and coconut palm leaves	Cheapest of all and readily available in the coastal regions of India	Not foolproof against insects, rodents, moisture Not hygienic and does not give good appearance Packing is laborious
Multiwall paper sack lined with 300 gauge LDPE	Hygienic, presentable and can be printed	Costly, polythene lining may break during handling and hence is not foolproof against insects, rodents, moisture
HDPE woven gusseted bags laminated with 100 gauge LDPE	Hygienic, presentable and can be printed Stackable can be packed uniformly	Nil

HDPE woven sack for bulk packaging of dry fish.

In the consumer market the dried fish is packed in low-density polyethylene or polypropylene. Due to the high moisture content of about 35 % in certain salted fishes they are often attacked by microbes. Hence fish should be dried to a moisture level of 25 % or below. Packets of different sizes and weights ranging from 50g up to 2 kg and bulk packs are available. Nowadays monolayer and multilayer films, combination and co extruded films are used for bulk packing and consumer packaging of dry fish Cleaned and processed, ready to-fry condiment incorporated and ready to serve products are also found in super markets. Polyester polythene laminates and thermoform containers are used to pack dried prawns and

value added dried products.

Various packaging materials used in consumer packaging of dry fish, their merits and demerits are given in table 2.

Table 2: Consumer packaging of dry fish

Type	Merits	Demerits
250 gauge low density polyethylene film	Cheap, readily available, good bursting and tearing strength and heat sealability	High water vapour and gas transmission rate, easy to puncture due to sharp spines, smell comes out. Shelf life limited.
250 gauge polypropylene film	Cheap, readily available, good bursting and tearing strength and heat sealability	High water vapour and gas transmission rate, easy to puncture due to sharp spines smell comes out. Shelf life i limited.
300MXXT Cellophane/150 gauge LDPE	Very low water vapour and gas transmission rate, transparent, good bursting and tearing strength, heat sealability and long shelf life.	Prone to easy attack by insects, costly.
12 micron plain polyester/150 g low density polyethylene	Very low water vapour and gas transmission rate, transparent, good bursting strength, puncture resistance & heat sealability. No insect penetration	Costly
20micron Nylon laminated with 150 gauge polyethylene	Very low water vapour and gas transmission rate, transparent, good bursting strength, puncture resistance & heat sealability. No insect penetration	Costly

In studies carried out by the institute, LDPE of gauges 100 to 700 gauge and PP of 100 gauges, were found suitable for storing dry fish. It also showed that dry fish when packed in films of higher gauge remained in good condition for a longer period. This is mainly due to the low water vapour transmission rate and oxygen transmission rate, which decrease with increase in thickness. In the case of overall quality 200, 300 and 400 gauge LDPE films also showed promising results. The advantages of low density polythene are clarity, low water vapour transmission rate, good bursting and tearing strength and heat sealing capacity. The main disadvantage is the high gas transmission rate. High gas transmission rate of films is undesirable in dried fish packaging because the smell dissipates to the surrounding atmosphere.

Dry shell - on prawns are packed mostly in duplex cartons or polystyrene trays and then covered with a laminate film. This is mainly due to the fact the spines will puncture the packaging material.

Polypropylene pouches of 300 gauge are recommended for salted fishery products with moisture content of 35% and above for obtaining a shelf life of 6 months. The advantages being good clarity, Low water vapour transmission rate (WVTR), good bursting strength and tearing strength. Currently laminate films of Polyester / polythene are mostly used for packaging of dried fish. Polyester films are capable of giving good mechanical strength and reverse colour printing can also be done. Polythene is heat sealable and has good food contact application. The keeping quality of dry fish can be enhanced in an air-conditioned room where the temperature and humidity is low. The disadvantage in keeping in an air conditioned room is mainly the

dehydration of the product due to the low vapour pressure in the room.

Packaging of AFD products

Accelerated freeze dried products demand a very high price in the export trade. The final moisture content of AFD products generally is about 2 %. Low moisture content and large surface area make these foods extremely hygroscopic. Most dried products deteriorate when exposed to oxygen. Changes in colour also may take place as a result of bleaching. Light accelerates oxidative reactions and hence contact with light also should be prevented. If proper packaging materials are not used there is every chance that the materials may undergo flavour changes due to the oxidation of the product and also migration of flavour from the packaging material. Since, fish contains fat there may be also a chance of it taking up the taints from the packaging material. The particular structural properties of freeze-dried products lead to damage by mechanical means. The light porous nature causes them to be very fragile and hence are easily prone to breakage during handling and transportation. Freeze dried products are also liable to damage caused by free movement within the package. Measures must be taken to fit the product compactly in the container, while leaving the minimum headspace for filling inert gas.

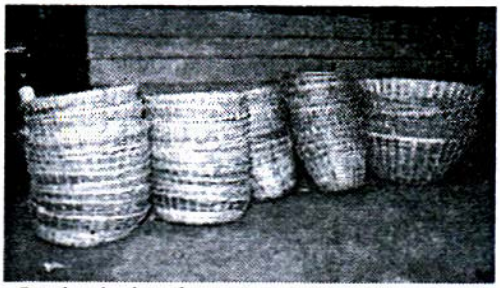
Rigid containers both glass and cans were used earlier for packaging of freeze dried products. However, it can now be seen that metallised polyester laminated with polythene or aluminum foil /paper/ polythenes are used since they have low oxygen transmission rate and water vapour transmission rate. Most of the packages are filled with an inert gas .The product can also be packed under vacuum to give better protection against damage.

Problems in packaging

Dry fish is irregular in shape and size leading to difficulty in packing. They also have spines and projections which may puncture the packaging materials. In the case of jute bags because of its permeable nature salted fish may absorb moisture depending on the relative humidity of the environment. In the coastal place where RH is always above 80 % this invariably takes place making the fish wet. Thus a suitable packaging material will ensure protection against migration of moisture and oxygen, and odour and insect attacks.

Transportation

By adopting containerization, dry fish can be handled properly. It helps in providing a hygienic and safe product which can be transported and distributed safely, where hazards in handling and distribution may be minimized. All



Bamboo baskets for transportation and storage of dry fish

information regarding the product, manufacturer, destination should be displayed on the container. At the same time the overall cost should also be taken into consideration so that the unit cost should be minimized.