REVIEW OF LITERATURE
ON HANDLING AND CURING OF FISH
CHAPTER TWO

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Fish is a rapidly perishable food item which requires extreme care in its handling and preservation. The quality of fish reaching the consumer or the processing factories will greatly depend on how the fish is handled after the catch on board the vessels and how it is preserved, packed and transported before it reaches the user. Preservation of the catch from hauling till it is unloaded at the landing centres is the responsibility of personnel on board the vessels. The objective shall be to land the fish in as good a quality as at the time of catch within the limits of practicability under good commercial practice. The fish that is landed is marketed fresh or taken for various types of processing. It is well known
that the quality of the end product will depend on how fresh the raw material was and therefore, in order to assure good quality for the products, it is necessary that extreme care should be taken in preserving the catch by scientific handling on board the vessels. Various factors affect the quality of the fish coming to the land, the main factors being the uncleanliness on the deck and fish holds, temperature at which the fish is kept, packing conditions and mode of handling in general. Good handling of the fish at sea should ensure that the catch retains its natural freshness as far as possible until landing. The important requirements are to clean the fish to make it free from dirt and extraneous matters and chill immediately, prevent its temperature from rising and maintain a high standard of cleanliness during handling. Cleanliness, in other words sanitation, requires particular attention. The fish should not be allowed to get contaminated with objectionable microbes, chemicals used in cleaning and disinfection, metals, paints, oils etc. There are various types of fishing vessels and the main mode of preservation on board the vessels is by icing. However, modern big size fishing vessels have facilities to preserve the catch by chilling with refrigerated sea
water or by freezing and storing in cold storages. At the same time, there are small fishing boats which have no facilities even for icing. In any case, the consumer or the processor is ready to pay a higher remuneration for a raw material of better quality. Since the size and type of fishing craft vary very much, it is not possible to suggest uniform codes of handling the catch.

2.1. Spoilage of fresh fish

When a fish dies, it stiffens almost immediately, the flesh becoming rather firm and elastic. This is called rigor mortis. Chemically, an increase in the amount of lactic acid is noted.

When fish is still in rigor mortis, or immediately after it passes off, the proteolytic enzymes begin to hydrolyse the highly complex protein of the fish muscle into simpler proteins, poly peptides and amino acids. This is called autolysis.

The process usually accompanying autolysis is bacterial decomposition. In addition to the bacteria naturally present in the fish, further additions take place as contaminants from utensils, water, ice etc. during
handling and processing. The result of bacterial action on proteins is the formation of the same type of compounds as are produced during autolysis, such as amino acids in the first stage. These are only intermediate products which are later decomposed into a wide variety of substances including ammonia, amines, indole, hydrogen sulphide etc. many of which have disagreeable odours. However, when bacterial decomposition occurs at low temperature, as in the case of iced fish, the principal products are intermediate ones i.e. amino acids. This is why fish is properly iced to control the spoilage. The following methods are usually employed for reducing the bacterial spoilage of fish.

2.2. Icing

One of the most effective and most commonly used means to retard spoilage is to reduce the temperature of the fish and hence control the proliferation of microorganisms which cause deterioration. Simple chilling of fish with ice works well for short term preservation.

Govindan (1962) observed the changes taking place in iced prawns. Under the influence of leaching of soluble nitrogenous constituents from the muscle and absorption of water by the muscle from the melted ice,
the total nitrogen, water soluble nitrogen and non-protein nitrogen contents of the prawn muscle showed very rapid fall, especially during the first 8-10 days of storage. He also recommended (1966) immediate icing of fish in alternate layers just after catch. Unprotected sources of water for cleaning the raw materials resulted in contamination with heavy bacterial load.

Gopalakrishna Iyer and Choudhuri (1966) pointed out the importance of purity of ice and water to be used in fish processing for improving the bacterial quality. They have shown the sources of contamination of water and ice and suggested remedial measures.

Govindan (1971) has also reported tremendous loss in solids and hence nutritive values during preservation of prawns in ice. He stressed that processors must reduce the pre-process storage period in ice to the minimum so as to retain the maximum nutrients and flavour bearing compounds and thereby to maintain high overall quality of the processed products.

Vasantha Shemoy and James (1974) found that seer fish in the form of chunks held out of direct contact with ice was acceptable up to 13 days based on organoleptic evaluation. The chunks and fillets held in direct contact
with ice were acceptable only up to 10 days. Perch kept in 
ice up to 9 days was found to be in acceptable condition 
(Solanki et al., 1977). Solanki and Venkataraman (1978) 
noted that urea content could be considerably reduced by 
icing shark fillets.

2.3. Chemical preservation of fresh fish

The primary aim of preservation of fish is to  
maintain the quality during storage for long periods.  
Chemical treatment in fish for preventing different types  
of spoilage has been suggested by many workers.

Surendran and Iyer (1971) reported that CTC when  
incorporated in ice at 5 p.p.m. level could prolong the  
shelf-life of prawn by at least six days. They stated  
that use of higher levels of CTC in ice was not advisable  
since it would result in higher amounts of absorbed CTC  
in muscle which was not completely destroyed during  
cooking. They observed a dull colour to the shell of CTC  
treated prawns. Since the effects of the antibiotic  
treatment become pronounced only after 8 days of storage,  
the use of CTC - ice would be restricted to fishing trips  
where the vessels have to remain off shore for more than  
8 days. Later, the same authors (1973) again stated  
that 5 p.p.m. CTC treatment considerably reduced bacterial
load in sardines and gave a better appearance to the fish. The high fat content in sardines resulted in rapid development of rancidity. Hence CTC treatment of sardines was found to be of limited advantage in extending the storage life of sardines in ice.

2.4. Packing and transportation of fresh iced fish

Large quantities of fresh fish are transported to distant and interior centres for regular distribution. During this transit, fish get spoiled and lost due to lack of proper care in packing and transportation. A survey conducted at Howrah, a major fish consuming centre, has revealed that about 50-80% of the fish arriving in the markets was of substandard quality when the period of journey from production centre to Howrah varied from 24 hours to 120 hours. This shows the tremendous economic loss incurred by the trade and fishermen due to the improper methods of handling, icing, chilling, packing and transport.

In tropical temperature conditions, ice melts at rapid rates necessitating re-icing at frequent intervals to keep the fish at low temperature. Moreover, rapid melting of ice affects the quality of fish adversely. The maximum period of ice storage of fish in the round form under the
above conditions is also limited. Certain varieties of fish like sardines pose special problems like belly bursting.

Rao and Perigreen (1964) attempted to reduce the rate of melting of ice and to increase the storage life of iced fish by providing additional lining to the conventional bamboo baskets used for transport of fish. They reported that iced fish (1:1) could be preserved for a period of 16-18 hours by using bamboo baskets lined with gunny, polythene or kraft paper.

Kamasastri et al. (1967) reported that fresh iced pomfrets transported in insulated holds from Gujarat to Bombay in mechanised boats were in better condition than those transported in non-insulated holds.

Venkataraman et al. (1976) reported that polythene lined thermocol insulated plywood boxes (second hand tea-chests) could be successfully used for transport of fresh iced fish. They found that a maximum of 25 mm thermocol insulation was necessary during summer (April-June) and 15 mm during winter (November-March). By using these insulated boxes, the initial fish-to-ice ratio could be brought down to 1:0.75 and still further to 1:0.50 at the height of winter in January to February.
Rao et al. (1978) conducted a comparative study of the insulation efficiencies of thermocol slabs and multi-layer gunny fabric in long distance transportation of fresh iced fish and found that their insulation efficiencies were comparable in respect of bacterial counts, organoleptic qualities and TMA and TVN values of the transported fish.

Govindan et al. (1978) conducted trials with a dismantlable insulated galvanised iron container for transportation of iced fish from Kakinada to Howrah, Kakinada to New Delhi and Paradeep to Howrah. The dismantlable container performed exceedingly well.

2.5. Salting of fish

Salting is the most important among the curing methods in India. Salting is also done as a preliminary step in the drying and smoking operations. During salting of fish, common salt exerts a high osmotic pressure and reduces the moisture content of the flesh.

During salting, a solution of salt is formed in the water extracted from fish. The salt, as a result of its hygroscopic ability and osmosis, absorbs water from the fish and is then dissolved by it. Adequate quantity of salt is very essential for salting fish.
Kandoran et al. (1964) studied the effect of calcium, magnesium and sulphate on penetration of sodium chloride in fish. They reported that the rate of penetration of salt had no relationship to the calcium and magnesium contents even at a level of 0.75%. The presence of calcium appeared to slightly retard the rate of drying of the salted fish.

Kandoran et al. (1965) suggested desalting of heavily salted shark flesh in 5% brine for removing urea from the flesh.

Rangaswami and Rao (1969) found that use of liberal amounts of salt kept the products free from insect infestation during storage.

Govindan (1969) studied the changes occurring in moisture, sodium chloride, extractable nitrogen, non-protein nitrogen and free amino acid nitrogen in dressed sardine and mackerel during heavy salting for short and prolonged periods and subsequent drying as well as pickling in saturated brine. The weight loss due to loss of water during heavy salting of sardine and mackerel was about 50% by the absorption of salt by the muscle. A certain amount of proteolysis was also indicated as shown by the higher NPN and free amino nitrogen values. Loss in salt
extractability was rapid during the drying stages of the heavily salted sardine. During pickling of heavily salted mackerel in saturated brine, moisture content of the muscle attained a steady value of 60\% and drastic loss in salt extractability of proteins took place.

2.6. Quality of salt

Quality of salt to be used in fish is very important. ISI (1962) has laid down standards for the common salt to be used for salting, but it is very difficult to get such salt.

Solar salt contains higher amounts of calcium and magnesium in the form of chlorides and sulphates when compared to rock salt. Their presence in considerable quantity affects the colour, texture and taste of the fish. Fine salt has the advantage of dissolving rapidly. Coarse salt is less soluble and the delay in salt penetration leads to some initial spoilage. Yellow or brown discolouration of salt is due to the presence of iron. Salt containing copper induces rancidity of fat affecting the colour and appearance of fatty fish. The insoluble matter present in salt leaves an unattractive crust on the cured fish (Rao and Sen, 1966).
Srinivasan et al. (1967) examined a total of 290 samples of common salt used for fish curing in Government curing yards, private fish curing yards etc. for their chemical analysis and compared the data with ISI standards. Only 45.8% of the samples drawn from Government fish curing yards, about 25% of that collected from private fish curing yards and 34.37% of the salt offered by salt manufacturers confirmed to the ISI specifications of 1954 with regard to minimum sodium chloride content of 96%. However, according to the revised IS standards of 1962 prescribing a minimum of 98% sodium chloride, none of the private fish curing yard salt samples satisfied the specifications. Only 1% of the Government yard samples and 10.4% of the salt samples offered by salt manufacturers confirmed to the revised standards.

2.7. Drying

Drying is the most important step in fish curing. Proper drying gives high quality fish. Fungal and bacterial attack will be quick if the moisture content of cured fish is high. ISI has recommended moisture levels for different species of cured fish. During sun drying precaution should be taken to avoid contamination of fish with dust. This can be achieved by drying fish on raised platforms (Rao, 1967).
Bhattacharyya et al. (1982) reported that a better sun dried product of 'Gudusia chapra' could be obtained by Blanching the material in 7% brine for one minute prior to drying.

2.8. Dehydration of fish

Sun dried fish invariably contains higher percentage of moisture which adversely affects its storage life. Sun dried fish may also be contaminated with pathogenic bacteria, flies, sand, dirt etc. Cured products could be prepared with better quality in all respects when processed under controlled conditions in the artificial dryers. Mechanical drying with hot air avoids most of the drawbacks of sun drying. Dryer will also facilitate continuous drying of fish during night time and rainy season. Prabhu et al. (1963) studied the drying characteristics of some important commercial fishes of India in a laboratory tunnel dryer. Swaminath (1964) reported that the optimum temperature for drying of commercial fish like mackerel, sardines, white baits and silver bellies in a half tonne dehydrator was about 45°C at 50% R.H. Relative humidity appreciably influenced
the drying rate mainly during the first part of the drying operation. To avoid case hardening, it was necessary to use low relative humidity in the beginning and to increase it during the later part of the operation.

Balachandran (1969) found that high temperature accelerated drying of fish considerably, but temperature above 50°C caused a certain amount of cooking of the muscle. The lower the R.H., the higher the rate of moisture loss. But R.H. below a certain level resulted in case hardening. Unduly high R.H. values increased the duration of drying. By increasing the temperature of drying after the constant rate period, the drying time could be considerably reduced without sacrificing the product quality.

2.9. Chemical preservation of cured fish

Several research investigations have been carried out in the field of chemical preservation of cured fish and new findings and recommendations on improved method of fish curing have been brought out.

Pickling is one of the earliest known methods of preservation of fish. Preservative action of salt coupled with the acidity of vinegar has been accounted for as a very effective principle in maintaining the quality of
preserved fish. Rao and Valsan (1962) showed that the storage life of pickled fish could be extended considerably by giving them a pre-dip treatment in propionic acid. The same authors (1962) also suggested dipping of fresh fish with 4% propionic acid for prevention of mould and red halophilic attack on dry salted fish. They observed that the treated samples had a storage life of about 62 weeks while the control could be stored only for 15-20 weeks.

Joseph (1962) reported that turmeric powder (5%) in curing salt enhanced the keeping quality of cured white-bait.

Cured fish is largely attacked by fungus and bacteria causing huge national loss of processed fish. The main reason for this problem is the high moisture content of the cured fish. Easy remedy is to bring down the moisture content of the cured fish to 30-35%. But the fish curers are not prepared to dry the fish to that extent because the weight of the product is considerably reduced. Moreover, hard dried product is not relished by many of the consumers. To preserve the cured fish with high moisture content for quite long time, some chemical preservatives can be used.

Valsan (1968) suggested that by smearing a mixture of 3% sodium propionate, 0.5% BHA and 0.5% sodium sulphate
in dry powdered salt over cured fish, the product could be kept for 9-12 months free from any visible sign of spoilage, browning or rancidity.

Conventional Colombo curing using 'Gorukha puli' (Garcina cambogia) as preservative had been extensively practiced for preservation of oil sardine, mackerel etc. especially along the west coast. This method affected the appearance and texture of the pickled fish. Devadasan et al. (1975) reported that treatment with tartaric acid in combination with garlic was effective for giving better appearance, texture, taste and shelf-life of pickled fish. Balachandran and Muraleedharan (1975) suggested sodium benzoate along with salt and small amount of 'Gorukha puli' for better quality of the salted fish.

Valsan (1982) recommended calcium propionate, an indigenously available, cheap and effective chemical, in the place of sodium propionate to preserve cured fish. Unnikrishnan Nair et al. (1982) reported that the fungus already present in cured fish could be removed and its re-infestation could be prevented by washing the affected samples and drying followed by smearing a mixture of refined salt and sodium propionate. Kalaimani et al.
(1982) found that sardine dipped in betel leaf extract immediately after salting followed by drying had better keeping qualities and lesser rancidity.

2.10. Packing and storage of cured fish

Method of packing and storage is important in the fish curing industry. At the same time, this is the most neglected aspect. The existing method of packing and storage of cured fish is very crude and unhygienic.


2.11. Quality Control in cured fish

Quality control means maintenance of quality at levels and tolerance acceptable to the buyers while minimising the cost to the producer. Quality control may be viewed from two angles (1) to prevent spoilage and
(2) to protect food from contamination. The national standard specifications have been published by Indian Standards Institution. Many dried fish products are covered by these specifications and they are important both in the internal as well as export trade. The specifications mainly relate to size, freedom from infestation with fungus and mites, freedom from excessive sand and salt, absence of deterioration etc. Specifications relating to moisture, salt and acid insoluble ash for some dried fish are shown in Table 3.

Maintenance of sanitation is an important step in the production of cured fish. Systematic application of detergents and disinfectants and proper cleaning of the curing yard and the utensils are essential to check the contamination of bacteria, mold, insects etc.

Sen and Sripathy (1967) also reported that most of the sun dried mackerel collected from the market showed 40-50% moisture whereas for the microbiological stability and proper storage fish should be dried to 30% moisture level. They also reported that the use of BHA and proper drying and packing would minimise oxidation of dry salted fish.

By maintaining proper hygienic conditions with better
Table 3. Requirements for dried fish and shellfish

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Moisture % (max)</th>
<th>Sodium chloride % (min)</th>
<th>Acid insoluble ash % (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>White baits</td>
<td>20</td>
<td>2.5</td>
<td>7.0</td>
</tr>
<tr>
<td>2.</td>
<td>Tuna (Sural)</td>
<td>35</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>3.</td>
<td>Prawn pulp</td>
<td>20</td>
<td>5.0</td>
<td>1.0</td>
</tr>
<tr>
<td>4.</td>
<td>Dried Bombay duck</td>
<td>15</td>
<td>7.5</td>
<td>1.0</td>
</tr>
<tr>
<td>5.</td>
<td>Laminated Bombay duck</td>
<td>15</td>
<td>6.0</td>
<td>1.5</td>
</tr>
<tr>
<td>6.</td>
<td>Mackerel (dry salted)</td>
<td>35</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>7.</td>
<td>Cat fish (dry salted)</td>
<td>35</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>8.</td>
<td>Dara (dry salted)</td>
<td>45</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>9.</td>
<td>Ghol (dry salted)</td>
<td>40</td>
<td>20.0</td>
<td>1.5</td>
</tr>
<tr>
<td>10.</td>
<td>Leather jacket</td>
<td>40</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>11.</td>
<td>Horse mackerel</td>
<td>40</td>
<td>25.0</td>
<td>1.5</td>
</tr>
<tr>
<td>12.</td>
<td>Shark</td>
<td>40</td>
<td>30.0</td>
<td>1.5</td>
</tr>
<tr>
<td>13.</td>
<td>Seer</td>
<td>45</td>
<td>30.0</td>
<td>1.5</td>
</tr>
<tr>
<td>14.</td>
<td>Shark fin</td>
<td>10</td>
<td>-</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Source: ISI Standards
salt, preservative chemicals, proper containers and packaging materials and storage conditions, the market for cured fish can be improved (Sen, 1969).

Unnikrishnan Nair and Valsan (1971) stressed the importance of freshness of raw fish used for curing. They reported that the maximum permissible time lag between catching of mackerel and its curing should be 8 hours in room temperature or 3 days in ice.

Sripathy (1974) reported that cured fish products obtained from market had very limited storage life and were subject to mould growth and attack by red halophiles, development of yellow or brown discolouration and rancid and off odour. The samples were contaminated with sand and when cooked, they were tough in texture and were often bitter in taste. Sripathy suggested the possibility of preparing better products by salting and sun drying than were being produced in commerce. Such products attractively packed and advertised could improve the market and fetch better prices in the internal and export markets. A transformation of this traditional trade into a modern industry would benefit the fishermen, trade and the consumer.

Mathen (1974) reported that the usually observed
quality defects in dried fish products are (1) inadequate drying limiting the shelf-life (2) heavy admixture with sand due to drying of the fish on the open beach (3) low salt content and (4) attack by fungus and dust and porous appearance of the product.

Valsan (1974) suggested to discard the age old curing sheds and change over to well built fish curing factories with provision for modern facilities for maintaining the quality of cured fish products.

2.12. Adoption of technology

No systematic investigation seems to have been made in fisheries technology on various factors associated with the adoption of improved or new technology. Therefore a few relevant references to studies in the related fields are cited here.

2.12.1. Age:

Hoffer (1942), Ryand and Gross (1950) Gross and Taves (1952), Wilkening (1952), Hess and Miller (1954) and Lionberger (1952) have reported that the age of operators was negatively associated with the adoption of improved farm practices.

However, Colemann (1951) and Wilson (1953) did not
find any significant correlation between age and adoption. Sawhney (1961) also reported that there was no significant association between age and adoption of improved practices.

2.12.2. Education:

Hoffer (1942), Gross (1949), Ryan and Gross (1950), gross and Taves (1952) and Wilkening (1952) found that education of the farmers was positively associated with adoption of improved practices. Dimit (1954) reported that four or more completed years of schooling by the farm operator was positively associated with the adoption of improved farm practices. Copp (1956) found that educational level of cattlemen was significantly associated with the number of practices adopted. Copp (1958) again concluded that education was definitely associated with adoption behaviour. Indian studies too, on the relation between education and adoption of improved practices revealed similar trends. Bose and Vishnoi (1960) concluded that education always played dominant role in the acceptance of the innovations. Bose (1961) and Dube (1961) found that those who adopted more practices were literate.

2.12.3. Social participation:

Past studies have shown that there is a positive
association between extent of farmer's social participation and his level of adoption of improved farm practices. Hoffer (1942) observed that social participation of an individual farmer was positively associated with the acceptance of improved farm practices. Gross (1949) stated that acceptors reported higher social participation and participated more fully in co-operatives. Ryan and Gross (1950) in a study of differential acceptance of hybrid corn established that earlier adopters had higher social participation and participated more frequently in co-operatives. Coleman (1951), Gross and Taves (1952) and Wilkening (1953) observed positive association between formal social participation and adoption of improved farm practices. Copp (1956) reported that formal social participation, membership in farm organisations and churches were significantly associated with number of practices adopted. Reddy (1962) found high association between farmer's social participation and adoption of improved practices. Sinha (1963) found that the high formal social participation group was significantly superior to medium and low participation groups in all stages of the adoption process.

2.12.4. Contact with extension agency:

Coleman (1951) observed a direct relationship between
extension contacts and the level of adoption of practices. Gross (1949), Lionberger (1952) and Bose (1961) support the generalisation that contacts with formal and informal agencies are significantly related to the adoption of practices. Sawhney (1961) reported that comparatively larger proportion of the respondents who had contacts with extension agencies adopted more practices than those who did not have contacts with them. Dhaliwala and Sohal (1965) found that frequency of contact with extension agency was significantly related to the adoption of agricultural practices. Thus it can be concluded that other things being constant, the higher the contacts a person has with extension agency, more are the number of improved practices followed by him.

2.12.5. Perception of profitability of technology:

Griliches (1957) indicated that the perception of profit from the innovation was highly related to the rate of adoption. Kivlin (1960) found that profitability measured by initial cost, continuing cost and recovery cost, as perceived by a panel of judges was not related to the rate of adoption. Perhaps the individual did not perceive that the innovation was profitable. Havens and Rogers (1961) pointed out that profitability like any
other items of information about an innovation must be diffused. It was their contention that what really determined the rate of adoption of an innovation was the adoptor's perception of profitability and not the objective profitability.

2.12.6. Income:

Gross (1949) observed that acceptors had higher income. Ryan and Gross (1950) found that farmers with higher income tended to adopt improved practices earlier than the farmers with lower income. Dimit (1954) showed that economic status was positively associated with adoption. Sahay (1960) and Singh (1960) reported that low income of the farmers was one of the main handicaps in their response to improved practices. Bose and Vishnoi (1960) concluded that economic condition always plays an important role in the acceptance of an innovation.

2.12.7. Debt:

Dubey (1958), Sahay, (1960), Singh (1960) Bose and Vishnoi (1960) and Reddy (1962) who carried out their research projects in different parts of India concluded that economic condition plays a dominant role in the acceptance of improved practices.
2.13. **Knowledge**

Hess and Miller (1954) reported that operators rating high on a knowledge test had higher producing herds than farm operators with low scores. Williams (1958) reported that lack of knowledge regarding fertilizer composition and use was an important factor which retarded the use of fertilizer.

Hoffer and Stangland (1958) found that level of knowledge of farmers regarding the improved practices was a significant factor affecting the adoption of improved practices. Sizer and Porter (1960) found a significant and positive relationship between knowledge about the recommended practices and their adoption. They reported that knowledge about innovations, social status, education and social participation of the farmers explained 25-68% variance in the innovations. Reddy (1962) reported that 41% of the respondents under study gave lack of information and knowledge about the practices as the reason for non-adoption of chemical control of weeds.

2.14. **Improved method of fish curing**

It has already been explained in the previous pages about the existing methods of fish curing in different centres and it was also established that the cured fish
products brought out from these centres were poor in quality due to lack of a standard method of processing. To avoid these problems, improved methods of fish curing were worked out for different types of products on the basis of research investigations carried out by different workers and transferred to the fish curing industry. A standard method of fish curing for dry salted fish is given below.

Select absolutely fresh fish for curing and wash well with chlorinated (10 p.p.m.) water to remove blood, slime, dirt etc. Mix the fish with ice in the ratio 1:1 and store till processing is started. Processing should be started as early as possible. However, if the delay of curing is unavoidable fish can be kept under iced condition upto 3 days. In such cases, iced fish should be properly stored in the specific place in the yard allotted for fish storage. Icing should be done in thin alternate layers in such a way that there is intimate contact between ice and fish. Not more than 3 ft depth of the material (fish and ice) should be put in one container, as otherwise the bottom layers are liable to get squeezed and bruised. Thermocole insulated containers should be used for storing iced fish.
If ice is not available or icing is not done, the fresh fish should be processed immediately within a maximum time lag between catching and processing as 8 hours.

The fish is dressed on the processing table and the viscera is removed immediately. Care should be taken to keep the table always clean. In the case of small fishes, evisceration and scaling are not practicable. In such cases, fish is salted directly after proper cleaning.

The dressed fish is washed in chlorinated water and the water is allowed to drain completely. Draining of water can be conveniently done in perforated plastic containers. After complete draining, the fish is taken out to the salting table where good quality salt is applied to the fish uniformly by hand. Proportion of salt to fish can be 1:4 in case of large fish, 1:5 for medium fish and 1:6 for small fish.

After salting, the fish is stalked in carefully cleaned cement tanks and kept for at least 24 hours in these tanks. After this, the fish is taken out and rinsed in freshly prepared brine to remove excess solid salt adhering to its surface. The salted fish is then dried on clean drying platform. This can be either
raised cement or bamboo platform. The ideal way is to
dry the fish in a tunnel dryer. Fish should be dried to
a moisture level as per the specification. The dried
fish is then dusted with calcium propionate to prevent the
attack of mould and red halophiles. One gram of calcium
propionate is used for 1 kg fish. The treated fish is
packed in polythene lined plywood boxes or gunny bags for
bulk packing. Retail quantity of 500 gm or 1 kg of the
treated fish can be packed in polythene bags and stored.

When the fish is soaked in water just before cooking
to remove excess salt, calcium propionate already added
also will be removed. Calcium propionate is even
otherwise known to be a completely safe, harmless and
acceptable chemical preservative for food material. This
chemical is widely used in food items like bread to
prevent spoilage. The dried fish preserved in this method
can be kept in very good condition for a minimum of eight
months while the conventional cured fish can be kept in
good condition only for about two months.