

PART I

GENERAL

TRANSPORTATION OF FISH IN INDIA — PROBLEMS AND PROSPECTS

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INTRODUCTION

India has a long coast line of about 4,800 km along which our fish landing centres are scattered. Our fish catches are showing an upward trend consequent on rapid mechanisation of fishing crafts. Economic utilisation of the landed fish is an essential prerequisite for the proper development of our fishing and fish processing industries. It was not in the distant past that we had occasions though rarely, of very heavy landings of fish when we had to bury them as manure in coconut gardens due to lack of proper transport facilities and scientific methods of handling and preservation. Of course, one way of preserving surplus fish which had been in vogue for quite a long period is salt curing which is not an efficient method in so far as the demand for such products and selling prices are comparatively unattractive. One of the most important methods of economic utilisation of fresh fish is to transport them expeditiously to internal markets which is not an easy job as far as our country is concerned, because some of our potential internal markets are

thousands of kilometres away from the fish landing centres.

PRESENT CONDITION

The pattern of distribution of fish in India has remained more or less unchanged till now in spite of the rapid progress made in the fields of fishing and fish processing. Prawns which constitute 10 to 12% of our total marine fish landings are alone subjected to preservation by the modern techniques of freezing and canning. The problem of transportation of this fish from the landing centres to the processing factories involving distances of the order of hundreds of kilometres at times has been somewhat successfully solved, even though much remains yet to be done for further improving the conditions. Due to the fact that our other fishes comprising of about 90% of the total marine fish landings, do not find an export market, sufficient attention is not bestowed at present on their handling and transportation. Employment of quick means of transport like trucks and vans to some extent has helped in easing the situation and more

fresh fish now find their way to the interior markets though in a coastal belt of limited distance from the sea shores. A few refrigerated rail wagons have recently been introduced in selected routes for transportation of fish to the interior cities. However, the quantity of fish that they can handle is negligibly small compared to the vast surplus available for distribution especially during heavy fishing seasons. Even here the optimum conditions of packaging and the most efficient containers to be used are yet to be worked out.

PRESERVATION AND TRANSPORTATION

It is well known that fish is one of the most perishable of human food materials and that it starts spoiling soon after death. 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 micro-organisms which cause deterioration. Crushed ice is usually employed for this purpose and fresh fish keeps well for limited lengths of time in contact with it. Cheap and efficient containers and methods of packaging are to be evolved for this purpose. There are several other problems also involved, most important of which, in a tropical country like ours, is the rapid meltage of ice necessitating frequent re-icing to maintain the low temperature levels required. In most of our fish landing centres shortage or even non-availability of ice, leave alone refrigerated storage facilities, is acutely felt and even where ice is plentifully available, economy in the use of ice is quite essential to prevent the cost of fish from shooting up unduly. This requires well insulated containers which can retard rapid meltage of ice. With these objectives in view, the Central Institute of Fisheries Technology has launched on an extensive programme of study of the problem on all its aspects

and some of the salient points observed are summarised in this communication.

ICED FISH

Simple chilling of fish with crushed ice works well for short term preservation or transport involving a couple of days, even though re-icing may be necessary at intervals of say, 24 hours depending upon the efficiency of the container. By this means spoilage of fish is controlled to a large extent. It has been reported that the rate of spoilage of fish at 2.5°C is twice as fast as that at -1.1°C. At 5.5°C it is twice and at 11°C about four times as fast as that at 0°C.

Improvements were tried on the traditional bamboo basket commonly employed for transportation of fish by giving linings inside with bitumin coated kraft paper, gunny and polythene, palmirah leaf mat and banana leaves. Considerable improvement in storage life of fresh fish packed with 1:1 ice in these containers was observed. A more sophisticated container developed by the Institute for long distance transport of fish (both iced and frozen) is thermocole insulated plywood box. Second hand teachests are perfectly suitable for the purpose. Thermocole slabs (2 to 2.5 cm thick) are cut to the inside size of the box, sealed in polythene bags (to prevent them from coming in contact with the ice melt water) and placed on all the six sides of the box. Fresh fish iced 1:1 and packed in this container remained in prime condition upto 60 hours at our ambient temperatures. Re-icing after this period keeps the fish in edible condition for an additional equal length of time. Lowering the storage temperatures as obtainable in refrigerated rail wagons reduces the meltage of ice and extends the storage life. Some of the important findings are listed in table I.

TABLE I STORAGE LIFE OF ICED FISH IN DIFFERENT CONTAINERS.
FISH: ICE = 1:1 (ALTERNATE LAYERS). STORAGE TEMPERATURE: 26 TO 32°C

S. No.	Container	Fish studied	Maximum storage life in hours *
1.	Bamboo basket (plain)	Sardine, jew fish, synagris	11-12
2.	-do- lined with kraft paper	-do-	19-21
3.	-do- lined with gunny and polythene	-do-	21-22½
4.	-do- lined with palmirah leaf mat	-do-	20-22
5.	-do- lined with banana leaves	-do-	18-20
6.	-do- lined with a layer of saw dust on top	-do-	24-27
7.	-do- with 2.5 cm thermocole lining	-do-	60
8.	Plywood box 30 cm ³ (plain)	Sardine and jew fish	14-16
9.	-do- lined with 2.5 cm thermocole	-do-	55-60

* Maximum temperature attained: 3 to 4°C.

In all the cases, prechilling the fish to 1.1 to 1.6°C prior to packing extended their shelf lives by 6 to 8 hours. It was also observed that increasing the proportion of ice beyond 1:2 (fish to ice) did not have any proportionate effect in enhancing the storage lives in the above studies. Oil sardines sealed in polythene bags without ice and stored at — 1 to — 1.5, 0 to + 1, and 6 to 8°C remained in edible condition for 13 to 16, 4 to 5 and 2 days respectively.

PARTIALLY FROZEN FISH

Partial freezing of the fish to — 3 to — 4°C prior to packing in the containers enhances the storage life considerably beyond that for ordinarily iced and packed fish. Results observed in some typical experiments are given in table II.

FULLY FROZEN FISH

During seasons of glut when the whole of the landings cannot be transported immediately to the interior markets, they can be deep frozen and stored at or near the landing centres and transported according to demand. The storage lives of fully frozen

fish in different containers are shown in table III.

BELLY-BURSTING IN OIL SARDINES

One of the problems associated with freezing preservation and transportation of oil sardines — one of the major varieties of commercially important fish constituting about one — third of India's total marine fish landings — is belly — bursting. During freezing and thawing, the belly walls break and the visceral portions protrude out reducing the consumer acceptability of the fish even though other organoleptic qualities are not affected by this phenomenon. The incidence of belly — bursting in some cases is upto 25 to 30% depending on the maturity, fat content and nature of stomach contents. The belly-bursting occurring during freezing and thawing can be effectively controlled to a considerable extent by a dip treatment of the fish in 15% brine for 30 minutes prior to freezing. The salt absorption is comparatively low and the brine treated sardines on cooking in water gives a slight saltish taste. Besides reducing the belly-bursting, the

TABLE II STORAGE LIFE OF PARTIALLY FROZEN FISH IN DIFFERENT CONTAINERS
INITIAL TEMPERATURE OF FISH: — 3 TO — 5°C

S. No.	Container	Fish studied	Maximum storage life in hours *
<i>With 1:1 ice</i>			
1.	Bamboo basket 30 cm ³ (plain)	Synagris	17-18 (24-30°C)
2.	-do- kraft paper lined	-do-	26-28 „
3.	Plywood box 30 cm ³ — 2.5 cm thermocole lined	-do-	68-70 „
<i>Without ice</i>			
4.	-do-	Baracuda	120 (4 to 7°C)
5.	-do- (plain)	„	72 „
6.	-do- 2.5 cm thermocole lined	Sardine (glazed blocks)	144 (5 to 10°C)
7.	-do- (plain)	„	72 „
8.	-do-	Tuna	72 (3 to 7°C)
9.	-do- 2.5 cm thermocole lined	„	120 „

*Maximum temperature attained: 2-4°C. Figures in parenthesis show the temperature at which the fish were stored.

TABLE III STORAGE LIFE OF FULLY FROZEN FISH AT DIFFERENT TEMPERATURES
AND IN DIFFERENT CONTAINERS
INITIAL TEMPERATURE OF FISH: — 15 TO — 18°C

S. No.	Container	Fish studied	storage temperature °C	Maximum storage life in hours *
1.	Plywood box 30 cm ³ (plain)	Sardine in glazed blocks	4.4 to 7.2	96
2.	{ -do- with a layer of 2.5 cm sawdust on all sides	-do-	25 to 30	78
3.	-do- (plain)	-do- (I. Q. F.)	26 to 32	55
4.	-do- 2.5 cm thermocole lined	-do- (glazed blocks)	-do-	96
5.	-do-	-do- (unglazed blocks)	-do-	73
6.	-do-	Synagris (glazed blocks)	4.4 to 7.2	192
7.	-do-	Seer (I. Q. F.)	26 to 32	67
8.	-do-	-do- with crushed ice	-do-	88

*The fish at the end of the storage period was in a partially thawed state and could be further preserved in ice for 2 to 3 days.

brine treatment also gives a better appearance and firmer texture to the sardines.

DRY ICE FOR TRANSPORTATION OF FISH

Work carried out on the use of dry ice (solid carbon-dioxide) for preservation and transportation of fish has shown that it can be used effectively for supplementary cooling of already chilled or frozen fish during transportation in insulated vans. It cannot be economically used for the initial cooling because its direct contact with the fish causes freezer burn and cooling without contact consumes unduly large quantities of the cooling agent. Moreover, cooling is not uniform and efficient.

FIELD TRIALS

Based on the information gathered from these studies, some field trials were successfully carried out. Fresh hilsa iced 1:1 in 2.5 cm thermocole lined plywood box and despatched by ordinary rail wagon from Veraval to Calcutta reached the destination in very good condition after a journey of 100 hours without any re-icing enroute. Fresh eel fillets sealed in polythene bags, packed in thermocole

insulated plywood box with 1:1 ice and transported in ordinary rail wagons from Veraval reached interior markets like Ahmedabad in very good condition. Sardines dipped in 15% brine for 30 minutes, frozen in blocks, packed in thermocole insulated plywood box, transported from Calicut to Madras in refrigerated wagon, iced at the top and further transported to Calcutta in ordinary wagon, reached the destination in fine condition. Without the step of re-icing at Madras also the material reached Calcutta still in acceptable condition.

CONCLUSION

It is gratifying to note that at least some of the private enterprenuers in the Saurashtra and Cochin areas have taken to these improved containers and methods of packaging though to a limited extent deriving their full advantage. Adoption of these methods on wider scale is sure to ensure better economic utilisation of our fish landings and thus help to improve the socio-economic status of the fishermen besides helping to solve the problem of protein mal-nutrition of our country to a considerable extent.