PART I

GENERAL

A REVIEW ON OIL SARDINE

I. DISTRIBUTION, PRESERVATION AND TRANSPORTATION

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Sardine, belonging to the family clupeidae and consisting of a few species, constitutes the single largest fishery of India. This incidentally, is the biggest pelagic fishery too. *Sardinella longiceps* Valenciennes, known as oil sardine is the most important among them and singularly contribute 20-30% of the total marine landings in India. Among the regional languages it is known by the names *'Nalla Mathi'*, *'Mathi'* in Malayalam, *'Baige'* in Canarese, *'Buthai'* in Kannada, *'Haid'* or *'Tarli'* in Marathi, and *'Pechalai'* in Tamil.

DISTRIBUTION

Occurrence of *Sardinella longiceps* has been reported along the coast of Somalia, Seychelles, Gulf of Aden, Red Sea, Gulf of Oman, Persian Gulf, Pakistan, Indian Peninsula, Ceylon, Malayan Archipelago, around Indonesian and Philippine waters, as well as off Vietnam, although their abundance varies with different regions. However, its presence in Red Sea, Persian Gulf and Seychelles is not proved beyond doubt (Antony Raja, 1969).

Around India, oil sardine is available from both coasts, west as well as east. Their occurrence in the east coast is reported as sporadic, the specimens are less fatty compared to their counterparts at the Malabar coast (Antony Raja, 1969). Along the west coast the fishery is distributed from Ratnagiri in the north to Quilon in the south; Malpe and Calicut being the regions of maximum abundance. The other economically less important species of sardine found to occur along the Indian coasts and predominantly in the east coast are: *Sardinella fimbriata, Sardinella gibbosa, and Sardinella sirm etc.* All these species together contribute on an average about 1/6 of the total sardine landings.

LANDINGS

Oil sardine is a fishery which has exhibited wide fluctuation showing a variation in contribution from as low as 1% to as high as 32%, the respective figures being 7412 tons in 1956 and 301641 tons in 1968. Suffering worst set back for about three decades from the twenties

TABLE I

YEAR-WISE LANDINGS OF SARDINE IN INDIA
Quantity in Metric Tons

Year	Oil sardine	Other sardines	Total Marine landings	% Oil sardine with respect to total
1964	274333	40398	859582	31.9
1965	261863	42770	832777	31.4
1966	247214	64643	890311	27.7
1967	256326	37261	891888	28.5
1968	301641	43450	934611	32.2
1969	174249	52467	913630	19.0
1970	226984	55239	1077466	21.0
1971	208982	63775	1154822	18.9

to the forties, the revival has started in 1957, with record of considerable increase in production in the sixties.

Marine biologists did not lose any time to study and explain the reason for this wide fluctuation in landings and came to the fore to forecast the prospects for successful oil sardine fishery. The following gives an account of the principal considerations associated with this phenomenon (Antony Raja, 1969).

i. Hydrological conditions such as temperature (27-28°C), salinity (34-35‰) and dissolved oxygen etc.

ii. Availability of certain species of diatoms which serve as food for the fish.

iii. Periodic migration to the offshore regions.

iv. Heavy natural mortality or over-fishing; and

v. Meteorological conditions such as average daily rainfall (30 mm.) during the spawning fortnight and intensity of monsoon.

Though the fishing season commences with the premonsoon showers, the fishery becomes regular only by July, the peak season being October to January, then falling and terminating by March. Seasonal variation in landing is more predominant along the Mysore coast than in the Kerala coast. However, of both the coasts, the largest catch comes from the last quarter of the year. The inter-quarter disparity is not so marked along the Kerala coast as on the Mysore coast.

FISHING

The normal fishing area for sardine is confined to a narrow strip of coastal waters extending to 12-15 km. from shore and at a depth of upto 15 m. The crafts engaged for fishing are mostly hand-rowed country crafts, a dug-out canoe known by the name of *'vanchi'* or *'odam'* of about 9-12 m. generally employed for operating boat seines; and *'thoni'*, a similar one of smaller length of about 8-9 m. used for operating drift-net and gill net. Along the Mysore and Konkan coasts in addition to the

dug-out canoes outrigger boats of 5-15m. length are used for operating *'rampani'*.

There are three types of gears mostly in use, viz; engulfing nets (boat seines), seine nets (beach seines) and gill nets, for sardine fishing. Among these the most important gear is boat seines, which include the *'kolliwala'* and *'thangu vala'* used along the Kerala coast. Shore seine, *'rampani'* is used along the Mysore coast to catch the shoals which enter the shallow inshore waters. *'mathi chala vala'* which falls under the category of gill nets is also operated with good results. With the introduction of nylon twines for fabrication of the gear boat seines now operated have increased in length from the usual length of about 18m. to about 30m.

UTILIZATION

Sardinella longiceps has a long and stout head, the body narrow and tapered towards the tail, covered with scales. In fresh condition the fish has an admixture of blue, green and brown colour on the back. Flanks are silvery with iridescent pink. During peak season the catch comprises of medium sized fish ranging in size from 12 to 15 cm. which belong to the one year class, weighing 25 nos/kg. As the name suggests the fish has an oil content, the value reaching as high as 17% on wet weight basis in November. The proximate composition of the fish is given in Table II.

Though the fish contains a good amount of protein and compares very well with other relished fishes, the price realised are often poor compared to others of similar nutritive value. There are many reasons which may account for this. Inadequate facilities for the quick distribution of heavy landings to the consumers in the interior ranks as the principal factor. This coupled with the improper methods of handling and preservation aggravates the problem and there had been instances in certain seasons of heavy landings when the catch had to be buried in the nearby shore. It should be pointed out that this did occur when millions of people were suffering from lack of adequate protein food in their diet in the interior places. However, with the increased demand from interior area, employment of quick means of transport like trucks, provision of a net work of a motorable roads connecting the landing places with interior markets, availability of ice at the landing places and the improved technical knowhow imparted by the various scientific laboratories working on such problems etc., the consumption of this fish in the fresh form has showed a commendable upward trend touching a 60% level of the total landings and this process in turn has resulted in realising a better return. Administrative reports of the Department of Fisheries, Kerala State show that the price of sardine in recent years have gone upto Rs. 250 per ton in 1968-69 as against Rs. 73 in 1960-61 and Rs. 116 in 1964-65.

Another fact which may have an effect on realisation of lesser price may

TABLE II

PROXIMATE COMPOSITION OF OIL SARDINE

Moisture	65.28%
Fat	14.34%
Crude protein	18.10%
Ash	1.65%
Inorganic phosphorus	175 mg%
α amino Nitrogen	105 mg%

be the peculiar taste preference of consumers. This fish with its high oil content imparts a taste particular to this species which may not be in par with the accustomed taste, and a judicious consumer might be reluctant to pay a price similar to that paid for other more delicious fish available in good quantities.

Preservation and Transportation

As the fish is landed all along the coast line and the potential markets are generally thousands of kilometres away, expeditious transportation of fresh fish is not easy. Even the introduction of refrigerated trucks and rail wagons in limited numbers has not been able to solve the problem to any significant extent. The conventional method of preservation by icing also is not as effective as with other fishes because of its high oil content. The main problems linked with transport of fresh fish are the selection of a cheap and efficient container, economy of use of ice and detailed knowledge of physical and chemical changes the fish undergo during storage and transport. Some of the problems encountered in the low temperature preservation and transport of oil sardine are highlighted below:

(I) Belly bursting: During ice storage as also freezing and thawing, the belly flaps of sardine break and the viscera protrudes reducing the consumer preference, even though the fish is of prime quality and the organoleptic properties are not affected. The incidence of belly bursting in certain cases ranges upto 25-30% depending on maturity, fat content and nature of stomach contents (Perigreen and Govindan, 1969).

(II) Rancidity: With an oil content as high as 17% (wet weight basis) during peak seasons with high degree of unsaturation due to the presence of a good amount of poly-unsaturated fatty acids, the incidence of oxidative rancidity is very high.

Thus, it is evident that evolution of a suitable method of transportation presents multifarious problems and it is for the technologist to face the challenge which has been accepted with the deserving spirit by the scientists at Central Institute of Fisheries Technology and elsewhere in the country and vigorous and extensive research programmes launched with encouraging results and the salient features of the successes and advancements made so far are summarised below:

The most popular mode of transport in vogue till recently was by bicycles, conventional bamboo baskets or tea chests serving as containers with or without icing (Anon, 1969). Investigations have shown that sardine can be preserved for 10-12 hours in bamboo baskets when packed with 1 : 1 ice and for 14-18 hours in tea chests. By providing an inner lining of gunny and polythene or bitumen coated kraft paper the storage life could be further increased, upto 18 - 20 hours (Rao and Perigreen 1964). When the tea chests are insulated with 2.5 cm. thick thermocole covered with polythene (to prevent wetting of thermocole) the storage life goes upto 55 to 60 hours (Anon, 1965). Frozen and glazed sardine when transported in thermocole insulated tea chests / plywood boxes can reach destinations as distant as would require 4 days' journey in a safe condition (Perigreen, 1968). The fish at the end point, however, will be in a thawed

state. The expenses involved in freezing, packing and transport work out to about 70-80 ps. per kg. of fish.

Belly bursting, as mentioned earlier, is a serious problem encountered in freezing of sardine. Studies have revealed that this phenomenon is maximum in small size sardine with low fat content and minimum with bigger sardine with higher fat content and can be mostly overcome by a dip treatment in 15% brine for 30 minutes prior to freezing (Perigreen, Govindan & Pillai, 1969).

The problem of oxidative rancidity in freezing and preservation of oil sardine has been studied in detail and after studying the efficacy of various dip treatments and glazes, it has been successfully demonstrated that the oxidative rancidity could be effectively controlled and the storage life extended considerably by dipping the fish in a 0.05% solution of hydroquinone for 5 minutes or in 0.1% agar agar solution (Cyriac Mathen, Choudhuri & Pillai, 1969). The influence of different pre-freezing ice storage period on the biochemical and organoleptic qualities in the individually quick frozen and block frozen forms has been a matter of detailed investigations. There is no significant difference in organoleptic and biochemical characteristics between individually quick frozen and block frozen sardine (Vasanth Shenoy & Pillai, 1971). Oil sardine lost its acceptability and shelf-life if the pre-freezing ice storage lasts for more than 3 days (Ibid, 1971).

The scientists having contributed their mite in efficient utilization of sardine, much need to be done at the field of operation to maintain the quality. Provision of modern operational facilities for handling of fish at various stages such as landing, sorting, auctioning, cold storages, ice plants etc., supply of plentiful fresh water, provision of mechanical devices for quick handling where human labour may fail to be efficient and facilities for quick transport by road and rail are some of the essential requisites which have to be urgently attended to. Above all, there is the human element working behind all these and it is the proper acclimatisation of this factor with the modern scientific methods evolved for betterment of quality and a strict maintenance of this in all fields of action that will ultimately determine the quality of the product reaching processing centre or the ultimate consumer. This can be achieved by giving proper training to the personnel engaged in this field of work.

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