DEVELOPMENT OF LOW COST PROCESSING TECHNOLOGY FOR FISHES AND SHELLFISHES

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India is the seventh largest fish producing country in the world with a landing of 2.3 million tonnes. She is also one of the leading exporters of processed fishery products earning foreign exchange worth Rs. 1797. 4 million in 1977. While export of frozen prawns registered a steady increase over the past years, that of canned prawns declined steeply from 1974 onwards. Irrespective of the spectacular achievements of the modern fish processing industry in the country, the fact that more than 75% of the installed capacity for freezing and more than 90% of that for canning are remaining idle is indeed staggering. The industry having specialised in the processing of prawns, has not ventured into processing of other fish or shellfish.

India has a very long coastline with thousands of landing sites scattered all along. The processing factories are situated in urban and semi-urban centres which offer the necessary infrastructural facilities for handling and processing, because the landing centres situated mostly in rural areas cannot offer any of these. In the absence of an organised and centralised landing system, pooling of the catch and its movement to the actual processing sites pose immense problems. Both freezing and canning involve high monetary investment and several infrastructural facilities including skilled personnel and plentiful supply of raw material for economic operation and hence are not adoptable in the fishing villages in the country.

The under-exploited pelagic resources are sure to add to our fish catch in coming years. Introduction of aquaculture for different varieties of fish and shellfish has great promise. All these are sure to contribute towards sustained increased production of fish in the future which brings in its trail the problem of their proper disposal without wastage. Though scientific transportation of fish has helped in wider distribution of fresh fish, it cannot provide a complete answer. The solution largely lies in processing and preservation of fish and shellfish other than the low-volume high-cost varieties like prawns and lobsters, in the fishing villages themselves which can later be distributed throughout the country, ensuring proper disposal of the fish catch and thereby increasing its per capita consumption. The processing methods to be employed in rural areas should be based on low cost technology, which should cover the requirements for long/short term preservation, utilization of very small and uneconomic varieties of fish and for waste utilization.

Curing

Sun-drying and salt-curing are the oldest known techniques of fish preservation. Though there has been a sizeable decrease in the percentage of fish preserved by this method in India which is attributable to the increase in marketing in fresh form, curing is bound to retain its significant position in processing fish because, this is an easy method of preservation of fish employing a low cost technology.

Cured fish processed by the traditional methods possess several defects such as easy spoilage, attack by moulds and insects, rancidity, discoloration etc. Being a method practised exclusively in fishing villages, any attempt to improve its efficiency will have a direct impact on the betterment of rural economy since an improved product can command a better reception from the consumer and consequently better fiscal returns.

Adequate attention has been paid to problems in the research and development activities pertaining to fish curing. It has been reported that fungus growth and incidence of reddening could be effectively controlled by a simple treatment with propionic acid at 0·5% level (Valsan *et. al*, 1961; Rao and Valsan, 1962 *a*). Similarly propionic acid at small levels has been found to be a very effective preservative for pickled fish (Rao and Valsan, 1962 *b*, 1962 *c*;

Valsan, 1963 *a*, 1963 *b*). A modification has been worked out in the process of Colombo-curing by incorporating a small amount of sodium benzoate along with correct proportion of salt and Malabar tamarind which yields an attractive product with prolonged storage life. (Balachandran and Muraleedharan, 1975). Another modification worked out in the field of pickle curing is to use tartaric acid and garlic at 2% levels each along with saturated brine (Devadasan *et. al*, 1975).

Smoking

Though very popular in many countries, smoked fish is yet to make its appearance in the Indian market. Smoked fish classed among 'delicatessen' products, is succulent and readily acceptable and as such has great demand in the sophisticated markets of the west. Smoking is also employed as an intermediate step in the manufacture of canned products. Smoking has the unique advantage of being a low cost technology easily adaptable to the fishing villages for producing a sophisticated item.

There are two methods of smoking applicable for the rural conditions - hot smoking and cold smoking. In hot smoking process, the fish, after dressing and salting is preliminarily held at about 85 - 90°C for about 20 minutes, the temperature raised to 145-150°C for nearly 25 minutes and then smoked at 95-100°C for about 20 minutes, all the processes taking place in the kiln itself. In the cold smoking process, which yields a more stable product the salted fish, after preliminary drying, is smoked at a temperature not exceeding 40°C. The smoking time varies with the type of fish from 36 to 72 hours. Exact details of the processes depend upon the type of fish and the properties desired in the end product.

Smoking is applicable to several varieties of fish. Attractive and delicious smoked fillets with good storage life have been prepared out of oil sardine employing a process of salting followed by smoking at 70-80°C for 6 hours; splitting, deboning, heat-treatment of the fillets to prevent attack by mites and insects and finally wrapping in cellophane sheets. (Muraleedharan and Valsan, 1976). Mildly smoked and dried mussel meat processed by a simple method has been shown to be on par with similar products popular in overseas markets. Export possibilities of the product are also being explored.

Drying and dehydration

Drying in sun, with or without salting, has been practised all over the world since time immemorial. Since there is absolutely no control over any of the parameters for drying the products always used to be substandard, often contaminated by bacteria, admixed by sand and having high moisture content resulting in early spoilage. The extremely slow rate of drying causes some spoilage even during the drying process. However, dried fish has several advantages over other types of processed fish. It is more concentrated, requires minimum equipment and can be stored and distributed comparatively more easily. By bestowing a little more care in the application of the process and providing certain essential facilities like raised cement platforms for drying, protection from animals and birds and by employing hygienic practices in the operation, good quality products can be prepared by sun-drying. Use of tiltable wooden frames with wire mesh support for holding fish which can be directed towards sun will be of great advantage for drying fish. In the case of larger fishes the Norwegian method of drying stock fish *viz.*, split open fish tied in pairs by the tail hung over poles or lines can be advantageously employed. A method of sun-drying Bombay-duck by hanging them on scaffoldings permitting adequate interspace between individual pieces to facilitite circulation of air and escape of moisture (Prabhu, 1972) has been found to be very effective in yielding an excellent quality dry fish.

Development of solar dryers suitable for dehydration of fish will be of great help for application in rural areas. An attempt in this direction has been made by designing and fabricating a pilot model of such a dryer at the Central Institute of Fisheries Technology which can handle 50 kg fish per batch. Split open and salted fish can be dried in this dryer, which develops a temperature of 40°C, in 13-15 day light hours to 20-25% moisture level (Chakraborty, 1976).

Utilization of uneconomical varieties of fish

Development of low cost technology for processing fish should envisage utilization of

uneconomic varieties of fish as also processing waste. One method adoptable is conversion of such material into fish meal. A small scale fish meal dryer which can handle half a ton of raw material per batch has been designed fabricated and trial runs conducted (Chakraborty *et al.*, 1970). Some of the other processes which can be advantageously employed in the fishing villages are mentioned below.

Fish ensilage

Fish offals and uneconomical varieties of small fishes which do not find a ready market can be converted into ensiled products intended for animal nutrition. Minced fish mixed with 10% of weight of molasses to which is introduced an active fermenter will yield an ensile product in 10 days which can be incorporated at 10% and 2% levels into other feeds for poultry and cattle respectively. Alternatively minced fish with 6% (by volume) of 90% formic acid also gives a similar product. Both the products keep well for over an year. The processes are simple, do not involve any sophisticated equipment and no expertise is required in the processing (James, 1966; James *et al.*, 1976). Compounding of a dry feed mix from ensilage using rice bran and other vegetable byproducts also has been successfully done (Anon, 1975).

Fish wafers and fish soup powder

In the matter of utilization of inexpensive varieties of fish, the preparation of wafers and soup powder offers promising prospects. The ingredients for these are given in Table 1. The ingredients for wafers are ground together into a slurry, spread in trays to a thickness of 3-4 mm, cooked by steaming, cut to desired shapes and dried to a moisture level below 6%. The product on frying in oil swells to several times its size and yields crisp wafers. Preparation of soup powder involves cooking the fish meat, mixing with other ingredients, grinding to paste, drying and powdering. (Gopakumar *et al.*, 1975).

Salted fish cakes

Several methods of rapid salting applicable to different species of fish have been reported (Mendelsohn, 1974). An extension of the process to certain varieties of Indian fishes in the preparation of edible fish cakes has been successfully carried out. The method consists in mincing the fish with 20% of its weight of common salt, setting aside for 2 hours with proper mixing for uniform salting, in a screw press and drying in sun (Anon, 1976).

Edible fish powder

Palatable and protein-rich fish powder from low fat fishes like 'kilimeen' *Nemipterus japonicus*) or jew-fish (Sciaenids) has been prepared by employing a process of cooking the picked meat in an equal quantity of water containing 0.5% acetic acid, decanting off the supernatant layer along with any separated fat, filtering, washing the residue, drying pulverising and seiving. The product fed to children in the age group of 1-5 years along with bread, cassava or in a chutney from showed significant improvement in them, particulariy with respect to gain in weight and increase in mid-arm circumference (Anon, 1978).

Chitosan

An estimated 40,000 tonnes of prawn waste comprising head and shell is annually turned out by the prawn processing factories. This can be made use of for the recovery of protein and for production of chitosan, an industrial chemical with wide and varied potential applications, employing a simple technology. Squilla (*Oratosquilla nepa*) which is caught along with prawns while trawling and thrown back into sea at present can also be made use of for production of chitosan, process for which are readily available (Madhavan and Nair, 1974, 1975).

Shark fin rays

Shark fin is already an item of export from our country. The importers process it for the 'rays' used in the preparation of soup. If, in place of fin, the rays are extracted and exported it can fetch better returns as also create local employment potential. Rays are also in demand from high class hotels within the country which is at present met by imports. A very simple and effective method of extracting rays from shark fins making use of acetic acid and involving no equipment other than enamelled bowls and trays has been worked out (Nair and Madhavan, 1974) and field units, working on a cottage scale, have been established making use of this technology.

TABLE 1. *Ingredients For The Preparation Of Wafers And Powder.*

Wafers

Dressed fish meat	2 kg
Tapioca starch	2 kg
Corn starch	1 kg
Refined common salt	50 g
Water	1 litre

Soup powder

Dressed fish meat	1 kg
Refined commn salt	170 g
Hydrogenated vegetable fat	125 g
Onion (chopped)	750 g
Coriander	12 g
Tapioca starch	250 g
Milk powder	100 g
Canesugar glucose	30 g
Pepper powder	15 g
Garlic	5 g
Ascorbic acid	1.5 g

REFERENCES

Anon. 1975. Working papers for the Third Workship on All India Co-ordinated Research Project on Transportation of Fresh and Utilization of Trash Fish. 8-9 October, 1975, Cochin.

Anon. 1976. Working papers for the Fourth Workshop on all India Co-ordinated Research Project on Transportation of Fresh and Utilization of Fresh Fish. 27-28 October 1976, Cochin.

Anon. 1978. *Fish Technology*, Newsletter, 1 (2) : 3.

Balachandran, K. K. and V. Muraleedharan. 1975. *Fishery Technology*, 12 (2) : 145.

Chakraborty, P. K. 1976. *Research and industry*. 21 (3) : 192.

Chakraborty, P. K., S. Ayyappan Pillai and K. K. Balachandran 1970 *Fishery. Technology*, 7 (2) : 164.

Devadasan, K., V. Muraleedharan and K. George Joseph. 1975. *Fishery Technology*, 12 (2) : 156.

Gopakumar, K., A. V. Shenoy, M. P. Kuttyayyappan, M. Arul James and K. M. Iyer, 1975. Proceedings, Symposium on 'Fish Processing Industry in India", 13-14 February, 1975. C. F. T. R. I., Mysore.

James, M. Arul. 1966. *Fishery Technology*, 3 (1) : 38.

James, M. Arul, K. Mahadeva Iyer and M. R. Nair. 1976. Proceedings, Conference on 'Handling, Processing and Marketing of Tropical fish, 5-9 July, 1976; Tropical Products Institute, London.

Madhavan, P. and K. G. Ramachandran Nair. 1974. *Fishery Teehnology*, 11 (1) : 50.

Madhavan, P. and K. G. Ramachandran Nair. 1975. *Fishery Technology* 12 (1) : 81.

Mendelsohn, Joseph, M. 1974 *Journal of Food Science*, 37 (1) : 125.

Muraleedharan, V. and A. P. Valsan. 1976. *Fishers Technology*, 13 (2) : 146.

Nair, K. G. Ramachandran and P. Madhavan. *Fishery Technology*, 11 (1) : 60.

Prabhu, P. V. 1972. *Fish Technology* 9 (1) : 64.

Rao, S. V. S. and A. P. Valsan 1962 *a*. *Research and Industry*, 7 (9):304.

Rao, S. V. S. and A. P. Valsan 1962 *b*. Proceedings, First International Congress on Food Science and Technology London.

Rao, S. V. S. and A. P. Valsan. 1962 *c*. *Indo-Pacific Fisheries Council* 10 (2) : 315.

Valsan, A. P. 1963 *a*. *Indian Journal of Fisheries* 10 B (1) : 1.

Valsan, A. P. 1963 *b*. *Indian Journal of Fisheries* 10 B (2) : 9.

Valsan, A. P., M. R. Nair and S. V. Rao. 1961. *Journal of Scientific and Industrial Research* 20 D (9) : 351.