THE CANNING OF INDIAN PELAGIC FISH IN A YUGOSLAVIAN CANNING PLANT

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Abstract

Experiments in canning Indian fish in a Yugoslavian canning plant were made in June, 1977. The purpose was to determine if modern continuous lines, developed for canning Mediterranean types of fish, are suitable for Indian species.

Four different types of fish were used: oil sardine (*Sardinella longiceps*), Indian mackerel (*Rastrelliger kanagurta*), little tuna (*Euthynnus affinis*) and whitebait (*Stolephorus* spp.). Eleven different products were packed in three different types of steel and aluminium containers.

The results were promising. With small changes in the canning lines and in the technological processes it will be possible to produce canned fish of standards acceptable in the world markets.

INTRODUCTION

Although Indian waters are reasonably rich with fish suitable for canning, particularly along the southwest coast of Goa, Karnataka, Kerala and Tamilnadu States, the fish canning industry is not well developed.

As there is likely to be a new trend in the development of the fishing industry in India, namely the proposed introduction of large size fishing vessels, the Pelagic Fishery Project organized an experiment for canning Indian fish in a modern canning plant at Kombinat Za Ulov, Preradu i Promet Ribom 'Adria', in Zadar, Yugoslavia. The experiment was organized in close cooperation with the Integrated Fisheries Project and the Marine Products Export Development Authority, both of Cochin, India and the Prehrambeno-Technoloski Institut, Zagreb, Centar Za Ribu Privredu Miditerana at Zadar, Yugoslavia.

This paper reviews these experiments and includes some data about the availability of raw material in Indian waters, the existing status of the fish canning industry in India and a short description of the activities of 'Adria'. Details of technological processes and packaging materials are included.

RAW MATERIAL AVAILABILITY

The most important fish suitable for canning in India are pelagic fish such as sardine, mackerel and tuna. Prawns and other crustaceans are presently canned in India but production is limited.

Sardine

There are several types of sardines available in Indian waters. Among them the oil sardine (*Sardinella longiceps*) is by far the most abundant (UNDP/FAO, PFP Progress Report No. 18); it has excellent qualities for canning and is without doubt the most important fish for canning. The average annual stock of oil sardine for the

period 1960-71 has been estimated at 400 000 tonnes in the present fishing grounds (Silas *et al.*, 1976). There are various opinions, from industrial and research sources, that 50 000 tonnes of oil sardine per year could be available for canning purposes in the area between Goa and Cochin.

Mackerel

Indian mackerel (*Rastrelliger kanagurta*) is available in large quantities in Goa, Karnataka and Kerala coastal areas. The standing stock has been estimated at 57 000 tonnes for the period 1960-71 (Silas *et al.*, 1976) but the trend in the catch shows erratic annual fluctuations which are characteristic for most pelagic species along the west coast of India.

Whitebait

The extent of the whitebait (*Stolephorus* spp., previously called *Anchoviella*) resource is not fully known and estimates are sometimes contradictory. According to the UNDP/FAO, PFP Progress Report No. 18, in the year 1973, the stock of whitebait was largest in June/July and was estimated to be about 500 000 tonnes. Surveys in August and October, 1974 indicated 780 000 and 810 000 tonnes respectively. The situation in 1976 and the beginning of 1977 was quite different with whitebait present only in limited quantities (personal communication, Master fishermen H. Klokk and N. Hellevang). Thus there appear to be large fluctuations in the annual stock of whitebait. The largest landings and heaviest fishing occur in the Gulf of Mannar from July to October; is in thought that 200 000 tonnes of whitebait could be landed for industrial purposes (personal communication, K.V. Narayan Rao).

Tuna

There are indications that the larger pelagic species (tunas and tuna-like fishes) in the waters around Lakshadweep, Maldive Archipelago, Andaman and Nicobar Islands are much larger than indicated by catch records. A few thousand tonnes of skipjack (*Katsuwonus pelamis*) are harvested in Lakshadweep and the Maldive Archipelago (Silas *et al.*, 1976). Skipjack and little tuna (*Euthynnus affinis*) are also present in the coastal area of the west coast. As the tuna fishery is not yet developed in India, tuna canning could become an important part of the Indian fishing industry.

EXISTING FISH CANNING INDUSTRY IN INDIA

Canning is a relatively new method of fish processing in India. Canning started in the early 1950s when an abundance of shrimp was discovered on the west coast and reached peak production in the early 1970s. During this period, many small canning plants were in operation. Kerala alone had 42 canning plants with a daily capacity of 693 000 round cans of 210 g each. The industry was completely oriented to can shrimp for export and, when frozen shrimp overtook canned shrimp in the world market, the canning industry collapsed.

According to our knowledge, only six fish canning plants are in operation today in Goa, Karnataka, Kerala and Tamilnadu. The technology and equipment in the existing factories is very old and out-dated and canning operations are based mainly on manual work with discontinuous processing.

Realizing the above shortcomings, government organizations and private industry wished to develop a canning industry using Indian fish, packaging and other materials but with modern technology and equipment. Development would begin with the canning of sardine and mackerel, which are available in sufficient quantities, and be followed by whitebait and tuna.

CANNING EXPERIMENTS

Purpose of experiments

Modern, continuous canning lines are sometimes designed for only one type of fish. A canning line for sprats (*Sprattus sprattus*) in Norway has equipment such grading, nobbing and head-cutting machines developed only for sprats. Canning lines developed in Mediterranean areas for sardine (*Sardina pilachardus*), known as the 'Mediterranean sardine line' (Perovic, 1977), have special machinery for nobbing, brining and precooking sardine, a fish which is somewhat similar to the Indian oil sardine (*Sardinella longiceps*). Likewise, specially designed processing equipment is necessary for other fish such as mackerel and whitebait. The machines must be designed and constructed for each type of fish depending on body dimensions and other physical properties.

The idea of conducting a canning experiment in Yugoslavia with Indian fish emerged when technology and equipment for the development of an Indian fish canning industry was discussed. The cheapest solution was to use an existing line, constructed for a similar fish, to establish its suitability for the Indian species. Kombinat Za Ulov, Preradu i Promet Ribom 'Adria', Zadar, in Yugoslavia was chosen since Yugoslavia has a well-known fish canning industry and 'Adria' has several canning lines suitable for canning sardines, mackerel, tuna and other types of fishes by continuous and discontinuous processes. The experiment was carried out with the help and supervision of the Centre for Fish and Economy of Mediterranean (CFEM) and the Zadar branch office of the Food Technology and Science Institute (FTSI), Zagreb.

Raw material

The four most important Indian pelagic fish were used. Two of them, namely tuna and *Stolephorus*, were available in very small quantities since the landing of these fish was poor during the preparation stage of the experiment.

The type of fish and the quantity used in the experiment are given below and a chemical analysis is given in appendix 1.

	k g
Sardine (*Sardinella longiceps*)	1 854
Mackerel (*Rastrelliger kanagurta*)	234
Little tuna (*Euthynnus affinis*)	32
Whitebait (*Stolephorus spp.*)	20
Total	2 140

As the handling of each type of fish before canning was different, a short description of the treatment given to fish after catching is described below.

Sardine

The sardine were caught and landed by purse-seiners NORIND-2, KALAVA-2 and M-13 (17.4, 13.1 and 9.7 m respectively) of the Integrated Fisheries Project, Cochin, during their daily fishing operations. The fish were caught in the forenoon from the waters off Cochin landed the same day and freezing was completed in the evening. The entire quantity of sardine was frozen between 19 February and 7 March, 1977.

No icing of fish was done on board the vessel. Only very good quality sardines free from defects and damage were selected for freezing. Total length of sardines was in the range of 158-172 mm. Immediately on landing, the sardines were washed thoroughly in chilled water (fresh water and crushed ice) in washing tanks, stowed in aluminium fish boxes and transported to the processing hall. Processing started immediately and the fish were

washed once again with chilled water and weigh in 6 kg units with 10 percent extra weight. The sardines were arranged regularly, a polyethylene lining was used and sufficient chilled water was added to each slab to glaze the fish completely in order to avoid dehydration and rancidity during subsequent frozen storage.

A contact plate freezer was used for freezing. The size of the sardine block was 48.5 x 29.0 cm and the time taken for freezing was two and a half hours. Three frozen blooks of sardines were packed in each master carton (3 x 6 kg = 18 kg net weight) and kept in frozen storage at a temperature between $-20^{o}C$ and $-23^{o}C$.

Although the quality of the fresh sardine used for freezing was excellent, the quality of the frozen sardine, when used for the canning experiments, had deteriorated due to fluctuations in temperature during transport and storage over a period of 4 months, but was definitely still good and quite suitable for canning.

Mackerel

The entire quantity of mackerel was caught by NORIND-2 and frozen on 8 March 1977. The quality was excellent since the fish were landed within 2 hours of catching. The procedure adopted for freezing, packing, etc., was exactly the same as described for sardines. The size of mackerel used for the experiment (186-199 mm total length) was slightly smaller than that normally caught in commercial fishing operations.

Little tuna

Tuna were caught by the purse-seiner SAMUDRADEVI and landed on 7 April 1977. Quality of the fresh tuna was very good and each fish weighed 3-4 kg. The tuna was frozen in a tunnel freezer at a temperature of $-30^{o}C$. After freezing, the tuna were glazed in chilled water, packed in master cartons and kept in frozen storage.

Whitebait

Two sizes of whitebait, large (total length 113-133 mm) and small (total length 59-83 mm), were used for the experiment. Large fish were caught by the vessel TUNA during her trawling operation and kept in ice for about 3 days and landed on 12 April 1977. Small whitebait were caught by the research vessel RASTRELLIGER and frozen aboard the vessel. On landing, the whitebait were thawed and refrozen.

The fish were washed thoroughly in chilled water, weighed in 2 kg units with 10 percent extra weight and arranged regularly in waxed duplex cartons with a polyethylene lining. Chilled water was added for glazing. Fish blocks of size 30 x 17.5 cm were frozen in two hours in a contact plate freezer.

Transport

The frozen sardine, mackerel and tuna were transported from Cochin to Madran (600 km distance) on an open truck in a refrigerated container designed to maintain the temperature at $-18^{o}C$. During the transportation, the temperature in the refrigerated container rose to $-5^{o}C$ on one occasion, due to a defect in the refrigeration system but the defect was rectified and the temperature brought down to $-18^{o}C$ shortly afterwards. The frozen fish were loaded in the refer space of the cargo ship S/S BAKAR, where a temperature of $-20^{o}C$ was maintained, and transported to Rijeka, Yugoslavia. From Rijeka to Zadar, the frozen fish were transported by a refrigerated truck holding a temperature of $-18^{o}C$.

The frozen whitebait were carried by the authors as hand baggage from Cochin to Zadar. The fish were packed in a plywood box, lined on all sides with 5 in (12.7 cm) polystyrene insulation. The fish were kept in frozen storage at Bombay, Rome and Zagreb where there were delays in the journey. On reaching Zadar, the whitebait were still hard frozen. The quality of the large whitebait was moderately good but the small fish were of poor quality because of thawing and refreezing.

Technological process

The different technological processes used in the experiment are described in general and are also shown by flow sheets.

Sardines

The process used is shown in Flow Sheet 1. After removing from the cartons, the frozen sardine blocks were placed in fish boxes and thawed by a spray of sea water.

A 'Baader 461' nobbing machine was used initially but, when it was found that more than 20 percent of the fish was not properly eviscerated, nobbing was carried out by hand. As the 'Baader 461' machine was adjusted for nobbing *Sardina pilchardus* and was in regular use, it was not adjusted for *Sardinella longiceps*. It was thought that some changes in the machine could be made in order to nob and eviscerate *Sardinella longiceps* properly. After nobbing, the bodies were transported by conveyor to the washing machine and then to the brining unit. Brining time was 20 minutes and the concentration of brine 24°Be. The fish were then washed in another conveyor. A third conveyor transported the fish to the packing table where sardines were packed in 1/4 club 'decollage' cans or in 1/4 dingley aluminium cans. The cans plus fish were transported to the continuous cooker, known under the trade name of 'Utor'. Precooking was divided into two operations: steaming and combined drying and baking. Steaming was carried out at a temperature of 90°C with open steam for 20 minutes. Drying and baking were done at 120°C for 10 minutes using a mixture of steam and hot air. Precooked cans were filled with soybean oil by an automatic filling machine and closed by an automatic seaming machine. A similar operation was used for cans filled with tomato sauce. After washing with hot water in a continuous washing machine, the cans were placed in baskets and sterilized at 115°C for a period of 45 minutes. Sterilization was carried out in hot water with over pressure of 2.5 kp/cm^2.

After sterilization, the cans were again transported to the washing and drying machine and washed with water and detergent before drying by hot air. The cans were then packed in master cartons. Next day, the canned sardines were inspected, transported and stored in the premises of CFEM, Zadar, The heads and viscera, which represent about 28 percent of the total weight of sardines, went to the fishmeal and oil plant together with offal from other processing lines in 'Adria'.

Mackerel

The handling and thawing operation was the same as for sardines (Flow Sheet 2).

Thawed mackerel were placed on trays and precooked at 100°C for a period of 30 minutes in a steam chamber. Cooked fish was cooled for about 30 minutes at room temperature. Skin, heads, guts, bones, etc., were removed from the meat and fillets were formed by knife. The smaller pieces of meat were packed as flakes. The fillets were packed in 1/4 club 'decollage' cans or in 1/4 dingley aluminium cans; flakes were packed only in 1/4 club 'decollage' cans. The cans were filled with refined soybean oil.

Seaming, sterilization and all other operations were the same as in the processing of canned sardines.

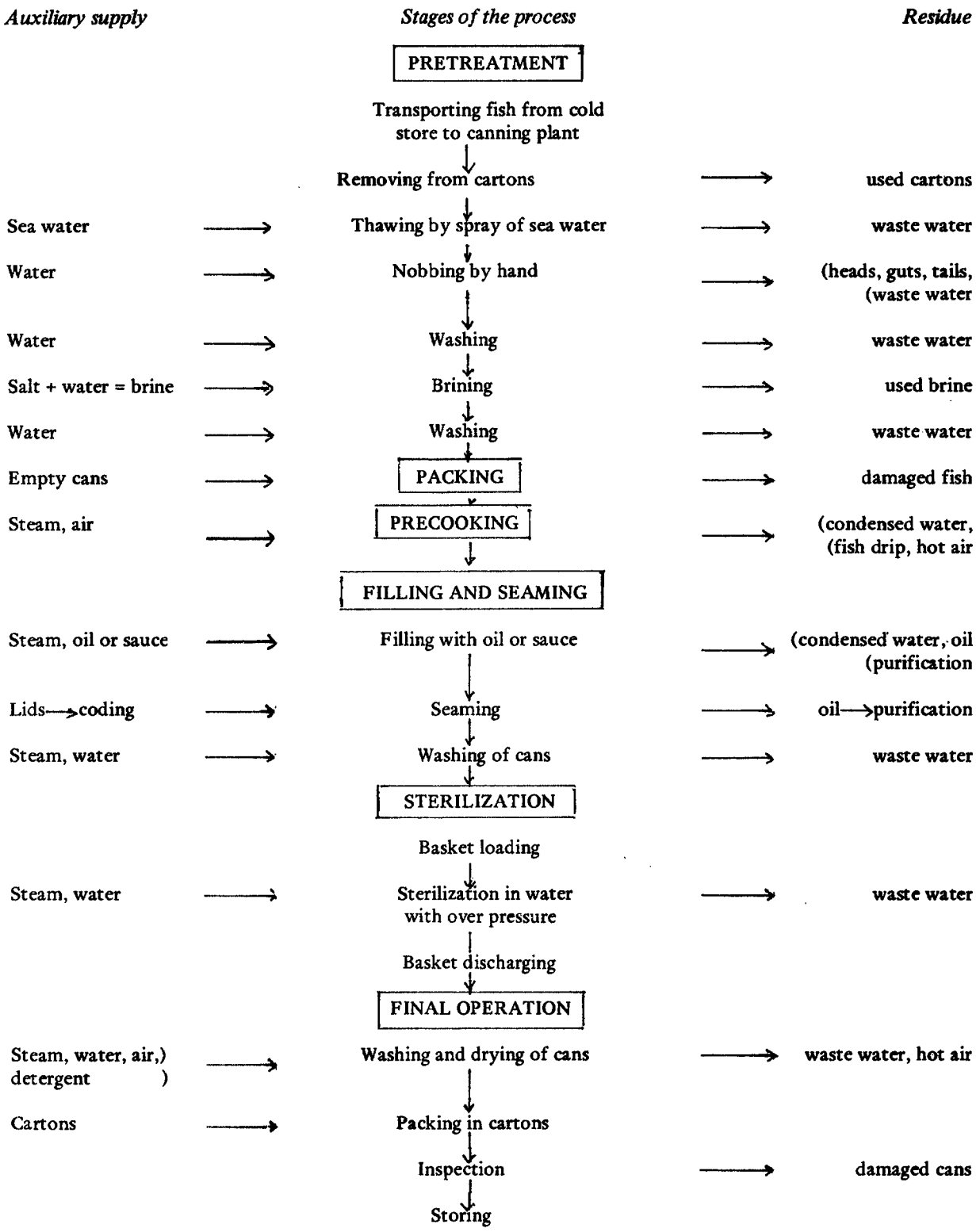
Little tuna

Although only a small quantity of tuna was available (32 kg), normal canning procedures were employed (Flow Sheet 3) but hand packing techniques in 1/4 club 'decollage' cans were used.

The tuna were thawed at room temperature overnight and in the morning were sprayed with sea water. Thawed fish were placed on trays and precooked in steam for 2 hours and 15 minutes at a temperature of 100°C, cooling was at room temperature for 1 hour. During the cleaning operations, heads, guts, skin, bones and

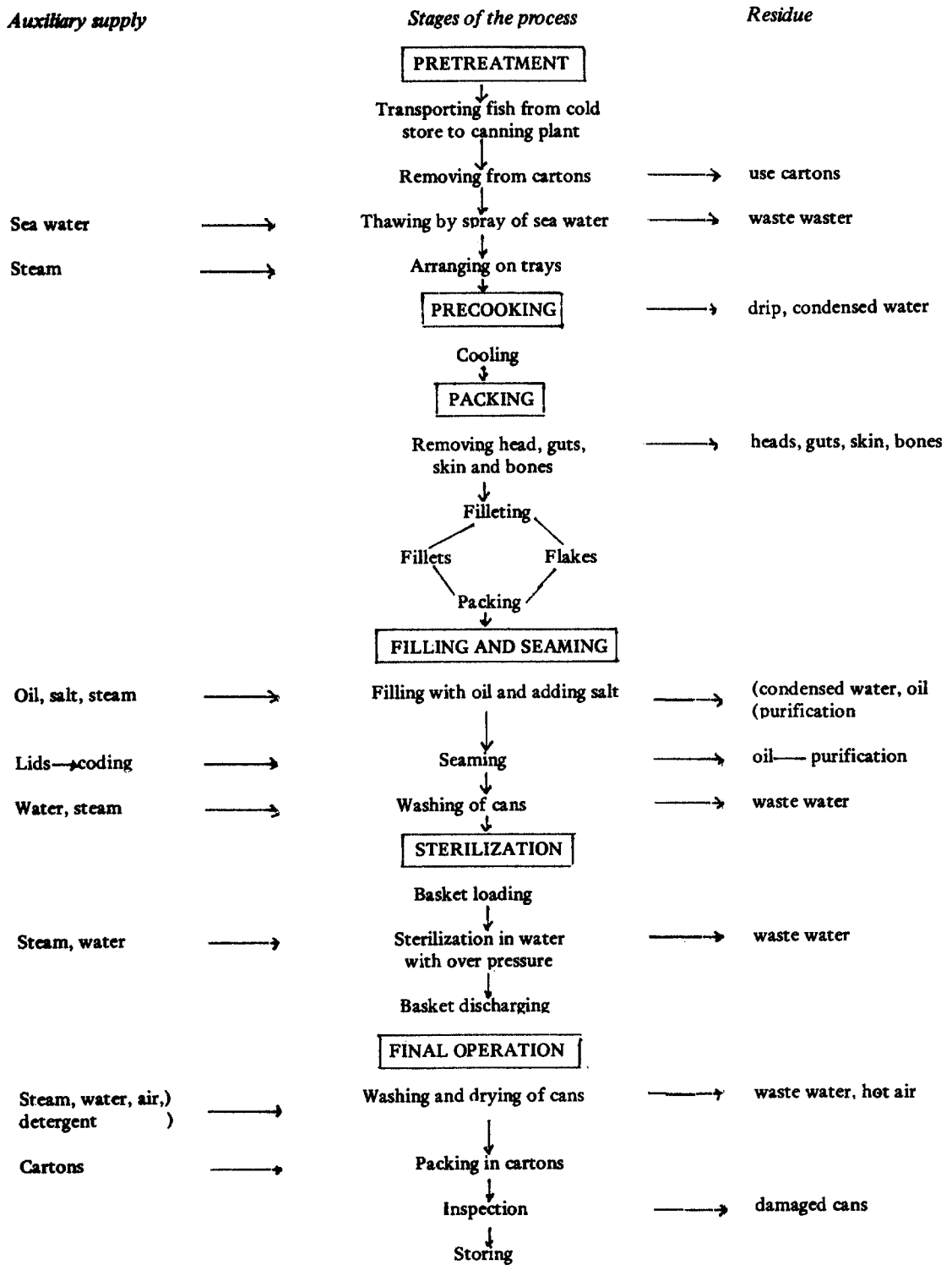
FLOW SHEET 1

Technological Scheme for Sardine Canning



FLOW SHEET 2

Technological Scheme for Mackerel Canning



black (dark) meat were removed. The cleaned meat was cut into flat pieces called fillets and smaller pieces of meat were packed as flakes. The fillets and flakes were packed in 1/4 club 'decollage' cans; oil and salt were added into the cans before seaming. Nine 1/4 dingley aluminium cans were packed with flakes, vegetable and tomato sauce.

All other canning operations were the same as in processing of canned sardines.

Fish spread

The experiments in canning fish spread using *Sardinella longiceps* and *Stolephorus* spp. were carried out in the technological laboratory of CFEM which has developed the technology for the production of canned fish spread (Flow Sheet 4).

The sardine were transported to the laboratory in frozen condition and thawed in running water. Heads and viscera were removed by hand. The edible portion of the fish was washed, placed in a double jacket tilting kettle and cooked with water, fat and salt for 15 minutes. After cooking, the fish and liquid were passed into a cutter where additives such as garlic, tomato concentrate, sodium caseinate and spices were added. The duration of cutting was 15 minutes. After cutting, the paste was packed into number 1/10 round 80 g aluminium cans and seamed by a semi-automatic machine using tear-off lids. Sterilization was effected in water at 115-116°C for 30 minutes with an over pressure of 1.5 kp/cm^2. The cans were then washed in hot water and detergent, dried and packed in master cartons. The cans were inspected the next day before being stored.

The procedure was the same for the canning of whitebait spread except that the heads and viscera were not removed; after thawing and washing, the frozen round whitebait were directly used for cooking.

Sardine and whitebait were processed into fish spread according to the following receipe:

Ingredient	*Sardine spread* (%)	*Whitebait spread* (%)
Fish	48.18	53.57
Water	22.00	13.29
Fat	23.29	26.79
Sodium caseinate	1.92	2.23
Salt	0.95	1.03
Tomato concentrate (30%)	1.68	1.88
Garlic (powder)	0.72	0.80
Spices	0.60	0.45
	100.00	100.00

Packaging material

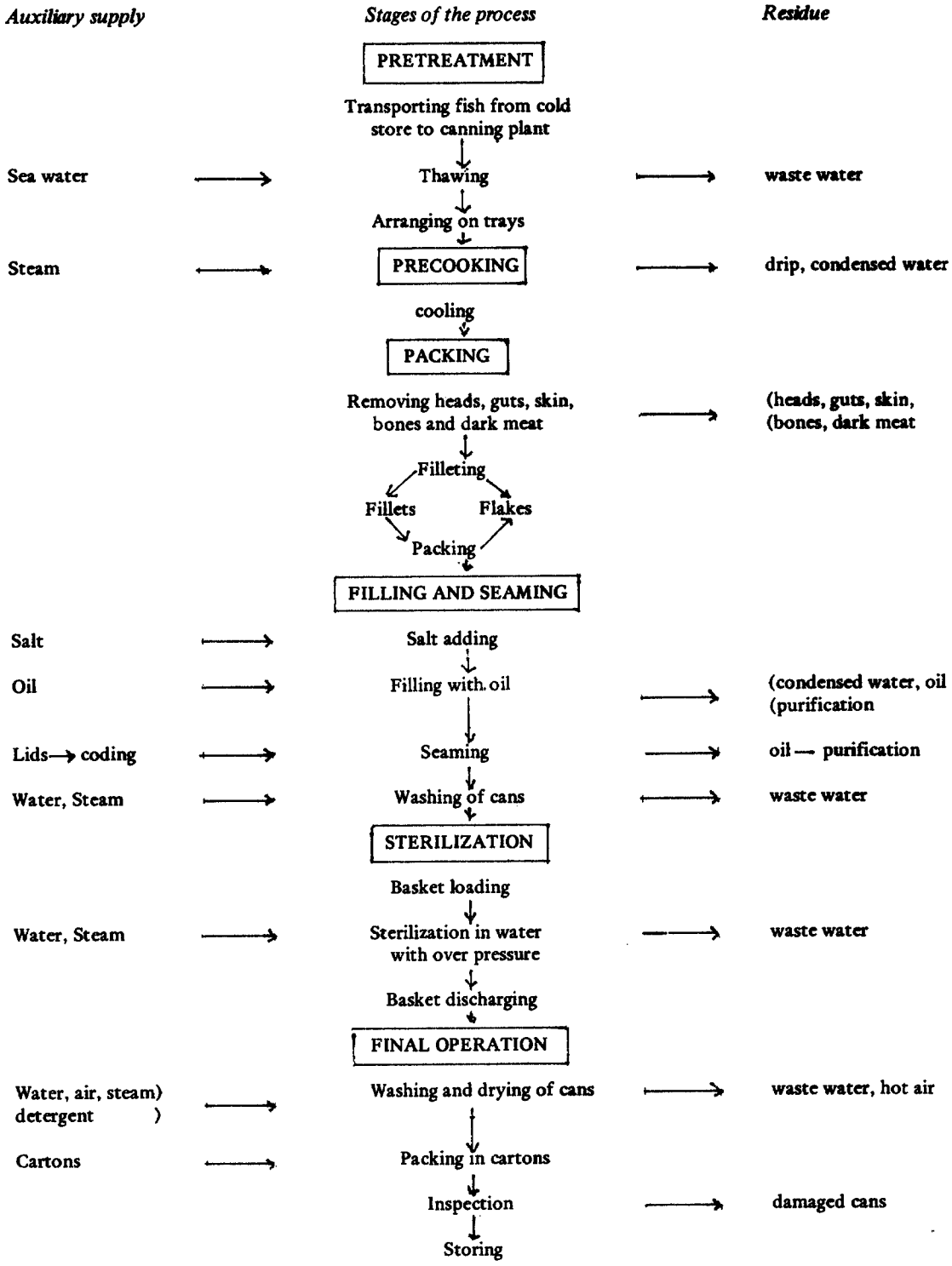
Three different types of cans were used in the experiment:

1/4 club 'decollage', made from tin plate, capacity 125 g
1/4 dingley aluminium, capacity 115 g
1/8 round aluminium, capacity 80 g

The 'decollage' can was closed by an ordinary lid, the dingley can lid had a tongue and a score line for easy opening, and the round can had a 'tear-off' lid.

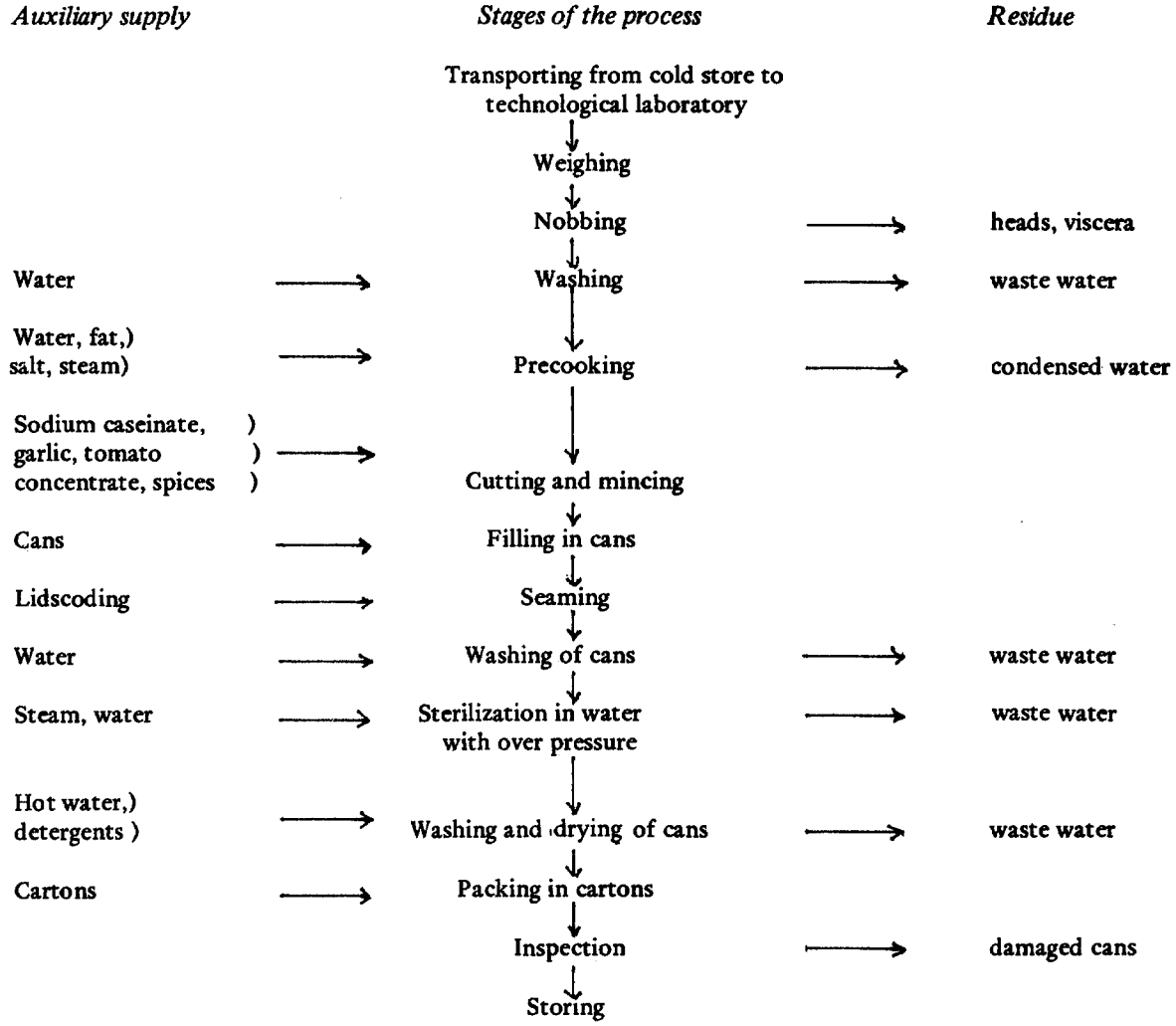
FLOW SHEET 3

Technological Scheme for Tuna Canning



FLOW SHEET 4

Technological Scheme for Fish Spread Canning



The club can is the typical Mediterranean type of can for packing sardines, fillets and similar products; it is not known in India. This type of can was used in the experiment of packing sardines, mackerel fillets and tuna fillets and also for flakes. The dingley can originated from Scandinavian countries and nowadays is generally produced from aluminium. This type of can, but made from tin plate, is used in India for packing sardines in oil. Sardines, mackerel fillets and flakes were packed in dingley aluminium cans during the experiment.

The round can of 80 g capacity is typical for packing spread or paste. The modern 'tear-off' lid permits easy opening, without additional apparatus, which is important in the marketing of canned foods. Sardine and whitebait spread were packed in this type of can.

All products were packed in master cartons, each carton containing 100 cans of 1/4 club 'decollage' type, 112 cans of 1/4 dingley type, or 98 round cans.

RESULTS AND DISCUSSION

The experiments were carried out between 3 and 29 June 1977. Total production was 11 323 cans with eleven different products packed in three types of containers. Product details and yields are given separately for sardine, mackerel, little tuna and whitebait in Tables 1-4. Results of the taste panel assessment for all products are given in Appendix 2. The discussion covers the most important aspects noticed during the experiment.

Sardine

Table 1

Product obtained and yield – sardine

No.	Product	Raw material (kg)	Net meat in cans (kg)	Yield (%)	No. of cans	Fish per can (g)	Medium		Additives (g)
							Oil (g)	Sauce (g)	
1.	1/4 club 'decollage' sardine in oil		446.7		4 467	100	25	–	–
2.	1/4 dingley aluminium sardine in oil		260.0		2 833	92	23	–	–
3.	1/4 club 'decollage' sardine in tomato sauce		87.9		879	100	–	25	–
4.	1/4 dingley aluminium sardine in tomato sauce		96.9		1054	92	–	23	–
5.	1/8 round aluminium sardine spread		35.8		840	42.6	–	–	37.4
	Total	1 854	927.2	50	10 073	–	–	–	–

Since more than 20 percent of the fish was not eviscerated by the 'Baader 461', this machine may have to be adapted for the Indian sardine. Alternatively, other types of nobbing machine available in the world market could be tested for nobbing *Sardinella longiceps*.

Precooking is one of the most important operations in the canning of this fish. The 'Utor' continuous cooker developed for precooking small pelagic fish gave excellent results with *Sardinella longiceps* but it will be necessary to make further studies on the time and temperature for precooking. It appears that the second part of the precooking is of significant importance in softening the scales which were not removed before canning. Present sardine canning operations in India include descaling of the fish.

The sterilization regime used in the experiment (115°C, 45 minutes and 2.5 kp/cm^2 over pressure) was not sufficient for sardine in 1/4 club cans (and possibly the 1/4 dingley cans also) as the backbone and scales were not soft enough.

Sardinella longiceps appears to be a good fish for canning and, because of certain physical properties, it will be easy to produce good quality canned products on a continuous line of the Mediterranean type.

Organoleptic assessment of the quality of canned Sardines by experts from the CFEM was carried out a few days after canning. The result (Appendix 2) indicated that the product was generally 'good' but not 'very good'.

The sardine spread produced with the recipe from CFEM is a good balanced product. The quality is similar to sardine spread made from *Sardina pilchardus.* This recipe could be adapted according to the Indian taste and we believe this product could be an important item for the Indian domestic market.

Mackerel

Table 2

Product obtained and yield – mackerel

No.	Product	Raw material (kg)	Net meat in cans (kg)	Yield (%)	No. of cans	Fish per can (g)	Medium oil (g)	Additives (g)
1.	1/4 club 'decollage' fillets in oil		51.0		510	100	25	–
2.	1/4 dingley aluminium fillets in oil		5.9		64	92	25	–
3.	1/4 club 'decollage' flakes in oil		34.9		349	100	25	–
4.	1/4 dingley aluminium flakes with vegetables		0.58		10	58	–	57
	Total	234	98.38	39.5	933	–	–	–

Mackerel fillets were made since there is no similar product in India. There were no problems during the processing operations; the product was good and the quality of fillets was of international standard. The only problem was that the fish used in the experiment were too small for filleting and the total yield was only 39.4 percent, of which 24.0 percent was fillets and 15.4 percent was flakes. Mackerel of this size may be good for packing in dingley cans of 130 g or oval cans of 200 g.

Fish flakes packed in oil are usually a cheap product but flakes can also be used to develop new canned products such as flakes of mackerel with vegetable and tomato sauce. Only tin cans were produced with a mixture of flakes, vegetable and tomato sauce. Quality of the product was very good, but more development is needed for this product.

Little tuna

Processing of only 32 kg of little tuna (*Euthynnus affinis*) was done to check the colour of the meat after canning, and to produce tuna fillets, one of the most valuable types of canned tuna product.

The colour of meat obtained after canning was similar to commercial packs of the same species, being somewhat darker than light meat tunas. Forming of fillets was easy, but total yield and yield of fillets was lower than the yield of other types of tuna canned at 'Adria'. The quantity of tuna was too small for any serious conclusion, especially in the yield of fillets but the taste and smell of the meat was good and was typical for this type of product.

Little tuna

Table 3

Product obtained and yield – little tuna

No.	Product	Raw material (kg)	Net meat in cans (kg)	Yield (%)	No. of cans	Fish per can (g)	Medium		Additives (g)
							Oil (g)	Sauce (g)	
1.	1/4 club 'decollage' tuna fillets in oil		6.50	20.31	65	100	25	–	–
2.	1/4 club 'decollage' tuna flakes in oil		6.30	19.69	63	100	25	–	–
3.	1/4 dingley aluminium tuna flakes with vegetable		0.52	1.63	9	58	–	–	57
	Total	32.0	13.32	41.63	137	–	–	–	–

Whitebait

Table 4

Product obtained and yield – white bait

No.	Product	Raw material (kg)	Net Meat in cans (kg)	Yield (%)	No. of cans	Fish per can (g)	Oil per can (g)	Additives (g)
1.	1/8 round aluminium whitebait spread	15	11.33	75.53	266	42.6	–	37.4
2.	1/4 dingley aluminium whitebait	2	1.19	60.00	13	92.0	17	–
	Total	17	12.52	–	279	–	–	–

The fish spread made from *Stolephorus* spp. had a typical light colour, good odour and taste. Consistency was good but still with some small particles which the cutter was not able to crush. A better consistency could be obtained by using a colloid mill but one was not available for these trials.

This type of minced product is ideal for the utilization of smaller fish such as whitebait (100–350 pieces/kg).

A few cans of nobbed whitebait were produced. The canned product was of inferior quality compared to canned sardines due to its organoleptic characteristics and appearance.

CONCLUSIONS

From these experiments, it can be concluded that the following types of pelagic fish available in India are suitable for canning.

Sardine (Sardinella longiceps)

This fish can be successfully processed by using the canning line for small pelagic fish of the Mediterranean type.

The nobbing machine must be adapted for this type of fish and further studies and trials should be conducted on precooking and sterilization of the fish.

The canned sardine made during the experiment were of good quality and acceptability. They are considered suitable for marketing in domestic and international markets.

Mackerel (Rastrelliger kanagurta)

The quality of the canned mackerel was good; the low yield resulted probably from the relatively small sized fish used in the experiment. It will be necessary to find a suitable type of round can for packing of mackerel of this size.

Little tuna (Euthynnus affinis)

The canned little tuna had a darker colour than light meat tuna packs. Most international markets prefer light meat tuna, so this would probably be acceptable in the 'bonito' market areas. It is also suitable for the development of varied products, such as little tuna with vegetable and tomato sauce.

Fish spread

The canned fish spread produced from *Sardinella longiceps* and *stolephorus* spp., is of similar quality to spread made from *Sardina pilchardus.* This type of product should play an important role in the utilization of Indian whitebait.

Packaging material

Two types of packaging materials were used in the experiment, tin plate and aluminium alloy, and three different types of cans. Though both packaging materials have good canning properties, aluminium alloy is readily available in India and has several advantages over tin plate and is suggested as the packing material to be used in India.

REFERENCES

Perovic, V., 1977 The canning of fish in tropics *In* Proceedings of the Conference on the handling, processing and marketing of tropical fish. London, Tropical Products Institute, pp. 337-49

Silas, E.G., S.K. Dharmaraja and K. Rengarajan, 1976 Exploited marine fishery resources of India; a synoptic survey with comments on potential resources. *Bull. Cent.Mar.Fish.Res.Inst., Cochin,* (27): 25 p.

APPENDIX 1

Chemical Analysis of Raw Material

Sardine (*Sardinella longiceps*)

	percent
Moisture	69.56
Oil	12.82
Protein	15.11
Ash	2.15

Indian mackerel (*Rastrelliger kanagurta*)

	percent
Moisture	68.13
Oil	9.56
Protein	18.87
Ash	2.58

Whitebait (*Stolephorus* spp.)

	percent
Moisture	73.11
Oil	7.27
Protein	16.63
Ash	2.61

Little tuna (*Euthynnus affinis*)

Due to small amount of fish, chemical analysis was not made.

APPENDIX 2

Panel Assessment of the Quality of Canned Fish

Features	Product							
	Sardine in oil	Sardine in sauce	Mackerel fillets	Mackerel flakes	Tuna fillets	Tuna flakes	Spreads Whitebait	Sardine
Appearance								
Very good	–	–	–	–	–	–	–	–
Good	x	x	x	x	x	x	x	x
Satisfactory	–	–	–	–	–	–	–	–
Odour								
Very good	x	–	–	–	–	–	–	–
Good	–	x	x	–	x	–	x	x
Satisfactory	–	–	–	–	–	x	–	–
Taste								
Very good	–	–	–	–	–	–	–	–
Good	x	–	x	–	x	–	x	x
Satisfactory	–	x	–	x	–	x	–	–
Texture								
Very good	–	–	–	–	–	–	–	–
Good	x	x	x	–	x	–	x	x
Satisfactory	–	–	–	x	–	x	–	–