STUDIES ON CANNING OF MACKEREL FILLETS IN OIL

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Canning operations suitable for packing mackerel *(Rastrelliger kanagurta)* in the form of skinless and boneless fillets in oil were studied and the process standardised. The technique of lye peeling for skin removal could be successfully applied. The storage life of the final product was tested over a period of one year and found to be quite comparable to other similar fish products.

INTRODUCTION

Several species of Atlantic and Pacific mackerels are widely used as raw material for canning (Jarvis, 1943). The Indian species *(Rastrelliger kanagurta)*, though smaller in size, is quite suitable for processing by canning. It forms a substantial proportion of our marine landings, the majority of which is fished on the west coast. At present this fish is canned in one or two pieces, with skin and bone, in round sanitary cans using brine, refined oil or tomato sauce as packing medium. A 'curry' has also been formulated as an alternate filling medium (Rai, Saralaya and Parashuram, 1971). This paper reports the development of a new product of superior quality in an attractive and more convenient form. In this improved form the product is expected to have better acceptability and also export potential.

MATERIALS AND METHODS

Mackerel obtained from commercial catches were used in fresh, iced or frozen condition. Double refined deodorised vegetable oil was used as filling medium and quarter dingly can (Anon., 1967) as container.

Fish canning procedures described by Broek (1965) were followed in this work. The fish were deskinned by lye peeling in hot sodium hydroxide solution, washed thoroughly and cooked in steam in autoclaves or retorts. They were then cooled

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to room temperature, cleaned and filleted. The fillets, after trimming, were packed into plain quarter dingly cans either longitudinally or across the cans by placing them in the can in two layers with their flat inner surface facing the bottom and top of the container. For this style of packing, two or two and a half fillets in each layer were generally sufficient for one can. The cans were then filled with hot (80-85°C) double refined groundnut oil to make up to the adopted 106 g. net weight, and about 2 g. of powdered table salt were added to each can to give the necessary salty taste and to provide a safety margin in the net weight. The filled cans were exhausted in steam with lids on for about 10 min. at 100°C, and then promptly double seamed while still hot. These were then adequately processed by retorting, cooled in water, wiped dry and stored at room temperature. The various operations were standardised by several trials. The product was tested at regular intervals for about an year after production and its acceptability and shelf life were ascertained. Microbiological examinations at various stages, from raw material to finished product, were also conducted to determine the efficiency of operations at different stages of processing.

Results And Discussion

Mackerel in the fresh, iced or frozen condition may be used for canning by this method. However, it was found that frozen fish in semithawed condition, being firmer than either fresh or iced fish, were more convenient for lye peeling, handling and preparation. On the other hand, fillets prepared out of fresh fish were prone to breaking easily during processing.

Relation of fish size to canning yield

Table I shows the relationship between fish size and the final yield of fillets obtained, as percentage of fish weight. It can be seen that mackerel of size around 100 g. round weight give the maximum yield when canned as fillets in quarter dingly cans, because of minimum wastage in cleaning and trimming. Incidentally this size group forms the majority of commercial catches.

Deskinning

'Lye peeling' of the skin, unlike manual peeling or peeling by other methods, has been found to be very convenient in the case of small fish like mackerel, since the method removes the skin neatly without disturbing the meat fibres, resulting in a smooth and even surface. Peeling loss can also be minimised by carefully controlling the lye concentration, temperature and dip time. The effects of different lye treatments are summarised in Table II. It was found that peeling effect was better when higher concentrations of alkali or longer dip durations were applied. Considering the peeled condition of the fish peeling loss and breakage of meat in the fillets, dipping the fillets in boiling 1% sodium hydroxide solution for one minute in the case of mackerel of normal size and for one to two minutes in the case of extra large fish, was found to be optimum.

The figures in this table refer to frozen thawed fish samples. But even fresh fish samples when subjected to lye treatments showed similar trends. Statistical analysis of the results showed that there was significant difference in

TABLE I
Influence of fish size on fillet length and canning yield.

Sample No.	Length of fish (cm.)	Weight of fish (g.)	Length of fillets obtained (cm.)	Final canning yield (% weight of fish)
1	19.0	67.0	9.3	22.4
2	19.4	88.0	9.5	24.2
3	19.8	89.1	10.2	28.7
4	20.3	96.9	10.3	29.9
5	20 4	100.0	10.5	32.0
6	21.1	111.8	10.9	28.9
7	21.5	116.0	10.6	28.1
8	22.5	133.0	11.5	29.8

TABLE II
Effect of lye treatments on mackerel used for canning as fillets.

Lye treatment given		Average initial weight of fish (g.)	Loss in peeling & washing (% of fish weight)	Meat breakage (% of No. of pieces)	Peeled condition
% NaOH	Dip time				
0.5	0.5	88.7	2.2	0	UP
	1.0	89.4	5.0	0	UP
	2.0	83.6	8.6	6.7	1/3UP, 2/3GP
	3.0	88.3	13.2	60.0	2/3GP, 1/3OP
	5.0	88.5	18.6	66.7	OP
1.0	0.5	86.6	2.0	13.3	UP
	1.0	86.0	8.6	13.3	GP
	2.0	84.7	12.1	66.7	2/3GP, 1/3OP
	3.0	81.8	15.9	80.0	OP
	5.0	79.3	27.5	100.0	OP
2.0	0.5	84.7	3.7	0	UP
	1.0	88.1	7.0	20.0	GP
	2.0	92.9	14.8	66.7	1/3GP, 2/3OP
	3.0	85.7	17.8	80.0	OP
	5.0	87.2	25.2	100.0	OP
3.0	0.5	88.2	4.7	33.3	1/3UP, 2/3GP
	1.0	87.1	6.3	53.3	OP
	2.0	81.7	16.5	93.3	OP
	3.0	90.9	23.1	100.0	OP
	5.0	94.9	31.8	100.0	OP

Note:- UP – Under peeling; GP – Good peeling; OP – Over peeling.

TABLE III
Influence of washing on lye peeled fish.

Samples	Control, dipped in boiling water for 1 min.		Lye treated, dipped in boiling 1% NaOH for 1 min.	
	pH of surface by paper	pH of meat by meter	pH of surface by paper	pH of meat by meter
After treatment and dip washing in tap water.	6.45	6.35	7.50	6.65
After washing in running water for 5 min.	6.35	6.23	7.25	6.38
-do- 10 min.	6.30	6.28	6.90	6.38
-do- 15 min.	6.25	6.18	6.40	6.23
-do- 20 min.	6.25	6.30	6.25	6.20

Note:- Initial pH of fish surface: 6.25 and of fish meat : 6.30

peeling effect with changes in either alkali concentration or dip time. But the difference between fresh fish and frozen fish samples was not significant at 5% and 1% levels.

It is necessary that washing the fish after lye peeling be sufficient to remove all traces of alkali from the fish, so as to avoid pH changes and other adverse effects of alkali on taste, flavour, can corrosion, etc. in the finished product. The influence of washing the lye treated fish over different durations is shown in table III. It can be seen that the fish treated with 1% alkali for one min. loses all the alkali, both on the surface and in the meat, when washed in running water for 20 minutes.

Precooking, cooling and filleting

The peeled and washed fish were cooked and cooled as in the case of canning tuna (Lassen, 1965). Cooking the fish in steam at 100°C for 20 min. and cooling overnight in racks served the purpose adequately. The total reduction in weight due to cooking and cooling was around 30% of the fish weight.

In cleaning and separating the fillets from bones, it was found that thin bamboo strips could be used with great advantage. The belly side of the fillets was cleaned by gentle washing; but dipping fillets in water for any length of time was avoided to prevent moisture intake. Care was necessary in these operations which were manually performed, so as to obtain the fillets whole and unbroken. The fillet ends were trimmed by sharp knives, to give lengths of 9.5 - 10.0 cm. for lengthwise packing and 6.5 - 7.0 cm. for breadthwise packing in quarter dingly cans. The trimming losses were around 6 to 8% of fillet weight. The yield of trimmed fillets was around 30 to 32% of the original fish weight in the optimum size group (Table I).

TABLE IV

Microbial fluctuations in the canning of mackerel fillets.

Stage of operation	Sample	Total plate count/g.	Mesophilic spores/g.	Thermophilic spores/g.
Raw material (round fish)	a	5×10^3	0	0
	b	7×10^3	5	0.
Lye peeled & washed fish	a	5×10^2	0	0
	b	5×10^3	0	0
Precooked fish	a	0	0	0
	b	1×10	0	0
Fish after overnight cooling	a	3.2×10^5	0	0
	b	7.2×10^4	0	0
Packed meat, after cleaning & filleting	a	3.5×10^5	10	0
	b	3.5×10^5	0	0
Final canned product	a	0	0	0
	b	0	0	0

Note:- Sample (a) : iced fish; sample (b) : frozen fish. (Values are average)

TABLE V

Thermal processes used or recommended for mackerel canned in oil, in containers of different sizes.

Product	Can used	Mininum dimension for heat penetration	Retort pressure psi	Temp-erature °C	Process time min.
Mackerel in oil (full size with skin & bone)	No. 1 Tall (301 x 409)	37 mm. (radius)	10	115	90-100
Mackerel in oil (half size with skin and bone)	8 oz. can (301 x 206)	27 mm. (half height)	10	115	70-75
Pacific mackerel fillets in oil	Square 5A can	14 mm. (half height)	8	112	75
Indian mackerel fillets in oil	Quarter dingly can	9 mm. (half height)	8 (Recommended)	112	40

TABLE VI

Results of product examination by 'cut-out' test and 'panel' tests.

Test	Charateristic of the product	Canned fillets made of	
		Iced mackerel	frozen mackerel
Cut-out Test	Net weight of contents (g.)	112.5	114.9
	Drained weight of solids (g.)	82.2	80.1
	% of water in drained liquid	37.5	34.6
	Can vacuum by piercing gauge (cm. of Hg)	6-16 (Mean : 9.25)	6-17 (Mean : 9.8)
	pH of contents	6.28	6.30
Panel Test	General appearance on opening the can	Good	Good
	Colour of meat	Good	Good
	Flavour	Acceptable	Acceptable
	Taste	Good	Good
	Texture of fillets	Good	Good
	Can condition (internal) with special reference to S-discolouration.	Acceptable	Acceptable

Exhausting.

Exhausting in steam was necessary since filling with hot oil alone could not be relied upon to give sufficient vacuum in the can, as the fillets were cold-packed in this method. The ten minute exhaust with lid on was found to give 9-10 cm. of vacuum in the final product, which is quite adequate, with reference to I. S. I. specifications, which require that for cans other than round there should be positive vacuum.

Microbiological evaluation and process requirement

Microbiological examinations showed that lye peeling and pre-cooking reduced the total count of organisms initially present whereas overnight cooling and further handling of the fillets caused increases. However, the final processing of the filled cans for 40 minutes at 112°C (8 psi) was found to be adequate for obtaining a product that was commercially sterile. The fluctuations in bacterial load are shown in Table IV. The thermal process recommended for this product has been compared with other processes employed for similar products in other containers (TableV).

Evaluation of product quality and shelf life

The canned mackerel fillets stored at ordinary temperatures, when subjected to regular cut-out tests and panel tests, were found to be satisfactory with respect to all the characteristics significant for canned fish products. The summary of results of these tests, conducted upto one year after production, is presented in table VI.

Of the six organoleptic characteristics, four have been judged as 'good' and two as 'acceptable' on a four point scale (excellent, good, acceptable and not acceptable). The presence of sulphide discolouration at certain points on the can interior, as found in the tested samples, were not so intense as to render the product unacceptable.

The quality of the product was found to be consistent upto one year after production of the canned fillets. There was no deterioration either in texture, colour, flavour or taste.

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