PREPARATION OF SMOKE CURED FILLETS FROM OIL SARDINE

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A method of preparation of smoke cured fillets of oil sardine is described. Various procedural steps like brining, smoking, packaging etc. have been described and the shelf life assessed. Sodium propionate treatment is recommended to ehnance storage life; BHA to control rancidity; and thermal treatment to overcome the insect infestation. The product has good consumer appeal.

INTRODUCTION

Oil sardine constitutes about 30 % of the country's total marine landings. Because of the lack of proper preservation facilities considerable quantity of the fish is either wasted or under utilized. Even smoke curing, a very popular method of preservation employed in Ceylon, Malaysia and Europe, is seldom practised in this country.

Various reasons are attributed to the neglect shown to smoke curing. In the first place smoke curing, as practised in the conventional method, yields a product of short storage life. Secondly smoking calls for more careful and critical operations, and the carefree approach usually adopted in the conventional dry curing and wet curing will not yield a product of satisfactory qualities.

Very little attention has hitherto been paid to improve this situation. Although certain preliminary studies have been reported to standardise the procedure, scanty efforts appear to have been made to improve the keeping quality of the product. The present paper reports the results of investigations undertaken to prepare good quality smoked sardine fillets.

MATERIAL AND METHODS

Fresh oil sardine *(Sardinella longiceps)* of average length 14 cm. (50 nos./kg.) were obtained from the nearby fish landing centres. Refined salt used was of commercial quality and sodium propionate, butylated hydroxy anisole (BHA), potassium sorbate etc. were food grade.

Estimations of moisture and chloride were carried out according to A.O.A.C.

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(1955) methods. Total volatile nitrogen (T.V.N.) and trimethyl amine (T. M. A.) were estimated on a trichloroacetic acid extract (Beatty and Gibbons, 1957) by the microdiffusion method of Conway (1947).

Fresh fish was headed, gutted and cleaned well in running water, and then dipped in brine (1 : 1 w/v) containing 3% (w/v) sodium propionate and 0.1% (w/v) BHA.

After brining, the fish was drained for 10 minutes, spread on a wire mesh tray and smoked for 6 hours at a temperature of 70-80°C in a smoke kiln. Coconut husk, shell, and saw dust were used to produce smoke. Smoked fish was then removed from the kiln, and allowed to cool to room temperature. Skin, backbone and most of the spines were carefully removed. 25 g. lots were packed in clean, coloured cellophane paper. They were stored in glass containers under ambient conditions for assessing the storage life.

Results and Discussion

Salt solutions of varying concentrations were tried for dip treatment. It has been observed that the high fat content of oil sardine tended to retard the penetration of salt into the muscle (Valsan, 1971 - unpublished). Therefore, a high concentration of salt in the brine was found to be essential. Saturated brine was found to give the best result. Even with this, the duration of immersion had to be sufficiently long to effect proper penetration of salt. A period of 15 minutes dip was found to be optimum (Table I). Longer durations of dip increased the salt content in the meat without improving the storage life. The presence of high amounts of salt in fish muscle will also accelerate the oxidation of fat (Howgate and Ahmed, 1972).

Proper draining of the brined fish reduces the content of surface water of the fish, thereby preventing the excessive absorption of smoke. This, in turn, ensures a uniformly smoked product having better appearance and flavour (Shewan, 1945). Draining for 10 minutes has been found sufficient for brined sardine.

By smoking the brined and drained fish for six hours at a temperature of 70-80°C the fish has been found to attain a characteristic smoked colour and flavour. The moisture content under these conditions comes down to 30%. Lower moisture level was found to diminish the reconstitution properties of the product besides accelerating the oxidation of fat, and also adversely affecting the appearance and texture.

Table I

Effect of the duration of brining on the storage life of the product

Concentration of brine	Dip period (minutes)	Chloride content in the product %	Storage life in days.
Saturated	5	10.65	18
Saturated	10	11.55	19
Saturated	15	11.98	21
Saturated	20	12.36	Rancid after 20 days
Saturated	30	13.10	Rancid after 19 days

TABLE II
Storage characteristics of smoked sardine fillets

Days of storage	TVN mg% DWB	Physical observation
Initial (immediately after curing)	50.42	
7	68.15	
14	87.04	
21	109.20	Stray patches of fungus and some mites appeared.
28	129.54	Fungus on the fillets; widespread attack of mites; rancid odour; smoky flavour faded.

TABLE III
Preservative treatment and its effect on the storage life of the product

*Sample	Storage in 4 weeks		Storage in 8 weeks		Storage in 16 weeks	
	TVN mg.%	TMA mg.%	TVN mg.%	TMA mg.%	TVN mg.%	TMA mg.%
1	115.5	6.18	138.24	7.97	151.64	9.72
2	91.5	5.46	109.30	5.99	123.43	7.67
3	103.3	7.01	123.73	8.52	144.80	10.32
4	97.17	6.03	117.92	7.15	136.04	8.96
5	96.95	6.22	128.51	7.74	147.82	9.65
6	94.52	5.61	131.24	6.98	153.21	8.74
7	99.54	6.55	124.14	7.05	145.02	9.41
8	97.60	6.82	129.44	8.44	150.03	10.25
9	129.54	7.89	149.95	10.32	158.98	11.97

*The samples have been treated as given below:

1. Dipped in saturated brine containing 3% (v/v) of acetic acid.
2. Dipped in saturated brine containing 3% (w/v) of sodium propionate.
3. Dipped in saturated brine containing 3% (w/v) of sodium benzoate.
4. Dipped in saturated brine containing 3% (w/v) of potassium sorbate.
5. Dipped in saturated brine containing no preservative but the finished product was smeared with 3% (w/w of fish) of sodium propionate.
6. Treated as in (5) above, but with 3% (w/w) of sodium benzoate.
7. Treated as in (5) above, but with 3% (w/w) of potassium sorbate.
8. Treated as in (5) above, but with 3% (w/w) of refined salt.
9. Control: simply dipped in saturated brine; no preservative used.

The smoked product prepared thus was found to have very short storage life (Table II). After three weeks the product became susceptible to spoilage by fungus, rancidity and the attack of insects.

The effect of various preservatives for improving the keeping quality of the product was, therefore, studied. The results are given in Table III.

Of all the preservatives used, sodium

TABLE IV

Effect of different concentrations of sodium propionate on the taste and storage quality of the product

Sample No.	% of sodium propionate	Duration of dip (minutes)	Taste of product	After 7 days storage		After 15 days storage		After 30 days storage		After 60 days storage	
				TVN mg.%	Fungus	TVN mg.%	Fungus	TVN mg.%	Fungus	TVN mg.%	Fungus
1	4.0	15	Distinct distaste	46.50	Nil	60.05	Nil	81.17	Nil	112.16	Nil
2	3.5	15	Slight distaste	47.10	Nil	63.15	Nil	89.95	Nil	115.55	Nil
3	3.0	15	Natural taste	47.80	Nil	68.20	Nil	95.75	Nil	117.64	Nil
4	2.5	15	Natural taste	49.50	Nil	75.40	Nil	107.42	Nil	125.87	Very little
5	2.0	15	Natural taste	51.01	Nil	79.72	Nil	109.86	Very little	129.38	Fairly widespread
6	1.5	15	Natural taste	51.94	Nil	79.92	Nil	110.22	Fairly widespread	130.42	wide-spread
7	1.0	15	Natural taste	53.04	Nil	83.12	Very little	122.43	Fairly widespread	140.14	wide-spread
8	0.5	15	Natural taste	56.72	Nil	85.24	Very little	125.34	Fairly widespread	144.23	Heavy
9	Nil (control)	15	Natural taste	68.15	Nil	87.25	Very little	134.35	Wide-spread	166.30	Heavy

TABLE V

Influence of BHA treatment on the onset of rancidity in the product

Sample No.	% of BHA w/v	Taste and flavour	Storage of the product in days			
			15	30	60	120
1.	0.5	Distinctly aromatic flavour with slight sour taste	Not rancid	Not rancid	Not rancid	Not rancid
2.	0.25	Slight aromatic flavour; slight sour taste	-do-	-do-	-do-	-do-
3.	0.1	Natural flavour and taste	-do-	-do-	-do-	very slightly rancid but acceptable
4.	0.05	Natural flavour and taste	-do-	-do-	Very slightly rancid; but acceptable	Bad flavoured; unacceptable
5.	Nil (control)	Natural flavour and taste	-do-	Rancid unacceptable	Bad flavoured	Bad flavoured

propionate was found to be the most effective in warding off the onset of fungus and molds. The effect of this preservative in dry curing of fish has already been reported (Valsan, 1963). This is most effective when incorporated in the brine at an optimum concentration of 3% (w/v) (Table IV). Higher concentrations of sodium propionate, although slightly improved the storage life, impaired the taste of the product.

The oxidation of fat and the consequent development of rancidity are other problems encountered in smoke cured products. The high fat content of sardine and the high temperature of smoking favour the early onset of rancidity. In general the product develops rancidity after 3 weeks of storage and very soon it loses the characteristic smoked flavour and taste. The antioxidant property of smoke alone was not found to be adequate to retard rancidity for an appreciable period of storage.

Earlier work has shown that B.H.A. is very effective to prevent rancidity in cured fish (Valsan, 1963) and was, therefore, employed in these experiments. For the most effective incorporation, BHA was dissolved in minimum volume of dilute alcohol (1 : 5) and then dispersed in the dip bath by vigorous stirring. The treated product was subjected to physical observation for rancidity at regular intervals. The optimum concentration of this antioxidant was worked out to be 0.1% (w/v) at which level rancidity will be prevented for a period of 4 months (Table V).

Another factor which shortens the storage life of the product is attack by mites and insects. Most of the degredation in the smoked product is brought about by mites belonging to *Lardoglyphus konoi* and *Tyrophagus putrencentiae* and beetles belonging to *Necrobia rufipes* and *Dermestes* spp. Different methods of chemical treatment to control insects have been suggested (Rangaswamy and Surya-

TABLE VI

Combined effect of sodium propionate, BHA and heat treatment on the storage quality of the product

*Sample No.	After 15 days storage			After 30 days storage			After 60 days storage			After 120 days storage		
	Fungus	Rancidity	Insects	Fungus	Rancidity	Insects	Fungus	Rancidity	Insects	Fungus	Rancidity	Insects
1	Nil	Not rancid	Nil	Nil	Not rancid	Nil	Nil	Not rancid	Nil	Nil	Very slightly rancid	Nil
2	Nil	-do-	Nil	Nil	-do-	A few number of insects	Nil	-do-	Intense attack. Product started crumbling	Nil	-do-	Most of the product crumbled into powder
3	Nil	-do-	Nil	Fungus on the fillets	Rancid	A few number of insects	Widespread attack	Highly rancid; bad-flavoured	-do-	Heavy fungus	Bad-flavoured	-do-

* 1. Treated with sodium propionate (3%) and BHA (0.1%) and heated at 125°C for 15 minutes;
2. Treated with sodium propionate (3%) and BHA (0,1%) but not heat treated;
3. Control — no treatment.

narayana Rao, 1969). But such chemicals as pointed out by West and Hardy (1961), are either too expensive to adopt or are unadvisable for incorporation in food products.

A safe and effective method was, therefore, employed in these studies. The method suggested by Valsan (1968) for the prevention of the attack of mites on *Masmin* was employed for the study ie. keeping smoked fillets at 125°C. for 15 minutes and then allowing to cool down to about 65°C. After keeping for 5 minutes in the open, smoked fillets were packed in cellophane. The treated product remained free of insects for more than five months.

Table VI shows the effect of the preservative treatment upon the keeping quality of the smoked product.

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