USE OF DIFFERENT GLAZES IN FROZEN OIL SARDINES

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This paper reports on the relationship between the seasonal variations in the oil content of the Indian oil sardines *(Sardinella longiceps)* and their frozen stroage life at -18°C and on the use of various chemicals and coating materials to extent their storage life. It is observed that there is an invese relationship between the oil content and the frozen storage life - oil content varying from 10.33 to 42.43% (MFB) and storage life from 2 to 5 months. Extension of storage life is achieved by dipping in hydroquinone solution prior to freezing or by coating with agar agar after freezing. Data on changes in peroxide value, free fatty acids, moisture, drip and organoleptic characteristics during frozen storage are presented.

INTRODUCTION

Although oil sardine is the most important commercial fishery in India no attempt has yet been made to preserve the fish by freezing. A negligibly small quantity of oil sardine is canned for internal consumption, while the bulk of the catch goes into the production of dried fish, fish manure, fish meal and fish oil. The seasonal nature of the fishery, competition in the export market for frozen and canned sardines etc. are mentioned as some of the reasons for the apparent lack of interest in the development of commercial freezing of this fish. A closer appraisal of the problem, however, reveals that technological factors are far more responsible for the nondevelopment of such processes than economic considerations. Experimental studies carried out on this fish so far (Vasavan *et. al.*, 1961) have borne out this fact.

The most important deteriorative change taking place in fatty fish during frozen storage is development of rancidity. Several attempts have been made in the past to get over this problem by either cutting off the accessibility of oxygen, the primary factor responsible for rancidity, to the fish oil or by the use of antioxidants. Coating materials like Rhodophyceae extracts containing ascorbic acid (Leonard, 1951), a mixture of gelatine, water, potash alum and glycerine (Griffith, 1933), sodium hydrogen pectinate (MaClay and Owens, 1948), vegetable parchments (Pottinger, 1950), Irish Moss extractives mixed with antioxidants (Stoloff, *et. al*, 1948), corn

syrup solutions (Anon, 1959), acetoglycerides (Tanka, 1960), sodium alginate alone or with different additives (Zuikova, 1961; Pillai, 1964) were tried in various countries with some amount of success in each. Among the antioxidants and other chemicals tried so far, ascorbic acid (Vasavan et al., 1961; Haning, et al., 1953; Morcuse, 1953; Thersteinson, 1952; Chotten, 1953), sodium glutamate (Norton, 1952) BHA and BHT (Nickerson and Starr, 1960), propylgallate, lecithin, thiodipropionic acid, NDGA, gallic acid andcitric acid (Stoloff and Cowther, 1948), liquid smoke and ascorbic acid (Erdman et al., 1954), mixture of ethyl catechuate, propylgallate and citric acid (Yamada and Hiroshi, 1956), glutamic acid, sodium glutamate, ascorbic acid and citric acid (Perepletchik, 1956) and polyphosphate (Margret and Betty, 1963) need particular mention. These reports showed that the results obtained with chemical treatments varied according to the species of fish and according to the nature of the chemicals while results with coatings did not show much variations with species.

The present study is an extension of the above findings. An attempt has been made to study the relative effects of some of the common preservatives and coating materials under commercial freezing conditions of the fish. This paper also reports on the variations in fat content.

Material And Methods

Fresh oil sardines collected from Cochin area during 1964–65 were individually quick frozen in round form after thorough washing, glazed with ice cold water and stored at commercial storage temperature in paper boxes. Agar agar was applied by dip from approximately 1.0% solution after freezing. Hydroquinone was applied as a dip from 0.05 – 0.5% solution prior to freezing. Besides the above two treatments the following were also tried: ascorbic acid, citric acid, mixtures of citric and ascorbic acids, gelatine, gum acacia, BHA and BHT. Samples were periodically withdrawn and the thawed meat was analysed for moisture, peroxide value (PV), free fatty acids (FFA) and organoleptic quality of the cooked meat in all cases and total bacterial count (SPC) of the frozen material and volume of the drip in few cases.

Results And Disscussion

(i) *Relationship between storage life and fat content.*

The storage life of frozen oil sardines at — 18°C in relation to the variation in fat content are shown in Table I.

It can be seen from Table I that the storage life varies from two to five months while the oil content varies from 42.43 to 10.33%. An inverse relationship is found between oil content and storage life, the higer the oil content, the lower the storage life and vice versa. Results show that the oil content is highest in October, November and December when samples have about two months' shelf life. Table I also shows that there is higher increase in free fatty acids at lower fat levels than at higher fat levels. Below 20.0% fat levels increase in free fatty acids are high and above this level it is insignificant, during frozen storage. The free fatty acid level in fresh oil sardine is nearly 2.00 irrespective of the oil content. However, it appears that at higher fat levels the most important deteriorative change in the oil is oxidative rancidity and at lower levels it is hydrolytic rancidity. It has been reported that oil content alone is not the only factor involving in the susceptibility to development of rancidity (Stansby, 1956). It seems that in the Indian oil sardine (*Sardinella longiceps*) the susceptibility to development of rancidity depends to a great extent on

TABLE I. STORAGE LIFE OF FROZEN OIL SARDINES IN RELATION TO FAT CONTENT.

Sample No.	Date of Collection	Fat % (MFB)	Storage life in months	Free Fatty Acids % (Oleic Acid)		Peroxide value (Mill. eq. Peroxide/kg. fat)	
				Initial	Final	Initial	Final
1	28- 7-1964	22.00	3.0	1.369	2.105	0.00	43.18
2	4-11-1964	42.43	2.0	2.560	2.815	0.00	48.35
3	6-11-1964	18.2	3.0	3.780	8.141	1.24	77.00
4	27-11-1964	32.1	3.0	2.771	3.772	8.54	52.08
5	2-12-1964	40.39	2.0	0.644	3.088	2.82	47.95
6	10-12-1964	35.18	2.5	1.755	3.495	3.15	39.13
7	25- 2-1965	17.66	4.0	1.737	7.810	2.15	37.11
8	7- 5-1965	10.30	5.0	2.173	19.46	0.00	60.98
9	10- 7-1955	15.33	4.0	2.315	12.71	1.211	38.15
10	8-10-1966	34.56	2.5	2.041	2.134	2.188	37.83
11	18-10-1965	34.37	2.5	2.051	3.125	2.171	39.55

the oil content. Since in the peak season for oil sardine fishery usually the oil content is the highest, the important problem in commercial utilization by freezing of this fish is prevention of oxidative rancidity.

(ii) *Extension of storage life with glazes.*

Treatments with ascorbic acid, BHA, BHT, citric acid, mixtures of citric and ascorbic acids, gelatine and gum acacia were not successful in preventing oxidative rancidity. Only hydroquinone and agar agar were effective. Changes occuring in water glazed, hydroquinone treated and agar agar coated samples, during storage are shown in Table II.

Since hydroquinone at 0.5% level in the dipping solution produced slight black discolouration at the fins, tail and gills, lower concentrations were tried and the results are shown in Table III.

Since the percentage of agar glaze was nearly seven, a water glaze of equal thickness was applied by repeated glazing to see the effectiveness and the results are shown in Table IV.

Results in Table II show that the storage life of water glazed samples was three months after which there was rancid flavour, odour and tendency to yellowing' compared to seven months for hydroquinone treated and eight months for agar agar coated materials. The decrease in moisture is more in hydroquinone treated than in thc other two and least in the agar agar coated. The increase in PV in the control samples become distinct after three months, while in dydroquinone treated samples after six months and in agar agar coated samples after 7–8 months. Changes in FFA and drip volume are almost insignificant among the samples during storage; and with storage period. Table III shows that 0.05% hydroquinone in the dip solution and a dipping time of five minutes are effective to prevent oxidative rancidity without adversely affecting the colour. Results in Table IV show that agar agar coating is better than water glaze of the same thickness in preventing oxidative rancidity. This difference may be due to the less permeability of the agar gel to oxygen than thc water glaze.

The ineffectiveness of ascorbic acid and citric acid to prevent deterioration in ice stored Atlantic sardines has been reported (Khristoferzen, *et al.*, 1963) and our observations confirm it even in the frozen state. Hydroquinone was found to retard autoxidation of fish oil (Huston et al., 1928), vitamin A (Quackenbush et al., 1941; Nair and Ramakrshnan, 1944), carotene (Turner, 1934) and milk powder (Hollender et al., 1945). Our studies show that hydroquinone is effective in retarding rancidity development in frozen oil sardines. This may help a long way in increasing storage life of oil sardines and may find commercial application depending on the residual amount of the chemical in the tissue. The application of agar agar poses difficulties in application due to its gelling at temperatures below 40°C

SUMMARY

Results of the experiments carried out on the use of different antioxidants and coating materials on the freezing preservations of oil sardines are reported in this paper. Of the various coating materials and chemicals tried agar agar and hydroquinone were the most effective. The minimum effective concentration of hydroquinone is also worked out. This paper also reports on the relationship between storage life and oil content of frozen oil sardines.

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TABLE II STORAGE CHARACTERISTICS OF TREATED

Storage time in months	CONTROL								
	Moisture %	SPC x10^3	PV	FFA	Drip gm/kg	Organoleptic quality	Moisture %	SPC x10^3	PV
0	70.7	2.3	1.73	2.77	58.0	good	70.4	3.6	1.31
1	70.1	9.8	20.98	2.19	49.40	good	67.4	7.3	11.80
3	69.8	8.0	52.08	3.77	40.7	Rancid slight yellow	66.9	5.7	13.00
5	69.8	3.3	139.3	4.18	54.0	off, yellow	66.24	5.0	22.00
6	67.5	2.2	244.2	5.39	56.7	do	67.22	5.8	50.88
7							67.61	11.0	36.88
8							65.60	0.41	64.60

TABLE III STORAGE CHARACTERISTICS OF FROZEN OIL SARDINES

Storage time in days	Control				0.05				Percentage	
	Moisture %	PV	FFA	Organo-leptic quality	Moisture %	PV	FFA	Organo-leptic quality	Moisture %	PF
10	76.6	0.00	4.90	good	76.59	0.00	4.86	good	77.34	5.53
45	77.0	28.54	8.35	good	76.64	21.48	6.66	good	77.64	14.45
72	76.32	68.08	8.41	good	75.30	58.99	6.02	good	76.98	37.54
110	76.15	109.8	10.55	fair	75.15	68.22	10.22	good	76.38	60.15
135	76.05	141.8	13.68	poor	76 26	75.11	13.23	fair	77.03	69.02
174	76.15	134.6	19.46	off	74.85	62.26	19.57	do	76.50	35.29
204					75.38	50.33	13.36	poor	72.75	63.75

AND UNTREATED FROZEN SARDINES AT—18°C

HYDROQUINONE			AGAR-AGAR					
FFA	Drip gm/kg	Organoleptic quality	Moisture %	SPC x10³	PV	FFA	Drip gm/kg	Organoleptic quality
0.88	61.0	good	70.9	3.00	0.67	2.8	125	good
1.97	51.0	good	69.7	5.60	7.24	2.21	114	good
2.98	40.0	good	69.6	7.50	9.29	3.36	89.3	good
4.13	74.8	fair	69.7	6.00	11.96	4.81	143.5	good
4.00	61.1	fair	69.63	1.80	11.31	2.62	119.0	fair
4.99	58.8	fair-poor	67.30	6.70	12.87	4.46	113.0	fair
5.70	48.9	off, yellow	62.43	0.97	36.26	6.50	84.61	fair-poor

TREATED WITH DIFFERENT AMOUNTS OF HYDROQUINONE

of hydroquinone 0.1				0.2				0.5	
FFA	Organo-lepitc quality	Moisture %	PV	FFA	Organo-leptic quality	Moisture %	PV	FFV	Organo-leptic quality
4.11	good	76.72	9.25	3.26	good	78.56	8.34	1.66	good
5.82	good	77.32	27.43	7.73	good	77.43	19.34	7.23	good
3.63	good	77.41	32.15	6.65	good	73.16	39.69	6.66	good
8.95	good	76.15	68.15	12.15	good	76.15	48.15	10.33	good
9.05	fair slight black	76.33	75.06	15.15	fair slight black	76.76	57.4	12.15	fair slight black
10.00	do	75.71	55.09	18.18	do	75.56	42.33	14.62	do
11.99	poor	79.56	32.96	11.99	poor	76.91	37.61	12.13	poor

TABLE IV STORAGE CHARACTERISTICS OF FROZEN OIL SARDINES WITH THICK WATER GLAZE AND AGAR—AGAR GLAZE.

Storage Time in months	Usual water glaze		Organoleptic quality	Thick water glaze		Organoleptic quality.	Agar–agar glaze.		Organoleptic quality
	PV	FFA		PV	FFA		PV	FFA	
0	2.52	2.13	good	2.25	2.15	good	2.31	2.25	good
1	2.71	2.66	do	2.52	2.29	do	2.38	2.45	do
2	9.91	12.71	Fair	9.83	8.11	Fair	8.93	7.18	do
3	28.31	15.19	do	24.42	12.14	do	9.28	10.58	do
4	126.9	16.28	Poor	116.6	15.2	Poor	29.51	11.31	Fair

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