

SUITABILITY OF ICE STORED MACKEREL AND SARDINE FOR CANNING

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The paper reports the results of studies on ice storage and subsequent canning of mackerel (*Rastrelliger kanagurta*) and Sardines (*Sardinella longiceps*) and the effect of such storage on the quality of the canned product prepared out of them. The changes in the physical and chemical characteristics during ice storage are determined and correlated with the quality of the finished product.

INTRODUCTION

Canning of mackerel and sardine has been practiced in India since some time. The main species used are *Rastrelliger kanagurta* and *Sardinella longiceps*, available in large quantities on the west coast, especially from Ratnagiri to Quilon. Although standard methods have been suggested (Anon 1964) and quality specifications laid down by the Indian Standards Institution (1963) there is a fair degree of variation in the quality and composition of the finished products turned out by the trade. This has been found to be due to the variations in the methods employed and the preprocess condition of the raw materials.

It is generally observed that a time lag varying from a few hours to a couple of days occurs between landing of the fish and processing, the period depending on

the time and intensity of landing and the distance between the landing centre and processing factory. During this period the fish is invariably kept in ice. Icing, as is already known (Venkataraman, *et al* 1966; Govindan 1962, 1964; Velankar, *et al*, 1961), is accompanied by loss of nutrients from the fish and flavour and textural changes to the meat, ultimately rendering the raw material unsuitable for further processing. However, precise data are not available on the suitability of ice stored fatty fishes like sardine and mackerel for canning. The present communication is aimed at gathering full information on this aspect of the problem. Data have been collected on the changes in the physical, chemical and organoleptic characteristics of the two important varieties of fish during ice storage and their effect on the quality of the canned product prepared at various stages of storage.

MATERIALS AND METHODS

Mackerels (*Rastrelliger kanagurta*) and sardines (*Sardinella longiceps*) caught by country crafts operated from Cochin were used in these experiments. The boats did not use any ice on board for preserving fish. The fish collected were in rigor always. They were immediately washed, packed in ice and brought to the laboratory. After reaching the laboratory the fish were reiced in the ratio 1:1 in insulated boxes provided with outlet for drainage of melt water. Only three layers of fish and ice in alternate layers were used so that the fish at the bottom layer were not subjected to excessive pressure. Samples were canned immediately after they were brought to the laboratory and then on subsequent days. Every day the fishes were reiced to ensure proper preservation during storage.

Analysis of the material was carried out on each day before canning and also after brining and precooking apart from judging the overall quality of the finished product by the assessment of the organoleptic properties. Moisture, total nitrogen and fat were estimated according to the methods of A.O.A.C. (1955), non-protein nitrogen according to the method of Bate Smith, Macara and Sharp (1944), peroxide value by the method suggested by Lea (1938) and free fatty acids by the A.O.C.S. official methods (1955). Trimethyl amine and total volatile nitrogen were estimated on a trichloroacetic acid extract (Beatty and Gibbons 1957) by microdiffusion method of Conway (1947) and α -amino nitrogen by the method of Pope and Stevens (1939).

CANNING METHOD

i) Mackerel:

The dressed fish was brined for 26 minutes in 15% brine, packed in cans and cooked at 0.35 kg/cm² steam pressure for 40 minutes with the cans inverted over a grid to allow the cook drip to drain off. The cans were then taken out, hot refined

groundnut oil added, exhausted, seamed and sterilized at 1 kg/cm² steam pressure (120°C) for one hour.

ii) Sardine:

The procedure adopted was the same, but the brining time was 15 minutes and sterilization time 75 minutes at 0.85 kg/cm² steam pressure (118°C).

RESULTS AND DISCUSSION

The initial analytical characteristics of mackerels immediately after arrival in the laboratory and the changes occurring on subsequent storage in ice along with the changes in physical characteristics of the material are shown in Table I.

The moisture and fat contents of the muscles remain steady during ice storage, whereas trimethylamine (TMA), total volatile nitrogen, (TVN), free fatty acid (FFA) and peroxide value (PV) show gradual rise as expected. Three days' storage in ice can be considered as the limiting period as evidenced by the overall quality of the raw material and the product subsequently canned as discussed later. Tanikawa *et al* (1953) while discussing the effect of freshness of mackerel on the quality of canned product made out of it has mentioned that the content of volatile nitrogen base (VNB) in raw material should be less than 20 mg % in order to get a good quality canned product. But it is seen from Table I that the TVN in the raw material exceeding 10.28 mg % should not be used for canning and the maximum value the material attained on the third day of icing is 12.95, when the canned product is unacceptable. The low VNB values in iced material are probably due to leaching during storage.

The analytical characteristics of the fish after brining and cooking in steam are given in Table II.

TABLE I PHYSICAL AND CHEMICAL CHANGES IN MACKEREL DURING ICE STORAGE

Days of storage in ice	0	1	2	3	4	5
Moisture %	73.23	73.43	73.52	73.52	73.73	73.70
TMA mg / 100 g	0.52	1.21	1.92	2.36	2.81	3.11
TVN mg / 100 g	3.62	9.76	10.28	12.95	17.09	17.80
Fat % (dry)	5.61	5.60	5.63	5.60	5.60	5.61
P. V.	0.00	10.24	21.20	36.24	42.30	45.21
FFA as oleic acid %	0.24	1.21	2.02	2.84	3.12	3.29
Overall appearance	Bright and shining	Bright	The bright sheen and colour decreased	No bright sheen	Dull	Dull
Texture	Soft but firm	Slightly soft	slightly soft	Retains finger impression	Retains finger impression	Soft and retains fingre impression
Gills	Bright brownish red without slime	Bright brownish no coating of slime	Reddish brown, with slight slime	Greyish with thick slime	Greyish yellow, with thick slime	Greyish yellow, with thick slime
Eyes	Bright with transparent cornea	Bright transparent cornea	Cornea opaque pupil becoming cloudy	Cornea opaque pupil milky and shrunk	Cornea opaque pupil milky and shrunk	Cornea opaque pupil milky and shrunk
Odour	Characteristic of the species slightly seaweedy	Characteristic of the species	Slightly rancid	Characteristic odour disappeared rancid odour develops	Oily odour	Slightly rancid

TABLE II MOISTURE AND FAT CONTENT OF THE ICE STORED MACKEREL AFTER PRELIMINARY COOKING AND THE LOSSES IN THE COOK DRIP

Days of storage in ice	0	1	2	3	4
Moisture %	66.02	65.98	66.51	66.48	66.81
Fat %	5.09	5.08	4.96	4.96	4.90
Total Nitrogen in cook drip: mg %	135.8	167.4	190.4	209.6	223.5
NPN in cook drip: mg %	116.2	128.6	144.7	166.3	182.6
α -amino nitrogen in cook drip mg %	15.86	18.00	21.33	25.44	28.02

As seen from the table, the moisture and fat contents do not show any significant change during preprocess storage in ice. A gradual increase in total nitrogen

(TN), non protein nitrogen (NPN) and α -amino nitrogen (α -NH₂-N) in cook drip with progressive storage of raw material in ice, is observed.

The physical and chemical changes of sardines during storage in ice are presented in table III.

Sardines too, like mackerel show no variation in the moisture and fat contents during storage in ice, though TMA, TVN, PV and FFA show a steady increase. The relative increase in the values of the latter two indices suggests that oxidative degradation of fat is more dominant during the early stages of ice storage.

The analytical characteristics of cook drip from sardines are tabulated in Table IV.

The behaviour of brined sardines on

pressure cooking by steam is similar to that of mackerel as far as the moisture and fat contents are concerned. Unlike in the case of mackerel, the amounts of TN and NPN released in the cook drip show only very little increase on progressive storage in ice. The values for $\infty\text{-NH}_2\text{-N}$ in the cook drip follow the same pattern as that of mackerel. It is also seen from the table that the amount of TN lost in cook drip is less in sardines than in mackerels.

Results of analysis of the canned mackerels and sardines discussed above are given in Table V.

An overall assessment of the different quality factors of the finished product,

TABLE III PHYSICAL AND CHEMICAL CHANGES OF SARDINES DURING ICE STORAGE

Days of storage in ice	0	1	2	3	4	5
Moisture %	70.26	70.74	69.74	69.26	69.66	70.87
TMA mg%	1.14	1.68	1.88	3.05	3.68	3.80
TVN mg%	9.11	10.09	12.51	18.05	19.14	20.50
Fat % (dry)	23.35	23.47	23.68	23.42	24.02	23.86
P. V.	6.52	16.32	32.06	36.79	39.11	42.34
FFA %	0.44	1.01	1.84	1.94	2.13	2.38
Over all appearance	Bright and lustrous	Bright but not lustrous	Looses the bright sheen and colour	No bright sheen	Dull	Dull
Gills	Bright brownish red without slime	Bright red without slime	Dull slimy with reddish tint	Discoloured and covered with thick slime	Greyish with thick slime	Greyish with thick slime
Eyes	Bright with transparent cornea	Bright with transparent cornea	Cornea opaque and eyes shrunk	Cornea opaque and eyes shrunk	Cornea opaque pupil cloudy and milky	Cornea opaque pupil cloudy and milky
Texture	Soft but firm	Firm	Slightly soft	Soft	Flesh softer retains finger impression	Flesh softer can be easily removed from the back bone
Odour	Seaweedy	Characteristic	Slightly Rancid	Rancid	Rancid	Rancid

TABLE IV MOISTURE AND FAT CONTENTS OF SARDINES AFTER PRELIMINARY COOKING AND THE LOSSES IN THE COOK DRIP

Days of storage in ice	0	1	2	3	4	5
Moisture %	60.21	61.4	61.72	61.31	60.6	59.65
Fat % (dry)	22.41	22.39	22.56	22.46	22.44	22.42
T. N. in cook drip: mg/100 gm.	134.3	145.2	151.0	153.0	158.4	167.0
NPN in cook drip: mg/100 gm.	114.0	116.5	118.6	122.2	126.8	131.2
∞ -NH ₂ N in cook drip: mg/100 gm.	16.67	22.47	23.28	22.94	24.86	29.22

TABLE V TEST RESULT OF CANS OF MACKERELS AND SARDINES

Storage Period	Vol. of oil cc	Colour of oil	Vol. of water cc	No. of pieces	No. of pieces with skin off	Colour	Odour	Flavour	Texture	Disintegration
0	60	Golden yellow	2.3	9	0	Slightly dull	Good	Good	Good	Nil
1	57	„	2.2	9	2	Glazy	Good	Fair	Fair	„
2	67	„	2.2	9	1	„	„	„	„	„
3	64	Slightly brownish	2.5	9	2	Slightly dull	F - P	F - P	Slightly soft	„
4	82	„	3.7	10	3	Dull	Slightly rancid	Poor	Soft	„
5	62	„	3.2	9	3	Pinkish	„	„	Soft and fibrous	„
0	30	Golden yellow	1.5	20		Dull white	Good	Good	Soft	„
1	38	„	1.0	20		White	Good	Fair	„	„
2	36	„	2.5	19		„	„	„	„	„
3	41	Slightly brownish	1.0	18		Dull	Slightly rancid	Poor	„	„
4	54	„	1.0	20		Slightly brownish	Rancid	„	Pasty	„
5	54	„	1.0	20		„	„	„	„	„

especially the organoleptic characteristics viz; colour, odour and flavour reveals that the maximum storage life of mackerels and sardines in ice to give a product of acceptable quality is three days and two days respectively. This is also supported by the physical and chemical characteristics of the ice stored fish prior to processing. Storage beyond this period results in the poor physical appearance, increase in PV

and FFA giving rancid smell and causing poor organoleptic quality. The sardines canned after three days of icing gave rancid odour and the texture becomes soft whereas under identical condition mackerel gives rancid odour only on fourth day and its texture becomes soft and fibrous on the 5th day. Icing up to 24 hours was found to impart better colour to the meat both in the case of mackerels and sardines,

without appreciably affecting the flavour of the product.

SUMMARY

Organoleptic analysis indicates that mackerel and sardine stored in ice up to three and two days respectively may be suitably used for commercial canning. Storage beyond this period results in the poor appearance of the material, increase in spoilage indices and poorer organoleptic characteristics of the canned material. Sardines stored for five days in ice give a product of pasty consistency, but under identical storage period the texture of canned mackerel is soft and fibrous only.

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