Quality of Cured Fishery Products from Malabar and Kanara Coasts

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Results of chemical, bacteriological and organoleptic quality studies of cured fishery products of commerce collected from six major fish curing centres on the west coast of India are presented. 77.12% of the samples had moisture above 35%, 97.18% showed salt content below 25% and all samples had acid insoluble ash above 1.5%. 42.32% gave standard plate counts above 10,000 and 45.77% were contaminated with 'Red' halophiles. The major defects in curing were imperfect cleaning, inadequate salting and unhygienic conditions of processing.

The first exhaustive study of the curing methods in India dates back to Nicholson (1930). The quality of wet-cured fish from the west coast of India was studied by Pillai *et al.* (1956). A survey of the quality of salt-cured fish in Kannyakumari district of Tamil Nadu State was conducted during 1963–64 by Srinivasan & Joseph (1966). Srinivasan *et al.* (1967) also studied the quality of dried white baits. Dried mackerel was subjected to quality assessment by Venkataraman *et al.* (1954). Rao *et al.* (1962) studied the storage characteristics of salted and dried fish. Similar studies have been conducted by Srinivasan & Venkataraman (1958), Venkataraman & Vasavan (1958, 1959). A survey of the quality of cured fish was conducted on the west coast from Chavakkadu in Kerala to Panaji in Goa to assess the present status of the industry and the findings are reported in this paper.

Materials and Methods

319 samples of dry cured fish of various species were collected from Chavakkadu, Calicut, Cannanore, Mangalore, Karwar and Panaji. About 500 g each of the samples were transferred to screw-UP glass bottles and analysed within 10 days for moisture, sodium chloride, acid insoluble ash and total volatile nitrogen (TVN) according to the methods of AOAC (1975).

Bacteriological quality was assessed by standard plate count (SPC) and faecal streptococci by the method followed by Chattopadhyaya & Bose (1978) and coagulase positive staphylococci according to Rajagopal (1978). *Escherichia coli* were enumerated using Tergitol-7 medium and total coliforms using desoxycholate agar (Difco Manual, 1972). Presence of 'Red' halophiles was tested using milk-salt agar (Dussault & La Chance, 1952). This medium was poured into sterile petri plates and allowed to solidify. Stored the plates for 24 h in a refrigerator. A known amount of the sample was blended with 100 ml sterile distilled water. One ml of the supernatant fluid was spread over the milk-salt agar plate and incubated at room temperature. Development of red pigmented colonies was taken as positive for the presence of 'Red' halophiles. The incubation period varied from 5 days to 5 weeks.

Results and Discussion

Results of chemical and bacteriological analyses, and organoleptic score are given in Table 1. 77.12% of the samples had moisture above 35%, 97.18% showed salt below 25% and all had acid insoluble ash above 1.5%. Table 2 gives the different ranges of moisture, salt and acid insoluble ash, corresponding percentage of total number of samples falling in that range, and the average values of moisture, salt and acid insoluble ash.

The products from Mangalore are of exceptional quality compared to those from other centres. The average values for all the samples from Mangalore are, moisture

Table 1. *Chemical, bacteriological and organoleptic characteristics (average values) of commercially cured fishery products*

Dried fish	Centre	No. of samples	Moisture %	Salt %	Acid insoluble ash %	TVN mg/100g	SPCx10^3 per g	Samples showing 'Red'	Organoleptic score*	Type of spoilage on storage
Sardine	Chavakkadu	12	40.41	18.68	6.12	77.58	26.9229	0	4	Discolouration and rancidity
Sardine	Calicut	15	50.96	17.38	6.02	115.72	3.7338	0	3	Soft texture and rancidity
Sardine	Karwar	28	42.40	18.45	8.21	65.94	1856.8642	18	0	'Red' attack, soft texture and rancidity
Sardine	Goa	9	39.15	19.05	10.46	77.44	2.9825	0	0	Discolouration and rancidity
White bait	Mangalore	15	41.30	19.19	7.56	117.31	3.0250	0	3	Soft texture and discolouration
White bait	Karwar	14	33.13	21.07	4.69	38.65	12.2477	14	0	'Red' attack
Silver belly	Calicut	15	46.96	17.71	5.18	103.30	5.1036	15	0	'Red' attack
Silver belly	Mangalore	10	29.74	18.36	3.65	62.06	3.6031	0	4	Soft texture
Silver belly	Karwar	24	40.61	18.68	8.13	59.39	19.3005	24	0	'Red' attack
Silver belly	Goa	12	31.98	17.77	12.29	56.43	11.6679	12	1	'Red' attack
Sole	Calicut	20	52.82	17.39	6.27	105.50	3.6365	9	2	'Red' attack, soft texture and highly moist
Sole	Mangalore	14	25.47	18.77	2.50	74.94	3.2295	0	4	Discolouration
Sole	Karwar	30	32.52	18.62	10.89	55.58	10.9312	14	0	'Red' attack, soft texture and discolouration
Lactarius	Mangalore	15	40.01	19.79	2.97	89.40	4.8493	0	3	Discolouration
Lactarius	Karwar	25	45.81	18.19	5.73	68.19	3528.1599	13	0	'Red' attack, soft texture and diacolouration
Mackerel	Mangalore	15	38.32	23.56	2.50	77.73	323.02	0	4	Discolouration and soft texture
Mackerel	Karwar	13	53.32	23.77	3.54	77.41	4112.3692	0	0	Off odour and discolouration
Miscellaneous	Calicut	10	48.44	19.27	7.50	131.40	4.1114	10	0	'Red' attack
,,	Cannanore	8	42.25	19.27	6.34	77.27	24.3661	8	0	'Red' attack
,,	Mangalore	6	40.48	20.39	7.43	120.80	2.6810	0	2	Off odour
,,	Goa	9	48.48	18.57	13.83	99.36	3.2665	9	0	'Red' attack

* Organoleptic score: 0 = poor; 1 = poor-fair; 2 = fair; 3 = fair-good; 4 = good; 5 = very good

Table 2. *Ranges of moisture, salt and acid insoluble ash of the commercial samples with corresponding average values*

	% of samples in the range	Average	Range
Moisture*			
Below 35%	22.84	30.48	22.86–34.95
Between 35–40%	19.12	38.91	35.10–44.91
Above 40%	57.99	46.16	45.19–56.46
Salt* (as NaCl)			
Below 20%	73.98	18.06	15.30–19.93
Between 20–25%	23.20	21.51	20.01–24.90
Above 25%	2.82	25.82	25.18–26.76
Acid insoluble ash*			
Below 1.5%	—	—	—
Between 1.5–10%	78.37	5.12	1.89– 9.91
Above 10%	21.63	12.95	10.25–16.82

* Accepted standard values for: Moisture – 35% max.; Salt (NaCl) – 25% min.; Acid insoluble ash – 1.5% max.

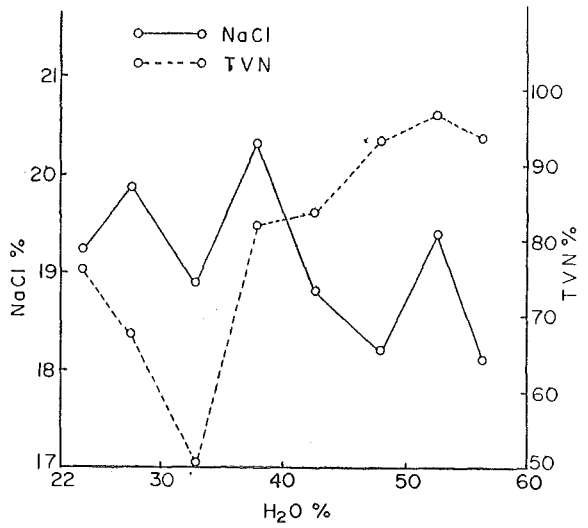

Fig. 1. Relation between moisture, salt and TVN

35.89%, salt 20.01% and acid insoluble ash 4.43%. Low moisture and ash contents showed better processing and drying conditions. Salt concentration was generally lower in these samples compared to others since fish curers in the Kanara region use smaller quantities of salt, roughly in the ratio 1:8 (salt:fish) and salting time is as low as 4 to 24 h, whereas on the Kerala coast, the ratio is usually 1:4 and there is no fixed time for salting; the fish is kept immersed in the self-brine as long as the demand comes up which may vary from a few days to even six months.

At Karwar, the final washing of the salted fish is by dipping the fish kept in a bamboo basket into the shore waters right on the beach and in Goa, drying is carried out by spreading the fish directly on the beach. Such practices cause heavy admixture of sand with the fish which account for the high values of acid insoluble ash in the samples from those centres. Srinivasan & Joseph (1966) also have reported very high values of acid insoluble ash in fish dried on the sand. The average value for acid insoluble ash of the entire lot of commercial samples tested is 7.06%.

At Goa, the old Ratnagiri method of wet-curing is still practised. Half of the required quantity of salt is rubbed on to the surface of fish and they are stacked on the sandy floor of the yard. The remaining half of the salt is applied on the fish in two consecutive days and marketed in interior rural areas in palm-leaf baskets without drying.

The TVN values range from 36.26 to 140.9 mg/100g, the average being 79.62 mg/100g. Fig. 1 shows the relation between

average values of moisture, TVN and salt content of samples. After an initial decrease, TVN increases with moisture, and salt content shows a gradual decrease. This is due to the insufficient salting, resulting in poor salt penetration. Such fish when subjected to the usual period of drying will not give end products with desired moisture levels. This observation is similar to that of Srinivasan & Joseph (1966) that higher TVN values indicate high degree of spoilage due to inadequate salting and drying. The average moisture and salt of the entire lot of commercial samples were 41.12% and 19.06% respectively. Comparison of Tables 1, 2 and 3 shows how much the commercial samples deviate from those prepared under hygienic conditions. All the laboratory samples were salted for 48h and dried in the sun to the required moisture level, and stored in tightly closed screw-cap glass bottles. The results of analysis after two months' storage at room temperature are presented in Table 3.

57.68% of the samples had SPC below 10,000; 28.53% above 10,000 but below 1 lakh, and the rest above 1 lakh. The highest count was observed in a mackerel sample from Karwar (1.0327 x 10 /g) and the lowest in a white bait sample collected from Mangalore (2.168 x 10^2/g). However, bacteria of public health significance like *E. coli,* faecal streptococci, coagulase positive staphylococci and coliforms were not detected in any of the samples. There is no definite correlation between SPC and the degree of spoilage. Samples with lower organoleptic score also had lower plate counts. Samples with zero score had a maximum storage life of five days while those with 3 and 4 ratings had 20 to 45 days. In samples with zero score, almost all were infested with 'Red.' But those with fair-to-good, and good ratings (30.09% of the samples) had counts around 10,000 the highest being 5.710 x 10^2 and the lowest 2.168 x 10^2 with an organoleptic score of 4. Those with zero rating had counts 3.759 x 10^2 to 1.0327x10^7/g and 51.40% of the total were in this group. 68.29% of these were con-

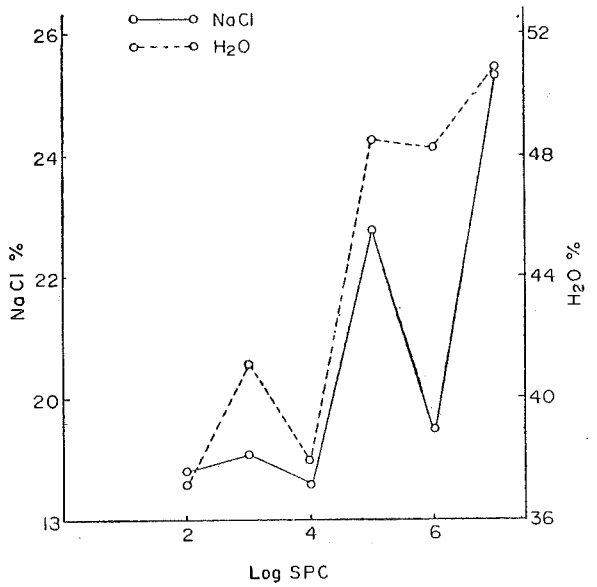

Fig. 2. Relation between log S P C (average value), salt and moisture

Table 3. *Results of chemical and bacteriological analyses and organoleptic score of laboratory samples*

Dried fish	Moisture %	Salt* %	Acid insoluble ash*%	TVN* mg/100g	SPC per g	Organoleptic score**
Sardine	34.25	25.62	1.61	93.76	1.308 x 10^2	4
Mackerel	40.50	21.76	2.21	95.20	9.010 x 10^2	3
Sole	18.33	24.83	1.40	42.00	8.547 x 10^3	4
Silver belly	31.78	20.92	1.23	76.40	4.256 x 10^3	4
Ribbon fish	42.32	18.78	1.98	81.32	2.968 x 10^2	3
Cat fish	38.60	26.52	2.01	63.64	3.145 x 10^3	3

* Moisture free basis

** Organoleptic score: O=poor; 1=poor–fair; 2=fair; 3=fair to good; 4=good; 5=very good

taminated with 'Red' halophiles. Reasons for spoilage in fish with lower plate counts are due mainly to rancidity and discolouration together with red halophiles. It is also assumed that some retarding mechanism, brought about by the breakdown products, is influenced the growth of microorganisms. SPC increases with moisture and salt (Fig. 2) in a more or less similar fashion. It also shows, SPC can definitely be brought down by judicious drying and salting. It is highly essential to use good quality salt (IS:594, 1962)

45.77% of the samples showed presence of 'Red'. In majority of the cases (Table 1), SPCs are highest in samples where 'Red' halophiles are absent and vice versa. Average SPC for samples showing presence of 'Red' is 479.6823×10^3, while that for samples without 'Red' is 687.93×10^3. 'Red' is unaffected by further salting or drying since salt itself is contaminated with these organisms. Average moisture and salt for 'Red' affected samples were 40.79% and 18.73% respectively while those for samples unaffected by 'Red' were 41.40% and 19.34% respectively. Rao *et. al.* (1962) observed incidence of 'Red' halophiles after 5 month's storage, but in the present study, 'Red' halophiles were noticed within 15 days of storage.

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*Not seen in original