Moisture, Salt, Trimethylamine & Volatile Nitrogen Contents & Bacterial Counts of Salt-cured Marine Fish*

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A LARGE percentage of the marine fish landed in India is marketed after "curing" with salt and drying in the sun. The methods employed are crude and the product is unattractive[1,2]. In spite of the great economic importance of the industry, fish-curing has received little attention in India.

A study of the salt-curing process has been taken up in the laboratories of the Central Marine Fisheries Research Station, Mandapam. In the first stage, the moisture, salt, trimethylamine and total volatile basic nitrogen contents and bacterial counts of cured fish from the east and west coasts of India have been determined with a view to arriving at a standard for evaluating the quality of marketed products.

Materials and methods

Samples of salted fish from local markets and curing yards were obtained within a week after curing.

Finely chopped fish muscle (5 g.), freed from skin, was ground with 96 per cent ethyl alcohol[3] (10 cc.) made up to volume (20 cc.) with 96 per cent alcohol, and filtered under pressure. The filtrate was used for the estimation of trimethylamine and total volatile basic nitrogen according to Conway's procedure[4]. An aqueous extract of the fish muscle (10 g. of muscle ground with distilled water, volume made up to 100 cc. and filtered) was used for chloride determinations by the Volhardt method. Moisture content was determined by drying the fish muscle (10 g.) to constant weight at 100°C. in an air oven. The results obtained are recorded in Table 1.

The inner portion of the muscle (1 g.) was cut aseptically from samples of cured fish and ground in a sterile mortar with autoclaved sea water (total volume 100 cc.). Suitable dilutions were made with sterile sea water, plated in duplicate using both Zobell's sea water agar[5] and nutrient agar (tap water), and incubated for 3 days at room temperature. The bacterial counts of different samples are also recorded in Table 1.

The moisture content of salted fish varies between 40 and 50 per cent; mackerel and fillets from the west coast have low moisture values. Pit-cured fish contain more moisture than fish cured in open yards.

The salt content of the majority of samples varied between 20 and 40 per cent; shark, skate, etc., from Adirampatnam curing yard contained 40 per cent or more salt.

The trimethylamine nitrogen content varied from 3·2 to 27 mg. and the total volatile basic nitrogen content from 20 to 116 mg. per 100 g. of muscle. In the majority of samples, the total volatile nitrogen content was 60 to 100 mg. per 100 g. muscle. Pit-cured samples contained comparatively low total volatile nitrogen. Mackerel samples from the west coast contained least trimethylamine.

Salted fish deteriorate in 2-3 months when stored at room temperature. Some specimens developed a red discolouration and were unfit for human consumption (TABLE 2). The volatile nitrogen content of discoloured samples was 200 mg. or more per gram of the muscle. The trimethylamine content, however, was less than that of cured fish in good condition. This is probably due to loss of trimethylamine during storage. Total volatile nitrogen, not trimethylamine nitrogen, gives a fair indication of the extent of spoilage.

Bacterial counts of cured fish are from 10,000 to 450,000 per g. of muscle. Pit-cured fish

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TABLE 1 — MOISTURE, SALT, TRIMETHYLAMINE AND VOLATILE NITROGEN CONTENTS AND BACTERIAL COUNTS OF SALT-CURED FISH

Sample No.	Fish	Source	Curing method	Trimethylamine (mg. N/100 g.)	Total volatile N (mg. N/100 g.)	Moisture	% NaCl (dry wt. basis)	Bacterial count/g.
1	Seer	Kakinada (local market)	Open yard	10·9	98·5	50·7	19·4	41,000
2	Pomfret		do	12·4	82·9	45·0	20·0	52,000
3	Clupeid			9·3	75·8	43·0	21·1	32,000
4	Flying fish	Vizagapatam (local market)	do	12·4	62·0	43·0	23·0	27,000
5	Clupeid	do	do	22·4	114·8	42·0	20·86	80,000
6	Red Mullet	do	do	22·5	116·4	44·0	18·75	63,000
7	Ribbon fish	do	do	20·8	97·9	44·5	23·43	59,000
8	Shark	Gopalpur (local market)	do	18·0	149·0	52·4	22·25	89,000
9*	Seer	do	do	24·3	210·0	50·1	19·64	—
10	Seer	Madras (local market)	do	6·5	82·0	57·9	32·1	41,000
11	Shark	Adirampatnam (curing yard)	do	24·7	105·7	39·8	44·8	15,000
12	Skate	do	do	9·7	91·6	33·0	38·5	23,000
13	Ray	do	do	9·1	116·0	40·3	36·85	29,000
14	Shark	Vizinagam (Travancore)	—	9·5	101·9	43·7	28·41	33,000
15	Ribbon fish	do	—	26·15	94·6	44·7	36·2	18,000
16	Otolithus	do	—	17·1	78·4	46·0	27·7	70,000
17	Mackerel	Calicut	—	5·2	48·0	30·8	17·1	9,000
18	Mackerel	Mangalore	—	5·4	57·0	25·4	16·9	13,000
19	Sardine	do	—	6·3	53·0	27·0	17·8	—
20	Cat fish (fillet)	do	—	2·2	39·0	23·0	20·78	—
21	Seer	Dhanushkodi	Pit cured	10·3	68·0	48·0	25·0	200,000
22	Shark	do	do	9·5	98·0	—	—	125,000
23	Seer	do	do	10·5	84·0	47·0	23·0	—
24	Mullet	Paramkudy market	do	5·2	36·3	46·6	43·0	370,000
25	Jew fish	do	do	10·7	76·6	42·9	22·76	—
26	Dorab	do	do	9·8	52·0	40·7	23·4	—
27	Clupeid	Thangchimadam (Pamban)	do	23·4	37·9	56·4	33·4	446,000
28	Jew fish	do	do	13·7	43·8	55·7	39·5	—
29	Lactarius	do	do	9·8	19·9	46·5	27·26	—
30	Perch	Mandapam	—	21·6	119·0	—	—	20,000
31	Horse mackerel	do	do	15·2	98·0	—	—	26,000
32	Lactarius	do	—	12·3	89·0	54·0	21·3	—
33	Lactarius	do	—	18·9	92·0	50·0	22·0	350,000
34	Clupeid	Thangchimadam (Pamban)	Pit cured	8·4	36·4	—	—	—
35	Dorab	do	do	2·4	25·5	—	—	—
36	Seer	do	do	9·2	88·5	—	—	—

* Fish were in a spoiled condition.

TABLE 2 — TRIMETHYLAMINE AND VOLATILE NITROGEN CONTENTS OF SALTED MARINE FISH AFTER STORAGE

Fish	Storage period, months	Condition	Trimethylamine (mg. N/100 g.)	Total volatile N (mg. N/100 g.)
Seer	2	Spoiled	2·5	200·0
Pomfret	2	Spoiled and discoloured	3·5	199·3
Mackerel	5	do	15·5	124·0
Flying fish	2	Spoiled	6·1	158·0
Ribbon fish	2	Spoiled and discoloured	4·3	213·8
Clupeid	2	Spoiled	17·4	218·5
Shark	2	do	17·3	216·6
Clupeid	2	—	2·3	226·5
Shark	2	Good	9·3	99·4
Skate	2	do	6·0	90·0
Ray	2	do	8·0	120·5
Jew fish	2	Spoiled	13·8	180·5
Seer	2	do	11·0	196·0
Clupeid	3	do	14·0	207·0

show high counts. Bacterial counts for dried fish are usually less than 100,000/g. Nutrient-agar plates were crowded with large, spreading colonies, while the colonies in sea-water-agar plates were small and discrete. Spore-forming rods were common. From the surface of fish showing red discolouration, halophilic cocci, producing a red pigment in lactose-salt-agar medium, were isolated.

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