

Assessment of Quality of Fish Landed at the Cochin Fisheries Harbour

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Assessment of quality of fish and shrimps landed at the Fish Harbour, Cochin was made over the period January, 1980 to December, 1982. A total of 201 samples were analysed. Nearly 75% of the samples scored between 6–10 in a 10 point hedonic scale and the percentage unacceptability based on sensory assessment was 5.5%. In 10.1% of the samples, total volatile nitrogen was $>30 \text{ mg}\%$ and in 8.3% of the samples trimethylamine-nitrogen was $>10 \text{ mg}\%$. Both, the gr Torrymeter and Intellectron Fish Tester VI readings marked significant correlation with sensory scores and chemical indices; but failed to bear any significant correlation with bacterial counts. Of the total samples 66.7% had total plate count (TPC) $\geq 10^5 \text{ g}^{-1}$ and 8.5% were considered unacceptable based on $\text{TPC} > 5 \times 10^6 \text{ g}^{-1}$; 63.2% of the samples were free from *Escherichia coli*; 26.4% had $>20 \text{ E. coli g}^{-1}$ and 20.4% of the samples contained faecal streptococci $>10^3 \text{ g}^{-1}$. Seven percent of the samples showed coagulase positive staphylococci $>100 \text{ g}^{-1}$. Salmonella could not be detected in any of the samples examined. Crushed ice samples and the platform of the harbour had high bacterial loads.

The Cochin Fisheries Harbour, is one of the major fish landing centres of the west coast of India. An average of 25000 t of fish/shellfish is landed at this harbour annually, which is about 10% of the total catch of fish in Kerala. However, the level of quality of the fish landed at this harbour as well as other fish landing centres is not known precisely. Statutory inspection and quality control checks are available only for the fishery products of the export trade. Even in such products, the initial quality of the raw material is not adequately controlled. Consequently, some consignments fail to meet the stringent requirements of the importing countries. So, it is felt that a quality assessment programme of the landed fish at the various fisheries harbours is vital in producing quality products for export as well as for internal marketing. Assessment of freshness of fish at the retail level or at port markets has been made by various workers (Connell *et al.*, 1976; Andrews *et al.*, 1977). However, such studies as applied to tropical countries are scanty (Zuberi *et al.*, 1980; Beri, 1980). Iyer (1982) has studied the quality of the fish from Bombay market. The objective of the present studies was to monitor the level of quality of the fish landed at the Cochin Fisheries Harbour using

different quality criteria and to suggest measures to improve the quality of landed fish.

Materials and Methods

Fish and prawn samples were collected from the Cochin Fisheries Harbour at weekly intervals of time during 1980–81 and fortnightly afterwards till December 1982. The species comprised of oil sardine (*Sardinella longiceps*), mackerel (*Rastrelliger kanagurta*), threadfin bream (*Nemipterus japonicus*), catfish (*Tachysurus* sp.), lizard fish (*Saurida tumbil*), white pomfret (*Pampus chinensis*), horse mackerel (*Caranx crumenophthalmus*), jewfish (*Pseudosciaena* sp.) lactarius (*Lactarius lactarius*) and assorted species of penaeid prawns. Ice samples and swabs from the platform of the harbour were also taken occasionally. The samples were taken in sterile polythene bags, kept in ice and brought to the laboratory about 1 km away from the harbour and analysed immediately. The freshness readings were noted using gr Torrymeter (TM) and Intellectron fish tester VI (IFT) without causing any mechanical damage to the fish. The Torrymeter was used in the individual mode of operation. Freshness meters were not used in assessing the quality of prawns.

Sensory assessment of the raw and the cooked fish was made by a panel of 4 to 6 members and scored in a 10 point hedonic scale i.e. excellent 10; very good 8, good 6; fair 4 and poor <4. The Torry score sheet was used as a guideline (Regenstein & Regenstein, 1981). Fish samples scoring below 4 were considered unacceptable for human consumption.

Total volatile nitrogen (TVN) and trimethylamine nitrogen (TMA-N) were the chemical indices of spoilage studied and were determined by the method of Conway (1947) using trichloroacetic acid (TCA) extracts of the muscle.

The total plate count (TPC) was determined by the ISI method (IS: 2237-1971). Similarly *Escherichia coli* and *Salmonella* were tested as per the ISI method (IS: 5887 Part I, 1976 and IS: 5887 Part III, 1976). Faecal streptococci counts were determined using KF agar (Kenner *et al.*, 1961). Coagulase positive staphylococci were determined by the method suggested by the Second Joint FAO/WHO Expert Committee (1977). Both

skin on and de-skinned (shell on and peeled and un-deveined, in the case of prawns) samples of fish were used for bacteriological analysis.

Results and Discussion

The data on sensory assessment of the samples are given in Table 1. In the raw fish/prawns 28.4% scored in between 8-10, 43.8% scored in the range of <8-6, 20.9% scored in between <6-4 and the rest marked below this range and 7% of the samples were not acceptable as per the sensory evaluation. A similar trend followed in the cooked samples also. In this case, 5.5% of the samples scored below 4. The low score of some samples may be attributed to the delay in icing of the catch. Fish were not iced on board and upon arrival at the harbour, they were put in heaps on the open space of the floor with or without ice until they were auctioned. This totally makes a delay of about 4-6 h from catch.

The freshness meter readings were different for different species of fish which were scored equally by sensory evaluation. Some typical readings by the two freshness meters

Table 1. *Sensory quality of the fish and prawns landed at the Cochin Fisheries Harbour during 1980-82*

Fish	Raw fish score-range (max. 10)				Cooked fish score-range (max. 10)			
	10-8	<8-6	<6-4	<4*	10-8	<8-6	<6-4	<4*
	Percentage of samples							
Sardine (38) +	21.1	31.6	34.2	13.2	13.2	52.6	23.7	10.5
Mackerel (34)	0.0	58.8	35.3	5.9	8.8	58.8	26.5	5.9
Threadfin bream (27)	37.0	51.9	11.1	0.0	29.6	55.6	11.1	3.7
Cat fish (20)	45.0	45.0	5.0	5.0	15.0	55.0	25.0	5.0
Lizard fish (15)	6.7	46.7	33.3	13.3	20.0	73.3	6.7	0.0
Pomfret (13)	23.1	53.9	15.4	7.7	38.5	38.5	15.4	7.7
Hoise mackerel (8)	12.5	50.0	25.0	12.5	0.0	62.5	25.0	12.5
Jew fish (8)	25.0	50.0	12.5	12.5	25.0	50.0	12.5	12.5
Lactarius (6)	16.7	50.0	33.3	0.0	0.0	66.7	33.3	0.0
Prawns (32)	68.8	25.0	3.1	3.1	65.6	31.3	3.1	0.0
Percentage of total samples (201)	28.4	43.8	20.9	7.0	20.9	56.2	17.4	5.5

* Also denotes the percentage samples unacceptable

+ Number of samples in each category

Table 2. *Some of the typical readings with freshness meters and the corresponding chemical and sensory (raw) values (in range)*

Fish	Organoleptic score (max. 10)	Intelectron reading	Torry/ meter reading	TVB-N mg/100g tissue	TMA-N mg/100g tissue
Sardine	7-9	30-47	12-15	19.05- 1.73	4.76-0
	4-6	18-27	8-12	28.35- 10.27	14.0-3.42
Mackerel	7-8	30-40	11-13	21.68- 9.15	4.35-1.65
	4-6	16-28	7-10	33.38- 17.39	9.02-1.25
Threadfin bream	7-9	34-54	11-14	19.03- 4.60	4.73-0
	4-6	26-36	10-11	26.54- 12.84	9.70-4.60
Cat fish	7-9	40-76	12-16	18.45- 4.23	4.72-0.85
	4-6	28-38	10-11	31.97- 12.05	9.96-4.17

and the corresponding chemical and sensory values for four species of fish are given in Table 2. It seems that the meter readings indicated the freshness of fish. Varma *et al* (1982) and Poulter & Curran (1982) have shown the usefulness of Intellectron fish tester VI and Torrymeter respectively in quality assessment of tropical fish stored in ice.

The distribution of TVN and TMA-N in the various species of fish are presented in Table 3. It has been suggested that TMA-N between 10-15 mg/100g or TVN between 30-40 mg/100g tissue be considered as the limit of acceptability for round, whole chilled fish (Connell, 1975). Based on this limit, 10.1% of the samples were unacceptable for human consumption (TVN > 30 mg/100g tissue). In this study a value of ≥ 10 mg TMA-N/100g of tissue is fixed as the upper limit of acceptability. Based on this, 8% of the samples were not acceptable.

Statistical analysis of the data (worked out only for sardine, mackerel, threadfin bream, catfish, lizard fish and pomfret) indicate

high correlation between the sensory scores and other parameters like freshness meters' readings, TVN and TMA-N. Thus, the raw and cooked scores (RS&CS) showed significant positive correlation with the IFT and TM readings ($P < 0.001$ for IFT and between $P < 0.001$ to $P < 0.01$ for TM). The correlation coefficients are $r = + 0.7057$ to $+ 0.9712$ for IFT and $r = + 0.7378$ to $+ 0.9546$ for TM. Domoglou (1979) also reported a good correlation between Torrymeter readings and sensory assessments. Again RS and CS marked significant negative correlation with TVN and TMA-N values ($P < 0.01$) in all the six cases except sardine wherein significance at 0.10% level was obtained. Similarly, IFT and TM readings bear significant negative correlation with the chemical indices studied (No significant correlation could be obtained with TM in mackerel and threadfin bream). The level of significance was at 1% in majority of cases with IFT. However, TM, indicated significance only at 5 to 10% level. Burt *et al.* (1976) also observed similar relations with sensory scores, IFT, TM readings and trimethylamine index. How-

Table 3. Total volatile nitrogen and trimethylamine nitrogen in fish and prawns

Fish	mg TVN/100g tissue				mg TMA-N/100g tissue		
	≤10	>10-20	>20-30	>30*	0-5	>5-10	>10*
Percentage of samples							
Sardine (38) +	13.2	39.5	36.8	10.5	47.4	41.2	13.2
Mackerel (34)	3.1	44.1	47.1	5.9	58.8	38.2	2.9
Threadfin bream (27)	18.5	59.3	11.1	11.1	70.4	18.5	11.1
Cat fish (20)	5.0	80.0	5.0	10.0	75.0	20.0	5.0
Lizard fish (15)	13.3	53.3	26.7	6.7	86.7	13.3	0.0
Pomfret (13)	15.4	30.8	38.5	15.4	61.5	30.8	7.7
Horse mackerel (8)	0.0	37.5	37.5	25.0	50.0	25.0	25.0
Jew fish (8)	12.5	50.0	37.5	0.0	50.0	37.5	12.5
Lactarius (6)	0.0	50.0	33.3	16.7	50.0	50.0	0.0
Prawns (32)	—	—	34.4	65.6	—	68.8	31.3
Percentage of total samples (201)	10.1	49.7	30.2	10.1	61.5	30.2	8.3

* Percentage samples unacceptable

+ Number of samples in each category

Table 4. Total plate counts in fresh fish and prawns (1980-82)

Fish	Bacterial count/g (range)				Percentage unacceptability based on TPC			
	<10 ³		Between 10 ³ -10 ⁵		>10 ⁵		>5 x 10 ⁵	
	SO	DS	SO	DS	SO	DS	SO	DS
Percentage of samples								
Sardine (38)	0	23.7	73.7	73.7	26.3	2.6	5.3	0
Mackerel (34)	0	32.4	82.4	64.7	17.6	0	2.9	0
Threadfin bream (27)	0	18.5	70.4	81.5	29.6	0	3.7	0
Cat fish (20)	0	5.0	65.0	90.0	35.0	5.0	25.0	0
Lizard fish (15)	0	46.7	86.7	53.3	13.3	0	0	0
Pomfret (13)	0	0	38.5	92.3	61.5	7.7	15.4	0
Horse mackerel (8)	0	12.5	75.0	87.5	25.0	0	12.5	0
Jew fish (8)	0	12.5	62.5	87.5	37.5	0	0	0
Lactarius (6)	0	0	83.3	100.0	16.7	0	16.7	0
Prawn (32)	0	0	37.5	93.7	62.5	6.3	12.5	6.3
Percentage of total samples (201)	0	17.4	66.7	79.6	33.3	3.0	8.5	1.0

SO - Skin-on; DS - deskinning and peeled in the case of prawns; + Number of samples in each category

ever, bacteriological results bear no correlation with organoleptic, chemical or instrumental parameters because the bacterial count would obviously vary depending upon the sanitary conditions.

Tables 4 to 7 illustrate the bacterial profile of the samples collected from the fisheries harbour. The total bacterial counts on skin-on fish/shell-on prawns fall in the range of 10³ to 10⁶ g⁻¹ of tissue and 66.7% of the

Table 5. Incidence of *E. coli* in fresh fish and prawn landed (1980-82)

Fish	Bacterial count range (g-1)						Percentage unacceptability based on <i>E. coli</i>			
	0		≤20		>20-100		>100-1000		>20	
	SO	DS	SO	DS	SO	DS	SO	DS	SO	DS
Percentage of samples										
Sardine (38) +	78.9	94.7	0	0	2.60	0	18.4	5.3	21.0	5.3
Mackerel (34)	67.6	100.0	2.9	0	14.70	0	14.7	0	29.4	0
Threadfin bream (27)	70.4	100.0	7.4	0	3.70	0	18.5	0	22.2	0
Cat fish (20)	35.0	75.0	10.0	5.0	25.0	10	30.0	10	55.0	20
Lizard fish (15)	73.3	100.0	6.7	0	6.7	0	13.3	0	20.0	0
Pomfret (13)	53.8	92.3	23.1	0	15.4	7.7	7.7	0	23.1	7.7
Horse mackerel (8)	50.0	100.0	12.5	0	0	0	37.5	0	37.5	0
Jew fish (8)	50.0	100.0	12.5	0	25.0	0	12.5	0	37.5	0
Lactarius (6)	33.3	100.0	33.3	0	33.3	0	0	0	33.3	0
Prawn (32)	62.5	96.8	12.5	0	12.5	31	12.5	0	25.0	3.1
Percentage of total samples (201)	63.2	95.5	8.5	0.5	11.44	2.0	16.9	2.0	26.4	3.98

SO - skin-on; DS - deskinning; + number of samples in each category

Table 6. Distribution of faecal streptococci in fresh fish and prawns (1980-82)

Fish	Bacterial count range (g-1)							
	0		≤100		>10 ² -10 ³		>10 ³ *	
	SO	DS	SO	DS	SO	DS	SO	DS
Percentage of samples								
Sardine (38) +	7.9	36.8	34.2	34.2	26.3	18.4	31.6	10.5
Mackerel (34)	17.75	47.1	20.6	38.2	58.8	11.8	2.9	0
Threadfin bream (27)	14.8	29.6	18.5	48.1	44.4	22.2	22.2	3.7
Cat fish (20)	5.0	15.0	30.0	50.0	55.0	35.0	10.0	0
Lizard fish (15)	0.0	13.3	33.3	73.3	66.7	13.3	0	0
Pomfret (13)	0	30.8	23.1	61.5	53.8	0	23.1	7.7
Horse mackerel (8)	0	25.0	37.5	62.5	50.0	12.5	12.5	0
Jew fish (8)	12.5	25.0	12.5	50.0	25.0	25.0	25.0	0
Lactarius (6)	0	33.3	50.0	50.0	33.0	16.7	16.7	0
Prawn (32)	6.35	25.0	21.9	28.1	31.3	34.4	40.6	12.5
Percentage of total samples (201)	8.5	30.3	26.4	44.3	45.8	19.9	20.4	5.0

* Percentage unacceptable based on faecal streptococci count.

+ number of samples in each category

Table 7. Incidence of coagulase-positive staphylococci in fresh fish and prawns (1980-82)

Fish	Bacterial count/g					
	Nil		≤ 100		$> 100^*$	
	SO	DS	SO	DS	SO	DS
Percentage of samples						
Sardine (38) +	73.7	97.4	13.2	2.6	13.2	0
Mackerel (34)	76.5	100	17.6	0	5.9	0
Threadfin bream (27)	77.8	100	14.8	0	7.4	0
Catfish (29)	80.0	100	15.0	0	5.0	0
Lizard fish (15)	73.3	100	20.0	0	0	0
Pomfret (13)	76.9	100	15.4	0	6.7	0
Horse mackerel (8)	62.5	100	25.0	0	0	0
Jew fish (8)	62.5	100	3.8	0	0	0
Lactarius (6)	83.3	100	16.7	0	0	0
Prawns (32)	75.0	100	18.8	0	6.3	0
Percentage of total samples (201)	75.1	99.0	17.4	0.5	7.0	0

SO - skin-on; DS - deskinning; * Percentage unacceptable based on coagulase-positive staphylococci count; + number of samples in each category

Table 8. Bacterial counts on the platform of the Cochin Fisheries Harbour and in the ice used during 1980-82

	TPC	<i>E. coli</i>	Faecal streptococci	Coagulase-staphylococci
<i>Floor (per cm²)</i>				
Average (35 values)	5.77×10^6	7.0	685	2
Range	2.0×10^3 - 7.14×10^8	0-72	0-2090	0-16
<i>Block ice (per ml)</i>				
Average (34 values)	1.50×10^3	2	5	0
Range	1.0 - 1.7×10^4	0.32	0-100	0
<i>Crushed ice (per ml)</i>				
Average (37 values)	9.32×10^3	14	96	0
Range	220 - 1.6×10^6	0-84	0-456	0

samples had TPC 10^5 . If 5×10^5 (IS: 4780-1978) is taken as the highest permissible level for TPC in fresh fish, 8.5% of the fish landed at Cochin Fisheries Harbour would be unacceptable. However, in one de-skinned sample (or peeled prawns) the unacceptability was reduced to 1%. The very low bacterial counts in the de-skinned samples indicate that most of the bacteria were on the surface and can be reduced drastically by washing. It also points out that the samples tested are either very fresh or only in the early stage of spoilage; otherwise the bacterial counts in the de-skinned samples would have also been higher. *E. coli* was absent in 63.2% of the samples. However, on removing the skin 95.5% of the samples were free from this organism; 26.4% of the skin-on samples and 4% of the de-skinned ones contained *E. coli* above the level permitted by the Indian Standards Specifications (IS: 6032-1971). Of the total samples 34.9% of skin-on and 74.6% of de-skinned samples had faecal streptococci 100. If 1000 organisms/g tissue is taken as the tolerance limit for faecal Streptococci (Iyer, *et al.*, 1973), there would be 20.4 and 5% of unacceptability in skin-on and de-skinned samples respectively. The high incidence of faecal streptococci indicates poor hygienic conditions of the environment. The high bacterial counts of the crushed ice compared to the block ice and swabs taken from the platform, also indicate the human contamination (Table 8).

Table 7 illustrates the incidence of coagulase positive staphylococci in the fresh samples from the harbour. Nearly 7% of the samples failed to satisfy the quality specification for these materials (IS: 4780-1978). Staphylococci was absent in 75% of the skin on samples and 99% of the de-skinned samples. Salmonella could not be detected in any of the samples. Therefore, based on bacteriological consideration, about 94% of the samples from the harbour were in acceptable condition. It should be noted that the total bacterial counts obtained in this study (10^3 – 10^6 g⁻¹) are very much lower than those quoted by Cann (1976) for prawns from Indian waters (10^4 – 10^7 g⁻¹). This may be due to the improvements in the handling of the catch during the past quarter of a century. However, it would be possible to increase the acceptability to 100% by washing the

platform twice a day and by providing facilities for washing the hand and foot of the workers. Icing the fish immediately after catch would well retain the freshness also.

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