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Microbial Hazards in Fish Sold in Retail Markets of Cochin

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Microorganisms play an important role in the spoilage of fish. Knowledge of the microbial quality of fish will help in assessing the quality of the fish and the extent of contamination with harmful microorganisms. A study was carried out to assess the microbiological quality of fish sold in retail markets in Cochin. Parameters like total plate count, counts of coliforms and *Escherichia coli*, presence of pathogens like *Salmonella*, and *Bacillus cereus* were studied. The results of the study showed that the microbiological quality of both fresh and frozen fish available in the retail markets in Cochin were very poor. 17.3% of the fresh fish and 6.3% of the frozen fish samples were found to be contaminated with *Salmonella*. Enterotoxigenic *Bacillus cereus* was detected in 19% of the fresh fish and 10.6% of the frozen fish samples. Total plate counts more than $10^6.g^{-1}$ were observed in 72% and 77 % of the fresh fish and frozen fish samples, respectively. *E. coli* was detected in 98.7% and 96.85% of the fresh and frozen fish samples, respectively and the counts were more than 20 $MPN.g^{-1}$ in 72.3% and 71.3%, respectively. The urgent need for introduction of good handling practices and quality standards for fish and fishery products for internal markets and its strict implementation in order to safeguard the health of the consumers are discussed.

Key words : Pathogenic bacteria, *Salmonella*, *Bacillus cereus*, enterotoxin

Cochin is a major fish landing centre in Kerala and being a cosmopolitan city it has got a large population of fish eating people. Fishes of almost all varieties are available in the market. Fishes from other parts of the state and also from neighbouring states reach the market. Some of the fishes are frozen and sold through the retail cold stores. There are a number of fish markets situated in different regions of the city catering to the local people. The demand being very high, all types of fish are sold in the markets.

Fish is a reservoir of large number of microorganisms. Some are inherent, coming from the environment from where the fish is caught, and

others are due to contamination at various stages of handling, from the time of catch till it reaches the consumer. Majority of these microorganisms are non-pathogenic, causing only spoilage of the fish, but there are some, which are pathogenic causing food poisoning. Quality standards have been prescribed for fish and fishery products meant for export and they are being monitored strictly. No such control exists for the retail trade of fish and fishery products. A number of reports are available on the quality of fish and fishery products meant for export (Pillai *et al.*, 1965; Iyer & Choudhuri, 1966; Iyer *et al.*, 1966; Sreenivasn & Joseph, 1966; Pillai & Rao, 1969; Mathen *et al.*, 1975). Joseph *et al.* (1983; 1986; 1988), Kalaimani *et al.* (1988) and Valsan *et al.* (1985) have reported on the quality of cured fish in different parts of the country. The quality of fishes sold in the retail markets of Bombay have been reported by Iyer *et al.* (1986) and the quality of commercially frozen boiled clam meat have been reported by Varma *et al.* (1988). Sanjeev *et al.* (1986); Lalitha & Iyer (1986) and Iyer & Srivastava (1988) have reported on the incidence of some pathogens in fishes available in the markets. Hatha & Lakshmanaperumalsamy (1997) have reported on the prevalence of Salmonella in fish from markets in Coimbatore, South India. Earlier studies (Nambiar & Iyer, 1990) have reported the incidence of *Salmonella* and some faecal indicator bacteria in fishes sold in the retail markets in Cochin. Heinitz *et al.* (2000) have reported on the incidence of *Salmonella* in imported as well as domestic fish and seafood in the US. This study was taken up to assess the possible health hazards in fishes sold in the retail markets in Cochin.

Materials and Methods

Samples of fresh fish were collected from six selected retail markets *viz.*, Ernakulam, Pachalam, Kaloor, Kadavanthra, Thevara and Polakandam, situated at different localities within the Cochin Corporation area. Samples were collected from all the markets on rotation basis at regular intervals, covering a period of one year. Samples of frozen fish were collected from retail cold stores situated in the Cochin Corporation area. The samples were brought to the laboratory under aseptic conditions and were analysed immediately for total plate count (TPC), counts of coliforms, *Escherichia coli, Bacillus cereus, Yersinia enterocolitica* and also for the presence of Salmonella. USFDA (2001) methods were used for the analysis. The enterotoxin of *Bacillus cereus* was detected by the Reverse Passive Latex Agglutination (RPLA) method of Oxoid, England (Anon, 1999).

Results and Discussion

A total of 300 samples, each of fresh fish and frozen fish were analysed. Table 1 gives the overall bacteriological quality of fresh fish samples. The fresh fish samples comprised of 26 different species commonly available in the market. Salmonella was detected in 17.3% of the fresh fish samples. Enterotoxigenic *Bacillus cereus* was detected in 19% of the fresh fish samples. *Yersinia enterocolitica* was not detected in any of the samples tested. Salmonella, being sensitive to heat will be destroyed during cooking, but still there are chances of cross contamination to other food items, which are not heat processed. Heinitz *et al.* (2000) have reported the incidence of *Salmonella* in 7.2% of the imported and 1.3% of the domestic seafood in the US. Lakshmanan *et al.* (1984) did not detect *Salmonella* in any of the samples analysed from the landing centers, while Iyer *et al.* (1986) detected *Salmonella* in 4.4% of the samples from Bombay markets. Nambiar & Iyer (1990) reported the incidence of *Salmonella* in 8.7% of the fresh fish samples from Cochin markets. *Bacillus cereus* is a spore forming bacteria and the spores can survive normal cooking temperatures. *Bacillus cereus* produces an enterotoxin, which will cause diarrhoea in human beings. The total plate count indicates the level of microbial contamination of the samples. In the case of fresh fish meant for export, the maximum allowable total plate count is $10^5.g^{-1}$. If these standards are taken as the criterion, 72% of the fresh fish were of poor quality on the basis of TPC. Moreover, 21.6% of the fresh fish samples had total plate counts exceeding $10^7.g^{-1}$. The presence of coliforms, especially *E. coli*, is an indication of faecal pollution. The presence of these bacteria is taken as an indication of the presence of other pathogenic bacteria, and limits have been prescribed for the counts of *E. coli* in frozen fish and fresh fish meant for export. *E. coli* counts more than $20.g^{-1}$ is considered as of poor quality. Taking this as the criterion, 72.3% of the fresh fish samples were above the limits prescribed. 47.6% of the fresh fish samples were having *E. coli* counts more than $100.g^{-1}$, which can be considered as heavily contaminated with faecal matter. Table 2 gives the bacteriological quality of fresh fish samples from different markets.

Maximum number of samples showing the presence of *Salmonella* was observed in Kaloor market (30%) and the least number in Pachalam market (6%). In the case of Enterotoxigenic *Bacillus cereus*, the maximum number was observed in Polakkandam market (34%) and the least number in Ernakulam market (10%). The highest number of samples showing TPC more than $10^6.g^{-1}$ was observed in Kaloor market (88%) and the lowest

Table 1. Bacteriological quality of fresh fish from local markets of Cochin

Name of fish	No of samples analysed	No. of samples positive for		No. of samples having TPC.g^{-1} (log no.)	No. of samples having *E. coli* MPN.g^{-1}	
		Salmonella	*Bacillus*	>6.0	>20	>100
Scomberomorus commerson	34	7	4	22	23	12
Acanthopagrus berda	33	4	6	27	25	15
Lutjanus argentimaculatus	33	5	7	27	30	19
Rastrelliger kanagurta	23	5	3	10	14	6
Parastromateus niger	22	2	4	17	15	13
Lethrinus frenatus	21	2	2	13	14	10
Euthynnus affinis	19	3	3	8	10	6
Sphyraena jello	18	2	3	14	16	15
Epinephelus melanostigma	15	3	5	12	11	3
Decapterus russelli	11	3	2	7	8	8
Etroplus suratensis	1i	4	1	10	10	10
Pampus argentius	8	3	2	6	4	2
Johnius borneensis	7	1	1	4	4	2
Lepturacanthus savala	6	0	1	5	5	2
Lactarius lactarius	5	2	3	4	3	2
Protonibea diacanthus	5	1	1	4	3	2
Gerres filamentosus	4	1	2	4	4	4
Epinephelus malabaricus	3	1	0	3	2	2
Mugil cephalus	3	1	1	3	2	2
Leiognathus splendens	3	0	0	2	1	1
Sardinella longiceps	2	0	2	1	2	0
Labeo rohita	4	0	0	4	2	0
Chanos chanos	2	1	1	1	2	2
Nemipterus japonicus	3	1	1	3	3	2
Sardinella fimbriata	3	0	0	3	3	2
Megalaspis cordyla	2	0	2	2	1	1
Total	300	52	57	216	217	143

number in Polakkandam market (54%). In the case of *E. coli*, the maximum number of samples showing counts more than 20.g^{-1} was observed in Kaloor market (90%) and the lowest in Polakkandam market (40%). Kaloor market showed the maximum number of samples having *E. coli* counts more than 100.g^{-1} (66%), and Polakkandam market showed the minimum number (30%). There was not much difference in the overall bacteriological quality of fish from different markets.

Among the different varieties of fresh fish, *Pampus argentius* showed the maximum number having Salmonella (37.5%), followed by *Etroplus*

suratensis (36%), *Rastrelliger kanagurta* (21%), *Scomberomorus commerson* (20%) and *Parastromateus niger* (9%). *Bacillus cereus* was detected in more number of samples in the case of *Pampus argentius* (25%) followed by *Parastromateus niger* (18%), *Rastrelliger kanagurta* (13%), *Scomberomorus commerson* (11%) and *Etroplus suratensis (9%).* Total plate counts more than $10^5.g^{-1}$ was observed in 90% of *Etroplus suratensis,* 77% of *Parastromateus niger*, 75% of *Pampus argentius*, 64% of *Scomberomorus commerson*, and 43% of *Rastrelliger kanagurta. E. coli* counts more than $20.g^{-1}$ was observed in 90% of *Etroplus suratensis*, 68% of *Parastromateus niger*, 67% of *Scomberomorus commerson*, 60% of *Rastrelliger kanagurta* and 50% of *Pampus argentius*. The results indicate that very poor quality was observed even in highly priced fishes (Table 1).

Table 2. Bacteriological quality of fresh fish from different local markets of Cochin

Characteristics	Ernakulam market	Pachalam market	Kaloor market	Kadavanthra market	Thevara market	Polakkandam market	Total
Total no. of samples	50	50	50	50	50	50	300
Presence of Salmonella	7	3	15	7	11	9	52
Presence of *Bacillus cereus*	5	9	7	7	12	17	57
TPC.g^{-1} log No. > 6.o	32	41	44	36	36	27	216
E. coli MPN.g^{-1} > 20	37	38	45	39	28	20	217
E.coli, MPN.g^{-1} > 100	29	26	33	22	18	15	143

Table 3 gives the overall bacteriological quality of frozen fish samples. The samples of frozen fish comprised of 24 different species. Salmonella was observed in 6.3% of the samples and *Bacillus cereus* in 10.6% of the samples. 77.5% of the samples were having total plate counts more than $10^5.g^{-1}$ and 32% showed TPC more than $10^8.g^{-1}$. *E. coli* counts more than $20.g^{-1}$ were observed in 71.3% of the samples and in the case of 49% of the samples the *E. coli* counts were more than $100.g^{-1}$. *Salmonella* was detected in 16.8% of *Etroplus suratensis* and 12% of *Lethrinus frenatus*. *Bacillus cereus* was detected in 19% of *Decapterus russelli*, 17% of *Sardinella longiceps* and 11.1%, each of *Parastromateus niger* and *Rastrelliger kanagurta*. TPC more than $10^6.g^{-1}$ was observed in 93.2% of the samples of *Etroplus suratensis*, followed by *Parastromateus niger* (85.2%), *Decapterus russelli* (81%), *Pampus argentius* (80%), *Lethrinus frenatus* (68%), *Rastrelliger kanagurta* (55%) and *Scomberomorus commerson* (50%). *E. coli* counts more than $20.g^{-1}$was observed in 100% of *Pampus argentius*, 88% of *Parastromateus niger*, 76% of *Lethrinus*

frenatus, 75% of *Etroplus suratensis*, 60% of *Scomberomorus commerson* and 50% of *Rastrelliger kanagurta*. In the case of frozen fish, most of the species which were in great demand, did not meet the quality standards.

Table 3. Bacteriological quality of frozen fish from local markets

Name of fish	No of samples analysed	No. of samples positive for		No. of samples having TPC.g^{-1} (log no.)	No. of samples having *E. coli* MPN.g^{-1}	
		Salmonella	*Bacillus*	>6.0	>20	>100
Etroplus suratensis	44	3	4	41	33	24
Sardinella longiceps	28	0	5	18	18	13
Acanthopagrus berda	27	1	1	24	20	18
Parstromateus niger	27	2	3	23	24	19
Scomberomorus commerson	26	1	2	13	16	9
Lethrinus frenatus	25	3	2	17	19	13
Decapterus russelli	21	1	4	17	13	8
Rastrelliger kanagurta	18	0	2	10	9	3
Mugil cephalus	14	2	0	13	13	9
Sphyraena jello	8	0	1	5	5	0
Oreochromis mossambicus	8	2	2	7	6	3
Epinephelus melanostigma	7	1	2	6	4	1
Alepes djeddaba	7	1	0	6	6	4
Rachycentron canadum	6	1	0	4	6	5
Chirocentrus dorab	5	0	2	5	5	4
Protonibea diacanthus	5	0	0	3	4	4
Euthynnus affinis	5	0	0	3	1	1
Pampus argentius	5	1	1	4	5	4
Leiognathus splendens	3	0	0	3	1	0
Seriolina nigrofaciata	5	0	1	3	3	2
Chanos chanos	2	0	0	2	1	1
Sardinella fimbriata	2	0	0	2	2	2
Valamugil speigleri	2	0	0	2	0	0
Total	300	19	32	231	214	147

The handling practices followed in the boat, landing centers, during transport and in the markets are responsible for such heavy contamination with microorganisms in the fishes sold in the retail markets. The fishes are not properly iced which will enable the bacteria present in the fish to multiply and even the poor quality of ice used adds to the contamination. In the retail markets, in most of the cases, the fishes are kept on the floor for sale and least attention is given to hygienic practices. The floors of the retail markets are never kept clean and frequently get contaminated with faecal matters of stray animals. This adds to the faecal contamination of the fish being sold

in the markets. The incidence of *Salmonella* and *Bacillus cereus* in both fresh as well as frozen fish in retail markets is of great concern for the health of the consumers. Good handling practices have to be followed during handling of fish right from the moment of catch till it reaches the consumer and it is high time that strict quality standards are prescribed and constantly monitored for fish sold in retail markets also.

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