Seafood Safety - Proceedings of the Symposium on Seafood Safety - Status and Strategies, 28-30 May 2002, Cochin, India

# Microbial Quality Status of Processed Seafood Exported from India

P.R.G. VARMA, S. SANJEEV and M.K. MUKUNDAN
*Central Institute of Fisheries Technology*
*P.O. Matsyapuri, Cochin - 682 029, India*

India has been a major exporter of marine products. During the last year India exported seafood products worth about Rs. 6000 crores. Occasionally India has been facing a number of quality problems for the export products including microbiological contamination. In recent years, especially after the implementation of European Union regulations, Indian seafood industry has made tremendous improvement both with regard to infrastructure facilities and product quality. This paper deals with the present status on the microbiological quality of the export products from India. This paper is based on the samples of frozen seafood collected and tested during the period of one year, 2001-02. The samples were collected from seafood processing units in and around Cochin and comprised of frozen shrimp, cuttlefish, squid, finfish, crab and octopus. The major defect was TPC above permitted level in 13% of samples and presence of *Vibrio parahaemolyticus* in about 4% of samples. Salmonella and *Vibrio cholerae*, though isolated, were present in only less than 1% of samples. *Listeria monocytogenes* was totally absent. The results also agree with the major microbiological defects reported in seafood from India by importing countries.

**Key words : Microbial quality, seafood, India**

India is a major exporter of marine products. Right from 1956, when the first consignment of processed seafood was exported from Cochin, the Indian seafood export has made steady progress and last year the export touched a figure of approximately Rs. 6,000 crores. During these years the seafood export industry had to face a number of quality problems resulting either in the rejection of the consignment by the importing countries or enforcement of alert or total ban of Indian seafood by some countries. The major problems encountered are decomposition, presence of chemical residues like heavy metals and antibiotics, contamination with filth and contamination with various indicator and pathogenic microorganisms.

In recent years, especially after the implementation of European Union regulations and adoption of HACCP system for seafood quality control,

Indian seafood industry has made tremendous improvement both with regard to infrastructure facilities and product quality. This paper evaluates the microbial quality of the seafood processed for export from India after the implementation of the new quality control system as per the EU regulations and adoption of HACCP system.

## Materials and Methods

The samples of processed seafood for this study were collected during the year 2001-02. The frozen seafood samples were collected from different seafood processing plants in and around Cochin. Some samples were received from other parts of Kerala and also from Mumbai and Chennai. These samples were brought to the laboratory in frozen condition in insulated containers. The samples comprised of frozen shrimps in different forms (HL, PD, PUD and PC), frozen cuttlefish, squid, finfish, crab and octopus. A total of 251 samples were collected. These samples were tested for total plate count (TPC), *Escherichia coli*, *Staphylococcus aureus*, Salmonella, *Listeria monocytogenes*, *Enterobacteriaceae*, *Vibrio cholerae*, *Vibrio parahaemolyticus* and other vibrios. All these microorganisms except *Listeria monocytogenes* were identified by the method given in Bacteriological Analytical Manual, (US FDA, 1995). In the case of *Listeria monocytogenes*, the sample after enrichment in Listeria Enrichment Broth (UVM) was streaked on Listeria Selective Agar (Oxford formulation) and presumptive colonies were confirmed as per the methods given in Bacteriological Analytical Manual (US FDA, 1995).

**Table 1. Microbiological quality of seafood processed for export**

| Microbial organism | Detected (%) | Exceeded limits (%) |
|---|---|---|
| Total plate count | NA | 13.14 |
| *Escherichia coli* | 2.35 | 1.19 |
| *Staphylococcus aureus* | 11.55 | 0.79 |
| Salmonella | 0.79 | 0.79 |
| *Vibrio cholerae* 01 | 0.4 | 0.4 |
| *V. cholerae* non-01 | 0.4 | 0.4 |
| *V. parahaemolyticus* | 3.98 | 3.98 |
| *Listeria monocytogenes* | 0.0 | 0.0 |

Limits: Raw shrimp (TPC) $1x10^6.g^{-1}$, Cooked shrimp (TPC) $1x10^5.g^{-1}$; Cuttlefish/squid (TPC) $2x10^5.g^{-1}$, *E. coli*: $20.g^{-1}$; *Staphylococcus aureus* $100.g^{-1}$; Salmonella, *Vibrio cholerae*, *V. parahaemolyticus* and *Listeria monocytogenes* - presence only

**Table 2. Microbial quality of seafood processed for export (item-wise)**

| Product | No. of samples | TPC above limit | *E. coli* | | *S. aureus* | | Salmonella | *V. cholerae* | *V. parahaemolyticus* | *L. monocytogenes* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P* | >20.g$^{-1}$ | P* | >100.g$^{-1}$ | | | | |
| Frozen shrimp (raw) | 125 | 17 | 3 | 0 | 15 | 1 | 2 | 0 | 10 | 0 |
| Frozen shrimp (cooked) | 27 | 0 | 0 | | 0 | | 0 | 0 | 0 | 0 |
| Frozen cuttlefish and squid | 75 | 16 | 3 | 3 | 11 | 1 | 0 | 0 | 0 | 0 |
| Finfish | 9 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Crab | 13 | 0 | 0 | | 0 | | 0 | 1 | 0 | 0 |
| Octopus | 2 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Total No. | 251 | 33 | 6 | 3 | 29 | 2 | 2 | 1 | 10 | 0 |
| % | | 13.14 | 2.38 | 1.19 | 11.55 | 0.79 | 0.79 | 0.4 | 3.98 | 0 |

P = Present

**Table 3. Occurrence of various species of pathogenic halophilic vibrios in different fish products**

| Number of sample | Total no. of samples | *V. algino lyticus* | *V. carchariae* | *V. cinci natiensis* | *V. damsela* | *V. fluvialis* | *V. furnissii* | *V. metsch nikovii* | *V. para haemoly ticus* | *V. vul nificus* |
|---|---|---|---|---|---|---|---|---|---|---|
| Frozen fish fillets | 13 | 2 | 1 | Nil | Nil | 1 | 2 | Nil | 1 | Nil |
| Frozen cuttlefish | 29 | 4 | Nil | 7 | Nil | Nil | Nil | Nil | Nil | Nil |
| IQF prawns | 100 | 4 | 2 | 4 | Nil | 1 | Nil | 2.1 | 1 | 2 |
| Frozen prawns (block) | 68 | 10 | Nil | 18 | Nil | Nil | Nil | 8.82 | 8 | 6 |
| Frozen squid | 84 | 17 | Nil | 13 | Nil | 2 | Nil | 2.38 | 4 | 6 |
| Frozen octopus | 14 | Nil | Nil | 3 | Nil | 1 | 1 | Nil | 2 | 1 |
| Frozen ark shell | 4 | Nil | Nil | 1 | Nil | Nil | Nil | Nil | 1 | Nil |
| Frozen split crab | 6 | 3 | Nil | 3 | Nil | Nil | Nil | Nil | Nil | Nil |
| IQF squid | 6 | 1 | 1 | 3 | Nil | 1 | 1 | 14.67 | Nil | Nil |
| Frozen yellow clams | 5 | 3 | 1 | 1 | Nil | Nil | Nil | Nil | 2 | 1 |
| Iced Prawns | 29 | 7 | Nil | 6 | 1 | 2 | Nil | 1 | 10 | 1 |
| Iced squid | 18 | 6 | 2 | 10 | Nil | Nil | Nil | Nil | 5 | 1 |
| Iced oyster | 6 | 1 | Nil | Nil | Nil | Nil | Nil | Nil | 2 | 2 |
| Total | | | | | | | | | | |
| No. | 382 | 58 | 7 | 69 | 1 | 8 | 4 | 12 | 36 | 20 |
| % | 53 | 15.18 | 1.83 | 18.06 | 0.26 | 2.09 | 1.05 | 3.14 | 9.42 | 5.24 |

## Results and Discussion

Tables 1 and 2 give the percentages of the total samples analysed in which the different microorganisms were present above the maximum limit permitted as per our export certification procedures. In the case of pathogens, mere presence was taken as criteria for rejection. For *E. coli* it was $20.g^{-1}$. and *Staphylococcus aureus* $100.g^{-1}$. TPC limit per gram was taken 10 lakhs for raw frozen shrimps, 1 lakh for frozen cooked shrimp and 2 lakhs for frozen cuttlefish and squid. Table 1 shows that TPC was above the limit in 13.14% of the samples, the problem being noticed in frozen raw shrimp and frozen cuttlefish and squid.

Although *E. coli* was present in 2.35% of the samples, its presence exceeded the limit only in 1.19% of samples. *E. coli* was present above permitted level only in frozen cuttlefish and squid. *Staphylococcus aureus* was present in 11.55% of the samples and the counts exceeded the limit in 0.79% of the samples only.

**Table 4. Comparison of microbial defects encountered in export products by CIFT and importing countries**

| Type of Fishery Products | Microbial defects identified by CIFT | Microbial defects reported by importing countries |
|---|---|---|
| Frozen prawns including scampi | Total plate count | Total plate count |
| | *E. coli* | Salmonella |
| | *S. aureus* | *V. parahaemolyticus* |
| | Salmonella | V. cholerae |
| | *V. parahaemolyticus* | Enterobacteriaceae |
| | Entero bacteriaceae | Thermotolerant coliforms |
| Frozen squid and cuttlefish | Total plate Count | Total plate count |
| | *E.coli* | Salmonella |
| | *S. aureus* | *V. cholerae* |
| | Enterobacteriaceae | *V. parahaemolyticus* |
| | *V. parahaemolyticus* | *E. coli* |
| Crab | *V. cholerae* 01 | *V. cholerae* 01 |
| | *V.cholerae* non-01 | *V. cholerae* non –01 |
| Octopus | Nil | Salmonella |
| Finfish | *S. aureus* | *S. aureus* |
| | *V. parahaemolyticus* | *V. parahaemolyticus* |
| | *V. alginolyticus* | Thermotolerant coliforms |
| | | *V. alginolyticus* |
| | | *V. metschnikovii* |

With regard to pathogens, *Listeria monocytogenes* was absent in all samples. This is also in agreement with earlier findings of Iyer *et al.* (1994). Salmonella was present in only 0.79% of the samples and it has shown reduction compared to the level reported by Iyer (2000), probably due to implementation of HACCP system and other quality control measures. Incidence of *Vibrio cholerae* 01 has not changed significantly but that of *V. cholerae* non-01 has shown significant change from the value reported by Varma *et al.* (1989). *Vibrio parahaemolyticus* was present in 3.98% of samples when compared to 9.42% samples as reported by Sanjeev *et al.* (2000) (Table 3). Table 3 also gives the percentages of other vibrios present in fishery products.

Table 4 gives a comparative statement of microbiological defects encountered in export products by CIFT and importing countries. The results indicate that there is a close similarity between the results except minor differences.

The studies reveal that even though there are some microbiological problems in our export product, it is very negligible when compared with the total quantity of our export.

The authors are thankful to Dr. K. Devadasan, Director, CIFT, Cochin for his permission to publish this paper.

## References

Iyer, T.S.G. (2000) in *Seafood Quality Assurance*, p. 53-57, Training Manual, CIFT, Cochin.

Iyer, T.S.G., Varma, P.R.G. and Gopakumar, K. (1994) *FAO Fisheries Report* No. 514 Supplement, p. 39-43, FAO, Rome

Sanjeev, S., Varma, P.R.G. and Iyer, T.S.G. (2000) *Fish. Technol.* **37,** 31

US FDA (1995) *Bacteriological Analytical Manual* (1995) Food and Drugs Administation, USA

Varma, P.R.G., Iyer, T.S.G., Joseph, M.A. and Zacharia, S. (1989) *J. Food Science Technol.* **41,** 342