Quality of Commercial Frozen Boiled Clam Meat

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The bacterial quality and sand content of commercial frozen boiled clam meat are discussed. In general the commercial frozen boiled clam meat belonging to the *Villorita cyprinoides* sp. collected from Cochin are highly contaminated with faecal indicator and pathogenic organisms than that belonging to the *Katelysia opima* sp. collected from Quilon. The studies also show that the bacterial quality of frozen boiled clam meat can be improved by enforcing better hygienic and sanitary practices.

Frozen boiled clam meat is a new addition to our seafood export industry. Recent years have witnessed a substantial increase in the export of frozen boiled clam meat from India. Although there is a compulsory pre-shipment inspection for marine products like shrimps, cuttle fish, squids, lobster etc. frozen boiled clam meat has not been included under this statutory inspection system and as such no standard has been specified for this commodity in this country. Considerable work has been done from time to time to assess the quality of frozen shrimps, cuttle fish, squid etc. that are processed for export (Varma *et al.*, 1985; Iyer, 1985). But no information is available on the quality of frozen boiled clam meat presently being processed in this country for export. Therefore studies were undertaken to assess the quality of commercially frozen boiled clam meat and to identify the probable source of bacterial contamination. The present paper deals with the bacterial quality of frozen boiled clam meat for export and also enlightens the possible sources of contamination during the different stages of processing. As the sand content is an important factor with regard to the quality of clam meat, the levels of sand content are also discussed.

Materials and Methods

The samples for the study were collected mainly from two important clam processing units situated at Quilon and Cochin. The samples collected include two different species, *Katelysia opima* from Quilon and *Villorita cyprinoides var cochinensis* from Cochin. The samples were aseptically collected from different stages of processing of frozen boiled clam meat and also from the commercially frozen product. These samples were analysed for sand content apart from detailed bacteriological examination.

Total bacterial count at 37°C, coliforms, faecal streptococci, *E. coli* and coagulase positive staphylococci were determined as per Indian Standard Specifications. (IS: 2237, 1971). *Salmonella* and *Vibrio cholerae* were determined as per the methods recommended by the AOAC (1975) and IS: 5887 Part IV (1976) respectively. Incubation temperature was 37°C in all the cases. Counts on tryptone glucose agar and KF agar were taken after 48 h, whereas those on tergitol-7 agar, desoxycholate agar and Baird-Parker medium were taken after 24 h. Bacto dehydrated coagulase plasma was used to test the characteristic colonies grown on BP medium. Sand and moisture contents were determined as given in AOAC (1975).

Results and Discussion

Table 1 gives an idea about the extent of contamination of commercially frozen boiled clam meat with bacteria of public health significance. In general, all the samples of frozen *Villorita cyprinoides* sp. collected were highly contaminated with faecal indicator and pathogenic organisms. Though *Salmonella* and *Vibrio cholerae* OI were totally absent in *Katelysia opima, Salmonella* was present to an extent of 5.4% in the *Villorita* sp. The *Salmonella* isolated from this species belong to a rare serotype in

Table 1. *Faecal indicator and pathogenic organisms in commercial frozen boiled clam meat (as percentage of total samples tested)*

Organisms	*Katelysia* sp.	*Villorita* sp.
Coliforms		
Present in	36.70	100.00
1-100 per g	18.90	Nil
Above 100 per g	17.80	100.00
E. coli		
Present in	13.90	100.00
1-20 per g	0.63	Nil
Above 20 per g	13.27	100.00
Faecal streptococci		
Present in	98.10	100.00
1-1000 per g	50.60	Nil
Above 1000 per g	47.50	100.00
Coagulase positive staphylococci		
Present in	45.50	100.00
1-100 per g	31.00	Nil
Above 100 per g	14.50	100.00
Salmonella	Nil	5.40
Vibrio cholerae 01	Nil	Nil
Vibrio cholerae non 01 (NAG)	4.40	27.00

India, namely, *Salmonella agona* (Iyer & Varma, under publication). *Vibrio cholerae* Ol was also absent in the *Villorita* sp. However some samples in both the species showed the presence of *Vibrio cholerae non* Ol (Non-agglutinable, NAG, vibrios). The NAG vibrio isolations varied from 4.4% in the *Katelysia opima* sp. to 27% in the *Villorita* sp.

All the samples of *Villorita* sp. tested were contaminated with faecal indicator organisms in very high numbers, much above the recommended levels for other seafood products. In the case of *Katelysia opima* sp, total coliforms were present in 36.7% of the total samples tested. So far, no limit has been specified in the present standard for the maximum number of coliform organism that can be permitted. If 100 coliforms per g can be taken as the maximum permissible limit, in 17.8% of the total samples tested the coliforms were above the limit. Coagulase positive staphylococci was present in 45.5% of the samples. The count of coagulase positive staphylococci was below 100 per g, the maximum limit specified for other frozen seafoods, in 31.0% of the total samples tested. However, this organism was above the permitted limit in 14.5% of the total samples.

Table 2 gives the total bacterial count (TBC) in commercial frozen boiled clam meat. As seen from the Table the TBC was also very high in *Villorita* sp. compared to that in *Katelysia* sp.

Table 3 gives the sand content in the fresh and frozen boiled clam meat. The average sand content was 0.2536% and 0.625% (wet weight basis, average moisture content 72–73%) in the *Katelysia* and *Villoria* sp. respectively compared to the average

Table 2. *Total bacterial count in commercial frozen boiled clam meat (as percentage of total samples tested)*

TBC per g	*Katelysia* sp.	*Viliorita* sp.
Less than 1 lakh	42.40	0.00
Less than 2 lakhs	54.30	0.00
Less than 5 lakhs	76.50	0.00
5 to 10 lakhs	10.70	8.10
Above 10 lakhs	12.80	91.90

Table 3. *Sand content in clam meat (% on wet weight basis)*

Fresh meat*	*Katelysia* sp.	*Villorita* sp.
Minimum	0.544	1.240
Maximum	3.697	5.576
Average	1.297	2.352
Frozen boiled meat**		
Minimum	0.012	0.278
Maximum	0.539	1.350
Average	0.253	0.625
Average moisture content %		* 83–84 ** 72–73

sand content of 1.297% and 2.352% (wet weight basis, average moisture content 83–84%) in fresh clam meat of *Katelysia* and *Villorita* sp. respectively. The higher sand content in the *Villorita* sp. can be due to its small size making the cleaning process more difficult.

The average sand content in the different size grades of the frozen boiled clam meat belonging to *Katelysia* sp. was also studied and the results are given in Table 4. Though there was an appreciable difference in the largest size studied (300–500 per kg), in the other three size grades studied the difference in the sand content was not appreciable.

Table 4. *Average sand content in frozen boiled clam meat of different size grades (Katelysia* sp.*)*

Size grade count/kg	Average sand content %
300/500	0.0638
500/700	0.2585
700/1000	0.2728
1000/1500	0.2881

Table 5 gives the changes in the bacterial load during different processing operations under controlled conditions and under commercial conditions as practised at present. In the present commercial practice the clams are depurated for 24 h and then the clams are boiled. After boiling the clams are dumped on the floor of the pre-processing units for picking up the meat and the picked up meat is washed with all available sources of water including the near-shore water. In the controlled conditions, the clams after boiling are transferred to clean vessels for picking up the meat and the picked up meat is washed with water chlorinated to a level of 10 ppm. As seen from the Table, the counts of faecal indicator and other pathogenic organisms decreased during the depuration process as reported by Balachandran *et al.* (1984), and were completely destroyed during the boiling operation. But in the subsequent meat picking and washing operations these organisms were either absent or showed very minor increase when these operations were carried out under strict hygienic and sanitary conditions. On the contrary the counts of these organisms increased very much when these operations were carried out as done at present in the commercial pre-processing centres. The major factors contributing for these contaminations may be due to keeping the material on the floor of the pre-processing centres after the boiling operation and the quality of water used for washing the separated meat. It is evident from these studies that the quality of frozen boiled clam meat can further be improved by introducing better sanitary and hygienic conditions in the pre-processing centres.

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Table 5. *Changes in the bacterial load (per g) in clam meat (Katelysia sp.) during different stages of processing*

Stage of processing	Present commercial condition				Controlled conditions			
	Coli-forms	Coag. +ve staphy-lococci	Faecal strepto-cocci	TBC	Coli-forms	Coag. +ve staphy-lococci	Faecal strepto-cocci	TBC
Initial*	126	Nil	198	8.24×10^4	126	Nil	198	8.24×10^4
After depuration for 24 h*	22	Nil	20	1.71×10^4	22	Nil	20	2.71×10^4
After boiling*	Nil	Nil	Nil	3.40×10^3	Nil	Nil	Nil	3.40×10^3
After meat separation	17	110	594	1.67×10^5	Nil	Nil	121	4.20×10^4
Washed meat received in the processing plant	407	164	2305	4.84×10^5	Nil	Nil	141	2.42×10^4

* same in both conditions

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