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Quality and Safety Aspects of Fresh and Frozen Prawn (*Macrobrachium rosenbergii)*, Bangladesh

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Abstract The study was conducted to evaluate the quality and safety assessment of fresh and frozen prawn of Bangladesh. Fish was assessed both fresh and frozen condition at-20°C in a deep freezer. The keeping quality of this sample during frozen storage (12 weeks) was evaluated by studying organoleptic, biochemical and bacteriological aspects. The initial protein, moisture, lipid and ash content of fresh prawn were 33.11%, 61.8%, 2.27 %, 2.13 %; On the 4th week it were reduced to 28.25%, 67.38%, 1.87%, 1.81%; in the 8th week the protein content were decreased to 25.41%, 70.52%, 1.52%, 1.43% and at the 12th week finally the protein content showed 21.51%, 75.23% , 1.23%, 1.08% respectively. The initial TVB-N value of fresh prawn was 20.90 mg/100g, on the 4th week it was increased to 23.65 mg/100g, in the 8th week the TVB-N value increased to 26.32 mg/100g and at the 12th week finally the TVB-N value showed 31.62 mg/100g respectively; and the microbial load of fresh prawn was 4.32×10^5 cfu/g, on the 6th week it was decreased to 6.73×10^3 cfu/g, in the 12th week finally the microbial load was slightly increased to 1.42×10^4 cfu/g respectively. The chemical test mainly heavy metal concentration in the prawn observed that Cd, Cu, Mn, Zn and Pb were 0.017, 0.051, 6.935, 11.288 and 0.133 µg/g which was in consumable limit according to WHO.

Keywords: *assessment, quality and safety, prawn in two condition*

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1. Introduction

Prawn has a great contribution in fisheries sector. Shrimp and Prawn caught from inland water body was 28.99 Metric Ton (MT) in the year of 2009-10 [1]. The fishery export earning stands at US$ 477 million in 2008-09 financial years by exporting 72,888 MT Shrimp and other fishery products, in which Shrimp alone contributed 85% of the total export in spite of having a severe price fluctuation in the international market [2].

Macrobrachium rosenbergii is a perishable product and need quick storage, but long time storage may lose the quality of the product. Prawn is a valuable exportable product in our country. Spoilage of any food product is attributed to microbial growth due to improper handling, inadequate processing and frozen storage. Prawn products of Bangladesh face many quality control challenges throughout the product range particularly in export markets. The lack of proper freezing, quality management and modern technological investments during processing, distribution and storage, especially the insufficient application of Hazard Analysis Critical Control Points (HACCP), continues to lead to hazardous infection in final products.

EU has rejected several shrimp consignments from Bangladesh being the products were found to have metabolites of banned nitrofurans and other health hazardous chemicals contaminants. This incidence undoubtedly affects the image of Bangladesh frozen foods and threatened up growing international export market along with serious economic setback to the concerned exporters, the nature of complaints made by the frozen food safety issue is different than that was occurred in 1995-97 [3].

The previous food safety issues were mostly concerned to the microbiological contamination in post-harvest shrimp due to improper harvesting, handling, transport, processing and preservations. But the new complaints are associated with the presence of nitrofurans (antibiotics) and some other health hazard chemicals in the shrimp which found entrance from the environment or any source of contamination in the production chain. Some poisonous substance (Hg, Pb, Cr, Cu, As, Mn, Zn etc.) may present in the prawn due to the water quality and careless handling, improper quality control and preservation process cause the content of microorganisms. The main purpose of this study to observe the quality of prawn in frozen condition and to indicate the time line of the consumable quality exists for the prawn. It also helps us to know the Assessment of the Quality and Safety aspects of frozen Prawn and Prawn products and aware against the health hazard and minimize the loss.

2. Materials and Methods

The study was conducted during January to June, 2012 and the prawn (*Macrobrachium rosebergii*) was collected from Sonapur Bazar under district of Noakhali, Bangladesh which is located at 22.83°N and 91.10°E.

Transportation to the BAU laboratory: The Collected prawn species were transported to the laboratory of fisheries Technology, Bangladesh Agriculture University, Mymensingh with ice in insulated box.

Storage of experimental material: The prawn species divided into three portions which were packed individually and use one packet to test the quality of fresh prawn and another two were put into a deep freeze at -20°C for studying the quality changes in prawn during frozen storage.

Organoleptic assessment: The organoleptic assessment is a simple and widely used method in selecting quality of fish in the industry. Sensory assessment is the use of one or more of the five senses to judge, or form an opinion on, some aspect of quality. The senses in question are sight, smell, taste, touch and hearing

Sampling procedure: The frequency was monitoring once a week up to 12 weeks. Frozen prawn was thawed and then water on fish skin (i.e. surface) was soaked with tissue paper. Only fish muscle was collected for examination. Then the muscle was chopped and finally ground with a blender for homogenous mixture.

Biochemical analysis:

Proximate composition: AOAC [4] method was followed for proximate composition of the fresh and frozen prawn.

Moisture: The loss of moisture was calculated with the following formula:

$$Moisture\ content\ (\%) = \frac{weight\ of\ wet\ material - weight\ of\ dry\ material}{weight\ of\ dry\ material} \times 100$$

Ash: The ash was calculated with the following formula:

$$Ash\ content\ (\%) = \frac{weight\ of\ ash}{weight\ of\ sample} \times 100$$

Crude Protein: The following Kjeldhal method was used to determine protein content of the dried fish samples.

Total nitrogen: Total nitrogen was calculated by using the following formula

$$Nitrogen\ (\%) = \frac{ml.Acid\ titrated \times normality\ of\ acid\ titrated \times milli\ equivalent\ of\ N\ (0.014)}{weight\ of\ the\ sample} \times 100$$

$$\%\ \text{of crude protein} = \text{Nitrogen}\% \times 6.25$$

Lipid: Lipid content was determined by soxhlet apparatus. Following formula was used.

$$\text{Lipid content}\ (\%) = \frac{weight\ of\ lipid}{weight\ of\ sample} \times 100$$

Total Volatile Base-Nitrogen (TVB-N): For chemical evaluation of shelf-life TVB-N test was used. Total Volatile Base Nitrogen (TVB-N) was determined according to the methods given in AOAC (1980) with certain modification.

$$TVBN\ (mg/100\ g\ sample) = \frac{ml.Acid\ titrated \times normality\ of\ acid\ titrated \times milli\ equivalent\ of\ N\ (0.014)}{weight\ of\ the\ sample} \times 100$$

Detection of unwanted materials: Collected tissues were weighed by electronic balance and 5 ml of diacid mixture (5 ml conc. HNO_3: 3 ml 60% $HClO_4$) were added to each sample [5]. The content mixed for overnight. Samples were then digested, initially at 80°C temperature and later on 150°C for 2 hours. The completion of digestion was indicated by almost colorless material. The samples were subjected to analysis by Atomic Absorption Spectrophotometer method of Clesceri *et al*., [6]. The concentration of heavy metal was calculated by the following formula:

$$Metal\ concentration = \frac{ppm\ concentration\ observed \times final\ volume\ of\ sample\ ml}{weight\ of\ tissue\ taken\ in\ gm}$$

Quantitative Bacteriological Analysis: Aerobic plate count (APC) was done by consecutive decimal dilution technique. Samples for the APC was accurately weighed and added with required amount of water and liquefied in a sterile blender jar and consecutive tenfold dilution were made in the test tubes. From all the dilutions spread plate cultures were made in duplicates and incubated at 35°C for 48 hours. Colonies developed on the plates were counted in a colony counter and plates having 30 to 300 colonies were selected for APC. According to International Standard Organization (ISO) APC was calculated by the following formula:

Calculation of microbial load: The microbial load of shrimp loaves from shrimp shell powder was calculated by using the following formula-

$$\text{Colony Forming Unit}\ (CFU/g) = \frac{No.\ of\ colony \times 10^n \times 10 \times volume\ of\ solution}{weight\ of\ sample}$$

3. Results and Discussion

Change in physical characteristics during fresh and frozen storage: Table 1 shows the change in organoleptic qualities on prawn (*Macrobrachium rosenbergii*) during frozen storage at -20°C. It was organoleptically in acceptable condition for 8 weeks. During observation up to 4th weeks it was in excellent condition with natural odor and flavor. The characteristics of bright appearance, soft and firm texture also present. During 8th week of observation there was little deterioration apart from some loss of natural odor and still the off-flavor was not introduced. During 12th weeks of observation there was loss of bright appearance, loss of natural odor, the loss of natural flavor was observed and the experimental agent

was in rejected condition. The quality of prawn was acceptable up to 4 hours in all case according to organoleptic assessment but this score gradually decrease over the range of time. At 24th hours prawn was without frozen prawn is near unacceptable [7].

Table 1. Change in physical characteristics of prawn (*Macrobrachium rosenbergii*) during frozen storage

Weeks of observation	Organoleptic quality (physical characteristics)	Defect point	Overall quality
0	Fresh, bright appearance; soft and firm texture with characteristics of fresh odor	1	Excellent
4	Fresh, bright appearance; slightly soft and firm texture with characteristics of fishy odor	2	Excellent / Acceptable
8	Slightly loss of bright appearance, slightly loss of odor and eyes were slight dull	3	Acceptable
12	Loss of bright appearance, loss of odor, off-flavor expressed and eyes were fully dull	5	Rejected

Farooqui [8] reported that shrimp in ice maintained good quality for 0-2 days as judged by organoleptic quality was acceptable up to 7 days and rejected after 9 days without frozen storage.

Biochemical change in fresh and frozen storage: The result of this study showed the biochemical change in prawn (*Macrobrachium rosenbergii*) during frozen storage. Moisture: The initial moisture content of fresh prawn was 61.8%, for the 4th week it increased to 67.38%, in the 8th week the moisture content was increased to 70.52% and at the 12th week the moisture content showed 75.23% value respectively. This is due to the free drip gain by the muscle in frozen storage (Table 2). Peplow *et al.* [9] indicated that in 0 days moisture content of shrimp was 77.6%, in 7 days it increased to 81.3% and after 14 days the moisture was increased to 83.5%. The increase of moisture was similar to present study.

Table 2. Change in proximate composition of prawn (*Macrobrachium rosenbergii*) during frozen storage

Weeks of observation	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
0	61.58±0.65	33.11±0.19	2.27±0.17	2.13±0.09
4	67.38±0.46	28.25±0.36	1.87±0.12	1.81±0.27
8	70.52±0.69	25.41±0.47	1.52±0.08	1.43±0.1
12	75.25±0.67	21.51±0.7	1.23±0.11	1.08±0.1

*Mean value ±standard deviation of 3 individual measurements
* Moisture basis

The initial protein content of fresh prawn was 33.11%, for the 4th week it decreased to 28.25%, in the 8th week the protein content was decreased to 25.41% and at the 12th week the protein content showed 21.51% value respectively (Table 2). Total crude protein content in prawn muscle decreased considerably with storage period. A slight decrease in crude protein with the laps of storage period was entirely due to the formation of free drip accompanied by loss of some sarcoplasmic protein [10]. Peplow *et al.* [9] indicated that in 0 days protein content of shrimp was 19.6%, in 7 days it was increased to 16.5% and after 14 days it was increased to 14.7%.The author found certain difference but the decrease of protein happened similarly.

The initial lipid content of fresh prawn was 2.27 %, for the 4th week it decreased to 1.87%, in the 8th week the lipid content was decreased to 1.52% and at the 12th week the lipid content showed 1.23% value respectively (Table 2). A slight change in lipid content during storage period could be explained by their individual variation since lipid content varies even within the same species and different species depending on age, sex, food availability etc. Peplow *et al. [9]* indicated that initial lipid content of shrimp was 0.9%, in 7 days it was increased to 0.8% and after 14 days it was increased to 0.8%.The author found certain difference but the decrease of lipid followed the agreement.

Ash content of fresh prawn was 2.13 %, for the 4th week it decreased to 1.81%, in the 8th week the ash content was decreased to 1.43% and at the 12th week the ash content showed 1.08% value respectively (Table 2). Peplow *et al.* [9] indicated that in 0 days ash content of shrimp was 1.8%, in 7 days it was increased to 1.4% and after 14 days it was increased to 1.0%.The author found certain difference but the decrease of ash indicated the similarly.

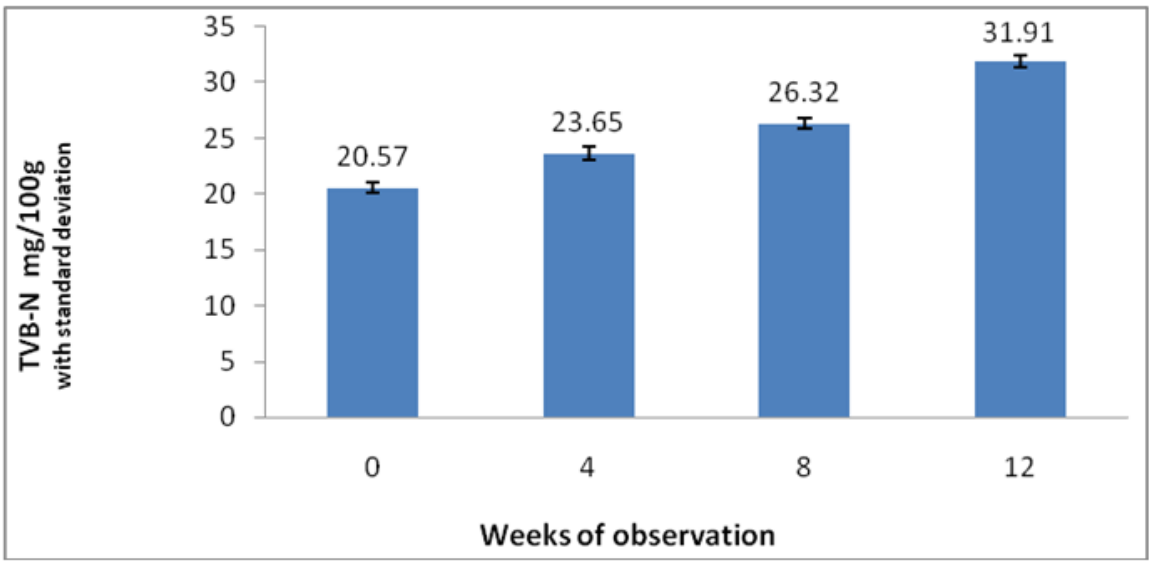

Figure 1. Changen Total Volatile base Nitrogen (TVB-N) in prawn (*Macrobrachium rosenbergi*) during frozen storage

Change in Total Volatile base Nitrogen (TVB-N) during fresh and frozen condition: The initial TVB-N value of fresh prawn was 20.57 mg/100g, in 4th week it increased to 23.65 mg/100g, in the 8th week the TVB-N value was increased to 26.32 mg/100g and at the 12th week the TVB-N value showed 31.91 mg/100g respectively (Figure 1). This is due to the free drip gain by the muscle in frozen storage. The available report suggested that the upper limit of TVB-N is 30 mg/100g was considered for finfish acceptability [11]. EOS [12] recommended that the permissible limit for TVB-N not more than 30 g/100g. Hassan and Ali [13] reported that the TVB-N of fresh and frozen fillets samples were 19.50 and 23.42 respectively, while for fresh and frozen shrimp were 20.90 and 24.65 mg/100g respectively.

Hassan and Ali [14] reported that fresh shrimp showed the TVBN value of 20.90mg/100g and increased in frozen condition to 24.65mg/100g meets the agreement with the corresponding author.

Microbiological change in during fresh and frozen storage: The initial microbial load of fresh prawn was 4.32×10^5 cfu/g, for the 6th week it decreased to 6.73×10^3 cfu/g some bacteria was death due to the lowering of temperature, in the 12th week the microbial load was slightly increased to 1.42×10^4 cfu/g respectively. Shrimp collected from Bagerhat, Khulna, and Satkhira and from all the points (*Gher*, Depot, Agent, and Processing Plant) indicated value within 10.5cfu/g, which was within the acceptable limit [15]. De Silva [16] reported that there was a gradual loss in quality of shrimp as stored at four different temperatures (0°C, 10°C, 20°C and 30°C). The highest spoilage rate was observed in shrimp stored at 30°C. The APC of freshly harvested Gulf of Maine shrimp ranged from <100 to 1.6×10^2 cfu/g. These data are comparatively lower than data reported on shrimp harvested in other areas of the United States [17]. In Gulf of Mexico shrimp, Green [18] reported APC of 4.2×10^4 cfu/g and Vanderzant *et al*. [19] found APC of 2.1×10^5 cfu/g. Harrison and Lee [20] reported on Pacific shrimp and found APC ranging from 3×10^5 cfu to 1.3×10^6 cfu/g. Iced shrimp as purchased by the firm had a plate count of 4.8×10^6 cfu/g. The author's present the result in fresh condition is similar to that result though there is some dissimilarity in frozen condition. Total bacterial load (Aerobic Plate Count) of raw freshwater prawn was 4.37×10^5 cfu/g whereas in frozen freshwater prawn was 1.42×10^5 cfu/g was reported by Khan *et al.* [21]. Present study showed similar result.

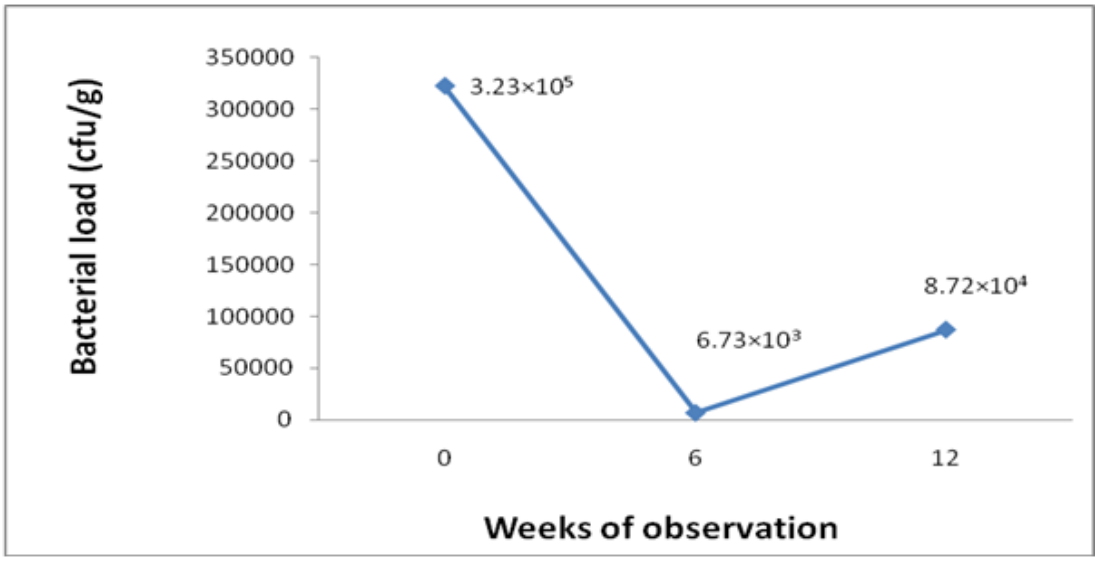

Figure 2. Microbiological change in prawn (*Macrobrachium rosenbergi*) during frozen storage

Detection of unwanted chemical in prawn (*Macrobrachium rosenbergii*): The concentration of Cd, Cu, Mn, Zn and Pb were 0.179µg/g, 0.517µg/g, 6.935µg/g, 11.288µg/g and 0.133µg/g found in the study. WHO [22] suggested the Maximum limits Mn, Cu, Zn, Pb and Cd for prawn are 1 µg/g, 30 µg/g, 100 µg/g, 2 µg/g, 1 µg/g and FAO suggested the Maximum limits Cu, Zn and Cd for prawn are 10 µg/g, 1000 µg/g and 0.2 µg/g [23].

Table 3. Unwanted chemical in prawn (*Macrobrachium rosenbergii*)

Unwanted chemicals	Concentration (µg/g muscles)
Cd	0.179
Cu	0.517
Mn	6.935
Zn	11.288
Pb	0.133

*Mean value of 3 individual measurements

4. Conclusion

It is necessary to give more attention to the quality and safety aspects of prawn products related to the harvesting, handling, processing and packaging. Now-a-days the fresh water prawn is creating a good market as a new product and test to the foreigner. This exportable product has a great chance to earn a lot from international market. Freshwater prawn (*Macrobrachium rosenbergii*) prefers for its taste, size and color. Lack of proper knowledge, negligence about sanitation and quality related factors at different stages of handling, transportation and processing results low graded frozen prawn and huge qualitative and quantitative losses. So, we should concern about the quality and safety aspects of fresh and fozen prawn. Low quality Prawn products are not only a great concern of food security and public health but also of serious national economic loss. If the defects and hazards of Prawn are controlled then export of Bangladesh would be increased.

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