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PROTEIN LOSS DUE TO POST-HARVEST HANDLING OF SHRIMP (*Penaeus monodon*) IN THE VALUE CHAIN OF KHULNA REGION IN BANGLADESH

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ABSTRACT

Study was conducted to assess the post-harvest quality loss of shrimp (Penaeus monodon) in the distribution channel of Khulna region in Bangladesh. The investigation was carried out in August 2011 to November 2011. The study was undertaken in nine selected shrimp farms, three Faria, three Depot and three factory receiving point in Paikgacha, Dacope and Koira of Khulna. Quality assessment included proximate analysis of protein parameters and Biochemical (TVB-N and TM A) content. The TVB-N and TMA were determined by using Conway's Micro-diffusion Technique and Protein determined by Kjeldhal method in wet weight basis. Protein content of thirty-six samples varied between 17.59% to 23.43% in wet method. In Paikgacha station the amount of protein were found as 23.43±.64%, 21.16±.33%, 19.60±0.57% and 18.76±1.07% at Farm, Faria, Depot and Factory gate levels respectively. Protein contents were found in Dacope station as 21.42±.88%, 19.80±.70% and 18.73±.30%, and 17.59±.69% at different marketing points. Average 4.51% protein loss was observed from farm to factory level. The TVB-N contents were found between 17.17±1.84 mgN/100g to 46.67±1.52 mgN/100; while TMA contents varied between 12.86±2.50mgN/100g to 38.54±.47mg/100mg at different points of value chain.

Key words: shrimp *(Penaeus monodon),* protein, TMA, TVB-N and Khulna.

1. INTRODUCTION:

Shrimp (*Penaeus monodon*) industry is one of the most important parts of fisheries sector in Bangladesh. Fisheries sector achieved second place in the fiscal year 2009-*10* by exporting frozen shrimps. 1.15 million Poor people are earning their livelihood by cultivating shrimp both fresh and brakish water. About 63% and 34% *of* frozen shrimps are exported to European Union and United States respectively (DOF, 201l).

EU and the USA are always concerned about the quality loss and food safety of the frozen shrimp products during transport and handling. In Bangladesh, shrimp passes a number of distribution channels to reach the factory gate for example farmer, foria, depot and factory gate. In this distribution channel, shrimp pass one stage to another stage with the elapse of time, because of time duration the inner biochemical degradation of shrimp body in the different stage, the protein content as well as other biochemical component for example TMA and TVB N and the amount of

shrimp in the different distribution channel. Though some works (Ali *et al*., 2008_a; Ali *et al*., 2010) have already been carried out in this respect, but there is not sufficient information on protein loss at different stages of marketing channel of shrimp in Khulna region. It is essential to know the degree of quality losses from farm to processing plants. It is also important to find out the reasons why such losses occur at farm and depot level during handling and transportation. Some causes of quality loss have been reviewed by Ali *et al.*, (2008_b) but they did not present any lab-based practical report on the protein loss in the value chain. There is quite a long value chain in the marketing of the shrimp in Bangladesh and it is likely to expect that the post-harvest losses occur in value chain during handling and transportation since the shrimp are more perishable and vulnerable to contamination and spoilage. Considering all these, the present study was conducted to obtain detailed information on quality loss, especially protein loss, during culture, handling and transportation in the shrimp *(Penaeus monodon)* value chain. Major objectives of the study were: to asses protein loss at different stages; to observe the variation in TVB-N (Total Volatile Base Nitrogen) and TMA (Tri-methyl Amine) contents in shrimps collected from different points of value chains in the Khulna region of Bangladesh.

2. Materials and Methods

2.1. Sample collection and preparation

The study conducted at Paikgacha. Dacope and Koira in Khulna district of Bangladesh. These were the southern parts of greater Khulna region and very near to Sundarban Mangrove Forest. The shrimp (*Penaeus monodon*) was collected from four distribution points i.e. Gher, Depot, Agent and Processing Plant. The shrimp was caught from the Gher (enclosed shrimp farm) situated in proposed area The next set of shrimp was collected from Depot, Agent and Processing Plant.

Three samples of each research station with each gher, depot, agent and processing plant were collected from the harvesting point (Gher), depot, agent and processing plant source. All the shrimp were not of same grades. Equal amount of shrimp was taken controlled study. Three shrimp from each research station was kept separate in ice box maintaining proper temperature. Following this method shrimp was taken from each point of distribution point (depots, agents and processing plants). From each point of distribution channel shrimp was brought to the Quality Control laboratory of Fisheries & Marine Resource Technology Discipline, Khulna University, Khulna.

2.2. Biochemical Quality Assessment

2.2.1. Protein Determination

The protein % of the samples were determined on the basis of total nitrogen content with Kjeldahl digestion method (AOAC, 1984; Pearson, 1976, Bradstreet, 1965).

2.2.1.1. Digestion

0.2-0.5 g of sample was weighed and inserted into a Kjeldahl flask and *2* g of resolvent and *5* ml of concentrated H_2SO_4 were added into the flask. The content of the flask was digested by heating in a micro Kjeldahl nitrogen digesting apparatus for *45* minutes till the clear color appears. After completion of digestion, the flask was transferred from digesting apparatus and let it be cooled for 10 minutes until the temperature decreased up to about room temperature.

2.2.1.2. Distillation

15 ml of 2% boric acid (H_2BO_3) was taken in a conical flask and 2-3 drops of Tashiro's indicator were added into the flask. The delivery tube of the apparatus was arranged with its tip below the surface of boric acid. Then adding 70 ml of distilled water diluted the digested materials and 0.5 gm of sandy zinc was added in the Kjeldahl flask. About 25 ml of 33-40% caustic soda (NaOH) solution was poured slowly in the flasks along sidewall. The flask was then connected to the Khjeldahl nitrogen distillation apparatus and distilled it for about 30 minutes to obtain 25-30 ml distilled solution. Distilled solution was stored in the conical flask through delivery tube.

2.2.1.3.Titration

The distilled solution stored in the conical flask was taken and titrated against 0. 1 (N) HCl solution.

2.2.1.4. Calculation

The percentage of gross portentous nitrogen was calculated with the formula: % N = Volume of HCI X normality of HCI X 0.014/weight of sample (gm) and % Protein = % N x 6.25 (conversion factor)

2.2.2. Moisture Determination

The moisture content was determined by the method described by Pearson (1976). About 5 gm of shrimp sample was taken in porcelain. The sample was weighed accurately by using an electric balance and dried in an over at 105°C for 24 hours . Drying, cooling, (in a desiccator) and weighing were continued for a constant final weight. The percentage of moisture content was calculated as: Moisture (%) = {(weight of sample – weight of dried sample)/ weight of sample}×100

2.2.3. TVB-N and TMA-N Determination

TVB-N and TMA-N were determined according to procedure stated in the manual of Siang and Kim (1992).

2.2.3.1. Extract Preparation

The extract of shrimp was prepared by mixing 2gm of the ground muscle with 8ml of 4% Trichloroacetic Acid in a 50 ml Mackerty bottle and was homogenized well. It was left for 30 mins at ambient temperature with occasional grinding. Then, it was filtered through filter paper (whatman no. l) The filtered solution was kept in Mackrerty bottle and was labelled. The filtered solution was also stored in a refrigerator at 0 -4°C (to prevent any further chemical, bacterial, enzymic break down of the muscle)

2.2.3.2. TVB-N:

Three Conway's units were taken which had been thoroughly cleaned with a neutral detergent to remove any containment. To the edge of the outer ring of each unit was applied the gum. Using a micropipette 1 ml of inner ring solution was pipetted into the inner ring of each unit. Into the outer ring of each unit, was pipetted 1 ml of the sample extract. 1 ml of Saturated K_2CO_3 solution was carefully pipetted into the outer ring of each unit, carefully to prevent the entering the inner ring and immediately the units were covered and closed with clip. The solution of the units was then mixed gently, to prevent any solution mixing from one ring to other. After then the units were placed.in an incubator at 45°C for 45 mins. After this the units covers were removed and the inner ring solution, now a green color was titrated with 0.02N HCl using a burette (50ml) until green color solution turned to pink. An average titrated volume of HCl was found from the result of three titration for each muscle sample. For each volume the TVB-N volumes were calculated. A blank test was also carried out using l ml of 1% TCA, instead of sample extract.

2.2.3.3. TMA-N:

Trimethyl Amine in shrimp muscle was determined by the Conway Micro-diffusion technique. Prior to addition of K_2CO_3 , l ml of 10% neutralized formalin was added to the extract to react with ammonia and thus allowed only the TMA to diffuse over the unit.

3. RESULTS AND DISCUSSION

3.1. Protein loss

The results of protein contents (%) are presented in Table 1 and patterns of protein changes are illustrated in Figure 1.The amount of protein varied significantly ($p<0.05$) at different points of value chain. In Paikgacha station, protein content was found as 23.43±.64%, 21.16±.33%, 19.60±.57% and 18.76±1.07% at farm, faria, depot and factory gate respectively .In Dacope, it was recorded as 21.42±.88%, 19.80±.70%, 18.73±.30% and 17.59±.69% at farm, faria, depot and factory gate respectively. In Koira the protein content was 22.79±.26%, 21.03±.55%, 19.47±.58%, 17.77±.36% at farm, faria, depot and factory gate respectively.

The protein loss from Farm to Factory was 4.67%, 3.83% and 5.02% in Paikgacha, Dacope and Koira distribution channel respectively (Table 1). Zakaria (2011) found 4% to 4.55%

in a study on shrimp quality in Satkhira region of Bangladesh. Thus our study is also in agreement with the previous work.

In our study on average basis, 4.5% protein loss was observed during time period from farm to factory gate (Table 1). Zakaria (2011) reported this loss as 4.22 in Satkhira region of Bangladesh. The trends are quite similar with some minor fluctuations. Protein loss changes with size, age, sex of the shrimp along with elapse of time, handling and transportation as well as other biochemical reaction (especially decomposition) in shrimp body. Another study found the amount of protein in Shrimp *(Fenneropenaeus penicillatus)* as 18.4 to 19% on the basis of wet weight basis (Kher-un-Nisa and Razia Sultana, 2010). Average protein loss (4.51%) in this study is not quite a big amount. Anyhow, it could be further minimized by using proper icing, handling and transportation.

Table 1: Protein contents (%) in shrimp (*P. monodon*) at different points of value chain in Khulna region.

	Farm	Faria	Depot	Factory Gate	Protein loss During Farm to Processing Gate	Average Protein Loss
Paikgacha	23.43±.64	21.16±.33	19.60±.57	18.76±1.07	4.67	
Dacope	21.42±.88	19.80±.70	18.73±.30	17.59±.69	3.83	4.51 %
Koira	22.79±.26	21.03±.55	19.47±.58	17.77±.36	5.02	

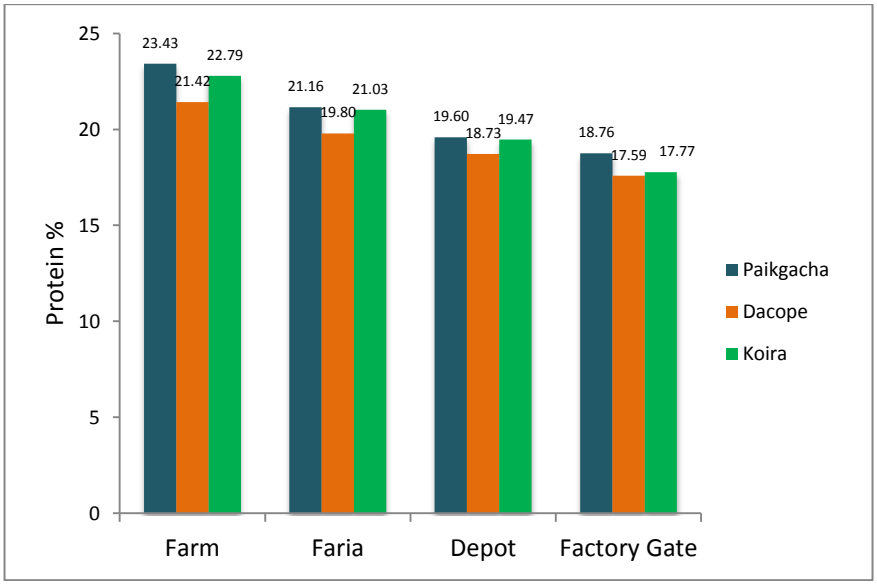

Fig 1: Changing trends of protein % at different points of value chain in Khulna region.

3.2. TVB-N

The results of TVB-N contents are given in Table 2. The patterns of TVB-N variations are illustrated in Figure 2. In Paikgacha TVB-N content was found as 18.39±4.10 mgN/100g, 22.15±1.46 mgN/l00g, 29.33±1.77 and 43.06±1.83 mgN/100g at farm, faria, depot and factory gate respectively. In Dacope it was recorded as 20.34±5.16 mgN/100g, 25.67±1.52 mgN/100g, 34.05±.22 mgN/100g and 45.82±1.29 mgN/100g at farm, faria, depot and factory gate respectively. In Koira station, it was found as 17.17±1.84 mgN/100g, 30.33±1.52 mgN/100g, 40.84±6.50 mgN/100g and 46.67±1.52 mgN/100g at farm, faria, depot and factory gate respectively (Table 2).

Increase in TVB contents were found as 24.67 mgN/100g, 25.48mgN/100g and 29.5mgN/100g in Paikgacha, Dacope and Koira respectively from farm to factory receiving room (Table 2). This increase was reported as 5.55 mgN/100g to 7.55mgN/100g at three marketing channel in Sarkhira region (Zakaria, 2011). Overall, TVB contents increased by 26.55mgN/100g from farm to factory level in marketing channel of Khulna region. Zakaria (2011) reported this increase as 6.37mgN/100g in Satkhira channel. Previous finding shows that The TVB-N contents of shrimp (*Peanus monodon*) ranged between 6.72±0.18 mg-N/100g to 91.43±0.49 mg-N/100g (Ali *et al.* 2010).
The acceptable amount of TVB N in the previous study showed that 6.72±.18mgN/100g is highly acceptable; 6.81±.17 to 13.57±.36mgN/100g is acceptable; 20.03±.02 mgN/100g to 33.50±.44 mgN/100g is moderately acceptable; 39.55±.47mgN/100g is just acceptable; 46.57±.37mgN/100g to 91.43±.49 mgN/100g is unacceptable (Ali *et al.*, 2010). According to this result, the TVB-N contents found in Paikgacha, Dacope and Koira are limited to acceptable limit in farm, faria, depot and factory gate level.

3.3. TMA

The results of TMA contents are given in Table 3. The patterns of TMA variations are illustrated in Figure 3.TMA content was observed as 13.24±.314 mgN/100g, 16.42±1.39 mgN/100g, 23.67±1.79 mgN/100g and 36.34±2.84 mg/at 100g at farm, faria, depot and factory gate respectively in respectively in Paikgacha shrimp distribution channel: while it was recorded as 12.86±2.50 mgN/100g, 17.33±2.08 mgN/100g, 26.40±.52 mgN/100g and 38.54±.47 mgN/100g accordingly in Dacope channel and 13.45±.2.79 mgN/100g, 23.53±3.93 mgN/100g, 31.67±2.08 mgN/100g and 38±2.64 mg/100 accordingly in Koira channel. The TMA-N contents of shrimp ranged between *6.81±0.17* mg-N/100g to *71.41±0.35* mg-N/100g. (Ali *et al.* 2010).

In our study, the increase in TMA from farm to factory were 23.10mgN/100g, 25.68mgN/100g and 24.55mgN/100g in Paikgacha, Dacope and Koira distribution channels respectively (Table 3). Zakaria (2011) reports that this increase varied between 5.09mgN/100g to 5.59mgN/100g which is slight lower than our present study.

All the values are gradually changing (increases) In all the cases in all the sampling area. As the TMA is the indicator of fish freshness, the lower amount of TMA indicates freshness oil the sample. As the time passes the amount of TMA begin to increase. The amount of TMA varies from l3.24 to 36.34 mgN/100g in the same way it increases 12.86 to 38.54 mgN/100g and 13.45 to 38 ml/100g in Paikgacha, Dacope and Koira accordingly.
The previous study showed that the acceptable amount of TMA varies from 6.81 ±.17 mgN/100g to 13.25 ±21 mgN/100g, 13.57±37 to 26.40±100g is moderately acceptable whereas 33.12±.11 mg/100mg is just acceptable, 39.37±.33 mgN/100g to 71.41±.35 is unacceptable for shrimp (Ali et al., 2010).The present study showed that the TMA content is in conformity with the acceptable to moderately acceptable limit from farm to depot level whereas it was somewhat unacceptable in factory gate level of the three stations.

TMA-N is, because of its universal production in all shrimp and fish species, an excellent indicator for the onset of spoilage and for the different stages of spoilage. The fishy odor is produced when TMA-N reacts with fat in the muscle of shrimp (Davies and Gill, 1936). In the course of spoilage, many off-odors are produced by bacteria, indicating the onset and development of spoilage. More TMA-N is produced from TMAO by bacterial action than by fish tissue enzymes, TMA-N produced by both these two

actions is responsible for the `fish odor' during spoilage e (Jones, 1954).

Table 2: TVB-N contents (mgN/100g) in shrimp at different points of value chain in Khulna region.

	Farm	Faria	Depot	Factory Gate	Increase From Farm to Processing Gate	Average Increase
Paikgacha	18.39±4.10	22.15±1.46	29.33±1.77	43.06±1.83	24.67	26.55
Dacope	20.34±5.16	25.67±1.52	34.05±.22	45.82±1.29	25.48	
Koira	17.17±1.84	30.33±1.52	40.84±6.50	46.67±1.52	29.5	

Table 3: TMA contents (mgN/100g) in shrimp at different points of value chain in Khulna region.

	Farm	Faria	Depot	Factory Gate	Increase From Farm to Processing Gate	Average Increase
Paikgacha	13.24±0.314	16.42±1.39	23.67±1.79	36.34±2.84	23.10	24.39
Dacope	12.86±2.50	17.33±2.08	26.40±.52	38.54±.47	25.68	
Koira	13.45±.2.79	23.53±3.93	31.67±2.08	38±2.64	24.55	

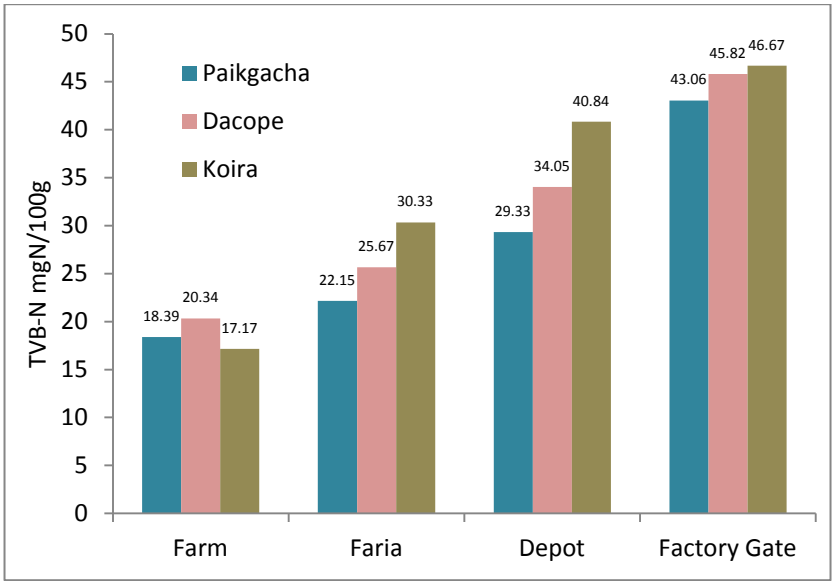

Fig 2: Variation trends of TVB-N contents (mgN/100g) at different points of value chain in Khulna region.

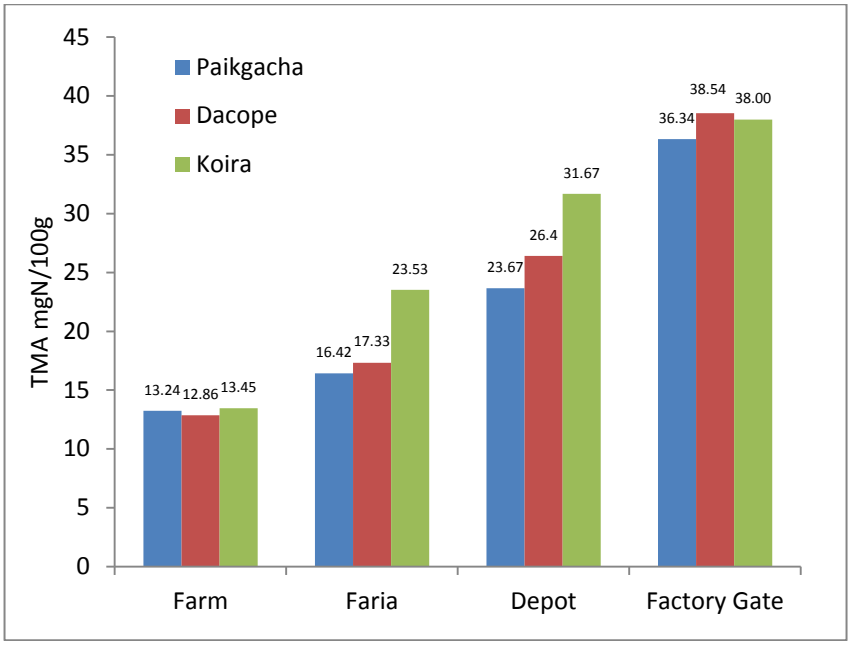

Fig 3: Variation trends of TMA contents (mgN/100g) at different points of value chain in Khulna region.

4. CONCLUSION

From the study it was found that quite big amount of protein is lost from the farmer to factory gate. Freshness quality also degrades. So we cannot deny the complaint by the foreign buyer. That is why measures should be taken to stop the quality loss of shrimp. In order to reduce quality loss, harvesting of shrimp should be done with minimum stress, better infrastructure should be developed inside the depot and shrimp landing point in the factory gate; the time elapsed from farmer to factory level should be kept as minimum as possible; the farmer and depot owner should be well trained about the quality loss of shrimp; during the transportation time good quality ice must be used to maintain the required temperature and to minimize the decomposition rate.

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