Post-Harvest Quality Loss of Shrimp (*Penaeus monodon*) in the Value Chain of Satkhira Region.

A Thesis

By

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Post-Harvest Quality Loss of Shrimp (*Penaeus monodon*) in the Value Chain of Satkhira Region.

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December, 2011

STATEMENT OF ORIGINALITY

Post-Harvest Quality Loss of Shrimp (*Penaeus monodon*) in the Value Chain of Satkhira Region.

The results presented in the thesis paper with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.

Zakaria Mahmud 10.09.12

(Signature of the candidate)

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December, 2011

Dedicated

To

My Beloved Parents

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ACKNOWLEDGEMENT

Omnipotent Allah, the creator and ruler of the Universe, gives me course and strength to complete this work successfully and without his magnanimity and mercy I could not reach a successful completion of the work.

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December, 2011 **The Author**

ABSTRACT

The present study was conducted to assess the quality loss of shrimp (*Penaeus monodon*) in the value chain of Satkhira region. The investigation was carried out in August 2011 to November 2011. The study was undertaken in nine selected shrimp farms, three faria, three dipo and two factory receiving point of different locations, viz. Kaligong, Munsigong and Asasoni in satkhira region. Quality assessment included Proximate analysis of protein parameters and Biochemical (TVB-N and TMA). The TVB-N and TMA were determined by using Conway's Micro-diffusion Technique and Protein determined by proximate analysis (kjeldhal method in wet way). Protein contents of thirty-six samples were found in the range of 17.43±.99% to 23.38±0.21% in wet weight method. At the farm level, the protein content was 23.38±0.21%, 22.90±0.26% & 21.98±0.71% respectively in Kaligong, Munsigong and Asasoni station in Satkhira region. At the Faria, protein content was 21.50±0.64%, 21.07±0.54% & 20.85±0.60% respectively in Kaligong, Munsigong and Asasoni station in Satkhira region. At Dipo, Protein content was 20.42±0.56%, 19.86±0.88% & 18.96±0.88% respectively in Kaligong, Munsigong and Asasoni station in Satkhira region. In factory receiving point, protein content was 19.38±0.46%, 18.80±0.46% & 17.43±0.99% respectively in Kaligong, Munsigong and Asasoni station in Satkhira region. Protein loss of Shrimp was being 17.12%, 17.90% & 20.68% in Kaligong, Munsigong and Asasoni from farm to factory receiving point. From farm to factory receiving point, grand protein loss was 18.57±1.87%. The TVB-N value was being to stay between 15.30±0.04 mg/100g to 25.46±0.99 mg/100g. The TMA value was being to stay between 12.75±0.02 mg/100g to 19.26±0.22 mg/100g. Overall major problems of quality deterioration in shrimp value chain were use of unclean pond water for washing, longer duration of harvesting, exposure of shrimp at high ambient temperature (delayed icing), contamination, excess water in shrimp, packed under pressure, piled up shrimp on a dirty floor, rough handling, use of dirty utensils, contamination with flies and insects at depot level, resulting in considerable loss of shrimp quality.

Keywords: Shrimp (*Penaeus monodon*), Protein, TVB-N, TMA and Satkhira region.

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Chapter One

Introduction

Introduction

Shrimps are one of the most economically important species in aquaculture due to their high world-wide demand. In Bangladesh, shrimp is the most expanding sector among the agro-based products including tea, raw jute, vegetables, fruits etc. Shrimp is one of main exporting product in Bangladesh. The demand of shrimp is increasing day by day in international market, at same time the culture practice of shrimp is increasing in coastal region area. Area of shrimp farm is increasing from 64000 ha to 1,40,000 ha in few years (DoF, 2011). The production of those shrimp farm is 1,57,000 MT in financial year of 2009-2010 which increased from 62,000 MT in financial year of 1999-2000 (DoF,2011). The frozen shrimp industries earned the second largest export sector which reported a total of export earning of US$ 412.173 million or 2885.212 crore taka in 2009-10 financial year (DoF, 2011). About 51,599.15 MT shrimp was exported in 2009-10 financial year (DoF, 2011). From July to November in 2010-2011 financial year, exporting earning of shrimp was US$ 223.532 million or 1,564.726 crore taka by 25,166.67 MT of shrimp exporting (DoF, 2011). Specially the southern part of Bangladesh plays a vital role in production of shrimp. Greater Khulna region (Satkhira, Khulna and Bagerhat) provided maximum amount of total foreign earnings in fish and shrimp products. Though Satkhira, Khulna and Bagerhat are the main region for shrimp culture yet Satkhira district plays the main role in this regard. The main cultivated species in this region are *Penaeus monodon*, more commonly referred to as Bagda.

Bagda *(Penaeus monodon)* has been recognized in the last few years as one of the most important aquatic resources of Bangladesh. This species has a number of advantages in comparison to other crustaceans. It adapts to wide range of temperature ($20^0 - 32^0$ C) fast growing individuals which reach marketable size in about 4 to 5 months, has high nutritional value and has carnivorous feeding habit thus being an excellent species for polyculture. *Penaeus monodon* has high demand in domestic and international market as well.

Satkhira district have a great contribute about shrimp export. Exportable shrimp requires special care to retain as much as practicable its original physical appearance, odor and organoleptic conditions. It must be free from dirt, filth, pathogenic organisms, uncertified chemicals and any antibiotics even in the minutest quantity. The importing countries, particularly the EU, USA and Japan are highly conscious about food hygiene and safety. These countries will not accept any food item with doubtful quality in respect of its freshness, hygiene and safety for human health.

There is now being asked a question about the quality of processed shrimp in the international market. Due to having dissatisfaction of the international buyer of Bangladeshi frozen food products about the quality loss from shipment to taking by the importer, a intensive and comprehensive research study is a crying need in this regard. As a result Bangladeshi frozen shrimp exporters will get more currency if we can identify the correct cause and the solution. Ultimately Bangladesh will earn more foreign currency from exporting it with maintaining proper quality control.

The samples were collected during the month of August to November of 2011. At first the sample was collected from Kaligong Upazilla. There are nine farm to be selected in Kaligong, Munsigong and Asasoni Station. Those farm are situated at Sannasirchak, Kajla and Tarali in Kaligong upazilla, at Harinagar, Borigoalini and gatkhali in Munsigong station, at Protapnagar, Bardal and Goaldanga in Asasoni upazilla. We are facing three faria in the station. Names of the faria are Kuddus Mia in Kaligong, Rakibul Islam in Munsigong and Sagor shaha in Asasoni. We are collected shrimp from faria after 1-2 hour later of farm's shrimp collection. There are three dipo from collection of shrimp. There are Dhrubo Fish in Satkhira, Al- Amin Fish in Noyabiki/ Chonabrige in Shamnagar, Shovo soni Fish in Satkhira. After one day later of farm collection, we collect shrimp from Dipo/Agent. We are collected sample from factory receiving point namely- Rupali Sea Food Ltd. in Rupsa & Atlas Sea Food Ltd. in Rupsa. The shrimp products are collecting in the evening period.

The study was conducted by selecting the three distinct part of Satkhira district namely Kaligong upazilla, Munsigong and Asasoni upazilla. Each station have three farm sample, three faria sample, three dipo sample and three factory receiving point sample. Totally twelve sample were collected from each station. We collected an icebox and carried all shrimp inside the ice box with adequate amount of ice to minimize the temperature stress as well as the biochemical degradation.

The faria sell their shrimp to dipo and dipo owner sell their shrimp to the agent and agent provides the shrimp to the factory gate. This is the distribution channel of shrimp of Satkhira district. I was collected the same shrimp sample from the factory gate those were caught from the same farm and dipot and foria.

All samples were properly iced in the ice box and brought to Biochemistry and Molecular Genetics Lab & Fish Nutrition Lab of fisheries and marine resource technology discipline of Khulna University.

Taking the information from various the depo owner and agent in Notun Bazar, Rupsa, Khulna and shrimp factory/processing plant namely Rupali Sea Food Ltd, Atlas Sea Food Ltd., Oriental Fish Processing Industry, Modern Sea Food Ltd., Saint Martin Sea Food ltd..

Overall major problems of quality deterioration in shrimp value chain were use of unclean pond water for washing, longer duration of harvesting, exposure of shrimp at high ambient temperature (delayed icing), contamination, lack of general hygiene, lack of personal hygiene, excess water in shrimp, packed under pressure, piled up shrimp on a dirty floor, body crushed due to heavy pressure, rough handling, use of dirty utensils, contamination with flies and insects at depot level, resulting in considerable loss of shrimp quality.

Shrimps are an extremely good source of protein, yet are very low in fat and calories, making them a very healthy choice of food. Shrimp has great importance in food consumed by human and other organisms. It is valuable in the diet, because apart from supply of good quality proteins and vitamins, it also contains several dietary mineral such as calcium, Iron etc, which are beneficial to human and other organisms. Proximate parameters in flesh were generally more concentrated than shell. The flesh of *Penaeus monodon* that high level of protein, carbohydrate and moisture content was reported in the flesh tissues. The level of protein in the flesh was of good comparison with the shell of *Penaeus monodon*. But the flesh contained low content of crude fibre then shell. Some researchers found variation level of protein in shrimp, the level started from 39, 45 to 52, and 70%. The proximate composition of flesh of *Penaeus monodon* is presented as protein in the flesh was higher (41.3% -70%) than that of shell protein (32.5%) (Ravichandran *et. al.* 2009).

The complex chemical composition of proteins makes them quite difficult to characterize by simple chemical or physical procedures. However, their component amino acids may be conveniently detected by various specific chemical tests. The standard method for determining nitrogen in inorganic compounds is the Kjeldahl method (Persson, 1995).

Until comparatively recent times, the protein content of foods could be estimated from the organic nitrogen by Kjeldahl procedure. In consequence it is included in official and statutory methods and approved by international organizations. Furthermore, the results obtained by Kjeldahl are used to calibrate physical and automatic methods (Pearson, 1995).

The Kjeldahl method is based on the wet combustion of the sample by heating with concentrated sulphuric acid in the presence of metallic and other catalysts to reduce of organic nitrogen in the sample to ammonia, which is retained in solution as ammonium sulphate. The digest, having been made alkaline, is distilled or steam distilled to release the ammonia which is trapped and titrated. Mercury, as mercuric oxide is generally agreed to be the most affective catalyst, with selenium almost as effective, but both have toxic hazard and waste disposal problems. Moreover, mercury forms ammonia complexes in the digest requiring the addition of sodium thiosulphate to break the complex and to release the ammonia. The use of a mixture of copper (II) sulphate and titanium dioxide is recommended (Williams 1978). However, Wall and Gehrke (1975) considered this mixture to be at least as effective.

TMA is the compound produced from TMAO by bacterial enzymatic process. TMA has been considered as useful index in quality determination for some species. TVB is used as alternative to measuring TMA content. Seafood, when closed to spoilage, contains several bases that are volatile. Volatile bases in TVB mainly contain TMA and Ammonia. Changes in TVB content during spoilage are very similar to those of TMA in the same species except that the initial value of TVB is much higher (Botta *et. al.* 1989).

TVB does not increase much in the early stages of spoilages but rises rapidly with bacterial activity. The variance of TVB of a sample of fish of the same origins and subjected to the same treatment is high compared to the average changes over the acceptability. So, it is not sensitive indicator of freshness, until the fish is spoiled rapidly (Connell and Howgate, 1986).

The TMA could be used as an index of freshness. During spoilage TMAO is reduced by bacteria to TMA (Connel, 1975) reported that TMA could serve as an index of spoilage for marine fish. TMA contents fluctuates with seasons as well as within a single species.

Different workers have suggested a number of method for determining TVB . Among the commonly used methods, the Conway micro diffusion technique is the most suitable and applied in this work for the determination of TVB and TMA.

TMA as an index of bacterial spoilage are similar to those of TVB-N . The index has widespread usefulness and correlates reasonably adequately with sensory changes during spoilage or deterioration e.g. in about 75% of cases , the taste panel and TMA results agree (Ruiter,1971).

As of late, all personnel involved in shrimp farming and processing are trying to upgrade quality of shrimp products following factors related with good quality. More research support is needed to improve the cultural and management practices of the various shrimp culture systems in Satkhira. Measures should be taken by the government to improve the collection centers or depots by creating adequate facilities for quality management of raw materials. It is recommended that farmers and depots owners should be provided financial support in the form of loan on easy term for modification of their existing management and infrastructure facilities, installation of ice plants, procurements of refrigerated van and developing other required facilities.

Objectives of the study:

The investigation was undertaken aiming at assessing the variation TVB-N and TMA-N of shrimp at different stages of handling process. The specific objectives were given below

- To observe the protein loss in the value chain of shrimp in Satkhira region.
- To observe the variation in TVB-N contents in different of shrimp (*Penaeus monodon*) collected from different sources in Satkhira region.
- To observe the variation in TMA-N contents in different of shrimp (*Penaeus monodon*) collected from different sources in Satkhira region.

Chapter Two

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Review of Literature

Review of Literature

Botta et al. (1989) studied on TMA is the compound produced from TMAO by bacterial enzymatic process. TMA has been considered as useful index in quality determination for some species. TVB is used as alternative to measuring TMA content. Seafood, when closed to spoilage, contains several bases that are volatile. Volatile bases in TVB mainly contain TMA and Ammonia. Changes in TVB content during spoilage are very similar to those of TMA in the same species except that the initial value of TVB is much higher.

Sato (1960) studied on certain chemical changes in spoiling shrimp appear to run parallel with changes in odor, texture, appearance etc. Various attempts have been made to measure freshness by estimating the quantities of same end product as a result of enzymatic and bacterial activity. Chemical tests of assessing the quality of shrimp and other fishery products are based on estimating the products of spoilage either as individuals or as groups.

Connell and Howgate (1986) studied on TVB does not increase much in the early stages of spoilages but rises rapidly with bacterial activity. The variance of TVB of a sample of fish of the same origins and subjected to the same treatment is high compared to the average changes over the acceptability. So, it is not sensitive indicator of freshness, until the fish is spoiled rapidly.

Shewan and Ehrenberg (1977) studied on TVB and T'MA measurement is probably the oldest chemical method to assess fish spoilage used as an index of spoilage. TVB and TMA-N is the indicator of the Nitrogen content of shrimp.

Connel (1975) studied on The TMA could be used as an index of freshness. During spoilage TMAO is reduced by bacteria to TMA reported that TMA could serve as an index of spoilage for marine fish. TMA contents fluctuate with seasons as well as within a single species. Different workers have suggested a number of methods for determining TVB. Among the commonly used methods, the Conway micro diffusion technique is the most suitable and applied in this work for the determination of TVB and TMA.

Ruiter (1971) studied on TMA as an index of bacterial spoilage are similar to those of TVB-N. The index has widespread usefulness and correlates reasonably adequately with sensory changes during spoilage or deterioration e.g. in about 75% of cases , the taste panel and TMA results agree.

Azam, K. (2004) studied on Quality of Shrimp in the Distribution Channel.

Malle and Poumeyrol (1989) studied on Total Volatile Bases Nitrogen (TVB-N) is one of the most widely used methods today to estimate the degree of decomposition of fish. It includes the measurement of trimethylamine (produced by spoilage bacteria), dimethylamine (produced by autolytic enzymes during frozen storage), ammonia (produced by the deamination of amino-acids and nucleotide catabolites) and other volatile nitrogenous compounds associated with seafood spoilage.

Konosu and Yamagushi (1982) studied on Trimethylamine, TMA, is formed in spoiling fish by the action of certain species of bacteria on the substance trimethylamine oxide, TMAO. Therefore determination of TMA content is a measure of bacterial activity and spoilage (Aitken et al. 1982). Increase in TMA during iced storage is similar to the increase in bacterial numbers. TMAO is not only an important compound for maintenance of physiological functions in fish and shellfish but it is also a key substance in the spoilage of raw or processed seafood (Norman and Benjamin 2000). The TMAO content in the muscle of crustaceans is 9-28 (mmole/kg wet weight). The measurement of total volatile basic nitrogen (TVB-N) is often used as an alternative to measuring TMA content because the TVB-N value includes mainly the content of ammonia, trimethylamine, and dimethylamine. Therefore, changes in TVB content during spoilage are very similar to those of TMA except that the initial value is much higher.

Malle and Poumeyrol (1989) studied on ammonia and trimethylamine (TMA). The suitability of using TMA content itself as chemical method of evaluating freshness quality of seafood has been investigated extensively. Depending on the species (ground fish, pelagic species, and shellfish), it has been observed to be a useful measure of freshness quality

- Beaker (250ml)
- Oven (N40C)
- Porcelain crucible
- Desiccators
- Filter paper (1.2)
- Separation funnel etc.

Chemicals:

1.Resolvent:

Potasium sulphate and mercuric oxide in the ratio of 10:0.7 were mixed and crushed properly and preserved in colored bottle.

2.Concentrated sulphuric acid.

3.2% Boric acid:

20 gm Boric acid crystal was added with 1 litter distilled water.

4.Tashiro's indicator:

80 gm methyl red and 20 gm methyl blue were dissolved in 95% ethanol to make up to 100ml with 95% ethanol.

5.Sandy zinc or zinc powder.

6.33-40% caustic soda:

400 gm NaOH and 10 gm potassium sulfide was added with 1 litter distilled water.

7.1% K_2S:

Sometimes it is added with the 40% NaOH solution to increase the absorption of NH_3 during distillation.

8.0.1(N) HCl acid:

8.48 ml HCl was added with 1 litter distilled water.

9. Acetone:

Methnol and Chloroform are mixed at a ratio of 1:2.

Samples:

1. Shrimp (*Panaeus monodon*) flesh

Working process:

Principle:

The process involves two steps:

a) Digestion of the sample to convert the N to ammonium sulphate.
b) Determination of nitrogen in the digest sample through distillation process.

$$\text{Sample-N} + H_2SO_4 \xrightarrow[\text{Diestion}]{\text{Heat}} (NH_4)_2SO_4$$

$$(NH_4)_2SO_4 + NaOH \xrightarrow[\text{Distillation}]{\text{Heat}} NH_3 + H_2O + Na_2SO_4$$

$$NH_3 + H_3BO_3 \longrightarrow NH_4BO_3$$

$$NH_4BO_3 + HCl \longrightarrow NH_4Cl + H_3BO_3$$

Calculation:

The amount of crude protein is calculated from the following equations…

$$\%\text{ Total nitrogen } (\%N) = \frac{\text{Titrant (ml) X Strength of titrant X } 0.014}{\text{Weight of sample (g)}} \text{ X } 100 \quad \text{------------(1)}$$

$$\%\text{Protein} = \%N \times 6.25 \text{ (Pearson, 1976)} \quad \text{---------------------(2)}$$

Biochemical Assessment

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

Solution and Reagents

Inner ring solution -1 % boric solution containing indicator.10 g boric acid were weighed into a one litre volumetric flask then added to 200ml of ethanol. After dissolving the boric acid , 10ml of mixed indicator solution was added, then made up to 1 liter with distilled water.

Mixed indicator

Bromcresol green (BCG 0.02 gm) and methyl red 0.01gm were dissolved into 1 0ml of ethanol.

0.02 Hydrochloric Acid, HCl

20ml of 1(N) HCl standard solution were diluted with distilled water made up to 1000 ml.

Standard Potassium Carbonate Solution

60gm of K_2CO_3 were weighed and then 50ml of distilled water was added. It was boiled gently for 10 mins. After cooling down, it was then filtered through filter paper.

50% Potassium Carbonate Solution

Saturated K_2CO_3 solution was diluted to twice its volume with distilled water.

4% Trichloroacetic Acid (TCA, CCl3COOH) Solution

40 gm Of TCA were dissolved in 1 L of distilled water.

Neutralized 10% formaldehyde Solution

10 gm of $MgCO_3$ were added to 100ml of formalin (35% formaldehyde Solution) and shaked in order to neutralize the activity of formalin. Then diluted the filtrate 3 times with distilled water.

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. 1) 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)

TVB-N Determination

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 1 ml of 1% TCA, instead of sample extract.

Determination of Trimethyl Amine Nitrogen (TMA)

Trimethyl Amine in shrimp muscle was determined by the Conway technique. Prior to addition of K_2CO_3 , 1 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. The calculation was done by the same formula as used in the Conway micro-diffusion technique for TVB-N. The calculation was done by the following formula:

Calculation

TMA-N or TVB-N (mg/100g) =Amount of HCI used in titration × Amount of ammonium nitrogen equivalent to 1 ml of 0.02N HCl × Ratio of the amount of sample used to 100g muscle

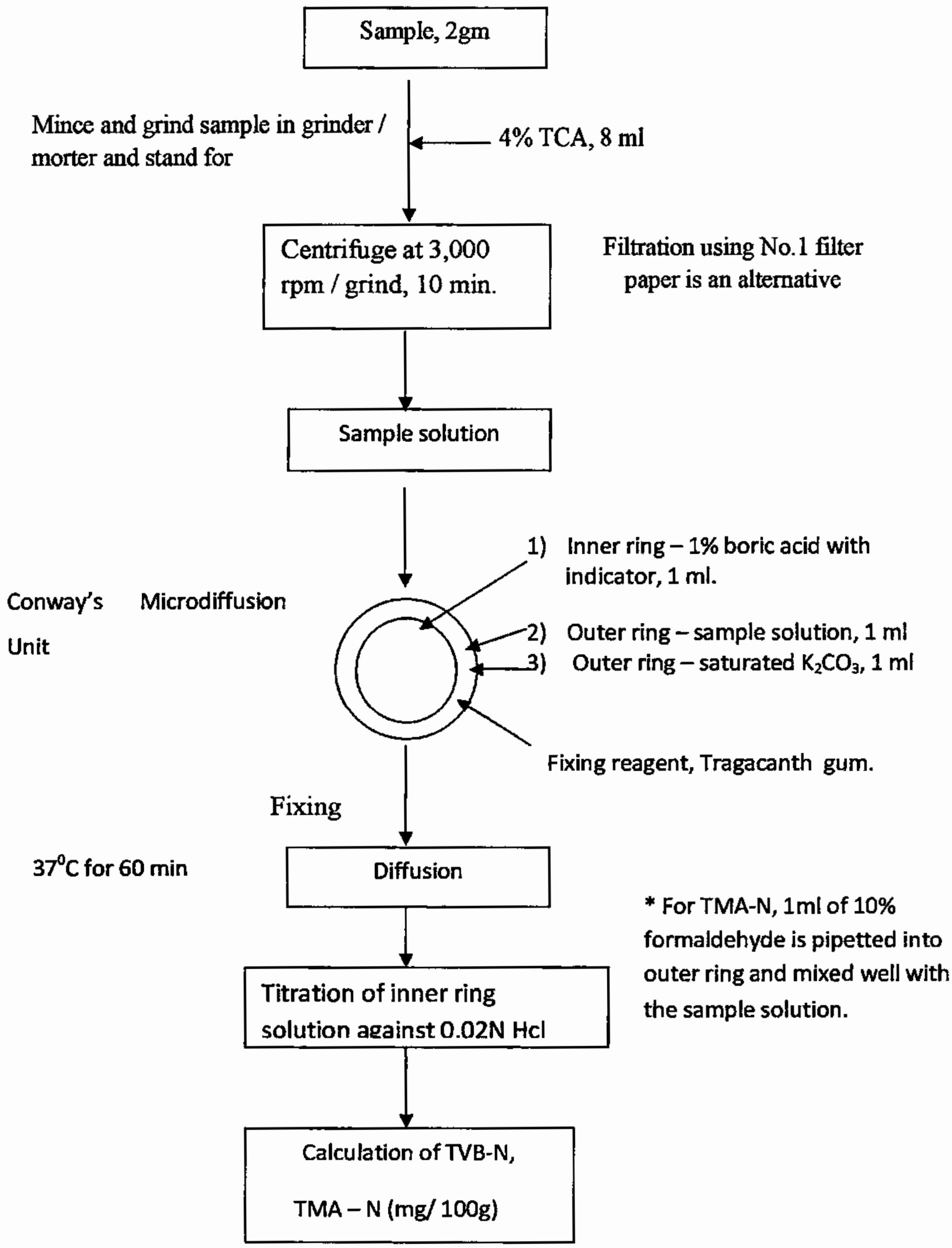
$$= (V_s - V_B) \times (N_{HCl} \times A_N) \times \frac{\{(W_S \times M/100) + VE\}}{W_s} \times 100$$

Where,

V_s = Titration volume of 0.02N HCl for sample extract (ml)

V_B = Titration volume of 0.02 N HCI for blank (ml)

N_{HCl}= Normality of HCl (= 0.02Nx F, Factor of HCl)



Flowchart 02: TVB-N and TMA determination by Conway's Micro diffusion Technique

Chapter Four

Results

Results

Protein (%)

The protein content of shrimp (*Penaeus monodon*) at different stages of value chain in Satkhira region is presented in figure 01. The figure shows that protein content was decreased gradually from farm to factory receiving point in Satkhira region. Grand protein loss was recorded at 18.57±1.87 % from farm to factory receiving point in Satkhira rigion (table 01).

Protein contents of thirty-six samples were found in the range of 17.43±.99% to 23.38±0.21% in wet weight method (figure 01). At Kaligong upazilla, protein contents were found 23.38±0.21%, 21.50±0.64%, 20.42±0.56% and 19.38±0.46% respectively in farm, faria, dipo and factory receiving point (figure 01). At Munsigong station, protein contents were found 22.90±0.26%, 21.07±0.54%, 19.86±0.88% and 18.80±0.46% respectively in farm, faria, dipo and factory receiving point. At Asasoni upazilla, protein contents were found 21.98±0.71%, 20.85±0.60%, 18.96±0.88% and 17.43±0.99% respectively in farm, faria, dipo and factory receiving point (figure 01). All those results were presented within the acceptable limit in concurrence with result of others investigation (Kher-un-Nisa and Razia Sultana, 2010, Begum *et al.*, 2011).

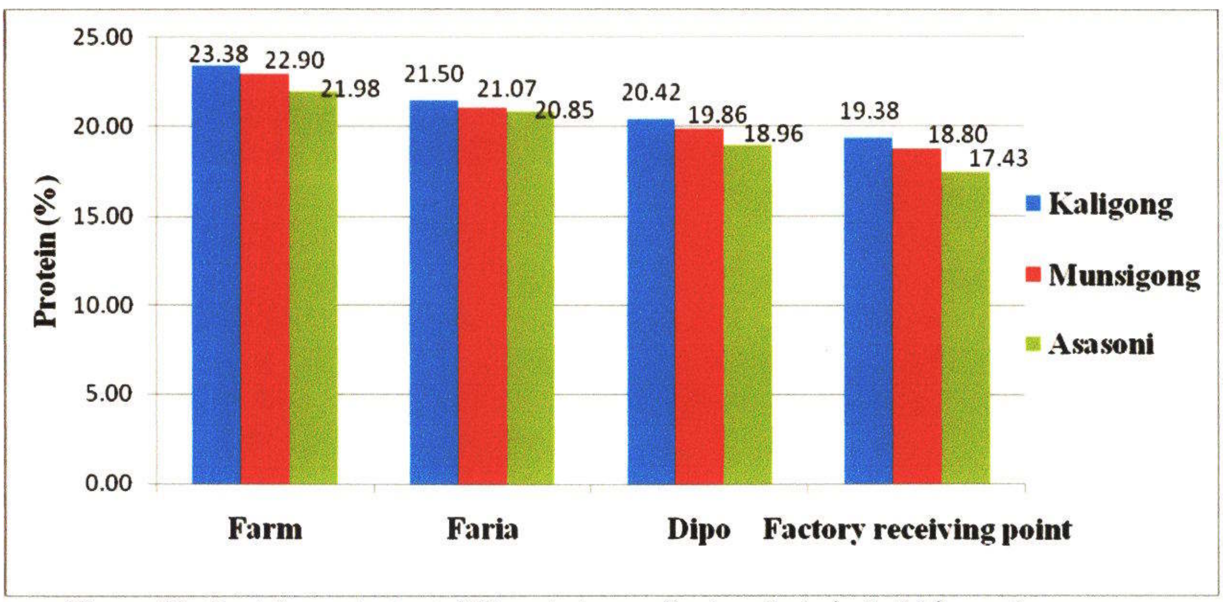


Figure 01: Protein contents at different stages of value chain in Satkhira region.

Protein loss of Shrimp was observed 17.12%, 17.90% & 20.68% respectively in Kaligong, Munsigong and Asasoni station from farm to factory receiving point (Table 01). From farm to factory receiving point in Satkhira region, Grand protein loss was recorded 18.57±1.87% (Table 01). However there was no published data on protein loss of shrimp (*Penaeus monodon*) in the value chain of Bangladesh. In the same way no data was found internationally on protein loss of shrimp (*Penaeus monodon*).

Station	**Protein (%) (Farm)**	**Protein (%) (Factory R. P.)**	**Protein Loss (%)**	**Grand Protein Loss (%)**
Kaligong	23.38±0.21	19.38±0.46	17.12	18.57±1.87
Munsigong	22.90±0.26	18.80±0.46	17.90	
Asasoni	21.98±0.71	17.43±0.99	20.68	

Table 01: Protein loss of Shrimp (*Penaeus monodon*) at different stage of value chain in Satkhira region.

Bio-chemical changes (TVB-N &TMA)

Total Volatile Base Nitrogen (TVB-N) in Shrimp (*Penaeus monodon*)

The results of TVB-N contents of shrimp (*Penaeus monodon*) at different stages of value chain in Satkhira region are given in figure 02. The figure shows that TVB-N contents were increased gradually from farm to factory receiving point in Satkhira region.

At the farm when shrimp were fresh, TVB-N contents in shrimp were recorded 15.30±0.04 mg/100g, 18.47±1.49 mg/100g and 19.91±1.18 mg/100g respectively in Kaligong, Munsigong & Asasoni station (figure 02). At Faria, The TVB-N value was observed 17.98± 3.77 mg/100g, 21.70±02.87 mg/100g & 22.81±0.61mg/100g respectively in Kaligong, Munsigong & Asasoni station. At dipo, The TVB-N value was observed 19.35±0.56 mg/100g, 23.24±0.88 mg/100g & 24.04±2.23 mg/100g in Kaligong, Munsigong & Asasoni station. At Factory receiving point, The TVB-N value was found 22.85±0.46 mg/100g, 24.48±0.46 mg/100g & 25.46±0.99 mg/100g respectively in Kaligong, Munsigong & Asasoni station (figure 02). All those results were presented within the acceptable limit in concurrence with result of others investigation (Pushparajan, N. and P. Soundarapandian, 2009, Jayasinghe P.S. *et al.*, 2006, Siang, N. C. and Kim, L. L, 1992, Ali, M. *et al.*, 2005).

The value of TVB-N was increasing in every value chain over passing of time. The low value of TVB-N initially was an indication quality of fresh shrimp while the high value may be due to action of autolysis enzymes and spoilage bacteria (Shewan and Ehenberg, 1957).

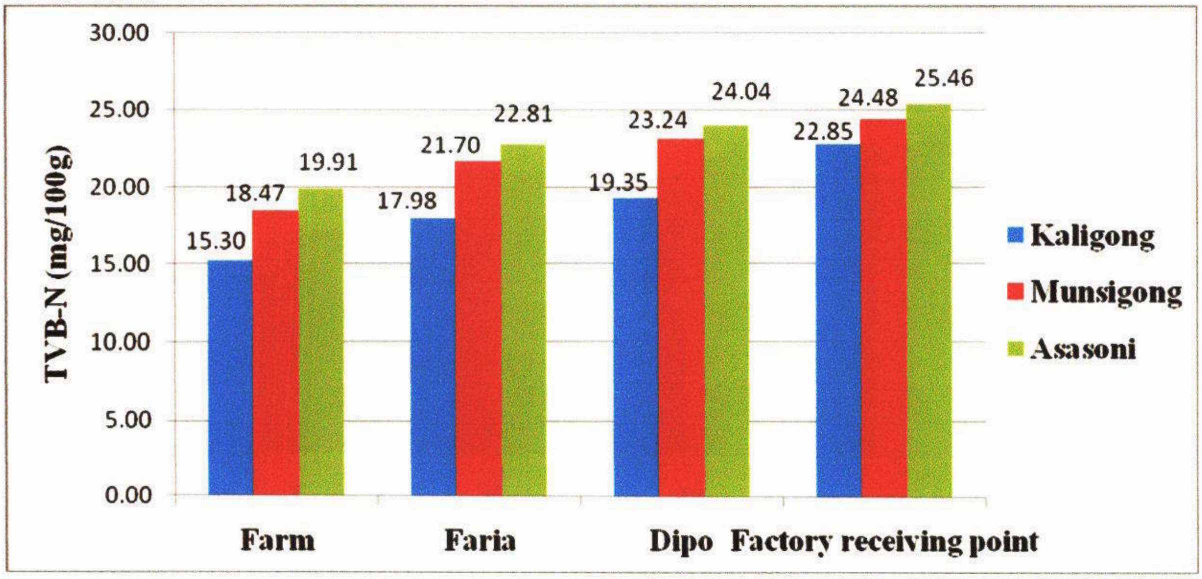


Figure 02: TVB-N contents at different stages of value chain in Satkhira region.

Trimethylamine nitrogen (TMA) in Shrimp (*Penaeus monodon*)

TMA contents of Shrimp are presented in figure 03 which ranged between 12.75±0.02 mg/100g to 19.26±.22 mg/100g. The figure shows that TMA contents were increased gradually from farm to factory receiving point in Satkhira region.

Initially TMA content was 12.75±0.02 mg/100g and it was in acceptable (A). At Kaligong upazilla, TMA contents were found 12.75±.02 mg/100g, 16.39±2.31 mg/100g, 16.28±0.56 mg/100g and 18.10±1.75 mg/100g respectively in farm, faria, dipo and factory receiving point (figure 03). At Munsigong station, TMA contents were found 12.88±.02 mg/100g, 16.39±2.31 mg/100g, 17.24± 0.55mg/100g, 17.97±0.90 mg/100g respectively in farm, faria,

Chapter Five

Discussion

Discussion

Protein (%) of shrimp (*Penaeus monodon*)

From this present study it was found that in fresher sample of farm, the protein value is higher than others of value chain. The value of protein content of shrimp (*Penaeus penicillatus*) was 15.5% to 21% in wet weight method (Kher-un-Nisa and Razia Sultana, 2010), which is as similarity of present study.

Kher-un-Nisa and Razia Sultana, (2010) reported that protein increased slightly from 17.2 % (stage I) to 18.0 % (stage IV) showing no variation in the proximate composition during maturation, significant variation throughout the maturation process. Showing a significant increasing trend during maturation whereas, protein increased from initial level of 15.90 % (stage I) to 18.40 % (stage IV). The increase in the protein content was not so significant in the midget gland as that of the ovary during different stages of sexual maturation, this increase in the protein in the ovary may be attributed to several biochemical processes.

The proximate analysis of raw and smoked catfish was presented Protein (17.8-18.6%), Fat (3.9 – 4.30%), and Moisture contents (78.2 - 79.4%) of fresh samples respectively subjected to different value chain (Omojowo *et al.*,2010).

The proximate composition of both non-added and formalin added prawn samples is presented. The initial moisture, protein, lipid and ash contents of non-added prawn were 78.67, 18.53, 1.34 and 0.94%, respectively (Begum et al., 2011).

Ali et al. (2005) reported that *that* Mean values of various body constituents in different fish species collected from a brackish water pond, Protein (wet wt.) amount of Mori-Rahu Hybrid (21.007%), *Labeo rohita* (18.490%) *Cyprinus carpio* (24.690%), Thalla- Rahu Hybrid (19.573%) *Cirrhinus mrigala* (18.975%), *H. molitrix* (20.217%) *Catla catla* (19.000%) were found.

This 18.57±1.87% of grand protein loss occurred due to 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. To minimize the protein loss to ensure good icing, good handling, maintain the temperature and better transportation.

However there was no published data on protein loss on shrimp in the value chain of Bangladesh. In the same way no data was found internationally on protein loss of shrimp (*Penaeus monodon*).

Total Volatile Base Nitrogen (TVB-N)

From this present study it was found that the value of TVB-N was increased by passing the time. At the farm when shrimp were fresh, TVB-N contents in shrimp were recorded 15.30±0.04 mg/100g, 18.47±1.49 mg/100g and 19.91±1.18 mg/100g respectively in Kaligong, Munsigong & Asasoni station. After passing of time at factory receiving point, the value of TVB-N was found 22.85±0.46 mg/100g, 24.48±0.46 mg/100g & 25.46±0.99 mg/100g respectively in Kaligong, Munsigong & Asasoni station. This result is an agreement with previous study Pushparajan, N. and P. Soundarapandian, 2009, Jayasinghe P.S. et al., 2006, Siang, N. C. and Kim, L. L, 1992, Ali et al., 2010.

The level of total volatile nitrogenous bases increases after spoilage begins, both enzymically and bacterially, and thus can be used as an index of spoilage. Using TVB-N as such an index of spoilage does not distinguish the origin or component of these volatile compounds, hence its use is more general. The use of TVB-N as an index of spoilage was first proposed by Shewan (1938). The low value of TVB-N initially is an indication of quality of fresh shrimp or fish while the high value may be due to action of autolytic enzymes and spoilage bacteria which might have passed their lag phase (Adebona, 1982). The volatile bases, in determination method, are aerated or distilled off from a midley alkaline fish extract, collected in standard acid and measured by titration (Stansby and Olcott, 1963).

During iced storage, the TVB-N content in Bele (*Glossogobius giuris*) and puti (*Puntius stigma*) were 11.45 mg/100g and 17.84 mg/100g respectively as fish were treated as highly acceptable (Rubbi, *et.al.*, 1985). Kimura and Kiamakura (1934) recommended TVB-N levels of 10 mg/100g or less for fresh fish, 20 – 30 mg/100g for beginning of spoilage and over 30 mg/100g for spoiled fish. Azam, *et.al.*, (1997) recorded a very high TVB-N value (17.03 mg-N) initially for tilapia. Similarly Mlay *et.al.*, (1985) also observed very high value of TVB-N (51.8 mg). However, the TVB-N value of the present study agrees with the recommendation of Kimura and Kiamakura (1934).

Trimethylamine Nitrogen (TMA)

From this present study it was found that the value of TMA was increased by passing the time. TMA was found at small amount which indicate that Shrimp be freshness. In the value chain, passing of time value of TMA was increased rapidly by activities of bacteria and enzyme. At the farm when shrimp were fresh, TMA contents in shrimp were recorded 12.75±0.02 mg/100g, 12.88±0.02 mg/100g and 13.67±1.18 respectively in Kaligong, Munsigong & Asasoni station. After passing of time at factory receiving point, the value of TMA was found 18.01±1.75 mg/100g, 17.97±0.9 mg/100g & 19.26±0.22 mg/100g respectively in Kaligong, Munsigong & Asasoni station. This result is an agreement with previous study Pushparajan, N. and P. Soundarapandian, 2009, Jayasinghe P.S. et al., 2006, Siang, N. C. and Kim, L. L, 1992, Ali et al., 2010.

TMA 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 reacts with fat in the muscle of shrimp/fish (Davies and Gill, 1936). In the course of spoilage, many off-odors are produced by bacteria, indicating the onset and development of spoilage (Reineccius, 1979). More TMA is produced from TMAO by bacterial action than by fish tissue enzymes, TMA produced by both these two actions is responsible for the 'fish odor' during spoilage (Jones, 1954). In the bacterial reduction of

TMAO to TMA, the participation of cytochromes as election carriers together with the enzyme TMAO reductase has been suggested (Sakaguchs and Kawai, 1978). At least 94% of TMA in spoiling fish originates from TMAO (Beatty, 1938).

Beatty and Gibbons (1937) suggested a TMA content of 4–6 mg/100g as the critical value for the edibility of fish, while Connell (1975) recommended 10 – 25 mg/100g for human consumption. There is also wide variation in critical values suggested for individual species , like 5 – 7 mg/100g for herring (Sigurdisson, 1955) and 1 –5 mg/100g for haddock (Castell and Triggs, 1955). Though, on the rejection, the level of TMA studied in the present investigation was bellowing the limits suggested by Connell (1975); the suggestion of Sigurdisson (1955) appears to be applicable to fish studied. However, the TMA value determined does not seem to be useful as an index of freshness.

As TMA is produced by bacteria, and bacterial activity is directly affected by temperature so temperature gradients in individual fish can affect TMA levels (Horner, 1985). Horie and Sekine (1956) also found a sudden increase in TMA (> 10 mg %) to be concurrent with the onset of bacterial purification.

Chapter Six

Conclusion

Conclusion

In the value chain of shrimp in Satkhira region, protein loss is occurred due to handling problem, highly temperature, over stress on shrimp body, using bad quality water for washing, using bad quality ice for storage, long transportation etc. Some Faria and Dipo owner have badly tendency to pushing a foreign bodies such as water, sagu, some small weighty particle that can easily enter into muscle of the shrimp. Any filth, foreign bodies in shrimp must be prohibited to ensure good quality shrimp products. Bangladesh incurs a significant amount of loss in earning foreign currency when quality loss of the frozen products is detected by the importing countries. That is why measures should be taken to stop the quality loss of shrimp. In this regard harvesting of shrimp should be done with minimum stress, infrastructure should be developed for example the internal environment of depot and shrimp landing point in the factory gate should be well furnished. The time elapsed from farmer to factory gate crossing depot and agent should be 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. The transportation system must be facilitated to the shrimp handler to reduce the time from farmer to factory gate. My suggestion about this work, we work 6 month, 3 station and 36 samples in the value chain of shrimp as well as we need year round data & sample collection and analysis more station & sample for better output in the value chain of shrimp.

Chapter Seven

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Appendix

APPENDIX–1: Protein (%), TVB-N (%) and TMA (%) contents of Bagda (*Penaeus monodon*) at different stage of value chain of Kaligong in Satkhira region.

Station	Value chain	Sample No	Protein (%)	TVB (%)	TMA (%)
Kaligong	**Farm**	**01**	23.22	15.34	12.78
		02	23.30	15.29	12.74
		03	23.63	15.27	12.73
	Faria	**04**	22.84	19.58	14.05
		05	21.89	26.06	19.54
		06	23.10	19.47	15.58
	Dipo/Agent	**07**	21.81	19.36	15.49
		08	21.84	19.32	16.54
		09	20.85	19.39	16.80
	Factory receiving point	**10**	19.74	23.23	19.35
		11	18.87	25.79	19.34
		12	19.54	19.53	15.62

APPENDIX–02: Protein (%), TVB-N (%) and TMA (%) contents of Bagda (*Penaeus monodon*) at different stage of value chain of Munsigong in Satkhira region.

Station	Value chain	Sample No	Protein (%)	TVB (%)	TMA (%)
Munsigong	**Farm**	**01**	22.92	19.29	12.86
		02	22.49	19.36	12.91
		03	22.97	16.75	12.88
	Faria	**04**	22.23	19.58	14.05
		05	17.36	26.06	19.54
		06	22.42	19.47	15.58
	Dipo/Agent	**07**	18.82	25.73	19.30
		08	20.56	21.63	15.58
		09	19.96	22.36	16.83
	Factory receiving point	**10**	18.32	24.82	18.36
		11	19.24	23.89	16.72
		12	18.84	24.73	18.83

APPENDIX–03: Protein (%), TVB-N (%) and TMA (%) contents of Bagda (*Penaeus monodon*) at different stage of value chain of Asasoni in Satkhira region.

Station	Value chain	Sample No	Protein (%)	TVB (%)	TMA (%)
Asasoni	**Farm**	**01**	22.35	19.27	12.85
		02	21.16	21.27	15.34
		03	22.43	19.18	12.82
	Faria	**04**	20.87	21.85	15.38
		05	19.66	23.64	17.82
		06	20.22	22.93	16.39
	Dipo/Agent	**07**	20.99	19.50	15.01
		08	17.46	26.09	19.57
		09	16.86	26.54	21.03
	Factory receiving point	**10**	18.26	24.89	18.95
		11	17.65	25.15	19.37
		12	16.32	26.33	19.46