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Nutritional and Microbiological Quality of *Chepa shutki* from *haor* Areas of Bangladesh

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Abstract

The present study was conducted to evaluate nutritional and microbiological quality of the semi-fermented fish product, locally known as *Chepa Shutki*. Samples were collected from producers and retailers in Kuliarchar upazilla of Kishoreganj and Ashuganj upazilla of Brahmanbaria district as well as control sample were prepared with proper hygiene and sanitation. Statistical analysis showed significant differences ($p<0.05$) among the samples. Lower levels of protein, lipid, fiber and nitrogen free extract content in the product obtained from retailers were probably related to the losses occurring at different stages of marketing chain during handling, transportation and preservation. The highest ash and the lowest moisture content were found in control. It was also found that total volatile base nitrogen (TVB-N) values were the highest in retailer and the lowest in control samples. Microbiological analysis revealed that the total bacterial count of samples was ranged from 6.01±0.28 to 8.10±0.18 log cfu g^{-1}. Higher moisture content along with higher microbial load in the retailer's samples reflected poor quality, whereas those obtained from producer's and control samples were within the acceptable limit. This present study can easily be concluded that the nutritional and microbiological quality of control sample was comparatively good than the commercially produced semi-fermented fish products.

Keywords: *Chepa Shutki*; Proximate composition; TVB-N; Microbial load

Introduction

Fisheries sector plays an important role in national economy of Bangladesh. Fish alone contributes about 60% of animal protein to the diet of the people of this country. In the year of 2014-2015 the total fish production was 36.84 million MT [1]. Besides, aquaculture fish production of Bangladesh is the fifth highest in the world after China, India, Vietnam and Indonesia and capture fisheries production of Bangladesh is the sixteenth highest in the world [2]. In 2014-15 fisheries sector contributes 3.65% of the Gross Domestic Product (GDP), 23.81% to the agricultural GDP and 2.09% of the foreign exchange earnings by exporting fish and fishery products [1].

Fish and fishery products are highly nutritious, in addition to the high percentages of animal protein, and they are good sources of some minerals like calcium, phosphorus and iron [3]. The global contribution of fish as a source of protein is high, ranging from 10% to 15% of the human food basket across the world [4]. A large number of people in Bangladesh suffer from various chronic malnutrition and most babies are born underweight since their mothers are chronically malnourished [5]. Protein malnutrition is one of the most serious problems in Bangladesh [6].Fish protein generally tends to be higher in Lysine and lower in Tryptophan content than other mammalian proteins [7].

Traditional fishery products are native to a country or culture. Major traditional fishery products of Bangladesh include dried, semi-fermented *(Cheap Shutki)*, fermented, salted and some smoked products [8]. A large number of people of Mymensingh, Netrokona, Kishoreganj, Brahmonbaria, Jamalpur and Tangail region are engaged with the production and marketing of semi-fermented fish products and it plays a vital role to increase their socio-economic condition [9]. They are mainly produced during winter season because of the availability of raw material, favorable weather condition and lower price. Processed fish includes dried, salt-dried and semi-fermented products locally known as "*Chepa Shutki*". *Chepa Shutki* is a home processed semi-fermented food, prepared from a small sized fish (Indian minor carp, *Puntius stigma* and *P. ticto*) by artitional fishermen.

Fermentation offers a wealth of possibilities and plays an important role in improvement of nutritional and functional properties of food. The WHO food safety unit has given high priority for the research in food fermentation, as it will improve the food safety by controlling the growth and activity of pathogens in foods. Moreover, fermented food products are a good source of peptides and amino acids [10, 11]. The calcium, phosphorus, magnesium and iron contents of *Chepa Shutki* were reported to be higher than those of similar kinds of Japanese processed fish and was regarded a high quality protein food

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[12]. The presence of microbes in *Chepa Shutki* also reflects the environment where they lived and the condition of places where *Chepa Shutki* are processed. Determination of microbiological quality of such processed fishes is very important for guarding consumer's health and hygiene [13]. Microbial action has been known to play an important role in the spoilage of fermented products. Growth of fungus causes off flavors, soften the flesh and some can produce potentially dangerous mycotoxins under certain circumstances [14]. The present study has been carried out to assess the nutritional and microbiological quality of *'Chepa Shutki'* of different sources.

Materials and Methods

Collection of sample

Punti (Scientific name- *Puntius sophore*, English name- Spot-fin swamp barb or pool barb) was selected as sample *Chepa Shutki* which is one of the most available and popular semi-fermented product in that region. Three types of *Chepa Shutki* samples collected from producer of Kuliarchar, retailer from Ashuganj and one sample was made in laboratory of Department of Fisheries Technology and Quality Control with proper hygienic condition (Figure 1). Sample was collected as monthly basis from December 2015 to April 2016 in total 5 months.

Preparation of control sample in laboratory

The main raw materials for producing *Chepa Shutki* which are fish, mutka, edible oil, cover paste and clay seal. Then the following diagram showed, maintain to produce *Chepa Shutki* (Figure 2).

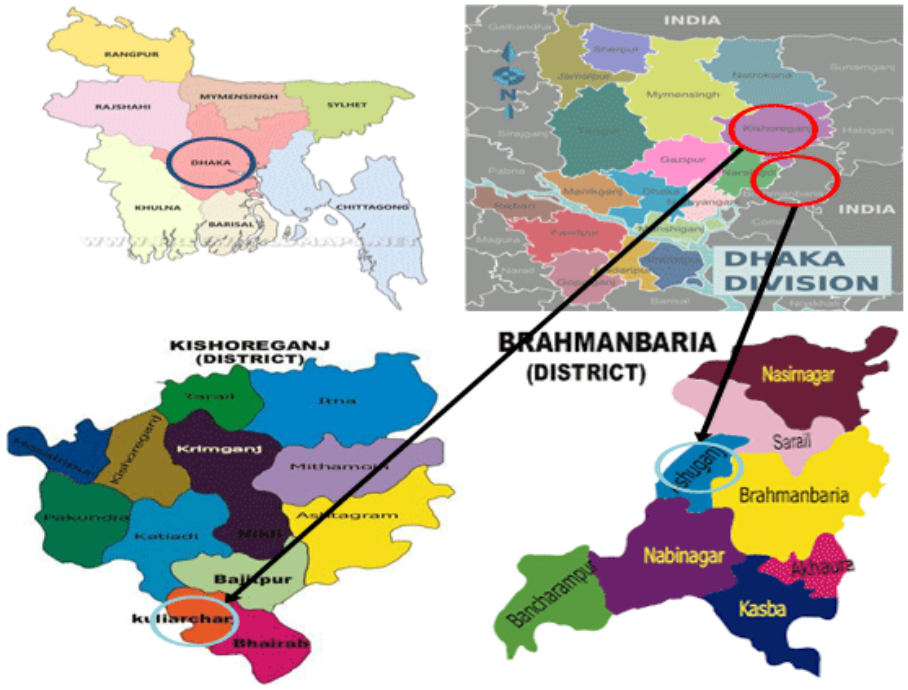

Figure 1: Map showing the study area

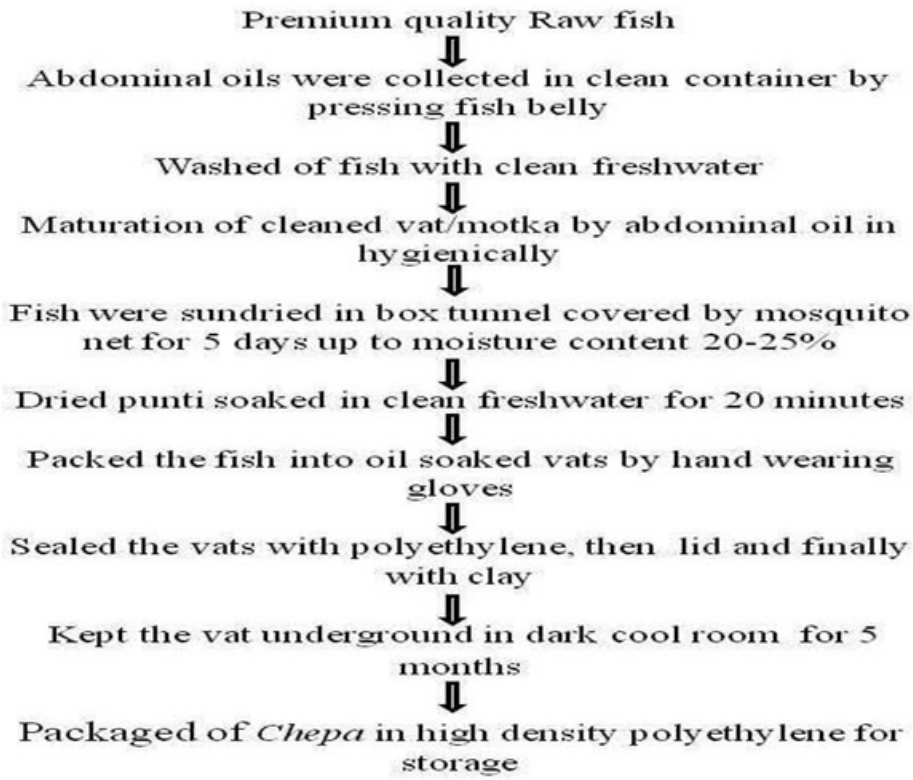

Figure 2: Flow diagram of preparation method of *Chepa Shutki* (control sample)

Proximate composition analysis

Proximate composition analysis of moisture, crude protein, crude lipid, ash, crude fiber and nitrogen free extract were carried out according to the methods of Association of Analytical Chemists [15].

Total volatile base nitrogen (TVB-N)

Total volatile basic nitrogen (TVB-N) was estimated according to the Antonacopoulos and Vyncke method [16].

Microbiological analysis

The microbiological characteristics such as Total Plate Count (TPC) were enumerated by using plate count agar by APHA [17].

Statistical analysis

Statistical analysis was done by performing one way ANOVA (Post Hoc, Duncan) and SPSS (IBM 2010 and Version 20) at 5% confidence level and presented in tabular and graphical format. All bacteriological counts were converted to log10 cfu g-1 for statistical analysis. Univariate and multivariate analysis of General Linear Model (GLM) was used to determine significant *(p<0.05)* difference between estimated data.

Results and Discussion

Proximate composition

The proximate composition of semi-fermented fish products *Chepa Shutki* obtained from producer, retailer and control were analyzed and the results are presented and summarized in tabulated form.

Moisture content of *Chepa shutki*

The moisture content varied from 33.74±0.71 to 45.03±1.06%, with higher values recorded in the samples obtained from retailers and lower values for samples from control (Table 1). These values slightly differ from the values obtained by Nayeem, et al. who found the proportion of moisture content were 39.62%, 42.79% and 46.85%, respectively in the *Chepa Shutki* obtained from producer, wholesaler and retailer [18]. This variation can be attributed to differences in period of maturation and the state of fish before preparation.

In each month significantly *(p<0.05)* higher moisture content was observed in the retailer samples and significantly lower moisture content was observed in the control samples. This finding is supported by Ahmed et al. obtained the average moisture

Table 1: Moisture, protein, lipid and ash content (%) of *Chepa Shutki* samples obtained from different sources in different month

Months	Proximate Compositions											
	Moisture (%)*			Protein (%)*			Lipid (%)*			Ash (%)**		
	Producer	Retailer	Control	Producer	Retailer	Control	Producer	Retailer	Control	Producer	Retailer	Control
Dec'15	37.14b±0.34	42.28c±0.73	33.74a±0.71	35.42b±0.32	34.04a±0.92	38.04c±0.31	22.49b±0.71	19.01a±0.88	24.18c±0.75	2.44a±0.41	2.75a±0.61	1.95a±0.25
Jan'16	37.86b±0.85	43.84c±1.09	33.99a±0.61	35.40b±0.36	33.19a±1.02	37.92c±0.84	22.61b±0.49	18.05a±0.76	23.93c±0.64	2.22a±0.16	2.65a±0.56	1.98a±0.13
Feb'16	39.26b±0.49	44.02c±1.16	34.11a±0.77	34.99b±0.81	33.11a±0.83	37.43c±0.85	21.65b±0.82	18.23a±0.63	23.81c±0.33	2.21a±0.42	2.60a±0.26	2.02a±0.10
Mar'16	38.66b±1.09	45.02c±0.64	34.98a±0.52	35.40b±0.58	32.33a±0.61	37.26c±0.86	21.12b±0.68	17.98a±1.03	23.74c±0.51	2.33ab±0.25	2.73b±0.15	1.80a±0.70
Apr'16	38.54b±1.05	45.03c±1.06	35.11a±1.04	35.08b±0.41	32.54a±0.44	37.20c±0.72	21.69b±0.61	17.30a±1.14	23.44c±0.53	2.29a±0.21	2.95b±0.17	2.07a±0.16

*Values are mean ± SD (n=5). Within a row, means not sharing a common superscript letters are significantly different at *(p<0.05)*.

**Values are mean ± SD (n=5). Within a row, means with sharing a common superscript letters are not significantly different at *(p>0.05)*.

content of producer and retailer samples were 39.34±1.70 and 43.20±0.99%, respectively [19]. Mansur reported the higher percentage of moisture content in retailer sample indicates their improper handling and storage system [11]. Similarly Some previous studies also revealed the similar outcome reported by Kakati and Goswami; Rahman; Khanum et al. [20,21,22]. From the observed results, it is evident that moisture content was comparatively significantly *(p<0.05)* higher in samples from retailers followed by producers and control.

The present finding is also supported by some previous research studies [18, 19, 22, 23]. They observed significantly higher moisture content in the samples collected from retailer and lower from producer. Retailers and wholesalers sample was loss its quality at different stages of marketing chain during handling, transportation and preservation. The moisture content was significantly *(p<0.05)* higher in the month of April and lower in the month of December, respectively. This variation might be due to difference of temperature and humidity of the air in different months.

Protein content of *Chepa Shutki*

The Protein content was varied from 32.33±0.61 to 38.04±0.31% in fresh matter basis, with higher values recorded in the control samples from and lower values for samples from retailer (Table 1). Similarly, Ahmed et al. reported that the average protein contents of producer and retailer samples were 35.20±0.23 and 34.73±0.06%, respectively [19]. Therefore, protein content was observed with highest values in the month of December and lowest values in the month of March, respectively. Significantly lowest protein content was observed in the samples of retailer during the month of March and April.

Besides, Nayeem et al. obtained the protein content were 33.83%, 32.78% and 32.46% respectively in the *Chepa Shutki* obtained from producer, wholesaler and retailer [18]. Majumdar et al. reported that proximate analysis of protein content of Chepa is 38.93% which are significantly higher than that of the present finding [24]. Our results also agree with some previous studies [20,21,22,26]. The protein content is significantly *(p<0.05)* higher in the month of December and lower in the month of March, respectively.

Lipid content of *Chepa Shutki*

The lipid content ranged from 17.30±1.14 to 24.18±0.75 %, with highest value obtained from control and lowest value in product obtained from retailers (Table 1). Ahmed et al. The average lipid contents of producer and retailer samples were 21.00 ± 0.65 and 17.92 ± 0.58%, respectively [19]. Similarly, Nayeem et al. got the proportion of lipid content were 24.97%, 22.47% and 19.25%, respectively in the *Chepa Shutki* obtained from producer, wholesaler and retailer [18].

The lowest lipid content was found in retailer's sample in the month of March and April. However, significantly *(p<0.05)* highest lipid content was observed in control sample than the lipid content of producer product. Majumdar et al. reported that proximate analysis of lipid content of Chepa is 16.73% which significantly differ from the present finding [24]. The increased rate of lipid content in the product is obvious due to reduction of moisture content. There is an inverse relation with moisture content and fat content. Nayeem et al. reported that the poor content of lipid in product obtained from retailers and wholesalers are probably due to loss of quality at different stage of marketing chain during handling, transportation and preservation [25]. Our result was also in agreement with the findings reported by Ahmed et al. [19].

Ash content of *Chepa Shutki*

In Table 1, it is clear that ash content varied from 1.80±0.70 to 2.95±0.17%, with highest value observed in product obtained from retailer and lowest values in products obtained from control. Nayeem et al. observed that the ash content were 0.81%, 1.01% and 0.89%, respectively in the *Chepa Shutki* from producer, wholesaler and retailer [18].

Ash content in product of retailer was observed significantly *(p<0.05)* highest in the month of April. Whereas, ash content in control samples were significantly lowest in the month of March. There were no significantly different (*p>0.05*) between producer and control sample of ash content. This agrees well with the findings of Ahmed et al. who reported that the average ash contents of producer and retailer sample were 2.26±0.04 and 2.37±0.02%, respectively [19]. The result of the present study is supported by some earlier findings [20, 21, 22, 26]. Ahmed et al. mentioned that the higher ash content noticed in the products sampled from retailers are probably associated with

contamination with filth, sand, dust etc. which might occur during handling, transportation and preservation in the marketing chain [19]. It is also in agreement with the opinion of [12, 25].

Fiber content of *Chepa Shutki*

It observed that fiber content varied from 0.81±0.01 to 0.92±0.03 % with the highest value obtained from producer and the lowest value in product obtained from retailer (Table 2). This agrees well with the findings of Mohammed who reported that fiber content was 0.80% in the fermented product terkin [27]. Besides, fiber content is lower than that reported by Mohammed [27]. He found the fiber content was 1.3% in the fermented product fassiekh. The fiber content is significantly *(p<0.05)* higher in the month of March and lower in the month of February. From the observed results, it is evident that fiber content did not significantly vary with other composition changes during processing.

Fiber content values were observed highest in the producer sample and fiber content of control sample was lowest. However, significantly higher fiber content was observed in the month of March and lower was observed in the month of February. There were no significantly different (*p>0.05*) between producer and control sample fiber content. No significant (*p>0.05*) difference in fiber content was observed among the samples collected either from producers, retailer or control in different month.

Nitrogen Free Extract (NFE) content of *Chepa Shutki*

The Nitrogen Free Extract (NFE) which composed mainly of digestible carbohydrates, vitamins and other non-nitrogen soluble organic compounds content varied from 0.83±0.04 to 1.08±0.02 %, with highest value observed in sample obtained from control and lowest values in products obtained from retailer (Table 2). NFE content in control sample was observed significantly *(p<0.05)* highest in the month of January. Whereas, NFE content in retailer samples was the significantly *(p<0.05)* the lowest in month of February. There were no significantly different *(p>0.05)* between producer and control sample NFE content. Therefore, significant *(p<0.05)* difference in NFE content was observed among the control samples in different month. But no significant *(p<0.05)* difference in NFE content was observed among the samples collected either from producers or retailer in different month. Nitrogen Free Extract (NFE) which composed mainly of digestible carbohydrates, vitamins and other non-nitrogen soluble organic compounds that reduced with the time of storage in fermented product. The lower NFE content noticed in the products sampled from retailers are probably associated with reduced carbohydrate content during long time handling, transportation and preservation.

Table 2: Fiber and nitrogen free extract (NFE) content (%) of *Chepa Shutki* samples obtained from different sources in different month

Months	Fiber (%)*			Nitrogen Free Extract (NFE) (%)**		
	Producer	Retailer	Control	Producer	Retailer	Control
Dec'15	0.89^{a}±0.04	0.87^{a}±0.07	0.84^{a}±0.02	1.02^{ab}±0.04	0.98^{a}±0.05	1.08^{b}±0.02
Jan'16	0.86^{a}±0.07	0.86^{a}±0.05	0.83^{a}±0.01	0.96^{b}±0.06	0.83^{a}±0.04	1.06^{c}±0.04
Feb'16	0.85^{a}±0.04	0.81^{a}±0.01	0.85^{a}±0.06	0.91^{a}±0.06	0.86^{a}±0.04	1.05^{b}±0.05
Mar'16	0.92^{a}±0.03	0.83^{a}±0.04	0.88^{a}±0.07	0.98^{a}±0.04	0.88^{a}±0.02	0.93^{a}±0.11
Apr'16	0.91^{a}±0.02	0.84^{a}±0.03	0.86^{a}±0.05	1.03^{b}±0.02	0.85^{a}±0.06	0.92^{a}±0.06

*Values are mean ± SD (n=5). Within a row, means with sharing a common superscript letters are not significantly different at *(p>0.05)*.
**Values are mean ± SD (n=5). Within a row, means not sharing a common superscript letters are significantly different at *(p<0.05)*.

Total volatile base nitrogen (TVB-N) content of *Chepa Shutki*

TVB-N value was ranged from 1.05±0.08 to 3.39±0.36 mg/100g, with highest value obtained from retailer and lowest value in product obtained from control (Table 3). Similarly, Nayeem et al. found that the TVB-N value were 1.12 mg/100g in producer and 3.12 mg/100g in retailer [18]. Therefore, TVB-N value was observed with highest in the month of March and lowest values in the month of December, respectively. Significantly lower TVB-N value observed of control sample in the month of December and February. However, no significant *(p>0.05)* difference were observed between control and producer values in the month of April. This agrees well with the findings of Ahmed et al. who reported that the average TVB-N value of producer and retailer samples were 1.34±0.20 and 2.96±0.35 mg/100g, respectively [19]. Some previous studies also revealed the similar preceding outcomes [20, 28, 29, 22, 26].

Majumdar et al. reported that the high concentration of TVB-N usually does not manifest any ammonia-like odor in the product [28]. This may be due to making of ammonical odor by the characteristic strong odor of Chepa. Autolytic enzymes might have caused de-amination of protein resulting in the formation of volatile bases [30, 31,32, 33]. Although the observed values of the present study are within the acceptable limit as suggested for fishery product by Connell [34].

Table 3: Total volatile base nitrogen (TVB-N) (mg/100g) and total plate count (log cfu g^{-1}) content of *Chepa Shutki* samples obtained from different sources in different month

Months	TVB-N (mg/100g)			Total Plate Count (log cfu g^{-1})		
	Producer	Retailer	Control	Producer	Retailer	Control
Dec'15	1.77^{b}±0.32	2.91^{c}±0.17	1.05^{a}±0.08	6.63^{b}±0.14	6.89^{c}±0.12	6.01^{a}±0.28
Jan'16	1.96^{b}±0.56	3.08^{c}±0.20	1.08^{a}±0.04	6.69^{b}±0.17	7.14^{c}±0.31	6.29^{a}±0.46
Feb'16	2.08^{b}±0.13	3.10^{c}±0.30	1.07^{a}±0.06	6.55^{b}±0.51	7.11^{c}±0.39	6.27^{a}±0.26
Mar'16	1.85^{b}±0.47	3.39^{c}±0.36	1.14^{a}±0.08	6.74^{b}±0.23	7.47^{c}±0.13	6.42^{a}±0.10
Apr'16	1.97^{a}±0.39	3.37^{b}±0.57	1.22^{a}±0.05	6.83^{b}±0.24	8.10^{c}±0.18	6.47^{a}±0.11

*Values are mean ± SD (n=5). Within a row, means not sharing a common superscript letters are not significantly different at *(p>0.05).*

Microbiological analysis

Total plate count (TPC) of *Chepa Shutki*

It was observed that the total bacterial count of *Chepa Shutki* ranged from 6.01±0.28 to 8.10±0.18 log cfu g^{-1} with the highest value in retailer's samples, while the lowest value was reported in control samples (Table 3). Majumdar, et al. reported that the total plate count was found to be 6.87±0.11 and 6.36±0.01 log $cfug^{-1}$ in punti and phasachepa, respectively [28].

The highest bacterial count was found in retailer sample in the month of March and April. Whereas, bacterial count of control samples were the lowest in the month of December, January and February. However, the lowest bacterial count were observed significantly (*p<0.05*) in control samples than producer products. However, the highest bacterial count was observed significantly *(p<0.05)* in the month of April and lowest was observed in the month of December. Kakati and Goswami found that the TPC of *punti (Puntius spp.)* and *phasa (Setipinna spp.) Chepa* were 5.1-5.4 log cfu g^{-1} [20]. Muzaddadi and Basu also found that TPC value were around 4 log cfu g^{-1} in Chepa [35]. Sarojnalini and Suchitra also reported that Total bacterial count 6 and 8 log cfu g^{-1} in naturally fermented Ngariwhich are consistent with the results of present study [36]. While, Mahanta and Muzaddadi found that total plate count 7 log cfu g^{-1} in salt treatment Chepa [37].

The findings of Ahmed et, al., Sarojnalini and Vishwanath in semi-fermented *Chepa agree* with the findings of the present study [19, 26]. These observations from the present study are also in agreement with the opinion of Thapa et al., Anihouviet al. [38,39]. Ahmed et, al. reported that higher TPC was found in retailer market than the producer sample [19]. It is revealed that all the TPC of *Chepa Shutki* was found in the marginally accepted quality category. The occurrence of high TPC might be due to use of low quality raw fish, poor sanitation practices during processing, inadequate packaging and storage, absorption of moisture by dried from the environment and different stages of marketing chain during handling, transportation and preservation [25, 19, 23, 22].

Conclusion

From the present study it can be concluded that, semi-fermented fish (*Chepa Shutki*) is a source of high-quality protein to improve the nutritional value of the cereal-based Bangladeshi diet. The nutritional quality of Chepa Shutki was in acceptable condition in control and producer sample but was unacceptable in the retail markets. While higher TPC was recorded in Chepa Shutki sample which indicates that it was severely contaminated with bacteria. This indicates loss of consideration amount traditional fishery products which is presumably due to lack of adequate knowledge about the quality aspect, lack of packaging system, lack of sanitation and poor marketing channel. Government and other agencies can take necessary steps to disseminate adequate knowledge about the quality aspects and improve the marketing channel for safe and steady supply of different traditional fishery products to the common people of Bangladesh.

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