E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2018; 6(2): 431-435

www.fisheriesjournal.com
Received: 23-01-2018
Accepted: 24-02-2018

M Biswas
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

MS Islam
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

P Das
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

PR Das
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

M Akter
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

Correspondence
M Biswas
Mithila Biswas,
Department of Coastal and Marine Fisheries, Sylhet Agricultural University, Sylhet, Bangladesh

Comparative study on proximate composition and amino acids of probiotics treated and nontreated cage reared monosex tilapia *Oreochromis niloticus* in Dekar *haor*, Sunamganj district, Bangladesh

M Biswas, MS Islam, P Das, PR Das and M Akter

Abstract
The study was carried out to identify the impact of probiotics on proximate composition and amino acids of cage reared tilapia *Oreochromis niloticus* for 120 days. Cage farming was done under four treatments as T_1 (biozyme), T_2 (rapid grow), T_3 (miracure probiotics) and T_4 (control), and each having three replicates. Proximate compositions and amino acids of fish were determined. Proximate composition and amino acid profiles varied significantly ($p<0.05$) between probiotic treated and nontreated fish. Higher amount of moisture and ash content observed in nontreated tilapia whereas comparatively higher protein and lipid content found in treated than nontreated. Among 14 recorded amino acids, essential amino acids were threonine, methionine, isoleucine, leucine, histidine, lysine, arginine and valine. Nonessential amino acids were aspertic, serine, glutamic, glycine, alanine and tyrosine. Comparatively higher amount of essential and nonessential acids secured in treated tilapia than nontreated tilapia. Therefore, results of the study imply that probiotics may use in tilapia farming to enhance protein and lipid content, which help to increase taste and good smell of fishes.

Keywords: Proximate composition, amino acids profile, probiotic, Monosex tilapia

1. Introduction
Tilapia is one of the most important fish species in freshwater aquaculture. It is a popular fish for its rapid growth and hardiness, resistant to environmental changes and disease, less bone and white flesh. Tilapia are beneficial to human beings as they make up a major part of the human diet and provide as much of needed proteins as in meat.
Cage culture is a popular form of aquaculture that has many advantages such as flexibility of management, ease and low cost of harvesting, close observation of fish feeding response and health, ease and economical treatment of parasites and diseases and relatively low capital investment compared to ponds and raceways. Tilapia can be cultured at high densities in floating cages that maintain free circulation of water. Monosex tilapia do not breed in ponds and cages, and therefore this fish can easily be cultured in cages without the problems of recruitment and stunting of growth.
Probiotics are also known as live beneficial bacteria that may serve as dietary supplements to improve the host intestinal microbial balance and growth performance [11]. Some common bacterial strains are used as probiotic products like *Bacillus* sp., *Lactobacillus acidophilus*, *L. bulgaricus*, *L. plantariu*, *Streptococcus lactis* sp. and *Saccharoromyces cereisiae* [9]. Feeding supplemented with probiotics improve appetite and growth performance of the farmed fish [12]. With increasing demand for environment friendly aquaculture, use of probiotics in aquaculture is now widely accepted [11, 16]. Uses of probiotics have many benefits in this field because it offers viable alternatives for the generation of higher-quality fish products in terms of size, production and health [4].
Proximate composition has been reported to be a good pointer of physiology needed for routine analysis of fisheries [7]. Fish carcass contains on average 75% water, 16% protein, 6% lipid and 3% ash. Main constituent of fish flesh is moisture, which usually varies between 60-80% in many fish [15, 17]. Proteins are the most important constituents of all living cells and represent the largest chemical group in the animal body. Use of protein concentrates and fish oil in diets have been reported to reduce heart diseases, arthritis, arteriosclerosis, asthma, auto-

immune disease, cancer, chronic infection, diabetes and multiple sclerosis [6, 13]. Fats are the primary energy depots of animals. These are used for long-term energy requirements during periods of extensive exercise or during periods of inadequate food and energy intake. Fat content of fish varies with the species [8].

High quality proteins are readily digestible and contain the dietary essential amino acids (EAAs) in quantities that correspond to human requirements [18]. Fish protein is an excellent source of these amino-acids especially lysine and methionine are generally found in high concentrations in fish proteins, in contrast to cereal and meat proteins [5]. Amino acids are the basis of all life processes as they are absolutely essential for every metabolic process. Majority of diseases as high-cholesterol levels, diabetes, insomnia or arthritis can essentially be traced back to metabolic disturbances [18].

Sporadic works on proximate composition and amino acid profiles of probiotics treated monosex tilapia in Bangladesh have been done. All the people of this country like this fish very much due to its palatability. But they do not know about nutritive values of this fish. This study can provide systematic information regarding the nutritional composition of muscles of fish, which will be fundamental information for the consumers, producers and researchers. Considering the above facts, the present research was undertaken with aims to investigate proximate composition and amino acid profiles of probiotics treated and nontreated cage reared tilapia (*O. niloticus*) in *haor* conditions.

2. Materials and Methods

2.1 Study area and experimental period

Tilapia were collected from an tilapia cage farming in Dekar *haor* (naturally depressed seasonal-perennial open waterbody), where the fishes were fed probiotics mixed commercials feed and only commercial feed. The *haor* is consisted of many small, medium and large interconnecting *beels*, canals, rivers and crop lands. The experiment was carried out for a period of 120 days from 1 September to 29 December 2016 in 12 floating cages set up at the periphery of the *haor*.

Figure 1: Map of Dakshin Sunamganj showing the experimental area.

2.2 Collection and preparation of sample

As a sample 12 fishes were collected from each treatment (T_1-biozyme, T_2-rapid grow, T_3-miracure and T_4-control) of tilapia cage culture until harvest. Monthly intervals samples were taken from the floating cages of tilapia. Only fresh muscle tissue from dorsal region without skin and bone of the fish body were collected and chopped then grinded by mortar and pestle to make a homogenous sample. The determination of proximate composition as well as amino acids profiles were done in laboratories.

2.3 Analytical procedures of proximate composition

Proximate composition as moisture, ash, crude protein and lipid of fish muscles was determined by conventional method of AOAC [2] with minor modification. For determination of moisture content 15 g fish samples were taken into a hot air oven at a temperature of 105 ^{0}C for 24 h. until constant weight was obtained. A total of 5 g samples were taken into a muffle furnace at a temperature of 600 ^{0}C for 6 h. for ash content measurement. Kjeldahl method was used to determine crude protein content of fish samples.

For most routine purposes, the percent of protein in the sample was then reckoned by multiplying the percent of nitrogen with protein conversion factor of 6.25 for fish. A ground joint soxhlet apparatus was used for the determination of lipid content.

2.4 Determination of amino acid profiles

The profile of amino acids was done following high performance thin layer chromatographic (HPTLC) method [3]. The HPTLC was analyzed the profile of amino acids in the muscle of tilapia.

2.5 Statistical Analysis

Statistical analysis were performed using one way analysis of variance (ANOVA) and Duncan's multiple Range Test was used to determine differences between treatments means at significance rate of $p<0.05$. The standard deviation of treatment means was also estimated. All statistics were carried out using Statistical Analysis program (SPSS, 20).

3. Results and Discussions

3.1 Proximate composition

Proximate composition of tilapia muscle was analyzed and presented in Table 1. Moisture content is expressed as the amount of water as a percentage (%) and the remaining portion is dry matter content. The major component of fish muscle is moisture. Moisture content in tilapia was varied from 62.92±0.04 to 68.09±0.02 % which is slightly lower than the findings of Akter (2015) [1] who found 73.91±0.16 and 79.62±0.29% moisture in cultured and wild koi (*Anabas testudineus*), respectively in Jessor region. Saini *et al.* (2014) [24] reported that significant difference (p<0.05) was found in moisture (65.44—66.88%) between probiotic supplemented diet and control group of *Labeo rohita*. Olagunju *et al.* (2012) [20] recorded 65.8% moisture for *T. zilli* without treatment of probiotics. These findings are consistent with the findings of the present study. The variations of ash content of tilapia fish were 1.52±0.02, 1.60±0.03, 1.15±0.04 and 1.83±0.02% in T_1, T_2, T_3 and T_4, respectively. Saini *et al.* [24] demonstrated significant difference (p<0.05) in ash content (2.43—2.97%) between probiotic supplemented diet and control group of *L. rohita*. Olagunju *et al.* (2012) [20] obtained 1.17% ash for *T. zilli* without probiotic. Fashina *et al.* (2012) [10] recorded ash content of 1.00 and 1.30%, respectively for *T. guineensis* and *T. mariae* without probiotic. Rubbi *et al.* (1987) [23] stated that both scaly and non-scaly freshwater fish contained 0.85—5.11% ash. These findings are more or less coincided with the findings of present study.

The variation of protein content of tilapia was 22.63±0.04, 23.03±0.05, 25.28±0.05 and 21.22±0.03%, respectively in T_1, T_2, T_3 and T_4, which is in agreement with the results obtained by Saini *et al.* (2014) [24], who recorded 20.12—23.98% protein between probiotic supplemented diet and control group of *L. rohita*. Akter (2015) [1] observed protein content of 12.13±0.01—16.04±0.02% in pre monsoon and 14.74±0.02—17.92±0.02% in post monsoon for wild and cultured koi, respectively. Olagunju *et al.* (2012) [20] and Fashina *et al.* (2012) [10] recorded 18.80% protein for *T. zilli* as well as 18.71 and 18.08% for *T. guineensis* and *T. mariae*, respectively without probiotics, which are slightly lower than the findings of the present study. Average value of lipid of the fish was ranged from 2.07±0.04—5.43±0.03%. Akter (2015) [1] reported the amount of lipid in wild and cultured koi was 3.61±0.02—3.82±0.02% and 5.14±0.01—5.56±0.01%, respectively, which is matched with the present findings. Saini *et al.* (2014) [24] reported lipid content in *L. rohita* fed probiotics supplemented diet and only supplementary diet was 6.30—6.87%, which is higher than the present findings. Olagunju *et al.* (2012) [20] and Fashina *et al.* (2012) [10] recorded 3.29% lipid for *T. zilli* as well as 0.40 and 0.60% for *T. guineensis* and *T. mariae*, respectively without probiotic treatment, which are lower than the findings of the present study. These indicate that higher amount of lipid is found in tilapia fed probiotics supplemented diet (probiotics treated tilapia) than the fishes fed only supplementary diet (nontreated tilapia). Taste of fishes might be associated with the lipid content in fish. Results of the study imply that probiotics treated tilapia contain more lipid than nontreated tilapia. That is why, probiotics treated tilapia are more tasty than controlled tilapia.

3.2 Amino acid profiles of the fish

3.2.1 Essential amino acids

Profiles of amino acids of fish muscle were determined and the results are furnished in Table 2. The variation of threonine content of tilapia was 0.66±0.03, 0.68±0.03 and 0.74±0.01 and 0.60±0.02% in T_1, T_2, T_3 and T_4, respectively. Comparatively higher threonine was found in probiotics treated tilapia than nontreated tilapia, which is coincided the findings of Akter (2015) [1] who obtained higher amount of threonine (0.437±0.003 and 0.460±0.023%) in cultured koi than wild koi (0.277±0.003 and 0.320±0.01%) during pre-monsoon and post-monsoon period. Roslan *et al.* (2012) [22] recorded 4.64±0.07% threonine for *O. niloticus* and Osibona *et al.* (2009) [21] found threonine as 4.80±0.29% for *T. zillii* without probiotics, which is higher than present study. Concentrations of methionine of tilapia were 0.37±0.04, 0.41±0.02 and 0.46±0.03 0.35±0.02%, in T_1, T_2, T_3 and T_4, respectively. Higher amount of methionine was found in probiotics treated tilapia than nontreated tilapia, which is in agreement with the result of Akter (2015) [1] who found higher amount of methionine in cultured koi (0.457±0.013 and 0.490±0.017%) than wild koi (0.313±0.017 and 0.350±0.012%) in pre-monsoon and post-monsoon. Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] found methionine as 1.78±0.62 and 3.17±0.19%, respectively for *O. niloticus* and *T. zillii*, which are not similar with the present findings. Value of isoleucine of probiotics treated tilapia was 0.82 ±0.01 to 0.92±0.02%, whereas in nontreated tilapia it was 0.75±0.03%, which is in agreement with the result of Akter (2015) [1] who found higher amount of isoleucine in cultured koi (0.8433±0.029 and 0.907±0.020%) than wild koi (0.527±0.019 and 0.620±0.023%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] reported isoleucine as 4.18±0.09 and 5.04±0.31%, respectively for *O. niliticus* and *T. zillii*, which are not coincided with the present findings. Contents of leucine in tilapia under T_1, T_2, T_3 and T_4 were 1.37±0.03, 1.41±0.01, 1.61±0.02 and 1.27±0.02%, respectively, which is matched with the result of Akter (2015) [1] who found higher amount of leucine in cultured koi (0.170±0.01 and 0.210±0.006%) than wild koi (0.133±0.012 and 0.170±0.012%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] measured leucine as 6.19±0.11 and 9.49±0.58%, respectively for *O. niloticus* and *T. zillii*. Histidine content of probiotics treated tilapia in the present study was 0.46±0.02 to 0.53±0.02%. But in nontreated tilapia it was 0.42±0.02%, which is similar with the finding of Akter (2015) [1] who found higher amount of histidine in cultured koi (2.023±0.048 and 2.240±0.023%) compared to wild koi (1.823±0.015 and 1.870±0.006%). Roslan *et al.* (2012) [22] found histidine as 3.31±0.07%, which is lower than the present findings. Values of lysine of probiotics treated tilapia were 1.53±0.02, 1.55±0.02, 1. 71±0.01 and 1.42±0.03%, respectively under T_1, T_2, T_3 and T_4, respectively. Data revealed that higher amount of lysine was found in probiotics treated tilapia than that nontreated tilapia, which is related with the finding of Akter (2015) [1] who obtained higher amount of lysine in cultured koi (0.367±0.007 and 0.440±0.017%) than that of wild koi (0.300±0.015 and 0.370±0.012%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] obtained lysine as 7.03±0.27 and 10.37±0.63%, respectively for *O. niloticus* and *T. zillii*, which is higher than present results. Mean concentration of arginine of fish was 1.23±0.02, 1.27±0.02 and 1.35±0.03, 1.10±0.01% in T_1, T_2, T_3 and T_4, respectively which is in agreement with the finding of Akter (2015) [1] who found higher amount of arginine in cultured koi (0.520±0.015 and 0.580±0.023%) compared to wild koi (0.407±0.009 and 0.470±0.006%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] found arginine as 5.63±0.15 and 11.66±0.72%, respectively for *O. niloticus* and *T. zillii*, which are not similar with the present findings. Values of valine in probiotics treated tilapia were 0.76±0.03, 0.79±0.02, 0.83±0.02%, respectively T_1, T_2 and T_3, but in nontreated tilapia it was 0.67±0.02%, which is consistent with the result of Akter (2015) [1] who found higher amount of valine in cultured koi (0.110±0.01 and 0.140±0.017%) than that of wild koi (0.090±0.012 and 0.100±0.006%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] recorded valine as 4.30±0.08 and 5.18±0.32%, respectively for *O. niloticus* and *T. zillii*. These are higher than the findings of the present study.

3.2.2 Nonessential amino acids

Table 3 shows the profiles of nonessential amino acids of fish muscle. The aspartic acid contents found in tilapia were 1.64±0.04, 1.72±0.02, 1. 91±0.01 and 1.55±0.04% in T_1, T_2, T_3 and T_4, respectively. Akter (2015) [1] reported the amount of aspartic acid was higher in cultured fish (0.890±0.01 and 0.930±0.006%) than wild koi (0.737±0.007 and 0.760±0.017%) in pre-monsoon and post-monsoon period, which is supported the present findings. Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] recorded aspertic acid as 7.79±0.01 and 11.17±0.69%, respectively for *O. niloticus*, *T. zillii* without treating probiotics, which is higher than present study. The average values of serine in probiotics treated tilapia were 0.56±0.03, 0.62±0.02 and 0.66±0.03%, respectively under T_1, T_2 and T_3. But lower amount 0.51±0.02% of serine was recorded in nontreated tilapia (T_4), which is similar with the results demonstrated by Akter (2015) [1] who obtained higher content of serine in cultured fish (0.360±0.023 and 0.490±0.006%) than wild fish (0.323±0.009 and 0.463±0.003%) during her study period. The findings of the present study are lower than the findings of Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21], who recorded serine as 4.26±0.08 and 4.47±0.27%, respectively for *O. niloticus* and *T. zillii*. Probiotics treated tilapia in the present study contained higher amount (2.65±0.02—3.01±0.04%) of glutamic acid. But it was lower (2.46±0.04%) in nontreated tilapia, which is in agreement with the findings of Akter (2015) [1] who recorded higher amount of glutamic acid in cultured koi (0.360±0.023 and 0.490±0.006%) than wild koi (0.323±0.009 and 0.463±0.003%). Nurullah *et al.* (2003) [19] reported higher content of glutamic acid among all the amino acids analized of some small indigenous fish species. Iwasaki and Harada (1985) [14] similarly reported the main amino acids in fish muscle were aspartic acid, glutamic acid and lysine. These findings are strongly supported the findings of the present study. Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] obtained glutamic acid as 15.94±0.27 and 18.16±1.11%, respectively for *O. niloticus* and *T. zillii*, which are not agreed with the present findings. The glycine content of in tilapia in T_1, T_2, T_3 was 0.74±0.04, 0.78±0.01, 0.87±0.02%, respectively. On the contrary, lower amount (0.71±0.02%) of glycine was obtained in controlled tilapia, which is matched with the findings of Akter (2015) [1] who found higher content of glycine in cultured koi (1.450±0.012 and 1.580±0.0%) than wild koi (1.290±0.015 and 1.380±0.012%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] secured glycine as 7.95±0.23, 5.20±0.32% respectively for *O. niloticus* and *T. zillii*, which are not similar with the present study. Mean values of alanine in probiotics treated tilapia recorded was varied from 1.14±0.02—1.30±0.02%, respectively. On the other hand, it was 1.0±0.03% in nontreated tilapia, which is similar with the findings of Akter (2015) [1] who recorded higher amount of alanine in cultured koi (0.490±0.01 and 0.550±0.029%) than wild koi (0.397±0.012 and 0.420±0.017%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] demonstrated alanine as 4.62±0.08 and 6.77±0.41%, respectively for *O. niloticus* and *T. zillii*, which are not in harmonious with the present study. Average values of tyrosine content of cage reared tilapia were 0.23±0.02, 0.25±0.02, 0.33±0.02 and 0.20±0.02 % in T_1, T_2, T_3 and T_4, respectively, which is coincided with the finding of Akter (2015) [1] who found higher amount of tyrosine in cultured koi (0.473±0.007 and 0.550±0.023 %) than that of wild koi (0.383±0.009 and 0.440±0.012%). Roslan *et al.* (2012) [22] and Osibona *et al.* (2009) [21] recorded tyrosine as 3.75±0.13 and 1.47±0.09%, respectively for *O. niloticus* and *T. zillii*, which are higher than present findings.

Table 1: Proximate composition (mean±sd) of probiotics treated and nontreated tilapia (*Oreochromis niloticus*) cultured in cages under four treatments.

Proximate composition (%)	Treatments			
	T_1 (Biozyme)	T_2 (Rapid grow)	T_3 (Miracure)	T_4 (Control)
Moisture	65.34^c±0.03	64.45^b±0.03	62.92^a±0.04	68.09^d±0.02
Ash	1.52^b±0.02	1.60^c±0.03	1.15^a±0.04	1.83^d±0.02
Protein	22.63^b±0.04	23.03^c±0.05	25.28^d±0.05	21.22^a±0.03
Lipid	4.14^b±0.04	4.60^c±0.04	5.43^d±0.03	2.07^a±0.04

Mean values in the same row with same superscript letters are not significantly different (p<0.05).

Table 2: Profiles of essential amino acids (mean±sd) of probiotics treated and nontreated tilapia (*Oreochromis niloticus*).

Amino acids	Treatments			
Essential amino acids (%)	T_1 (Biozyme)	T_2 (Rapid Grow)	T_3 (Miracure)	T_4 (Control)
Threonine	0.66^b±0.03	0.68^b±0.03	0.74^c±0.01	0.60^a±0.02
Metheonine	0.37^b±0.04	0.41^c±0.02	0.46^d±0.03	0.35^a±0.01
Isoleucine	0.82^b±0.01	0.83^b±0.02	0.92^c±0.02	0.75^a±0.03
Leucine	1.37^b±0.03	1.41^c±0.01	1.61^d±0.02	1.27^a±0.02
Histidine	0.46^b ±0.02	0.47^b±0.02	0.53^c±0.02	0.42^a±0.02
Lysine	1.53^b± 0.02	1.55^c±0.02	1.71^d±0.01	1.42^a±0.03
Arginine	1.23^b±0.02	1.27^c ±0.02	1.35^d±0.03	1.10^a±0.01
Valine	0.76^b±0.03	0.79^c±0.02	0.83^d±0.02	0.67^a±0.02

Mean values in the same row with same superscript letters are not significantly different (p<0.05).

Table 3: Profiles of nonessential amino acids (mean±sd) of probiotics treated and nontreated tilapia (*Oreochromis niloticus*).

Amino acids	Treatments			
Nonessential amino acids (%)	T_1 (Biozyme)	T_2(Rapid Grow)	T_3 (Miracure)	T_4 (Control)
Aspertic acid	1.64^b±0.04	1.72^c±0.02	1.91^d±0.01	1.55^a±0.04
Serine	0.56^b±0.03	0.62^c±0.02	0.66^d±0.03	0.51^a±0.02
Glutamic acid	2.65^b±0.02	2.7^c±0.02	3.01^d±0.04	2.46^a±0.04
Glycine	0.74^b±0.04	0.78^c±0.01	0.87^d±0.02	0.71^a±0.02
Alanine	1.14^b±0.02	1.19^c±0.02	1.30^d±0.02	1.00^a±0.03
Tyrosine	0.23^b±0.02	0.25^c±0.03	0.34^d±0.02	0.20^a±0.01

Mean values in the same row with same superscript letters are not significantly different (p<0.05).

4. Conclusion

Tilapia (*O. niloticus*) has high cultural value and consumers prefer it all over the country. This is an excellent candidate for monoculture or mixed/polyculture with other species in seasonal waterbodies owing to it is hardy, diseases resistant and it may live in poorly oxygenated water. It is commercially important due to its high demand for protein. Findings of the study conclude that there is much variation in proximate composition and amino acid profiles between probiotics treated and nontreated cage cultured tilapia. Amount of moisture and ash is higher in nontreated tilapia compared to treated tilapia. On the contrary, treated tilapia contains higher amount of protein as well as lipid owing to treated tilapia are fed with probiotics supplementd feed, which is more beneficial for fish and other animals. As a result probiotics treated tilapia is an excellent source of protein and lipid because higher amount of amino acids composition and degree of digestibility. So it is more preferable and tasty fish than nontreated fish.

5. Acknowledgements
Authors are deeply grateful to Krishi Gobeshona Foundation (KGF) for providing fund to conduct the research under the project entitled “Farm Productivity Improvement in *Haor* areas through Integrated Farming systems Approach”.

6. References
1. Akter MT. Seasonal variations in proximate, amino acid and fatty acid profile of wild and cultured *Anabas testudineus* Bloch, 1795, MS Thesis, Department of Fisheries, University of Dhaka, Dhaka. 2015.
2. AOAC. Official Method of Analysis, Association of Official Analytical Chemists and W Horwitz (Editor) 12th Ed, Washington. DC. USA, 1980.
3. Anonymous. Amino acid analysis system introduction manual. Shimadzu HPLC amino acid analysis system. Analytical Instruments Division, Kyoto, Japan, 1993, 63-65.
4. Cruz PM, Ibanez AL, Hermosillo OAM, Saad HCR. Use of probiotics in Aquaculture. International Scholarly Research Notices. 2012, 13.
5. Chandrashekar K, Deosthale YG. Proximate composition, amino acid, mineral and trace element content of the edible muscle of 20 Indian fish species. Journal of food Composition and Analysis. 1993; 6(2):195-200.
6. Cobiac L, Cliffton PM, Abbey M, Belling GB, Westel PJ. Lipid, lipoprotein and lemostatic effects of fish in fish oil n-3 fatty acid is mildly perhipidenmic males. American Journal of Clinical Nutrition. 1991; 53:1210-1216.
7. Cui Y, Wootton RJ. Effects of ration, temperature and body size on the body composition, energy content and condition of the minnow, *Phoxinus phoxinus* (L.). Journal of Fish Biology. 2011; 32:749-764.
8. Exler J, Kinsella JE, Watt BK. Lipids and fatty acids of important finfish: New data for nutrient tables**.** Journal of American Ocean Chemist’ Society. 1975; 52:154-159.
9. FAO (Food and Agriculture Organization).Twenty year fishery development plan for Bangladesh, USA. 2004.
10. Fashina HAB, Megbowon I, Olumide O, Ozor Pa, Ibrahim AO, Adejonwo.*et al*. Comparative study of the proximate composition of some world Tilapiine fishes in Epe lagoon, Lagos, Nigeria. Journal of Fisheries and Aquatic Science 2012; 8:265-267.
11. Gatesoupe FJ. The use of probiotics in aquaculture, Aquaculture 1999; 180:147-165.
12. Geovanny GR, Luis BJ, Shen M. Probiotics as control agents in aquaculture. Journal of Ocean University of China. 2007; 6(1):76-79.
13. Gerhard GT, Patton BD, Lindquist SA, Wander RC. Comparison of three species of dietary fish: Effects on serum concentrations of low-density lipoprotein cholesterol and apolipoprotein in normottingly ceridermic subjects. American Journal of Clinical Nutrition. 1991; 4:334-339.
14. Iwasaki M, Harada R. Proximate and amino acid composition of the roe and muscle of selected marine species. Journal of Food Science. 1985; 50(6):1585-1587.
15. Love RM. The Chemical Biology of Fishes. Academic Press, Inc. London, U.K. 1970, 547.
16. Moriarty DJW. Control of luminous vibrio species in penaid aquaculture ponds. Aquaculture. 1998; 164:51-358.
17. Murra J, Burt JR. The Composition of Fish. Ministry of Technology, Torry Research Station Torry advisory note, 2001, 38.
18. Mohanty B, Mahanty A, Ganguly S, Sankar TV, Chakraborty K, Rangasamy A *et al.* Amino acid compositions of 27 food fishes and their importance in clinical nutrition. Journal of Amino Acid. 2014; 2014:47.
19. Nurullah M, Kamal M, Wahab MA, Islam MN, Ahsan CT, Thilsted S. Nutritional quality of some small indigenous fish species of Bangladesh. In BAU-ENERCA/DANIDA Workshop on potentials of small indigenous Species of Fish (SIS) in Aquaculture & Rice-field Stocking for Improved Food & Nutrition Security in Bangladesh. Small Indigenous Species of Fish in Bangladesh, 2003, 151-158.
20. Olagunju A, Muhammad A, Mada SB, Mohammed A, Mohammed HA, Mahmoud KT. Nutrient composition of *Tilapia zilli*, *Hemisynodontis membranacea*, *Clupea harengus* and *Scomber scombrus* consumed in Zaria. World Journal of Life Sciences and Medical Research. 2012; 2(16):16-19.
21. Osibona AO, Kusemiju K, Akande GR. Fatty acid composition and amino acid profile of two freshwater species, African catfish (*Clarias gariepinus*) and tilapia (*Tilapia zillii*). African Journal of Food Agriculture Nutrition and Development. 2009; 9(1): 608-621.
22. Roslan J, Kamal SMM, Yunos KFM, Abdullah N. Nutritional and amino acid composition of red tilapia fish (*Oreochromis niloticus*). In: International Conference on Agricultural and Food Engineering for Life. 2012, 752-757.
23. Rubbi SF, Mujibar MAR, Jahan SS, Majeda B. Proximate composition and quality of some commercial species of fresh water fish. Journal of Regulatory Science 1987; 5:1-20.
24. Saini VP, Ojha ML, Gupta MC, Nair P, Sharma A, Luhar V. Effect of dietary probiotic on growth performance and disease resistance in *Labeo rohita* (Ham.) fingerlings. International Journal of Fisheries and Aquatic Studies 2014; 1(6):7-11.