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Evaluation of nutritional properties of some small indigenous fishes species in Bangladesh

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Abstract

Small indigenous fish species (SIS) are cheap and easily available sources of nutrition in Bangladesh due to plenty of water resources. The proximate and mineral composition of 10 diverse SIS have been investigated. *Amblypharyngodon mola* (Mola) exhibited the highest percentage of both protein (17.95±1.34 %) and lipid (6.28±0.75 %) indicating a potent small fish with higher nutritive value. The lowest quantity of protein (14.29±0.66 %) and lipid (1.54±0.34) experienced in Esomus danricus (Darkina) and Awaous grammepomus (Bele) respectively. *Channa punctata* (Taki) is quantified as highest (3.47±1.23 mg/100g) in ash content but Gonialosa manmina as lowest (1.49±1.02 mg/100g). The maximum concentration of Ca (289.70±0.68 mg/100g), Mg (182.48 ±0.43) and Fe (2.02±0.49) observed in *Chanda nama* (Nama chanda), *Channa punctata (Taki)* and *Batasio tengana* (Tengra) respectively. The result of our present study implies that the average nutritive values of SIS were adequate in quantities. Hence, increasing the SIS consumption in mass poor people of Bangladesh might be helpful to achieve their nutritional requirement.

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Introduction

Fish plays a significant role for animal proteins in the world. The world's population consume around 16 percent of animal protein which are derived from fishes and more than one billion people depend on fish as their main source of animal protein (FAO, 2000). As a potential source of animal protein, fish received widespread attention for essential nutrients of human diets (Arts *et al.,* 2001; Fawole *et al.,* 2007). Fish protein are easily digestible in nature and are important source of essential minerals. Minerals constitute the micronutrients, serve as the components of many enzymes and are necessary for all metabolic activities by which the human body acquires and utilized food to maintain health and physical activity (Allen and Gatlin,1996). The species attaining a maximum length of 25 cm are defined as small indigenous fish species (SIS) and especially in Bangladesh with plenty of water resources, small indigenous fishes are a valuable and easily available source of nutrition and serve as important way for the livelihoods of the rural poor people (Felts *et al.,* 1996).

Nevertheless, for ensuring the requirements of food regulations and commercial specifications, the measurement of proximate analysis such as protein contents, lipids, moisture contents and analysis of major minerals are necessary (Watermann, 2000). What is more, the information on the chemical composition of fish in respect to the nutritive value is important to compare with other source of animal protien, foods such as meat and poultry products (Stansby, 1954). There is some information on biochemical and nutritional composition of some freshwater fish species (Kamaluddin *et al.*, 1977; Gheyasuddin *et al.,* 1979). Despite of a large amount of fish protein consumption, there are a few reports on the nutritive or caloric values of SIS. Although, experimental studies were conducted previously on nutritional composition of SIS (Mazumder et el., 2008, Musa, 2009, Ahmed *et al.*, 2012) but the informative database on nutritive value of SIS in Bangladesh has not been formulated. As the ample of Bangladeshi people consume SIS in their daily diet, a tenable nutritional information of such fish species is indisputable. Therefore, our present study was aimed to getting informed about the nutritional composition of diverse SIS of Bangladesh in order to properly establish suggestive nutritional diets for mass people.

Materials and methods

Collection of samples

The experimental fishes were collected from the three different local fish markets (Kawran Bazar, Town Hall Bazar and Hatirpul Bazar) of Dhaka city. The samples were tightly packed in separate pre-sterile polyethylene bags following the aseptic collection of samples. Then the samples were placed in ice-box and were immediately transported to the Fish Technology Research Section of the Institute of Food Science and Technology (IFST) of Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhanmondi, Dhaka, Bangladesh where the entire experiment was carried out. Finally the average size of each fish species were recorded (table-1 and figure - 1).

Proximate composition analysis

Determination of moisture of the raw fishes were conducted following the AOAC method (AOAC, 2003) by which the raw fish samples were dried at elevated temperature and reported the loss in weight in terms of moisture by the following equation.

$$\text{Moisture content (\%)} = \frac{\text{Loss of weight}}{\text{Weight of sample taken}} \times 100$$

The crude protein of the fish was determined by Micro-Kjeldhal method (Pearson, 1999). Firstly, The percentage of nitrogen of fish samples were calculated and the percentage of protein in the samples were calculated by multiplying the percentage of N with an empirical factor 6.25.

$$\text{N (\%)} = \text{(Titration reading - blank reading)} \times \text{strength of acid} \times \frac{100}{5} \times \frac{100}{\text{Weight of sample}}$$

Protein content (%) = Total N (%) × 6.25

Total lipid content of fish samples was accomplished by Bligh and Dyer method (Bligh and Dryer, 1999) and calculated using following equation.

$$\text{Total lipid content (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample taken}} \times 100$$

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

The ash content of the fish samples were determined as the inorganic residues such as oxides, sulphates, silicates and chlorides left behind, in the dry muscle. The samples heated to the temperatures of 500-600 °C in a muffle furnace for about 3 hours. Afterwards, the percentage of ash content was calculated.

Determination of minerals

Three types of minerals were estimated in this study following AOAC guideline (AOAC, 2003). The calcium content was determined based on the precipitation of calcium oxalate and titration using 0.01N $KMnO_4$. The magnesium concentration was evaluated using calcium free filtrate (Obtained from the filtrate after precipitation of calcium as oxalate). Iron was determined by UV-visible spectrophotometer (Shimadzu -UV-1800, Shimadzu corporation, Japan) at a wavelength of 540 nm based on the fact that ferric iron gives a blood red color with potassium thiocyanate (KCNS). All of the mineral concentrations were reported as mg/100g of sample.

Statistical analysis

All the analyses were performed in three independent experiments for three samples each collected from different regions. The standard deviation as well as arithmetic mean of the triplicate samples were estimated . Data were analyzed and compared by analysis of variance (two factorial ANOVA). Probability level was fixed at $p<0.05$. Correlation coefficient (r) was calculated for the different parameters to observe their acceptance level.

Results and discussion

Proximate composition analysis

The result of our experiment reveals that the highest moisture content experienced in Awaous grammepomus (Bele) by 77.21±0.47 % whereas *Amblypharyngodon mola* (Mola) found to contain lowest amount of moisture by 72.29±0.28 (table- 2). Similar results obtained by previous studies (Kamal, 2007; Begum and Minar, 2012).

Table 1. List of collected small indigenous fishes species (SIS) along with their English name, scientific name and background of collection.

Sample (fish) Name			Collection history	
Local Name	English Name	Scientific Name	Place of collection	Average fish size (cm)
Punti	Puntio barb	*Puntius puntio*	Kawran Bazar, Dhaka	4-6
Mola	Mola carplet	*Amblypharyngodon mola*	Kawran Bazar, Dhaka	3-5
Kechhki	Yellowtail mullet	*Corica soborna*	Kawran Bazar, Dhaka	2-4
Koi	Climbing perch	*Anabas testudineus*	Kawran Bazar, Dhaka	9-12
Tengra	Assame batasio	*Batasio tengana*	Kawran Bazar, Dhaka	8-11
Taki	Spotted snakehead	*Channa punctata*	Town Hall Bazar, Dhaka	10-12
Nama chanda	Elongate glass-perchlet	*Chanda nama*	Town Hall Bazar, Dhaka	2-3
Bele	Scribbled goby	Awaous grammepomus	Town Hall Bazar, Dhaka	5-6
Chapila	Ganges river gizzard shad	Gonialosa manmina	Hatirpull Bazar, Dhaka	12-14
Darkina	Flying barb	Esomus danricus	Hatirpull Bazar, Dhaka	3-5

The percentage of protein in experimental fishes ranged among 14.29 to 17.95 whereas the highest protein content (17.95±1.34) found in *Amblypharyngodon mola* (Mola). The 14.29±0.66 % was the lowest amount of protein observed in Esomus danricus (Darkina) compared to other fishes (table- 2). The quantity of crude protein generally remain higher than all other nutrient compositions in the fish

(Azim *et al., 2012)*. Mazumder *et al*; *(*Mazumder *et al*; 2008) conducted an experiment of six indigenous small fishes of Bangladesh and reported that *Amblypharyngodon mola* (Mola) contained 18.46% of protein. We here in, found a supportive co-relation with the protein percentage of *Amblypharyngodon mola* (Mola) containing highest protein than other species.

Table 2. Proximate composition of collected SIS of Bangladesh.

Sample (fish) Name	Proximate composition (%)			
	Moisture	Protein	Lipid	Ash
Puntius puntio	76.19±0.34	*15.20*±1.57	2.01±0.91	3.06±0.13
Amblypharyngodon mola	72.29±0.28	17.95±1.34	6.28±0.75	1.78±0.35
Corica soborna	73.83±0.90	16.95±0.23	4.35±0.45	2.4±0.70
Anabas testudineus	72.60±0.17	*16.18*±0.13	5.31±0.37	3.02±1.12
Batasio batasio	76.49±1.67	14.37±0.54	4.46±1.65	2.29±1.27
Channa punctata	76.35±1.45	15.91±0.34	3.01±0.23	3.47±1.23
Chanda nama	75.12±0.23	17.31±0.37	3.88±0.69	1.59±0.38
Awaous grammepomus	77.21±0.47	16.21±1.76	1.54±0.34	2.06±1.33
Gonialosa manmina	76.34±0.26	15.09±1.03	4.90±0.78	1.49±1.02
Esomus danricus	75.97±0.24	14.29±0.66	5.33±0.72	2.37±0.56

The above values are the means of three replicates ±SD.

Table 3. Mineral composition form collected SIS of Bangladesh.

Sample (fish) Name	Mineral composition mg/100g		
	Ca	Mg	Fe
Puntius puntio	178.02±0.76	104.42±0.74	0.68±0.45
Amblypharyngodon mola	121.84±1.04	123.67±0.62	0.75±0.63
Corica soborna	174.89±0.17	89.35±1.42	0.59±0.65
Anabas testudineus	114.35±0.53	94.23±1.13	0.45±0.87
Batasio tengana	275.10±0.31	103.45±0.85	2.02±0.49
Channa punctata	167.23±0.54	182.48 ±0.43	0.86± 0.35
Chanda nama	289.70±0.68	303.1 ±0.49	1.85±0.25
Awaous grammepomus	164.47±0.72	97.44±0.86	0.43 ±0.46
Gonialosa manmina	124.48±0.42	88.34±0.38	0.78±0.57
Esomus danricus	145.56±0.58	102.12±0.32	0.82±0.49

The above values are the means of three replicates ±SD.

Comparatively, the lipid content however showed significant variability among the ten collected fish species (table- 2). The maximum total lipid percentage detected in *Amblypharyngodon mola* (Mola) by 6.28±0.75 percent and fewest by 1.54±0.34 in Awaous grammepomus (Bele). Begum and Minar (Begum and Minar, 2012) analyzed the biochemical composition small and large carp fishes of Bangladesh where they found lipid ranged around 3-4% . The similar concentration of lipid in small indigenous fish in Bangladesh found by previous studies (Ahmed *et al.*, 2012). However, *Amblypharyngodon mola* (Mola) exhibited the highest percentage of both protein (17.95±1.34) and lipid (6.28±0.75) indicating a potent SIS with higher nutritive value. Previous studies (Mazumder *et al.,* 2008, Roos *et. al.,* 2007) on *Amblypharyngodon mola* (Mola) also refers such decent nutritional enrichment of this species in Bangladesh and they suggested to exploit this species to combat malnutrition among poorer children of Bangladesh.

The three fish species such as, *Puntius puntio* (Punti) *Anabas testudineus* (Koi) and *Channa punctata* (Taki) contained more than 3% of inorganic residue or ash remaining other seven species with lower than 3%. The highest amount of ash obtained in *Channa punctata* (Taki) by 3.47±1.23 mg/100g. The range of ash concentration (1.49 to 3.47) in our study remained fewer than large fishes, a report published couple of scientists Mazumder *et al.,* 2008; Minar *et al.*, 2012) that the lower ash concentration in SIS might be due to the minimal amount of bone and muscle.

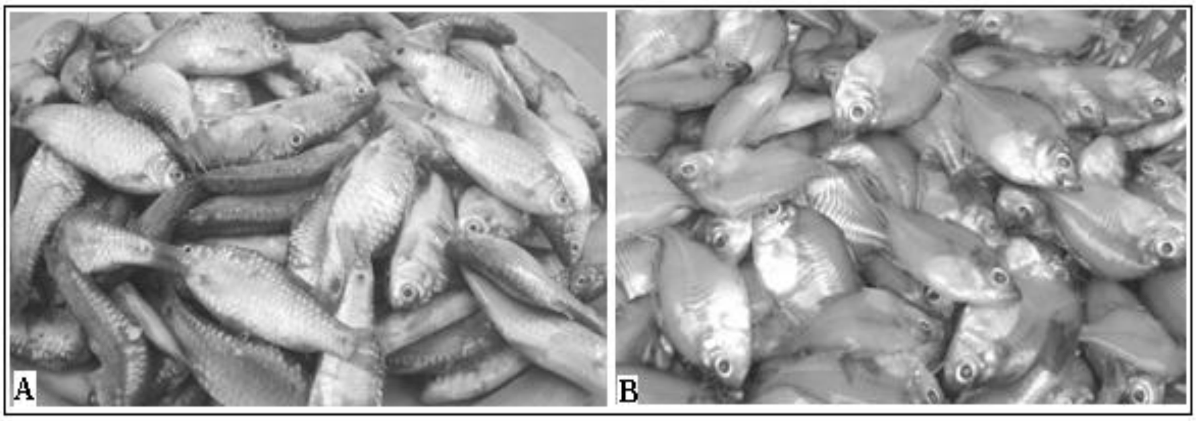

Fig. 1. Collected experimental fish samples : A) *Puntius puntio* (Punti) and B) *Chanda nama* (Nama chanda).

Determination of minerals

Minerals evaluation from experimental SIS showed that the maximum content of Ca obtained in *Chanda nama* (Nama chanda) by 289.70±0.68 mg/100g followed by *Batasio tengana* (Tengra) at 275.10±0.31 mg/100g (table-3). *Anabas testudineus* (Koi) found to contain lowest Ca in compared to other species. Our results of *Puntius puntio* with 178.02±0.76 mg/100g Ca more or less coincides with the findings of Musa and Nurnadia (Musa, 2009; Nurnadia *et al.,* 2013). In Bangladesh, generally SIS are eaten as whole including the bones, and consequently contributing rich calcium source where large fish do not contribute in calcium intake because of their bones are discarded as waste and not eaten (Roos, 2001). Therefore, insisting SIS consumption in the daily diet of Bangladeshi people would significantly meet their daily Ca requirement.

However, the result of Mg comparatively showed more variability than the other minerals (table-3). exhibiting highest (182.48 ±0.43 mg/100g) in *Chanda nama* (Nama chanda) and lowest (88.34±0.38) in Gonialosa manmina (Chapila). The variability of mineral contents might be due to several factors such as species, individuals, sampling period as well as many other physical and environmental conditions (Roos, 2001; Yilmaz *et al.,* 2010; Nurnadia *et al.,* 2013). Owing to the higher quantity of Mg (182.48 ±0.43) *Channa punctata* might play a pivotal role to reach the Mg demand in human body because adequate intake of Mg having some useful roles in metabolism such as; regulation of enzyme systems, maintenance of bone health and acting as a part of protein synthesis in all cells of soft tissues (Oksuz *et al.,* 2011, Whithney *et al.,* 2008)

The concentration of Fe remained as far less than the other minerals analyzed (table-3). As Fe is a trace element so it is to be present in lower quantities and the recommended daily intake of Fe is 8-15mg (Oksuz *et al.,* 2011). Iron is such a component which is inevitably important for the formation of haemoglobin, necessary to form red blood cells (Moller *et al.,2005*; Oksuz *et al.,* 2011). The maximum concentration of Fe (2.02±0.49) obtained in *Batasio tengana* (Tengra) and this species may be considered as a good supplemental source of Fe. We herein, quantified three minerals form experimental samples but the other minerals such as sodium (Na), zinc (Zn), phosphorus (P) and iodine (I) however, have not been investigated. Future studies are needed to explore the quantities of such minerals to establishing a standard nutritional database of SIS in Bangladesh.

Conclusion

The result of our present study implies that despite of some little variations, SIS in Bangladesh exhibited adequate quantities of protein, fat, ash and minerals. The enormous number of people in Bangladesh are poor and unable to afford large fish to their daily diet due to hickey price. SIS on the other hand, are cheap and easily available. Consequently, it can be suggested that small fish species might be a good alternative in mass poor people of Bangladesh to meet their daily nutritional requirement in improving their health status.

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