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Protein and Mineral Contents in Some Fish Species Available in the Brahmaputra River of Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MSAE collected samples, performed analysis and wrote the first draft of the manuscript. Authors HMZ and QFQ designed the study, supervise the work, performed the statistical analysis and corrected the final draft of the manuscript. Author MSR helped in manuscript preparation. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted in the laboratory of the Department of Agricultural Chemistry, Bangladesh Agricultural University (BAU), Mymensingh to determine protein and major mineral nutrients (viz. Ca, Mg, Na, K, P, S and Fe) in different available fish species of the Brahmaputra River of Bangladesh. Total 32 fish samples of 15 fish species were collected from three locations of the river during November 2017. The highest amount of Ca (2.00%), Mg (4.17%), Na (0.41%), K (3.24%), P (0.17%), S (0.129%) and Fe (226.9 mg kg^{-1}) were obtained from *chela* (*Salmophasia bacaila*), *chanda* (*Chanda nama*), *chingri* (*Macrobrachium sp.*), *shingi* (*Heteropneustes fossilis*), *bele* (*Glossogobius giuris*), *baim* (*Macrognathus aculeatus*) and *mola* (*Amblypharyngodon mola*), respectively and the sequence of the mineral nutrients was K > Mg > Ca > Na > P > S > Fe. The study results revealed that 100% of daily Ca requirement can be replenished by consuming 100 g fish flesh portion of the *chela* (*Salmophasia bacaila*)/ *chingri* (*Macrobrachium sp.*)/ *bele* (*Glossogobius giuris*). Similarly, among the 15 fish species, 11 and 12 species alone can contribute 100% of Mg and K requirement for human by taking 100 g fish flesh, respectively. The maximum content of N (3.88%) was obtained from *shingi* (*Heteropneustes fossilis*), while the

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minimum (2.81%) was recorded from *mola* (*Amblypharyngodon mola*). The protein content among the fish samples varied between 17.6-24.3% with a mean value of 21.2%. Finally, the study results concluded that the common fishes available in the Brahmaputra River are a good source of protein and major mineral nutrients, which contributes in nutrition to the local people of the country.

Keywords: Protein; minerals; fish species; the Brahmaputra River; Bangladesh.

1. INTRODUCTION

Fish is commonly found in natural water bodies and well known for its superior nutritional quality with a very good supply of essential minerals [1-3]. Furthermore, fishes found in river are very popular in Bangladesh. A few years ago, fishes available in natural water bodies were the major consumed protein sources of people in this country, as they were easily accessible, less expensive, culturally acceptable and can be purchased in small quantities [4]. But nowadays, discharge of industrial wastewater/ effluents into river, canal or other surface water bodies without any treatment is the common scenario in Bangladesh [5-9]. These wastewater/ effluents contained metals and other toxic substances [10-14], which often lead to decrease in number of fish species in rivers and canals of Bangladesh.

However, mineral elements are essential for the normal maintenance of the human body, and these elements are mainly provided to the body through dietary intake. The human being may suffer from diseases like anaemia, osteoporosis, goitre, stunted growth and genetic disorders due to insufficient dietary intake of minerals [15-17]. The World Health Organisation reported that about 2 billion of the world's population is suffering from mineral and vitamin deficiencies and the majority of these are in the third world countries [18].

Surface water fishes are a great resource which is easily accessible to low income people and vulnerable communities prone to nutrient deficiency diseases. Nowadays mineral supplementation and food fortification are the strategies used for mitigating nutritional deficiencies but unsustainable especially for developing countries [15]. On the other hand, food based strategies are considered very much effective as well as sustainable for mitigating mineral and nutritional deficiencies. Fish can play a big role for this strategy because it can provide a variety of nutrients, including essential elements to the body [3]. Minerals commonly found in fish flesh are sodium, potassium, calcium, magnesium, phosphorus, sulphur, iron, zinc and iodine [19-20]. These mineral elements participate in several biochemical reactions, viz. calcium, magnesium and phosphorus are crucial in the formation of bones and teeth; sodium and potassium work together in the transmission of nerve impulses and keeping electrolyte balance; zinc is mostly found as a cofactor in enzyme reactions, iron forms part of the haemoglobin molecule which transport oxygen around the body [21]. But there are published reports that the nutritional quality of fish depends on their species, age, size, feed and water quality [22-25].

The Brahmaputra River is one of the major rivers in Bangladesh, which provide a variety of different fish species to the local people of the country. In the meantime, a total of 67 finfish species including 63 indigenous and 4 exotic/alien species have been recorded from the Brahmaputra River belonging to 46 genera, 24 families and 8 orders [26]. Considering the fact stated above, this study was undertaken to quantify the protein and mineral contents in common fish species found in the Brahmaputra River and identify the species with high protein and mineral contents which can be recommended for consumption in combating mineral and protein deficiencies of the people in Bangladesh.

2. MATERIALS AND METHODS

2.1 Study Area

The Brahmaputra River is an antecedent, snow fed, and large trans-Himalayan river originating in southern Tibet (China). Geologically, it is the youngest of the major rivers of the world and unique in many respects. It runs for a length of 2880 km and its river system drains parts of China, Bhutan, India and Bangladesh [27]. However, total of 32 fish samples from 15 fish species were collected from three locations (viz. *Bhabakhali bazar*, BAU campus and Mymensingh town) of the Brahmaputra River. Details about the fish species along with their sampling locations are presented in Table 1 and Fig. 1, respectively.

2.2 Collection of Fish Samples

A reasonable amount (500 g to 1.0 kg) of fish samples were purchased directly from the aforementioned locations of the river system, and requisite amount of samples were brought to the laboratory of the Department of Agricultural Chemistry, BAU, Mymensingh and processed for subsequent experiment.

2.3 Processing of Fish Samples

After collection, scales of fish samples were removed and cleaned first. Then the fish samples were separated into edible part and non-edible part. After separation, edible part of fish samples were sun dried for 2 days, and then the samples were oven dried at 50-60^{0}C for another 2-3 days until a constant weight was obtained. After drying, the samples were ground well with the help of mortar and pestle, and then the powdered samples were preserved in polythene bags with appropriate marking for further chemical analyses.

2.4 Extraction of Fish Samples

Powdered fish samples were used to prepare extract for the determination of different mineral nutrients. Extract was prepared by wet oxidation method using di-acid mixture [28]. In this method, approximately 0.5 g of finely ground samples were taken into a 250 mL conical flask and 5 mL of di-acid mixture (HNO_3:$HClO_4$ = 2:1) was added to it. Then the flask was placed on an electric hot plate for heating at 180-200ºC temperature until the solid particles disappeared and white fumes were evolved from the flask. Then, it was cooled at room temperature, washed with distilled water and filtered into 100 mL volumetric flask through filter paper (Whatman No. 1). Finally, the volume was made up to the mark with distilled water and preserved for the determination of major mineral nutrients in the fish samples.

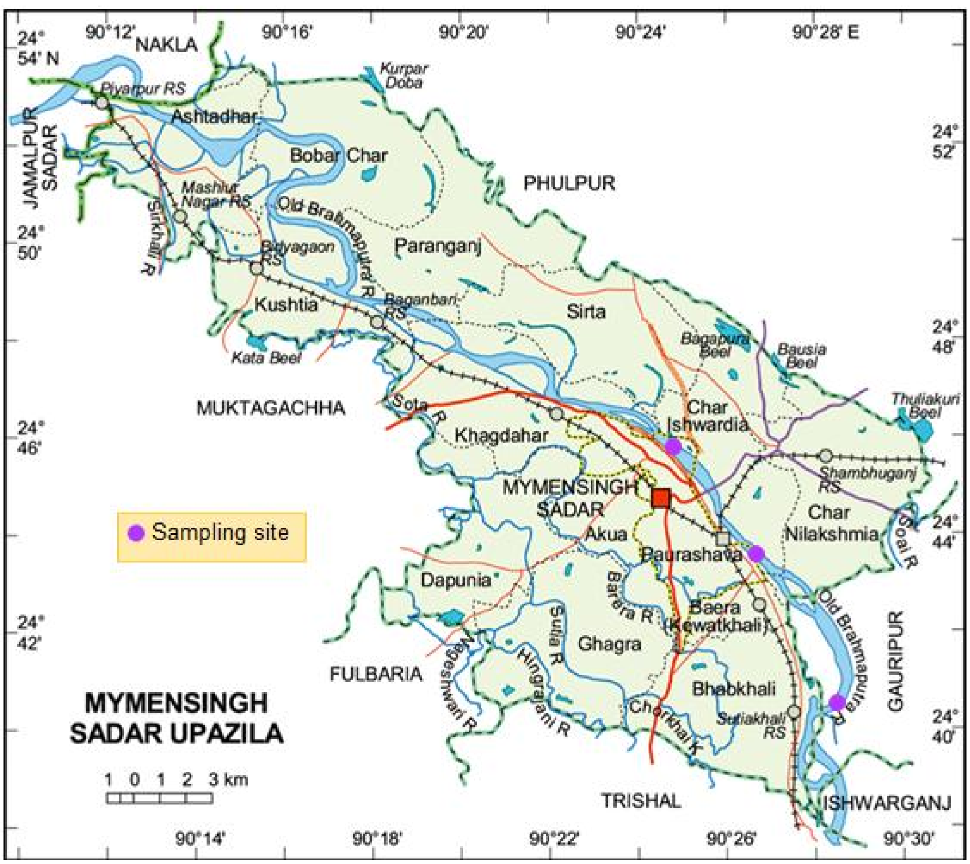

Fig. 1. Map shows the sampling sites of collected fish samples from the Brahmaputra River of Bangladesh

Table 1. Details of fish samples collected from three locations of the Brahmaputra River, Bangladesh

SL. No.	Bengali name	English name	Scientific name	Sampling location*			Total
				Bhabakhali bazar	**BAU campus**	**Mymensingh town**	
1.	*Punti*	Ticto barb	*Puntius ticto*	1	1	1	3
2.	*Tengra*	Striped dwarf catfish	*Mystus vittatus*	-	1	1	2
3.	*Bele*	Tank goby	*Glossogobius giuris*	1	1	1	3
4.	*Bangna*	Reba	*Labeo ariza*	1	1	-	2
5.	*Baim*	Zig-zag eel	*Macrognathus aculeatus*	-	1	1	2
6.	*Shingi*	Stinging catfish	*Heteropneustes fossilis*	-	1	1	2
7.	*Kalibaush*	Orange-fin labeo	*Labeo calbasu*	1	-	1	2
8.	*Mola*	Mola carplet	*Amblypharyngodon mola*	1	1	-	2
9.	*Chela*	Silver razor-belly minnow	*Salmophasia bacaila*	1	-	1	2
10.	*Kaikka*	Garfish	*Xenentodon cancila*	1	-	1	2
11.	*Meni*	Gangetic leaffish	*Nandus nandus*	1	-	1	2
12.	*Chanda*	Elongate glassy perchlet	*Chanda nama*	1	-	1	2
13.	*Chingri*	Prawns or shrimps	*Macrobrachium sp.*	1	-	1	2
14.	*Guizza* or *Guizza ayre*	Giant-river catfish	*Sperata seenghala*	1	-	1	2
15.	*Hiralo* or *Murari*	Carplet	*Aspidoparia murar*	-	1	1	2
		Total		**11**	**8**	**13**	**32**

** Number in the column indicates type of fish species present in that particular location*

2.5 Determination of Nitrogen and Protein

Total nitrogen content of the fish samples was determined by Kjeldahl method by digestion with concentrated H_2SO_4 and digestion mixture (K_2SO_4:$CuSO_4$:Selenium powder = 100:10:1) and then distilling with 40% NaOH. The ammonia distilled over was absorbed in boric acid indicator and titrated against 0.05N H_2SO_4 [29]. The total N (%) in edible parts of fish sample was calculated by using the following formula-

$$\%\mathrm{N} = \frac{(\mathrm{T} - \mathrm{B}) \times \mathrm{N} \times 1.4}{\mathrm{W}}$$

Where, T = Actual titration reading (mL); B = Blank titration reading (mL); N = Normality of H_2SO_4 and W = Sample weight in g. The crude protein (%) was calculated by multiplying the total nitrogen (%) with a factor of 6.25.

2.6 Determination of Major Mineral Elements

Among the major mineral nutrient elements, Ca and Mg were determined by titrimetrically, P and S were measured spectrophotometrically (660 and 425 nm absorbance wavelength, respectively; T60 UV-Visible Spectrophotometer, PG Instrument, UK), and Na and K were estimated by flame photometrically (589 and 766 nm emission wavelength, respectively; 0.2 ppm limit of detection; Jenway PFP7, Flame Photometer, UK) [28]. Determination of Fe in the fish extracts was done by atomic absorption spectrophotometer (AAS) using a Fe hollow cathode lamp operating at 248.3 nm as the radiation source and the lamp current was set at 15 mA. The instrumental parameters were adjusted according to the manufacturer's recommendations.

2.7 Data Recorded and Statistical Analysis

Data on protein and different mineral element content of fish samples were measured thrice and the mean value was recorded for presentation. Finally, obtained data were analysed statistically with the help of computer package M-STAT. Single factor ANOVA at $P \leq 0.05$ significant level was applied to compare concentrations of minerals and proteins among the fish species.

3. RESULTS AND DISCUSSION

3.1 Mineral Nutrients Status in Different Fish Species

3.1.1 Calcium (Ca)

Calcium is an essential macronutrient element, which is important for bone formation. Fishes, particularly small fishes are known to be a good source of this mineral [3-4,30]. The minimum and maximum concentration of Ca in fish samples were 0.16% in *shingi* and 2.00% in *chela*, respectably where the mean of Ca concentration was 0.80% (Fig. 1). The Ca concentration in fishes was in the sequence of *chela* > *chingri* > *bele* > *meni* > *kaika* = *bangna* > *punti* > *chanda* = *baim* = *guizza ayre* > *hiralo* > *kali baush* > *tengra* > *mola* = *shingi*. The recommended daily intake (RDI) of calcium for adults is 1000-1300 mg [18], which can be replenished by taking 100 g fish flesh of any one species among the *chela* (*Salmophasia bacaila*), *chingri* (*Macrobrachium sp.*) and *bele* (*Glossogobius giuris*). For the poor households in Bangladesh, cereals contributed 27.3% of the total Ca intake followed by fish (21.8%), vegetables (14.0%), and milk and dairy products (10.6%). In case of non-poor households, the contribution of cereals, fish, vegetables, and milk and dairy products was 27.3%, 21.7%, 14.9%, and 10.6% of the total Ca intake, respectively [31]. Present study results revealed that in most cases higher amount of Ca was present in different available fish species collected from the Brahmaputra River of Bangladesh compared to past studies in different countries of the world and FAO measured concentrations (Table 2). The higher calcium concentrations obtained in this study may be attributed from higher levels of calcium in their feeds, and therefore more trophic transfer and accumulation of this mineral in fish flesh. However, it is also suggested that small fish with bones may be an important source of Ca in human diets [30].

3.1.2 Magnesium (Mg)

Magnesium content in different available fish species collected from the Brahmaputra River of Bangladesh ranged from trace to 4.17% (Fig. 2). The highest amount of Mg was obtained from *chanda* (4.17%) followed by *mola* (2.54%), *chela* (2.52%) and *chingri* (1.59%), which may be a very good source of Mg for human nutrition. On the other hand, trace amount of Mg was obtained from *baim* and *kaikka* fishes. The recommended daily intake of magnesium for adults is 220-260 mg [18]. So, it can be inferred from this result that 11 fish species (except *tengra, guizza ayre, baim* and *kaikka*) can contribute 100% of this requirement by taking 100 g fish flesh portion. Comparison to other past studies, the present work obtained much higher magnesium

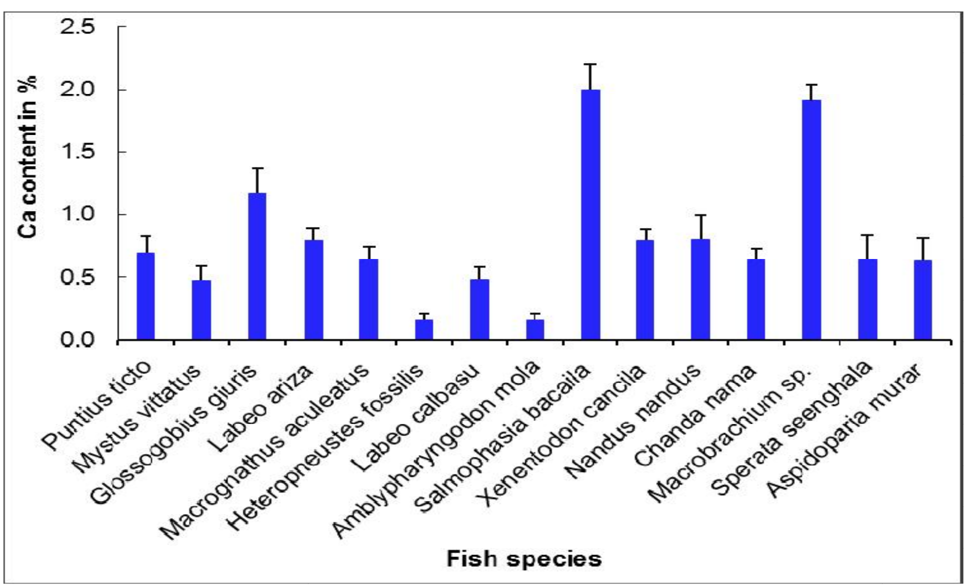

Fig. 2. Calcium content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

Table 2. Comparison of mineral concentrations range (mg 100 g^{-1}) in fresh water fishes of this work with past studies in abroad

Mineral element	Lagoon in USA[a]	River in Pakistan[b]	Lake in Ethiopia[c]	Lagoon in Botswana[d]	Lake in Poland[e]	River in Sudan[f]	Rivers in India[g]	Present study	FAO[h] conc. in fish muscles	RDA (mg/day) for Indians[i]
Ca	760-2200	33-1080	124-981	413-1290	53-103	107-588	220-2023	160-2000	19-881	600-1200
Mg	27-140	81-156	60-81	34-48	84-143	68-75	74-120	5-4170	4.5-452	540-1002
Na	36-400	85-163	163-210	86-145	148-328	180-280	87-107	170-410	30-134	1100-3300
K	nd	282-371	1121-1728	245-443	1429-2387	954-1210	24-132	320-3240	19-502	1875-5625
P	nd	969-1730	25-56	435-1375	1047-1261	727-935	nd	60-170	68-550	600-1200
S	nd	nd	nd	nd	nd	nd	nd	95-129	130-257	nd
N	nd	11987-12736	2397-2760	nd	nd	9568-12656	958-4198	2810-3880	2400-3200	nd
Fe	2.3-9.0	2.5-7.4	1.6-2.6	1.7-6.4	0.8-1.1	1.7-6.1	7.9-24.7	0.04-22.7	1.0-5.6	17-35

[a](USA)= Moeller et al. [36]; [b](Pakistan)= Jabeen et al. [37]; [c](Ethiopia)= Teame et al. [38]; [d](Botswana)= Mogobe et al. [24]; [e](Poland)= Luczyiska et al. [39]; [f](Sudan)= Mohamed et al. [40]; [g](India)= Romharsha and Sarojnalini [41]; [h]= FAO [34]; [i]= RDA [42]; nd= not determined.

content in most of the fish species (Table 2). The concentration of Mg in the muscles of perch from a Siberian pond (Russia) was 136 mg in 100 g^{-1} dry weight [32]. The mean value of Mg in fish samples ranged from 29-41 mg 100 g^{-1} [33] and 36.4 mg 100 g^{-1} [22]. Similarly, present study results also revealed that out of 15 fish species, 12 samples contained higher amount of Mg compared to past studies conducted in different countries of the world (Fig. 2 and Table 2). This could be due to the difference of species, seasons, area of catch, feed and many other physical and environmental conditions of the area.

3.1.3 Sodium (Na)

Sodium is good for muscle functions and electrolyte balancing but it is not usually a problem in mineral deficiencies as it is frequently used to salt food [21]. Sodium content in different available fish species collected from the Brahmaputra River of Bangladesh varied from 0.17-0.41% with a mean value of 0.26% (Fig. 3), which was more than twice as recommended by FAO (30-134 mg 100 g^{-1}) [34]. The highest amount of Na was obtained from *chingri* (0.41%) followed by *bele* (0.33%) and *chanda* (0.32%), which are a good source of Na for human nutrition. On the other hand, the lowest amount of Na was obtained from *baim* and *bangna* fishes. The muscle tissues of three species of fishes contained 381 mg Na 100 g^{-1} collected from the fresh water of Dhanmondi Lake in Bangladesh [35], which is comparable to the present study results. However, the results were at the higher end compared to some studies carried out past in freshwater fishes of other countries like USA (36-400 mg 100 g^{-1}), Pakistan (85-163 mg 100 g^{-1}), Ethiopia (163-210 mg 100 g^{-1}), Botswana (86-145 mg 100 g^{-1}), Sudan (180-280 mg 100 g^{-1}), India (87-107 mg 100 g^{-1}) and Poland (148-328 mg 100 g^{-1}). Furthermore, the Na contents obtained by this study were also higher compared to FAO reported concentrations in fish muscles (Table 2).

3.1.4 Potassium (K)

Potassium plays also an important role like Na for muscle functions, transmission of impulses in the nerves and sugar metabolism. The highest concentration of potassium among different available fish species collected from the Brahmaputra River of Bangladesh was obtained from *shingi* fish (3.24%) and the lowest was in *chanda* fish (0.32%) (Fig. 4). The K concentration in fishes was in the sequence of s*hingi* > *tengra* > *bangna* > *bele* > *kali baush* > *hiralo* > *guizza ayre* > *meni* > *punti* > *kaika* > *chingri* > *baim* > *mola* > *chela* > *chanda*. However, some studies carried out past in freshwater fishes in Turkey (321-441 mg 100 g^{-1}) [21], China (301-402 mg 100 g^{-1}) [43], Pakistan (282-371 mg 100 g^{-1}), Botswana (245-443 mg 100 g^{-1}) and India (24-132 mg 100 g^{-1}) were at the lower end compared to this study results (Table 2). But the studies from Ethiopia, Sudan and Poland obtained much higher K concentration levels (1121-1728, 954-1210 and 1429-2387 mg 100 g^{-1}, respectively) which is at par with the present study (Table 2). The recommended daily allowance (RDA) of K for males aged between 25-50 years is 800 mg [18]. So, the consumption of 100 g of this river fish flesh will provide 40-100% of the daily requirement of potassium, assuming cooking will not affect the quantity of the mineral.

3.1.5 Phosphorus (P)

Phosphorus as phosphate is an essential nutrient involved in many physiological processes, such as the cell's energy cycle, regulation of the whole body acid-base balance, as a component of the cell structure (as phospholipids), in cell regulation and signaling, and as a major constituents of

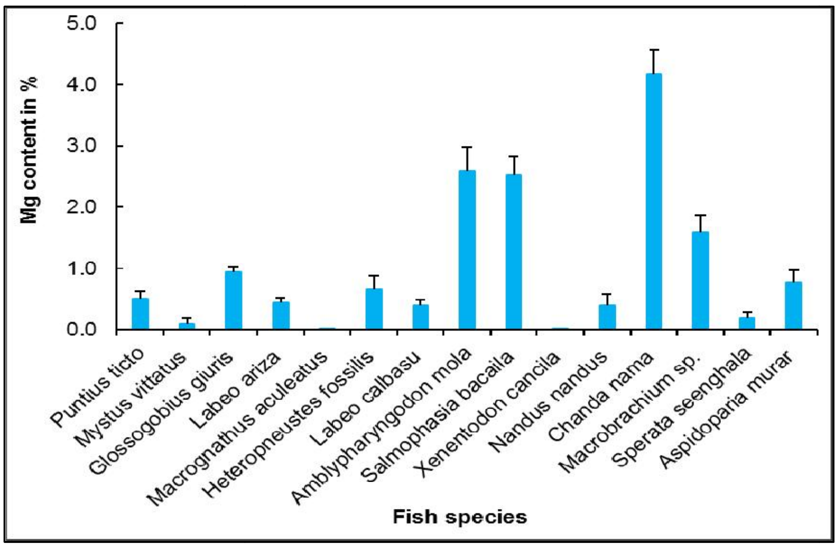

Fig. 3. Magnesium content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

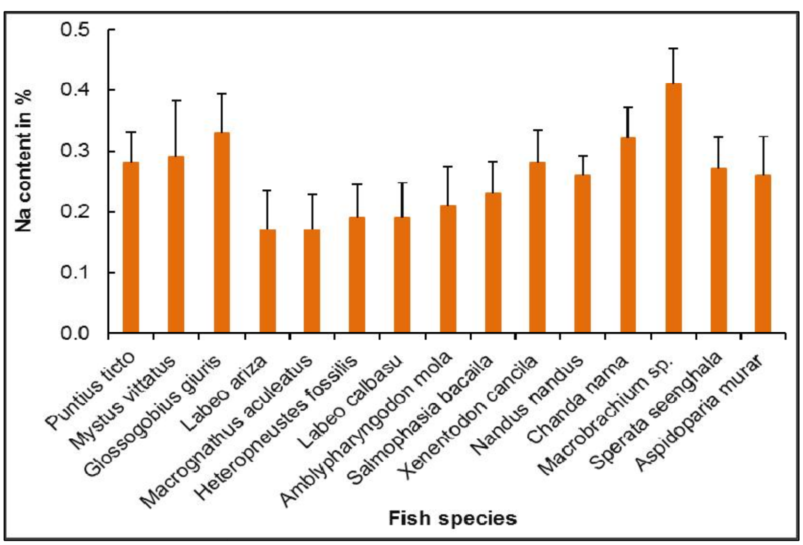

Fig. 4. Sodium content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

bones and teeth [44]. The maximum concentration of P in available fish species collected from the Brahmaputra River of Bangladesh was 0.17% in *bele* fish followed by *mola* (0.16%), *chela* (0.15%), *hiralo* (0.15%) and *chanda* (0.15%). On the other hand, the minimum P concentration was 0.06% in *baim* fish (Fig. 5). The P concentration range obtained in this work was within the FAO range of 68-550 mg 100 g^{-1} sample, but the range was lower compared to previous studies conducted in Pakistan (969-1730 mg 100 g^{-1}), Botswana (435-1375 mg 100 g^{-1}), Poland (1047-1261 mg 100 g^{-1}) and Sudan (727-935 mg 100 g^{-1}) for freshwater fishes. On the contrary, the range was higher compared to the past study conducted in Ethiopia (25-56 mg 100 g^{-1}) for freshwater fishes (Table 2). However, this variation of P content in different fish samples could be due to the difference of species, seasons, area of catch and many other physical and environmental conditions of the area.

3.1.6 Sulphur (S)

The minimum S content (0.095%) in available fish species collected from the Brahmaputra River of Bangladesh was obtained from *kali baush* fish, while the maximum (0.129%) was found in *baim* fish (Fig. 6). Sulphur concentration range obtained in this study was at the lower end of FAO reported range of 130-257 mg 100 g^{-1} sample (Table 2). Similarly, the range was also lower compared to the past study conducted in Bangladesh (160 to 300 mg 100 g^{-1}) for some fish species [45]. However, such variations in mineral concentrations in different fish samples could be due to the difference of species, seasons, area of catch and many other physical and environmental conditions of the area.

3.1.7 Iron (Fe)

Iron (Fe) is the most abundant metal in the human body. Body Fe content is approximately 3-4 g, which almost corresponds to a concentration of 40-50 mg of Fe per kilogram of body weight [46]. Iron deficiency causes anaemia, which is one of the commonest mineral deficiency diseases in Africa with 206 million people at risk [47]. The rich sources of dietary Fe include red meat, liver, lentils, beans, peas, nuts, seeds, poultry, fish, seafood, leafy vegetables, watercress, tofu, chickpeas, black-eyed peas, blackstrap molasses, fortified bread, and fortified breakfast cereals [48]. The average concentration of Fe in different fish samples collected from the Brahmaputra River was 44.79 mg kg^{-1}. The minimum and maximum concentrations of Fe in fish samples were 0.40 and 226.92 mg kg^{-1}, respectively (Fig. 7). The highest amount of Fe was obtained from *mola* followed by *chingri* and *chela*

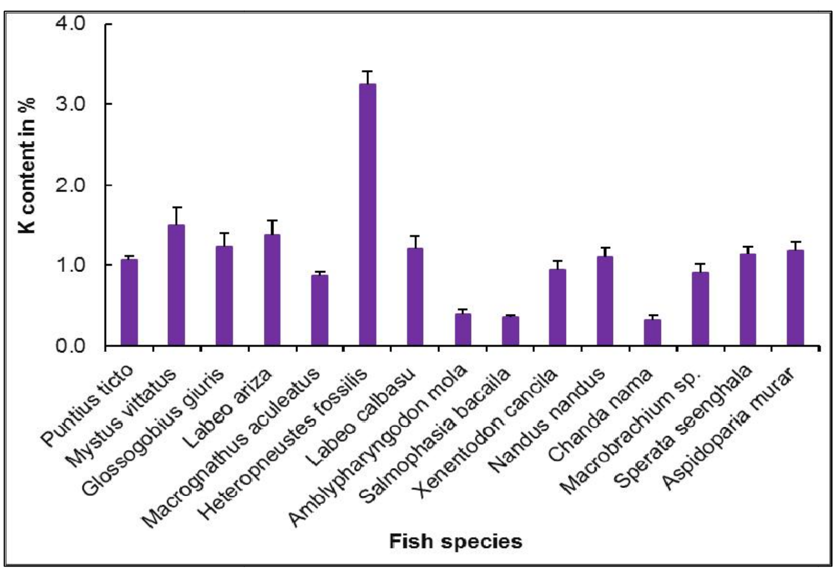

Fig. 5. Potassium content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

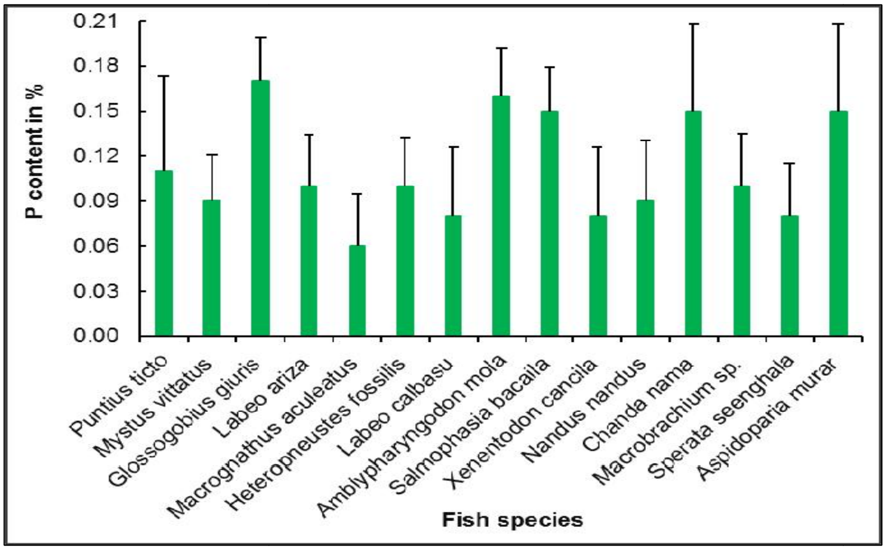

Fig. 6. Phosphorus content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

that might be due to contribution of fish bone. It is worth mentioning here that these three fish samples were processed for digestion along with exoskeleton and bone. Furthermore, in most cases these fish species also consumed by the people along with exoskeleton and bone. The mean Fe contents in muscle of red mullet ranged from 8.93-49.30 mg kg^{-1} (wet wt.), whereas levels in the liver of the same species ranged from 83.90-889.00 mg kg^{-1} (wet wt.). The differences between two tissues were not that significant in whiting and found 21.90-160.00 mg kg^{-1} (wet wt.) in the muscle and 49.90-328.00 mg kg^{-1} (wet wt.) in the liver tissues [49].

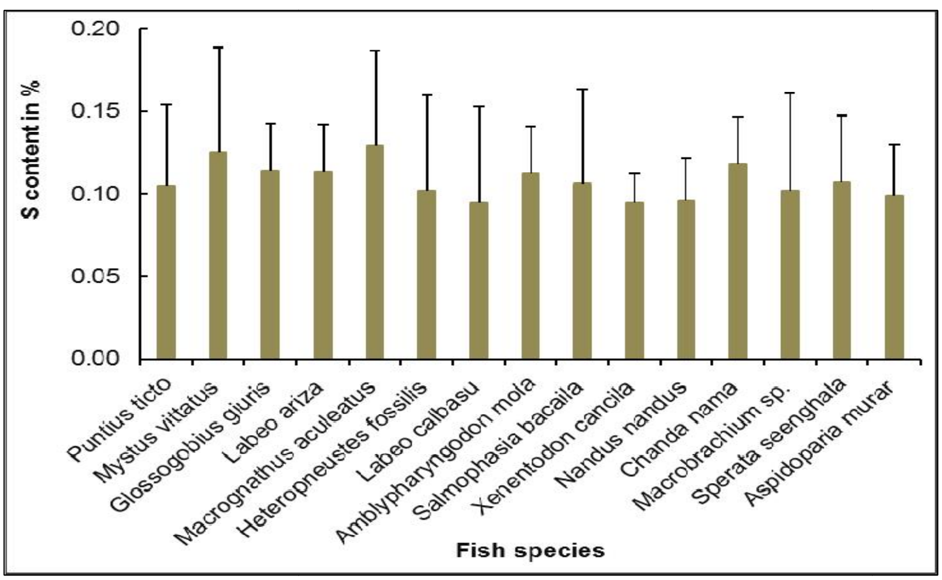

Fig. 7. Sulphur content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

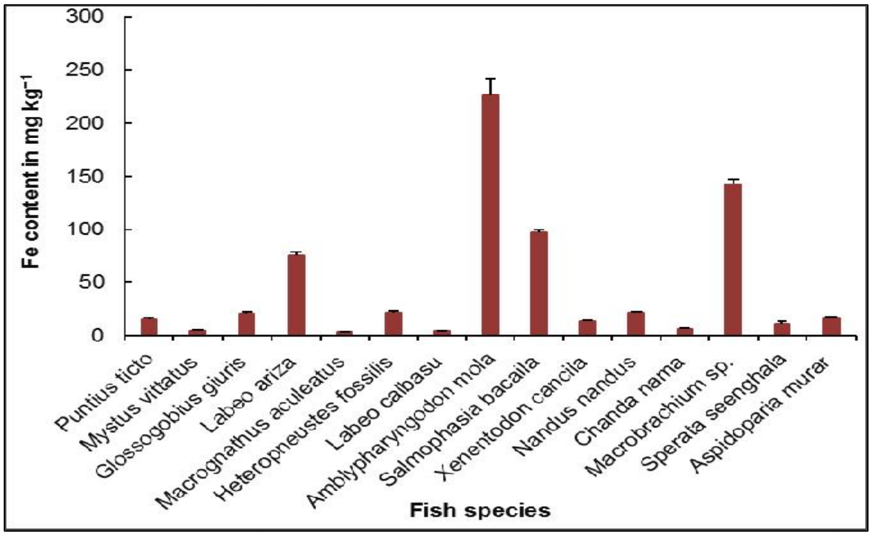

Fig. 8. Iron content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

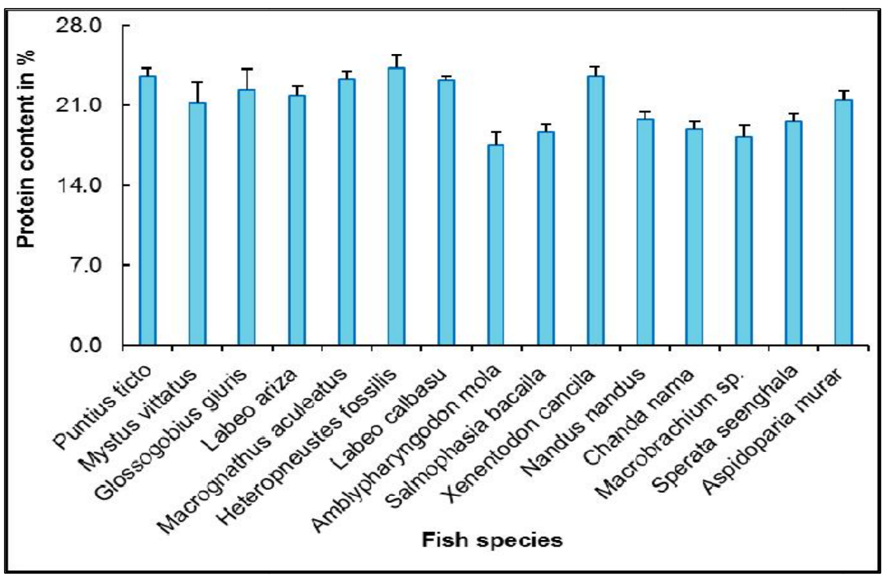

Fig. 9. Protein content (%) in different fish species collected from the Brahmaputra River of Bangladesh. Each value is the mean for three replicates, and vertical bars indicate the standard errors

3.2 Nitrogen and Protein Status in Different Fish Species

The highest concentration of N among different available fish species collected from the Brahmaputra River of Bangladesh was obtained from *shingi* fish (3.88%) and the lowest was in *mola* fish (2.81%). The mean N concentration among the fish samples was 3.39%. The N content in fishes was in the sequence of *Shingi* > *kaikka* > *punti* > *baim* > *kali baush* > *bele* > *bangna* > *hiralo* > *tengra* > *meni* > *guizza ayre* > *chanda* > *chela* > *chingri* > *mola*. However, the dry matter content of different fish species collected from fresh water examined averaged 2.17±2.93% nitrogen [50]. Nitrogen content in different available fish species collected from the Brahmaputra River was comparatively higher, which contributed to higher protein content.

Fish protein provides a good combination of amino acids which is highly suited to man's nutritional requirements and compares favourably with that provided by meat, milk and eggs. Fish protein showed a high biological value, comparable with that of milk, as shown by the similar values for apparent N absorption and N retention at each protein level [30]. In addition aquatic protein is highly digestible and rich in several peptides and essential amino acids that are limited in terrestrial meat proteins, as for example methionine and lysine [51]. The maximum amount of protein in available fish species collected from the Brahmaputra River of Bangladesh was 24.27% in *shingi* fish followed by *kaikka* (23.59%), *punti* (23.52%), *baim* (23.31%) and *kali baush* (23.19%). On the other hand, the minimum amount of protein (17.53%) was obtained from *mola* fish. The amount of protein in fish muscle is usually somewhere between 15-20%, but values lower than 15% or as high as 28% are occasionally met with in some species. However, the amount of protein obtained by this study was within the range.

4. CONCLUSION

Present study provides data on major mineral nutrients viz. Ca, Mg, Na, K, P, S and Fe in different fish samples collected from the Brahmaputra River of Bangladesh. Study results revealed comparatively higher amount of Ca, Mg, Na and K in different available fish species collected from the river compared to some other studies carried out in different countries of the world for freshwater fishes. The study results found that 3, 11 and 12 fish species alone can contribute 100% of Ca, Mg and K requirement by taking 100 g fish flesh, respectively. On the other hand, average consumption of 100 g of this river fish flesh will provide 80-100% of the daily requirement of Ca, Mg and K, assuming cooking will not affect the quantity of the minerals. Thus the study inferred that fishes of the Brahmaputra River are a good source of protein and minerals, which contributes in nutrition to the local people of the country. The information generated from this study could be used as a baseline data for developing food composition database of the country. Finally, the study concluded that the variation of major mineral nutrient contents in different fish samples collected from the Brahmaputra River due to the difference of species, age, area of catch, feed, quality of water and many other physical and environmental conditions of the area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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