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Nutrient Composition of Small Indigenous Fish Species (SIS) from Homestead Ponds of Noakhali Coast, Bangladesh

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ABSTRACT

Estimating the nutrient composition of edible fish is the most important aspect of fish nutrition. Ten small indigenous species (SIS) were collected from the homestead ponds of the Noakhali coast, Bangladesh, to estimate and compare their nutrient composition. The major nutrient compositions (like protein, fat, moisture, ash, and carbohydrate) of raw fish were estimated using the Association of Official Analytical Chemists methods. The protein content (%) of *Colisa fasciatus*, *Amblypharyngodon mola*, *Puntius ticto*, *Puntius sarana*, *Macrognathus aculeatus*, *Mystus tengara*, *Anabas testudineus*, *Heteropneustes fossilis*, *Channa punctatus*, and *Clarias batrachus* were found to be 14.51±1.2, 14.57±1.19, 14.39±1.23, 16.31±0.48, 17.3±1.74, 13.73±1.34, 13.95±0.43, 14.11±0.82, 13.18±0.57, and 17.15±1.27, respectively. The lipid content (%) of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* were found to be 1.55±0.11, 2.51±0.26, 2.14±0.18, 3.05±0.09, 1.67±0.17, 2.54±0.18, 2.85±0.08, 2.51±0.21, 2.11±0.09, and 3.1±0.23, respectively. The ash content (%) of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* were found to be 3.43±0.23, 3.1±0.32, 3.72±0.32, 2.79±0.08, 2.44±0.24, 2.56±0.17, 3.06±0.08, 1.68±0.1, 1.7±0.07, and 2.15±0.15, respectively. Moisture content varied from 75.27% in *P. sarana* to 81.05% in *C. punctatus*. The carbohydrate content ranged from 1.81% (*H. fossilis*) to 3.28% (*M. aculeatus*). One way analysis revealed significant variation ($P<0.05$) in the mean value of nutrient contents among the fish species. From the present study, it could be concluded that the homestead ponds contain fish with a good source of nutrition that can help in decreasing the nutrient deficiency in Bangladesh. Thus, it can be added to the cultural system for consumption, as well as, supporting the livelihood of the coastal people.

INTRODUCTION

Bangladesh is gratified with immense open water resources with a wide range of aquatic diversity. Its biodiversity includes almost 260 freshwater fish species **(Hasan *et***

***al.*, 2013; DoF, 2018)**. Small indigenous species (SIS) is an important freshwater group of fish in Bangladesh. SIS grows to a size of about 25-30cm in the mature or adult stage **(Mohanty *et al.*, 2011)**. SIS such as Khalisha (*Colisa fasciatus*), Mola (*Amblypharyngodon mola*), Punti (*Puntius ticto*), Sharpunti (*Puntius sarana*), Tarabaim (*Macrognathus aculeatus*), Tengra (*Mystus tengara*), Koi (*Anabas testudineus*), Shing (*Heteropneustes fossilis*), Taki (*Channa punctatus*), and Magur (*Clarias batrachus*) are considered as a delicious and nutritive food in Bangladesh. Besides being an important source of proteins, these small indigenous fish species are enriched with micronutrients, minerals, and vitamins.

The proximate composition comprises the estimation of moisture, protein, fat, and ash component in the fresh fish body. The percentage of composition of these constituents accounts for about 96-98% of the total tissue constituents in the fish **(Nowsad, 2007)**. In Indian coastal waters, the values of these constituents in the common fish species followed the pattern moisture (65-90%) > protein (10-22%) > lipid (1-20%) > ash (0.5-5%). Carbohydrates, vitamins, minerals, and other non-protein nitrogenous compounds were also present in small quantities **(Stansby, 1962)**.

Noakhali is one of the Southern coastal districts of Bangladesh. Homestead ponds in Noakhali are important habitats of small indigenous fish species in which it grows without care and culture. These fish~~es~~ enter the ponds from floodwater from different sources, grow and reproduce there. But in most cases, these small ponds are covered with shade, received leaves of trees and organic matters from homestead areas having aquatic weeds, bushes, holes, and roots of trees. In these ponds, *Colisa fasciatus, Amblypharyngodon mola, Puntius ticto, Puntius sarana, Macrognathus aculeatus, Mystus tengara, Anabas testudineus, Heteropneustes fossilis, Channa punctatus*, and *Clarias batrachus* provide major catches from homestead ponds. In the past, some of these small fish species were thought to be weed fishes and were removed using pesticides. However, recently, these species have been viewed as an important source of essential macro-and micro-nutrients, which can play a vital role in the reduction of malnutrition in Bangladesh **(Ahmed *et al.*, 1997; Thilsted *et al.*, 1997; Hossain, 1997; Hossain & Ahsan, 2003;** and **Wahab *et al*., 2003)**.

Mazumder *et al.* (2008) examined the proximate composition of some ~~(~~SIS~~)~~ in Bangladesh. **Begum & Minar (2012)** carried out a comparative study on the body composition of different SIS, shellfish, and ilish in Bangladesh. However, the proximate composition of SIS of homestead ponds fish has been less investigated. Therefore, considering the importance of the small indigenous species in human nutrition, the present study was undertaken to analyze the proximate composition of small indigenous fish species harvested from homestead ponds of Noakhali coast, Bangladesh.

MATERIALS AND METHODS

Sample collection

Ten fresh small indigenous fish species (*viz.* Khalisha (*Colisa fasciatus*), Mola (*Amblypharyngodon mola*), Punti (*Puntius ticto*), Sarpunti (*Puntius sarana*), Tarabaim (*Macrognathus aculeatus*), Tengra (*Mystus tengara*), Koi (*Anabas testudineus*), Shing (*Heteropneustes fossilis*), Taki (*Channa punctatus*), and Magur (*Clarias batrachus*)) were collected during the period from April to June 2019 from the homestead ponds and the drained pond of Noakhali coast **(Figure 1)**. Samples were collected using cast and push nets and stored in an icebox before laboratory analysis. The number of samples collected for each SIS was dependent on the average size of each fish species and a total weight of approximately one kilogram for each sample.

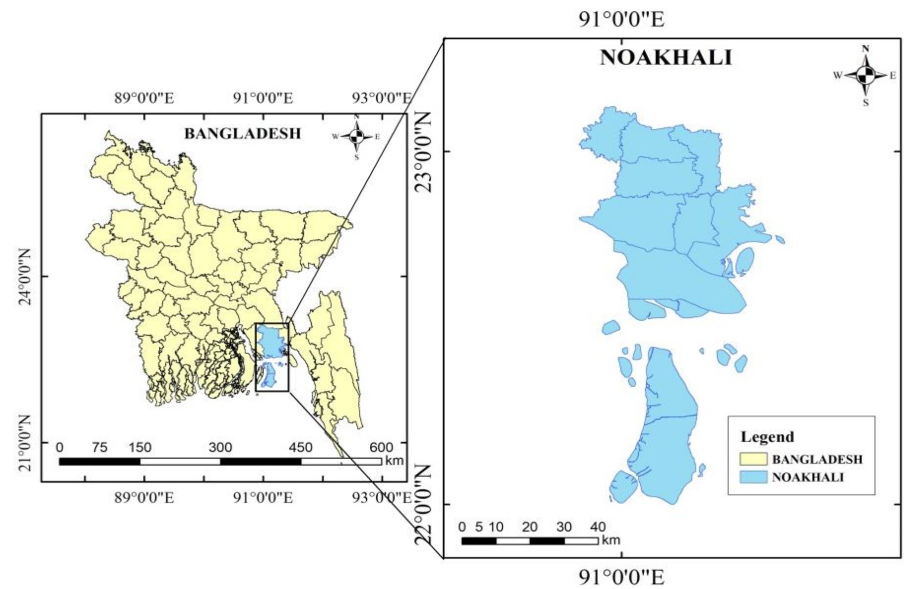

Fig. (1): Sample collected from homestead ponds (Subornochar) of the Noakhali coast

ample preparation

Captured fish samples were then transported to the laboratory of Glove Agrovet Ltd, Mirwarishpur, Noakhali. Samples were carefully washed with cooled tap water. Fins, gills, and viscera were removed and again washed with tap water to remove blood, slime, and unnecessary flesh. After washing, the fish samples were cut into small pieces and finally ground with a blender to produce a homogenous mixture.

Proximate composition

For analysis, the proximate compositions of each species were analyzed using conventional methods of the Association of Official Analytical Chemists **(AOAC, 1995)**. Each sample was run in three replicates.

Moisture: The moisture content was determined by drying the sample at 105 °C to a constant weight for 24 hours.

$$\textbf{Moisture content (\%)} = \frac{\textit{Weight loss}}{\textit{Original weight of the sample taken}} * \mathbf{100}$$

Ash: Total ash content was evaluated from weighed samples in a porcelain crucible placed in a muffle furnace at 600 °C for 6 hours.

$$\textbf{Ash content (\%)} = \frac{\textit{Weight of dry sample}}{\textit{Original weight of the sample taken}} * \mathbf{100}$$

Crude Protein: The protein content of the fish was determined by micro-kjeldahl method. Samples (0.5 g) were digested in the digestion unit for 45 minutes. The digested samples were then distilled in a distillation unit and titrated with 0.1N HCl. Crude protein was obtained by multiplying the total nitrogen by a conversion factor of 6.25.

$$\textbf{Protein content (\%) = \% of total } \mathbf{N_2 * 6.25}$$

$$\mathbf{N_2}\ \textbf{(\%)} = \text{(Titration reading-blank reading)} * \text{(Strength of Acid)} * (100/5) * (100/\text{weight of the sample})$$

Crude Lipid: The estimation of the fat content in the experimental raw fish was accomplished by the Bligh and Dyer method **(Bligh and Dyer, 1959**):

$$\textbf{Fat content (\%)} = \frac{\textit{Weight of the residue}}{\textit{Weight of the sample taken}} * \mathbf{100}$$

Total carbohydrate: Carbohydrate content was determined by calculating the difference between 100% and the sum of values of moisture, protein, fiber, lipid, and ash.

Data analysis

MS Excel 2010 was used for data analysis. The study performed Analysis of Variance (ANOVA) to test the significant variation ($p<0.05$) in nutrient contents among the investigated fish species.

RESULTS AND DISCUSSION

1. Protein content (%):

The protein content ranged from 13.18% to 17.3% among the examined species **(Table 1)**. The lowest protein content recorded was in *C. punctatus* (13.18%), whereas the highest was in *M. aculeatus* (17.3%). The protein content (%) of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* were found to be 14.51±1.2, 14.57±1.19, 14.39±1.23, 16.31±0.48, 17.3±1.74, 13.73±1.34, 13.95±0.43, 14.11±0.82, 13.18±0.57, and 17.15±1.27, respectively (**Figure 2**).

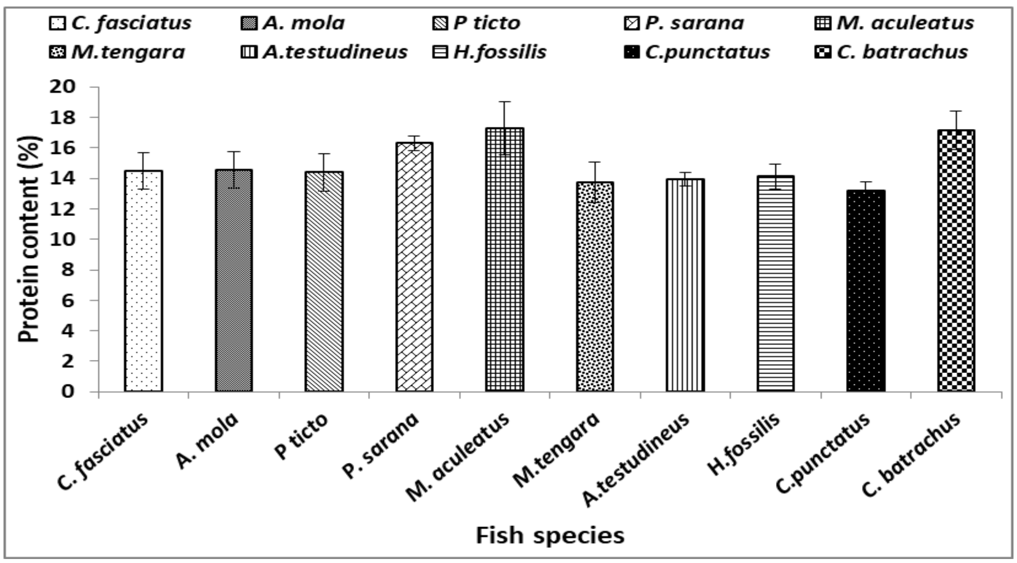

Fig. (2): Variation of protein contents (%) among the fish species

Protein contents of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C.batrachus* were similar to the findings of other researchers **(Hossain *et al*., 1999; Mazumder *et al*., 2008; Siddique *et al*., 2011; Ahmed *et al*., 2012; Begum & Minar, 2012; Paul *et al*., 2017; Jena *et al*., 2018;** and **Kamruzzaman *et al*., 2018)**. Protein content in *A. testudineus* (19.50%) recorded by **Ahmed *et al.* (2012)** was higher than that of the present study (**Table 1**). This deviation may occur due to size, seasonal variation or feeding habits of the fish. The results also state that protein contents show an inverse relationship with moisture contents.

Table 1. Values of proximate composition of the examined fish species collected from homestead ponds in the present study in comparison with previous studies from other localities

Species	Moisture	Protein	Lipid	Ash	Carbohydrate	Reference
Colisa fasciatus	**78.32±1.45**	**14.51±1.2**	**1.55±0.11**	**3.43±0.23**	**2.19±0.3**	**Present study**
	0.75	15.82	2.58	0.85	-	[1]
	73.18±0.17	13.86±0.09	4.79±0.18	3.14±0.04	5.03±0.41	[2]
	74.44	14.14	7.25	3.97	-	[3]
Amblypharyngodon mola	**77.99±1.38**	**14.57±1.19**	**2.51±0.26**	**3.1±0.32**	**1.83±0.36**	**Present study**
	76.68	17.95	2.87	2.50	-	[1]
	74.68±0.09	16.75±0.12	1.84±0.03	1.93±0.09	4.79±0.17	[2]
	76.38±2.52	18.46±1.86	4.10±0.98	1.64±0.54	-	[4]
	76.59	14.75	5.15	3.28	-	[3]
Puntius ticto	**77.3±1.95**	**14.39±1.47**	**2.14±.026**	**3.72±.032**	**2.46±.022**	**Present study**
	75.02	18.08	3.56	3.34	-	[1]
	71.00	16.43	7.12	5.22	-	[3]
Puntius sarana	**75.27±0.72**	**16.31±0.48**	**3.05±0.09**	**2.79±0.08**	**2.58±0.07**	**Present study**
	77.31	18.30	3.69	-	-	[5]
	71.39±0.54	16.73±0.92	9.00±1.09	2.02±0.25	-	[6]
Macrognathus aculeatus	**75.31±2.48**	**17.3±1.74**	**1.67±0.17**	**2.44±0.24**	**3.28±0.34**	**Present study**
	75.12±0.40	16.53±0.06	3.02±0.13	3.58±0.05	1.75±0.33	[2]
	78.12	15.32	4.12	2.25	-	[3]
Mystus tengara	**79.12±2.05**	**13.73±1.34**	**2.54±0.18**	**2.56±0.17**	**2.06±0.52**	**Present study**
	77.17	17.86	3.48	1.48	-	[1]
	74.26±0.29	13.33±0.29	3.84±0.29	4.11±0.15	4.46±0.39	[2]
	79.45	13.07	2.76	4.30	-	[3]
Anabas testudineus	**77.6±0.63**	**13.95±0.43**	**2.85±0.08**	**3.06±0.08**	**2.54±0.05**	**Present study**
	76.60	19.50	2.27	1.62	-	[1]
	68.00±1.77	16.91±0.59	6.98±1.49	5.50±0.49	-	[7]
Heteropneustes fossilis	**79.89±1.18**	**14.11±0.82**	**2.51±0.21**	**1.68±0.1**	**1.81±0.04**	**Present study**
	80.44	15.14	3.49	0.94	-	[1]
	78.21±0.67	15.28±0.28	1.96±0.50	2.48±0.09	-	[8]
	78.94±1.08	14.09±0.96	6.47±0.56	0.95±0.07	-	[9]
Channa punctatus	**81.05±0.82**	**13.18±0.57**	**2.11±0.09**	**1.7±0.07**	**1.96±0.09**	**Present study**
	81.93	15.22	1.60	1.25	-	[1]
	75.43	17.15	1.87	5.49	-	[3]
	78.99±2.21	15.23±1.89	2.21±0.16	2.89±0.27	-	[10]
Clarias batrachus	**75.28±1.83**	**17.15±1.27**	**3.1±0.23**	**2.15±0.15**	**2.33±0.18**	**Present study**
	80.74	15.22	3.08	0.95	-	[1]
	78.69±0.77	15.33±0.20	2.03±0.28	2.38±0.07	-	[8]

[1] Ahmed *et al.* (2012); **[2]** Jena *et al.* (2018); **[3]** Hossain *et al.* (1999); **[4]** Mazumder *et al.* (2008); **[5]** Siddique *et al.* (2011); **[6]** Begum & Minar (2012); **[7]** Paul *et al.* (2017); **[8]** Paul *et al.* (2015); **[9]** Kamruzzaman *et al.* (2018); **[10]** Zaman *et al*. (2014)

2. Lipid content (%):

The lipid content (%) varied from 1.55 to 3.1 (**Table 1**). The lowest lipid content (1.55%) was found in *C. fasciatus*, whereas the highest (3.1%) was in *C. batrachus*. The lipid content (%) of *C. fasciatus, A. mola, P. ticto, P. sarana, M. aculeatus, M. tengara, A. testudineus, H. fossilis, C. punctatus,* and *C. batrachus* were found to be 1.55±0.11, 2.51±0.26, 2.14±0.18, 3.05±0.09, 1.67±0.17, 2.54±0.18, 2.85±0.08, 2.51±0.21, 2.11±0.09, and 3.1±0.23, respectively (**Figure 3**).

Results of lipid content in *C. fasciatus, A. mola, P. ticto, P. sarana, M. aculeatus, M. tengara, A. testudineus, H. fossilis, C. punctatus,* and *C. batrachus* were in line with the findings of other studies **(Hossain *et al.*, 1999; Mazumder *et al.*, 2008; Siddique *et al.*, 2011; Ahmed *et al.*, 2012; Paul *et al.*, 2015; Jena *et al.*, 2018;** and **Kamruzzaman *et al.*, 2018)** (**Table 1**). The highest amount of lipid was recorded by **Hossain *et al.* (1999)** in *C. fasciatus* and *P. ticto,* **Begum & Minar (2012)** in *P. sarana,* and **Paul *et al.* (2017)** in *A. testudineus*. This finding might be attributed to the difference in size, sex, organ, fasting condition of the fish, or fat oxidation.

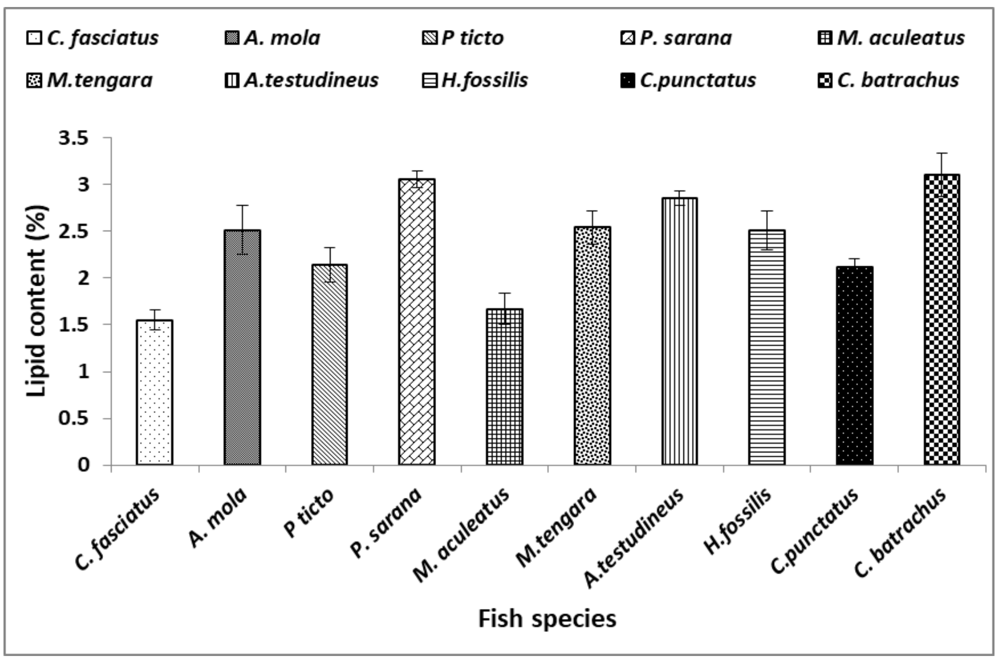

Fig. (3): Variation of lipid contents (%) among the fish species

3. Ash content (%):

Ash content (%) varied among the examined species (**Table 1**). The lowest ash content (1.68 %) was recorded in *H. fossilis,* whereas the highest ash content (3.72 %) was in *P. ticto*. The ash content (%) of *C. fasciatus, A. mola, P. ticto, P. sarana, M. aculeatus, M. tengara, A. testudineus, H. fossilis, C. punctatus*, and *C. batrachus* were found to be 3.43±0.23, 3.1±0.32, 3.72±0.32, 2.79±0.08, 2.44±0.24, 2.56±0.17, 3.06±0.08, 1.68±0.1, 1.7±0.07, and 2.15±0.15, respectively (**Figure 4**).

Table 1 showed that the ash contents of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* were almost close to the results of other researchers **(Hossain *et al*., 1999; Mazumder *et al*., 2008; Ahmed *et al*., 2012; Begum & Minar, 2012; Paul *et al*., 2017; Jena *et al*., 2018;** and **Kamruzzaman *et al*., 2018).** The ash content determined by **Ahmed *et al.* (2012)** in *C. fasciatus*, **Hossain *et al.* (1999)** and **Ahmed *et al.* (2012)** in *C. batrachus* did not coincide with the present study. This deviation may be attributed to the variations in season and methods used in these studies. Results of the present study also indicated that the ash content of the small indigenous species was higher than other species due to the higher amount of skeleton in small indigenous species.

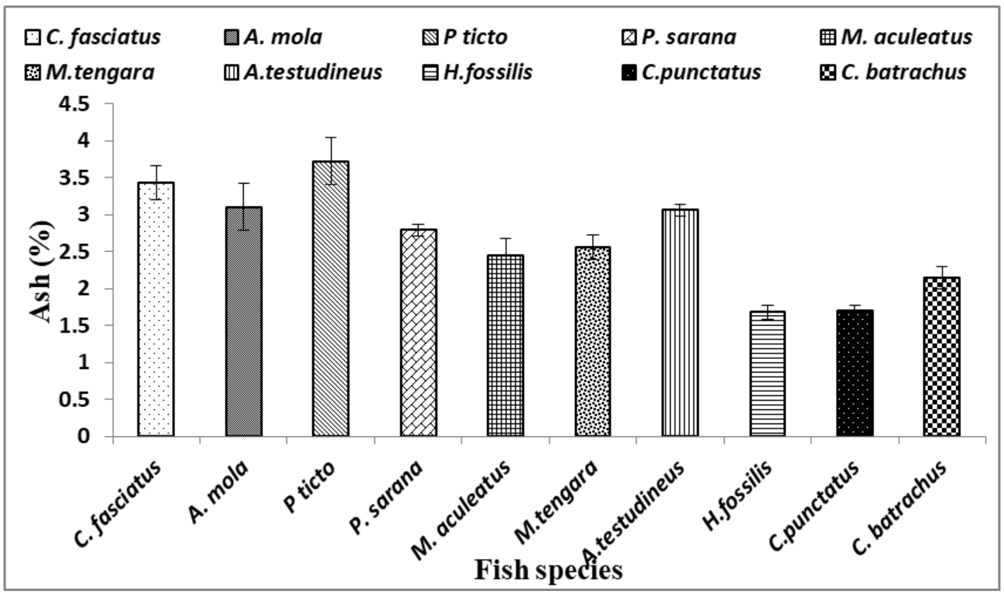

Fig. (4): Variation of ash contents (%) among the fish species

4. Moisture content (%):

The moisture content, in the present study, varied among the examined species (**Table 1**). The lowest moisture content (75.27 %) was recorded in *P. sarana*, whereas the highest (81.05 %) was in *C. punctatus*. The moisture content (%) of *C. fasciatus*, *A. mola*, *P. ticto*, *P. sarana*, *M. aculeatus*, *M. tengara*, *A. testudineus*, *H. fossilis*, *C. punctatus*, and *C. batrachus* were found to be 78.32±1.45, 77.99±1.38, 77.3±1.95, 75.27±0.72, 75.31±2.48, 79.12±2.05, 77.61±0.63, 79.89±1.18, 81.05±0.82, and 75.28±1.83, respectively (**Figure 5**).

The results of the present study are similar to the findings of other researchers **(Hossain *et al*., 1999; Mazumder *et al*., 2008; Siddique *et al*., 2011; Ahmed *et al*.,**

2012; Begum & Minar, 2012; Paul *et al*., 2015; Jena *et al*., 2018; and **Kamruzzaman *et al*., 2018) (Table 1).** However, **Hossain *et al.* (1999)** and **Paul *et al*. (2017)** recorded the lowest moisture values in *P. Ticto* and *A. testudineus*, respectively. This deviatation might be attributed to the difference in season or feeding habit of the species. The current results observed an inverse relationship between the amount of moisture and protein.

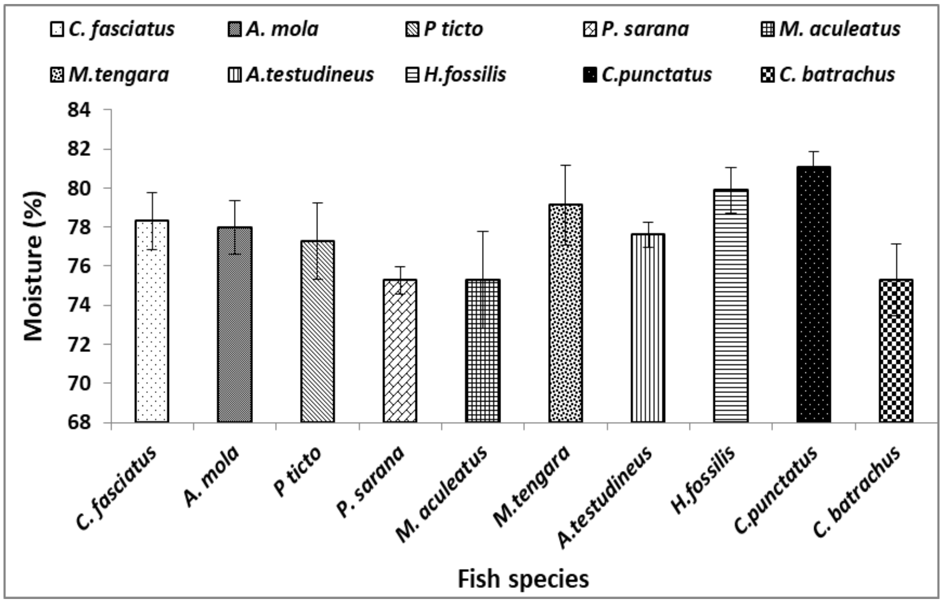

Fig. (5): Variation of moisture contents (%) among the fish species

5. Carbohydrate content (%):

The carbohydrate content, in the present study, ranged from 1.81% (*H. fossilis*) to 3.28% (*M. aculeatus*) **(Table 1)**. The carbohydrate content (%) of *C. fasciatus, A. mola, P. ticto, P. sarana, M.aculeatus, M. tengara, A. testudineus, H. fossilis, C. punctatus*, and *C. batrachus* were found to be 2.19±0.3, 1.83±0.36, 2.46±0.22, 2.58±0.07, 3.28±0.34, 2.06±0.52, 2.54±0.05, 1.81±0.04, 1.96±0.09, and 2.33±0.18, respectively (**Figure 6**).

The present results coincided with the results of **Jena *et al.* (2018)** in *M. aculeatus* and *M. tengara* **(Table 1)**. Carbohydrate content is an important element of fish and it is supposed to be the first among the organic nutrients to be utilized to produce required energy **(Heath, 1987)**.

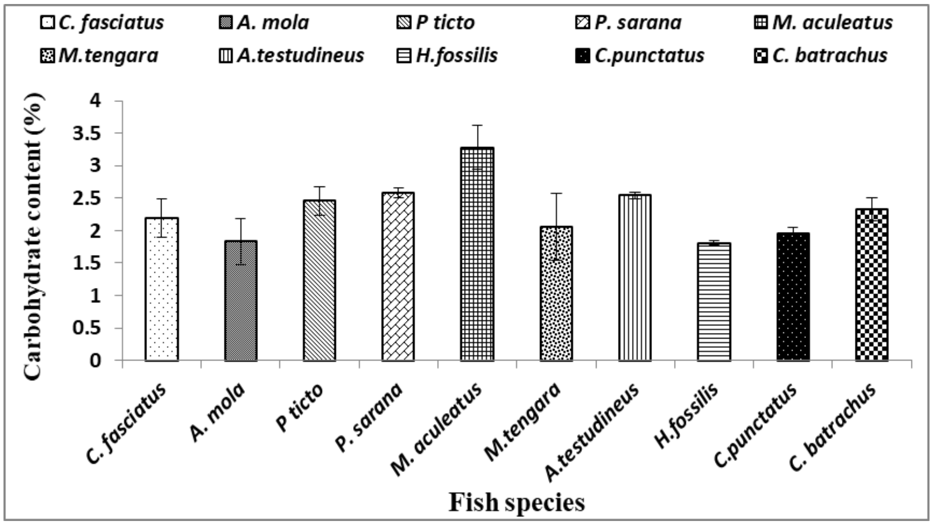

Fig. (6): Variation of carbohydrate contents (%) among the fish species

The mean values of protein, lipid, ash, moisture and carbohydrate contents varied significantly ($P<0.05$) among the fish species (**Table 2**).

Table 2. ANOVA table showing the variation in moisture, protein, lipid, ash, and carbohydrate contents among the investigated fish species

Nutrient	Source of Variation	SS	df	MS	F	p-value
Moisture %	Between groups	108.399	9	12.0443	4.928	0.001447*
	Within groups	48.8811	20	2.44405		
	Total	**157.28**	**29**			
Protein %	Between groups	57.5326	9	6.39251	5.231	0.00101*
	Within groups	24.442	20	1.2221		
	Total	**81.9746**	**29**			
Lipid %	Between groups	7.69328	9	0.854809	29.55	$1.218E^{-09}$*
	Within groups	0.578533	20	0.0289267		
	Total	**8.27182**	**29**			
Ash%	Between groups	12.8997	9	1.4333	36.55	$1.735E^{-10}$*
	Within groups	0.784267	20	0.0392133		
	Total	**13.6839**	**29**			
Carbohydrate	Between groups	5.26547	9	0.585052	8.332	$4.464E^{-05}$*
	Within groups	1.4044	20	0.07022		
	Total	**6.66987**	**29**			

SS: sum of square; df: degree of freedom MS: Mean square; F: F-statistic; %: percent.; * significant

CONCLUSION

In a nutshell, results of the present study showed that the examined ten small indigenous fish species of homestead ponds contained a high amount of nutrients that can enhance the nutritional security in the rural area. Culturing these fish species will provide poor people with the required source of animal protein. The study recommends using homestead ponds in fish culture. Accordingly, future research works are needed to determine the minerals required to establish a nutritional database of SIS in homestead ponds.

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