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Nutritional value of some small indigenous fish species (SIS) of Bangladesh

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Abstract

Twenty three small indigenous fish species (SIS) in the size range of 3-18 cm were analysed for proximate composition and minerals (Ca and P) content to evaluate their nutritive value. The moisture content of different species ranged between 71.00 and 81.94%. In general, small sized fishes showed higher moisture content. The muscle protein content among the species varied widely (16.16-22.28%). In general, the muscle protein content of fishes showed higher value than the whole carcass protein content. The carcass lipid content varied between 1.87 and 9.55% and showed an inverse relationship with the moisture content. The gross energy content ranged from 19.51-27.30 KJ/g on dry matter basis. In the present study, the calcium and phosphorus contents ranged between 0.85-3.20% and 1.01-3.29% respectively. The calcium and phosphorus ratio (Ca/P) varied between 0.44 and 2.00. From the nutritional point of view, it shows that the SIS are good source of protein and minerals especially calcium and phosphorus.

Key words : Small fish, Proximate composition, Ca, P

Introduction

The Small Indigenous Fish Species (SIS) of Bangladesh are generally considered to be those fish which grow to a length of approximately 5-25 cm at maturity (Felts *et al.* 1996). These fish are commonly referred to as "Chhotomach" in contrast to the large and commercially important large fish "Baromach". Although small in size they constitute a major part of fish caught in the inland fisheries due to their large numbers and abundance.

Small indigenous species of fish are valuable and easily available source of food rich in protein, vitamin and minerals, not commonly available in other foods in Bangladesh. Many SIS are eaten whole contributing calcium, phosphorous and vitamins to the human diet. Hossain *et al.* (1994) mentioned

that among the fishing communities, small fish occupy an important position as a popular food item. In a country with a population suffering from malnutrition and protein deficiency, consumption of these fish species may have positive effects in improving the health of the nation.

Small fish provide food and nutrition, subsistence and supplemental income to the great majority of people in this country, particularly the poor and disadvantaged. There is considerable demand for small indigenous fishes *viz.* mola (*Amblypharyngodon mola*), chapila (*Gudusia chapra*), tengra (*Mystus vittatus*), pabda (*Ompok pabda*), colisha (*Colisa fasciata*), punti (*Puntius sophore*) and chela (*Chela cachius*) both in rural and urban markets. Landless and marginal farmers and people with low income are unable to afford costly species such as carp.

The need for thorough and long-term investigation on the nutritional value of small indigenous fish is urgently needed. Considering the importance of the small indigenous fish, this study was undertaken to assess the nutritional value of some small fishes available in Bangladesh.

Materials and methods

Fish samples of 23 different small indigenous fish species (SIS) were collected from the local market of Mymensingh during the month of August to September, 1996. Physical data in respect of length and weight of individual fishes were recorded which are shown in Table 1. The fish were then cleaned and ground whole by using a morter and pastel. The ground whole fishes were kept in a deep freezer in air tight container for chemical analysis. Fish muscles were also collected separately from fishes of each species to determine muscle protein content. Triplicate samples of each fish species were used to determine the following chemical compositions.

Moisture : Moisture was determined by keeping fish samples in a thermostat oven at 105°C for 24 hours.

Crude protein : Samples (0.5 g) were digested in digestion unit (Digestor, model 2020) for 45 minutes. The digesta was then distilled in distillation unit (Kjeltec System, Distilling unit, model 1026). Finally it was titrated with 0.2 N HCl and crude protein was obtained by multiplying the total nitrogen by a conversion factor of 6.25.

Crude lipid : Crude lipid was determined by extracting a weighed quantity of sample with acetone in Soxhtec Extraction Unit (model 1045).

Ash : Ash content was determined by igniting fish samples in a muffle furnace at 450°C for overnight.

Gross energy : The gross energy content was calculated from the chemical composition using values of 5.65 and 9.45 Kcal/g for protein and lipid

respectively according to Brody (1945). The data are expressed in Kilojoules per gram (1 Kcal = 4.184 KJ)

Calcium : Calcium content of fish carcass was determined by Flame Photometer (Jenway, RFP 7, England) by the method of EDTA titration (Black, 1965).

Phosphorus : Phosphorus content was determined by following the method described by Olsen *et al.* (1954).

Results

The data of average length and weight and proximate analyses of various small indigenous fish are shown in Table 1 and 2 respectively. The results indicate that the range of muscle protein content among the species varied widely (16.16-22.28%). The highest muscle protein was found in Taki, *Channa punctatus* (22.28%) while the lowest value was found in Gulsha, *Mystus cavasius* (16.16%). In general, the muscle protein content of different fishes were higher than there of whole carcass proteins.

Table 1. Average length and weight of various small indigenous fishes used in this study

Sl. No.	Local name/ Common name	Scientific name	Average body length (cm)*	Average body weight (g)*
1	Puti	*Puntius sophore*	8.40 ± 0.5	9.24 ± 1.86
2	Tit puti	*Puntius ticto*	6.30 ± 0.1	3.59 ± 0.35
3	Madhu pabda	*Ompok pabda*	14.30 ± 1.06	19.53 ± 3.72
4	Gulsha	*Mystus cavasius*	9.67 ± 0.76	5.97 ± 2.05
5	Tengra	*Mystus vittatus*	6.67 ± 0.74	2.71 ± 1.22
6	Batashi	*Pseudeutropius atherinoides*	5.70 ± 0.44	1.40 ± 0.26
7	Kajoli	*Ailia coila*	10.97 ± 0.85	6.42 ± 1.22
8	Taki	*Channa punctatus*	15.17 ± 0.45	32.79 ± 4.60
9	Kholisha	*Colisa fasciata*	8.76 ± 0.22	13.36 ± 2.81
10	Boicha	*Colisa sota*	3.90 ± 0.10	1.20 ± 0.06
11	Kakila	*Xenentodon cancila*	16.73 ± 1.18	8.32 ± 1.38
12	Mola	*Amblypharyngodon mola*	5.80 ± 0.44	1.93 ± 0.49
13	Chela	*Chela cachius*	6.27 ± 0.49	1.64 ± 0.08
14	Lamba chanda	*Chanda nama*	4.80 ± 0.26	1.09 ± 0.14
15	Gol chanda	*Chanda ranga*	5.57 ± 0.35	3.57 ± 0.35
16	Chapila	*Gudusia chapra*	9.93 ± 1.43	10.30 ± 3.99
17	Tara Baim	*Mastacembelus aculeatus*	12.43 ± 0.89	6.84 ± 0.29
18	Guchi Baim	*Mastacembelus pancalus*	12.13 ± 3.62	9.79 ± 4.37
19	Bhagna	*Cirrhinus reba*	11.90 ± 0.96	15.21 ± 3.79
20	Kachki	*Corica soborna*	. 3.47 ± 0.45	0.35 ± 0.12
21	Rani	*Botia dario*	6.80 ± 1.06	4.83 ± 0.93
22	Bheda	*Nandus nandus*	11.43 ± 0.57	23.19 ± 4.49
23	Bialia	*Glossogobius giuris*	-	-

**Mean ± S.D.*

Table 2. Muscle protein, proximate carcass composition and gross energy content of various small indigenous fishes available in Bangladesh (% fresh matter basis)

Sl. No.	Scientific name	Muscle protein	Moisture	Protein	Lipid	Ash	Gross energy (KJ/g)
1	*Puntius sophore*	17.64	71.59	15.77	7.62	4.84	6.74
				(55.50)*	(26.83)	(17.04)	(23.73)
2	*Puntius ticto*	19.46	71.00	16.43	7.12	5.22	6.70
				(56.66)	(24.56)	(18.03)	(23.10)
3	*Ompok pabda*	16.63	78.67	15.34	3.56	2.35	5.03
				(71.91)	(16.70)	(11.02)	(23.60)
4	*Mystus cavasius*	16.16	78.99	13.81	2.26	4.77	4.16
				(65.72)	(10.78)	(22.68)	(19.80)
5	*Mystus vittatus*	17.59	79.45	13.07	2.76	4.30	4.18
				(63.60)	(13.44)	(20.92)	(20.35)
6	*Pseudeutropius atherinoides*	16.91	76.06	13.92	6.54	3.34	5.88
				(58.15)	(27.53)	(13.96)	(24.55)
7	*Ailia coila*	17.57	74.21	13.81	9.55	2.33	7.04
				(53.56)	(37.02)	(9.02)	(27.30)
8	*Channa punctatus*	22.28	75.43	17.15	1.87	5.49	4.79
				(69.81)	(7.60)	(22.34)	(19.51)
9	*Colisa fasciata*	17 14	74.44	14.14	7.25	3.97	6.21
				(55.31)	(28.40)	(15.56)	(24.30)
10	*Colisa sota*	17.10	78.41	13.50	3.26	4.44	4.48
				(62.53)	(15.10)	(20.57)	(20.75)
11	*Xenentodon cancila*	21.00	77.98	16.21	2.23	3.48	4.71
				(73.60)	(10.11)	(15.80)	(21.40)
12	*Amblypharyngod on mola*	17.04	76.59	14.75	5.15	3.28	5.52
				(63.02)	(21.99)	(14.02)	(23.51)
13	*Chela cachius*	18.17	78.09	14.47	4.27	3.15	5.10
				(66.03)	(19.50)	(14.39)	(23.32)
14	*Chanda nama*	18.22	78.17	14.40	4.03	3.38	5.01
				(66.00)	(18.50)	(15.48)	(22.92)
15	*Chanda ranga*	17.95	77.01	13.41	4.47	4.96	4.94
				(58.32)	(19.44)	(21.56)	(21.47)
16	*Gudusia chapra*	18.90	76.68	13.90	4.79	4.50	5.18
				(59.61)	(20.52)	(19.28)	(22.20)
17	*Mastacembelus aculeatus*	22.05	78.12	15.32	4.12	2.25	5.25
				(70.03)	(18.82)	(10.30)	(24.01)
18	*Mastacembelus pancalus*	19.75	74.68	17.41	4.85	2.82	6.03
				(68.77)	(19.15)	(11.14)	(23.83)
19	*Cirrhinus reba*	21.77	71.82	16.62	8.75	2.83	7.39
				(59.00)	(31.06)	(10.04)	(26.23)
20	*Corica soborna*	ND	81.94	12.49	3.48	2.08	4.33
				(69.15)	(19.28)	(11.51)	(23.97)
21	*Botia dario*	17.02	75.59	14.54	6.55	3.30	6.03
				(59.57)	(26.82)	(13.52)	(24.69)
22	*Nandus nandus*	17.69	75.52	14.86	4.86	4.71	5.43
				(60.72)	(19.85)	(19.24)	(22.20)
23	*Glossogobius giuris*	17.36	80.43	14.32	1.93	2.94	4.14
				(73.19)	(9.88)	(15.02)	(22.21)

* *Figures in the parentheses indicate values on dry matter basis.*
ND = Not determined

The ranges of carcass moisture content ranged between 71.00 and 81.94%. The highest moisture content was observed in Kachki, *Corica soborna* (81.94%) and the lowest in Tit puti, *Puntius ticto* (71.00%). The moisture content in Madhu pabda (*Ompok pabda*), Boicha (*Colisa sota*), Chela(*Chela cachius*), Lamba chanda (*Chanda nama*) and Tara baim (*Mastacembelus aculiatus*) were more or less similar (78.29 ± 0.25%). The protein content of fish carcass ranged between 12.49 and 17.41% (Table 2). The highest carcass protein content was found in Guchi baim (*Mastacembelus aculeatus*) and the lowest was in Kachki (*Corica soborna*). The carcass protein content in Mola (*Amblypharyngodon mola*), Chela (*Chela cachius*), Lamba chanda (*Chanda nama*), Rani (*Botia dario*) and Bele (*Glossogobius giuris*) were more or less similar (14.50 ± 0.16%). The lipid content varied widely from 1.87 to 9.55%. The carcass lipid content in Chela (*Chela cachius*), Lamba chanda (*Chanda nama*), Chapila (*Gudusia chapra*), Gol chanda (*Chanda ranga*), Tara baim (*Mastacembelus aculeatus*), Guchi baim (*Mastacembelus pancalus*) and Bheda (*Nandus nandus*) were more or less similar (4.48 ± 0.35%). Kajoli (*Ailia coila*) showed the highest (9.55%) and Taki (*Channa punctatus*) showed the lowest (1.87%) carcass lipid content. The ash content of all the fish ranged between 2.08 and 5.22% (Table 2). The highest ash content was observed in Tit puti, *Puntius ticto* (5.22%) and the lowest in Kachki, *Corica soborna* (2.08%). The gross energy content of fish carcass varied between 19.51 and 27.30 KJ/g on dry matter basis. The highest value was obtained in Kajoli (*Ailia coila*) and the lowest was observed in Taki (*Channa punctatus*). The gross energy content in Puti (*Puntius sophore*), Madhu pabda (*Ompok pabda*), Mola (*Amblypharyngodon mola*), Guchi baim (*Mastacembelus pancalus*) and Kachki (*Corica soborna*) were more or less similar (23.74 ± 0.16 KJ/g).

Results of the calcium and phosphorus content of various small indigenous species (SIS) are shown in Table 3. The range of calcium was from 0.85 to 3.20%. The highest calcium content was found in Gol chanda, *Chanda ranga* (3.20%) and Madhu pabda (*Ompok pabda*) showed the lowest value (0.85%). Calcium content in Puti (*Puntius sophore*), Kajoli (*Ailia coila*), Boicha (*Colisa sota*), Bhagna (*Cirrhinus reba*) and Bele (*Glossogobius giuris*) were more or less similar (2.33 ± 0.05%). The phosphorus content ranged between 1.01 and 3.29%. Colisha (*Colisa fasciata*) fish had the highest value (3.29%) and Gulsha (*Mystus cavasius*) showed the lowest (1.01%). Tengra (*Mystus vittatus*), Chela (*Chela cachius*), Chapila (*Gudusia chapra*), Kachki (*Corica soborna*) and Rani (*Botia dario*) had similar phosphorus content (2.39 ± 0.06%).

Table 3. Carcass calcium and phosphorus content of various small indigenous fish available in Bangladesh (% dry matter basis)

Sl. No.	Scientific name	Calcium (Ca)	Phosphorus (P)	Ca/P
1	*Puntius sophore*	2.34 (0.66)*	2.17 (0.62)	1.08
2	*Puntius ticto*	2.87 (0.86)	2.60 (0.78)	1.10
3	*Ompok pabda*	0.85 (0.18)	1.59 (0.22)	0.53
4	*Mystus cavasius*	1.45 (0.30)	1.01 (0.21)	1.44
5	*Mystus vittatus*	2.09 (0.43)	2.39 (0.49)	0.87
6	*Pseudeutropius atherinoides*	1.45 (0.35)	1.77 (0.42)	0.82
7	*Ailia coila*	2.30 (0.59)	2.72 (0.70)	0.85
8	*Channa punctatus*	1.30 (0.32)	1.79 (0.44)	0.73
9	*Colisa fasciata*	2.08 (0.53)	3.21 (0.84)	0.63
10	*Colisa sota*	2.42 (0.52)	1.21 (0.26)	2.00
11	*Xenentodon cancila*	0.94 (0.21)	2.14 (0.47)	0.44
12	*Amblypharyngodon mola*	1.17 (0.27)	1.87 (0.44)	1.34
13	*Chela cachius*	1.84 (0.40)	2.36 (0.52)	0.78
14	*Chanda nama*	2.01 (0.44)	2.14 (0.47)	0.94
15	*Chanda ranga*	3.20 (0.74)	2.78 (0.64)	1.15
16	*Gudusia chapra*	1.43 (0.33)	2.39 (0.56)	0.59
17	*Mastacembelus aculeatus*	1.75 (0.38)	2.56 (0.56)	0.68
18	*Mastacembelus pancalus*	1.70 (0.43)	2.04 (0.52)	0.83
19	*Cirrhinus reba*	2.30 (0.65)	2.78 (0.78)	0.83
20	*Corica soborna*	1.94 (0.35)	2.49 (0.45)	0.78
21	*Botia dario*	1.90 (0.46)	2.34 (0.57)	0.81
22	*Nandus nandus*	2.10 (0.51)	3.09 (0.76)	0.68
23	*Glossogobius giuris*	2.28 (0.45)	1.76 (0.34)	1.29

** Figures in the parenthesis indicates values on fresh matter basis.*

The Ca/P ratio varied from 0.44 to 2.00. The highest ratio was observed in Boicha, *Colisa sota* (2.00) and the lowest in Kakila, *Xenentodon cancila* (0.44). Tengra (*Mystus vittatus*), Batashi (*Pseudetropius atherinoides*), Kajoli (*Ailia coila*), Guchi baim (*Mastacembelus pancalus*), Bhagna (*Cirrhinus reba*) and Rani (*Botia dario*) showed the similar values (0.84 ± 0.02).

Discussion

The concentration of protein, lipid, ash and minerals (calcium and phosphorus) are extremely variable among the small indigenous species (SIS). Different species of fish and even strain within a species vary significantly in the nutritional content of the carcass (Refstie and Austreng 1981). The carcass composition is also influenced by housing conditions in cultured species, especially by water temperature (Huisman *et al.* 1979). Research work on the evaluation of proximate composition of SIS of

Bangladesh have not so far been undertaken in detail. Only a few species are reported to subject to analysis of vitamin A and minerals such as calcium, magnesium and iron (Thilsted *et al.* 1997).

The moisture content in the present study ranged between 71.00 and 81.94%. Since the moisture has an inverse relation with size of the fish, the fishes in the present study being small showed comparatively higher moisture content than that obtained by Rahman *et al.* (1982) in small zeol fishes of Bangladesh (70.60 to 80.44%).

The carcass protein content of SIS in the present study varied between 12.49 and 17.41%. CSIR (1962) reported the protein content of some selected fish species in India to be 14.32 -19.8%, which are more or less similar to the values obtained in the present study. The protein content of SIS are also similar to that found in other large carp fish species (rohu, *Labeo rohita*) and the value was 17.91% (Humayun *et al.* 1987). Hossain *et al.* (1997) reported similar protein content (16.7%) in Thai sharpunti (*Puntius gonionotus*). Felts *et al.* (1996) reported 16. 6-19.59% protein content in 100g Indian carp.

The lipid content of SIS in the present study ranged between 1.87 and 9.55%. The carcass fat content was inversely correlated with moisture contents. Such inverse relationship between lipid and moisture has also been reported earlier (Andrews and Stickney 1972). Rahman *et al.* (1982) reported that crude fat content in some Bangladeshi zeol fish was 2.18 - 9.38% which are more or less similar to the values obtained in the present study.

The ash content of all the fish species in present study ranged between 2.08 and 5.22%. The highest ash content was found in Tit puti (5.22%) which is slightly lower than the values reported by Rahman *et al* (1982) in Koi (6.79 ± 1.26%). CSIR (1962) reported that the ash content of some selected fish species in India ranged between 1.53 and 2.60%.

The gross energy content of small indigenous fish species in the present study ranged between 19.51 and 27.30 KJ/g. The calculated gross energy content of Puti, Madhu pabda, Mola, Guchi baim and Kachki were more or less similar to that reported by Henken *et al.* (1986) in African catfish, *Clarias gariepinus* (24.12 ± 0.40 KJ/g). Craig *et al.* (1978) reported that the gross energy content of somatic tissues of *Perca fluviatilis* was 26.04 ± 1.29 KJ/g which are similar to the values obtained with Kajoli, Bhagna and Rani (26.07 ± 1.31 KJ/g).

Minerals such as Ca and P are closely related to metabolism especially in bone formation and the maintenance of acid-base equilibrium in fish. Almost the entire store of calcium (99%) and most of the phosphorus (80%) in the body of are in the form of bones, teeth and scales. The remaining small portions are widely distributed throughout the organ and tissues. Moreover,

it has been established that the fish derived inorganic elements such as Ca and P from the surrounding water as well as from diets. Some minerals are easily absorbed by fish from environmental water (Phillips *et al.* 1958). In the present study, the calcium content ranged between 0.85 and 3.20% with the highest in Gol chanda (3.20%) which might be due to its bony structure. Thilsted *et al.* (1997) reported Ca content of 1.06 to 1.26% in 5 minor carps. Ogino and Takeda (1978) found that Ca content of rainbow trout in different experimental group was 0.81-0.82% which are similar to the values obtained in the present study.

The phosphorus content in the present study ranged between 1.01 and 3.29%. The highest value was obtained in Colisha (3.29%). CSIR (1962) reported phosphorus content of 1.20% in sharpunti, *Puntius sarana*. Yone and Toshima (1979) reported that phosphorus content of vertebrae of carp fish was 1.90 ± 0.06% which is more or less similar to the values obtained with minor carps like puti, *Puntius sophore* in the present study.

In Bangladesh, fish is an important source of protein as well as mineral and vitamins. Some SIS fish are very small (<10 cm) and they are typically eaten whole. All small fish contain large amounts of calcium and phosphorous. Big fish like silver carp (*Hypophthalmicthys molitrix)* and rohu (*Labeo rohita*), which are promoted in aquaculture do not contribute significantly to calcium and phosphorous input since the bones are not eaten (Thilsted *et al.* 1997). In countries like Bangladesh where milk and milk products make up only a small amounts of the diet, small fish can be an important calcium and phosphorus source.

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