COMPARATIVE ANALYSIS OF AMINO ACID PROFILE OF *Tenualosa ilisha* AND *Catla catla* AND THEIR POTENTIAL CONTRIBUTION TO RECOMMENDED NUTRIENT INTAKE

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ABSTRACT

Objective: The current study aimed to determine the amino acid profiles and proximate compositions of two commonly consumed fish species of Bangladesh: *Tenualosa ilisha* and *Catla catla,* commonly known as Hilsha, the national fish of Bangladesh and Catla, respectively. **Methodology**: The fish samples were collected from two wholesale fish markets (ghaats) in Dhaka city, the capital of Bangladesh. The Amino Acid content of the selected samples was analyzed by an amino acid analyzer. Fourteen amino acids (eight essential and six non-essential) could be detected by the analyzer. **Results**: In the case of the essential amino acid content of the samples, threonine, valine, isoleucine, histidine, and lysine content was greater in the Hilsha fish than that of Catla. On the other hand, methionine, leucine, and phenylalanine content were higher in Catla than that in Hilsha. All six non-essential amino acids were found in greater amounts in Hilsha. Concerning the potential contribution (%) of the selected samples to the daily recommended nutrient intake (RNI) of essential amino acids in children (5-10 years), Hilsha fish potentially contributes (>50%) to the daily RNI of threonine, methionine, and lysine and Catla fish potentially contributes (>50%) to the daily RNI of methionine and lysine. In regards to the adult's RNI, Hilsha potentially contributes (>50%) to the daily RNI of methionine and lysine but Catla was found to contribute potentially (>50%) to the daily RNI of methionine only. **Conclusion**: Both of the samples were found to be a substantial source of protein and essential amino acids to significantly contribute to the daily RNI of essential amino acids concerning children (5-10 years) for growth and adults for maintenance.

KEYWORDS: Amino acid profile, essential amino acid content, recommended nutrient intake.

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Introduction

Bangladesh generated 42.77 lakh Metric tons (MT) in total in 2017–18, ranking it third in the world for aquaculture output in 2018 (Sofia, 2018). The agricultural GDP is comprised of 24.41% of the fisheries sector's contribution, which is 3.61% of the total GDP (FRSS, 2018). About sixty percent of animal protein intake is contributed by fish. Moreover, in comparison with other animal protein sources, both availability and affordability are better for fish. Fish is a major food component in our daily diet since it is a rich source of amino acids, some of the vitamins, minerals, and essential fatty acids needed to lead a healthy life (Borgstrom, 1961). Amino acids such as Lysine and methionine are found in large amounts and tryptophan in small amounts in fish protein in comparison with mammalian protein (Nowsad, 2007).

Tenualosa ilisha (Hamilton, 1822) of the family Clupeidaeis one of the most significant tropical fishes of the Indo-Pacific region and is also recognized as the national fish of Bangladesh. Hilsha accounts for around 12% of all fish produced in the nation. Hilsha output climbed from 1.99 lakh MT in 2003-2004 to 5.17 lakh MT in 2017-2018. Hilsa has been designated as Bangladesh's Geographical Indicator (GI) (FRSS, 2018). On the other hand, entire fish production's 19.79 percent of Bangladesh comes from major carp (Rui, catla, mrigal). Among them, only catla contributes to about 6.40% of Annual Fish Production in Inland Waterbodies in 2017-18 which is about 2.32 Lakh MT (FRSS, 2018).

Several studies have been undertaken to determine the nutritional quality of hilsa and catla (Alam *et al*., 2012; Begum *et al*., 2016; Debnath *et al*., 2018; Dewan *et al*., 2015; Ganguly *et al*., 2017; Hossain *et al*., 2014; Jana and Chakrabarti, 2017; Longvah *et al*., 2017; Moniruzzaman *et al*., 2014; Paul *et al*., 2018; Rao *et al*., 2012; Rohomania *et al*., 2014; Shaheen *et al*., 2022) but no study has been conducted on comparative analysis of amino acid and proximate composition of *Tenualosa ilisha* and *Catla catla*. Hence, the study's main objective was to investigate the amino acid composition and proximate analysis of the two commonly consumed fish species of Bangladesh and to determine their likely contribution to recommended nutrient intake (RNI) of essential amino acids. It is known that animal proteins are

more digestible than plant proteins (FAO, 2013) and plant-origin proteins are found to be a deficit in some essential amino acids (Boye *et al*., 2010) and consequently animal protein sources have been found to be superior in quality than that of plant sources assessed by various protein quality measuring indexes (Hoffman and Falvo, 2004; Marinangeli and House, 2017; Mathai *et al*., 2017; Rutherfurd *et al*, 2015; Sarwar, 1997; Sarwar *et al*., 1989; Van Vliet *et al*., 2015). Knowledge of their potential contribution to RNI will further facilitate the use of these fishes in nutritional consultancy.

Materials and Methods

Sample Selection: Two commonly consumed fish species of Bangladesh were selected for the current study (consumption of Catla: 7.50 gm/person/day and consumption of Hilsha: 3.43 gm/person/day) (BBS, 2010). Only the matured fish (without eggs) were selected as samples for the current study. The average length and weight (Mean ± SD) of Hilsha fish samples were 32.5 cm ± 2.6 cm and 850 gm ± 55 gm, respectively. On the other hand, the average length and weight of Catla fish samples were 42.22 cm ± 3.4 cm and 1266 gm ± 70 gm, respectively.

Sample Collection: The samples were collected from two wholesale fish markets (Ghaat) in Dhaka city: Showari Ghaat and Badamtoli Ghaat in December 2015. Samples were collected in air-tight zip bags and were brought to the Food Analysis Laboratory of the Institute of Nutrition and Food Science (INFS) for Proximate analysis and to the Institute of Food Science and Technology (IFST), BCSIR, Dhaka for Amino Acid Composition.

Sample Identification: After bringing to the laboratory, the samples were identified up to species and their scientific classification is given below. The two samples are locally known as Ilish and Catal.

Taxonomy	**Hilsha**	**Catla**
Kingdom	Animalia	Animalia
Phylum	Chordata	Chordata
Class	Actinopterygii	Actinopterygii
Order	Clupeiformes	Cypriniformes
Family	Clupeidae	Cyprinidae
Genus	*Tenualosa*	*Catla*
Species	*T. ilisha*	*C. catla*

Sample Preparation: The two fish specimens were cleaned with distilled water followed by air drying. Only the fillets were collected for further analysis. Most of the analytical methods in proximate analysis were conducted by standard methods. Each sample were analyzed in duplicate and mean values were recorded accordingly.

Analytical Methods for the analysis of Proximate Composition: Methods given in the official methods of analysis of Association of Official Analytical Chemists (AOAC) International were adopted for proximate analysis so that precision and accuracy could be ensured. However, modification of the official methods was needed in some cases and in these circumstances, ASEAN Manual of Nutrient Analysis was considered (AOAC, 2005; Prosky et al., 1985; Pwwastein et al., 2011; Raghuramulu et al., 2003; Rand et al., 1991).

Amino Acid Analysis

Sample Preparation: Amino Acid Composition was done in the Laboratory of Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh. The samples were identified up to species, after their arrival at BCSIR. The samples were then cleaned with distilled water and gutted. Only the flesh was taken for further analysis as raw edible portion. For analysis of amino acids, sample was made fat-free at first and then by using a mortar-pestle, fine paste was obtained by 6N HCI. After that, it was filtered in 250 ml round bottom flask and was put in a heating mantle at 110°0 for 22 hours for protein hydrolysis. An evaporating dish was used then to keep the solution on water bath for the purpose of HCL evaporation. Afterwards, stock solution was made after filtering solution using Whatman No. 1 filter paper and was collected in a 25 ml volumetric flask.

Amino Acid Profile: A 0.45 pm syringe filter was used to filter the stock solution. Then an amino acid analyzer (Shimadzu, Japan) was used to run the stock solution and standard solution and hence, amino acid profile was determined (Anomynous, 1993).

Estimation of Contribution to Recommended Nutrient Intakes (RNIs): The contribution of the two fish species to the daily suggested values of each amino acids regarding children (5-10 years) and adult (>18 year) were calculated. At first, average RNI value for each amino acid were estimated for children (5-10 years) and adults since RNI changes throughout the growing period of young childhood as well as different physiological conditions in case of adulthood (WHO, 2007). Later on, a standard portion size of each fish was considered (50 g/day for adult and 50 g/day for children (5-10 years) (BIRDEM, 2013; Bogard *et al*., 2015) to calculate the contribution of the fish to the daily RNI of children (5-10 years) and adults as RNI percentage.

Results and Discussion

The results of the current study will bring about the proximate and amino acid profiles of two above-mentioned fish species. Moreover, it will depict the potential contribution of the

samples to RNI (young children and adult) of essential amino acids. Table 1 illustrates the proximate composition of the selected fish It shows that moisture percentage was higher in Catal(76.04%) than that of Ilish (62.18%). On the other hand, protein percentage was higher in Ilish (23.5%) than that of Catal (20.37%). In case of fat percentage of the two fishes, it was seen that Ilish contained a much larger percentage of fat (13%) than that of Catal (2.34%). However, this type of larger percentage of fat is also found in some other fresh water fish species like Rui (11%), Tilapia (12.6%) etc (Shaheen *et al.*, 2016). Although fat percentage is much higher in Ilish than that of Catal, but it may reduce blood cholesterol level in hypercholesterolemic subjects (Quazi *et al.*, 1994). On the other hand, the ash content of Catal and Ilish was 1.25% and 1.32%, respectively. Paul *et al* (2018) reported that the ash content of Catal was 2.68±0.13 g/ 100 g.

Table 1. Proximate composition of *Tenualosa ilisha* and *Catla catla*

Proximate Composition	*Tenualosa ilisha*	*Catla catla*
Water (%)	62.18	76.04
Protein (%)	23.5	20.37
Fat (%)	13	2.34
Ash (%)	1.32	1.25
TDF (%)	0	0
CHO (%)	0	0

N.B.: Analysis were conducted in duplicate and hence the mean values were reported. Values are reported as gram/100-gram edible portion.

Table 2 depicts the essential amino acid (EAA) content of the selected samples. It can be observed from the table that among the analyzed EAAs, Lysine content was higher than other essential amino acids and isoleucine content was found to be the lowest EAA in Hilsha and Catla. Threonine content was about 29 mg and 26mg in Hilsha and Catla respectively; valine content was about 27mg both in Hilsha and Catla; Mthionine content was found to be higher in Catla (46.05 mg/g protein) than that of Hilsha (37.02mg/ g protein); Isoleucine content was about 15mg in Hilsha and 13 mg in Catla; Leucine content was about 39 mg in Hilsha and 45 mg in Catla; Phenylalnine content was higher in Catla (35.81 mg) than that of Hilsha (31 mg); Histidine content was about 17 mg/g protein in Hilsha and 16 mg/g protein in Catla; and Lysine content was about 79 mg in Hilsha and 81 mg in Catla.

Table 2. Essential Amino Acid (EAA) content of *Tenualosa ilisha* and *Catla catla*

EAAs	*Tenualosa ilisha*		*Catla catla*	
	mg/g protein	**mg/100g EP**	**mg/g protein**	**mg/100g EP**
Threonine	29.36	690	25.58	550
Valine	27.23	640	26.98	580
Methionine	37.02	870	46.05	990
Isoleucine	14.89	350	13.02	280
Leucine	38.72	910	44.65	960
Phenylalanine	31.06	730	35.81	770
Histidine	17.02	400	16.28	350
Lysine	78.72	1850	80.93	1648

Table 3 depicts the non-essential amino acid content of the fish samples. Aspartic acid content was found higher in Hilsha (29.36) than that of Catla. Serine and glutamic acid content was found almost equal in two fishes, whereas, glycine was found in higher amount in Hilsha (121.28) than that of Catla (87.66). Alanine and arginine were also higher in Hilsha fish.

Table 3. Non-essential Amino Acid (NEAA) content of *Tenualosa ilisha* and *Catla catla*

NEAAs	Hilsha		Catla	
	mg/g protein	**mg/100g EP**	**mg/g protein**	**mg/100g EP**
Aspartic acid	29.36	690	23.83	560
Serine	34.04	800	32.77	770
Glutamic acid	44.26	1040	43.83	1030
Glycine	121.28	2850	87.66	2060
Alanine	35.74	840	26.81	630
Arginine	38.72	910	35.32	830

Table 4 shows the average amino acid requirement of children (5 to 10 years) and percent contribution of the selected samples to their daily EAA requirement from their one serving (50g). Given that the average weight of 5-10 years children is

25 kg (WHO, n.d.), different EAA requirements were calculated as 450 mg/day (Threonine), 725 mg/day (Valine), 450 mg/day (Methionine), 575 mg/day (Isoleucine), 1100 mg/day (Leucine), 750 mg/day (Phenylalanine), 300 mg/day (Histidine) and 875 mg/day (lysine). Regarding the percent contribution of Hilsha and Catla to their daily EAA requirement, it can be seen from the Table below and Figure 1 that one standard portion size of hilsha contributes about 77% of the daily Threonine requirement, whereas, the percent contribution of catla is about 61%. The percent contribution of Hilsha concerning other EAAs are 44% (Valine), 97% (Methionine), 30% (Isoleucine), 41% (leucine), 49% (Phenylalanine), 67% (Histidine) and 106% (Lysine). On the contrary, the percent contribution of Catla concerning other EAAs are 40% (Valine), 110% (Methionine), 24% (Isoleucine), 43% (leucine), 51% (Phenylalanine), 58% (Histidine) and 94% (Lysine).

Table 4. Amino acid requirement of children (5-10 years) and contribution (%) of *Tenualosa ilisha* and *Catla catla*

Amino acids	Thr	Val	Met	Ile	Leu	Phe	His	Lys
Average requirement (mg/kg/day)	18	29	18	23	44	30	12	35
Requirements for children (5-10 years) mg/d	450	725	450	575	1100	750	300	875
Percent contribution (%) of Hilsha and Catla to daily EAA requirement of children (5-10 years)								
Hilsha	76.67	44.14	96.67	30.43	41.36	48.67	66.67	105.71
Catla	61.11	40.00	110.00	24.35	43.64	51.33	58.33	94.17

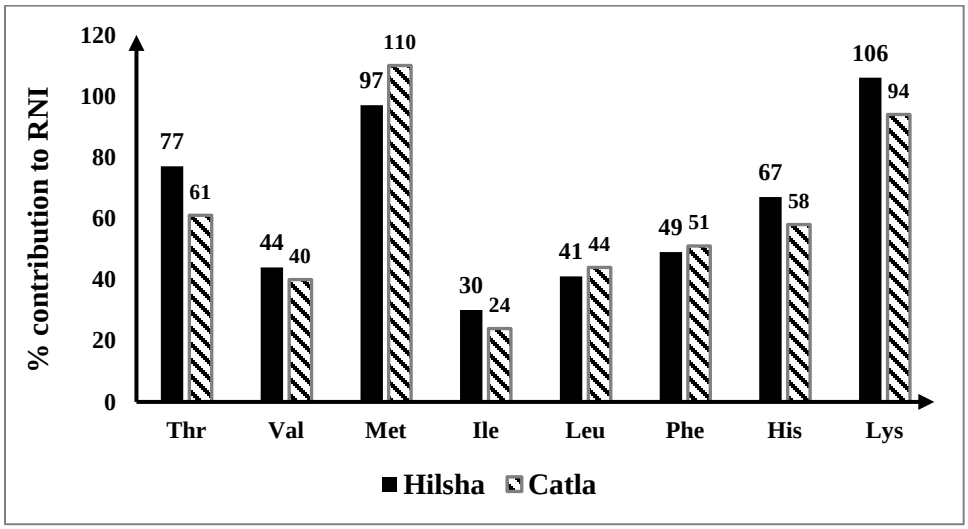

Figure 1. Percent contribution (%) of *Tenualosa ilisha* and *Catla catla* to RNI of EAAAs in children (5-10 years)

Table 5 illustrates the average amino acid requirement of adults (60 kg body weight) and percent contribution of the selected samples to their daily EAA requirement from their one serving (50 g). Given that an average adult is 60 kg, different EAA requiremnets were calculated as 900 mg/day (Threonine), 1560 mg/day (Valine), 600 mg/day (Methionine), 1200 mg/day (Isoleucine), 2340 mg/day (Leucine), 1500 mg/day (Phenylalanine), 600 mg/day (Histidine) and 1800 mg/day (lysine). Regarding the percent contribution of Hilsha and Catla to their daily EAA requirement of adults, it can be seen from the Table below and Figure 2 that one standard portion size of hilsha (50 g) contributes about 38% of daily Threonine requirement, whereas, percent contribution of catla is about 31%. The percent contribution of Hilsha concerning RNI of other EAAs are 21% (Valine), 73% (Methionine), 15% (Isoleucine), 19% (leucine), 24%(Phenylalanine), 33% (Histidine) and 51% (Lysine). On the contrary, the percent contribution of Catla concerning other RNI of other EAAs are 19% (Valine), 83% (Methionine), 12% (Isoleucine), 21% (leucine), 26%(Phenylalanine), 29% (Histidine) and 46% (Lysine)

Table 5. Amino acid requirement of adults and contribution (%) of *Tenualosa ilisha* and *Catla catla* to RNI

Amino acids	**Thr**	**Val**	**Met**	**Ile**	**Leu**	**Phe**	**His**	**Lys**
Average requirement (mg/kg/day)	15	26	10	20	39	25	10	30
Requirements for adults (60 kg) mg/d	900	1560	600	1200	2340	1500	600	1800
Percent contribution (%) of EAA to daily EAA requirement of adults								
Hilsha	38.33	20.51	72.5	14.58	19.44	24.33	33.33	51.39
Catla	30.56	18.6	82.5	11.67	20.51	25.67	29.17	45.78

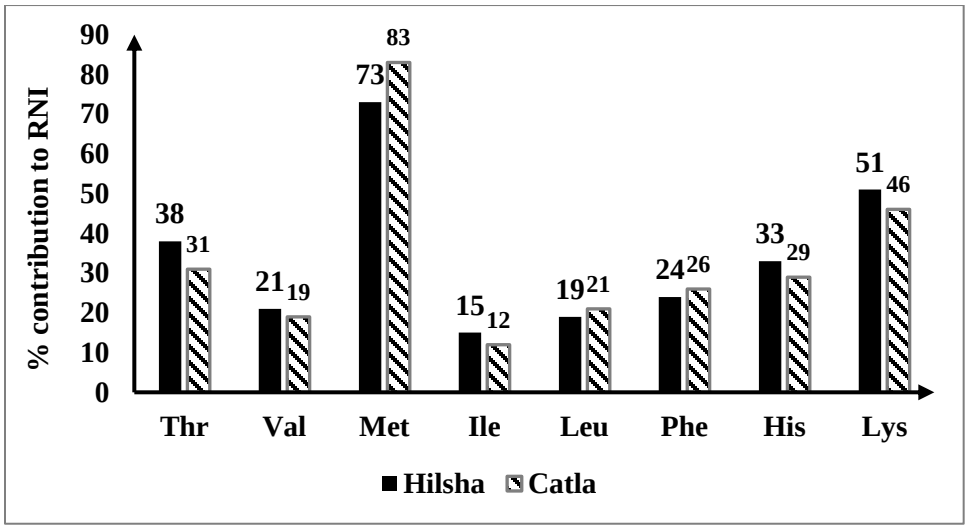

Figure 2. Percent contribution (%) of *Tenualosa ilisha* and *Catla catla* to RNI of EAAAs in adults

Table 6 shows the total EAAs (sum of eight analyzed essential amino acids), total NEAAs (sum of six analyzed non-essential amino acids), total AAs (sum of 14 analyzed amino acids) and the ratio of total essential amino acids by total amino acids. It may be observed for the following table that total EAA and total NEAA was higher in Hilsha than that of Catla. Consequently, it was found that Hilsha contained more AAs than that of Catla. But, concerning the ratio of total EAA by total AA, Catla showed a slightly higher ratio (0.51) than that of Hilsha (0.48).

Table 6. Amino acid contents in mg/ 100 g EP and ratio of TEAA/TAA of the selected samples

Amino Acids	**mg/ 100 g edible portion**	
	Tenualosa ilisha	***Catla catla***
Total EAA (sum of 8 EAAs)	6440	6128
Total NEAA (sum of 6 NEAAs)	7130	5880
Total AA (sum of 14 AAs)	13570	12008
Total EAA/ Total AA	0.48	0.51

Conclusion

The study displayed a comparative nutritional evaluation of two commonly consumed fishes in Bangladesh and provided valuable information on their potential contribution to RNI of both essential and non-essential amino acids in children (5 to 10 years) to promote their growth and adults. Even though all the amino acids could not be detected, the results from the study on essential amino acid content might be helpful to compare the two fishes regarding their nutritional values in terms of essential amino acids as well as, percent contribution to RNI of growing age children.

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