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Amino Acid Compositions of Selected Commercially Important Marine Fishes of Bangladesh and Their Potential Contribution to Recommended Nutrient Intake

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Abstract:*Fishes are known to be good sources of complete protein. The purpose of this study was to determine amino acids in five selected commercially important marine fish species viz. Pampus chinensis, Lates calcarifer, Johnius argentatus, Harpodon nehereus, and Lepturacanthus savala;of Bangladeshand evaluate their nutritional status in terms of Recommended Nutrient Intake (RNI) for adults and infants.Total 14 amino acids were detected of which eight were essential amino acids (EAAs) and six were non-essential amino acids (NEAAs).EAAs according to highest to lowest contents were histidine, isoleucine, phenylalanine, lysine, valine, leucine, threonine and methionine whereas NEAAsaccording to highest to lowest contents were glutamic acid, aspartic acid, arginine, glycine, alanine and serine. P. chinensis, L. calcarifer, L. savala and J. argentatus contained well proportion of amino acids and would fulfill maximum portion of histidine requirement or RNI (Recommended Nutrient Intake)for adults and infants. P. chinensis, L. calcarifer and L. savala would fulfill >25% and >40% of RNI of isoleucine for adults and infants respectively. L. calcarifer and L. savala would fulfill 20% and 25% of RNI of phenylalanine for adults and infants respectively. RNIs of other essential amino acids were below 20% for both adults and infants whereas RNIs of leucine and methionine for adults and infants for the selected fish species were ≤5%. Among five sampled fish species, H. nehereus contained the lowest amount of amino acids. Total amino acids (AAs), total EAAs, total NEAAs and EAA/NEAA were highest in L. savala whereas lowest in H. nehereus except EAA/NEAA which was 1.2. The five marine fish species had good level of essential amino acids and they could be served in mixed diet or complementary with other diets containing essential amino acids to fulfill the essential amino acid requirements. Knowledge from this study would increase the utilization of food fish, making balanced diet chart and patient guidance in case of specific nutritional needs.*

Keywords: *Marine fish, essential amino acids, non-essential amino acids, Recommended Nutrient Intake (RNI)*

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I. Introduction

Fish protein, which is required for health management for humans, is a blend of essential amino acids, minerals and vitamins [1]. As the population growth is increasing throughout the world, the production of foods with good quality proteins to meet human requirements is becoming a major challenge [2]. Protein quality of food depends on content of essential amino acids like leucine, lysine and phenylalanine [3]. Amino acids are building blocks of proteins and acts as intermediates in different crucial metabolic pathways [4]. Biologically important substances including nucleotides, peptide hormones, and neurotransmitters are synthesized from amino acids [5]. Inadequate consumptions of quality proteins and calorie intake lead to lethal form of malnutrition/hunger called Protein-Calorie Malnutrition (PCM) or Protein-Energy Malnutrition (PEM). Extreme conditions of PCM are kwashiorkor and marasmus, which are observed in children [6]. And about 870 million people in the world are suffering from chronic protein malnutrition where 80% of children suffering from PCM are from developing countries [7, 8].

In Bangladesh marine fisheries production was 6.26 lakh MT in 2015-16 and its contribution to total fish production was 16.15% with growth rate of 4.49% [9]. It has been estimated that about 80% of the animal protein in our diet comes from fish alone [10]. People choose marine fishes in terms of taste, availability, affordability and varieties of species. So, the knowledge of the composition of marine fish species is essential before including them in diet. Information concerning the amino acid compositions of marine fishes of Bay of Bengal is still scarce. Therefore, a proper understanding about the amino acid compositions of these species has become a primary requirement for the nutritionists and dieticians to consider them as a source of the essential nutritional components for human. Thus, this study wasundertaken to generate information on amino acid composition of commercially important as well as edible five species of marine fishes from Bay of Bengal, and in addition, to compare with reference value of essential amino acid requirements of adult (>18 yr)population and infants (7-23 months) as Recommended Nutrient Intake (RNI)to enhance the scope of utilization of nutritional knowledge in diet consultancy and clinical chemistry.

II. Materials And Methods

2.1 Sampling method

Five marine fish species Rupchanda(*Pampus chinensis*, Euphrasen 1788), Coral (*Lates Calcarifer*,Bloch 1790), Poa(*Johnius argentatus*,Houttuyn 1782), Loitta(*Harpodon nehereus,* Hamilton 1922), Churi (*Lepturacanthussavala*, Cuvier 1829) were collected from Fishery Ghat, Chittagong; one of the most commercial marine fish landing centers of Bangladesh during July to September 2015. Three replicates of collected samples were immediately preserved in ice and transported in an insulated ice box to Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh. After arrival at BCSIR, collected fish samples were identified according to Rahman [18]. The average length and weight (mean ± standard deviation) of *P. chinensis* were accordingly 22 ± 3.75cm and 180 ± 20gm, *L. calcarifer* 28 ± 4.30cm and 260 ± 30gm, *J. argentatus* 21.5 ± 3.32cm and 85 ± 10gm, *H. nehereus* 23 ±2.22 cm and 55 ± 10gm and *L. savala* 67±3.67cm and 265 ± 50gm. Then the samples were beheaded, gutted, washed, filleted and only muscle portion was taken which was homogenized as raw edible portion prior to analytical tests.

2.2. Analysisof the profiles of amino acids

The crude protein content was determined by Kjeldahl method [11].Amino acid compositions were determined by using an amino acid analyzer (Shimadzu, Japan), which could only determine fourteen amino acids.At first 0.5gm sample was taken and paste was made with 50ml 6N HCl by mortar pestle and then filtered. The filtrate was hydrolyzed for 22-24 hr in a hydrolyser apparatus. After hydrolyzing,HCl was removed from filtrate by evaporating in a water bath for 3-4 times with distilled water. At the end of evaporation, the solution was volume up to 25 ml in a volumetric flask by 0.1N HCl. This stock was used for determining amino acid in High Performance Liquid Chromatography (HPLC) by the following method [12].

2.3. Statistical analyses of results

Data were presented as mean ± SEM and evaluated by using the statistical softwarepackage IBM SPSS Windows version 20.0 (IBM Corp.) with the level of significance at $p< 0.05$. Microsoft Office Excel 2007 was used to produce graphs.

2.4. Calculation of potential contribution to recommended nutrient intakes

The potential contribution of each species to daily recommended value in infant at the age of 7-23 months and adult (>18 year) was calculated first by assigning an average reference value for each EEAs for infants to account for variations in requirements throughout the period from age 7 to 23 months and for adult to account for variations in requirements throughout the age >18 year [7]; then by calculating the contribution from a standard portion of each species that is 50 g/day for adult and 25 g/day for infants [13,14] as a percentage of the average RNI. Weight was estimated at the 50th percentile according to WHO growth standards where 7months old of 7.6 kg and 23 months old of 12.0kg and the mean of weight 10kg was taken for infant [15] and for adult 60kg was taken as standard weight.

III. Result And Discussion

Dietary protein in ample amount is required for growth, survival, development, reproduction and maintaining good health throughout life. Amino acids are building blocks of proteins and actas intermediates in metabolism [16]. Important roles of amino acids include cell signaling, regulators of gene expression and protein phosphorylation cascade, nutrient transport, metabolism in animal cells, innate and cell-mediated immune responses [5]. Amino acids are of two types: essential or indispensable amino acids and non-essential or dispensable amino acids.Essential amino acids (EAAs)cannot be synthesized by the organism, but must be supplied in its diet and these are phenylalanine, valine, threonine, tryptophan, methionine, leucine, isoleucine, lysine, and histidine [5]. Five non-essential amino acids (NEAAs) are dispensable in humans, meaning they can be synthesized in the body and these are alanine, aspartic acid, asparagine, glutamic acid and serine.Six other non-essential amino acids are considered conditionally essential in the human diet, meaning their synthesis can be limited under special patho-physiological conditions, such as prematurity in the infant or individuals in severe catabolic distress. These six are arginine, cysteine, glycine, glutamine, proline and tyrosine [16].

3.1 Essential amino acids(EAAs)

Total eight essential amino acids (EAAs) were identified *viz*. histidine, isoleucine, phenylalanine, lysine, valine, leucine, serine, and methionine;and their individual quantity in five selected fish species is presented in table-1.

Table- 1: Essential Amino Acid Compositions of Five Selected Fish Species

Sl. No.	Amino acids	gm / 100gm of edible portion				
		P. chinensis	*L. calcarifer*	*J. argentatus*	*H. nehereus*	*L. savala*
1	Histidine	864.33 ± 2.12	837.2 ± 70	698.17 ± 8.47	419.58 ± 2.22	884.5 ± 10.15
2	Isoleucine	627.46 ± 0.28	628.6 ± 2.80	519.09 ± 3.63	307.84 ± 5.18	640.9 ± 1.30
3	Phenylalanine	487.86 ± 0.42	628.6 ± 5.60	434.39 ± 4.84	254.56 ± 2.22	577.1 ± 7.25
4	Lysine	418.78 ± 1.41	392 ± 0.70	306.13 ± 2.42	185.74 ± 0.51	410.35 ± 7.25
5	Valine	287.64 ± 1.41	295.4 ± 0.42	212.96 ± 0.24	139.86 ± 0.14	304.5 ± 0.43
6	Leucine	235.48 ± 2.82	274.4 ± 1.40	174.24± 2.42	99.9 ± 0.74	272.6 ± 4.35
7	Threonine	186.12 ± 0.141	203 ± 0.28	152.46 ± 0.484	95.46 ± 0.222	191.4 ± 0.58
8	Methionine	55 ± 0.141	65.8 ± 0.28	38.72 ± 0.36	20.72 ± 0.37	60.9 ± 1.02

Histidine was found to be the highest estimated amino acid among all amino acids in all the sampled fishes. Multiple roles of histidine include protein interaction [17], growth and repairing of tissue, maintenance of the myelin sheaths, and removing heavy metals from the body [18].Maintaining the osmoregulatory process, energy production and use in other metabolic pathways during emergency conditions are also the roles of histidine [19]. It was found to be ranged from 419.58 ± 2.22 to 884.5 ± 10.15 mg/100gm of raw edible (muscle) portion where highest content of histidine belonged to *L. savala* while lowest was found in *H. nehereus*.Three sampled fish species *viz.P. chinensisL. calcarifer* and *L. savala*would fulfill 70% of recommended nutrient intake of histidine for adult.*J. argentatus* and *H. nehereus* could contribute 58% and 35% of the reference value of histidine from a standard portion. For the nutritional requirements for infants, proportion of histamine is more than the requirement in *L. savala*.*P. chinensis* and *L. calcarifer*and might contribute ≥95% of histidine requirement. Presence of high level of histidine in *L. pangusia*would contribute to better taste [20] and that is the probable reason for better taste of these marine fishes. Histidine also involves in the production of histamines [17], which are responsible for allergic and inflammatory reactions. So cautions should be taken by not exceeding the limit for those who have food allergy.After histidine the second highest concentration of EAAs was isoleucine and it varied considerably from 307.84 ± 5.18 to 640.9 ± 1.3mg/100gm where highest and lowest level belonged to *L. savala* and *H. nehereus* respectively.*P. chinensisL. calcarifer, L. savala*would fulfil >25% of recommended nutrient intake of isoleucine for adult. *J. argentatus* and *H. nehereus* could contribute 21% and 12% of the reference value of isoleucine from a standard portion.Moreover, P. *chinensisL. calcarifer, L. savala*could balance >40% and *J. argentatus, H. nehereus*might contribute 36% and 21% respectively of daily isoleucine requirement for infant. Isoleucine is a branched chain amino acid and is needed for muscle formation and proper growth [21]. Chronic renal failure (CRF) patients on hemodialysis need low plasma level of the branched chain amino acids (BCAA) such as leucine, isoleucine, and valine [22].

Phenylalanine ranged from 254.56 ± 2.22 to 628.6 ± 5.6mg/100gm where maximum and lowest content belonged to*L. calcarifer* and *H. nehereus* respectively. Requirement of phenylalanine is quite higher. *L. calcarifer* and *L. savala* might fulfill around 20% and *P. chinensis* and *J. argentatus* might contribute around 15% and *H. nehereus* might fulfill 8% of daily required value of phenylalanine for adult. *L. calcarifer* and *L. savala* might contribute around 25% whereas *P. chinensis* might balance 20% of daily phenylalanine requirement in infant from standard portion.Lysine is required for optimal growth and immunodeficiency is caused by its deficiency. Cold sores have been reported to be treated by lysine [23]. It is taken by mouth or applied directly to the skin for this use. Lysine concentration considerably ranged from 185.74 ± 0.51 to 418.78 ± 1.41mg/100gm where highest concentration was found in *P. chinensis* and *H. nehereus* had only with a concentration of 185.74 ± 0.51mg/100gm of Lysine. Lysine content was found to be varied from 110 to 780 mg/100gm between pre monsoon and monsoon season in Ribbon fish [4] and this kind of data is scarce for other fishes. *P. chinensis*,*L. calcarifer* and *L. savala* mightfulfill>10% of the daily requirement of lysine of adult.*P. chinensis*,*L. calcarifer* and *L. savala*might contribute >15% of daily lysine requirement of infant.

Sampled fishes were lower in valine concentration. The amount of valine estimated to be ranged from 139.86 ± 0.14 to 304.5 ± 0.43mg/100gm, where highest and lowest concentration belonged to *P. chinensis* and*H. nehereus* respectively. *P. chinensis*,*L. calcarifer* and *L. savala* might fulfill around 15% of regular reference value of valine in infant. During intense physical activity, valine supply extra glucose to the muscles for energy production which results in prevention of the breakdown of muscles[15]. Muscle protein synthesis is stimulated only by leucine [25]. Moreover,leucine plays important remedial role in critical conditions like burn, trauma, and sepsis. Leucine slows down the degradation of muscle tissues by increasing the synthesis of muscle proteins [26]. Leucine usually found very high in marine fishes [16].Leucine was found to be ranged from 99.9 ± 0.74 to 274.4 ± 1.4mg/100gm of raw edible portion where highest content belonged to *L. calcarifer* and lowest belonged to *H. nehereus*. Requirement of Leucine is the maximum in concentration of all EAAs but regrettably*P. chinensis*,*L. calcarifer*, *L. savala*,*J. argentatus* and *H. nehereus* might contribute ≤5% of total requirements of adult.

Table-2: Amino acid requirements of adult (60kg) andpotential contribution (%) offish species from standard value. Reference value according to WHO 2007.

Amino acids	Histidine	Isoleucine	Leucine	Lysine	Methionine	Phenylalanine	Threonine	Valine
Average requirement mg/kg/d (RNI)	10	20	39	30	10	25	15	26
Requirementfor 60kg BW mg/d	600	1200	2340	1800	600	1500	900	1560
Potential contribution (%) to daily EAA requirement of adult (60kg)								
P. chinensis	72	26.2	5.03	11.63	5	16.3	10.34	9.22
L. calcarifer	69.8	26.2	5.9	11	5.5	21	11.3	9.5
J. argentatus	58.2	21.63	3.73	8.5	3.22	14.5	8.5	6.8
H. nehereus	35	12.83	2.2	5.2	1.73	8.5	5.3	4.5
L. savala	73.7	26.7	5.83	11.4	5.1	19.24	10.7	9.8

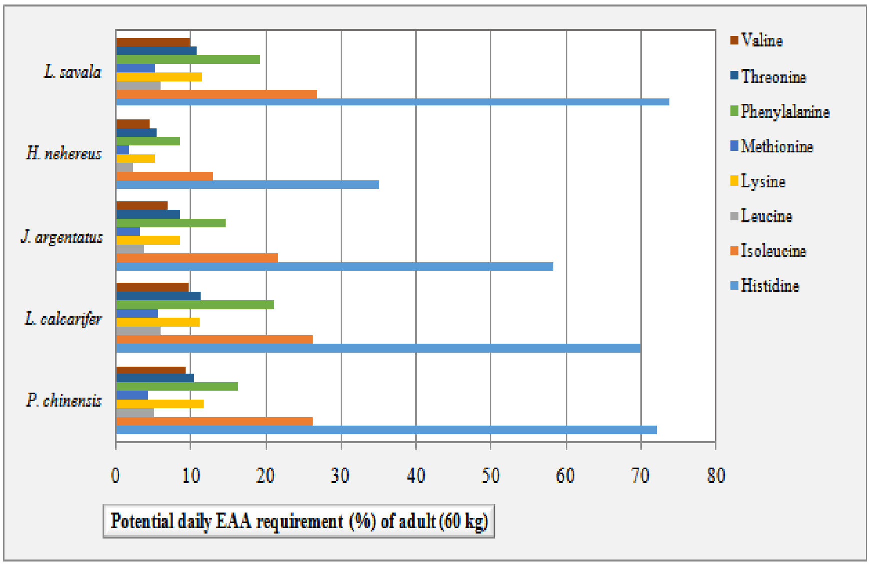

Fig. 1 Potential contribution to daily EAA requirement from a standard serve of fish for adult (60 kg BW).Standard serve of fish for Adult is 50 g/p/day.

On the other hand essential amino acid threonine concentration was identified to be ranged from 95.46 ± 0.222 to 203 ± 0.28mg/100gm. *L. calcarifer* had maximum concentration of threoninewhile lowest concentration was found in *H. nehereus*.Threonine is used for treating various nervous system disorders including spinal spasticity, multiple sclerosis, familial spastic paraparesis, and amyotrophic lateral sclerosis [24].*P. chinensis*, *L. calcarifer* and *L. savala* mightfulfill>10% of the daily requirements of threonine in adult. In addition, *P. chinensis*, *L. calcarifer*, *L. savala* and *J. argentatus*might complete 10-15% of recommended value of threonine in infant from standard portion. All sampled fishes were lower in valine concentration. The amount of valine estimated to be ranged from 139.86 ± 0.14 to 304.5 ± 0.43mg/100gm, where highest highestconcentration belonged to *P. chinensis* and lowest to*H. nehereus*. *P. chinensis*,*L. calcarifer* and *L. savala* might fulfill around 15% of regular referenced value of valine in infant.Valine helps to prevent the breakdown of muscle by supplying the muscle with extra glucose for energy production during intense physical activity [15].Leucine is the only dietary amino acid that can stimulate muscle protein synthesis [25] and has important therapeutic role in stress conditions like burn, trauma, and sepsis [26]. As a dietary supplement, leucine has been found to slow the degradation of muscle tissue by increasing the synthesis of muscle proteins [26]. Leucine usually found very high in marine fishes [16].Leucine was found to be ranged from 99.9 ± 0.74 to 274.4 ± 1.4mg/100gm of raw edible portion, where highest content belonged to *L. calcarifer* and lowest belonged to *H. nehereus*. Requirement of Leucine is the maximum in concentration of all EAAs. *P. chinensis*,*L. calcarifer*, *L. savala*,*J. argentatus* and *H. nehereus* might contribute ≤5% of total requirements of adults.

Table-3: Amino acid requirement of infant (7-12 months) and potential contribution (%) of each fish species from standard value. Reference value according to WHO 2007.

Amino acids	Histidine	Isoleucine	Leucine	Lysine	Methionine	Phenylalanine	Threonine	Valine
Average requirement mg/kg/d	22	36	73	64	31	59	34	49
Requirements for infants (7-12month) mg/d	220	360	730	640	310	590	340	490
Potential contribution (%) to daily EAA requirement of adult (60kg)								
P. chinensis	98	43.57	8	16.35	4.4	20.6	13.7	14.7
L. calcarifer	95	43.65	9.4	15.3	5.3	26.6	15	15
J. argentatus	79.34	36	6	12	3.12	18.4	11.2	10.9
H. nehereus	47.68	21.3	3.4	7.2	1.67	10.8	7	7.13
L. savala	100.5	44.5	9.33	16	5	25	14	15.5

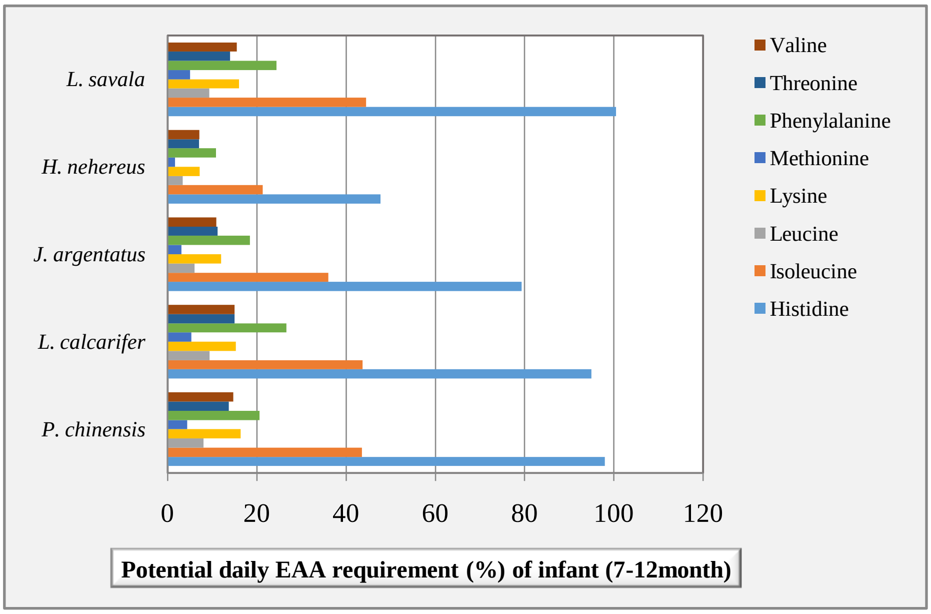

Fig. 2 Potential contribution to daily EAA requirements from a standard serve of fish for Infants (7-12months).Standard serve of fish for infants (7-12 months) is 25 g/p/day.

On the other hand, essential amino acid threonine concentration ranged from 95.46 ± 0.222 to 203 ± 0.28mg/100gm where *L. calcarifer* had maximum concentration of threonineand lowest concentration was found in *H. nehereus*.Nervous system disorders such as spinal spasticity, multiple sclerosis, familial spastic paraparesis, and amyotrophic lateral sclerosis reported to be treated with threonine [24].*P. chinensis*, *L. calcarifer* and *L. savala* might fulfill >10% of the daily requirements of threonine in adult. In addition, *P. chinensis*, *L. calcarifer*, *L. savala* and *J. argentatus*might complete 10-15% of recommended value of threonine in infants from standard portion.Among the eight essential amino acids identified, methionine was found to be in lowest concentration in the sampled fishes. The concentration of methionine ranged from20.72 ± 0.37 to 65.8 ± 0.28mg/100gm with highest and lowest level in *L. calcarifer* and *H. nehereus* respectively.Methionine reported to be highest among all amino acids in marine fishes [27] but this is dissimilar with the result of present study which might be due to variability of seasons, ecology of fish catching area, and amino acid content variations among fish species[4].Methionine has been reported to treat liver disorders, mental disorders such as depression schizophrenia and alcoholism. Allergies, asthma, copper poisoning, radiation side effects, drug withdrawal, and Parkinson’s disease were also treated with methionine [28]. All the five sampled fish species would fulfill ≤5% of the daily methionine requirements of both adults and infants.

3.2. Non-Essential amino acids (NEAAs)

In this experiment total six non-essential amino acids were detected of which four are dispensable in humans, meaning they can be synthesized in the body. These are alanine, aspartic acid, glutamic acid and serine. And two are conditionally dispensable which are arginine and glycine. Species wise composition of NEAAs is presented in table-4. Among NEAAs, glutamic acid was the most abundant and considerably varied from 392.2 ± 3.7 to 813.45 ± 10.15mg/100gm wherehighest and lowest concentration level of glutamic acid belonged to*L. savala* and *H. nehereus* respectively. Glutamic acid is the major constituents in some marine fishes like grey mullet and moreover Indian halibut and silver jaw fish show higher amounts of glutamic acid [29]. Presence of high amount of glutamic acid in the fishes contributes to the sweet taste of the fishes [21].Glutamic acid especially its monosodium salt is a known as flavoring agent and hence its predominance in amino acid make up can be a reason for the preferred flavor of the fishes [29].Aspartic acid (FAA) is the precursor of methionine, threonine, isoleucine, and lysine that regulates the secretion of important hormones [5]. The amount of aspartic acid concentration varied from 218.3 ± 2.22 to 510.4 ± 5.8mg/100gm in sampled fishes in which highest and lowest level belonged to *L. savala* and *H. nehereus* respectively.

Table- 4: Non-essential amino acid contents of Selected Fish Species

Sl. No.	Amino acids	mg / 100gm of edible portion				
		P. chinensis	*L. calcarifer*	*J. argentatus*	*H. nehereus*	*L. savala*
1	Glutamic acid	731.79 ± 2.82	775.6 ± 4.2	636.46± 4.84	392.2 ± 3.7	813.45 ± 10.15
2	Aspartic acid	439.92 ± 1.41	498.4 ± 2.8	365.42 ± 3.63	218.3 ± 2.22	510.4 ± 5.8
3	Arginine	530.16 ± 0.141	466.2 ± 0.56	408.98 ± 0.363	242.72 ± 2.96	478.5 ± 4.35
4	Glycine	362.37 ± 0.423	380.8 ± 0.28	292.82 ± 0.121	169.46 ± 0.148	408.9 ± 0.435
5	Alanine	298.92 ± 0.282	312.2 ± 0.14	238.37 ± 0.242	152.44 ± 0.222	332.05 ± 0.725
6	Serine	245.34 ± 0.28	264.6 ± 0.14	189.97 ± 0.24	125.06 ± 0.14	236.35 ± 0.58

Special patho-physiological conditions, such as prematurity of infants and severe catabolic distress limit the synthesis of arginine in human body. Highest arginine content (530.16 ± 0.141) was found in *P. chinensis* whereas lowest (242.72 ± 2.96) found in *H. nehereus*. Glycine plays important roles in metabolic regulation, preventing tissue injury, enhancing anti-antioxidant activity, promoting protein synthesis and wound healing, and improving immunity and treatment of metabolic disorders in obesity, diabetes, cardiovascular disease, ischemia-reperfusion injuries, cancer, and various inflammatory diseases [30].Highest glycine content (408.9 ± 0.435) was found in *L. savala* whereas lowest (169.46 ± 0.148) found in *H. nehereus*. Amino acids such as tryptophan, tyrosine, histidine, and arginine are used by the brain for the synthesis of various neurotransmitters and neuromodulators [31]. Alanine content variably ranged from 152.44 ± 0.222 to 332.05 ± 0.725mg/100gm found in *L. savala* and *H. nehereus* respectively. Serine concentration was considerably varied from 125.06 ± 0.14 to 264.6 ± 0.14mg/100gm where highest and lowest level belonged to *L. calcarifer* and *H. nehereus* respectively. Serine is being used for treatment of schizophrenia.

Table- 5: Total amino acid contents of Selected Fish Species

Sl. No.	Amino acids	gm / 100gm of edible portion				
		P. chinensis	*L. calcarifer*	*J. argentatus*	*H. nehereus*	*L. savala*
1.	Total AAs	5771.13±18.189	6022.8 ± 26.6	4668.18± 25.773	2823.84±21.016	6121.9 ± 45.235
2.	Total EAA	3162.67±8.742	3325±12.18	2536.16±22.86	1523.66±11.60	3342.25±32.33
3.	Total NEAA	2608.5±5.36	2697.8±8.12	2132.02±9.44	1300.18±9.39	2779.65±22.04
4.	EAA/NEAA	1.211	1.232	1.2	1.2	1.2

In case of total amino acid contents, highest was estimated in *L. savala* (6121.9 ± 45.235mg/100gm) followed by *L. calcarifer* (6022.8 ± 26.6mg/100gm), *P. chinensis* (5771.13 ± 18.189 mg/100gm), *J. argentatus*(4668.18 ± 25.773mg/100gm) and *H. nehereus* (2823.84±21.016mg/100gm). *L. savala* (3342.25±32.33mg/100gm) had the highest estimated total essential amino acid value followed by *L.calcarifer* (3325±12.18mg/100gm), *P. chinensis* (3162.67±8.742 mg/100gm), *J. argentatus* (2536.16±22.86mg/100gm) and in *H. nehereus* (1523.66±11.60mg/100gm). The ratio of EAA/non EAA was estimated to be highest in *L. calcarifer* (1.23) then followed by *P. chinensis* (1.211) whereas the ratio was 1.2 in *J. argentatus*, *H. nehereus*, and *L. savala*. The ratio of EAA/non EAA is important [21] and it is needed to maintain EAA more than non EAA because the body cannot synthesize it. The ratio of EAA/non EAA was around 1.2 in five fishes that showed excellent in essential amino acid content.

III. Conclusions

Considerable amount of EAAs *viz*. histidine, isoleucine, phenylalanine, lysine, threonine and NEAAs *viz*. glutamic acid, aspartic acid, arginine and glycine were found in *P. chinensis*,*L. calcarifer* and *L. savala*. Other EAAs and NEAAs were found to be in moderate concentration in those three species except valine and methionine. So, these three fish species might contribute to the daily amino acid requirements in combination or along with the other food sources with amino acids. *J. argentatus* also contained justifiable amount of different amino acids and could contribute in combination with those three fishes or with other food sources to fulfill the amino acid requirements of human. All the EAAs and NEAAs reported to be lowest in *H. nehereus* and thus its amount of consumption need to be calculated to fulfill the daily amino acid requirements. The current study might be a milestone to the assessment of ediblemarine fish nutrition which will lead to investigations on nutritional information of other marine fish species of Bangladesh.

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