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Chemical composition and nutritional value of Anchovy (*Stolephorus commersonii*) caught from Kerala coast, India

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ABSTRACT

Proximate composition, amino acid profile, fatty acid composition and mineral status of Commerson's anchovy (Stolephorus commersonii) in three different size groups (3-5g,6-10g,25-30g)were studied. Moisture content was high in big size group and low in small size group. Fat content was found to be high in small size group and low in big size group showing an inverse relation between moisture content and fat content. It was observed that the protein content was high in medium sized fish. The essential amino acid content was significantly higher in small(3-5g)and medium sized fish compared to larger fish. The polyunsaturated fatty acid content was higher in small sized anchovies compared to other groups. The docosahexaenoic acid (DHA) content was five times higher than the eicosapentaenoic acid (EPA) content in all the fishes irrespective of size. The higher content of EPA produces antithrombotic anti-inflammatory effects and help in calcium metabolism. The mineral content was found higher in small sized fishes. Anchovy can be a cheap and ideal dietary supplement for children and elderly.

Keywords: Anchovy; *Stolephorus commersonii*; Proximate composition; Amino acid; Fatty acids; Mineral composition.

INTRODUCTION

Fish is generally considered as high in nutritional value due to its cheap and high quality protein with a higher biological value of 15-23%. Interest in fish consumption increased of late due to the high content of health significantomega-3 PUFAs, particularly eicosapentaenoic acid (20:5n-3, EPA) and docosahexaenoic acid (22:6n-3, DHA)[1].Besides playing important role in cardiovascular and inflammatory diseases, are significant in the development of neuron in infants and in fat glycemic control[2, 3 and 4]. Further, fish has a good complement of the essential amino acids, particularly lysine which is low in cereals, thus providing a nutritional balance in the overall quality of a mixed diet [5].Fish are important sources for many other nutrients namely vitamins such as Vitamin A, D and E as well as minerals including calcium, iodine, selenium etc. There are abundant evidence indicating the significant of fish in brain development and learning in children, protects vision and eye health, and protection from cardiovascular disease and some cancers.

The landing of anchovies in India is 79127t in 2010[6] shows a high potential and this low value fish has a high liking in the costal populations. Anchovies are small saltwater fish that grow up to 20 cm (8 in.) and prefer the warmer waters around the world. Anchovies belong to the family *Engraulidae* and there are 144 species in 17 genera, found in the Atlantic, Indian, and Pacific Oceans. Anchovies are usually classified as an oily fish[7, 8].The

biochemical evaluation of nutritional parameters of Commerson's anchovy (*Stolephorus commersonii*) was carried out with reference to its in order to define it nutritional value and to relate to health benefits.

MATERIALS AND METHODS

Sample collection and preparation

The Commerson's anchovy (*Stolephorus commersonii*) for the study were collected from fish landing center at Cochin, India. Fish samples were transported to the laboratory in iced condition in insulated Styrofoam boxes. The samples were cleaned with distilled water and surface water was blotted with filter paper and whole anchovies were homogenized to form mince. The homogenized fish samples were stored at -20^{0}C pending analysis. A portion of homogenized samples were used for evaluation of proximate composition, evaluation of amino acid and fatty acid profiles and mineral contents.

Chemicals

All reagents and solvents used in this investigation were of analytical grade. Standards like amino acids, fatty acid methyl esters, etc were purchased from Sigma–Aldrich GmbH (Steinheim, Germany).

Biochemical analyses

Moisture of the fish samples was determined according to the AOAC (2000) method by drying in a hot air oven at 105°C. Total protein content in the homogenized samples was determined using micro Kjeldahl method[9]. The total nitrogen was multiplied by 6.25 to get the crude protein in the fish meat. The estimation of crude fat content was done by continuous extraction of fat with petroleum ether according to AOAC (2000). Ash content was determined by igniting the sample for 12 h in a furnace at 525°C[9]. Mineral contents of the ash were assayed using standard methods. Macro elements (Na, K and Ca) were determined by flame photometry (BWB XP) using working standards in the range of 10-40 ppm for each element. Trace metals (Cu, Fe, and Zn) were determined by atomic absorption spectrophotometer (Spectra-220 AA, Varian). All determinations were carried out in triplicates and the mean values were taken.

Amino acids analysis

For amino acid analysis, 100 mg of homogenized sample was hydrolyzed in 6 N HCl in evacuated sealed tubes at 110°C for 24 hrs[10]. After derivatization by O-phtalaldehyde, amino acids were identified and quantified by ion exchange chromatography using an amino acid analyzer (LC-10AS,Shimadzu Corporation) equipped with an ion exchange column (Shim-Pack Isc-07/S1504Na), quaternary pump (LC-10ATVP) and fluorescence detector(RF-10AXL). Mobile phase (Buffer A) contained trisodium citrate, distilled ethanol and perchloric acid(pH 3.2) and Buffer B had sodium citrate, NaOH and Boric acid (pH 9.8). The flow rate was constant at 0.4 ml/min, and the oven temperature was set at 60°C. The fluorescence excitation and emission wavelengths were 340 nm and 450 nm respectively. The results were expressed area percentage.

Determination of fatty acid profile

Total lipids were extracted according to the method of Folch *etal.*,[11]using chloroform/methanol (2:1). Aliquots of the chloroform layer extract were evaporated to dryness under nitrogen and the lipids were quantified gravimetrically. Fatty acids methyl esters (FAMEs) were prepared by modified method of Metcalfe *et. al.*,[12],as suggested by Sankar *et al.*, [13].Methyl esters of the fatty acids were separated by gas chromatography [Trace GC Ultra, Thermo] equipped with a capillary column [30m long and 0.25mm diameter] and a flame ionization detector. Nitrogen was used as carrier gas at a flow rate of 0.8ml/min. The conditions of the GC include increasing the temperature from 110°C to a final temperature of 20 at a rate of 2.7°C/min. Injector and Detector temperature were kept at 260°C and 275°C respectively. Fatty acids separated were identified by comparing retention times with those obtained by a mixture of standard fatty acids and quantified using Thermochrom card (Thermo Corporation) software. Individual fatty acids were expressed as a percentage of total fatty acids.

Statistical analysis of data

Data are presented as means ± standard deviation of means. Statistical analysis was performed using Microsoft excel software.

RESULTS AND DISCUSSION

Proximate analysis

Fish has the potential to be considered as a balanced food and can therefore be expected to provide relief from malnutrition. The proximate composition of anchovies (Table1) compares well with the general composition of fish reported earlier [14]. The composition of fish however, varies with diet, feed rate, genetic strain and age [15].

Moisture content was high in 25-30 g size group and low in 3-5g size group. The Protein content ranged between 14-16 g/100g was relatively higher in 6-10gsize group. Fish is an excellent and relatively a cheaper source of animal protein of high biological value. Fat content in the fishes ranged between 1.25 to 2.41% with 3-5g size group contributing to high fat content. Therefore the different sizes fall in the low to medium fatty group. The data shows an inverse relation between moisture content and fat content which is in concordance with earlier studies[16, 17 and 18]. Ash content was high in 3-5g size group.

Table1. Proximate composition (g/100g) of *Stolephorus commersonii* at three different size groups

Size groups	Moisture mean±SD	Protein mean±SD	Fat mean±SD	Ash mean±SD
3-5g	76.47±0.36	14.71±0.39	2.41±0.20	6.63±0.33
6-10g	76.97±0.59	16.95±0.27	1.97±0.14	4.02±0.08
25-30g	80.65±0.29	15.71±0.34	1.25±0.10	2.40±0.46

Amino acids analysis

The amino acid profile follows the same pattern in all the three size groups with aspartic acid, glycine, alanine, valine and leucine contributing to major portions expects that the lysine content was also double in 6-10g size group. The total essential amino acid content almost compares well among the three species. Essential amino acids are essential for the growth and maintenance of the body, and they want to supply through diet. This fish contains almost all the essential amino acids, so consumption of both fishes is good for health.

Table2. Amino acid profile(g/100g protein) of *Stolephorus commersonii* at three different size groups

Amino Acid Size groups			
	3-5 g	6-10 g	25-30 g
Aspartic acid	10.41±0.48	11.71±1.02	10.77±0.98
Threonine	6.37±0.32	5.50±0.17	5.78±0.16
Serine	6.42±0.12	5.97±0.26	6.27±0.31
Glutamic acid	15.12±0.26	14.77±0.23	14.92±0.31
Proline	1.57±0.40	1.51±0.23	0.99±0.24
Glycine	10.73±0.49	11.04±0.42	11.30±0.43
Alanine	9.05±0.32	8.87±0.46	10.46±0.47
Cysteine	0	0	1.06±0.28
Valine	7.37±0.17	6.95±0.21	7.14±0.28
Methionine	2.90±0.34	1.44±0.21	2.24±0.14
Isoleucine	4.64±0.22	5.03±0.31	4.81±0.37
Leucine	9.73±0.27	7.99±0.35	8.62±0.32
Tyrosine	1.24±0.40	0.57±0.35	1.60±0.45
Phenylalanine	3.85±0.29	3.74±0.20	3.56±0.11
Histidine	3.24±0.24	3.49±0.29	3.85±0.37
Lysine	4.55±0.36	8.66±0.24	4.08±0.16
Arginine	0.91±0.28	0.60±0.44	0.32±0.44
Tryptophan	1.57±0.33	1.72±0.27	1.53±0.21
Total Essential amino acids	40	40.17	38.77

Fatty acid analysis

There were changes in the fatty acid profiles among the 3 size groups. PUFA was the predominant fatty acid in the small size fishes which in medium size fish saturated fatty acids were predominating. The PUFA content was decreasing with increasing size. The large size fishes showed a higher proportion of monounsaturated fatty acids (MUFA). Among the individual fatty acids the C16 increased with size and C18 acids up to medium size and showed a decrease in large fish. Fatty acids, C16:1, C18:1 and C 20:1 were the major MUFA. Only C 16:1 acid showed an increased with size while the other two acids differed significantly. The PUFA ranged between 23 to 52% of total fatty acids with the smaller size showing higher content. Docosahexaenoic acid (C22:6) showed a higher content ranging from 10 to 22% with maximum (22.5%)showing in smallest size followed by medium (14%) and bigger size (10%). In small fish C22:2 showed a higher content. The EPA content was 2.8 to 4.9 with maximum being in smaller fishes. The ration of n-3 to n-6 for the fishes varied between 1.8 and 4.4 with lowest being in smaller fishes. The higher is the ratio, higher is the physiological significance of the fish oil and better the biological activity.

Biosynthesis of long-chain PUFA, including eicosapentaenoic acid (EPA; 20:5n-3), docosahexaenoic acid (DHA; 22:6n-3) and arachidonic acid (AA; 20:4n-6), which play a major role in maintaining health, is not very efficient in humans.[19, 20, 21and 22].These ω-3 fatty acids also regulate prostaglandin metabolism, which regulates the vascular functions in growing children. DHA is essential for the normal functional development of the retina and brain, particularly in premature infants [23].

Table3. Fatty acid profile (% of fatty acids in terms of total fatty acids) of *Stolephorus commersonii* at three different size groups

Fatty Acid Size groups			
	3-5 g	**6-10g**	**25-30g**
Saturated fatty acids(SFA)			
C 12:0	0.03±0	0.63±0.21	0.1±0
C 13:0	0.08±0	4.56±0.45	0.11±0.04
C 14:0	1.8±0.11	4.76±0.55	1.32±0.9
C 15:0	1.29±0.12	1.78±0.12	0.86±0.13
C 16:0	8.79±0.34	30.34±0.74	31.83±1.21
C 17:0	1.06±0.3	1.35±0.33	1.03±0.16
C18:0	8.09±0.45	10.87±0.54	2.37±0.7
Others	2.91±0.41	2.99±0.35	1.43±0.4
Monounsaturated fatty acids(MSFA)			
C 16:1, n7	3.96±0.04	5.26±0.42	6.33±0.9
C 17:1,n7	0.91±0.07	0.11±0	2.59±0.5
C18:1, n9	8.94±0.56	10.16±0.81	0.22±0.1
C20:1, n9	6.08±0.45	0.27±0.15	23.3±1.1
C22:1, n9	1.05±0.2	0.56±0.16	1.95±0
Others	2.97±0.46	0.83±0.29	2.2±0.16
Polyunsaturated Fatty Acids(PUFA)			
C 18:2, n6	0.45±0.04	1.24±0.09	2.26±0.13
C 18:3, n3	2.32±0.15	2.17±0.17	0.12±0.21
C 20:2, n6	11.97±0.56	0.5±0.1	1.53±1.22
C 20:3, n6	1.31±0.1	0.54±0.3	0.67±0.2
C 20:4, n6	2.12±0.33	2.03±0.27	0.13±0.04
C 20:5, n3	4.97±0.39	2.87±0.76	3.07±0.45
C 22:6, n3	22.47±1.15	13.83±0.95	9.91±0.7
Others	6.25±0.69	1.93±0.06	5.67±1.45
∑SFA	24.04±1.2	57.28±1.65	39.05±1.14
∑MUFA	23.92±1.09	17.19±0.94	36.59±2.76
∑PUFA	51.87±1.99	25.11±1.54	23.36±1.44
n3	29.77	18.87	13.1
n6	15.85	4.31	4.59
n3/n6	1.88	4.38	2.85

Mineral composition

Fish is a rich source of important minerals, which are required for the normal life processes. Low sodium is the importance of fish but the value increases with increasing size. The potassium and calcium contents are comparable to other fish reported by kumaran *et al*.,[24].Trace minerals Cu, Mg and Zn were present in the range of 10 to 30 mg /100g in the fish. Mineral and metal contents may vary according to the surrounding environment [25, 26]. Zn was not noticed in the small and medium size fishes. The minerals are responsible for skeletal formation, maintenance of colloidal systems, regulation of acid-base equilibrium and for biologically important compounds such as hormones and enzymes. Mineral deficiencies can cause biochemical, structural and functional pathologies which depend on several factors, including the duration and degree of mineral deprivation. Here sodium, potassium and calcium were high in6-10gsize group compared to other size groups. This is in agreement with earlier findings.

Table4. Mineral profile (g/100g) of *Stolephorus commersonii* at three different size groups

Size groups	Na%	K %	Ca%	Cu%	Mn%	Zn%
3-5 g	0.39±0.05	1.27±0.04	0.44±0.05	0.02±0.04	0.01±0.03	0
6-10g	0.4±0.07	1.89±0.03	0.93±0.04	0.02±0.04	0.03±0.02	0
25-30g	0.93±0.07	1.22±0.04	0.73±0.05	0.01±0.05	0.01±0.03	0.01±0.05

CONCLUSION

The anchovy the low value fish demonstrated a high nutrient complement and hence can be an effective nutrient supplement for daily food. The higher essential amino acids, higher content of PUFA and MUFA and low sodium and high potassium and calcium could make a better nutrient for the consumers at a cheaper rate. India with its 8,118 km long vast coastal line has tremendous potential in terms of marine food resources[27].The high quality protein and essential fatty acids, vitamins and minerals found in fish and the effects of adding fish to traditional bland staple diets can stimulate appetite and increase food consumption of the young child and the aged, and of the ill including people living with HIV/AIDS [28].

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