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Some biochemical and nutritional studies on *Eutropius noloticus* and *Schilbe mystus*: Family Schilbeidae.

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ABSTRACT: The biochemical and nutritional composition of Oven dried *Eutropius nitoticus* and *Schilbe mystus* collected from Niger-Benue confluence were determined using standard. Analytical procedures, methods and Technicon sequential multi sample Amino Acid analyzer (TSM). The carbohydrate, lipid and protein were in the ratio of 1:3:4. The highest proximate component contained in the two species was protein (39.5-49.1g/100g) followed by lipid (30.0-33.3g/100g) and least contained was carbohydrate (10.4-12.8g/100g). The two species have high calorific values (570.04-649.28 kcal./100g) which are within the US/RDA recommended value. Glutamic acid (12.30-15.02g/6Gn) dominated the pool, followed by lysine (9.6-10.81g/16gN). However, the essential amino acids were within the FAO/WHO recommended pattern. The calculated chemical indices indicated that the two species are superior sources of high quality proteins. The essential minerals were within the WHO recommended values.

Key words: Proximate composition; Calorific values; Minerals, Fishes

Introduction

A number of metabolic adjustment involving nutrient stores, tissue synthesis and maintenance of metabolism takes place at various physiological stages of human development. At pregnancy the mother have to overcome these changes with high physiologic cost and increased material nutrition requirements (Hytten and Leitch, 1964). Nutrient deficiency has resulted in high opportunistic infections and diorrhoea (Taylor *et al*, 1997). Nutrient deficiency is also associated with decreased antioxidant and auto-immune defense mechanism; lower intelligence quotient (IQ), increased fetal, infant and children mortality, poor growth and birth defects (Hetzel, 1994).

Fish is an excellent source of protein, amino acids, carbohydrate minerals and fish oil for human nutrition (Peterson, 1978; Qyvind *et al*, 1994). Fish is highly digestible ($\geq$ 95%) than any other animal protein because of the absence of collagen (Bhuiyan *et al*, 1993).

The major problem with some dietary items is bio-availability of the nutrients contained in them and not the availability of the diets. The high digestibility and bio-availability of nutrients in fish places it above all other diets.

Given that there are considerable evidences in the use of fish and fish products as health food, the need arises for the investigation of nutritional composition of fresh-water fishes of tropical Africa, most of

available reports are on temperate marine and fresh water fishes (Arai, 1981, Ogata *et al* 1983 and Wilson and Poe, 1985). This paper discusses the proximate composition, amino acid, calory, nutritional values and the mineral composition of *Eutropius milotius* and *Schilbe mystus.* The species are numerous and form an important part of commercial catches. The data obtained will be useful to food industrialists, consumers and the dietetics.

Materials and Methods

A total of 688 fish samples were collected from Tiga, Zaria, Shiroro reservoirs and Niger – Benue confluence of Northern Nigeria. They are transported in ice-cooled boxes to the laboratory and analyzed within five days, after being eviscerated and weighed.

Proximate contents

The moisture content was determined by heating weighed fresh samples in an oven at 105°C until a constant weight was obtained. The difference between the fresh weight and the weight was recorded as the moisture content.

The dried samples were pooled for each species and milled into a pre-weighed porcelain crucible and ignited in an ashing muffle furnace maintained at 600°C. The ash determined when a constant weight was obtained.

The crude protein was obtained by the micro-Kjeldahl method and multiplied by 6.25, lipid and crude fibre were determined in duplicate according to the procedures of AOAC (1980) while the crude carbohydrate was estimated by different method (AOAC, 1975). The calorific values were calculated using conversion factors of 9.5 for lipid, 5.5 for protein and 4.1 for carbohydrate (Winberg, 1971).

One hundred grams of defatted powder was hydrolyzed and refluxed with 25cm^3 of 6M HCl. 10ml of internal standard (norleucine), 10ml amino acid standard (No 18) and 20ml of the buffered acid hydrolysate of sample (PH2) in duplicate were loaded in resin equilibrated cartridge of amino acid analyzer (TSM). A chromatogram was obtained with amino acid peaks corresponding to the magnitudes of their respective concentrations estimated in g/16gN to the equivalent of g/100g protein. The concentrations of the respective amino acid were read out according to the accepted formula in the operational manual of the TSM models. Chemical indices used to determine the nutritional values have the protein qualities of the two species. The calculated values were compared with the standard reference values of FAO/WHO (1973). The calculated values were compared with the standard reference values of FAO/WHO (1973). The essential to non-essential amino acid ratio (E:N), Essential amino acid to total nitrogen ratio (E:T), essential amino acid index (EAAI), Chemical/protein score. (C.S/P.S) and essential amino acid to protein ratio (E.P) were calculated as follows:

$$E:N = \frac{\text{Ratio of essential amino acid}}{\text{Ratio of non-essential amino acid.}}$$

$$E:T = \frac{\text{Essential amino acid}}{\text{Total amino acid}} \times 100$$

$$EAAI = \frac{\text{Ratio of essential amino acid}}{\text{Essential amino acid of whole hen's egg.}} \times 100$$

$$C.S/P/S = \frac{\text{Essential amino acid of protein} \times 100}{\text{Total amino acid of whole hen's egg}}$$

$$E:P = \frac{\text{Ratio of essential amino acid} \times 100}{\text{1000g test protein}}$$

Minerals Contents

The minerals in the ash were brought into solution by wet digestion using conc. Nitric acid (63%) perchloric acid (60%) and sulphoric acid (98%) in the ratio of 4:1:1 (Harris, 1974). Potassium and sodium were determined using flame photometer (Allen, 1974). Phosphorus was determined using Spectronic 20E, other minerals were by Perkin-Elmer Atomic Absorption Spectrometer model 2900 (US) (AOAC, 1980).

Data analysis

All data sets were subjected to analysis of variance (ANOVA) and Duncan's New Multiple Range Test (Steel and Tone, 1981). Means and Standard deviations were calculated following established statistical procedures (Miller and Miller, 1986).

Results and Discussion

The proximate components, calory and the US/RDA values are presented in Table 1. The two species contain high moisture (74.72 – 75.44g/100), this is probably responsible for the high digestibility of fish and ready bio availability of nutrients contained (Bhuiyan *et al* 1993 and Qyvind *et al*, 1994). The values are comparable with those of *Oreochromis miloticus, Clarias gariepinus, Marmyrus rume*, beef, lamb and pork (Otitologbon *et al* 1997). The crude carbohydrate (10.4-12.8g/100g) was generally low in the two species but fall in the range of US/RDA (1994) recommended values. The content therefore indicate that the two species could be dependable sources of low carbohydrate in human diet especially for the diabetics.

The crude lipid (30.0-33.3g/100) was high and above the low fat class of (20-40g/kg) according to Ackman (1989) classification. These values were higher than those reported in *C. gariepinus, M.rume , O niloticus, C. Citharus and C.latus* (Otitologbon *et al* 1997; Abdullahi 1999, Abdullahi 2000) but lower than those reported in *Alestes species, Distichodus rostratus, Distichodus engycephalus and Lates niloticus* (Abdullahi *et al* 1999; Abdullahi[a] 2000). The crude Protein content of the two species were high (39.5-49.1g/100) and above the US/RDA (1994) recommended values for humans of all ages with the bio availability of nutrients from fish, these species are ready sources of concentrated protein. The protein contents are higher than reported in beef (180g/kg), lamb (160g/kg), Pork (100g/kg), sardine (200g/kg), Mackerel (120g/kg) and oyster (110g/kg) (Bhuiyan *et al* 1986; Brain and Allan 1977; Pearson 1981; Abdullahi 2000).

The two species were also found to be high sources of dietary calory. The vcalues were above the US/RDA (1994) recommended values (450-600kcal/10g and similar to those reported in *Clupeids* (Olatunde 1980; Eyo 1992).

The profile and concentrations of amino acids recovered in *E. niloticus and S. mystus* as well as the FAO/WHO (1990) reference values are presented in Tables 2. Glutamic acid (12.30-15.02g/16Gn) dominated the amino acid pool, followed by lysine (9.6-10.81g/16Gn) while the least contained was serine (2.02 – 66g/16N) *E. niloticus* contained higher quantities of essential amino acids of the two species with the FAO/WHO (1990) recommended pattern for humans of all ages, indicated that the two species had contents above the reference values and therefore dependable sources of the essential amino acids. The results agree well with those earlier reported in other fresh-water fish species (Sadiku and Oladimeji, 1989; Otitologbon *et al* 1997; Abdullahi 1999; Abdullahi *et al* 1999; Abdullahi[a] 2000, Abdullahi[b] 2000).

The calcukated chemical indices, essential to non-essential amino acid ratio (E:N), Essential amino acid to total nitrogen (E:T), Essential amino acid index (EAAI), Chemical or protein score (C.S/P.S.) and Essential amino acid to protein ratio (E:P) of the two species are presented in Table 3. The E:N, E:T, EAAI and E:P in the two species were above the FAO/WHO (1973) reference values, implying that both species contain proteins of high qualities and good sources of dietary amino acids compared to the whole hen's egg standard of FAO/WHO (!973). Duggal and Eggum (1977; Sikka *et al* 1979) similarly reported chemical indices of temperate fish species.

The mineral contents of *E. niloticus* and *S. mystus* as well as the WHO (1974) recommended values are presented in Table 4. The two species have high concentration of calcium (3290.0-3782.0 mg/100g) followed by potassium (517.5-616.3mg/100g) then sodium (280.6-313.7mg/100g) with the least cointained being Copper (3.0-3.6mg/100g). however, *S.mystus* was found to contain insignificantly less ($P>0.05$)

Table 1: Proximate composition (g/100g) and calorie (kcal/100g) of *E. niloticus* and *S. mystus*.

Fish species	g/100g wet wt. moisture	Ash	Organic Matter	Carbohy-drate	Lipid	Protein	Calorie
E. niloticus	75.44	13.4 ± 0.9	86.6 ± 0.9	12.8 ± 1.4	33.3 ± 2.3	39.4 ± 0.08	649.28
S. mystus	74.72	10.7 ± 1.3	89.3 ± 1.3	10.4 ± 1.3	30.0 ± 2.1	49.1 ± 3.11	570.04
US/RDA (1994)	–	–	–	12 – 16 g/day	20 – 35 g/day	30 – 45 g/day	450 – 600

Table 2: Amino acid composition of four species of *E. niloticus* and *S. mystus* (g/16N).

Fish Species	Lys	His	Arg	Asp	Thr	Ser	Glu	Pro	Gly	Ala	Cys	Val	Met	Ile	Leu	Tyr	Phe
E. niloticus	10.81	3.86	4.15	9.02	2.90	2.66	15.02	3.02	3.00	4.80	4.00	2.95	3.22	3.06	6.99	3.00	3.05
S. mystus	9.6	3.60	4.15	9.00	3.00	2.02	12.30	2.10	2.34	3.40	3.70	2.20	3.00	2.90	6.10	2.10	2.04
FAO/WHO (1990)	5.80	2.5	5.2	7.7	3.40	7.7	14.7	10.7	2.2	6.1	3.0	5.0	2.50	2.80	6.60	1.10	6.30

Values represent the means of duplicate determinations.

Lys – Lysine; His – Histidine; Arg – Arginine; Asp – Aspartic acid; Thr – Threonine; Ser – Serine; Glu – Glutamic acid; Pro – Proline; Gly – Glycine; Cys – Cysteine; Met – Methionine; Ile – Isoleucine; Leu – Leucine; Tyr – Tyrosine.

potassium, Iron, Sodium, phosphorus and Zinc. Generally, the two species contain significantly higher ($P<0.05$) essential mineral than WHO (1974) recommended values. The calcium, Zinc and iron contents of the two species are interestingly good dietary sources for pregnant and nursing mothers.

The richness of dietary minerals in fresh-water fish species were similarly reported (Olatunde 1980; Otitologbon *et al* 1997; Abdullaha 1999; Abdullahi *et al* 1999; Abdullahi[a] 2000, Abdullahi[b] 2000).

Conclusion

Fresh-water fish species have great potential as health food source of therapeutic substances. *E. niloticus* and *S. mystus* appropriately contain all essential nutrients in disered quantities recommended by FAO/WHO. The food industrialists can avail this opportunity to improve human nutrition.

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Table 3: Chemical indices of some species of *E. niloticus* and *S. mystus*

Fish Species	E:N %[a]	E:T %[b]	EAA1%[c]	CS/PS %[d]	E:P %[e]
E. niloticus	1.05	51.26	137.26	63.19	1.12
S. mystus	1.08	51.99	119.73	55.12	1.18
FAO/WHO (1990)	1.00	50.00	100.00	100.00	1.00

[a]Ratio of essential to non-essential amino acid.

[b]Ratio of essential to total nitrogen.

[c]Essential amino acid index.

[d]Chemical protein score.

[e]Ratio of amino acid to protein.

Table 4: Mineral contents of *E. niloticus* and *S. mystus* (mg/100g Ash).

Fish Species	Calcium	Potassium	Iron	Magnesium	Sodium	Copper	Phosphorus	Zinc
E. niloticus	3290.0 ± 33.8	616.3 ± 73.2	12.2 ± 23.0	132.6 ± 32.1	313.7 ± 18.2	3.0 ± 0.6	233 ± 2.1	10.1 ± 0.7
S. mystus	37820 ± 266.1	5175 ± 23.7	9.6 ± 1.4	145.4 ± 28.3	280.6 ± 24.7	3.6 ± 0.6	19.7 ± 3.3	12.0 ± 1.3
WHO (1994)	1000 – 1400 mg/day	220 mg/day	6 – 15 mg/day	460 mg/day	500 – 2000 mg/day	0.2 – 1.3 mg/day	20 – 23.8 mg/day	3 – 5 mg/day

Values represent the means and S.D.

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