African Journal of Food Science Vol. 5(10), pp. 550-554, 30 September, 2011
Available online http://www.academicjournals.org/AJFS
ISSN 1996-0794 ©2011 Academic Journals

Full Length Research Paper

Chemical composition of *Tilapia mosambis* fish from major dams in Ekiti-State, Nigeria

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Accepted 29 August, 2011

The chemical compositions of *Tilapia mosambis* fish from major dams in Ekiti State were analysed. The proximate analysis shows that the protein content (69.70 to 79.56%) of the fish sample was very high as well as the organic matter (92.03 to 96.15%). The sample was low in Zn, Fe, Pb, and Mn but slightly high in Na, K, Mg and Ca. The total amino acid was 920.5 to 956.1 mg/g crude protein while the essential amino acid was 379.5 to 433.8 mg/g crude protein. The amino acid scores ranged between 0.45 to 2.0 showing leucine to be the limiting amino acid. The results show that fish sample is a good source of protein.

Key words: Tilapia mossambis, dams, chemical composition, amino acid.

INTRODUCTION

Tilapia mosambis are common fish in most fresh water in Nigerian rivers, dams and ponds. They are of high commercial values and marketing trends indicates higher demand for these fresh water fish species (Balogun and Adebayo, 1996). Fish and fish products provide as much as 17 to 63% protein intake of the large Nigerian populace (Abdullahi, 2001). The current status of fisheries in Nigeria can only be said to pose serious developmental challenges. Nigeria's demand for fish annually is about 1.5 million metric tons, but presently produce 511,700 metric tons while the shortfalls is met by importation of 680,000 metric tons (Adeyeye and Adamu, 2005). The use of protein concentrates and fish oil in diets have been reported to reduce heart diseases, arthritis, arterio-sclerosis, asthma, auto-immune disease, cancer, chronic infection, diabetes and multiple sclerosis (Cabiac et al., 1991; Gerharo et al., 1991).

Proteins, essentially the amino acids are required for foetal development and growth. Dietary protein, the amino acids are needed principally for growth, metabolism and maintenance especially in the young ones. The high demand for and fish products call for studies into the nutritional status of the fish. Earlier Abdullahi and Abolude (2000) reported the effect of season and geographical location of nutrient status on some fresh water fish species, the proximate, amino acid and mineral composition of some fish species were variously reported by Abdulahi et al. (1999), Adegboye (1985), Abdullahi and Abdulahi (2002), Abdulahi (2002), Adeyeye and Adamu (2005) and Abolude and Abdullahi (2003).

The present study was carried out to determine the chemical composition of *T. mosambis* fish samples from major dams in Ekiti State to access their nutritional status since member of the public that lives around the dam sites feed on the fish.

MATERIALS AND METHODS

Collection and treatment of fish sample

The fish samples *T. mosambis* were bought from fishermen at the various dam sites (Ureje, Ero, Egbe and Itapaji). The fish samples were thoroughly washed and rinsed with de-ionized water to remove any adhering contaminants and then drained under fold of filter paper. The weights of the fresh fish samples were taken. The whole fish samples were oven dried for four days at a temperature between 95 to 105°C until a constant weight, the sample grinded and kept in a sample bottle prior analysis.

Proximate analysis

Moisture and ash contents were determined using the air oven and dry ashing methods of Pearson (1976). Samples were analysed for fat and crude protein according to the method of AOAC (1990). The percentage nitrogen was converted to percentage crude protein by multiplying by 6.25.

Table 1. Proximate analysis (%) of the fish samples (*Tilapia mosambis*) from major dams in Ekiti State.

Analysis	Dams			
	Ureje	Egbe	Ero	Itapaji
Moisture content	79.50	69.70	74.46	72.54
Ash content	7.58	3.85	7.64	7.97
Protein content	61.25	53.34	67.88	62.45
Fat content	6.62	18.30	13.99	6.45
Fibre content	8.97	13.23	9.28	6.45
Carbohydrate	15.60	11.28	1.21	13.91
Organic matter	92.42	96.15	92.36	92.08

Mineral determination

The minerals in the fish samples were brought into by wet digestion using concentrated nitric acid and concentrated perchloric acid in the ratio 5:3, the mixture was placed on a water bath for three hours. The resultant solution was cooled and filtered into a 100 ml standard flask and made to mark with distilled water (Gagophein and Nwajei, 2000). The mineral were analyses using atomic absorption spectrophotometer (Buck scientific model 200A)

Determination of amino acid

Defatting

About 2.0 g of each sample was weighed into the extraction thimble and the fat extracted with chloroform/methanol mixture using a soxhlet extraction apparatus (AOAC, 1990). The extraction lasted for 5 to 6 h.

Hydrolysis of sample

Between 30 to 35 mg of each defatted sample was weighed into glass ampoule, 7 ml of 6 N HCl was added and air was expelled by passing nitrogen into the ampoule (to avoid possible oxidation of some amino acids during hydrolysis). The glass ampoule was then sealed with bursen flame and put in an oven at 150 ± 5°C for 22 h. The ampoule was allowed to cool before breaking at the tip and the content was filtered to remove the humans. The filtrate was then evaporated to dryness at 40°C under vacuum in a rotary evaporator; the residue was dissolved with 5 cm^3 of acetate buffer and stored in a plastic specimen bottle which was kept in a deep freezer.

Sample analysis

The method of analysis used was ion-exchange chromatography (IEC) (FAO/WHO, 1991). The amount loaded for each of the samples was between 5 to 10 µl; this was dispensed into the cartridge of the analysed. The T.S.M. analyser is designed to separate and analyse free acidic, neutral and basic acids amino acid of the hydrolysates and the period of analysis lasted for 76 min for each sample. The liquid flow rate in the coloum was 0.5 cm^3/min and the coloum temperature was maintained at 60°C. It has reproducibility consistent within ± 3%.

RESULTS AND DISCUSSION

The proximate analysis of the fish samples (*T. mosambis)* from the four dams are shown in Table 1. The moisture content of the fish samples from the four dams ranged between 69.7 to 76.6%. The high moisture content of the fish sample would increase the deterioration level of fish when kept for a long time. This is because the micro-organisms would be highly active with high moisture content (Love, 1980). Similar observations have been reported by Abolude and Abdullai (2003), Otitologbon et al. (1997) and Balogun and Adebayo (1996). The value of the ash content ranged between 3.85 to 7.97%, the values are comparable to the observation of Abolude and Abdullahi (2003, 2005) who studied the proximate analysis and mineral contents in the components of *Clarias garipenus*. The crude protein values are relatively high indicating that the fish sample is a good source of protein.

Therefore, these fishes under examination are likely to be a good source for meeting our daily protein needs if it has balanced amino acids, an added advantage of the fish is that its protein is highly digestible (Albert, 1998). A higher concentration of protein in fish sample has been observed by several workers when studying fresh water fish species collected from various locations in Nigeria (Abdullahi and Abdullahi, 2003; Abdullahi, 2001; Otitologbon et al., 1997; Abolude and Abdullahi, 2005). The crude protein content in the fish sample is in close agreement with the one obtained by Olaofe et al. (1998) on grasshopper. The values of crude fat content ranges between 6.45 to 18.30%. The fat content value is also in close agreement with the one observed by Abolude and Abdullahi (2005) in *C. garipenus* fish and that of Olaofe et al. (1998) for grasshopper. The values of the proximate components in the fish samples are within the reference values of FAO/WHO (1991) for humans.

The mineral composition of *T. mosambis* fish are presented in Table 2. The concentrations of Zn, Fe, Pb, Mn, ranged between 1.00 to 2.10, 1.56 to 3.46, 0.01 to 0.11 and 0.89 to 2.42 mg/100 g, respectively. This similar observation has been observed by Asaolu and Olaofe (2004) for fishes and crayfish from coastal water of Ondo State. The concentration of the heavy metals in the fish samples from all the four dams are lower than the one reported by Kakulu (1985) for fishes from Niger-Delta area of Nigeria, Okoye (1989) and Asaolu (1998) for Lagos

Table 2. Mineral composition (mg/100 g) of *Tilapia mosambis* fish from major dams in Ekiti State.

Minerals	Dams			
	Ureje	Egbe	Ero	Itapaji
Zinc	1.21	1.02	2.10	1.00
Iron	2.01	3.46	3.43	1.56
Lead	0.03	0.08	0.11	0.01
Manganese	1.52	2.42	1.86	0.89
Sodium	6.40	7.12	8.40	8.60
Potassium	9.60	8.90	9.75	10.10
Magnesium	6.20	6.10	5.86	6.20
Calcium	8.60	10.10	6.20	9.40

Table 3. Amino acid composition of fish sample from major dams in Ekiti State (mg/g crude protein) dry weight.

Amino acid	Ureje	Egbe	Ero	Itapaji
Lysine (LYS)[a]	44.0	45.3	46.00	43.7
Histidine (His)[a]	20.2	21.6	29.3	22.3
Arginine (Arg)[a]	83.1	78.7	67.8	70.5
Aspartic Acid (Asp)[a]	104.6	143.7	142.2	103.0
Threonine(Thr) [a]	46.8	55.5	56.4	51.0
Serine(Ser)	39.0	40.0	40.1	42.0
Glutamic Acid (Glu)	151.3	150.2	153.5	151.6
Proline (Pro)	36.0	56.3	60.3	48.3
Glycine (Gly)	6.7	8.5	10.3	7.6
Alanine (Ala)	98.7	99.8	96.8	92.3
Cystine (Cys)	28.7	24.6	18.1	12.4
Valine (val) [a]	100.0	91.2	98.2	95.6
Methinonine (Met) [a]	34.3	34.4	39.3	36.4
Isoleucine(Ile) [a]	21.8	22.1	29.0	26.0
Leucine (Lue) [a]	33.4	31.8	34.6	32.3
Tryosine (Tyr)	26.8	29.7	28.9	27.5
Phenylalanin (Phe) [a]	50.2	46.9	35.5	48.3

a: Essential amino acid.

Lagoon. The result was also lower than the report of Adeyeye and Adamu (2005) on *Gymnarchus niloticus.* The extent of the concentration of these metals in fish sample can suggest to what degree a particular fish picks up particulate matter from the surrounding water and sediment while feeding, bottom feeder are known to concentrate more metals than the surface feeder (Okoye, 1989). The high level of iron and manganese in the fish could be associated with the fact that these metals are naturally abundant in Nigerian soil (Kakulu, 1985; Asaolu et al., 2005; Adefemi and Awokunmi, 2010) and no matter the source of the metals the final repositories are the aquatic system. The levels of the metal are below the limit set by World Health Organisation standard for food (WHO, 1993). The concentration of Ca, Mg, Na and K ranged between 6.20 to 10.10, 5.86 to 6.20, 6.40 to 8.60 and 8.90 to 10.10 mg/100 g, respectively. Potassium is the most abundant metal in the fish samples from all the dams, the metals under investigation are not known to be toxic to fish, their bio-accumulation could be very beneficial to man since thy are essential minerals in human nutrition (Adeyeye, 1996b).

Table 3 shows the amino acid profile, essential, non-essential, acidic, neutral and amino acid scores for the fish samples (*T. mosambis*) for the four major dams. Trytophan was not determined in the fish sample. Glutamic acid (150.2 to 153.5 mg/g) and aspartic acid (103.3 to 113.7 mg/g) were the most concentrated amino acid in the fish sample, similar observation have been found by Olaofe et al. (1993, 1994), Oshodi et al. (1993)

Table 4. Essential, non essential, acidic, basic neutral, aromatic amino acid (mg/g) crude protein) of fish sample (dry weight).

Amino acid	Ureje	Egbe	Ero	Itapaji
Total amino acid (AA)	925.1	950.3	956.1	920.8
Total non-essential amino acid (TNEAA)	491.3	522.8	576.6	494.7
Total essential amino acid (TEAA)				
- Wilh HIS	433.8	427.5	379.5	426.1
- No HIS	413.6	405.9	359.2	403.8
% TNEAA	53.1	55.0	60.3	53.8
% TEAA				
- Wilh HIS	46.9	45.0	39.7	46.3
- No HIS	49.7	42.7	36.6	43.9
Total neutral amino acid (TNAA)	521.8	540.8	547.2	57.5
Total acidic amino acid (TAAA)	255.9	263.9	265.7	254.6
%TAAA	27.7	27.8	27.8	27.7
Total basic amino acid (TBAA)	147.3	145.6	143.1	136.5
%TBAA	15.9	15.3	15.0	14.8

Table 5. Amino acid scores of the fish sample from all the dams (*Tilapia mosambis*).

Amino acid	Provisional amino acid scoring pattern	Ureje	Egbe	Ero	Itapaji
Isoleucine	40	0.55	0.55	0.73	0.65
Leucine	70	0.47	0.45	0.49	0.46
Lysine	55	0.80	0.82	0.84	0.79
Met + Cys (TSAA)[c]	35	1.75	1.69	1.64	1.68
Phe + Tyr (TArAA)[d]	60	1.28	1.28	1.07	1.26
Threonine	40	1.17	1.39	1.41	1.28
Tryptophan	10	nd	nd	nd	nd
Valine	50	2.0	1.82	1.96	1.91

and Adeyeye and Adamu (2005). The least amino acid in the fish sample is glycine (6.7 to 83.1 mg/g), valine and arginine constitute the highest essential amino acid (EAA) with a value ranged between 91.2 to 100.0 and 67.8 to 83.1 mg/g, respectively. Arginine is an essential amino acid for children growth (Robinson, 1987) and it is high in the fish sample, this is in agreement with Adeyeye (2005). Lysine content of the fish sample (43.7 to 46.0 mg/g) was close to the content of egg reference protein (63 mg/g), it will therefore serve as a good source for fortification of cereal weaning foods. The total essential amino acid (TEAA) in the fish sample is between 379.5 to 433.5 mg/g without trytophan which is 67 to 76.5% egg reference protein (566 m/g) (Paul et al., 1980). This suggests that the fish samples will contribute significantly to the supply of essential amino acid in the diet. The total sulphur amino acid (TSAA) and aromatic amino acid (ArAA) of the fish sample were 57.4 to 59.0 and 64.4 to 76.6 mg/g, respectively are close to the ranged suggest for ideal infant protein of 58 and 68 to 118 mg/g crude protein, respectively (FAO/WHO/UNU, 1985).

Protein is made up of acidic, basic and neutral amino acid, the present analysis indicated that the neutral amino acid is the most abundant in the fish sample while total basic amino acid is the least (Table 4). The entire fish protein is likely to be acidic since total acidic amino acid (27.7 to 27.9%) is greater than total basic amino acid (14.8 to 15.9%), this is attested to by the estimate value of iso-eletric point between 5.2 to 5.4. Table 5 shows that leucine has the lowest amino acid score of 0.45 to 0.49, although this would have been describe as the limiting amino acid. In the study, the essential amino acid score value for lysine is (0.79 to 0.84), MET + CYS TSAA (1.64 to 1.79) and Thr (1.17 to 1.41), while Try was not determined. Most animal proteins are found to be low in cystein (Adeyeye, 2005; Adeyeye and Afolabi, 2004).

Conclusion

From the result and discussion it can be concluded that the fishes from the dams will contribute to the nutritional qualities and growth of human being as indicated by high protein content and the various amino acid compositions. The levels of the metals are within the standard limit set for fish in Australia, United Kingdom and New Zealand.

REFRENCES

Abdullahi SA (1999). Nutrient content of *Citharinus citharinus* and *Citharinus latus* (family:Cithanindae) Geaffery. Zuma. J. Pure Appl. Sci., 2(1): 65-68.

Abdullahi SA (2001). Biochemical composition of oven dried *Auchenoglanis occidentalis* and *Clarotes:* Family Bagridae. Zuma. J. Pure Appl. Sci., 3(1): 57-61.

Abdullahi SA , Abdullahi HI (2002). Some biochemical composition and nutrition studies in *Eutropics niloticus* and *Schilbe mystus*. Family: Schilbeidae. Biosci. Res. Comm., 14(1): 71-83.

Abdullahi SA , Abolude DS (2000). Studies on the effect of season and geographical location on nutrient content of two fish family. Nig. J. Experimental Appl. Biol., 1(2): 117-123.

Abolude DS, Abdullahi SA (2003). Nutritional status of the flesh and body parts of some fresh water fish species in Zaria. Nig. Food J., 21: 41-44.

Abolude DS, Abdulahhi SA (2005). Proximate and mineral contents in component parts of *Clarius garipenus* and *Synodontis schall* from Zaria, Nigeria. Nig. Food J., 23: 1-7.

Adefemi SO, Awokunmi EE (2010). Determination of physico-chemical parameter and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria. Afr. J. Environ. Sci. Technol., 1: 145-148.

Adegboye JOD (1985). Distribution of calcium ions in the issues of Synodontis schall. Nig. J. Sci., 19: 38-40.

Adeyeye EI (2005). Amino acid composition of *Zonocerous variegates*. Trop. Sci., 45(4): 141-143.

Adeyeye EI (1996). Waste yield, proximate and mineral compositin of three different types of land snails found in Nigeria. Int. J. Food Sci. Nutrit., 47: 111-116.

Adeyeye EI, Adamu AS (2005). Chemical composition and food properties of *Gmynarchus niloticus*. Bios. Biotechnol. Res. Asia, 3(2): 265-272.

Adeyeye EI, Afolabi EO (2004). Amino acid composition of three different types of land snails consumed in Nigeria. Food Chem., 85: 535-539.

Albert CM (1998). Fish composition and risk of sudden death. J. Am. Med. Assoc., 279: 23-28.

Asaolu SS (1998). Chemical pollution studies of coastal water of Ondo State. Ph.D, Thesis Federal University of Technology, Akure.

Asaolu SS, Adefemi SO, Onipede AF (2005). Interdepedence of some macro and metals in soil of Imo State, Nigeria. J. Appl. Environ. Sci., 1: 79-82.

Asaolu SS, Olaofe O (2004): Biomagnification of some heavy and essential metals in sediment, fish and crayfish from Ondo State coastal region. Bios. Res. Comm., 16(1) 33-40.

Association of Official Analytical Chemists (AOAC) (1990). Official method of analysis (15th ed). Washinton D.C.

Balogun MA, Adebayo FE (1996). Flesh yield and aspects of chemical composition of the flesh of some commercially important fresh water fish species in Nigeria. J. Agric. Technol., 4(1): 33-40.

Cobiac L, Cliffton PM, Abbey M, Belling GB , Westel PJ (1991). Lipid, lipoprotein and lemostatic effects of fish is fish oil n-3 fatty acid is mildly perhipidenmic males. Am. J. Clin. Nutrit., 53: 1210-1216.

FAO/WHO (1991). Protein quality evaluation (Report of joint FAO/WHO expert consultation. FAO food and nutrition paper 51). Rome, Italy; FAO/WHO.

FAO/WHO/UNU (1985). Energy and protein requirement. Report of a FAO/WHO/ UNU. Expert consultant on energy and protein requirements. World Health Organisation Technical Report series 724, WHO, Geneva. Switzerland. pp. 133-129.

Gagophien PO, Nwajei JE (2000). Distribution of heavy metals in the sediment of Lagos Lagoon. Pak. J. Sci. Ind. Res., 43(6) 338-340.

Gerhard GT, Patton BD, Lindquist SA , Wander RC (1991). Comparison of three species of dietary fish: effects on serum concentrations of low-density lipoprotein cholesterol and apolipoprotein in normottingly ceridermic subjects. Am. J. of Clin. Nutri., 4: 334-339.

Kakulu SE (1985). Heavy metals in the Niger Delta. Impact of petroleum industry on the baseline levels; Ph.D Thesis, University of Ibadan, Nigeria.

Love RM (1980). The chemical biology of fishes. Academic Press. New York and London, 11th edition, 467.

Olaofe O, Adeyemi FO, Adediran GA (1993). Amino acid, mineral composition and functional properties of some oil seeds. J. Agric. Food Chem., 42(4): 878-881.

Olaofe O, Arogundade IA, Adeyeye EI , Falusi OM (1998). Amino acid composition and food properties of variegated grasshopper. *Zonocerous variegates.* Trop. Sci., 38: 233-237.

Okoye BCO (1989). Levels and impact of some heavy metals in Lagos Lagoon. PhD Thesis, O.A.U. Ile-Ife.

Oshodi AA, Olaofe O, Hall GM (1993). Amino acid, fatty acid and mineral composition of pigeon pea (*Cajanus cajan*). Int. J. Food Sci. Nutrit., 43: 187-191.

Otitologbon SA, Oniye SJ, Peters OA, Agbaji EB (1997). Proximate and mineral composition of three Nigerian fresh water fishes. J. Sci. Food Agric., 75: 312-314.

Paul AA, Southgate DAT, Russels J (1980). First supplement to McCance and Widowhood's. The composition of foods, HMSO, London and Elsevier, New York.

Pearson D (1976). Chemical analysis of food. 7th edition. J and A Churchill. London U.K. pp. 7-11.

Robison OS (1987). Food biochemistry and nutritional value. Longman Scientific and technical, UK. pp. 137-149.

World Health Organization (1993). World Health Commission on Health Land Environment. Draft report, WHO, Geneva, Switzerland.