International Journal of Nutrition and Metabolism Vol. 4(9), pp. 130-134, September 2012
Available online at http://www.academicjournals.org/IJNAM
DOI: 10.5897/IJNAM12.007
ISSN 2141-2499 ©2012 Academic Journals

Full Length Research Paper

Chemical composition of an ecotype tilapia of Epe lagoon commonly called '"Wesafu"'

Fashina-Bombata, H. A.* and Oduntan, T. H.

Department of Fisheries, Lagos State University, Ojo, Badagry Expressway, Lagos State, Nigeria.

Accepted 13 July, 2012

The chemical composition of wild and domesticated "Wesafu", an ecotype cichlid found abundantly in Epe Lagoon fisheries in Lagos, south-western coast of Nigeria and a private fish farm in Badagry, Lagos, was investigated for proximate, mineral, fatty acid and amino acid compositions. The proximate compositions of the two specimens were found to be similar except for crude protein contents of 16.80 and 19.51% for the wild and farmed specimens, respectively. Seventeen different amino acids, twelve fatty acids and ten minerals were obtained in the tissues of the fish. The amino acids compositions of both the wild and farmed specimen were essentially similar and no wide variation in the amino acids compositions. Palmitic and oleic acids were the main saturated and monounsaturated fatty acids respectively. The principal oil in the polyunsaturated group was linoleic acid. Ten minerals were determined, including iron; 30.73 and 18.39, cobalt; 0.47 and 0.32, manganese; 13.64 and 2.75, zinc; 35.35 and 33.17 in mg/kg, respectively for the wild and farm raised specimens. This ecotype cichlid of Epe Lagoon, Nigeria "Wesafu" is thus a nutrient dense food fish being rich in quality protein, polyunsaturated fatty acids and having an array of essential minerals. It is recommended for culture and introduction to the bodies of water across the country to further guarantee food fish security, especially in the poor coastal communities of the country.

Key words: Ecotype cichlid, "Wesafu", chemical composition, amino acids, fatty acids, minerals.

INTRODUCTION

Fish constitute a very important component of the diet for many people and often provides the much needed nutrients that are not provided in cereal based African diets (Clucas and Sutchiffe, 1981). Saisithi (1994) reported that fish provides between 30 and 80% of the total animal protein intake of the coastal people of West Africa, while Olomu (1995) also reported that fish is rich in protein with amino acid composition very well suited for human dietary requirements and compare favorably well with egg, milk and meat. The concentration of dietary essential amino acids is a major factor in determining the nutritional value of food protein. Fish muscle contains an excellent amino acid composition and is a source of nutritive and easily digestible proteins (FAO/WHO, 2001).

Cichlids, commonly called the "*Tilapias*" of the family Cichlidae are perch-like fish and the family is known to have produced an enormous variety of freshwater species in Africa. The problem of precocious sexual maturity and unwanted reproduction has long been accepted as a major constraint to further development and expansion of tilapia culture in Nigeria. However, there exists an ecotype cichlid in Epe lagoon, Nigeria that grows up to 1500 g, and has a broad and deep fleshy body when landed from the wild in Epe where they are endemic in Nigeria (Fashina-Bombata et al., 2008). "Wesafu" is therefore a candidate for culture and introduction to water bodies as stock replenishment to reduce fishing efforts of artisanal fisher folks. Sex reversal is more successful and has been adopted in many commercial hatcheries, but has yet to be widely adopted in Nigeria until recently with this ecotype with interesting results in an ongoing study (Fashina-Bombata et al., 2008).

"Wesafu" is a vernacular name of a tilapia that is very prominent in Epe lagoon of Lagos State. This species is highly prized (Fashina-Bombata et al., 2004). The huge size of this species makes it a desirable food fish for culture.

*Corresponding author. E-mail: bombatta2002@gmail.com.

Table 1. Proximate composition of wild and domesticated "Wesafu".

Parameter	Wild "Wesafu" (%)	Farmed "Wesafu" (%)
Moisture content	76.92	76.31
Crude protein	16.80	19.51
Crude fibre	0.03	0.02
Total fat	2.33	2.62
Ash	1.35	1.54

Fashina-Bombatta et al. (2005, 2006) reported "Wesafu" to be highly priced fish in Lagos, Nigeria, for its tasty flesh and large size of over 1,500 g in the wild. At the moment, 1 kg of "Wesafu" is sold for between 7.74 and $9.67 [the exchange rate is N160 to one US Dollar] in Lagos, probably the highest priced fish in Nigeria (Megbowon et al., 2010). The objective of this study was thus to document the chemical composition of this unidentified ecotype cichlid of Epe Lagoon in Lagos, Nigeria.

MATERIALS AND METHODS

Representative samples of 350 g (average of 'Wesafu') were obtained from the wild and a domestic source from a private farm. Each sample was scaled and then filleted on both sides in Fish Laboratory of Lagos State University. Fillets obtained from samples were dried in an oven for two days at 60°C. The dry ti ssue samples were then bulked for analyses.

Proximate analysis

Proximate analyses were carried using the methods of AOAC (2000), which included moisture, ether extractives, crude protein, crude fiber and ash contents. Moisture content was determined by drying samples to a constant weight at 105°C in an oven (Table 1.).

Estimation of protein

Optical density measurements were achieved with a spectrometer to estimate amino acid and protein levels according to the Lowry et al. (1951) method. The values of the optical densities were then recorded. The quantification of proteins was done by tracing the various optical densities relative to the standard proteins, and similarly for amino acids. A standard amino acid, methionine, with known optical density (570 nm) was used to calibrate the spectrometer.

Fatty acids determination

Extraction of the crude oil was carried out at the Analytical laboratory, National Institute for Freshwater Fisheries Research (NIFFR), New Bussa. The extracted oil was stored at ambient temperature before taken to the Central Science laboratory. The fatty acids were converted to their methyl esters according to the method of Christy (1997). About 5 ml of the oil was esterified with acetone (59:41). The mixture in vials was heated at 80°C on hot plate for 30 min, cooled and then diluted with water; it was then extracted with diethyl ether and analyzed by high pressure liquid chromatography (HPLC). Identification and quantification of fatty acids were carried out in HPLC using the methods of Christy (1997). Fatty acids in the samples were identified by relative retention time matched to reference standards. Percentage composition of each fatty acid identified was calculated using peak area as follows:

$$\% \text{ Fatty acid} = \frac{\text{Peak area of sample} \times \text{conc. of std.} \times \text{dilution factor}}{\text{Peak area of standard}}$$

Determination of minerals

The mineral contents of fish flesh samples were determined in triplicate by the acid digestion method involving microwave technology. A 0.5 g sample was placed in a vessel and 6 ml HNO_3 was added. The sealed vessel was heated until digestion was completed, and the digested sample was cooled for 5 min. An inductively coupled argon plasma optical emission spectrometer (Model CIROS, SPECTRO Analytical Instruments) was used to analyze the mineral content.

RESULTS AND DISCUSSION

The results of the analysis on the chemical compositions of "Wesafu" are represented in Tables 1 to 4. Proximate composition of both wild and domesticated "Wesafu" was observed to have close values of 16.80 and 19.31% crude protein (CP), total fat (2.33 and 2.62), ash (1.35 and 1.54) and moisture (76.92 and 76.31), which is as high as the values recorded by Osibona et al. (2009) on *Tilapia zillii* [crude protein (19.0 ± 1.90), total fat (1.1 ± 0. 4), ash (1.2 ± 0.2), moisture (80.4 ± 3.79)]. Moisture content was within previously reported range in other tilapiine fishes (Gallagher et al., 1998).

The range of amino acids in "Wesafu" is reported in Table 1 and shows a generous composition in both the wild and the farmed fish. These values are also similar to those of *T. zillii* reported by Osibona et al. (2009) [http://findarticles.com/p/articles/mi_7400/is_1_9/ai_n32063507/]. "Wesafu" also contain significant amounts of essential amino acids, particularly lysine (10.82%), which is low in cereals and common staples of African diets. "Wesafu" protein can therefore be used to complement the amino acid pattern and the overall protein quality of diets of inhabitants of poor coastal communities in Nigeria. Furthermore, "Wesafu" is a good source of polyunsaturated fatty acid (PUFA) having a high content of arachidonic acid (4.20% for wild and 3.36% for the

Table 2. Amino acid composition of wild and farmed “Wesafu”.

Amino acid	“Wesafu” (Wild) (%)	“Wesafu” (Farmed) (%)
Glysine	5.22	5.22
Alanine	5.79	5.78
Serine	3.59	3.59
Proline	3.08	3.08
Valine	4.05	4.05
Threonine	4.56	4.56
Isoleucine	4.45	4.45
Leucine	8.60	8.60
Aspartate	9.56	9.56
Lysine	10.82	10.82
Glutamate	17.30	17.30
Methionine	5.12	5.12
Phenylalanine	4.70	4.70
Histidine	2.11	2.11
Arginine	5.68	5.68
Tyrosine	4.82	4.82
Cysteine	0.46	0.46

Table 3. Fatty acid composition of wild and farmed “Wesafu”.

Fatty acid	“Wesafu” (Wild) (%)	“Wesafu” (Farmed) (%)
Myristic acid	4.86	5.27
Palmitic acid	23.98	26.81
Palmitoleic acid	6.01	6.70
Stearic acid	4.46	5.057
Oleic acid	19.79	21.43
Linoleic acid	13.92	15.09
Linolenic acid	8.93	8.66
Arachidic acid	0.20	0.11
Arachidonic acid	4.20	3.36
Behenic acid	7.22	4.50
Erucic acid	6.42	2.56
Lignoceric acid	-	0.45

Table 4. Average measurements are listed for the mineral composition of wild and domesticated “Wesafu” (n = 10).

Parameter	Wild “Wesafu” (mg/kg)	Farmed “Wesafu” (mg/kg)
Iron	30.73	18.39
Cobalt	0.47	0.32
Manganese	13.64	2.75
Zinc	35.35	33.17
Phosphorus	24.19	22.11
Copper	2.81	3.62
Sodium	894	853
Magnesium	1349	158
Calcium	1572	892
Potassium	13105	11483

farmed strain), which is known to facilitate the blood clotting process. Other abundant mono-unsaturated fatty acids included palmitoleic acid (6.01 and 6.70), palmitic (23.98 and 26.81), oleic (19.79 and 21.43) in wild and domesticated species respectively, thus making “Wesafu” a good source of essential fatty acids.

In addition, the ecotype cichlid, “Wesafu” appears to be a good source of phosphorus with a level of 22.11 and 24.19 mg/kg for domesticated and wild specimen, respectively. A low calcium intake, coupled with inadequate intake or production of vitamin D, greatly increases the risk of bone fractures in older people. Getting enough calcium and vitamin D every day can decrease the risk. An adequate intake of calcium also may contribute to the taming of high blood pressure and the prevention of (polyps) growths in the colon that sometimes turn cancerous. Calcium content of “Wesafu” is capable of meeting the requirements of a young adult. Like calcium and vitamin D, magnesium is an essential nutrient for bone health. Recommended intake for men of 420 mg a day and women 320 mg a day is easily met with a regular consumption of this fish. Moreover, potassium is present in every cell of the body and plays a vital role in muscle contraction, transmission of nerve impulses and maintenance of fluid balance. Adequate potassium intake is a way to keep blood pressure in check and to promote bone health. Potassium is so important to blood pressure control. The recommended intake for men and women is 4,700 mg a day. With a content of 13105 mg/kg, a kilogram of “Wesafu” will give about 278% of the daily requirement of adult male and female. Thus, wesafu is a good source of potassium.

Zinc is involved in the metabolism of carbohydrates, fats and proteins. It also plays an important role in the production of DNA. Additionally, zinc is also essential for wound healing and for maintaining immunity and sense of taste. Dietary surveys show that about 50% of men and 75 percent of women over the age of 51 do not get enough zinc in their diets, making supplementation a good idea. The recommended intake for men is 11 mg a day; women: 8 mg a day. With a zinc content of 35.35 mg/kg, the regular intake of about a kilogram of “wesafu” can only meet 70 and 47% requirement zinc for men and women, respectively. On the other hand, copper is involved in the absorption, storage and metabolism of iron and the formation of red blood cells. It also helps supply oxygen to the body. The symptoms of a copper deficiency are similar to iron-deficiency anemia. Copper is needed to help body use iron, also important for nerve function, bone growth and help the body use sugar. Many survey studies show that people consume about 1.0 mg or less of copper per day. With a content of 3.62 mg/kg, “Wesafu” is capable of meeting the daily need for copper.

The daily requirement for manganese in man is 2.0 to 5.0 mg/d ay for adults, 2.0 to 3.0 mg for children 7 to 10 years, 1.5 to 2.0 mg for children 4 to 6 years, 1.0 to 1.5 mg for children 1 to 3 years, 0.6 to 1.0 mg for children 6 months to 1 year, and 0.3 to 0.6 mg for infants 0 to 6 months. Manganese content in “Wesafu” is 13.64 mg/kg which is way beyond the daily requirement. Iron deficiency is common in infants, adole-scent girls and pregnant women. Iron deficiency in infants can result in impaired learning ability and behavioural problems. It can also affect the immune system and cause weakness and fatigue. Women and teenage girls need at least 15 mg a day, whereas men can get by on 10 mg per day. It is important that children get about 10 to 12 mg of iron per day, preferably from their diet. “Wesafu” is also a rich source of iron with a content of 30.73 mg/kg.

Current dietary recommendation suggests that we avoid too much sodium, and many individuals have been advised to reduce their sodium intake because of hypertension (high blood pressure) or other disorders. Sodium is always found in pairs of electrolyte with other elements. Electrolytes function in the maintenance of water balance and distribution, kidney and adrenal function, acid-base balance, muscle and nerve cell function, and heart function (FAO/WHO, 2001). Fish in general are low in sodium and even those species with the highest sodium levels contain less than 100 mg per 3 ounce cooked portion, which is less than 5% of the current daily recommended maximum sodium intake. A daily diet intake of 500 mg/day for adults and 120 mg for infants is recommended. “Wesafu” offers 0.894 mg/kg, which is low compared to the daily recommendation and may not be regarded as a good source of sodium. This is good as it does not increase the risk of excessive intake and the effect of the low content in “Wesafu” will not be too pronounced due to the availability of sodium in purified form such as table salt. Furthermore, cobalt was 0.47 and 0.32 mg/kg in the specimens and is an integral component of cyanocobalamin (vitamin B12), essential for red blood cell formation and the maintenance of nerve tissue. Wesafu will rank among other rich dietary sources of cobalt like copra meal (2 mg/kg Co), linseed meal, dried brewers yeast, fish meal, meat meal, cottonseed meal, and soybean meal (0.5 to 0.1 mg/kg).

This study reveals that “Wesafu” is a fish that is high in nutrients. “Wesafu” is rich in leucine (8.60), aspartate (9.60), lysine (10.82) and glutamate (17.30); making it a quality source of protein, although its protein content is low due to its herbivorous feeding habits. The lipid content is, however, encouraging as the fish contains high level of essential poly-unsaturated fatty acid [PUFA] such as arachidonic acid (4.20 and 3.36), mono unsaturated fatty acids such as palmitoleic acid (6.01 in the wild specimen and 6.70 for farmed), palmitic (23.98 and 26.81) and oleic (19.79 and 21.43).

Conclusion

The overall assessment of this fish suggests its nutritional benefits as an important food fish in the coastal community of Epe lagoon, where it is believed to be endemic in

in the State. Hence, there is an urgent need to conserve this wild species by immediately introducing it in the culture systems in the country. This will limit its aggressive fishing to stem stock depletion while efforts are underway to conclude DNA studies for proper naming of this fish for conservation.

REFERENCES

Association of Official Analytical Chemists (222). Official Methods of Analysis of the Association of Official Analytical Chemists, Vols. I and II, Association of Analytical Chemists, Arlington, 2000.

Christy WW (1997). Gas chromatography mass spectrometry methods for structural analysis of fatty acids. Lipids 33(4):343-353.

Clucas IJ, Sutcliffe PJ (1981). An introduction to fish Handling and Processing. Tropical Products Institute. London. 86 pp.

FAO/WHO (2001). Recommended intakes of nutrients in Handbook on Human Nutritional Requirement, WHO, Geneva.

Fashina-Bombata HA, Ajepe RG, Hemmed AM, Jimoh AA (2005).Characterization of an ecotype cichlid commonly referred to as “Wesafu”, endemic to Epe lagoon, Nigeria. World Aquacult. 36:20-22.

Fashina-Bombata HA, Ajepe RG, Hemmed AM (2006). Food and feeding habits of an ecotype cichlid,”Wesafu” from Epe lagoon, Lagos, Nigeria. World Aquacult. 37:62-66.

Fashina-Bombata HA, Ajepe RG, Hammed AM (2008): Age and Growth of an ecotype Cichlid ‘Wesafu’ in Epe Lagoon, Lagos, Nigeria. Global J. Agric. Sci. 7(1):105-109.

Gallagher ML, Paramore L, Alves D, Rulifson RA (1998). Comparison of phospholipid and fatty acid composition of wild and cultured striped bass eggs. J. Fish Biol. 52(6):1218–1228.

Lowry OH, Rosebrough NJ, Farr AL, Randall RJ (1951) J. Biol. Chemistry of vitamins C and K3 on human urologic tumour cell lines. J. Biol. Chem.193:265-275.

Megbowon I, Bombata-Fashina HA, Mojekwu TO, Babalola AF, Okunade OA (2010). Hybridization and Speciation Among Cichlids: The Case of “Wesafu”, An Ecotype Cichlid. Proceedings of the 25th Annual Conference of the Fisheries Society of Nigeria [FISON].

Olomu JM (1995). Monogastric Animal Nutrition Jachem Publications, Benin City. pp. 165-200.

Osibona AO, Kusemiju K, Akande GR (2009). Fatty acid composition and amino acid profile of two freshwater species, African catfish and tilapia. Afri. J. Food, Agric. Nutri. Develop. http://findarticles.com/p/articles/mi_7400/is_1_9/ai_n32063507/

Saisithi P (1994). Traditional fermented fish source production. In Fisheries Processing Biotechnological. pp. 1389-1400.