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Investigation of the Biochemical Composition of *Heterobranchus longifilis*, *Clarias gariepinus* and *Chrysichthys nigrodigitatus* of the Cross River, Nigeria

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Abstract: The proximate composition and mineral contents of *Heterobranchus longifilis*, *Clarias gariepinus* and *Chrysicthys nigrodigitatus* caught in the Cross River, Nigeria were investigated. Live specimens of these species were bought from the market and conveyed to the laboratory for study. In the laboratory, the food components of protein, fat, moisture and some minerals were measured following the methods given by AOAC. Crude protein in *C. nigrodigitatus* was 19.0% and in *C. gariepinus* it was 20.0% and 20.5% in *H. longifilis*. Fat contents were 5.04%, 5.0% and 6.0% in *C. nigrodigitatus*, *C. gariepinus* and *H. longifilis* respectively, while 75%, 73% and 75% were determined as moisture in *C. nigrodigitatus*, *C. gariepinus* and *H. longifilis* respectively. These values were not significant ($p>0.05$). The species are good sources for calcium, potassium and phosphorus and also excellent sources for iron. Copper was not detected in any of the species. These results are linked to the nutritional aspects of the species as food fish and also as animal feed and drug concentrates.

Key words: Proximate composition, minerals, catfishes, Nigeria

INTRODUCTION

The biochemical composition of several temperate and tropical fin and shell fishes are reported in literature (Gooch *et al*., 1982; Anthony *et al*., 2003; Pickerell, 2003; Osibona *et al*., 2009). The health implications associated with their consumption are also reported elaborately (Stanby, 1962; Leaf and Webbere, 1988; Ackman, 1990; Anonymous, 2004; FAO, 2005). Researchers affirm that some seafood extracts when consumed properly can assist to alleviate or even cure arthritis, blood pressure problems, weight control and even heart diseases (Eruvbeline *et al*., 2002).

Literature reports are extensive on the importance of dietary minerals of aquatic origin to humans, indicating the contribution of calcium, phosphorus, magnesium, manganese, chloride and the vitamins (A, C and D) as valuable in human health. Some of these minerals are major players in bone formation and repairs; with calcium playing a leading role in blood clotting, muscle contraction and in enzyme activities (Ardon *et al*., 1998; Abulude *et al*., 2006).

The role of protein, carbohydrate and lipids in the well being of organisms are generally known. The interest of Scientists in the proximate level of these substances in the organisms are related to their several importance uses; the knowledge of the proximate composition of organism recommends its food value to the nutritionist and to the aquaculturist its suggest to him the value of the cultured species and the level of food classes to be incorporated in their meals.

Information on the food value and mineral content of most local but economically important edible aquatic organisms are scarce. Most of these local species are not only delicacies but are also affordable by the low income earners (Etim, 1990; Ifon and Umoh, 1987). This study provides data on the proximate composition of three important catfish species of the Cross River namely *Clarias gariepinus*, *Heterobranchus longifilis* and *Chrysicthys nigrodigitatus*. These data are intended to provides clues as related to usefulness of these substances viz; as food to man, additives and concentrates in animal feed and even better as components in food supplements. Aquatic organisms (fish, shrimp, crabs, squids, mammals) have recently been assessed as possible sources for the supply of food nutrients and other ingredients to both man and in animal feed production. The carcass of most them and the shells of periwinkle and oysters (of which are mostly discarded for their flesh) are known sources for calcium and contain large amounts of other beneficial minerals (Ojewole and Udom, 2005).

MATERIALS AND METHODS

Live specimens of *Heterobranchus longifilis*, *Clarias gariepinus* and *Chrysichthys nigrodigitatus* used for this study were bought from Watt market, in Calabar, Nigeria. In the laboratory, each specimen was filleted, weighed and dried in an oven at 75°C for 24 hrs. The specimens were re-weighed after drying to record their moisture content.

The dried fillets were powdered and stored in an air tight container as stock sample for analysis. Methods extant in AOAC (1998) were used for the determinations of the proximate and mineral composition. The crude protein was determined using the Micro-kjeldahl method, fat by Soxhlet extraction, ash by furnace ashing at 600°C for 12 hrs while NFE was by difference (AOAC, 1998). The mineral contents were determined from the solution obtained by dissolving the ash (residues left after burning in furnace) in distilled water containing a few drops of concentrated HCL. Sodium and Potassium were determined with flame photometer. Iron, manganese, calcium, copper and other minerals were measured with the Spectrophometer at various wavelengths.

The significant differences in proximate composition and macro-and trace elements of the organisms were tested with the one way Analysis of Variance (ANOVA) (Sokal and Rohlf, 1969).

RESULTS

The fat contents of the species ranged between 12.42±0.02% in *Heterobranchus longifilis* to 17.50±1.01 in *Clarias gariepinus* (Table 1). There were no significant differences in the protein levels and ash contents of these three species ($p>0.05$). The proximate food composition of *H. longifilis*, *C. nigrodigitatus* and *C. gariepinus* were similar ($p>0.05$) except carbohydrate that was significantly different in *H. longifilis* compared to the other two species.

Copper was not detected in any of the species. Calcium was ten times more in *C. gariepinus* than in *H. longifilis* and about one and half times more in *C. gariepinus* than that determined in *C. nigrodigitatus* (Table 2). Phosphorus was similar in all these species giving approximately 33% (Table 2).

A comparison of the levels of iron in the species showed a ratio of 3:1:2 being more in *H. longifilis* than in *C. gariepinus* and *C. nigrodigitatus* (Table 2). The contents of phosphate, Nitrate-nitrogen and phosphorus were similar ($p<0.05$), while the concentration of other minerals were significantly different ($p>0.05$).

DISCUSSION

In this study, the food value of the three species were not significantly different ($p>0.05$) (Table 1). The protein level determined in these species are within the limits reported for other fin fishes. Data on the protein content of 62 New Zealand Marine fin fishes range from 9.5% in Black stick head to 24.0% and 23.4% in Albacore tuna and skipjack tuna respectively (Vlieg, 1984, 1988). Osibona *et al.* (2009) reported 18.8% protein for *C. gariepinus* of Lagos lagoon, Nigeria; this data contradicts the results of this study probably because the concerned species originated from different populations or that the method of processing of specimens for the studies could have led to the minor differences. This minor difference could as well have resulted from genetic differences of these species. In this study, the carbohydrate and fat contents in *H. longifilis*, *C. gariepinus* and *C. nigrodigitatus* (Table 2) are above known values for CHO and fat in fin fishes for reasons yet to be investigated. In general, the fat contents of fin-fishes are reported to be below 5.0% (Anthony *et al.*, 2003) while carbohydrate is below 2.0% (Vlieg, 1988). The low fat contents of sea foods over fats from conventional animals is an advantage; the former is able to synthesize its essential fatty acids as needed while the later whose fat are less nutritious (for example animals that produce beef) must be provided with fat in their meals (Rosenfeld *et al.*, 1997; Emmanuel *et al.*, 2008).

The Gross Energy (GE) (Kj/kg) measured in *C. gariepinus* (327.08 Kj/kg), was significantly different from that determined in *C. nigrodigitatus* (281.11 Kj/kg) and *H. longifilis* 272 Kj/kg ($p<0.05$). This presumes that *Clarias gariepinus* probably contain more calories than that available in the other two catfish species with far reaching implication to nutritionist.

Fin fishes are good sources for macro-minerals such as calcium, phosphorus, magnesium and potassium. Anthony *et al.* (2003) reports that the normal ratio of sodium to potassium in aquatic species is between 1:4 to 1:15. In this study, the ratio of sodium to potassium in *H. longifilis* was 1:6 (slightly higher) and 1:1 in *C. gariepinus* and *C. nigrodigitatus* respectively (Table 2).

Calcium was high in *C. gariepinus* (129.30 gm/100 gm) than in the other two species (Table 2). The ratio of this

Table 1: Proximate composition of some commercially important food fishes in Nigeria, West Africa

	Proximate composition (%)						
Fish species	Protein	Carbohydrate	Moisture	Ash	Fat	NFE	Energy
H. longifilis	20.54±0.34	19.52±0.01	75.01±0.15	6.02±0.01	12.42±0.02	3.36	272.02±0.11
C. gariepinus	20.00±0.22	23.08±0.98	73.18±0.27	5.00±0.09	17.50±0.01	3.00	327.08±0.08
C. nigrodigitatus	19.00±0.13	21.03±0.01	75.00±0.00	5.04±0.07	14.00±0.06	3.00	281.04±0.13

Table 2: Some mineral constituents of *H. longifilis*, *C. gariepinus* and *C. nigrodigitatus*, of the Cross River, West Africa

	Mineral composition (gm/100 gm)						
Fish species	Na	Ca	Cu	Fe	K	PO_4	$NO_3 + N$	P%
H. longifilis	67.40	11.00	0.00	358.90	10.80	1.61	45.50	29.92
C. gariepinus	34.30	129.30	0.00	118.68	38.00	1.39	48.30	33.40
C. nigrodigitatus	24.30	91.60	0.00	291.11	21.90	2.02	50.25	33.20

mineral in this species compared to other minerals in this study give approximately the ratio of 1:9. This is not true in the other two species; lower values of calcium were measured in the other two species (91.6 gm/100 gm and 11.0 gm/100 gm). These calcium concentrations in *C. gariepinus* and in the other two species were significantly different (p>0.05).

The concentration of phosphorus in the studied species were significant (p<0.05) (Table 2). Ojewole *et al.* (2003) reported lower values for calcium (7.28%) and 1.725% for phosphorus. In this study, the values of these two minerals in *C. gariepinus* and *C. nigrodigitatus* were higher and significantly different (p<0.05) from that measured in *H. longifilis* (Table 2). The contribution of calcium and phosphorus in bone formation and the consequence of their deficiencies are well known. It could also be observed that mineral contents of poultry and broiler feeds made from shrimps and grasshopper meals were equivalent/similar in concentration to the mineral contents of these three fish species; implying that if any of the species of this study is made to replace shrimp/grasshopper in meals of poultry animals they could probably perform equally. However, the cost implication must be the determining factor on which is the more suitable of the options in the preparation of poultry feeds (Apendi *et al.*, 1974; Ravinder *et al.*, 1996).

Conclusion: From these results, it is evidence that these species showed sufficient amounts of dietary elements useful for feed formulation, food for man and sufficient ingredient to serve as good food sources, additives, concentrates and as food supplements. Similar inferences could be made for *E. radiata* and grasshopper meals (Etim, 1990; Ravinder *et al.*, 1996; Ojewole *et al.*, 2003).

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