

## Proximate and Mineral Composition in Some Selected Fresh Water Fishes in Nigeria

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**Abstract:** The study on the elemental and proximate composition of dried samples of *Oreochromis niloticus*, *Sarotherodon galilaeus*, *Clarias gariepinus* and *Heterotis niloticus* was determined to gain the knowledge of the risk and benefits associated with indiscriminate consumption of freshwater fishes. Wet digestion was done for the samples and was analyzed for minerals and heavy metals spectrophotometrically. The species examined contained appreciable concentrations of sodium, potassium, phosphorous, magnesium, calcium, and iron suggesting that the fish species could be used as a good source of minerals. Few heavy metals analyzed were present but within tolerable limits. Likewise the values of the proximate composition obtained were seen to be highly pronounced most especially the crude protein and this also makes the fishes to be a good source of protein as well. Therefore, it can be suggested that taste, size, freshness and other related external appearances should not be the only factor to be considered in making choice for marketing and consumption of freshwater fishes.

**Key words:** Freshwater fishes, proximate composition, elemental composition *Oreochromis niloticus*, *Sarotherodon galilaeus*, *Clarias gariepinus* and *Heterotis niloticus*

### Introduction

Fish is known to be one of the cheapest sources of animal protein and other essential nutrients required in human diets (Sadiku and Oladimeji, 1991). The nature and quality of nutrients in most animals is dependent upon their food type. Also, feeding habit of an individual fish species has great effect on its body nutrients composition (Lagler *et al.*, 1977). The importance of fish in developing countries increased greatly after the Sahelian drought of 1971 -1974 which greatly decimated the cattle population, made the price of livestock virtually prohibitive to the majority of Nigerians; a trend which triggered a corresponding increase in the demand for fish which then was the main alternative animal protein source (Ladipo *et al.*, 1982). Foran *et al.*, (2005) submitted that, fish is a highly proteinous food consumed by a larger percentage of populace because of its availability and palatability.

The study of mineral elements present in living organisms is of biological importance; since many of such elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974). The body usually contains small amount of these minerals, some of which are essential nutrients, been components of many enzymes system and metabolic mechanisms, and as such contribute to the growth of the fish. The most important mineral salts are that of calcium, sodium, potassium, phosphorous, iron, chlorine while many others are also needed in trace amounts. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning; as it reduces productivity and causes diseases, such as inability of blood to clot, osteoporosis, anemia etc. (Shul'man, 1974 and Mills, 1980).

Moreover, the measurement of some proximate profiles such as protein contents, carbohydrates, lipids, moisture contents and ash percentage is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000). In addition, one of the major pollution sources that pose serious health risk and environmental concern is that which result from heavy metals (Neil *et al.*, 1995). All living organisms

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require these mineral elements and some of these biochemical attributes at moderate levels; but when they exceed metabolic demand or requirement, they tend to become accumulated in tissues of organisms such as fish which can only metabolize it to lesser extents because most of these heavy metals are non-biodegradable (Lenntech, 2006). Therefore, considering the various health risk and the nutritional benefits associated with fish consumption; it has therefore become important that, fish's mineral and proximate composition and their health status be assessed in order to establish the safety level of the table sized species prior their consumption.

Therefore, the aim of this work is to determine the mineral metals and proximate composition of some freshwater species in Nigeria.

### Materials and Methods

The fish samples used for this work include *Oreochromis niloticus*, *Sarotherodon galilaeus*, *Clarias gariepinus* and *Heterotis niloticus*; they were collected from various locations in Asa reservoir, Ilorin, Kwara State, Nigeria. The fishes collected were virtually of the same size as variability in size stands to affect the proximate composition and the mineral elements concentration. All the samples were collected fresh and refrigerated below 4°C prior use.

Each species of the fish sample was oven-dried in an electric oven at between 70 – 80°C until the samples had constant weight. From each composite sample; 2g were measured and taken as analytical sample; the samples were digested with concentrated nitric acid. The determination of the percentage proximate composition was analyzed chemically according to the method of analysis described by the Association of Official Analytical Chemist (AOAC, 1975) while the percentage mineral elemental concentration including heavy metal concentrations were determined using (AAS) Atomic Absorption Spectrophotometer (AOAC, 1975).

### Results

The results of the percentage means of mineral elements concentrations were given in Table 1a. The variations observed in the values obtained showed insignificant difference. All the mineral elements investigated were represented in all the species analyzed. Sodium, Potassium, Phosphorous, Magnesium, Iron and Calcium were particularly abundant in the fish analyzed in that order while; Zinc, Nickel, Arsenic, Copper, Lead and Cadmium were present in the fish tissues in trace amounts. *O. niloticus*, *S. galilaeus*, *C. gariepinus* and *H. niloticus* presented a relatively higher amount of mineral contents in that order with which they were listed.

Table 1b depict the results of the mean percentage proximate composition (i.e., protein content, carbohydrate content, crude fiber, ash content, dry matter and ether extract) of the selected species analyzed. The food values analyzed recorded varied values of their presence in the body tissue of the fishes analyzed; with the percentage dry matter content and crude protein recording higher values in that order; followed by moisture content, ash content, ether extract and crude fiber. The fish samples analyzed presented a relatively higher and lower amount of proximate concentrations in the order of *H. niloticus*, > *C. gariepinus*, > *S. galilaeus* > *O. niloticus*.

### Discussion

Fish is a highly proteinous food consumed by the populace; A larger percentage of consumers do eat fish because of its availability, flavors, palatability while fewer percentage do so because of it's nutritional value. Therefore, studies on the proximate composition and elemental composition of the freshwater fishes have not really caught attention of researches in fisheries; Hence the consumer and fishery workers are left with limited or paucity of information's on the importance of particular fish species in their daily diets (Adewoye *et al.*, 2003).

Table 1a. The percentage means of mineral elements in the body tissue of some selected fish species

Parameters (%) Sample	P	Ca	K	Mg	Fe	Na	Cu	Pb	Cd	Zn	Ni	As
<i>O. niloticus</i>	0.23	0.20	0.32	0.23	0.12	0.80	0.02	0.01	0.01	0.43	0.10	0.02
<i>S. galilaeus</i>	0.25	0.24	0.34	0.22	0.10	0.73	0.03	0.02	0.01	0.35	0.10	0.04
<i>C. gariepinus</i>	0.34	0.33	0.36	0.30	0.12	0.80	0.02	0.01	0.02	0.40	0.14	0.03
<i>H. niloticus</i>	0.38	0.40	0.32	0.29	0.14	0.74	0.03	0.03	0.01	0.30	0.03	0.02

Table 1b. The percentage means proximate composition in the body tissue of some selected fish species

Parameters (%) Fish Samples	Crude protein	Crude Fibre	Either Extract	Ash Content	Moisture Content	Dry Matter
<i>O. niloticus</i>	38.40	0.38	3.50	4.55	7.50	92.50
<i>S. galilaeus</i>	41.28	0.12	4.15	4.76	5.80	94.20
<i>C. gariepinus</i>	44.28	0.10	7.80	4.00	6.60	93.40
<i>H. niloticus</i>	46.28	0.12	8.25	9.00	7.90	92.10

Concentration of sodium ( $\text{Na}^+$ ) were observed to have appreciably dominated other elements analyzed in all the fish samples examined; This is an indication that the water body from which the fishes were collected is very rich in sodium and that must have allowed an active movement of this ion across the gill structure, which in turn may depend on the concentration in the external medium and that the richness in sodium ( $\text{Na}^+$ ) concentrations would boost the osmoregulatory activities in the organisms (Bentley, 1971). Considering the remaining elements analyzed, there was no well-defined order of magnitude within and across the samples analyzed. The variations recorded in the concentration of minerals in fish muscles examined could have been as a result of the rate in which they are available in the water body and the ability of the fish to absorb these inorganic elements from their diets and the water bodies where they live (Adewoye and Omotosho, 1997). Variations recorded in the values obtained for both calcium and phosphorous could be due to an increase in the proportion of bone to flesh as the fishes grow; this is in conformity with the submission of Boyd and Davis, (1978). Both *H. niloticus* and *C. gariepinus* recorded high level of calcium, the benthic nature of these species and their relative preference for consumption of hard structure could be a contributing factor. This conforms with the submission of Adewoye *et al.*, (2003) and Boyd and Davis (1978) that the high calcium content recorded in *H. niloticus* and *C. anguillar* could probably be due to preferential accumulation and calcification of scales and hard tissues. The richness in phosphorus level in the two species compared to other species can be attributed to the fact that phosphorous is a component of protein (Taylor, *et al.*, 2002).

Other elements (such as Zinc, Copper, Lead, Cadmium, Nickel and Arsenic) composition of the fish samples recorded variations in their concentrations both within and between the selected species sampled. This observation was supported by the findings of Windom *et al.*, (1987) which showed that such variations in concentrations of these mineral elements from one species of fish to another was due to the chemical forms of the elements and their concentrations in the local environment. They were present

in the fish tissues in the following order (i.e.  $\text{Zn} > \text{Ni} > \text{As} > \text{Cu} > \text{Pb} > \text{Cd}$ ). This report is in agreement with the one obtained by Ako and Salihu (2004). Most of these microelements that are present in trace amount in this work are equally important in body but in trace amounts as observed; but they tend to become harmful when their concentrations in body tissue exceeds metabolic demands.

Then, the proximate composition of *O. niloticus*, *S. galilaeus*, *C. gariepinus* and *H. niloticus* show encouragingly high crude protein contents of 38.40%, 41.28%, 44.28% and 46.28% respectively (Table 1b). The relatively high to moderate percentage crude protein could be attributed to the fact that; fishes are good source of pure protein, but the differences observed, in the obtained values may also be attributed to fish's consumption or absorption capability and conversion potentials of essential nutrients from their diet or their local environment into such biochemical attributes needed by the organisms body (Burgess, 1975 and Adewoye and Omotosho, 1997). The percentage ether extract, ash contents, crude fibers and moisture contents followed the same order in all the species analyzed.

This study therefore, showed that freshwater fishes are good sources of minerals. Thus, it is right to say that, the mineral elemental contents of each species is a function of the availability of these elements in their local environment, diet absorptive capability and as well as their preferential accumulation. However, it was discovered that, microelements recorded very low values; this may be due to the fact that the body needs them in trace amounts and that the concentrations in the water body is very low. It is therefore become important to equally consider the minerals status of fish and the persistence food safety of the fish prior to consumption in addition to the prevailing choice of taste, size, type and external morphology of fish. Also, this present work has elucidated more on the importance of freshwater fishes as good sources of protein and minerals. It has also broadened our knowledge on the nutritional value of some freshwater fish species that had been previously neglected probably because of their taste, rough surfaces and even taboos attached to each of them.

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