RESEARCH ARTICLE

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Proximate and minerals compositions of three species of fish, *Champsocephalus gunnari*, *Oreochromis niloticus* and *hybrid catfish* sold in Birnin Kebbi, Kebbi State, Nigeria

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ABSTRACT

Background: Fish is known to be one of the cheapest sources of animal protein and have essential nutrients needed in human diets. The present study investigated the proximate and nutrient composition of three species of fish, *Champsocephalus gunnari, Oreochromis niloticus*, and hybrid catfish (*Clarias gariepinus*).
Methods: The sample collection, proximate and mineral analysis were conducted using the standard protocols of sample collections and chemical analysis.
Results: The results revealed that *Champsocephalus gunnari, Oreochromis niloticus*, and *Clarias gariepinus* contain moisture (66.00±0.50%, 52.00±1.00%, and 70.00±0.20%), crude protein (9.20±0.1323%, 3.75±0.02%and 5.80±0.05%), crude lipid (10.16±0.91%, 2.37±0.01% and 12.00±0.30%), ash (11.92 ±0.02%, 39.40±0.03% and 11.97±0.06%), and crude fiber (2.03±0.01%, 2.36±0.02% and 0.19±0.01%) respectively. The mineral contents were: iron (4.50±0.01mg/kg, 3.70±0.01 mg/kg and 4.70±0.02mg/kg), Zinc (2.35±0.01mg/kg, 2.15±0.0100mg/kg and (1.89±0.01mg/kg) for *Champsocephalus gunnari, Oreochromis niloticus*, and *Clarias gariepinus* respectively, while copper was only detected in C. gunnari (0.25±0.01mg/kg). The same amount of chromium (0.01±0.00 mg/kg) was detected in all the samples. Manganese was undetected in all the samples.
Conclusion: In conclusion, the present study demonstrated the nutritional value of *Champsocephalus gunnari, Oreochromis niloticus* and *Clarias gariepinus*. This information would help in choosing any of the fish bases on their nutritional values rather than taste and other physical features.

Keywords: Proximate; Minerals; *Champsocephalus gunnari*, *Oreochromis niloticus* and *Clarias gariepinus*

1.0 Introduction

Fish is one of the most important animal protein and other vital nutrients sources that are widely consumed by all races and classes of people, proper knowledge on the biochemical composition of fish finds application in several areas. Today there is an ever-increasing awareness about healthy food and fish is finding more acceptance because of its special nutritional qualities. (Andrew, 2001; Abolude and Abdullahi, 2005). Fish is widely accepted because of its high palatability, low cholesterol, tender flesh, cheap. (Eyo, 2001).

Fish is known to be one of the cheapest sources of animal protein and have essential nutrients needed in human diets (Sadiku and Oladimeji (1991). The advantages of fish as food are its easy digestibility and high nutritional value. The high demand for fish is not only because of its taste but also largely due to its nutritional values which is a function of its proximate composition (Njinkoue *et al.,* 2016).

Fish flesh generally contains about 15-20% protein and less than 1% carbohydrates. Fish flesh or muscle naturally contains only traces or low levels of carbohydrates, in the form of sugars, sugar phosphates, and glycogen. Some other tissues such as the liver contain a larger amount of glycogen, and most molluscan shellfish also contain a fair amount of glycogen. (Mclay *et al*, 1986). Lipids from fish are well known as a rich source of long-chain n-3 polyunsaturated fatty acids (LC n-3 PUFA) such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which cannot be synthesized by humans and commonly

obtained from the diet (Alasalvar *et al.,* 2002). Polyunsaturated fatty acids from fish have been reported to have preventive and/or curative effects for several diseases including arterial hypertension cancers and inflammatory diseases (Turkmen *et al.,*2005). It may also aid in lowering the risk of Dementia, Alzheimer's diseases and prevent cardiovascular diseases ((Turkmen *et al.,* 2005).

Fish have been one of the main food for many countries. It is a vital source of food for people. It is man's most important source of high-quality protein consumed by the world's population, according to the food and agricultural organization (FAO) of the United Nations (1997). In Africa, as much as 5% of the population, some 35 million people demand wholly or partly on the fisheries sector for their livelihood (FAO, 1996). In Nigeria, fish is a major food item contributing a total of 40% dietary protein requirements and a readily available source of animal protein in the diet of man (Adebowale, *et al,* 2008). Fish is highly nutritious with balanced amino acids, minerals, and vitamins for healthy human growth. It is less tough and more digestible when compared with chicken, beef, and mutton (Fagbenro *et al,* (2005).

Fish also has substantial social and economic importance. The value of fish traded internationally is about fifty-one billion US dollars per anum. Over 36 million people are employed directly through fishing and aquaculture (FAO, 2000). It is estimated that by 2050, when the world population is projected to be over 9 billion, Africa will have to increase food production by 300%, Latin America by 80%, and Asia by 70% to provide minimally adequate diets for the projected population of 2 billion, 810 million and 5.4 billion people in the respective region (Fawole and Olagunju, 2007). These data show that a consistent source of fish is essential for the nutritional and financial health of a large segment of the world's population.

However, fish of various species do not provide the same nutrient profile to their consumers (Soriguer *et al.,* 1997; Fawole and Olagunju, 2007; Takama *et al.,* 1999). These differences in the nutritional compositions of different species may be attributed to food composition, food and feeding habit, feeding rate, habitats, sex, age, size, genetic traits, and season/migration (Dawson and Griman, 1980; Abdullahi, 2001; Ajah, 2009). Besides being used as food, fish is also increasingly demanded use as feed. However,

information concerning the chemical composition of freshwater fishes, in general, is valuable to nutritionists concerned with readily available sources of low-fat, high-protein foods such as most freshwater fishes (Sadiku and Oladimeji, 1991; Mozaffarian *et al.,* 2003; Foran *et al.,* 2005) and to the food scientist who is interested in developing them into high-protein foods, while ensuring the finest quality flavor, color, odor, texture, and safety obtainable with maximum nutritive value (Elagba *et al.*2010). The aim of this study is to compare the proximate values and minerals of three selected different fishes and to help consumers in choosing fish based on their nutrient values.

2. Material and methods

2.1 Sampling and sample preparation

The samples required for this research work were three different species of fishes in Birnin Kebbi. Two were gotten from the Birnin Kebbi main market (Sabuwar kasuwa), they are Local tilapia fish (Nile tilapia) *(oreochromis niloticus)* and mackerel icefish *(Champsocephalus gunnari)* the third sample was obtained from a fish farm (Halil poultry and fisheries Badariya Area Birnin Kebbi) i.e hybrid catfish (*Clarias gariepinus).* They were collected and transported to the laboratory in their fresh forms in separate containers. The sample was separately minced and pounded in mortar and mixed. After pounding them, they were transferred as quickly as possible to a dry and rigid plastic container and sealed to avoid moisture loss or gain. They were clearly labeled, and stored in a cool environment (Edeoga *et al.,* 2005).

2.2 Reagents and Chemicals

All chemicals used were of analytical grade and were products of Sigma Chemical Co., USA.

2.3 Proximate Composition Analysis

The proximate analysis of the moisture, ash, crude fiber, crude protein, and nitrogen was done using the standard method of the Association of Official Analytical Chemists, AOAC (1990). The sample was prepared in triplicate and the nitrogen was determined by the micro Kjeldahl method described by Pearson (1976) and the nitrogen content was converted to protein by multiplying it by a factor of 6.25. Carbohydrate was determined by the difference.

% carbohydrate = 100 - (% moisture + % ash +% fat +% protein)

2.4 Preparation of sample for ash content

About 6g of each sample was weighed into an already weighed crucible then the weight is taken. Few drops of glycerol were added to the samples and mixed. The sample in the crucible was gently heated over a Bunsen burner until it became charred and smoking ceased. It was then transferred to a muffle furnace and heated for about 24-48 hours at 550°C until black ash resulted. Few drops of water were added to the blackened ash to dissolve the salt in the complex. The ash was dried in an oven and the ashing process repeated until grey ash resulted. It was cooled in a desiccator and the weight of the ash was taken. The same process was carried out on all the samples.

2.5 Digestion of sample from ash

A 15ml of concentrated HCl and 15ml of nitric acid were added to the ash in a crucible and boiled on a hot plate for 40 minutes for the complete removal of organic matter remaining. This was done in a fume cupboard and the acid was added as necessary to maintain the volume during boiling. The digested sample was filtered and transferred to a beaker after the crucible had been washed with distilled water. The volume of the extract was transferred into a 100cm^3 volumetric flask and made up to the mark with distilled water. The solutions were transferred into containers, corked, and labeled for the determinations of individual minerals (Yeshajahu, 2005).

2.6 Determination of mineral elements using atomic absorption spectrophotometer (AAS)

Analysis of mineral elements was carried out using atomic absorption spectrophotometer (AAS) using the standard method of the Association of Official Analytical Chemists, AOAC (1990).

2.6 Statistical analysis

Data collected were subjected to statistical analysis using the statistical package for social science version 21.0 and express as mean ± standard error of mean (SEM). Statistical significance of the results between groups was determined using One-way analysis of variance (ANOVA) followed by Duncans multiple range test (DMRT) Differences in mean were considered to be significant at p<0.05 (Adamu and Johnson, 1997

3.0 RESULTS

3.1 Proximate Composition

The results of the proximate values of the three species of fish selected for this study are presented in table 1. The moisture contents values were 66.00±0.50 in *C. gunnari*, 52.00±1.00 in *O. nicoticus while* 70.00±0.200 *in Clarias gariepinus.* The crude protein values were 9.20±0.13 (*C. gunnari)*, 3.75±0.03 (*O. nicoticu)* and 5.80±0.0500 (*Clarias gariepinus)*. O. *nicoticus* has the least (2.37±0.01) while *Clarias gariepinus* (12.00±0.30) has the highest rude lipid contents Carbohydrates and Crude fiber ranges from 2.03±0.01, 2.36±0.02 and 0.19±0.01**.**

Table 1: The proximate composition of the fish species sold and consumed in Birnin kebbi.

Proximate	*C. gunnari*	*O. nicoticus*	*Clarias gariepinus*
Moisture (g/100g)	66.00 ± 0.50[a]	52.00±1.000[b]	70.00 ± 0.20[c]
Crude Protein (g/100g)	9.20 ± 0.13[a]	3.75 ± 0.03[b]	5.80 ± 0.05[c]
Crude lipid (g/100g)	10.16 ± 0.91[a]	2.37± 0.01[b]	12.00 ± 0.30[c]
Ash (g/100g)	11.92 ± 0.03[a]	39.40 ± 0.03[b]	11.97±0.06[a]
Carbohydrate & fiber (g/100g)	2.03 ± 0.01[a]	2.36 ± 0.02[a]	0.19 ± 0.01[b]

Data are presented in mean standard deviation and Columns followed by the same alphabet are significantly similar. While columns followed by different letters are significantly different at 5% level of significance (p > 0.05)

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Iboyi et al., 2021

3.2 Mineral Composition

The results of the mineral content of the three species of fish selected for this study are presented in table 2. The result for the values of the different minerals shows that Iron, Chromium, and Zinc are detected. Iron has the highest concentration of 4.70±0.0200 (ppm) in *Clarias*

gariepinus followed by *C. gunnari* with 4.50±0.0100. Chromium has no significant difference between *C. gunnari* and *O. nicoticus* with 0.01concentration. Manganese was not detected in all three samples, while Copper was only detected in *C. gunnari* with 0.25±0.0057 (PPM) concentration.

TABLE 2: The mineral contents of the fish species sold and consumed in Birnin Kebbi

Minerals (ppm)	*C. gunnari*	*O. nicoticus*	*Clarias gariepinus*
Copper	0.25 ± 0.01	undetected	Undetected
Zinc	2.35 ± 0.01[a]	2.15 ± 0.01[a]	0.89 ± 0.01[b]
Chromium	0.01 ± 0.00 [a]	0.01 ± 0.00 [a]	0.0 1± 0.00 [a]
Manganese	Undetected	undetected	Undetected
Iron	4.50 ± 0.01[a]	3.70 ± 0.01[b]	4.70 ± 0.02 [a]

Data are presented in mean standard deviation and Columns followed by the same alphabet are significantly similar. While columns followed by different letters are significantly different ($p > 0.05$).

4.0 Discussion

Fish is primarily composed of water (66–81%), protein (16–21%), carbohydrates (<0.5%), lipids (0.2–25%) and ash (1.2–1.5%) (FAO, 1999). The proximate composition of nutrients in all fish samples showed variation among the individual species. The moisture contents of two species of the fish, (*C. gunnari* and Hybrid catfish) were within the acceptable level (60-80 %), which could be due to the stable water levels in the location where the fish were collected (Adewumi *et al.,* 2014). Yeannes and Almandos, opined that differences in the nutrient composition of the fishes could be due to accessibility of these components in water, and/or the ability of the fish to consume and convert these vital nutrients either from food or water.

The percentage of water is also a good indicator of its relative content of energy, protein and lipid (Olagunju *et al.* 2012). Furthermore, biological variations, seasonal changes and environmental conditions are factors that can influence the biochemical composition of fish El Shehawy, *et al* (2016*)*. Similar findings were reported by Adewoye and Omotosho (1997), Prapasri *et al* (199). The observed differences in the proximate compositions in the four fish species were not significant.

The percentage range of the moisture contents of fish species as observed in this study was between 52.00 and 70.00 %. The result shows that moisture is the major constituent of edible fish

part. Moisture content in all the species agreed with observation of Udo and Arazu (2012), Olagunju *et al.,* (2012), and Mazumder *et al.,* (2008) in several freshwater fish species. The high moisture content can cause the degradation of polyunsaturated fatty acids, increase the fishes' vulnerability to spoilage by microorganisms, and consequently reducing fish quality for longer periods of preservation. However, high moisture content could also play important roles in metabolic reactions and help to easily solubilize certain elements. High moisture was also reported by Ayanda *et al*.

Protein and fat are the most important nutrient present in fish and their composition help to describe the nutritional status of a particular organism (Aberoumad and Pourshafi 2010). There were variations in the protein content of the three species examined in this study of *C. gunnari, O. nicoticus, Hybrid catfish* which showed high crude protein contents of and 9.20, 3.75, 5.80 respectively. The result revealed that all the analyzed species of fish were high-quality sources of protein. The high protein content in the tissue of the fish species in this study may be due to similarity in diet of the fishes that are very rich in protein, (Osibona O. 2005.).

The ash content measures of the total mineral content in the tissue, (Nair and Mathew 2001). It is also helpful in the development of the body and growth. *O. nicoticus* had the highest ash content (39.40 ± 0.0320) while *C. gunnari* had the lowest

Iboyi et al., 2021

ash content (11.92 ± 0.0208). The high value of ash in the fish species is an indication of its high mineral content like magnesium, calcium, potassium, and zinc, (Emmanuel *et al.,* 2011).

The carbohydrates and crude fiber level in all the samples were low, though *Clarias gariepinus* has the lowest. According to Mclay, (1986) fish flesh or muscle naturally contains only traces or low levels of carbohydrates and this is evident especially in *Clarias gariepinus* (0.19) where there might not even be a trace.

In the mineral elements, the difference in the level of Iron is significant, Copper was undetected in *O. niloticus and Clarias gariepinus* but present in a very low level in *C. gunnari.* Zinc level in all the samples has very low level significance difference, while Chromium level is the same in all the samples, Manganese was undetected in all the samples.

Zn is an essential metal known to play important roles in human metabolic pathways and its shortage can cause appetite loss, retarded growth, skin changes and dysfunction of the immune system (Malakootian *et al,* 2011). Zn was detected in all the three samples of the fish with concentrations of (2.35, 2.15 and 1.89 respectively). High concentration of Zn can lead to death, stunted growth, and reproductive injury (Sorensen 1991). Excess Manganese can induce oxidative stress and toxic effects in aquatic organisms (Edward e*t al., 2013*) but it was undetected in this study.

5.0 Conclusion

This study is all about the importance and nutritional value of three species of fish, *champsocephalus gunnari*, *oreochromis niloticus* and *Clarias gariepinus* as a good source of protein and other minerals values. The information on the nutritional values can also help in choosing any of the fish bases on their nutritional values rather than taste and other physical features.

Authors' contributions

This work was carried out in collaboration between all authors. Author Nathaniel Onuche Iboyi designed the study and performed the statistical analysis. Authors Jummai Suleiman wrote the protocol. Authors Harrison Ogala help in carrying out the analysis and wrote some of the protocol. All authors managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

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Competing Interests

Authors have declared that no competing interests exist.

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Iboyi et al., 2021

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