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# Comparative Studies on the Nutritional Fitness of some Selected Cichlids Sampled from OBA Reservoir, South Western Nigeria

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## Abstract

Comparative analysis of the nutrient fitness of some selected wild fish species from Oba Reservoir were carried out using standard methods. Seven different species *(Tilapia guinnensis, Tilapia dageti, Tilapia zilli, Oreochromis aureus, Sarotherodon galilaeus, Oreochromis niloticus and Hepsetus odoe)* were sampled and analyzed for the period of twelve months. The results of the proximate composition showed that all the sampled fish species contain adequate amount of protein, moisture, lipid, ash and carbohydrates with a significant difference ($p<0.05$) in ash content and crude protein. Also, the results of the minerals contents indicated that sampled species contain an appreciable amount of zinc, iron, copper, calcium, sodium, potassium and manganese, with a significant difference in protein, zinc, calcium and iron. Therefore, further studies should focus on the improving the quality of the water body in order to enhance the overall nutritional composition of the residing organisms.

**Keywords:** Fresh water; Oba reservoir; Species; Amino acid and proximate.

## Introduction

Fish has traditionally been a popular part of diets in many parts of the world, especially some West African countries where it constitutes the main source of animal protein among the coastal dwellers. The freshwater fish species provide foods, subsistence and supplemental income to a wide range of people, especially those that live in coastal areas [1]. Fish and fishery product represent a valuable source of nutrients for diversified and healthy diets [2]. Fish has an edge over meat, in Nigeria, because it is cheaper and relatively more abundant [3]. Fish is generally appreciated as one of the healthiest and cheapest source of protein and essential amino acids like Lysine, methionine, cysteine, threonine and tryptophan [4].

Proximate composition determination involves analysis of moisture, crude protein (CP), lipid and ash contents, while elemental composition analysis involves the determination of mineral contents such as potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn). The body of fish usually contain small amount of minerals, some of which are essential nutrients, being components of many enzymes system, metabolic mechanisms, and as such, contribute to the growth and development of the fish. The most important mineral salts are calcium, sodium, potassium, phosphorus, iron and chlorine, while many others are needed in trace amounts. All living organism requires mineral elements for biochemical activities at moderate levels [5].

Water is the home of fishes and its quality is most over looked. It is therefore important to know about Water quality parameters and their management which have influence on growth and survival of aquatic organisms especially fish. The nutritional composition of fish varies greatly from one species to another depending on age, source, feeding habit, size, sexual variations, and water quality due to spanning, environment and season [6-8]. However, the high demand for fish products in Nigeria call for studies on the nutritional status of different fish species for its maximum utilization. Therefore, this work aimed at evaluating the water chemistry and the nutritional fitness of selected fish species in Oba Reservoir, Nigeria.

## Materials and Methods

### The study area

Oba Reservoir is located in Ikose, Oriire Local Government area, Ogbomoso, Oyo State. Three different sampling Sites (A, B and C) were selected for water sampling and the coordinates of the Sites in DMS (Degrees Minutes Seconds) are, Site A: 811’896” N and 4° 12’242” E; Site B: 8°11’519” N and 4°12’075” E; and Site C: 8°11’263” N and 4°12’112” E. The height elevation of the river is 305m with the Geographical Positioning system (GPS) used having 3 m accuracy. The reservoir receives water from different tributaries, majorly from Afon and Asa Rivers, and thus makes it vulnerable to pollution especially through the water sources as well as run offs from agricultural and domestic premises.

### Collection of water samples

Surface water samples were collected from the sampling points twice monthly from January through December, 2018. Samples were collected with the assistance of fishermen into sample bottles, which were previously soaked in 3% nitric acid and washed with distilled water as per WHO in 2011. Samples for the determination of dissolved oxygen were collected in dark glass containers and fixed on the spot with Winkler reagent. The water samples for the determination of other parameters were preserved with a known percentage of HCL. The water samples were digested by introducing 100 ml of water samples from each sampling point into three different beakers. Five (5 ml) of concentrated ($HNO_3$) was added and the sample evaporated on a hot plate. Another 5 ml of concentration $HNO_3$ were added to the samples and a gentle re-fluxing was carried out using a condenser. Heating and addition of concentrated $HNO_3$ continued until the samples became lightly coloured. Two (2 ml) of concentrated $HNO_3$ were added to dissolved the residue on the wall of the beaker. Digested samples were filtered and made up to 50 ml with deionized distilled water and then analysed using Atomic Absorption Spectrophotometer, model (AAS- Perlin-Elmer 4100 ZL).

### Biological sample collection and analyses

The fish species used in this work were wild *Hepsetusodoe, Tilapia dagetti, Oreochromis aureus, Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zilli and Tilapia guineensis*. They were purchased from the fishermen at the landing point. The collected samples were oven dried to constant weight and made powdered with a sterile mortar and pestle and kept refrigerated.

### Specimen digestion

Five grams of each of the samples were weighed and transferred into a beaker; then 5 ml of concentrated trioxonitrate (v) acid ($HNO_3$) was added and allowed to evaporate on a hot plate to the lowest volume possible (15-20 ml) before precipitation occurred, another 5 ml of concentrated trioxonitrate (v) acid was added to the sample and a gentle refluxing was carried out by covering the beaker with a watch glass. Heating and addition of concentrated trioxonitrate (v) acid continued until the sample became light coloured. Furthermore, 2 ml of concentrated trioxonitrate (v) acid were added to dissolve the residue on the wall of the beaker. The beaker walls and watch were thereafter washed down with deionized water. The digested samples were then filtered and made up to the mark in 100 ml volumetric flask, after which they were stored in pre-weigh sample bottles and placed in refrigerator before analysis of heavy metals. Proximate and metal evaluation of the collected fish species was done using the standard method described by the Association of Official Analytical Chemists (AOAC) in 2010.

### Amino acid analysis

The amino acid profile in a known sample was determined using methods described by Hiroyuki–Kato et al. The known sample was dried to constant weight, defatted, hydrolysed, evaporated in a rotary evaporator and then located into the technician Sequential Multisampling Amino Acid Analyser (TSM) Model DNA 0209. The TSM analyser is designed to separate and analyse free acidic, neutral and basic amino acids of the hydrolysed. The period of an analysis lasted for 76 minutes.

## Statistical Analysis

Simple descriptive statistics graphical representations were used in the summarization of parameters of interest in this study. Appropriate inferential statistics were used in examining the difference in composition between wild and cultured population.

## Results and Discussion

### Physico-chemical properties

The results of the physico-chemical analysis of Oba Reservoir water are presented in Figure 1, to show the quality status of the reservoir water. The measured parameters were explored with respect to each of the three sites under consideration. The results showed that, Site B had the lowest temperature (23C), with Site C recording the highest (28.2C). Varied level of temperature was recorded in this present work across all the Sampled Sites. Generally, the varied level of temperature recorded is a direct reflection of low depth of the water body and irregular slow movement which does not ensure a complete mixing of the entire water column. This observation agreed with the submission of Oyewo, on the temperature profile of Lagos Lagoon. The three values obtained were statistically different across the Sampling Sites.

The highest rate of conductivity was recorded in site A (128.11) while site B had the lowest. The maximum amount of dissolved oxygen was higher in site B (6.33) than the other two sites. Site A (1.98) had the lowest rate of biological oxygen demand while the highest was observed in site C (3.46). Nitrate content observed was higher in site C than the other two sites. Phosphate, copper and, lead content were maximally higher in site B than the other two sites. Furthermore, the amount of Zinc, Manganese and Iron content were higher in site B than the other two groups (Figure 1).

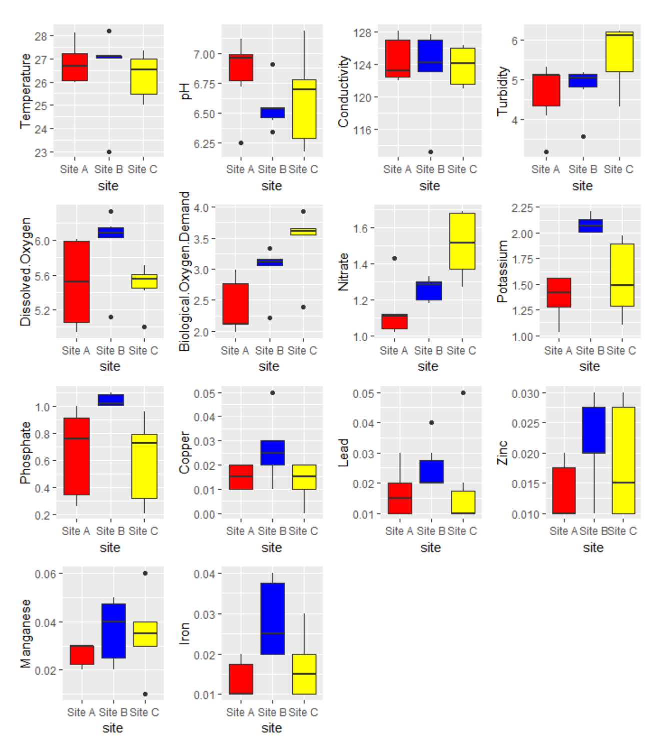


**Figure 1:** Distribution of parameters disaggregated by site.

Dissolved oxygen content of the water is measured as the amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the biology of fish culture [9]. The DO values obtained from the sampling sites as shown in Figure 1 ranges from 4.94 mg/l to 6.33 mg/l, and thus can sustain aquatic life. These values also agree with the minimum DO of 5.0 mg/l as reported for tropical fishes by Saloom and Duncan and Lawson for many countries. Biological oxygen demand varied slightly among the three sampling sites as observed in the study areas. In this present work, the BOD values are higher than the permissible levels and this may be attributed to the recorded levels of high temperature, high density of planktons, high concentration of organic matter and so on. The recorded level of this parameter conformed to the submission of Ogundiran and Fawole and Adewoye et al.

For most water bodies and their resident species, a pH range of between 6.5 and 9.0 is generally ideal [10]. The pH range recorded in this work falls between 6.5 and 7.0 (Figure 1), and this is an indication that the water is fairly natural. Such pH range could be due to the influx of agricultural and domestic wastes. The fluctuation observed in the pH values recorded may be due to the buffering capacity of the total alkalinity [11]. Usually, freshwater normally has a conductivity of between 20 and 1550 µmho/cm [12]. Electrical conductivity increases with an increase in salinity. Fish generally thrive well over a wide range of electrical conductivity. Hence, the values obtained in this study fall within the acceptable limits and this conform to the report of Ogundiran and Fawole & Adewoye et al.

The turbidity values obtained across the three Sampling Sites were high and statistically significant between Sites. This increased turbidity may be connected to the fact that, Oba Reservoir is fed by many tributaries (Ajala and Fawole), and also could be because of moderate to heavy rainfall that is always experienced in the area [13]. This work has reported varied concentrations of some selected metals such as copper, lead, zinc, iron and manganese, which were generally high in value across the three Sampling Sites (Figure 1). Those values recorded in this work could be adduced to anthropogenic activities going on around the reservoir and because of its exposure to domestic and agricultural influences. This report is similar to the report of Adeniyi based on his research at Agboyi creek segment near Lagos lagoon. All the metals analyzed in this work were found to be higher than those reported previously by Adewoye.

The concentration of lead is significantly high in Site B than in A and C. The value of B is also higher than the permissible level of 0.01 mgL as regulated by the WHO and NIS. This is an indication that lead is ubiquitous in our environment with diverse pollution source. The same trend was recorded in the case of metals analyzed and this is in agreement with the work of Ogundiran and Fawole, in their work on heavy metal in water and sediment from Asa River, Nigeria. Also, low level of these metals in surface water in Sites A and C might not necessarily reflect that such area were not polluted as the additive effects of these metals is capable of forming toxic compounds that could alters the aquatic environment.

## Mineral elemental composition

An analysis of variance revealed no statistical significant difference in the mean Zinc content across all sampled species, F=2.133, p-value=0.074. There was a statistical significant in the Iron content across sampled species, F=7.126, p-value<0.001. Similarly, mean Lead content differed significantly across species, F=7.036, p-value<0.001. Further, there was a statistical significant difference in the mean Copper content across species, p-value=0.004. Also, mean Calcium content differed significantly across species, 26.751, p-value<0.001. There was no statistical significant difference in the mean Sodium content across species, F=0.557, p-value=0.762. There was a statistical significant difference in the mean content of each of Potassium, Magnesium, and Manganese across species, p-value<0.001 (Table 1).

The pattern of elemental concentration in each of the species is in the order of K>Na>Fe>Mg>Mn>Zn>Ca>Pb>Cu, which is slightly similar to the result reported by Adewumi et al. Potassium was the most abundant mineral in all the sampled species as shown in (Table 1), this may be due to the high content of potassium recorded in the water Samples thus creating an alarm that the fish species might have accumulated potassium and biomagnified it over a period of time. The high value of calcium portrays that the sampled fish species can play a role in bone and strong teeth formation [14-16]. The presence of Zinc in the samples could mean that the sampled fish species can play valuable roles in blood boosting and help in pregnancy for the normal growth of both fetus and mother [17]. The main source of Zn pollution in aquatic environment is from fertilizers, sewage sludge, industrial wastes and most especially mining [18]. The highest mean Zn concentration was observed in *Tilapia guineensis* (37.24 ± 1.54 mg/kg) and the lowest in *Tilapia zilli* (32.12 ± 0.91 mg/kg). This result correlates with the work doneon Afikpo freshwater ecosystem in Nigeria where lower Zn levels in *Tilapia zilli* have been recorded [19]. The sources of Zn in the study may be attributed to use of chemical fertilizers.

| Parameters | Mean ± SError | | | | | | |
|---|---|---|---|---|---|---|---|
| | H. Odoe | O. niloticus | S. galilaeus | T. dageti | T. guineensis | O. aureus | T. zilli |
| Zinc | 36.5 ± 0.42 | 34.4 ± 1.71 | 33.01 ± 1.39 | 34.74 ± 0.69 | 37.24 ± 1.54 | 35.06 ± 1.38 | 32.12 ± 0.91 |
| | F (6, 35)=2.133, p-value=0.074 | | | | | | |
| Iron | 86.91 ± 1.59 | 85.98 ± 0.91 | 89.20 ± 2.39 | 78.49 ± 0.88 | 89.15 ± 0.57 | 86.64 ± 2.43 | 79.78 ± 1.50 |
| | F (6, 35)=7.126, p-value<0.001 | | | | | | |
| Lead | 0.52 ± 0.17 | 0.01 ± 0.004 | 0.09 ± 0.03 | 0.06 ± 0.02 | 0.01 ± 0.004 | 0.09 ± 0.04 | 0.03 ± 0.02 |
| | F (6, 35)=7.036, p-value<0.001 | | | | | | |
| Copper | 0.12 ± 0.05 | 0.01 ± 0.004 | 0.02 ± 0.01 | 0.06 ± 0.03 | 0.01 ± 0.003 | 0.01 ± 0.003 | 0.01 ± 0.003 |
| | F (6, 35)=3.944, p-value=0.004 | | | | | | |
| Calcium | 17.92 ± 0.22 | 23.66 ± 0.70 | 19.28 ± 0.52 | 23.02 ± 0.55 | 26.02 ± 0.85 | 19.28 ± 0.52 | 24.06 ± 0.56 |
| | F (6, 35)=26.751, p-value<0.001 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sodium** | 77.19 ± 1.74 | 76.66 ± 2.01 | 74.34 ± 6.39 | 67.95 ± 0.64 | 69.25 ± 8.08 | 74.34 ± 6.39 | 74.32 ± 1.21 |
| | F (6, 35)=0.557, p-value=0.762 | | | | | | |
| **Potassium** | 90.53 ± 0.44 | 101.87 ± 1.95 | 93.50 ± 1.35 | 102.03 ± 2.61 | 93.50 ± 1.35 | 95.58 ± 1.49 | 100.98 ± 1.74 |
| | F (6, 35)=7.898, p-value<0.001 | | | | | | |
| **Magnesium** | 42.99 ± 1.22 | 52.37 ± 1.69 | 46.83 ± 0.72 | 48.44 ± 1.08 | 46.83 ± 0.72 | 57.53 ± 0.45 | 47.88 ± 1.46 |
| | F (6, 35)=17.217, p-value<0.001 | | | | | | |
| **Manganese** | 44.14 ± 0.69 | 50.34 ± 2.38 | 45.44 ± 1.02 | 49.96 ± 1.68 | 45.44 ± 1.02 | 59.22 ± 0.92 | 49.16 ± 0.61 |
| | F (6, 35)=14.843, p-value<0.001 | | | | | | |
| *p-value<0.05 indicates significance. | | | | | | | |

**Table 1:** Comparative analyses of mineral content in sampled fish species.

Good concentration of sodium ($Na^+$) observed in all the fish examined indicates 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 ($Na^+$) concentrations would boosts the osmoregulatory activities in the organisms [20-22]. However, higher sodium content recorded might be a disadvantage due to the direct relationship of sodium intake with hypertension on human. Several reports have shown that Iron (Fe) is one of the most abundant metals in the earth crust.

Lead (Pb) is a non-essential element and higher concentrations in aquatic organisms may be due to discharge of industrial, sewage and agricultural wastes into aquatic environment. Lead (Pb) concentrations recorded in all the seven fish species selected during this study were lower than the WHO recommended limit of 2.0 mg/kg for Pb in fish and fish products as per WHO in 2004. *Tilapia guineensis* and *Oreochromis niloticus* however recorded the lowest average means (0.01 ± 0.004). The value recorded for *Tilapia zilli* was even much lower compared to that recorded by Anim et al. at Densu River in Ghana.

Manganese is one of the commonly found elements in the lithosphere. It is an essential micro nutrient and functions as a co-factor for many enzyme activities. The Manganese concentration levels in the selected fish species is high, however, high Mn concentration interferes with central nervous system of invertebrates and hence a matter of concern as the consumption of Mn contaminated fish could result to Mn related disorders in the consumers by Krishna et al. The highest Mn concentration was in *Oreochromis aureus* (59.22 ± 0.92) followed by *Oreochromis niloticus* (50.34 ± 2.38) and the lowest level (44.14 ± 0.69) was recorded in *Hepsetus odoe*.

## Proximate composition

Fish is composed of mainly water, lipid, ash and protein though small amounts of carbohydrate and non – protein compounds are present in a small amount. Most fishes usually consist of water (70-80%), protein (20-30%) and 2-12% of lipid. The seven fish species examined are high in protein content with the highest mean value recorded in *Oreochromis niloticus* (50.52 ± 2.45) and the lowest in *Oreochromis aureus* (23.34 ± 0.65) (Table 2). Protein content for fish species varies according to many factors. The percent of protein increases with spawning season, maturation, and the high protein diet. The variation in protein source has influenced the organoleptic properties of fresh water fish by changing the colour or altering the flavour.

| **Parameters** | **Mean ± S Error** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **H. Odoe** | **O. nilotica** | **S. galilaeus** | **T. dagetti** | **T. guineensis** | **T. nilotica** | **T. zilli** |
| **Moisture** | 68.08 ± 1.10 | 55.13 ± 0.76 | 57.69 ± 0.46 | 73.2 ± 2.4 | 50.96 ± 1.8 | 78.07 ± 0.7 | 64.22 ± 1.4 |
| | **F (6, 35)=49.274, p-value<0.001** | | | | | | |
| **Ash** | 5.88 ± 0.4 | 6.13 ± 0.37 | 9.24 ± 0.33 | 4.67 ± 0.16 | 4.58 ± 0.42 | 4.57 ± 0.16 | 4.48 ± 0.21 |
| | **F (6, 35)=30.461, p-value<0.001** | | | | | | |
| **Crude Fiber** | 1.98 ± 0.16 | 2.07 ± 0.12 | 1.74 ± 0.15 | 2.51 ± 0.15 | 1.79 ± 0.20 | 2.25 ± 0.11 | 2.59 ± 0.18 |
| | **F (6, 35)=4.521, p-value<0.002** | | | | | | |
| **Protein** | 27.85 ± 0.46 | 50.52 ± 2.45 | 29.34 ± 0.29 | 24.2 ± 0.35 | 24.42 ± 1.03 | 23.34 ± 0.65 | 27.7 ± 0.67 |
| | **F (6, 35)=75.389, p-value<0.001** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lipid** | 2.12 ± 0.06 | 2.41 ± 0.12 | 3.99 ± 0.45 | 6.55 ± 0.25 | 6.41 ± 0.36 | 6.77 ± 0.26 | 7.90 ± 0.30 |
| | **F (6, 35)=64.760, p-value<0.001** | | | | | | |
| **Carbohydrate** | 6.52 ± 0.71 | 2.95 ± 0.32 | 3.71 ± 0.12 | 3.27 ± 0.29 | 6.4 ± 0.41 | 2.92 ± 0.46 | 3.95 ± 0.45 |
| | **F (6, 35)=13.101, p-value<0.001** | | | | | | |
| df=Degree of freedom, p-value<0.05 indicates significance | | | | | | | |

**Table 2:** Mean comparison of proximate compositions among sampled species.

The percentage of water in fish species is a good indicator of its relative content of energy, proteins and lipids. The lower the percentage of water, the greater the lipid and protein contents, and the higher the energy density of the fish. The fish moisture content from this study shows that the percentage moisture of only four fish species were within the acceptable level (60% to 80%) which could be attributed to the stable water levels in the environmental location where the fish were caught. The high moisture content is disadvantageous to fishes because it increases the fishes' susceptibility to microbial spoilage, oxidative degradation of polyunsaturated fatty acids and consequently decreases in the quality of the fishes for longer preservation time. However, high moisture content in fish is conducive for human organs which it helps to lubricate.

Lipid content of fish flesh is directly related to the nutrition of the fish and the lipid content of natural channels fish, however, cannot be manipulated by the fisherman and will be mainly influenced by the prey type and availability, among other factors. In this study, *Tilapia zilli* recorded the highest value for fat contents followed by *Oreochromis aureus, Tilapia dagetti, Tilapia guineensis, Sarotherodon galilaeus, Oreochromis niloticus* and *Hepsetus odoe*. Fish can be grouped into four categories according to their fat content as lean fish (<2%), low (2–4%), medium (4–8%) and high fat (>8%). From the results obtained, the mean lipid contents in *Hepsetus odoe, Oreochromis niloticus* and *Sarotherodon galilaeus* indicates that they are low fat fish, while *Tilapia dagetti, Tilapia guineensis, Tilapia zilli* and *Oreochromis aureus* can be classified as high fat fish. This indicates that the genera Tilapia are better sources of lipid in the body when consumed. Low–fat fish have higher water content, as observed in this study and this agreed with the submission of Osman et al. Fat content is influenced by species, geographical region, age, and diet.

The concentration of ash was found to be highest in *Oreochromis niloticus* (6.13 ± 0.37) and lowest in *Oreochromis aureus* (4.57 ± 0.16). *Tilapia guineensis* has the mean ash value of (4.58 ± 0.42) which disapproves the result of Abimbola in *Tilapia guineensis* which contained 1.30%. Ash is a measure of the mineral content of food item. It is the inorganic residue that remains after the organic matter has been burnt off. The result from this work reveals that all the sampled species contains a very high percentage of ash content indicating that the species are good sources of minerals such as calcium, potassium, zinc, iron and magnesium. However, it should be noted that ash in muscle declined steadily during the starvation of non-fatty fish once the water content has increased above a critical value, and since almost all the sampled species are non- fatty species, this should be expected.

A good source of energy that comes to mind is carbohydrate which helps in body development and growth. However, fish generally have very low levels of carbohydrates because glycogen does not contribute much to the reserves in the fish body tissue and the carbohydrate content in fish is practically considered to be zero. The value recorded in this study is also low for most fish species which may be as a result of high values of moisture and a relatively high value of crude protein content. None the less, a good amount of carbohydrate was recorded in *Hepsetus odoe* which can be attributed to the fact that *Hepsetusodoe* is piscivorous, feeding on several species of smaller fish. They are primarily diurnal ambush predators, hiding out in dense vegetation and lunging suddenly to seize prey. Their diet consists primarily of cichlids and mormyrids. Although smaller specimens have been found to eat mochokid catfishes in greater amounts than cichlids or mormyrids.

## Amino acids composition

Table 3 depicts the comparison of mean contents of amino acid profiles of fishes. There was no statistical significant in each of lysine, histidine, leucine, soleucine, tryptophan, methionine, phenylalanine, threonine, and valine across the sampled species. All the essential amino acids with Histidine that are very important for the human body are present in the fish species examined. These essential amino acids cannot be manufactured in human bodies but can only be obtained from food. This is an indication that these fish species would be a good source of essential amino acids in the diet of the populace.

| **Parameters** | **Mean ± S Error** | | | | | | |
|---|---|---|---|---|---|---|---|
| | *H. Odoe* | *O. niloticus* | *S. galilaeus* | *T. dageti* | *T. guineensis* | *T. nilotica* | *T. zilli* |
| Lysine | 6.4 ± 0.2 | 6.48 ± 0.16 | 6.42 ± 0.14 | 6.42 ± 0.14 | 6.35 ± 0.14 | 6.35 ± 0.14 | 6.52 ± 0.15 |
| | **F (6, 35)=0.166, p-value=0.984** | | | | | | |
| Histidine | 3.32 ± 0.10 | 3.13 ± 0.22 | 3.23 ± 0.11 | 3.23 ± 0.11 | 3.2 ± 0.07 | 3.2 ± 0.07 | 3.3 ± 0.14 |
| | **F (6, 35)=0.239, p-value=0.960** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Leucine | 2.60 ± 0.17 | 2.57 ± 0.25 | 2.55 ± 0.22 | 2.55 ± 0.22 | 2.50 ± 0.17 | 2.50 ± 0.17 | 2.77 ± 0.19 |
| | **F (6, 35)=0.200, p-value=0.975** | | | | | | |
| Isoleucine | 7.25 ± 0.22 | 7.08 ± 0.28 | 7.22 ± 0.29 | 7.22 ± 0.29 | 7.28 ± 0.14 | 7.28 ± 0.14 | 7.22 ± 0.43 |
| | **F (6, 35)=0.062, p-value=0.999** | | | | | | |
| Tryptophan | 1.18 ± 0.05 | 1.70 ± 0.18 | 1.35 ± 0.16 | 1.35 ± 0.16 | 1.18 ± 0.17 | 1.18 ± 0.17 | 1.55 ± 0.19 |
| | **F (6, 35)=1.939, p-value=0.102** | | | | | | |
| Methionine | 4.3 ± 0.13 | 4.27 ± 0.23 | 4.22 ± 0.25 | 4.22 ± 0.25 | 4.43 ± 0.14 | 4.43 ± 0.14 | 4.25 ± 0.21 |
| | **F (6, 35)=0.220, p-value=0.968** | | | | | | |
| Phenylalanine | 6.67 ± 0.21 | 6.68 ± 0.16 | 6.67 ± 0.26 | 6.67 ± 0.26 | 6.67 ± 0.19 | 6.67 ± 0.19 | 6.55 ± 0.16 |
| | **F (6, 35)=0.049, p-value=0.999** | | | | | | |
| Threonine | 4.32 ± 0.12 | 4.57 ± 0.10 | 4.30 ± 0.14 | 4.30 ± 0.14 | 4.48 ± 0.12 | 4.48 ± 0.12 | 4.52 ± 0.17 |
| | **F (6, 35)=0.747, p-value=0.616** | | | | | | |
| Valine | 5.02 ± 0.09 | 5.13 ± 0.21 | 5.30 ± 0.13 | 5.30 ± 0.13 | 5.37 ± 0.31 | 5.37 ± 0.31 | 5.10 ± 0.21 |
| | **F (6, 35)=0.830, p-value=0.555** | | | | | | |
| *P-value<0.05 indicates significance. | | | | | | | |

**Table 3:** Comparative analyses of amino acids content among sampled species.

To obtain maximal growth in human body, the dietary essential Amino Acid should be available at levels equal to or higher than essential Amino Acid levels in fish. Deficiency of essential amino acids may hinder healing recovery processes. For example, Leucine promotes the healing of bones, skin and muscles tissue. Glycine, a major component of human skin collagen together with other amino acids (e.g. alanine, proline, arginine, serine, isoleucine and phenylalanine form polypeptides for growth and tissue healing. Isoleucine is necessary for hemoglobin formation, stabilizing and regulating blood sugar and energy. Witono et al. affirmed that failure to obtain enough of even one of the essential amino acids results in the degradation of the muscle proteins in the body.

With regard to their nutritional values, all selected fish contained all the essential amino acids that were needed by the human beings. It appeared that *Tilapia zilli* and *Hepsetus odoe* were richer source of total essential amino acids as it had the highest respective amounts than the other species. The nutritional quality of these selected fish species was also assessed on the basis of essential amino acid profile of their muscle protein as compared to those of the standard protein of FAO. The mean values obtained for phenylalanine across the selected fish species is high in comparison with the standard of (6.3) according to FAO thus making all the selected freshwater species a good source of Phenylalanine. The same scenario is observed for valine, threonine, methionine, isoleucine and lysine, all the selected fish species having a considerable amount of them thus making the selected fish species good sources of essential amino acids. However, leucine and tryptophan were found to be low in comparison to other studied amino acids. Consumption of food containing enough tryptophan can be recommended as a safe source instead of supplements. Tryptophan supplements are prescribed for sleeplessness, depression to relieve pain, to regulate appetite, mood and sensory perception but excess of these supplements has many harmful effects. The most concentrated essential amino acid (EAA) in all the fish species studied was Isoleucine. Isoleucine is a branched chain amino acid and is needed for muscle formation and proper growth. Chronic renal failure (CRF) patients on hemodialysis have low plasma level of the branched chain amino acids (BCAA) leucine, isoleucine and valine. The abnormalities in the plasma amino acid pool can be corrected with appropriate high-protein supplements.

## Conclusion

*Tilapia guinensis* and *Tilapia nilotica* both having (7.280.14) mean values contain the highest amounts of isoleucine among the fish species studied. It was reassuring to find that the fish species of this study compared reasonably well with the FAO standard of a quality protein as reflected by their amino acid compositions. In fact the Oba Reservoir fish species of this study were a good source of nutrition to supply excellent composition of essential amino acids.

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