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Evaluation of Nutritional Quality of *Clarias gariepinus* from Selected Fish Farms in Nigeria

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Abstract

Evaluation of nutritional quality of *Clarias gariepinus* from selected fish farms in Oyo, Ekiti and Ondo States in Nigeria was carried out by analyzing the proximate composition, trace elements, fatty acids and cholesterol levels of the fish. A total of nine (09) commercial fish farms namely: Durante Fish Industries ($Durantee_{Oy}$), Hillary Sydenham Fish Farms ($Hillary_{Oy}$), Azimor Agric Biz ($Azimor_{Oy}$), Concentrated Fish Farms ($Conc_{Ek}$), ASAE Fish Farms ($Asae_{Ek}$), ABUAD Farms ($Abuad_{Ek}$), Dafed Fish Farms ($Dafed_{Od}$), Obembe Fish Farms ($Obembe_{Od}$) and Ondo State Government Farms ($OSGF_{Od}$) were purposively selected for the research based on output. Five kilogram of live fish samples of average weight (1kg/one) were randomly collected twice at three months interval in a production circle of six months from each farm for laboratory analysis using standard procedures. The proximate analysis of both wet and dry samples showed that all the samples examined were good source of protein with mean values ranging from 22.0% in fresh to 46.6% in dried fish sample.

Keywords

Nutritional Quality, *Clarias gariepinus*, Proximate Analysis, Minerals, Fatty Acids, Cholesterol

1. Introduction

In Nigeria, fish is a major food item contributing a total of 40% dietary protein requirement and a readily available source of animal protein in the diet of man (Adebayo *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 [1].

The African catfish, *Clarias gariepinus* is one of the most widely consumed freshwater fish in Nigeria due to its large acceptability [2]. Nutritional composition of cultivated fish is majorly dependent on the type of feed administered. Other factors may include feeding habit, water quality, cultured medium and period [3]. To produce lean fish with less fat deposition, feed materials are to be carefully selected and administered. Visual assessment of fish using size, freshness, and other physical appearances may not give accurate nutritional information about the fish, hence the need for laboratory analysis of fish for in-depth information on the nutritional quality [4]

Many commercial fish farms have imbibed the practice of feeding their fish with poultry droppings to fertilize the pond bottom with the aim of improving the concentration of natural life organisms in the pond. Some farmers feed fish primarily on maggots and other dead animals, while some supplement their fish diets with growth hormones to achieve optimum growth within a short period of time. All these practices change the nutritional quality of fish produced with possible cumulative health risks.

Considering the various nutritional benefits associated with fish consumption, the objective of this study is to evaluate the nutritional composition of cultured catfish *Clarias gariepinus* from selected fish farms by analyzing the proximate composition, trace elements, fatty acids and cholesterol levels. Results would be compared with the most recent standard values for good health by the World Health Organization.

2. Materials and Methods

2.1. Sampling Procedure

The study was carried out using laboratory analysis in line with the set objectives. A total of nine(09) commercial fish farms were purposively selected in Oyo, Ekiti and Ondo States of Nigeria, namely: Hillary Sydenham fish farms (Hillary$_{Oy}$), Durantee fish industries limited (Durantee$_{Oy}$) and Azimor Agric biz (Azimor$_{Oy}$), Concentrated fish farms (Conc$_{Ek}$), ASAE fish farms (Asae$_{Ek}$) and ABUAD farms (Abuad$_{Ek}$), Dafed fish farms (Dafed$_{Od}$), Obembe fish farms (Obembe$_{Od}$) and Ondo State Government Farms (OSGF$_{Od}$) respectively. Criterion for selection of farms was based on large fish turn out to the Nigeria market.

2.2. Fish Samples Collection and Preparation

Five kilogram of live fish samples of average weight of one kg/one were collected twice at three months interval in a production circle of six months from each farm for analysis. At each collection, fish were transferred to the Central Laboratory of the Federal University of Technology Akure, Ondo State, Nigeria where they were gutted, washed, filleted, finely minced and homogenized for analysis.

2.3. Chemical Analysis

Both fresh and dried fish carcasses from all the farms were analyzed for proximate composition: moisture, ash, crude protein, crude fat, and carbohydrate according to the methods [5].

2.4. Analysis for Trace Elements, Fatty Acids and Cholesterol Levels

Trace elements, fatty acids and cholesterol levels in fish samples were analyzed using standard methods [5]

2.5. Statistical Analysis

Data obtained from laboratory analysis for each farm were subjected to one way analysis of variance (ANOVA) to determine the significance of variations among parameters examined at ($P<0.05$) using SPSS 21.0 Software 2014.

3. Results

3.1. Proximate Composition of the Wet and Dry Samples of Fish Analyzed

The results of the proximate composition of (wet) and (dry) samples of fish are presented in Table 1. The result of wet sample clearly showed that the moisture content of all the fish samples analyzed were significantly different ($p<0.05$) among the farms, while protein and fat contents were significantly high in all the fish samples analyzed with protein value ranged from 21.8% and 25.6% in most farms and fat value ranged from 18.8% and 24.4% in Dafed$_{Od}$ and Obembe$_{Od}$ respectively. Ash contents of fish from all the farms were significantly different ($p<0.05$) with the lowest value (6.01%) and highest value (9.27%) in Azimor$_{Oy}$ and Abuad$_{Ek}$ respectively. All the fish samples examined were low in carbohydrate with lowest values of 0.80% in Asae$_{Ek}$ and highest value of 5.30% in Dafed$_{Od}$. The protein and fat contents of all the fish samples were very high. However, the protein content of fish sample from Obembe$_{Od}$ farm was significantly different ($p<0.05$) from the rest of the samples from other farms with the lowest value of 39.6%. The fat content of wet sample of fish from OSGF$_{Od}$ was significantly ($p<0.05$) lowest (6.49%) from other farms. The ash content of sample from Abuad$_{Ek}$ was significantly different from the rest of the farms ($p>0.05$) with the least value of 9.5%. The carbohydrate level of sample from Dafed$_{Od}$ was significantly different ($p>0.05$) from the rest of the farms with the highest value (5.30%) recorded in fish sample from Dafed$_{Od}$ farm and least value (0.11%) from Obembe$_{Od}$ farm. However, the protein and fat contents were higher in the dry and wet samples respectively.

Table 1. *Proximate composition (wet) and (dry) samples of Clarias gariepinus from selected fish farms in Nigeria.*

Farms									
Proximate (%)	**HillaryOy**	**AzimorOy**	**DuranteOy**	**ASAEEk**	**ConcEk**	**ABUADEk**	**DAFEDOd**	**ObembeOd**	**SgfOd**
Wet Samples									
Crude protein	24.7^{d}	25.3^{f}	24.0^{d}	25.6^{f}	25.1^{f}	24.0^{d}	23.0^{c}	22.0^{a}	22.8^{a}
Fat	35.2^{de}	35.3^{de}	35.9^{de}	34.0^{bc}	34.4^{cd}	33.8^{ab}	34.4^{bc}	33.3^{ab}	34.0^{bc}
Ash	6.01^{a}	7.62^{bc}	7.73^{bc}	7.52^{bc}	8.72^{cd}	9.25^{d}	8.19^{cd}	8.46^{cd}	9.07^{d}
Moisture	47.1^{e}	46.8^{cd}	43.0^{a}	47.8^{e}	44.0^{b}	46.2^{cd}	44.5^{b}	46.2^{cd}	45.9^{b}
Nitrogen free extract	0.65^{a}	0.80^{a}	4.72^{c}	0.30^{a}	2.71^{b}	1.02^{a}	5.30^{d}	0.80^{a}	0.80^{a}
Dry Samples									
Crude protein	46.6^{de}	41.4^{c}	43.7^{e}	43.7^{e}	40.4^{b}	42.3^{c}	43.2^{e}	39.6^{a}	40.8^{b}
Fat	20.8^{de}	20.3^{de}	20.5^{de}	19.5^{bc}	19.7^{bc}	19.5^{bc}	18.8^{cd}	24.4^{ab}	6.49^{f}
Ash	14.6^{de}	15.0^{cd}	13.5^{b}	14.3^{de}	14.3^{de}	15.4^{cd}	13.8^{b}	14.1^{de}	14.0^{de}
Moisture	6.81^{b}	6.91^{b}	6.15^{b}	7.01^{a}	6.30^{b}	6.65^{b}	7.00^{a}	5.91^{c}	6.53^{b}
Nitrogen free extract	0.73^{c}	1.50^{c}	0.93^{c}	0.98^{c}	4.64^{b}	1.91^{b}	5.30^{a}	0.11^{d}	4.63^{b}

Different alphabets in the same row show significance difference at $p<0.05$

3.2. Fatty Acids Composition of Fish Samples

Table 2 represents the percentage composition of fatty acids of all the fish samples analyzed. Palmitic acid value in all the fish samples ranged between (19.45%) and (27. 80%) with the highest value of (27.80%) in fish sample from Obembe$_{Od}$. However, there was a significant difference ($p>0.05$) in the palmitic acid content of fish sample from Conc$_{Ek}$ and the rest of the samples from other farms. Stearic acid (C18:0) of all the samples were significantly different ($p>0.05$) with sample from farm Asae$_{Ek}$ having the highest value of 9.40%. Lauric acid (C1:20) of all the samples were not significantly different ($p<0.05$) with the value of all the samples ranging from (2.95 – 3.35.%) Pentadecanoic acid (C15:0) were presents in trace amount in all the fish samples examined. Decasahexaenoicacid (C15:0) showed a higher value (3.50%) in fish sample from Abuad$_{Ek}$ with sample from Hillary$_{Oy}$ having the least value (2.30). Linolenic acid (C18:3) also ranged from 2.00% in fish sample from Azimor$_{Oy}$ to 3.80% in sample from Asae$_{Ek}$ farm

The value of Cetalic acid (C22:1) in sample from Azimor$_{Oy}$ significantly different from the rest of the samples from other farms ($p<0.05$). Oleic acid value of the sample from Abuad$_{Ek}$ significantly different from the rest of the samples from other farms with the least value of 23.60% recorded in sample from Obembe$_{Od}$. Gadoleic acid value of fish samples from Hillary$_{Oy}$ was significantly different ($p<0.05$) from other fish samples with the highest value of 3.70% in sample from Durantee$_{Oy}$. Hepadeconic acid was present in all the fish samples in a very trace amount. However, Capric acid (C8:0), Arachindonic acid (C20:4) and Myristoleic acid were not detected in all the fish samples analyzed.

Table 2. *Fatty Acids Composition of Clarias gariepinus.*

Farms									
Fatty acid (%)	**Hillary$_{Oy}$**	**Azimor$_{Oy}$**	**Durante$_{Oy}$**	**Asae$_{Ek}$**	**Conc$_{Ek}$**	**Abuad$_{Ek}$**	**Dafed$_{Od}$**	**Obembe$_{Od}$**	**SGF$_{Od}$**
SFA (Saturated Fatty Acid)									
Capric acidC8:0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Palmitic acid C16:0	27.35^{a}	19.95^{d}	22.20^{b}	22.55^{b}	19.45^{d}	20.75^{c}	22.60^{b}	27.80^{a}	20.75^{c}
Stearic acidC18: 0	8.39^{ab}	8.55^{ab}	8.00^{b}	9.40^{c}	8.05^{b}	8.10^{b}	8.30^{ab}	8.00^{b}	8.40^{ab}
Lauric acid C12:0	3.25^{a}	2.95^{b}	3.10^{b}	3.20^{b}	3.35^{a}	3.10^{b}	2.95^{b}	3.20^{a}	3.30^{a}
Pentadecanoic acid C15:0	0.08^{c}	0.04^{c}	0.07^{c}	0.06^{c}	0.05^{c}	0.15^{b}	0.09^{c}	0.03^{b}	0.25^{a}
PUFA (Poly Unsaturated Fatty)									
Decasahexaenoic acidC15:0	2.30^{e}	2.65^{d}	2.90^{d}	2.25^{a}	3.30^{c}	3.50^{c}	3.50^{c}	3.00^{d}	5.20^{a}
Linolenic acid C18:3	2.20^{b}	2.00^{c}	2.05^{c}	3.80^{a}	3.65^{a}	2.10^{c}	2.45^{b}	2.20^{b}	2.25^{b}
Arachindonic acid C20:4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cetalic acid C22:1	1.30^{c}	1.80^{b}	0.65^{d}	1.30^{c}	1.70^{b}	2.00^{a}	1.50^{b}	1.50^{b}	1.45^{b}
Octadecatetraenoic C18:44	ND	ND	ND	ND	ND	ND	ND	ND	ND
MUFA									
Oleic acid C18:1	30.20^{a}	27.05^{b}	28.25^{a}	29.95^{a}	27.05^{b}	26.05^{b}	23.90^{c}	23.60^{c}	24.15^{c}
Gadoleic acid	2.30^{b}	2.45^{b}	3.70^{a}	3.25^{a}	3.15^{b}	2.85^{b}	2.95^{b}	3.05^{b}	3.10^{b}
Myristoleic acid	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hepadeconic acid C17:1	0.25^{b}	0.10^{c}	0.75^{a}	0.35^{b}	0.75^{a}	0.40^{b}	0.10^{c}	0.30^{c}	0.30^{c}

Different alphabets in the same row show significance difference at $p<0.05$

3.3. Cholesterol Levels of Fish Samples

Table 3 shows the concentrations of total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL) and low density lipoprotein (LDL) in all the samples examined. The triglyceride content of all the fish samples were significantly different ($p<0.05$) with the value ranging from 1.87 – 2.70mg/100g. The total cholesterol of all the farms were also significantly different ($p<0.05$). The results of high density lipoprotein ranged from 2.10mg/100g in fish sample from Abuad$_{Ek}$, to 2.48mg/100g in fish sample from Hillary$_{Oy}$. Also, the low density lipoprotein of fish sample from Azimor$_{Oy}$ significantly different ($p<0.05$) from the rest of the samples from other farms with Hillary$_{Oy}$ having the highest value of 0.61%.

Table 3. *Cholesterol content (mg/100g) of fish samples.*

Farms									
Cholesterol (mg/100g)	**Hillary$_{Oy}$**	**Azimor$_{Oy}$**	**Durante$_{Oy}$**	**Asae$_{Ek}$**	**Conc$_{Ek}$**	**Abuad$_{Ek}$**	**Dafed$_{Od}$**	**Obembe$_{Od}$**	**SGF$_{Od}$**
TG	2.70^{bc}	2.50^{bc}	2.90^{c}	2.95^{c}	1.87^{a}	2.20^{ab}	2.25^{ab}	2.50^{bc}	2.90^{c}
TC	4.20^{bc}	3.35^{a}	4.30^{c}	4.33^{c}	1.87^{ab}	3.15^{a}	4.20^{bc}	4.30^{d}	3.35^{c}
HDL	2.48^{b}	2.26^{ab}	2.15^{b}	2.17^{c}	2.20^{a}	2.10^{b}	2.30^{b}	3.00^{a}	2.40^{b}
LDL	0.61^{c}	0.24^{ab}	0.65^{c}	0.60^{c}	0.33^{b}	0.17^{a}	0.95^{a}	0.20^{ab}	0.30^{a}

Different alphabets in the same row show significance difference at $p<0.05$

The results of the percentage means of mineral element concentrations were given in Table 4. The variations observed in the values obtained showed significant difference ($p<0.05$) in all the fish samples examined. Potassium, Calcium, Sodium were particularly abundant in all the fish samples analyzed while Zinc, Iron, Lead, magnesium and cadmium were present in trace amounts. Fish samples from $\text{Hillary}_{\text{Oy}}$ $\text{Durante}_{\text{Oy}}$, Asae_{Ek} Dafed_{Od}, $\text{Obembe}_{\text{Od}}$ and SGF_{Od} presented a relatively higher amount of mineral contents while fish samples from Conc_{Ek} and Abuad_{Ek} showed relatively low mineral contents

Table 4. *Trace elements in fish samples (mg/g).*

Farms	**Minerals (mg/g)**							
	K	**Na**	**Ca**	**Mg**	**Zn**	**Fe**	**Mn**	**P**
$\text{Hillary}_{\text{Oy}}$	9.40^{e}	3.94^{cd}	8.25^{e}	0.20^{d}	0.06^{b}	0.48^{c}	0.11^{c}	0.56^{b}
$\text{Azimor}_{\text{Oy}}$	7.25^{bcd}	4.32^{de}	0.06^{b}	0.10^{bc}	0.07^{b}	1.02^{d}	0.12^{d}	0.52^{abc}
$\text{Durante}_{\text{Oy}}$	7.30^{bc}	4.03^{cde}	3.10^{a}	0.12^{c}	0.12^{c}	1.02^{d}	0.21^{e}	0.10^{a}
Asae_{Ek}	8.86^{e}	3.80^{bc}	2.94^{a}	$0.08a^{b}$	0.01^{a}	0.08^{b}	0.11^{cd}	0.82^{c}
Conc_{Ek}	3.05^{a}	4.43^{e}	8.05^{e}	0.04^{a}	0.01^{e}	0.09^{b}	0.22^{e}	0.87^{c}
Abuad_{Ek}	6.66^{b}	3.08^{a}	8.26^{e}	0.08^{ab}	0.01^{e}	0.06^{ab}	0.03^{ab}	0.32^{ab}
Dafed_{Od}	7.16^{bcd}	3.16^{a}	6.05^{b}	0.08^{ab}	0.06^{b}	0.03^{ab}	0.10^{cd}	0.45^{abc}
$\text{Obembe}_{\text{Od}}$	7.65^{cd}	3.44^{ab}	8.21^{e}	0.06^{ab}	0.09^{b}	0.04^{ab}	0.06^{bc}	0.46^{abc}
SGF_{Od}	7.60^{bc}	3.42^{ab}	6.72^{e}	0.06^{ab}	0.08^{b}	0.08^{b}	0.01^{a}	0.44^{abc}

Different alphabets in the same row shows significance difference at $p<0.05$

4. Discussion

Dried fish had higher crude protein than the fresh fish. Increase of crude protein in dried samples may be due to the dehydration of water molecule present between the proteins thereby, causing aggregation of protein and thus resulting in the increase in protein content of dried fishes [6]. [7] reported that protein (nitrogen) was not lost during drying, so that protein content increased with the reduced moisture content in the fish samples this report is similar to that of [8] who reported (42.88%) and (17.50%) for dry and wet crude protein respectively, [9] reported (58.60%) for dry *Clarias gariepinus*, [10] reported (18.3%) and (64.86) for fresh and dried crude protein respectively. However, this study and other studies shows superiority of *Clarias gariepinus* in Crude protein content compared to other values in other fresh water fish where 8.31 to 15.18% in *Chrysichtys nigrodigitatus* was reported by[11]; 5.26 -16.99% in *Ailia coila* by [12]. [13] reported values of 9.14 to 12.23% in *Tilapia mossambicus* and values of 5.13 to 14.16% in *Chrysichtys nigrodigitatus*. [14] reported a value of 7.35 to 15.50% in *Hypophthalmichthys molitrix*. These differences observed may be attributed to fish size, differences in fish species, their consumption or absorption capacities, their ability to metabolize and utilize essential nutrients from their diets [15]. However, irrespective of the method of preparation, moderate percentage of crude protein observed in this study could be attributed to the fact that *Clarias gariepinus* are good sources of pure protein. However, the nature and quality of nutrient in most animals is dependent upon their food types. This is why the feeding habit of individual fish species has great effect on their body's nutrient composition [1]. Also dried fish had lower fat content than the fresh (wet) fish. However, this result disagreed with [17] who reported that fresh Catfish showed lower fat contents than the dried samples. After drying, there was a decrease in fat content and this variation could be the result of evaporation of moisture content which is in agreement with the previous work of [7]. [18] however argued that fat contents fluctuate considerably with age, feed and sexual cycle of fish. Based on the 5% fat composition criteria for discriminating lean fish from fatty species [19], it was apparent that *Clarias gariepinus* could be regarded as a fatty fish species. Moisture content of fresh fish in Table 1 was higher than that of dried fish as a result of dehydration of water molecule present in dry fish. However, [20] reported 12.80% and 68.1% for moisture content analysis of dry and fresh fish respectively.[9]reported a value of 18.20% for dry fish sample. This disparity may be due to size or type of fish species. The results in this study showed that the ash content in the dried samples was higher than in the wet samples and this is due to water loss in the dried samples. However, this result is in agreement with the report of [21] who analyzed *Clarias gariepinus* to have a value range of 6.40 to 24.10%, but the ash percentage of this study is higher than what reported by [20] who reported 4.03% – 4.45% in the wet samples and 8.33% - 12.85% in dry samples. The observed range of ash content in this study indicated that the species is a good source of minerals such as calcium, potassium, zinc, iron and magnesium. Ash is a measure of the mineral content of food item [8].

The carbohydrate of all the samples in both fresh and dried samples had varied values (0.11 -5.30%) However, the results of carbohydrate obtained from this work was higher than the values reported by [22] who reported 0.07% in fresh *Clarias gariepinus*. *Clarias gariepinus* is low in carbohydrates when compared withrecorded values of 20.8% and 18.3% in fresh *Lates calcarifer* and *Mugil cephalus* respectively[23]. [24] reported higher carbohydrate content in fresh fish sample than in dried fish sample.

The most abundant fatty acids in all the samples examined were similar: Palmitic and Stearic acids for saturated fatty acid, oleic acid for monounsaturated, linoleic acid for polyunsaturated acid. Report from other authors on similar studies also indicated the dominance of these fatty acids in fish species {[25], [26]}. Fatty acid composition is important as aspect of quality of raw material, sensory attributes and storage ability. All the fish samples analyzed were high in monounsaturated fatty acids especially oleic acid. [27] reported that high proportion of monounsaturated fatty acids could account for low iodine value in the fish, though substantial amount of palmitic acid and linoleic acid could also necessitate high iodine value. Saturated fatty acid and cholesterol are major dietary contributors to coronary heart disease due to their oxidation in the presence of light and molecular oxygen through a free radical reaction [28].

The variation in the concentration of fatty acids in all the samples may be attributed to the feed eaten among other factors. [29] reported that diet had a major effect on the fatty acid composition of fatty acids. Other factors that may influence fatty acid composition include size or age, reproductive status, geographic location and season [27]

All the fish samples examined contained appreciable concentrations of potassium, sodium, magnesium and calcium suggesting that these fishes could be used as good sources of minerals. Potassium was observed to dominate other minerals in all samples examined. This tends to disagree with the work done by [30] at Asa reservoir, in Ilorin, Kwara State Nigeria; where the dominant element in *Clarias gariepinus* sampled was sodium. This could be inferred from the high concentration of potassium in the tissues of the fish species that the fresh water body from which the fishes were collected is rich in potassium which 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 potassium (K) concentrations would boost the osmoregulatory activities in the organisms [17]. The concentrations of Sodium (Na) and Calcium (Ca) in the all fish samples examined ranked second among the mineral elements analyzed. The variations recorded in the concentration of mineral in fish muscles examined could be as a result of the rate in which they are available in the freshwater body [31] and the ability of the fish to absorb these inorganic elements from their diet and the environment where they live [15]. Heavy metals such as Lead and Cadium were not detected in fish samples analyzed. This report is in agreement with the one obtained by [32]. The levels of most of these mineral elements present are in trace amount and are still below World Health Organization limits for human consumption.

Other elements such as Zinc and Iron varied in concentration among all the fishes studied. Most of these Micro elements are equally important in trace amounts as observed, but they tend to become harmful when their concentrations in the tissues exceed the metabolic demands [32]. Minerals are important for vital body functions such as acid, base and water balance. Calcium is good for growth and maintenance of bones, teeth and muscles [33]. Normal extra cellular calcium concentrations are necessary for blood coagulation and for the integrity, intracellular cement substances [34]. Sodium is an activator of transport ATP-ases in animals and possibly also in plants [35]. There is also direct relationship of sodium intake with hypertension on human [28]. Iron is essential for metabolic reactions and the regulation of cell growth and differentiation; it is also an important constituent of heamoglobin [36]. The presence of Zinc in the fishes could mean that the fishes can play valuable roles in the management of diabetes, which result from insulin malfunction [34]. According to [37] phosphorus forms the structure of teeth, bones and cell membranes, acts as a cofactor for many enzymes and activates the vitamin B complex. Potassium is an essential nutrient used to maintain fluid and electrolyte balance in the body.

The results obtained in the studies shows a relatively low cholesterol level compare to other types of fish.[38]reported cholesterol content of fresh rainbow trout to be 35.04 mg/100 g. [39] and [40] concluded that, for human health and nutrition, fresh water fish is preferred compare to sea fish since cholesterol content in river fish is lower compared to sea fish. However, {[41], [42]}, reported that the level of cholesterol in blood of fish, in addition to increased alimentary intake of cholesterol and excessive energy intake influenced an increased intake of certain long chain saturated fattyacids (SFA) and increased intake of trans-isomers of unsaturated fatty acids

5. Conclusion

The aim of this work was to investigate the moisture content, minerals, fatty acids and cholesterol contents of *Clarias gariepinus* from selected commercial fish farms in South West Nigeria and compare their nutritional quality with the recommendation of World Health Organization. However, the overall significance of this study shows that the nutritional composition of the selected samples is within the nutritional ranges required by humans but the percentage of fat which is more than the 5% requirement may be put into consideration when consuming catfish. Other nutritional information obtained would be useful to the consumers to know the nutritional status of the fish prior to consumption in addition to choice of taste, size, type and external morphology of fish.

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