COMPARATIVE STUDY ON PROXIMATE AND MINERAL ELEMENT COMPOSITION OF CLARIAS GARIEPINUS FROM THE CULTURED AND WILD SOURCES

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ABSTRACT

Fourty (40) samples of Clarias gariepinus representing twenty(20) each for cultured and wild fishes, were obtained from Labana Farms and Kashin Zama fish landing site both in Aleiro, Kebbi state, Nigeria, and considered for comparative proximate and mineral elements compositions. The fish were categorized into two size groups of juveniles and adults with an average total weights of (72.47±9.05g, 288.43±2.16 g and 69.80±3.22g, 110.70±1.44 g respectively). The crude protein (CP) of cultured juvenile and adult fish species were 28.71±0.61%, 28.24±0.79%, and 29.49±1.75%, 29.23±1.47 % for the wild juvenile and adult fish species respectively. The percentage lipid in the cultured juvenile and adult fish species were 19.39±1.30% and 17.83±0.86 %, while in the wild juvenile and adult fish species it was observed to be 11.70±1.33% and 15.45±1.34 %. There were variations in the dry matter and lipid compositions of both fishes. The cultured fish species had less protein content when compared with the fish species obtained from the wild, while the lipid content was observed to be higher in cultured than the wild fish species. Differences in protein content could be as a result of different varieties of food available in a large water body when compared with the cultured system, while the difference in the lipid content could be as a result of less active movement in the cultured system when compared to the large expanse of water body in the wild. This study shows that, the proximate composition of both the cultured and wild fishes varies.

Keywords: Protein, lipids, juveniles and adults.

INTRODUCTION

Fish production from capture fisheries has been erratic and on the decline in recent years globally. Fish has always been a potential source of animal protein and essential nutrients in Africa and the world over, it is needed for the maintenance of a healthy body (Fawole, *et. al.,* 2007). Fish are excellent sources of protein when compared with other sources of protein due to the amino acid composition and protein digestibility (Louka *et. al.,* 2004). They also serve as a favourite foodstuff for large number of people across the globe due to its several health benefits (Ali and Kumar, 2010).

In fish farming, sufficient consumption of feed is essential for increased yield and profitability and there is now need to search for alternative protein sources for fish feeds especially in developing countries like Nigeria (Sales and Janssens, 2003). Fish is one of the cheapest and direct sources of protein and micro nutrients for millions of people in Africa (Ben and Heck, 2005). Therefore, to solve the high demand for fish, aquaculture production remains the best option to bridge the wide gap between fish demand and domestic production in most countries of the world especially the sub Saharan Africa (Dauda *et al.,* 2013).

The major constituents of fish are; water, protein, lipid and carbohydrate (Waterman, 1980). It has been reported that, proximate composition of fish varies greatly and the variation could be due to age, feed intake, sex and sexual changes connected with spawning, the environment and season (Silva, and Chamul, 2000). Proximate composition has been reported to be a good pointer of physiology needed for routine analysis of fisheries (Cui, and Wootton, 2011). A number of investigators have attempted to relate changes in body composition to seasonal variables (Dawson and Grimm, 1980; Jarboe, and Grant, 1996). The knowledge of fish composition is essential for its maximum utilization. The aim of this study is to determine the proximate and mineral composition of *Clarias gariepinus* both from the wild and cultured environments.

LITERATURE REVIEW

The African Catfish (*Clarias gariepinus)* belongs to the family Clariidae (air-breathing catfishes), order Siluriformes (catfish), class Actinopterygii (ray-finned fishes), sub-phylum Vertebrata, phylum Chordata and kingdom Animalia. The family Clariidae is divided into two genera viz: *Clarias* and *Heterobranchus*. There are over hundred species in this family occurring naturally throughout most of Africa and the southern half of Asia to Java and the Philippines (Little *et al.,* 1999).

C. gariepinus is generally considered to be one of the most important tropical catfish species for aquaculture. It has an almost Pan-African distribution, ranging from the Nile to West Africa and from Algeria to Southern Africa. They also occur in Asia Minor (Israel, Syria and South of Turkey). *C. gariepinus* at various geographical locations bears different names. It is called *C. lazera* in Northern and Central Africa, *C. senegalensis* in East Africa, *C. mosambicus* in West Africa and *C. gariepinus* in South Africa (Viveen *et al*, 1985). *C. gariepinus* is characterized with naked skin and with fairly long dorsal and anal fins. The dorsal fin has 61-80 soft rays and the anal fin has 45-65 soft rays. They have strong pectoral fins with spines that are serrated on the outer side (Teugels, 1986). It possesses nasal and maxillary barbells and smallish eyes. Their colouring is dark grey or black dorsally and cream colored ventrally. Adults possess a dark longitudinal line on either side of the head; however, this is absent in young fish. Adult's heads are coarsely granulated, while the head is smooth in the young. The head is large, depressed and heavily boned. The mouth is quite large and sub-terminal (Skelton, 1993; Teugels, 1986). In *C. gariepinus*, exchange of respiratory gases (i.e., oxygen and carbon dioxide) takes place through the gills. Like any other mudfish, it has accessory breathing organ which enables the fish not only to live in stagnant pools but to travel over damp ground (Haylor, 1993).

Catfishes of the world are represented by at least 2,000 species in over 25 families (Beleau, 1992). In Nigeria, Reed *et al* (1967) reported seven families, sixteen genera and fifty one species of catfishes, and noted that most of them live in freshwater and very few are marines. Holden and Reed (1972) reported the presence of catfishes in most part of Northern Nigeria, where they make up more than twenty per cent of the catches and in some places up to fifty per cent of the total catch.

The identification features, habitat, size and commercial status of catfishes have been described (Reed *et al*., 1967; Holden *and* Reed, 1972; Janssen, 1985; Beleau, 1992, De Graaf *et al*., 1996). Freshwater fish constitutes 69.6% of the total fish supply available to Nigeria (FOS, 1990). Most of this amount is mudfish, *Clarias gariepinus (*Burchell), family

Clariidae, which marketing trends predict an increase in consumer demands, because most of its production comes from artisanal fisheries.

Returns from Africa' s capture fisheries are stagnating and access to food, incomes and livelihoods of the small scale fishermen who depend upon them are likely to reduce further (Bene and Heck, 2005). In Nigeria, there is abundant fishery resources comprising of marine environments as well as inland freshwater bodies that are replete with a variety of fish species (Akegbejo-Samsons, 1997). According to Eyo (2001), a decline in fish availability would have a detrimental effect on the nutritional status of the citizenry, particularly in places where fish contribute significantly to the protein diets of the people.

The range of moisture, protein, fat and ash content of some Nigerian smoked catfish species were reported as follows; 7.16-10.71%, 33.66-66.04%, 1.58-6.09% and 9.12-12.16 %, respectively (Adebowale et. al., 2008). The proximate composition of *Oreochromis niloticus* were once observed to be as follows; lipid content 18.6 %, Protein content 38.19 %, Moisture content 27.66 %, Ash content 1.76 %, Carbohydrate content 10.41 %, and Crude fibre content 3.38 % (Bolawa, et. al., 2011). Protein and fat contents of *Macrones nemurus* were also recorded as; 32.25 and 32.06 %, respectively, and values of 38.81% and 8.02 % (Huda et al., 2010) were recorded for *Cryptopterus micronema*.

MATERIALS and METHODS

Sample collection

African catfish (*Clarias gariepinus*) used for this study were obtained from Labana Farms and Kashin Zama fish landing site both in Aleiro, Kebbi state, Nigeria. Fish samples comprising juvenile and adults were purchased, specimens were packaged in separate labeled polythene bags containing ice chips at an average temperature of 4^{o}C and immediately conveyed to the Biology Laboratory, Kebbi State University of Science and Technology, Aleiro, for analysis.

Preparation of fish sample

Morphometric measurements of total weight, gutted weight, standard and total lengths were conducted. Each gutted fish samples were cleaned and oven dried at a temperature of 40 - 60ºC. The muscles of the dried samples were prepared into powdered form and labeled for the proximate composition analyses.

Analysis of Proximate Composition

Determination of dry matter

The moisture content of each fish samples was determined using the oven dry method (Bolawa, et. al., 2011). 5g of the samples were placed in weighed crucibles maintained at 80 ^{0}C in an oven until constant weights were obtained. The samples were transferred into desiccators to cool to ambient temperature and reweighed. The difference in weights indicates the dry matter and was calculated as follows;

$$\% \text{ Moisture content} = \frac{W_1 - W_2}{W_1} \times 100$$

Where; W_1 = Wet sample

W_2 = Dry sample

Determination of ash content

Ash content of fish samples was determined by incineration in a carbolated Sheffield LMF3 muffle furnace at 5000^0C (AOAC. 1988). The difference in weight of the fish samples before and after heating was taken as the ash content, the formula is as follows;

$$\% \text{ Ash content} = \frac{W_2 - W_0}{W1 - W_0} \times 100$$

Where; W_0 = Empty crucible,
W_1 = Dry sample; and W_2 = Ash sample

Determination of lipid content

The percentage lipid content in the muscles were determined using the soxhlet extraction method of (Bolawa, et. al., 2011). an empty extraction thimble was weighed and noted as W_1, about 5 g of the ground muscle was measured into the empty thimble, the weight of the extraction thimble plus the sample was recorded as W_2. The extraction thimble and its content was placed gently in the extractor, 110 ml of petroleum ether at 40 – 60 °C boiling point was turned into the round bottom flask and then placed in the heating mantle, the extractor was fitted onto the round bottom flask followed by the reflux condenser and connected to tapped water inlet tube with the outlet emptied in the sink. The heating mantle was switched on and adjusted so that the solvent in the round bottom flask boils gently. During the heating process, water was allowed to run constantly through the reflux condenser to cool and condense the evaporating solvent which then collects in the extractor thus extracting the lipid from the sample in the extraction thimble of the extractor, when the extractor is filled with solvent it is then siphoned back into the round bottom flask, this process goes on continuously for 6 hours. At the end of 6 hours, the extraction thimble and its content was removed from the extractor and oven dried at 50°C to a constant weight which was recorded as W_3. The percentage lipid was calculated as follows:

$$\% \text{ lipid content} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where W_1 = Weight of empty extraction thimble
W_2 = Weight of extraction thimble plus sample extraction
W_3 = Weight of extraction thimble plus sample residue after extraction.

Determination of protein content

The total nitrogen (crude protein) was determined using the Kjeldahl method (Huda et al., 2010). About 0.5 g of the fish sample was weighed on a Nitrogen-free paper. The paper was wrapped round the sample and dropped at the bottom of the Kjeldahl digestion flask together with 6-8 glass beads, 4-5 spatulas full of granular mixture of $CuSO_4$ and K_2SO_4 as catalyst and 20 ml of concentrated H_2SO_4 was carefully added. The flask was gently heated on a Gerhardt heating mantle in an inclined position in a fume cupboard until full digestion was achieved (when the liquid changed from brown to colourless). The contents of the flask were

then transferred to a clean 100 ml volumetric flask, and 25 ml aliquot was used for the distillation and total nitrogen was determined calorimetrically.

Statistical analysis

Descriptive statistics (mean and standard deviation) were used in presenting the data, while ANOVA was used to test for significant differences with the help of SPSS 19.0 version.

RESULTS

Morphometric Measurement of Fish Species

Table 1 presents the morphometric values of both the cultured and wild fish studied. The total weights of juvenile and adult of cultured fish were 72.49±9.05g and 288.43±2.16 g, while the juvenile and adult of wild fish were 69.80±3.22g and 110.70±1.44 g. The total length of juvenile and adult of cultured fish were 21.10±1.01cm and 30.27±1.75 cm, while the juvenile and adult of wild fish species were 21.40±2.01cm and 23.33±2.08 cm respectively.

Table 1: Morphometric measurement of *Clarias gariepinus* both from the cultured and wild sources.

Locations /Grps		Total Weight		Gutted Weight		Standard length		Total length	
		Range	Mean± SD	Range	Mean ±SD	Range	Mean± SD	Range	Mean± SD
Cultured	J	62.90-80.90	72.47±9.05	2.50-4.00	3.00±0.75	18.00-20.00	18.83±1.04	20.00-22.00	21.10±1.01
	A	286.90-290.90	288.43±2.16	4.70-5.50	5.07±.0.40	24.0028.30	26.40±2.19	28.50-32.00	30.27±1.75
Wild	J	66.40 - 72.80	69.80±3.22	2.50-3.70	3.07±0.60	17.10-20.70	18.83±1.80	19.50-23.50	21.40±2.01
	A	109.50-112.30	110.70±1.44	3.50-4.50	3.90±0.53	18.50-22.00	20.57±1.83	21.00-25.00	23.33±2.08

Key: J – Juvenile A – Adult. n = 20

Proximate Composition of Cultured and Wild C. gariepinus

Table 2 indicates that adult of the cultured samples had the highest dry matter content of 93.63 ±1.29%, while the adult of the wild samples had the lowest dry matter value of 90.36± 1.31%. The highest crude protein 29.49±1.75% was observed in the wild juvenile fish, while the lowest 28.24±0.79% was recorded for cultured adult fish. The highest percentage lipid content was observed in cultured juvenile fish species with a percentage value of 19.39±1.30%, while the least was observed in the wild juvenile with a percentage of 11.70±1.33%. Cultured juvenile had the highest ash content with a percentage of 3.53±0.53% while the minimum was recorded in wild adult with a percentage of 2.92±0.79%. Analysis of variance shows significant difference ($P < 0.05$) in the dry matter and lipid contents of the fish species.

Table 2: Proximate composition of *Clarias gariepinus* from the cultured and wild sources.

GROUPS		**DG %**		**CP %**		**LIPID %**		**ASH %**	
		Range	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**
Cultured	J	91.70-94.10	92.79±1.19^{ab}	28.46-29.06	28.71±0.61^{a}	18.22-20.79	19.39±1.30^{a}	3.11-4.13	3.53±0.53^{a}
	A	92.25-94.79	93.63 ±1.29^{a}	27.90-26.67	28.24±0.79^{a}	17.12-18.79	17.83±0.86^{a}	2.33-4.79	3.39±1.27^{a}
Wild	J	89.32-91.96	90.75 ±1.33^{b}	28.65-30.40	29.49±1.75^{a}	10.33-12.93	11.70±1.33^{b}	3.11-4.10	3.50±0.53^{a}
	A	89.22-91.79	90.36± 1.31^{b}	28.60-30.04	29.23±1.47^{a}	14.22-16.87	15.45±1.34^{b}	2.10-3.67	2.92±0.79^{a}

Key: J – Juvenile, A – Adult, DG – Dry Matter, CP – Crude Protein, n=20.
Same letters in a row indicates no significant different (P>0.05).

DISCUSSION

According to (AOAC. 1988), proteins, lipids and moisture contents were the major constituents, when evaluating the nutritional value of fish. The nutritional elements showed variable values in all the fishes analyzed, with crude protein recording the highest values and lipid recording the lowest. This makes the fish an important candidate of good dietary protein sources and this is in agreement with the findings of (Vlieg, 1988), who recorded higher protein content in fish. The crude protein content in fish from the wild were observed to be higher than those of the cultured and this could be attributed to varieties of natural food available in the wild waters.

In this study, it was observed that, the cultured fish had higher lipid content than the wild fish. Cultured juvenile fish had higher lipids content than the adult and this tallied with the work of (Zuraini et al., 2006), who reported higher lipid contents in *Synodontis schall, Clarias anguillaris* and *Lates niloticus.* The higher percentage of lipid in cultured fish might be due to restricted movements in the confined environment, while the lower percentage of lipid recorded in the wild could be as a result of greater energy requirement in search for food and avoidance of predators due to unrestricted movement in the wild water.

CONCLUSION

This present work has elucidated that, the wild fish species of *C. gariepinus* had more protein and less lipid contents than the cultured species, thus there is the need to improve on the quality of cultured fish through the provision of adequate and qualitative high protein fish feed. More research needs also to be intensified with a view to improving on the technology of producing a cost effective fish feed to enhance higher growth performance and feed conversion ability of *C. gariepinus* in artificial culture systems.

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