International Journal of Agriculture, Environment and Bioresearch

Vol. 2, No. 05; 2017

ISSN: 2456-8643

COMPARATIVE STUDY OF THE NUTRIENT CONTENTS OF CULTURED AND WILD AFRICAN CATFISH (Clarias gariepinus, Burchell 1822)

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ABSTRACT

Proximate composition of cultured and wild samples of catfish Clarias gariepinus were studied using standard methods. Five (5) samples each of table-sized cultured and wild C. gariepinus were used for determining proximate composition. The cultured C. gariepinus was higher than the wild sample (P<0.05) in crude protein, carbohydrate and energy, while crude fibre, fat, ash and moisture content was higher in the wild samples. There was no significant difference (P>0.05) in the carbohydrate content between wild and cultured C. gariepinus, however other proximate parameters showed significant variation (P<0.05) between cultured and wild C. gariepinus. The species is recommended as a good source of minerals.

Keywords: Clarias gariepinus, proximate composition, wild, cultured, mineral

Introduction

Fish is one of the most important foods and is valued for its nutritional qualities. Fish protein is a good source of high protein containing essential amino acids in the amount and proportion required for good nutrition. It also provides a good source of vitamins and minerals. More than one third of the sub-Saharan African population is under nourished (FAO, 2003). Fish provides 22% of protein intake and exceeds 50% in the poorest countries where animal is expensive and scarce. Eyo (2001) pointed out that in the coastal countries of West Africa the proportion of dietary protein from fish is extremely high (47% in Senegal, 67% in Gambia and 63% in Ghana). The importance of fish in the diets of infants, young children and pregnant women cannot be over-emphasized. The crude protein content of fish can be of immense nutritional value to pregnant women for proper development of the foetus and prevention of abortion. It will also enhance the proper mental and immunity development against disease among growing children (NAFDAC, 2003).In low-income countries, staple foods such as rice, wheat and maize supply majority of energy. However, some essential nutrients (essential amino-acids and micronutrients) are not found in these staples. (Eyo, 2001). It is an indispensable source of micronutrients, such as iron, iodine, zinc, vitamin A and B (Haruna, 2003).

Clarias gariepinus which is the specimen fish belongs to the family Clariidae (Air-breathing catfishes). There are over hundred species in this family occurring naturally throughout most of Africa and southern half of Asia to Java and the Philippines. (Little *et al*., 1993).*C. gariepinus* is generally considered to be one of the most important tropical catfish species for aquaculture. The knowledge of fish composition is essential for its maximum utilization. The nutritional composition of fish varies greatly from one species and individual to another, depending on age, feed intake sex and sexual changes connected with spawning, the environment and season (Silva and Chamul., 2000).

It is not fully known, however, whether cultivated or farmed fish and shellfish have nutrient composition similar to their wild counterparts. Few earlier studies suggest that nutrient contents of farmed fish are more uniform than that of wild (Jahncke*et al*., 1988;Chanmugam*et al*., 1986; Mustafa and Medeiros, 1985;Neltleton and Exler, 1992). The present knowledge of the chemical/proximate composition of fish species from Nigerian water is scanty, some of these are works of Emmanuel*et al*. (2011), Degani (1988), Osibona*et al*. (2006), Onyia*et al*. (2013), Olapade*et al*. (2011) and Nilgun*et al*. (2009).

The objective of the present study was to compare the proximate composition of farmed and wild *C. gariepinus*.

2. MATERIALS AND METHODS

2.1 Study area

The research was conducted in the Department of Fisheries and Aquatic Environmental Management fish farm in University of Uyo, Uyo, Nigeria. The culture medium was a concrete tank measuring 8M^2. The culture lasted six months.

2.2 Experimental procedure and design

Wild *Clarias gariepinus* used in this study were purchased from fishermen operating at IfiayongOsuk in Uruan L.G.A of Akwa Ibom State. A total of five samples were purchased in the same location prior to proximate determination. The fingerlings for culture were collected from University of Uyo fish farm in Akwa Ibom State, Nigeria. The total numbers of fingerlings collected were 110 fingerlings. There were stocked in the same tank and fed with Multifeed (40% CP) for a period of six (6) months. The treatments were cultured and wild *C. gariepinus*.

2.3 Analysis of proximate composition

At the end of the culture period, 5 samples each of cultured (randomly selected) and wild *C. gariepinus* were sent to the Department of Biochemistry, University of Uyo for determining proximate composition according to method of Association of Official Analytical Chemists (AOAC) (2005).

2.4 Statistical analysis

Data obtained from chemical analysis were subjected to one-way analysis of variance (ANOVA) to test for significant differences among means of proximate parameters of cultured and wild samples of *C. gariepinus* according to method of Sokal and Rohlf (1995). Statistical significances were tested at $P<0.05$ level of significance.

3. RESULTS

The proximate composition in the cultured and wild samples of *C. gariepinus* during the study is presented in Table 1. Table 2 shows the correlation matrix between the body composition parameters of cultured and wild *C. gariepinus*. Results showed significant differences ($P<0.05$) in proximate composition parameters among cultured and wild *C. gariepinus* except for carbohydrate. Of the 28 associations, 10 were negatively correlated while 18 had positive associations.

From results, the crude protein content in the cultured samples of *C. gariepinus* was significantly ($P<0.05$) higher (57.19 ± 2.80) than that of the wild samples (42.68 ± 1.03).Carbohydrate content was insignificantly ($P>0.05$)higher (9.09 ± 03) in cultured samples than that of wild (7.35 ± 0.34). However, a significantly ($P<0.05$) higher amount of lipid was found in the wild (19.44 ± 0.71) than cultured samples (18.01 ± 1.08). Moisture content had a higher significant ($P<0.05$) value in wild samples (76.06 ± 0.44) than that of the cultured samples (73.22 ± 1.62). Ash content was significantly ($P<0.05$) higher in the wild ($17.34 \pm 0.85\%$) than ($1.12 \pm 1.21\%$) in the cultured samples respectively. The fibre content was significantly ($P<0.05$) higher in wild (11.33 ± 0.07) than cultured (6.58 ± 0.11) samples. Energy values were also significantly ($P<0.05$) higher in the cultured (426.74 ± 0.01) than the wild (381.17 ± 0.01) samples. Comparison between the cultured and wild samples of *C. gariepinus* showed higher level of crude protein, carbohydrate, and energy content recorded in the cultured tissues, while higher level of moisture, crude fibre, ash and fat were noticed in the wild samples of *C. gariepinus.*

Seventeen (17) statistically significant associations were revealed out of the 28 associations that existed among the parameters. The significant negative associations (inverse relationships) were those between moisture and protein ($r = -0.636$, $p<0.001$), moisture and metabolic energy ($r = -0.615$, $p<0.05$), protein and fat ($r = -0.644$, $p<0.05$),protein and crude fibre ($r = -0.926$, $p<0.001$), protein and ash content ($r = -0.952$, $p<0.001$), fat and carbohydrate ($r = -0.520$, $p<0.05$), fat and metabolic energy ($r = -0.541$). Carbohydrate content exhibited an inverse relationship with fat ($r = - 0.520$, $p< 0.05$). The positive relationships include those of moisture and fat ($r = 0.442$, $p< 0.05$), moisture and ash content ($r = 0.686$, $p<0.05$), crude fibre and moisture ($r = 0.537$, $p<0.05$), fat and ash content ($r = 0.663$, $p<0.05$). Fat also associated positively with crude fibre ($r = 0.672$, $p<0.05$), ash content and crude fibre ($r = 0.960$, $p<0.001$).Other associations were statistically insignificant ($p>0.05$).

Table 1: Proximate composition of cultured and wild *C. gariepinus* during the study

Parameters	**Wild (% Mean ± SE)**	**Cultured (% Mean ± SE)**
Moisture content	75.06 ± 0.44	73.23 ± 1.63
Crude protein	44.68 ± 1.03	57.19 ± 2.80
Fat	19.44 ± 0.71	18.01 ± 1.09
Ash	17.34 ± 0.05	9.13 ± 0.13
Crude fibre	11.33 ± 0.07	6.58 ± 0.11
Carbohydrate	7.35 ± 0.34	9.09 ± 0.31
Energy kcal	381.17 ± 0.01	426.74 ± 0.02

Table 2: Correlation matrix among proximate composition

Parameters	Moisture	Protein	Fat	Ash	Fibre	CHO	Energy
Moisture	1.000						
Protein	-.636*	1.000					
Fat	.442*	-.644*	1.000				
Ash	.686*	-.926*	.663*	1.000			
Fibre	.537*	-.952*	.672*	.960*	1.000		
CHO	-.211	.144	-.520*	-.468*	-.380	1.000	
Energy	-.615*	.929*	-.541*	-.980*	-.963*	.370	1.000

4. DISCUSSION

The moisture content in fish is the principle component (up to 80%) of the edible portions of seafood. Usually, the oil and water content together is about 80%. The method of storage as well as further processing, such as soluble nutrients, may be lost in thaw drip (Pigott and Tucker, 1990). Water retention is higher in fresh fish. Moisture contents generally show an inverse relationship to the lipid content. The average percentage of moisture in raw edible flesh summarized from various sources is 77.2% with a range of 64.3 – 82.8% (Agwalon, 2004).The study revealed higher level of moisture content in the wild sample (75.06 ± 0.04) than that of the cultured sample (73.22 ± 1.62). The value recorded for the wild sample falls within the values reported by Degani (1988), Osibona*et al*. (2006), Ayinla (1993), Adeniyi*et al*. (2012) and Ayeloja*et al*. (2013). However, the moisture content recorded in this study for *C. gariepinus* cultured sample is higher than report of Emmanuel*et al*. (2011). The result also showed that there was significant difference ($P<0.05$) in the moisture content between the wild and cultured *C. gariepinus*. This is at variance with the report of Onyia*et al*. (2013). However, Emmanuel*et al*. (2011) stated that, moisture content in fish may not be different in respect to environment since the animals from the two sources have access to constant source of water.

Animals require a continual supply of protein throughout life for maintenance and growth. Actually, they do not have a requirement for protein as such, but rather require amino-acids that compose protein and nitrogen for synthesis of other nitrogenous compounds (Robinson and Li, 2012). The optimum level of dietary protein to include in commercial catfish diets is dependent on several factors, but using high quality feedstuffs containing as little as 24%protein provides for fast growth and high feed efficiency (Robinson and Li, 2012). The result showed that the crude protein in the cultured *C. gariepinus* was higher (52.19 ± 2.80) than that of the wild (42.68 ± 1.03).The work of Degani (1988) has supported this study that *Clarias gariepinus* has a very high protein level in the muscle and protein level is relatively high compared to other carnivorous fish like *Salmon gairdneri* (Reintz*et al*., 1979). Higher protein content in cultured samples were also reported by Nilgun*et al*. (2009) and Olapade*et al*. (2011). Nevertheless, the protein content from cultured samples recorded in this study is higher than reports of Emmanuel*et al*. (2011) and Ayeloja*et al*. (2013). Also, the protein content from wild sample recorded in this study is higher than reports ofAyinla (1993) and Adeniyi*et al*. (2012). Riziwan*et al*. (2000) attributed the higher protein content in cultured sample to quality of feed given to cultured fish. This complements the fact the cultured samples were fed commercial diet of crude protein >38% throughout the duration of the experiment. This could influence the results of compositing of the strains of *C. gariepinus* from wild and cultured. The result of this study supports the report of Onyia*et al*. (2013) that the crude protein content had significant difference (P<0.05) between the two strains of *C. gariepinus.*

Taking all species into account, the fat content of fish can vary much more widely than the water, protein, or mineral content (Murray and Burt, 2001). While the ratio of the highest to the lowest value of protein or water content encountered is not more than 3:1, the ratio between highest and lowest fat values is more >300:1 (Murray and Burt, 2001). The highest amount of lipid was found from the wild samples (19.44 ± 0.71) and lowest in the cultured samples (18.01 ± 1.0). This result contradicts the report of Degani (1988),Olapade*et al*. (2011) and Onyia*et al*. (2013) who reported higher lipid content in cultured samples. The values of lipid from the current study is dissonant with reports of Degani (1988), Ayinla (1993), Olapede*et al*. (2011),Ayeloja*et al*. (2012) and Onyia*et al*. (2013). However, Onyia*et al*. (2013) reported significant difference (p<0.05) in the lipid content between wild and cultured *C. gariepinus.* This is similar to the present study. The higher values of lipid observed in wild samples indicate the availability of a variety of food materials rich in fat and oil in their immediate environment of which they utilized effectively.

Ash is the name given to all non-aqueous residue that remains after a sample is burned, which consist mostly of mental oxides. Ash as one of the components in the proximate analysis of biological materials consists mainly of salt and inorganic constituents. It includes metal salt which are important for processes requiring ions such as Na^+ (sodium), K^+ (potassium), and Ca^{2+} (calcium). It also includes trace minerals, such as chlorophyll and haemoglobin. A higher value of (17.34 ± 0.85) of ash content was noticed in the cultured samples as against the samples from the wild (9.12 ± 1.21). The result of the present study is higher than reports of Ayinla (1993) and Olapade*et al*. (2013). The result also showed significant differences (P<0.05) in the wild and cultured samples, this is in consonance with the report of Onyia*et al*. (2013). An increase in ash content for cultured *C. gariepinus* might be attributed to the feed quality given them owing to the fact that Multifeed incorporates nutrients such calcium, potassium and phosphorus during manufacture.

Carbohydrates belong to a group of compounds that includes sugars, starches, celluloses, and other closely related substances that are among the most abundant organic compounds found in nature (Robinson and Li, 2012). For catfish and other simple-stomached animals, carbohydrate can be broadly divided unto an indigestible fraction (fibre) and a digestible fraction sugars and starched as an energy source differs among fish species (Robinson and Li, 2012).

Carbohydrate content of cultured samples was higher (9.09 ± 2.85) than the wild samples (7.35 ± 2.53). This vary with report of Emmanuel *et al*. (2011).Higher CHO value in cultured samples is an indicate of efficient utilization of the metabolic energy in the feed given them.Fibre content and metabolic energy differ significantly between the two groups. Feeding is not regulated in the wild. This could influence the amount of nutrient available to fish in the natural environment. Thus, quality feeds given to the cultured specimens could inform the difference.

5. CONCLUSION

The result of this study revealed higher content of crude protein, carbohydrate and energy in the cultured *Clarias gariepinus.* Thus, the consumption of the cultured species should be preferred because of their higher nutritional quality.

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