COMPARATIVE EVALUATION OF THE NUTRITIONAL PROFILES OF WILD AND POND REARED CATFISH (*Clarias gariepinus*) in Obubra LGA, Cross River State.

ABSTRACT

Fish is a good source of rich protein regardless of it source of habitation. However, there are notable variations in the nutritional composition. Thus, this study was conducted to compare the nutritional composition of wild and pond raised African Catfish (*Clarias gariepinus*). Twenty samples of *Clarias gariepinus* each were collected from Ahaha Beach, Obubra LGA and University of Calabar fish farm for the study. Standard methods were employed in the analysis of body nutrients, for samples from both habitats. The results revealed that pond raised samples had higher values of crude protein (59.23 ± 2.86), carbohydrates (9.37 ± 0.75), fat (20.01 ± 1.01) and energy (464.74 ± 0.03) than samples from the wild. Although, moisture contents (64.05 ± 0.23), crude fibre (10.10 ± 0.06) and ash content (16.40 ± 0.08) were higher in wild samples, moisture contents and crude fibre were not significant ($p<0.05$). However, for crude protein, carbohydrates, ash content and energy (kcal), there were significant difference ($p<0.05$) between both samples. There was a weak positive correlation between protein and carbohydrate and carbohydrates and energy (kcal). Nonetheless, crude protein had strong negative correlation between other variables. Conclusively, pond raised system for Catfish is encouraged for commercial and nutritional purpose (consumption).

Keywords: Comparison, Nutritional profile, Wild and Pond raised, African Catfish (*Clarias gariepinus*), Cross River State.

INTRODUCTION

In Africa and other developing countries in the globe, fish is an important economic species in resolving and sustainability food and income. It is estimated that over 2.6 billion people consume 20% of their animal protein from fish, and over 400 million people in Asia and Africa consume at least 50% of their animal protein from fish. However, only 13% of animal protein consumption is provided in developing countries (FAO, 2018). Fish is a good source of inexpensive yet quality protein required in human diets (Bello *et al.*, 2018) and contains all of the essential amino acids. It is a widely accepted good source of protein and other elements necessary for the maintenance of a healthy body (Adebayo-Tayo *et al.*, 2012). Fish provides 22% of protein intake and exceeds 50% in the poorest countries. It also provides a good source of vitamins and minerals. More than one third of the sub-Saharan African population is under nourished (FAO, 2018). It is a major agricultural important and frequent consumed product in Nigerians. It is cheap and highly acceptable, with little or no religious bias, which gives it an advantage over pork or beef (Eyo, 2001; Ligia, 2002). Fish is a highly perishable commodity that undergoes spoilage as soon as it is harvested. Once spoilage sets in, the odor/flavor, texture, color and chemical composition change (Omoruyi *et al.*, 2016). 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 (Affognon*et al.,* 2015).Fish products are very important in human diet because of their high digestibility and high nutritional values, mostly characterized by the presence of high proteins, rich and amino acids. This latter quality makes frozen food a valuable protein source to populated countries (Silva and Chamul, 2000). Mineral elements like selenium, iodine (in marine species) phosphorus and zinc are present in a significant amount in many fish species. Fatty acid stores vitamin A and E in the muscle tissue, while low fat fish accumulates fat soluble vitamins in the liver. Shellfish have chemical composition similar to that of low fat fish. All fish species have specific nutritional profiles. However, overtime they have been several reports on the variations of results from same species. These are most times a function of food and external factors (environmental factors) (Okon *et al.,* 2020). Pollution and anthropogenic activities have also been reported to cause a change in the nutritional profile of aquatic species that inhabit the affected water bodies (Akpabio *et al.,* 2024). Silas *et al.,* (2024) reported significant variation in the prevalence of gastrointestinal parasite between wild and pond raised *Clarias gariepinus.* This too can affect the cause a change in the nutritional profile. Hence, the need to compare the nutritional and sensory qualities between wild and pond reared Catfish (*Clarias gariepinus*) in Cross Rover State.

2.0 MATERIALS AND METHODS

2.1 Study Area

This study will be carried out in the Laboratory of the Department of Fisheries and Aquatic Science, Cross River University of Technology, Obubra Campus, Cros River State, Nigeria.

2.2 Experimental Fish

A total of 40 matured *Clarias gariepinus*were obtained. Twenty samples were purchased from the Ahaha Beach, ObubraLGA and carried to the laboratory in ice boxes to maintain their freshness and the other twenty live samples were purchased from the University of Calabar Fish Farm and transported to the laboratory of Faculty of Agriculture, University of Calabar for proximate analysis.

2.3 Analysis of proximate composition of samples

10 samples from each pond raised and wild *C. gariepinus*were sent to the Department of Biochemistry, University of Calabar for determining proximate composition according to method of Association of Official Analytical Chemists (AOAC) (2005).

2.4 Statistical analysis

The 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.* Statistical significances were tested at P<0.05 level of significance

3.0 RESULTS

Result of the proximate composition in the wild and pond raised samples of *C. gariepinus*during the study are presented in Table 1. The correlation coefficient amongst composition parameters of the wild and pond raised *C. gariepinus*is revealed in Table 2. Results showed significant differences (P<0.05) in proximate composition parameters among wild and pond raised *C. gariepinus*except values for carbohydrate ($C_6H_{12}O_6$). The crude protein content in wild and pond raised were 48.77 ± 1.00 and 59.23 ± 2.86 respectively. Carbohydrate content recorded in wild and pond raised were 7.55 ± 0.44 and 9.37 ± 0.75 respectively. The values for moisture content were higher in wild than pond raised samples at 64.05 ± 0.23 and 63.20 ± 1.53 respectively. Fat contents for wild and raised pond samples were 18.12 ± 0.82 and 20.01 ± 1.01 respectively. Fibre and Ash contents for wild and raised pond samples were significant (P<0.05) with at 10.10 ± 0.06 and 7.88 ± 0.31 and 16.40 ± 0.08 and 6.63 ± 0.58 respectively. Energy values were also significantly (P<0.05) higher in the pond raised (464.74 ± 0.03) than the wild (401.20 ± 0.03) samples.

Comparison between the wild and pond raised samples of *C. gariepinus*showed higher level of crude protein, carbohydrate and energy content recorded in the pond raised samples, while higher level of moisture, crude fibre and ash. However, fat content in both were the same in the wild and pond raised samples of *C. gariepinus.*

Table 1: Proximate composition of fresh and frozen wild-caught and fresh and frozen pond reared *Clarias gariepinus.*

Parameters	Wild (% Mean ± SE)	Pond (% Mean ± SE)
Crude protein	48.77 ± 1.00	59.23 ± 2.86
Carbohydrate	7.55 ± 0.44	9.37 ± 0.75
Moisture content	64.05 ± 0.23	63.20 ± 1.53
Fat	18.12 ± 0.82	20.01 ± 1.01
Crude fibre	10.10 ± 0.06	7.88 ± 0.31
Ash	16.40 ± 0.08	6.63 ± 0.58
Energy kcal	401.20 ± 0.03	464.74 ± 0.03

The 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 protein and moisture (r= -0.684), protein and fat (r= -0.637) protein and crude fibre (r = -0.899), protein and ash content (r = -0.900), carbohydrate and moisture (r = -0.196), carbohydrate and fat (r = -0.509, carbohydrate and crude fibre (r= -

0.404), carbohydrate and ash (r= -0.453), energy and moisture (r= -0.684), energy and fat (r= -0.578), energy and crude fibre (r= -0.684) and energy and ash (r= -0.684). The positive relationships between carbohydrate and crude protein(r= 0.154) and carbohydrates and energy (r= 0.394) were not significant (p< 0.05). The positive relationship between moisture content and fat (r = 0.444), moisture content and crude fibre (r = 0.577), moisture and ash content (r = .698), fat and crude fibre (r = 0.686), fat and ash content (r = 0.621), crude fibre and ash (r = .958) were statistically significant (p<0.05). Other associations were statistically insignificant (p>0.05).

Table 2: Correlation matrix among proximate composition

Parameters	Crude protein	Carbohydrate	Moisture content	Fat	Crude Fibre	Ash	Energy kcal
Crude protein	1.000						
Carbohydrate	.154	1.000					
Moisture content	-.684*	-.196	1.000				
Fat	-.637*	-.509*	.444*	1.000			
Crude fibre	-.899*	-.404	.577*	.686*	1.000		
Ash	-.900*	-.453*	.698*	.621*	.958*	1.000	
Energy (kcal)	.951*	.394	-.684*	-.578*	-.998*	-.993*	1.000

Correlation coefficient values with * indicate significance values (p<0.05)

3.1. Discussion

The nutritional components showed variable values amongst both fish samples. These relatively high levels of crude protein could be attributed to the fact that fishes are evidently good source of pure protein, and was similar to the observations of Isangedighi*et al.*, (2017) who reported that protein forms the largest quantity of dry matter in fish. The high protein contents in wild and pond raised *C.garieppinus*samples were similar to that found in Ondo and Osun States (Michael and Adedayo, 2017).

The differences observed, in the values could be attributed to the fish's consumption or absorption capability, and the rate in which these components are available in the different water body Adeyemi and Akande (2011). This could also be attributedwith the conversion potentials of essential nutrients from their diet or their local environment into such biochemical attributes needed by the organisms' body (Ukagwu*et al.,* 2014. The difference between the crude protein in pond raised and wild catfish could also be attributed to the fact

that in addition to natural supply of protein source from zooplankton in ponds, fish under intensive or semi-intensive culture are fed with high-quality diet. Preys in the wild that are accessible to samples from the wild are rich protein sources, compared to the compounded man-made feeds. However, depending on the commercial fish feeds examples; Coppens and Bluecrown (Okon *et al.,* 2020). Their constituteincludes ingredients such as soybean meal, fishmeal, groundnut cake, among others inaddition to energy rich sources of feedingredient, while wild fishes rely solely on proteinsource from zooplankton within the water columnand they expend a lot of energy while hunting forthe food (Effiong and Fakunle, 2011). The low value of CP in wild compared to the pond raised samples could also be a state of food scarcity; as preys may not be also available. This could also lead to cannibalism. This result is in agreement to reports from Isangedighi*et al.,* (2017) in Uyo, Akwa Ibom State that record higher CP value in pond raised than samples from the wild. However, reports from Ukagwu*et al.,* (2017) did not support this result; they were no significant difference between samples from both the pond raised and the wild.

Carbohydrates is a member to a group of compounds that includes starch, sugars, starches, celluloses, and other closely related substances that are among the most abundant organic compounds found in nature (Robinson and Li, 2012). It is the origin of ATP creation in all animals. 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 pond raised samples was higher (9.37 ± 0.75) than the wild samples (7.55 ± 0.44). This was strongly similar to Isangedighi*et al.,* (2017). However, it varied with report of Emmanuel *et al*. (2011). Higher value of CHO value in pond raised samples is indicative of efficient utilization of the metabolic energy in the feed given them. 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 pond raised specimens must have encouraged that. Amidst competition, samples in the wild tend to go in search for food which consumes their energy before they finally secures the food. Unlike samples in the ponds that were regulated in feeding

The moisture content is the principle component (over 80%) of the edible portions of fish. Usually, the oil and water content together is about 80%(Olele, 2012). Water retention is higher in fresh fish. Moisture content of food is an important factor that has a functional effect on some quality characteristics such as texture. Previous studies have revealed moisture level obtained to be similar for wild catfish (58.9±0.01) (Adeosun *et al.*2015) and Azuka and Goodnesschinwe (2018) "70.3" for *C. gariepinus*form markets in Nigeria. Higher percentages of 71.7 and 70.35% for *C. gariepinus*fish were also recorded by Olopade *et al.,* (2013) and Oladipo and Bankole (2013), respectively. Adeniyi *et al*. (2012) and Ayeloja*et al.* (2013) also had related results for moisture content.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.*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.

According to Murray and Burt (2001), the fat content of fish varies more than the protein or mineral contents. The results for lipids between both samples were similar to the report of Olapade*et al.* (2011), Onyia*et al.* (2013) and Ayeloja*et al*. (2012) who reported higher lipid content in pond raised samples. However, Onyia*et al.* (2013) reported significant difference ($p<0.05$) in the lipid content between wild and pond raised *C. gariepinus.* The higher values of lipid observed in the pond raised and wild samples are indicative of the availability of a variety of food materials rich in fat and oil in their immediate environment of which they utilized effectively and in the formation of the feeds respectively.

Lipids are important component in fishes which consist of fats, oils and waxes making up the fish tissues and organs. Lipids in catfish can be stored in the muscles, liver and skin in different forms. Studies have reported fats content to be generally higher in pond raised than wild fish (Olapade *et al*. 2011;Ayeloja*et al*., 2012; Onyia *et al*. 2013). Diet and activity levels are essential factors in sustaining and building up fat content in fish. The higher results in pond raised catfish are likely attributed to the high-caloric feed which promote rapid growth. High activity of fish (in search of food, mating partner, competition to survive) uses up the energy accumulated by the fish; thus could have contributed to the higher result in pond raised than the wild samples. However, lipid level for the wild sample was commendable.

Crude fibre in fish refers to the indigestible portions of plants/food materials that is remained after the fish has digested the available nutrients. Crude fibre is an important component of fish feed, as it helps to maintain the health of the digestive system and regulates the digestion process (Okereke *et al.,* 2013). This result agrees to Isangedighi*et al.,* (2017) who reported higher crude fibre in wild than pond raised catfish. This is likely attributed to the diversity of food material (plants) in the wild compared to the pond. However, Catfish are not herbivores, but in the wild they could feed on herbivorous animals rich in plants. This contributed to the higher crude fibre contents in the wild.

Ash content in fish refers to the inorganic mineral component that remains after the fish has been subjected to high temperature which includes 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. It is typically expressed as a percentage of the fish's total weight which varies depending on the fish diet and environmental condition. There was significant difference between the ash content in the pond raised and wild fish samples. Fish from the wild had the highest ash content, and could be linked to the level of minerals available in the water body or the materials they feed on. This is in agreement to Onyia *et al*. (2013), Isangedighi*et al.,* 2017 and Michael and Adedayo (2019) results that reported higher ash content in wild samples. Miroslav *et al.,* (2011) and Adeosun *et al.,* (2015) reported a positive correlation between crude fibre and ash, which was evident in this result.

The caloric value of the catfish had a weak positive correlation with carbohydrates, which implies thatboth variables are dependent on each other; the higher the carbohydrates, the higher the caloric vales, however, the correlation was a weak one. According to Pyz-Łukasik and Paszkiewicz, 2018) meat from *C. gariepinus*males and females had a low calorific value, averaging 496.59 kJ/100 g on average. This report is also supported by Sayed Abd-Allah, (2019).

3.2. CONCLUSION

This study shows that there is significantdifference in higher content of crude protein, carbohydrate and energy betweenthe pond raised and wild Catfish (*Clarias gariepinus*). This is attributed to a variety of factors including type of food and feeding pattern, environment, enclosure etc. Thus, the consumption of the pond raised samples fed with rich commercial feeds should be encouraged because of their higher nutritional quality.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author (EEA) upon request.

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