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Proximate analysis of *Clarias gariepinus* and *Oreochromis niloticus* in River Benue at Ibi Landing Site, Taraba State, Nigeria

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ABSTRACT: This study was carried out to examine the proximate composition of selected *Clarias gariepinus* and *Oreochromis niloticus* and to compare the composition of *Clarias gariepinus* and *Oreochromis niloticus* from the Ibi River. The samples were collected from Ibi, the study site and transported to the laboratory for examination using standard methods. The percentage ratio obtained from laboratory analysis using Tube Fumace Thermo Scientific, Soxhlet Apparatus, Tecator Digestor (kjeldahl method), Distillation Setup and Genlab Oven. Both wet and dry samples were represented, and their results were compared. The result showed that the dry samples had higher protein content than the wet samples, *Clarias gariepinus* having the highest value of 71.63%, while *Oreochromis niloticus* had the highest crude fat content of about 10.21%. It was also observed that the carbohydrate content was higher in dry samples, with *Clarias gariepinus* having 1.55%. Crude fibre was higher in dry samples, *Oreochromis niloticus* having the highest values of 1.91%. Ash content was higher in the dry samples, *Clarias gariepinus* having the highest value of 7.43%, and the moisture content was higher in the wet samples, *Clarias gariepinus* having the highest of 79.9%. From the study, it was generally observed that dried *Clarias gariepinus and Oreochromis niloticus* have high protein, micronutrients and essential fatty acids, for consumption.

Keywords: Carbohydrate, crude fat, protein content.

INTRODUCTION

Fish are an important source of protein and other nutrients for humans. Over time, studies have shown that fish possess high nutritional value; they rank high on the list of best sources of heart-healthy omega-3 fatty acids, high-quality protein metabolism-friendly selenium, energy boosting vitamin B_{12} and inflammation fighting vitamin D (Ande *et al.,* 2012). Fish is a cheap source of high protein, so there is a need to produce it as an alternative way of fulfilling animal protein requirements for the poor rural communities, Sutharshiny and Sivashanthini (2011). Feeding habit, gender, species diversity, seasonal variation, climate change and other environmental features greatly affect the nutrient composition of individual fish species (Rasul *et al,.*2021). Evaluation of some proximate profiles, such as protein contents, lipids, carbohydrates, moisture and ash percentages, is necessary to ensure that they meet the requirements of food regulations and commercial guidelines. Fish is known to be one of the cheapest sources of animal protein and has essential nutrients needed in human diets (Balami *et al.,* 2019). Protein, fat and water content of fish are important to consumers, scientists and manufacturers for many aspects, including nutritional value, seasonal variations and considerations regarding processing (Ahmed *et al.,* 2022). Some nutritional components of fish have functional effects on human health, for example, fish oil is one of the most important natural sources of polyunsaturated fatty acids, including eicosapentaenoic

acid (EPA) and docosahexaenoic acid (DHA), which have been proven to have useful effects on human health (Swanson *et al*., 2012). However, nutritional studies of many fish species have not been conducted elaborately. The biochemical composition of fish is essential to estimate their energy value (Tsegay *et al.,* 2016). The basic cause of change in the composition of fish is usually the amount of food that the fish eats and the amount of movement it makes. Therefore, the study was carried out to determine the composition of proximate and mineral content of two commonly consumed fish species from River Ibi.

MATERIALS AND METHODS

Study area

The study area was in the River Ibi, in Ibi Local Government Area, Taraba State, Nigeria. It is located in the Southern part of Taraba State, which is predominantly occupied by Jukun and the Hausa. It is located between latitude 8°11'5.798" N and longitude 9°44'12.566" E. It covers a land mass of about 2,672 Km^2. River Ibi is the main source of water for irrigation, fishing and industrial purposes in the community.

Sample collection and analysis

Samples of *Clarias gariepinus* and *Oreochromis niloticus* were bought at the landing site of the River Ibi bank. The samples were placed in a plastic bag containing ice and transported to the Department of Fisheries Dry Laboratory, Modibbo Adama University, Yola. The samples, C. *gariepinus* and *O. niloticus* were washed thoroughly with tap water and then distilled water to remove any adhering contaminant, and then were drained under the fold of filter paper. The fish was gutted, the viscera and bones were removed, and the heads were cut and each was cut into halves. A half was oven dried and used to determine the proximate analysis for the dried sample, while the other half was used to determine the proximate analysis for fresh samples. The GenLab oven was used; it is generally recommended to use a low temperature, around 145 – 175°F (63 -79°C) and adjust the drying time accordingly. The fresh samples were homogenised using an electrical blender, while the dried sample was ground into powder form using a mortar and pestle. The fresh samples were stored in a freezer, while the dried samples were stored in an air-tight container for analysis.

Determination of moisture content using the air oven method

Two crucibles for each sample were used. A standard analytical balance was used to obtain the weight of the two crucibles. 2.0 g of *Clarias gariepinus* and *Oreochromis niloticus* was weighed into the crucibles and allowed to dry in the oven. A temperature of 100°C was maintained for 17 hours. The sample was then removed from the oven after drying, and the lids were replaced. The crucibles were placed in a desiccator and allowed to cool to a temperature of 20°C, and then weighed. The process of drying, cooling and weighing was continual until a constant weight was obtained (Khir *et al.*, 2014). This was calculated as:

Moisture = t – u

$$\%\ \text{moisture} = \frac{t-u}{s} \times 100$$

Where: s = weight of sample for analysis, t = weight of sample + crucibles before drying, and u = weight of sample + crucibles after drying.

Determination of total ash content

Clean porcelain crucibles were weighed using an analytical balance, 2.0 g of the sample was weighed into the crucibles and allowed to dry in an oven at 100°C for 8 hours and then removed. The crucibles were then heated over a Bunsen flame to initiate the destruction of carbon, after which they were heated gently until the contents turned black. The crucibles and content were then placed into a muffle furnace and heated at 56°C for about 17 hours until a greyish – white residue was obtained to indicate the destruction of the organic carbonaceous portion of the sample. Tongs were used to remove the hot crucibles from the furnace. The sample was dried again and re-burnt in a muffle furnace for 45 minutes. The sample was then removed and placed in a desiccator to cool completely and for any traces of moisture present to be absorbed by the desiccant. The crucibles and the content were weighed to determine the ash (Shabir *et al,.*2018). This was calculated:

$$\%\ \text{ash} = \frac{x-y}{z} \times 100$$

Where: x = weight (g) of crucibles and content after drying, y = weight (g) of empty crucibles and z = weight of the sample for the analysis.

Determination of Crude Lipids using Soxhlet Apparatus

The 2.0 g of homogenised samples was weighed on a filter paper and placed into an extraction thimble. The thimble and contents were placed into a 100 ml beaker and were dried in a mechanical convection oven (100°C) for 17 hours to expel traces of moisture, so that water-soluble substances that were not extracted will not be weighed as part of the crude fats. The thimble and contents were then

removed from the oven and taken to the Soxhlet apparatus. The beaker was rinsed twice with the extract, and the rinsing was added to the Soxhlet apparatus. The sample was extracted for 7 hours in normal hexane at a condensation rate of about 240 drops per minute (AOAC 2012). This was calculated:

$$\% \text{ crude fat } = \frac{x - y}{z} \times 100$$

Where: X = weight (g) of crucibles and content after drying, y = weight (g) of empty evaporator crucibles, and z = weight (g) of sample taken for analysis.

Determination of protein content using Kjeldahl method

The 2.0 g of the sample was weighed into a nitrogen-free filter paper. The paper was dropped into a Kjeldahl digestion flask. A new bumping chip of 3.0 g of the digestion catalyst and 250 ml of the pure concentrated nitrogen and free H_2SO_4 was added. The flask was placed on an electro-thermal heater and was held in a slanting position with a clamp on a retort stand. The flask was heated gently thermostatically until frothing ceased and the content became completely liquefied. The temperature was increased, and the flask was rotated occasionally to pick up undissolved particles on the wall of the digestion flask. The digest was cooled at room temperature and diluted into 1000 ml of distilled water. The flask was heated to distil out evolved ammonia (NH_3). The distillate was collected in a boric acid solution placed at the tip of the receiver adaptor. The ammonia distillate was titrated with standard 0.1 ml Hydrogen Chloride) (HCl) back to pink colour. Then, the volume of the acid that turned the distillate to a permanent pink colour was the titre value (AOAC, 2012).

Determination of carbohydrate by difference

This was achieved after the values of moisture, lipid, ash, fibre and protein were summed up and subtracted from 100. The difference obtained is the carbohydrate (Nayeem *et al.,* 2019). This was calculated:

% carbohydrate: 100 – (MC + AC + PC + LC + CF)

Where: MC = moisture content, LC = lipid content, AC = ash content, PC = protein content, and CF = crude fibre.

Determination of fibre contents

Two grams of the fish samples was defatted with petroleum ether, after which it was boiled under reflux for 30 minutes in 200 ml of solution containing 1.25 g of H_2SO_4 per 100 ml of the solution. The solution was filtered through a lining on a floated funnel. It was then washed with boiling water until the wash was no longer acidic. The residue was transferred to a beaker and boiled for 30 minutes in 200 ml solution containing 1.25 g of carbonate-free sodium hydroxide per 100 ml. The final residue was filtered through a thin. The closed part of the wash was in ignited asbestos crucible, it was then dried and weighed (Bhuyain *et al,* 2019). This was calculated:

$$\% \text{ Crude fibre} = \frac{C2 - C3}{W} \times 100$$

Where: C_2 - C_3 = loss in weight on ashing (incineration) and W = weight of original sample.

RESULTS and DISCUSSION

The nutritional composition of all wet and dry samples of *Clarias gariepinus* and *Oreochromis niloticus* is shown in Table 1. The result showed that *Clarias gariepinus* has the highest moisture content of 79.67%, while *Oreochromis niloticus* has 78.78% moisture content in the wet sample. The disadvantage of high moisture content is that it increases fisher's susceptibility to microbial spoilage, oxidative degradation of polyunsaturated fatty acids, also decreases the quality of fish during long preservation (Oluwaniyi and Dosumu, 2009). In the dry sample, *Clarias gariepinus* has the lowest moisture content with a percentage composition of 9.17%, while *Oreochromis niloticus* has the highest moisture content percentage of 26.12%. The dry *Clarias gariepinus* had the highest protein content of 71.63%, while *Oreochromis niloticus* had 48.77%. High to reasonable percentage crude protein may be attributed to the fact that fish are a good source of uncontaminated protein, but differences observed in values could be a result of fish absorption capability and adaptation potentials of some essential nutrients from their diets. However, both *Clarias gariepinus* and *Oreochromis niloticus* wet samples had low protein composition of 17.01% and 14.19%, respectively. Dry *Oreochromis niloticus* had the highest ash content of 11.57%, while the lowest ash content was found in *Clarias gariepinus.* The dry *Oreochromis niloticus* had the highest lipid (crude fat) content of 10.29%, while the *Oreochromis niloticus* had the lowest 0.69% lipid composition in the samples. Crude fibre was highest in dry *Oreochromis niloticus* samples, while *Clarias gariepinus* samples had the least crude fibre content, 0.36%. Carbohydrate was highest in *Clarias gariepinus* dry samples with 1.55%, and lowest was found in wet samples of *Clarias gariepinus,* 0.15%. The result obtained from this study agrees with Olopade *et al.* (2016), who reported that the main constituents of freshwater fishes are moisture (65 – 80%), protein (15 – 24%), fats (0.1 – 22%), carbohydrate (1 – 3%) and inorganic substances (0.8 – 2%). The moisture content values from this study ranged from 26.12 to 78.78% in *Oreochromis*

Table 1. Proximate composition of wet and dry samples of *Clarias gariepinus* and *Oreochromis niloticus,*

Parameters (%)	Wet Sample		Dry sample	
	(C. gariepinus)	*(O. niloticus)*	*C. gariepinus*	*O. niloticus*
Moisture content	79.69	78.78	9.17	26.12
Protein content	17.01	14.17	71.63	48.77
Ash content	1.98	4.99	7.43	11.57
Crude fat	0.80	0.69	8.60	10.21
Crude fibre	0.36	0.88	1.59	1.91
Carbohydrate content	0.16	0.49	1.59	1.42

niloticus and 9.17 to 79.69 in *Clarias gariepinus* of which is similar to the findings of Abdel-Mobdy *et al.* (2021). The crude protein content of *Clarias is* between 0.69 and 10.29%. The finding in this research disagrees with the results of Mabroke *et al.* (2019), who reported that the lipid content in red hybrid tilapia (Florida red Tilapia x Stirling red *O. niloticus*) fillets (0.33%) was significantly lower (p>0.05) than that of the Stirling Nile tilapia fillets (2.07%). Ash content values ranged from 4.99 to 11.57% for the *O. niloticus* and 1.98 to 7.43% for the *C. gariepinus.* The results of ash content were comparable to the results of Abimbola (2010) in *Tilapia guineensis* and *Tilapia melanotheron,* which contained 1.30 and 1.06% ash contents, respectively. *Clarias gariepinus* were observed to have significantly higher crude protein content than *O. niloticus*. This is not surprising as the nutritional value of the freshwater fish has been reported to differ between species, sizes, seasons and geographical localities. The results of crude protein contents in both fish species were lower than those reported by Fawole *et al.* (2007) and Olopade *et al*. (2013); however, it was similar to El-Hawarry (2012), who obtained 11.32% and 9.8% in *O. niloticus* and hybrid (*O. aureus x O. niloticus*). The fat contents of the *C. gariepinus* ranged from 0.80 to 8.49% while that of the *O. niloticus* ranged.

Conclusion

The nutritional composition of *Clarias gariepinus* and *Oreochromis niloticus* showed significant variations between wet and dry samples. *Clarias gariepinus* had higher protein content, while *Oreochromis niloticus* had higher ash and lipid content. The results highlight the importance of considering the species, processing method, and nutritional content when evaluating the quality of fish for human consumption. The overall study provides valuable insights into the nutritional composition of *Clarias gariepinus* and *Oreochromis niloticus*, hence, these also contribute to the existing knowledge on the nutritional value of freshwater fish.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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