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Proximate Composition and Technological Properties of Wild African Catfish *Chrysichthys nigrodigitatus* (Lacépède1802)

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Abstract
The African catfish, *Chrysichthys nigrodigitatus* (Lacépède1802), is an omnivorous species cultured in both fresh and brackish waters because of its good growth rate, excellent taste, and high market demand. *C. nigrodigitatus* were collected from a fish landing site at Ogudu/Agboyi Lagos lagoon fishing grounds on monthly basis for six months within March to August 2013. The proximate and technological properties (body characteristics and yield indices) of wild *C. nigrodigitatus* were carried out. The proximate composition showed that protein in the edible tissue of the fish was 18.70% the lipid, ash and moisture contents were 4.50, 1.3 and 75.5% respectively. The mean and Standard deviation values of Total length (cm) and weight (g) were 27.69±2.05 and 159.87±28.48 respectively. However, the data obtained for the yield characteristic revealed a mean decrease in the order of fillet, head, frame and gut 43.92 > 32.38 > 17.06 > 5.74. This study shows that *Chrysichthys nigrodigitatus* has a high fillet yield and belong to high protein and semi high oil category of fish species.

1. Introduction

The African catfish, *Chrysichthys nigrodigitatus* (Lacépède), a siluroid fish, of the family Bagridae, is one of the most economically abundant species found in the Lagos lagoon complex is consumed by many people especially in sub-Saharan Africa (Holden and Reed, 1991). It occurs in most of the major rivers and coastal zones of Africa including Nigeria, Senegal, Gambia, Ivory Coast, Liberia, Zaire, and Gabon (Ezenwa, 1981). *C. nigrodigitatus* is a benthic euryhaline teleost fish which migrates to freshwater to spawn, but spends most of its life in estuaries. It is widely distributed in fresh and brackish waters in West Africa. It makes significant contribution to the artisanal fisheries of the lagoons and its aquaculture potentials are great (Oribhabor and Ezenwa, 2005; Erondu, 1997; Ezenwa *et al*., 1986). In Nigeria, *C. nigrodigitatus* is highly valued and is among the dominant fishes of commercial catches because of its good taste and high market demand (Adewolu and Benfey, 2009). Ezenwa *et al*. (1990) described *C. nigrodigitatus* as good and culturable fish species from the wild. Lawal *et al*. (2010) reported that *C. nigrodigitatus* in the lagoon feed on variety of food items of which phytoplankton (mainly algae and diatom), crustaceans and molluscs are of primary importance. Other food items that probably serve as supplements are plant materials and fish parts which make *C. nigrodigitatus* an omnivorous feeder. However, Food studies reveal the status of foraging, rate of growth and seasonal life history and changes in fish

species which are useful in balancing the management of the species (Ugwumba and Ugwumba, 2007). Due to its economic importance and suitability for culture, considerable research has been devoted to the study of several aspects of the species in Nigerian waters (Ikusemiju and Olaniyan, 1977; Ezenwa, 1981; Anyanwu, 1991; Ekanem, 2000; Offem *et al*., 2008).

However, the emanating need to culture fishes in other to boost protein consumption for the swarming rapidly growing populations in the developing countries (Nigeria), have made it necessary to increase studies on the proximate compositions and technological study of the African brackish water fishes. The proximate composition such as protein contents, carbohydrates, lipids, moisture and ash percentage is necessary to ensure fishes meet requirements of food regulations and commercial specifications (Watchman, 2000). However, various studies have been carried out on the proximate composition of different fish species (Eun *et al*., 1994; Uauy and Valenzuela, 2000). Categorically, we still have dearth of accurate basic proximate composition for fish species particularly from Africa and Asia sources (Schonfeldt, 2002). In Nigeria, our present knowledge of the proximate composition of fishes present in our waters is very limited and this constitutes a barrier to development and use of the resources.

In fisheries management, parameters such as length-weight relationship, condition factor and sex composition are essentially used to predict the possible yield and determination of size at capture for obtaining most favourable yield (Offem *et al*., 2008). However, the yield of preliminary processing of fishes such as shredding, gutting and filleting and quality features of fish meat and those of the by products are the technological properties of the fish. This accounts for the utilization of the different products (Lewiski and Autheiewic, 1996). The percentage yield form the different aspects of fish processing are affected by the ratio of edible parts of fish and non-edible parts. However, the yield percentage is high when the ratio of edible parts is higher than non-edible part (Akande and Faturoti, 2005). Lewiski and Autheiewic, (1996), reported that the yield percentage is high when the ratio of edible parts is higher than non-edible part. Ultimately, fish processing considers maximum utilization of facilities, filleting, the use of off-cuts, by-products for minced food, fish meal, silage and even leather production. Moreover, the fish processor, nutritionist, cook and consumer all have direct interest in the physical and chemical composition of fish.

The collected data from the present study is expected to provide the proximate composition of *C. nigrodigitatus* for nutritional information for dietary planning and technological properties (fillet yield and by products) for a better utilization of this important fish species.

2. Materials and Methods

Fresh samples of *C. nigrodigitatus* were collected on monthly basis for six months from the a fish landing site at Ogudu/Agboyi Lagos lagoon fishing grounds within March to August 2013. Fish samples were kept on ice in an insulated ice box and transported to the Nigerian Institute for Oceanography and Marine Research and stored at 18^0C for subsequent use. Forty- five samples were randomly selected for proximate composition and the technological properties.

The fillet of the fish samples were homogenized and were used to determine proximate composition. The moisture content was estimated using the oven dry method (AOAC, 1994). Lipid was carried out using the modified Bligh and Dyer procedure (AOAC, 1994), the ash content of the fish was determined by incineration in a carbolite Sheffield LMF3 muffle furnace while the total nitrogen (crude protein) was determined by the Kjedahl method (Vlieg, 1984).

Body characteristics and meat yield indices were carried out using standard graduated fish measuring board to the neatest centimeter. This was done for all the specimens by placing the fish on a calibrated measuring board. The standard length was measured from the tip of the snout to the posterior end of the mid lateral portion of the hypural plate.

The weight was measured using Sartorius top loading electronic weighing balance. This is done after draining water from the bucal cavity and blotting and excess water on the fish body (King, 1996). Anatomical measurements were carried out by be-heading, gutting and filleting, weighing them and relating these weights to the total body of the fish. The separate parts were weighed each (in grammes) to determine the percentages compared to the local body weight.

Statistical analysis of results was performed with descriptive statistics using SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA).

3. Results

The results of the proximate composition of the *C. nigrodigitatus* are shown in Table 1. The Crude protein, total lipid, total ash and moisture values were 18.70, 4.50, 1.30 and 75.50% respectively**.**

Table 1. *Proximate composition of C. nigrodigitatus*

Parameters measured	Composition (%) for *C. nigrodigitatus*
Crude protein	18.70%
Total Lipid	4.50%
Total ash	1.30%
Moisture	75.50%

The yield of preliminary processing of *C. nigrodigitatus* in Table 2 revealed mean value of whole fish gut, head, fillets and frame as 5.74, 32.38, 43.92 and 17.06 (g) respectively while the range of the gut of whole fish varied between 4.91-16.35 (g), the head of whole fish varied between 37.31-65.14 (g), fillet skin of whole fish varied between 48.66-97.11(g) and the frame of whole fish was 17.16-39.02 (g). However, standard deviation for the gut, head, fillets and frame were

3.50, 8.57, 13.72 and 6.13 respectively.

Table 2. *Yield characteristics of C. nigrodigitatus*

Parameters measured	*C. nigrodigitatus*
Gut of whole fish	X 5.74 (g) R 4.91- 16.35 (g) SD 3.50
Head of whole fish	X 32.38 (g) R 37.31-65.14 (g) SD 8.57
Fillets skin of whole fish	X 43.92 (g) R 48.66-97.11 (g) SD 13.72
Frame of whole fish	X 17.06 (g) R 17.16-39.02 (g) SD 6.13

Where
X-mean,
R-range,
SD - standard deviation

The Forty-five randomly selected samples of *C. nigrodigitatus* had a Total body weight (g) between 112.36-214.38 with a mean and standard deviation of 159.87±28.48, Total length (cm) varied between 23.50-31.00 with mean and standard deviation of 27.69±2.05, Standard length (cm) ranged from 18.20- 23.20 with mean and standard deviation of 20.89±1.3 and head length (cm) ranged from 9.2- 4.35 with mean and standard deviation 6.19±0.78 as shown in Table 3.

Table 3. *Body characteristics of C. nigrodigitatus*

Parameter measured	Range of measured parameter	Mean ± SD
Total weight (g)	112.36-214.38	159.87±28.48
Total Length (cm)	23.50-31.00	27.69±2.05
Standard length (cm)	18.20- 23.20	20.89±1.3
Head length (cm)	9.2- 4.35	6.19±0.78

4. Discussion

In this study, proximate composition of *C. nigrodigitatus* showed that the fish belongs to a semi-fatty fish species. Stanby, (1982) revealed that fishes with lipid content below 5% are considered lean which is in agreement with the findings of this study. The low lipid content value in the fish tissue might be as a result of the environment and the type of diet the fishes feed upon (Onyia *et al*., 2007). Lipid in fish is a source of energy, carrier of fat soluble vitamins (A, D, E and K). It also acts as protective cushions to the visceral and some other organs of the fish (Huss, 1988). The moisture content of *C. nigrodigitatus* was within the range as previously reported by (Gallagher *et al.*, 1991). However, Osibona *et al*. (2006) previously reported moisture content also within the same range in other fish species. High moisture contents in animals are considered as an advantage because of its contribution in the stabilization of the animal during movements (Eddy *et al*., 2004). Food intake and amount of fat in the body of an animal are said to influence moisture level (Maynard *et al*., 1984). According to FAO (1999), moisture and lipid contents in fish fillets are inversely related to the total composition of the fish with approximately 80% and other components accounting for the remaining 20%. Protein is essential for growth and body defense (Gates and Parker, 1992). Ackman and McLeod, (1989) also reported that proteins are useful in the transportation of gases, building of organ components and in water and metabolic regulation in animals. The protein value observed in this study shows that *C. nigrodigitatus* can be an ideal source of animal protein. The ash content *C. nigrodigitatus* revealed a good range and is in agreement with FAO, (2005) report. Ash content of animals is an indication of the mineral concentration present in that animal (Eddy *et al*., 2004; FAO, 2005). However, the ash content levels gave an indication that the fish samples are good source of minerals such as calcium, potassium, zinc iron and magnesium.

The concentration of mineral contents in the fish can be influenced by a number of factors such as seasonal, biological differences (size, age, sex and sexual maturity), food source and physico chemical parameters of the water where the fishes were caught (Akande and Faturoti, 2005; Oramadike and Kolade, 2015).

The yield of edible flesh (fillet) is a function of the fish anatomical structure (Miyauchi and Steinberg, 1970). The wide food range of *C. nigrodigitatus* is an indication of flexibility in trophic level which gives the fish ecological advantage to feed effectively on different categories of diet based on the availability of the food items (Warren, 1993; Offem *et al*., 2008). In this study, the edible flesh (fillet) of *C. nigrodigitatus* revealed a good range and this will certainly make it a good source of raw material for canning and other value added products. This result is in agreement with (Akande and Faturoti, 2005). The body characteristics measurements lie on the ability to provide data in respect of edible flesh (fillet) for further processing into value added products and also the amount of wastes generated which could be used for fish meal or silage production for animal feeds.

Determination of some proximate profiles such as protein, lipid, ash and other nutrients are often necessary, to ensure that they are within range of dietary requirements and commercial specification (Watchman, 2000; Akande and Faturoti, 2005). *C. nigrodigitatus* can be called a semi high oil fish. Nevertheless, due to the yield of edible flesh, they can be utilized maximally by food processors in fish canning and other fish products such as fish cake, fish crackers and fish burger and also for use in controlling diet while the wastes can be used for fish meal or silage production for animal feeds.

5. Conclusion

The proximate and the technological properties data from this present study have actually indicated the importance of

the wild African catfish C. nigrodigitatus as a relevant industrial material for possible utilization for different product development. These measured parameters are significant as to meet consumers' curiosity in local and export markets.

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