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# Flesh Yield, Waste Yield, Proximate and Mineral Composition of Four Commercial West African Freshwater Food Fishes

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**Abstract:** Four west African freshwater food fishes namely *Clarias gariepinus*, *Heterobranchus bidorsalis*, *Gymnarchus niloticus* and *Malapterurus electricus*, were analysed for their flesh yield, waste yield, proximate and mineral composition, with a view to obtain their utilization potentials. Proximate composition revealed their crude protein, crude lipid and ash as 66.66, 18.7 and 6.39% in *C. gariepinus*; 69.30, 19.67 and 5.96% in *H. bidorsalis*; 66.66, 18.74 and6.39% in *G. niloticus*; 66.66, 18.74 and 6.39% in *M. electricus*, respectively. The total flesh obtainable ranged from 70.57 to 81.62% in *C. gariepinus*; 75.34% to 84.23% in *H.* bidorsalis; 70.57 to 81.62% in *G. niloticus*; and 70.57 to 81.62% in *M. electricus*. Waste yield was 29.43% in *C. gariepinus*, 24.67% in *H. bidorsalis*, 29.43% in *G. niloticus*, and 24.67% in *M. electricus*. The sizes of the four fish species did not significantly affect the proximate composition of their flesh.

**Key words:** African freshwater fishes, composition, nutritive value, waste yield, flesh yields

## INTRODUCTION

In Africa, fish is the cheapest and one of the most readily available sources of animal protein in the diets of rural and urban dwellers. Fish and fish products are highly nutritious, with protein content of between 15 and 20% and are particularly efficient in supplementing the cereal and tuber diets widely consumed in Africa. Fish flesh is the easiest to digest with fillet of most species having protein digestibility of between 90% and 98% . The major commercially important fishes include *Gymnarchus niloticus*, *Malapterurus electricus*, *Clarias gariepinus*, *C. anguillaris*, *Heterobranchus bidorsalis* and *H. longifilis*. The knowledge of their tissue composition is essential for their optional utilization as food fish. Chemical compositions vary widely, not only from fish to fish of the same species but also with an individual fish[1-2] and the extreme variation in their utilizations[3]. Most of the previous research on African freshwater food fish species has been directed to mainly the study of their biology and ecology. Limited attention has been paid to the nutritional values, flesh yield and chemical composition of many important freshwater food fish species[4-7]. The objective of the study was to assess the variability in flesh yield and chemical composition of the flesh of four commercially important African freshwater food fishes namely *C. gariepinus*, *H. bidorsalis*, *G. niloticus* and *M. electricus*.

## MATERIALS AND METHODS

Adult *C. gariepinus*, *H. bidorsalis*, *G. niloticus* and *M. electricus* specimens were purchased live from the artisanal fishermen in River Ogbese, River Niger and River Benue in Nigeria. They were transported live in 50 L capacity open plastic containers to the Department of Fisheries and Wildlife of Federal University of Technology, Akure laboratory. The fishes were killed and each fish was measured for standard length (SL, cm) and weighed on a mettler balance (g). The fish specimens were dissected and the viscera of individual fish specimen was removed and weighed to determine the tissue weight composition of the fish flesh and were thereafter were separated into their anatomical sections. The % flesh and waste yield was calculated as:

$$\%\ \text{Flesh yield} = \frac{\text{Total weight} - \text{Waste yield}}{\text{Total weight}} \times 100$$

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The fleshes were cut into slices of 50 g each and the samples were oven-dried at 105 °C for 3 hours. Dried samples were milled separately; the flesh was minced by using Moulinex blender and later kept inside labeled cellophane inside the desiccator. Moisture was

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determined by over drying at 105 °C for 24 hours and fillets obtained were used for analyses. Crude protein was determined by the micro-kjeldahl methods[8] after distillation process. Crude lipid content was determined after extraction with 40-60 °C petroleum either for 8 hours. Ash determination was pre-ashed and kept in the muffler furnace at 500 °C for 3 h. The mineral contents of the samples were determined by wet ashing/oxidation method. 2g of each flesh sample was ashed before transferring them into a Muffler furnace (Gallenkamp SG94/11/183) at 550 °C for 3 hours. These samples were allowed to cool. 50 mls of distilled water was used to dilute the ashed residue and filtered with filter paper into sample bottles. Mineral elements were analysed by atomic absorption spectrophotometer, while Na and K contents were determined by flame photometry (Model AAS200A Buck Scientific). P content was determined colorimetrically using the phospho–vanadomolybdate method.

## RESULTS AND DISCUSSION

Mean weight and flesh yield of fresh samples of the fish species are presented in Table 1 and 2 which showed that there was no relationship between the body weight and the total waste yield (Table 1). Proximate and mineral analyses of the fish species are presented in Table 3 and 4. Statistical analysis revealed no significant differences ($p>0.05$) in Fe, K, Na, Mg, P and Zn contents of fresh samples of both species. The concentration of manganese and copper were below the level of detection in all the samples. The percentage anatomical weight composition of the fish species are presented in Table 1.

Protein content was high in the three specimens and there was a significant difference ($p<0.05$) in the lipid values of all samples (Table 3). Fat content in animals depends upon their diet and method of processing variation in fat is largely due to proportion of lean and fat tissues with older animals having greater proportion than young ones (Degani,1988). Fatty fish are known to deteriorate due to oxidation of fat (lipid) content of the flesh resulting in rancidity and off flavour[9]. Species with higher lipid content requires careful post harvest handling to avoid spoilage whereas fishes like *M. electricus* and *G. niloticus* with low lipid content are less prone to oxidative rancidity and thus, it is possible to use them for low lipid concentrates. Ash content showed a significant difference ($p<0.05$) for all the samples. For mineral, fish meat is regarded as a valuable source of Ca and P while marine fish have high content of I. The Na content of fish meat is relatively low and this makes it suitable for low sodium diets[2-9].

In terms of flesh yield, differences in morphology might be responsible for the variation in the flesh yield of individual species. The result of the present study

Table 1: Weight (g) of anatomical portions of fish samples

| | Total weight | Flesh yield weight | Head weight | Viscera weight | Total waste |
|---|---|---|---|---|---|
| *Clarias gariepinus* | 490.06 ±48.60 | 346.02 ±29.90 | 113.06±18.30 | 31.04 ±12.06 | 144.04±31.58 |
| *Heterobranchus bidorsalis* | 396.10 ±38.40 | 292.80 ±20.88 | 88.40±10.10 | 14.81 ±3.65 | 103.30±28.75 |
| *Gymnarchus niloticus* | 628.67 ±35.84 | 450.78 ± 8.75 | 119.04± 20.38 | 58.85 ±21.36 | 177.88± 37.56 |
| *Malapterurus electricus* | 212.37 ± 51.94 | 155.86 ±37.71 | 44.81± 16.29 | 11.70 ±4.97 | 56.51± 18.89 |

Table 2: Percentage (%) composition of anatomical portions to total weight of fish samples

| | *Clarias gariepinus* | *Heterobranchus bidorsalis* | *Gymnarchus niloticus* | *Malapterurus electricus* |
|---|---|---|---|---|
| Flesh yield | 70.57±6.07 | 75.33±4.84 | 71.86±4.33 | 73.44 ±4.42 |
| Head | 23.03±4.21 | 19.60±2.49 | 18.86±2.25 | 21.02 ±4.30 |
| Viscera | 6.40±1.86 | 5.07±1.25 | 9.28±2.91 | 5.54 ±1.47 |
| Total waste | 29.43±4.20 | 24.67±4.64 | 28.14±4.33 | 26.56 ±4.42 |

Values are means of three replicates ± SD; Means in a row with the similar superscripts are not significantly different (p > 0.05) from one another.

Table 3: Proximate composition of fresh fish samples

| | Dry matter | Crude protein | Crude lipid | Total ash | NFE |
|---|---|---|---|---|---|
| *Clarias gariepinus* | 26.49±0.04 | 66.66±0.47 | 18.74±0.26 | 6.39±0.69 | 1.93±0.62 |
| *Heterobranchus bidorsalis* | 27.30±0.09 | 69.30±0.27 | 19.67±0.37 | 5.96±0.42 | 1.84±0.33 |
| *Gymnarchus niloticus* | 20.92±0.23 | 85.18±1.92 | 7.49±0.33 | 6.39±1.32 | 0.94±0.55 |
| *Malapterurus electricus* | 26.83±1.74 | 81.30±1.06 | 9.17±0.41 | 6.74 ±0.95 | 2.79±0.29 |

Values are means of three replicates ± SD; Means in a column with the similar superscripts are not significantly different (p > 0.05) from one another

Table 4: Mineral composition of fresh fish samples

| | *Clarias gariepinus* | *Heterobranchus bidorsalis* | *Gymnarchus niloticus* | *Malapterurus electricus* |
|---|---|---|---|---|
| Fe | 15.28±1.64 | 19.24±1.28 | 18.47± 1.08 | 12.84 ±1.16 |
| Mg | 118.57±16.80 | 108.10±18.38 | 97.77± 6.87 | 111.01± 17.62 |
| K | 79.08±8.78 | 82.32±13.96 | 80.77 ±9.08 | 85.52 ±16.93 |
| Zn | 26.65±0.82 | 28.92±3.26 | 23.79± 0.46 | 28.30 ±4.56 |
| Na | 72.02±5.23 | 70.89±7.08 | 62.98 ±5.73 | 71.64 ±8.86 |
| Ca | 26.79±6.50 | 27.96±3.44 | 28.94 ±6.33 | 30.94 ±1.72 |
| P | 883.02±38.40 | 912.04±62.96 | 913.14 ±52.64 | 1199.90 ±312.87 |

Values are means of three replicates ± SD; Means in a row with the similar superscripts are not significantly different (p > 0.05) from one another revealed a direct relationship between fish size flesh and waste yield (Table 1 and 2). Observations from the fish species investigated in the present study revealed the variability in absolute weight and percentage weight composition among species and within species of the same family. This may be due to differences in morphology of individual species. Although, it is difficult to compare the flesh yield with respect to individual fish species, fresh *M. electricus* showed the highest flesh yield of 73.44%. Apart from the nutritional significance for the above species, their high flesh yield could be utilized in the setting up of cottage industries for the production of fish fillets, fish mince, fish sausages, pies, fish nuggets and condiments. These utilization channels of these fish species may further enhance the distribution of the commercially exploitable species of freshwater fishes.

**Waste Yield:** The results of the present study also revealed a direct relationship between size of flesh and waste yield as shown in Table 1 and 2. The weight or length of the fish species under study was positively correlated which means that the habitat was suitable for the fish growth. Total waste yield was between 26.56 and 30.48% out of which waste attributable to the head region accounted for 71.06% of the total waste. Size was also positively correlated to waste yield[10]. The results showed that significant amount of wastes were generated (Table 1 and 2). Apart from the utilization of fish wastes in the production of fish meals[11-12], the use of other part of fish such as the bones and the scales as well as fish and shrimp wastes in the production of other industrial by-products[13-14].

Flesh yield and chemical composition of *C. gariepinus* and *H. bidorsalis* revealed the variability of the absolute weight and percentage weight composition among species of the family. It may be very difficult to compare the flesh between *C. gariepinus* and *H. bidorsalis* since the knowledge of their diet in their environment is not available, however, *C. gariepinus* showed low flesh yield than *H. bidorsalis.* The variability in the body composition of fish has been attributed to several factors such as environment, age, size, diet and species[1,3-15].

The relatively higher protein content of *H. bidorsalis* than *C. gariepinus*, may be as a result of its feeding habit, although *H. bidorsalis* and *C. gariepinus* are omnivorous, *Heterobranchus* has a high propensity for being piscivorous Generally, clariid catfishes have higher percentage of protein than other fishes. Although the amount of protein in the fish flesh is between 66.66 and 69.30%, values lower than 65 or high as 76% are occasionally accounted in some species [9,16].

The result of the proximate composition of dry matter showed that *H. bidorsalis* had higher percentage of fat than *C. gariepinus* and this may be attributed to the possession of adipose fin which serve as fat storage in *H. bidorsalis*. The fat content of fish varied very much more widely than the moisture and protein contents. The highest differences between highest and lowest fat content was 2.9%, the positively correlated relationship between the flesh yield and fat content of the flesh agreed with those found in some studies on rainbow trout and African catfish[1,3].

In *C. gariepinus*, the major variation occurs in the ash content (Table 2). Ayinla[17]obtained 3.0-3.2% (wet body tissue) while in this study, the ash value ranged between 5.66 and 9.20%. This could be due to variation in the environment and ingested metabolic rate[18]. This observation was supported by Reinitz[1]that different species of fish and even strain within the same species vary significantly in the nutritional content of the carcass. The relationship between body weight and percentage protein in the tissue is significant ($p<0.05$) as seen in Table 3. These results agree with those reported for rainbow trout[1]. The body composition of fish is influenced by previous nutritional history and the specimens in this study may have similar nutritional history, therefore, the only influencing factors might be age and size or even sex. The findings of Degani[3]agrees with this study that *C. gariepinus* and *H. bidorsalis* have a very high protein level in the muscle and is relatively high compared to other carnivorous fishes.

## REFERENCES


1. Reinitz, J., 1983. Variations of body composition and growth among strains of rainbow trout. Transactions of the Am. Fisheries Soc., 108: 204 -207.
2. Hoffman, L.C. N.H. Casey and J.F. Prinsloo, 1992. Fatty acid, amino acid and mineral contents of African catfish (*Clarias gariepinus*) fillets. South African J .Food. Sci., 4: 36-40.
3. Degani, G., 1988. Body composition of African catfish (*Clarias gariepinus*) at different ages. Israeli J. Aquaculture-Bamidgeh 40: 118-121
4. Emokpae, A.O., 1983. Chemical composition of Nigerian marine species of fish and shrimps. Annual Report of Nigerian Institute for Oceanography and Marine Research No. 33: 2-3.
5. Emokpae, A.O. and A.I. Oyeneke, 1981. Chemical composition of commercially important fish and shrimps of Nigeria. Nigerian Institute for Oceanography and Marine Research Annual Report, pp: 39-40.

6. Hoffman, L.C., J.F. Prinsloo, L.M. De Wet, and H.J. Schoonbee, 1995. The chemical composition of African sharptooth catfish, *Clarias gariepinus* (Burchell), found under natural conditions in municipal final effluent oxidation ponds. South African J. Clin. Nutr., 8: 17-22.
7. Balogun, A.M. and E.A. Fasakin, 1996. Flesh yield and aspects of chemical composition of the flesh of some commercially important fresh water species in Nigeria. J. Agri. Technol., 1: 33-40.
8. AOAC, 1990. Official Methods of Analysis, 12th Edn., N. Horwitz, N. (Ed.), Association of Official Analytical Chemists, Washington, D.C. USA, pp: 1094.
9. El-Faer, M.Z., T.N. Rawdah, M.A. Khudre and M. Arab, 1992. Mineral and proximate composition of some commercially important fish of the Arabian Gulf. Food Chemistry, 45: 95-98.
10. Li, M. And R.T. Lovell, 1992. growth, feed efficiency and body composition of second and third year Channel catfish fed various concentrations of dietary protein to satiety in production ponds. Aquaculture, 103: 153-163.
11. Balogun, A.M. and S.O. Talabi, 1985. Proximate Analysis of the flesh and anatomical weight composition of Skipjack Tuna (Katsuwonus pelamis). Food Chemistry, 17: 117 – 123.
12. Hoffman, L.C., N.H. Casey and J.F. Prinsloo, 1993. Carcass yield and fillet chemical composition of wild and farmed African sharptooth catfish, *Clarias garipeinus*. In: Production, Environment and Quality. Bordeaux Aquacutlure '92 (Barnabe G. and Kestemont P., editors). European Aquaculture Society Special Publication, 18: 421-432.
13. Kulikov, P.I., 1978. Production of meal, oil and protein, vitamin preparation in fishing industry. Amerind Publishing Co. Pvt. Ltd., New Delhi
14. Balogun, A.M. and Y. Akegbejo-Samsons, 1992. Waste yield, proximate and mineral composition of shrimp resources of Nigeria coaster waters. Bioresource Technology 40: 157-161.
15. Degani, G., 1989. The effect of different protein level and temperatures on feed utilization, growth and body composition of *Clarias gariepinus* (Burchell 1822). Aquaculture 76: 293-301.
16. Murray J. And Burt J.R., 1977. The composition of fish. Printed in Scotland by Her Majesty Stationery Office (HMSO) Press, Edinburgh.
17. Ayinla O.A., 1993. Chemical composition of *Clarias gariepinus* collected from the wild. Nigerian Institute for Oceanography and Marine Research (NIOMR) pp: 86: 3-11
18. Stansby M.E., 1962 Proximate composition of fish. In, Fish in Nutrition (E. Heen and R. Krueuzer, editors) . Fishing News (Books) Ltd., London, pp:55.