



PROXIMATE AND MINERAL CONTENTS OF FLESH AND BODY PARTS OF *Oreochromis niloticus* AND *Synodontis clarias* IN MUBI, NIGERIA

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ABSTRACT

Study on the proximate and mineral composition of flesh and other body parts of *Synodontis clarias* and *Oreochromis niloticus* was carried out in September, 2012 using standard procedures. The protein content ranged from $(31.10 \pm 0.92 - 21.00 \pm 0.81\%)$ in the *S. clarias* while in *O. niloticus* ranged from $(29.80 \pm 0.86 - 20.40 \pm 0.73\%)$ both in the head sector and flesh. Concentrations of fats were $(10.30 \pm 0.81 - 2.30 \pm 0.89\%)$ in *S. clarias* while in *O. niloticus* were $(8.20 \pm 0.73 - 2.00 \pm 0.85\%)$ in the flesh and bones. Fibre values ranged from $(2.30 \pm 0.92 - 0.20 \pm 0.81\%)$ in the *S. clarias* and *O. niloticus* observed to be $(1.82 \pm 0.86 - 0.20 \pm 0.73\%)$ in head and flesh. Carbohydrate recorded in *S. clarias* ranged from $(42.82 \pm 0.81 - 14.03 \pm 0.91)$ in the flesh and bones while in *O. niloticus* ranged from $(53.20 \pm 0.77 - 36.40 \pm 0.85\%)$ in fins and bones. Ash observed was $(46.45 \pm 0.91 - 15.48 \pm 0.81\%)$ in the fins and flesh of *S. clarias* while in *O. niloticus* shows $(25.80 \pm 0.85 - 10.00 \pm 0.73\%)$ in bones and flesh. Moisture contents recorded in *S. clarias* was $(10.20 \pm 0.81 - 6.10 \pm 0.92)$ while in *O. niloticus* shows $(11.20 \pm 0.73 - 5.70 \pm 0.86\%)$ in the flesh and head. Dry matter values observed in *S. clarias* were $(93.90 \pm 0.92 - 89.80 \pm 0.81)$ while in *O. niloticus* were $(94.30 \pm 0.86 - 88.80 \pm 0.73\%)$ in heads and flesh. The highest calcium (8.18 ± 0.45) and (8.03 ± 0.49) was recorded in bones and lowest values (0.18 ± 0.71) and (1.00 ± 0.69) in flesh and fins of *O. niloticus* and *S. clarias* respectively. The highest magnesium (9.83 ± 0.54) and (9.82 ± 0.71) was recorded in flesh and fins while the lowest (5.43 ± 0.45) and (6.68 ± 0.71) observed in heads of the fish species. Iron observed high (3.45 ± 0.45) and (2.38 ± 0.45) in bones and head while the lowest (0.34 ± 0.72) and (0.68 ± 0.49) in fins and flesh of the *O. niloticus* and *S. clarias* respectively. The study showed that the best body parts in terms of proximate and mineral composition of the two fish species were the head, flesh and bones, although there was no significant difference.

Key words: *Synodontis* species, *Oreochromis niloticus*, proximate, mineral contents.

INTRODUCTION

Fish is very important food stuff, especially in developing countries due to its high protein content and nutritional value of unsaturated fatty matter. It may be the solely accessible and / or affordable source of animal protein for poor households in urban semi-urban areas (Bene and Heck, 2005). Fish is also widely acceptable because of its high palatability, low cholesterol and tender flesh (Eyo, 2001). However the feeding habit, sex, species, seasonal variation and other factors greatly affect the nutrient composition of an individual fish species (Effiong and Fakunle, 2011).

Despite its nutritive value, fish is highly susceptible to damage once caught and so have become source of pollution in the environment (Vignesh and Srinivasan, 2012). However, processing methods such as salting, boiling, frying, sun drying, roasting and smoking have been used to preserve and increase its availability to consumers (Olayemi *et al.*, 2011). Most processing methods often times involve removal of the head, viscera and other parts of the fish which may have either negative or positive effect on the total nutritive values of the fish (Saliu, 2008). Previous works reported the effect of processing methods on different fish types (Oluwaniyi and Dosum, 2008; Osibona, 2011).

Determination of some proximate profiles such as protein content, lipid, ash and other nutrients is often necessary to ensure that they are within the range of dietary requirement and commercial specifications (Watchman, 2000). The study of micro-nutrients present in living organisms is of biological importance because many of such micro-nutrients take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974). Fishes contain small amount of these micro-nutrients some of which are essential nutrients, being components of many enzymes system and metabolic mechanisms that contribute to the growth of the fish. The most important micro-nutrients in form of mineral salts include Ca, K, P, Fe, Cl, while many others are required in trace amount. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning as it reduces productivity and causes diseases such as inability of blood to clot, osteoporosis, anemia etc (Shul'man, 1974, Mills, 1980). This research is therefore conducted to determine the proximate and mineral contents of some commercially important freshwater fishes from Digil Dam, Mubi, Nigeria.

MATERIALS AND METHODS

The research was conducted in the laboratory of Biological Sciences Department, Adamawa State University, Mubi. Mubi town is located about 214km northeast of the State capital (Yola) and about 290km north-west of Maiduguri, the capital of Borno state (Adamawa State university student 'Handbook, 2003). It is situated between latitude 11° and 8° north of the equator to south and longitude $11^{\circ}42'$ west and $13^{\circ}34'$ east (fig. 1). The vegetation of Mubi was typical of savanna grassland with seasonal spread between May to October annually (Adebayo, 2004).

Digil Dam as a research area located in Digil village which is predominately dominated by Fulani people. The Dam was established since 1970's by ministry of agriculture and natural resources for the purpose of irrigation. Later in 1986 it was then transferred to the Department of fisheries in the same ministry. Adamawa state University Mubi took over from the ministry after establishment of fisheries and aquaculture in 2005. The dam has an area of 400×300×4m deep. It also contains different species of fishes and other aquatic organisms (Adebayo, 2004).

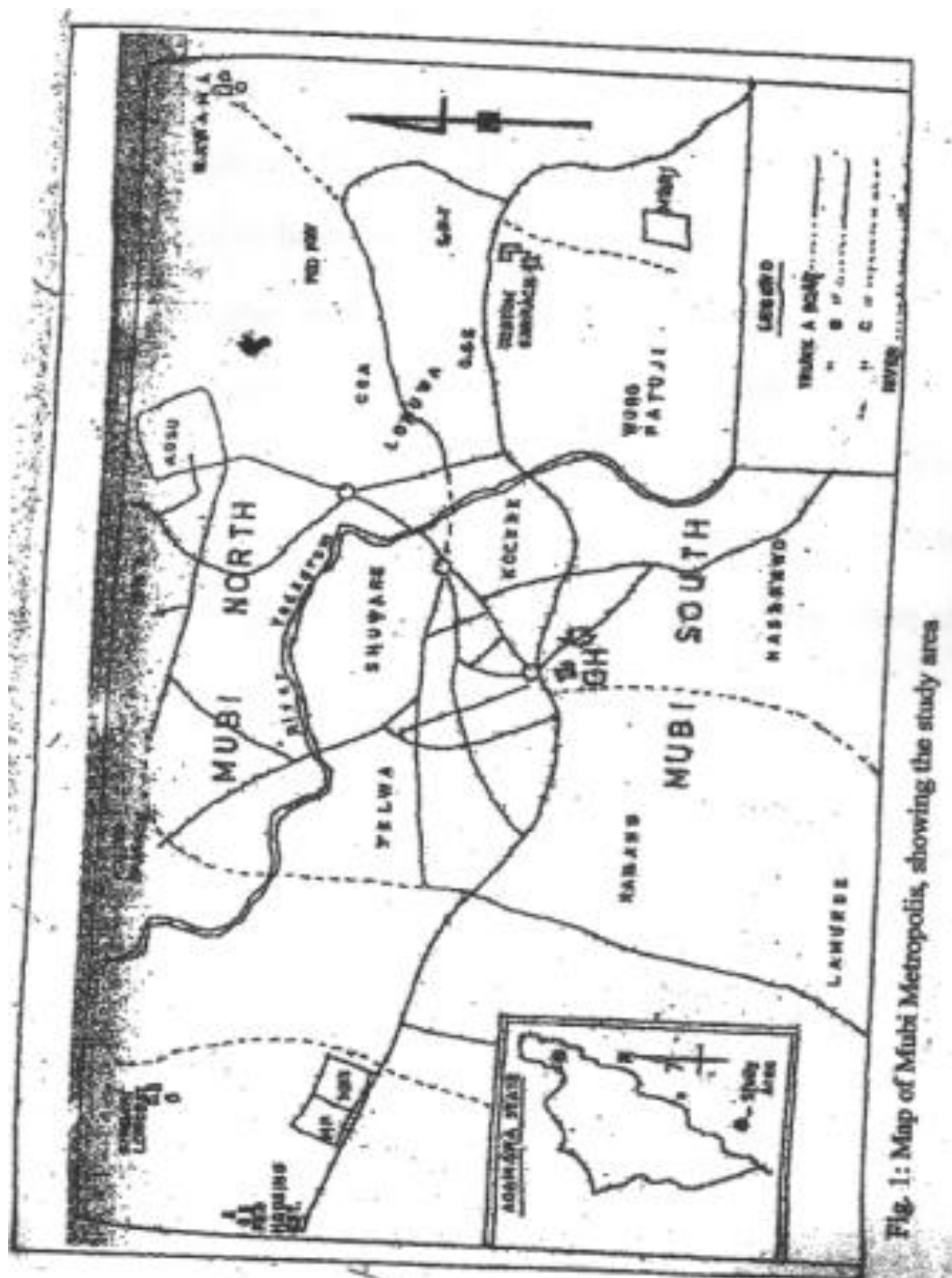


Fig. 1: Map of Mubi Metropolis, showing the study area

FISH SAMPLING/ANALYSIS

Freshly caught samples of two commercially important fish species namely *Oreochromis niloticus* and *Synodontis clarias* was purchased from fish mongers along General Hospital Mubi, a fish landing sites after fish mongers left Digil Dam. They were transported in Eleganza cold boxes filled with ice blocks to the laboratory for further analysis. Each sample was blotted dry with filter paper. Morphometric parameters including fresh weight, lengths and depth was taken, each fish was separated into different anatomical parts and appropriately labeled (which includes; flesh, fins, bones, heads). Weight of the component parts in fresh and dry samples was taken and percentage contribution to the whole body was calculated;

$$\text{e.g. } \frac{X}{T} \times \frac{100}{1}$$

Where; X = Weight of part
T = Total body weight

PROXIMATE ANALYSIS

Fat was determined using soxhlet method as recommended by Association of official analytical (AOAC), (2001) the percentage fat will be obtained.

The formula:

$$\% \text{ fat} = W_o - W_i/W_o$$

Where W_o = Initial weight of fat

W_i final weight of fat

PROTEIN DETERMINATION

Protein was determined using Kjeidahi method which involves digestion, distillation and titration as recommended by AOAC (2001). The percentage protein was obtained using the formula:

$$\% \text{ protein} = N \times 6.26$$

Where N = Nitrogen free extract.

MOISTURE DETERMINATION

Moisture was determined using method as recommended by AOAC (2001). Percentage of moisture was calculated using the formula:

$$\% \text{ water} = W_o - W_i/W_o \times 100$$

Where; W_o = initial weight

W_i = final weight

ASH ANALYSIS

Ash weight was analyzed using over drying method as recommended by AOAC (2001). The percentage of Ash was obtained using the formula:

$$\% \text{ Ash} = \text{wt of dish + ash} - \text{wt of dish} \times 100$$

W_t = weight

DETERMINATION OF CRUDE FIBRE

Fibre was determined using trichloroacetic acid method as recommended by AOAC (2001). The percentage of crude fibre was obtained using the formula.

$$\text{Percentage fibre} = W_o - W_i \times 100/W_o/W_o$$

Where W_o = Initial weight

W_i – final weight

CARBOHYDRATE DETERMINATION

Carbohydrate was determined using differential method as recommended by AOAC (2001). The percentage carbohydrate was obtained using the formula.

$$\% \text{ CHO} = 100 - \text{Ash}\% + \text{fibre}\% + \text{protein}\% + \text{fat}\%.$$

MINERAL DETERMINATION

The minerals in the ash samples were brought into solution by wet digestion as described by Harris (1979). Calcium and magnesium was determined by the Allen's method using Collins and Polken-Horne flame photometer (model GT 240, Perkin Elmer G. Ltd. Michigan [7]). The other mineral was determined by Perkin-Elmer Atomic absorption Spectrophotometer (model 2903-Perkin-Elmer co. Ltd. USA: AOAC, (1980)

DATA ANALYSIS

Data obtained in this study was subjected to analysis of variance (ANOVA) and least significant difference (LSD) as described by Steel and Torie (1987).

RESULTS

The results of the proximate composition of flesh, head, bones and fins of *S. clarias* and *O. niloticus* are presented in table 1. The highest protein ($31.10 \pm 0.92\%$) was observed in the head of *S. clarias*, and ($29.80 \pm 0.80\%$) was reported in the head of *O. niloticus* while the lowest protein ($20.40 \pm 0.73\%$) was discovered in the flesh of *O. niloticus*, and ($21.00 \pm 0.81\%$) was reported in the flesh of *S. clarias*. There was no significant different ($P > 0.05$) observed. Highest fats ($10.30 \pm 0.81\%$) was recorded in the flesh of *S. clarias* while ($8.20 \pm 0.86\%$) recorded in the flesh of *O. niloticus* and the lowest fats ($2.00 \pm 0.85\%$) was reported in the bones of *O. niloticus*, and ($2.30 \pm 0.89\%$) was reported in the bones of *S. clarias*. No significant difference was observed ($P > 0.05$).

In fibre the highest ($2.30 \pm 0.92\%$) was observed in head of *S. clarias*, followed by ($1.82 \pm 0.86\%$) was reported in *O. niloticus* head. The lowest fibre ($0.20 \pm 0.81\%$) was reported in the flesh of both *S. clarias* and *O. niloticus*. The highest ash ($46.45 \pm 0.73\%$) was recorded in fins of *S. clarias* and ($25.80 \pm 0.85\%$) was reported in the bones of *O. niloticus* while the lowest ($15.48 \pm 0.81\%$) was discovered in the flesh of *S. clarias*, ($10.00 \pm 0.73\%$) was reported in the flesh of *O. niloticus*.

The highest moisture ($11.20 \pm 0.73\%$) was recorded in the flesh of *O. niloticus* followed by ($10.20 \pm 0.81\%$) was reported in the flesh of *S. clarias* while the lowest ($5.70 \pm 0.86\%$) and ($6.70 \pm 0.92\%$) was observed in the head of *O. niloticus* and *S. clarias* respectively. The highest dry matter ($94.30 \pm 0.86\%$) was recorded in the head of *O. niloticus* followed by ($93.90 \pm 0.92\%$) was also reported in the head of *S. clarias* while the lowest ($88.80 \pm 0.73\%$) and ($89.80 \pm 0.81\%$) were reported in the flesh of *O. niloticus* and *S. clarias* respectively.

The highest carbohydrate ($53.2 \pm 0.77\%$) and ($42.82 \pm 0.81\%$) was reported in the fins and flesh of *O. niloticus* and *S. clarias* respectively while the lowest ($14.03 \pm 0.91\%$) was observed in fins of *S. clarias* and ($36.40 \pm 0.85\%$) was also reported in the bones of *O. niloticus*.

Table 1: Percentage proximate composition of the flesh and body parts of *Synodontis clarias* and *Oreochromis niloticus*. Data= mean \pm SD, n=3

Body components	Protein%	Fat%	Fibre%	Ash%	Moisture%	Dry mater%	Carbohydrate%	Not significantly different
Flesh 1	21.00 \pm 0.81	10.30 \pm 0.81	0.20 \pm 0.81	15.48 \pm 0.81	10.20 \pm 0.81	89.80 \pm 0.81	42.82 \pm 0.81	Similar
2	20.40 \pm 0.73	8.20 \pm 0.73	0.20 \pm 0.73	10.00 \pm 0.73	11.20 \pm 0.73	88.80 \pm 0.73	50.00 \pm 0.73	Similar
Bone 1	29.40 \pm 0.89	2.3 \pm 0.89	1.40 \pm 0.89	30.90 \pm 0.89	7.40 \pm 0.89	92.60 \pm 0.89	28.60 \pm 0.89	Similar
2	27.00 \pm 0.85	2.00 \pm 0.85	1.20 \pm 0.85	25.80 \pm 0.85	7.60 \pm 0.85	92.40 \pm 0.92	36.40 \pm 0.85	Similar
Head 1	31.10 \pm 0.92	3.40 \pm 0.92	2.30 \pm 0.92	42.20 \pm 0.92	6.10 \pm 0.92	93.90 \pm 0.92	14.90 \pm 0.92	Similar
2	29.80 \pm 0.86	3.10 \pm 0.86	1.82 \pm 0.86	21.80 \pm 0.86	5.70 \pm 0.86	94.30 \pm 0.86	37.78 \pm 0.86	Similar
Fins 1	28.60 \pm 0.91	3.00 \pm 0.91	0.72 \pm 0.91	46.45 \pm 0.91	7.20 \pm 0.91	92.80 \pm 0.91	14.03 \pm 0.91	Similar
2	26.70 \pm 0.77	2.65 \pm 0.77	0.45 \pm 0.77	11.20 \pm 0.77	5.80 \pm 0.77	94.20 \pm 0.77	53.20 \pm 0.77	Similar

1. *Synodontis clarias*. 2. *Oreochromis niloticus*.

Note P>0.05= not significant.

The results for mineral composition of the flesh and other body parts of *S. clarias* and *O. niloticus* are presented on table 2. There was no significant difference observed in all the minerals under study (P>0.05). The highest calcium (8.18 \pm 0.45) and (8.03 \pm 0.49) was reported in the bones of *O. niloticus* and *S. clarias* respectively while the lowest calcium (0.18 \pm 0.71) was observed in the flesh of *O. niloticus*, and (1.00 \pm 0.69) was reported in the fins of *S. clarias*. The highest magnesium (9.83 \pm 0.54) and (9.82 \pm 0.17) was reported in the flesh and fins of *S. clarias* and *O. niloticus* respectively while the lowest (5.43 \pm 0.45) and (6.68 \pm 0.71) was reported in the heads of both *O. niloticus* and *S. clarias*.

The highest Iron (3.45 \pm 0.45) and (2.38 \pm 0.45) was reported in the bones of *O. niloticus* and head of *S. clarias* while the lowest Iron (0.34 \pm 0.72) and (0.68 \pm 0.49) was reported in the fins, flesh of *O. niloticus* and *S. clarias* respectively.

Table 2: Percentage proximate composition of mineral contents (mg⁻¹) flesh and body parts of *Synodontis clarias* and *Oreochromis niloticus*. Data= mean \pm SD, n=3

Body components	Ca.mg ⁻¹	Mg.mg ⁻¹	Fe.mg ⁻¹	Not significantly different
Flesh 1	1.53 \pm 0.54	9.83 \pm 0.54	0.68 \pm 0.54	Similar
2	0.18 \pm 0.71	9.10 \pm 0.71	1.36 \pm 0.71	Similar
Bones 1	8.03 \pm 0.49	6.97 \pm 0.49	0.68 \pm 0.49	Similar
2	8.18 \pm 0.45	5.43 \pm 0.45	3.45 \pm 0.45	Similar
Head 1	4.57 \pm 0.71	6.68 \pm 0.71	2.38 \pm 0.71	Similar
2	3.54 \pm 0.55	6.15 \pm 0.55	1.02 \pm 0.55	Similar
Fins 1	1.00 \pm 0.69	8.15 \pm 0.69	1.02 \pm 0.69	Similar
2	2.00 \pm 0.72	9.82 \pm 0.71	0.34 \pm 0.72	Similar

1. *Synodontis clarias*. 2. *Oreochromis niloticus*.

Note P>0.05=not significant.

DISCUSSION

Every consumer wants to obtain a good quality nutrient especially protein from fish. Fish like any other animals show preferential bio-accumulation of nutrients in the various organs of the body. From this study, it has been observed that protein is more concentrated in the head than other parts of the body under investigation, followed by bones then fins and lastly flesh. The result of this study is at variance with that of Abolude and abdullahi (2005) where protein was more concentrated in the flesh of *Bargus filamentous* and *hydrocynus brevis*. The values of protein obtained from two fish species are less than (21.62-60.57%) reported by Effiong and Fakule (2011). These values indicate they are a rich source of protein to consumers. This finding similar to that reported by Eyo (2001). The values were higher than those reported in mackerel and oyster (Eyo, 2001). The protein content in fish range with species due to certain factors such as the season of the year, effect of spawning and migration, food availability etc (Abdullahi, 2001).

The ash content was higher in the fish species used for this experiment than those reported by Effiong and Mohammed (2008) with highest values (5.88 and 5.50) respectively in *Late niloticus* and *Bagrus Bayad*. This could be attributed to the fish species, season, sex, or food availability (Effiong and Mohammed, 2008)

The high moisture contents recorded for the two fish species are comparable to those reported by other fresh water fish species such as *Mormyrus rume*, *Oreochromis niloticus* and *Clarias lazera* (Otitologbon *et al.* 1997). The dry matter observed in this report is higher than the one reported in *C. anguillar* (91.03 \pm 1.5) and *H. niloticus* (90.30 \pm 1.3) by Oyebanji *et al.*, (2008). The carbohydrate values of the two fish species were higher than the US/RDA (1994) recommended values of 12-16g/day and 12g/100g reference value of Ackman (1992). This shows that the species could be dependable sources of high dietary carbohydrate.

The fat concentration in this report is higher than the value (5.21%) of *Gymnarchus niloticus* (Adeyeye, and Adamu, 2005). This shows that the fish species might be very good sources of fish oil. This is required for food therapy in humans (Oyebanmiji *et al.*, 2008). The significant reduction of fibre observed in this study posed no threat because fish is usually consumed as adjuncts or additives to other food. This observation concurred with the report of Adeyemi *et al.* (2013) who demonstrated that higher fibre is poorly digested by animals and interferes with other nutrients. Recently, the interest in dietary fiber has been stimulated due to its ability to prevent chronic diseases such as cardiovascular disease, cancer and diabetes mellitus (Adeyemi *et al.* 2013).

The result of the mineral analysis of two fish species showed abundance of calcium in the bone of the fish species. The significant concentration of calcium observed in the bone of two fish species is expected because of it deposit in the

bone. These finding suggest that bones could be a veritable source of calcium to reduce the risk of osteoporosis and osteomalaria in adults and infants respectively, if transformed into high valued products for human consumption (Adeyemi *et al* 2013).

The highest magnesium was recorded in the flesh and fins of *S.clarias* and *O.niloticus* respectively. The highest levels of magnesium in the fish species may be attributed to the rate in which they are available in the water body and the ability of the fish to absorb these inorganic elements from their diet and the environment where they live (Ibiyo *et.al* 2006). Eyo (2001) reported that the mineral content of fish makes fish unavoidable in the diet as it is a source of different minerals that contribute greatly to good health.

Iron was recorded in bone and head of the two fish species. Iron recorded showed variations in their concentrations among the two fish species used for the study. The variations attributed to the chemical forms of the element and concentration in the environment (Effiong and Fakunle, 2011).

In conclusion, this study have shown these fish species from Digil Dam, Mubi, Nigeria as good source of nutrients to the consumers and within the limits required by the body for healthy growth and development. The study has also provided an insight into the mineral content of these species in line with food safety when consumed.

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