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Flesh and Waste Yields, Proximate and Mineral Compositions of *Ctenopoma kingsleyae* (Gunther 1896) (Pisces, Anabantidae)

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Abstract

Ctenopoma kingsleyae specimens obtained from River Oluwa in Agbabu (Ondo State Nigeria) were analysed for flesh yield, proximate composition, mineral content and amino acid composition. The relative proportion of flesh, head and viscera to total biomass were determined in male and female specimens. Flesh yield was 35.91±3.49% and 41.96±3.41% of total biomass for male and female; waste yield (head, viscera, scales) was 32.07±1.55% and 35.39±1.26% for male and female fish, respectively. There were positive correlations between total body weight fish and flesh yield (r^2 = 0.980 and r^2 =0.991 for male and female *C. kingsleyae*) and between total body weight and total waste (r^2 = 0.902 and 0.938 for male and female *C. kingsleyae*), respectively. Female *C. kingsleyae* had higher protein and mineral values than male samples. Male *C. kingsleyae* had higher moisture content than female *C. kingsleyae*. Male fish had higher mineral content values than female *C. kingsleyae* in Na, Mg, Fe, and Cr while female fish had higher K, Ca, Zn, Cu, Mn and P than male fish. There were significant differences (P≤0.05) in mineral composition of male and female *C.kingsleyae*. High percentage of protein, mineral content, essential amino acid profile and the high flesh yield potential as well as low lipid content confirmed that male and female *C. kingsleyae* are nutritious and represent a suitable source of animal protein in human diets.

Keywords: Flesh yield, waste yield, nutrient composition, *Ctenopoma kingsleyae*.

Introduction

Anabantoid fishes are found throughout tropical Asia and Africa. The genus *Ctenopoma* Peters, 1844 (Anabantidae) is endemic to Africa, and is composed of at least 21 species (Gosse, 1986) that can be divided between three quite distinct (and apparently monophyletic) groups generally referred to as “deep-bodied,” ”shallow-bodied,” and “dwarfed” (Elsen, 1976; Norris & Teugels, 1990; Norris & Douglas, 1991). Two species belonging to the genus *Ctenopoma* occur in commercial fisheries in Nigerian freshwaters namely *C. kingsleyae* and *C. petherici*. Both species live in weedy rivers, stream and floodplains and are different from each other by the fineness of the opercula serrations (serrations are finer in *C. petherici*). *Ctenopoma kingslayae* (Gunther, 1896) belongs to the deep-bodied clade of the genus.

The high demand for fish and fish products calls for studies into their nutrient composition. The proximate, amino acid and mineral composition of some commercial fish species were reported by Abdullahi (1999), Abdullahi (2001), Abdullahi & Abdulahi (2002), Adeyeye and Adamu (2005), Abolude & Abdullahi (2005) and Fagbenro *et al.* (2005); to date no such information is available for *Ctenopoma* spp. The objectives of this study were to determine and compare the flesh yield of male and female *C. kingsleyae*, as well as to determine the proximate, amino acid and mineral composition of their body tissues.

Materials and Methods

Twenty specimens of *C. kingsleyae* (SL, 15.6-17.2 cm; mean weight, 67.98g and 77.36g, respectively) were obtained live from catches of artisanal fishermen in River Oluwa at Agbabu (Ondo State, Nigeria), the features of which were described by Omoniyi *et al*., (2005). Standard length (SL) and total length (TL) of individual fish were measured using measuring board calibrated from 1-60cm. The specimens were killed, dissected, the viscera removed and weighed on a Mettler balance, after which they were sorted into male or female according to Olurin and Odeyemi (2010) and were individually weighed to determine the tissue weight composition of fish flesh; and were separated into anatomical fractions namely: flesh, head, fins (dorsal, anal, caudal, pelvic, pectoral). The flesh was cut into slices and oven-dried at 105°C for four hours. The carcasses of the specimens were decapitated and head weights of individual fishes were recorded. For the dressing weight, fins were cut off and weights of the carcasses were determined.

Moisture, crude protein, crude lipid and ash contents of fish samples were determined according to AOAC (1990) methods. The mineral contents of the samples were determined by wet ashing/ oxidation method. The mineral elements were analysed by atomic absorption spectrophotometer for Ca, Mg, Fe, Zn, Cu and Mn) while a flame photometer was used to determine Na and K contents. The P content was determined colorimetrically using the phosphorvanadomolybdate method (AOAC, 1990).

The % flesh and waste yield was calculated as:

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

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

The data obtained were analysed using Students t-test and Tukey test at P-value of 0.05 for significant difference, using SPSS version 15.0.

Results and Discussion

Flesh and waste yield

The mean body weight, SL and TL measurements are presented in Table 1. Head weight, viscera weight, scale weight, fin weight and bone weight data are also presented in Table 1. Total waste and flesh yield, are shown in Table 1. There were no significant differences (P≥ 0.05) between TL, viscera weight, scale weight, fin weight, bone weight of male and female fishes. However, SL, total body weight, head weight, total waste and flesh yield values showed significant differences (P≤ 0.05) between male and female *C. kingsleyae.*

Table 1: Mean anatomical weights (g) of *C. kingsleyae*

	Male	Female
Standard length	$11.66{\pm}0.35^a$	$12.25{\pm}0.22^b$
Total length	$14.11{\pm}0.37^a$	$14.77{\pm}0.24^a$
Total body weight	$67.98{\pm}4.94^a$	$77.36{\pm}4.62^b$
Head weight	$15.03{\pm}1.14^a$	$17.56{\pm}0.97^b$
Viscera weight	$4.27{\pm}0.15^a$	$4.41{\pm}0.15^a$
Scale weight	$4.74{\pm}0.99^a$	$4.87{\pm}0.04^a$
Fin weight	$1.65{\pm}0.42^a$	$1.71{\pm}0.46^a$
Bone weight	$6.38{\pm}0.22^a$	$6.84{\pm}0.69^a$
Total waste	$32.07{\pm}1.55^a$	$35.39{\pm}1.26^b$
Flesh yield	$35.91{\pm}3.49^a$	$41.96{\pm}3.41^b$

Values (means ± SD) in a row with similar superscripts are not significantly different (P≥0.05)

Results revealed variability in the absolute weight and percentage weight composition of both male and female specimens. This was similarly reported by Reinitz (1983), Degani *et al.* (1988) in rainbow trout and catfishes, respectively, as well as in 13 commercially important freshwater fishes (Balogun & Fashakin, 1996). It may be very difficult to compare the flesh between male and female *C. kingsleyae* since the knowledge of their diet in their environment is limited (Omoniyi *et al.*, 2011), however, male showed lower flesh yield than female *C. kingsleyae*. The variability in the body composition of fish has been attributed to several factors such as environmental, age, size, diet and season.

Proximate Composition

Proximate analysis for the fresh samples of male and female *C. kingsleyae* is presented in Table 2. Crude protein content for male and female samples differed significantly (P≤ 0.05). There were no significant differences (P≥ 0.05) in fat, ash and moisture contents. Therefore, discrepancies observed in the proximate composition between male and female *C. kingsleyae* could be due to any of the above factors including season. Reproduction is also an important factor that affects proximate composition of fishes as they have been known to reduce or abstain from feeding during spawning and drawn from their reserves of fat.

Moreover, when fish experiences adverse situation/stress and food supply becomes inadequate, food intake will be lowered and body composition will change accordingly.

Table 2: Proximate composition (%) of male and female *C. kingsleyae*

	Male	Female
Moisture	2.14±0.07^{a}	1.63±0.01^{a}
Ash	12.61±0.15^{a}	13.61±0.13^{a}
Fat	8.22±0.11^{a}	8.82±0.08^{a}
Protein	73.29±0.06^{a}	75.65±0.06^{b}
NFE	3.74±0.34^{b}	0.29±0.11^{a}

Values are means of three replicates ± SD
Row means within the same row are not significantly different (P≤0.05) from one another.

C. kingsleyae has a high protein content which is higher compared to *Oreochromis mossambicus* (Adefemi, 2011). Protein and ash contents were relatively higher in female *C. kingsleyae* than male *C. kingsleyae*, and may be due to differences in food habits (amount and quality of food eaten) and season as suggested by Fagbenro *et al*. (2005), Fawole *et al.*(2007), Adefemi (2011) and Effiong & Fakunle (2011). Fat content was comparable with those of *O. mossambicus* (Adefemi, 2011) and *Clarias gariepinus* (Abolude & Abdullahi, 2005).

Mineral Composition

There were significant differences (P≤ 0.05) in male and female specimens for K, Ca, Mg, Zn, Cu, Fe, Mn, Cr and P contents (Table 3). Saadettin *et al.* (1999) reported that the most abundant micro element in fish were Zn and Fe followed by Cu with the remaining element present in amounts below toxic levels. The high levels of both minerals in the specimens may be attributed to the high concentration in which they occur in the habitat and the ability of the fish to absorb them from their diet and the habitat where they live (Adewoye & Omotosho, 1997; Ibiyo *et al.,* 2006). Eyo (2001) reported that mineral contents of fish make fish unavoidable in human diet as fish

Table 3: Mineral content (mg/kg) of male and female *C. kingsleyae*

Mineral	Male	Female
Na	55.67±0.67^{b}	46.33±0.88^{a}
K	32.33±1.45^{a}	43.33±1.45^{b}
Ca	4816.67±8.33^{a}	13916.67±166.67^{b}
Mg	75.00±1.54^{b}	66.67±0.88^{a}
Zn	23.33±0.33^{a}	96.33±0.67^{b}
Cu	55.33±0.33^{a}	70.33±0.67^{b}
Fe	179.00±1.15^{b}	128.00±1.15^{a}
Mn	75.33±2.03^{a}	89.67±0.88^{b}
Cr	193.67±0.67^{b}	122.00±1.00^{a}
P	57703.33±435.94^{a}	66163.33±240.65^{b}

Values (means ± SD) in a row with similar letters are not significantly different (P≤0.05).

represents a source of various minerals that contribute greatly to good health. Phosphorous is good for brain development, K and Mg are both osmoregulatory products, protein synthesis, growth and co-enzymes in carbohydrate metabolism. Both Ca and P are used in bone formation. Despite this variability, the results obtained in this study agree with the categorization report of fish by Standsby (1962).

Amino Acid Analysis

Generally, each essential amino acid (EAA) was higher in male than in female *C. kingsleyae* (Table 4). The least EAA was methionine (Table 4), while lysine and leucine constituted the highest EAAs. Similar observations were reported by Olaofe *et al.* (1993), Oshodi *et al.* (1993), Adeyeye and Adamu (2005), and Adefemi (2011).

Flesh and Waste Yield

The results of the percentage anatomical weight composition of male and female *C. kingsleyae* species investigated are presented in Table 5. Flesh yield varied between 52.09±1.36% and 53.67±1.16% for male and female *C. kingsleyae*, respectively. The percentage waste for the fish was between 47.91±1.36% and 46.33±1.16%, respectively for male and female. There was positive correlation between total body weight, total waste and flesh yield (Figures 1 and 2), thus indicating that flesh and waste yield were dependent on total body weight.

Table 4: Essential amino acid composition (g/100g protein) of *C. kingsleyae*

Amino Acid	Male	Female
Lysine	8.21	8.00
Histidine	2.97	2.90
Arginine	5.70	5.61
Threonine	5.02	4.91
Valine	5.04	4.98
Methionine	2.92	2.89
Isoleucine	4.06	4.00
Leucine	7.59	7.51
Phenylalanine	4.30	4.05
Tryptophan	ND	ND

ND = not determined

Table 5: Mean percentage (%) tissue composition of *C. kingsleyae*

	Male	Female
Total body weight	67.98±4.94	77.36±4.62
Flesh yield	52.09±1.36	53.67±1.16
Head weight	22.12±0.54	22.78±0.41
Visceral weight	6.45±0.30	5.79±0.17
Total waste	47.91±1.36	46.33±1.16

The predictive equations are given in Figures 1 and 2. Where Y= flesh yield, total waste, and X=total body weight. The R^2 value for flesh yield, total waste for male and female are given in Figures 1 and 2. Figure 1 presents the linear relationship between total waste and flesh yield of male *C. kingsleyae*. It revealed that total body weight and flesh yield of male *C. kingsleyae* had the highest coefficient of determination R^2 (0.980) while that of total body weight and total waste had the lowest R^2 (0.902).

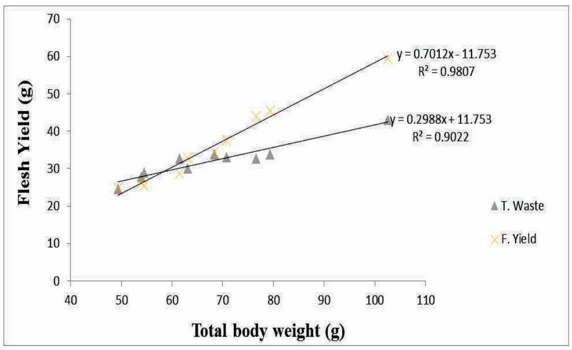

Figure 1: Relationship between body weight, flesh yield and total waste of male *C. kingsleyae*

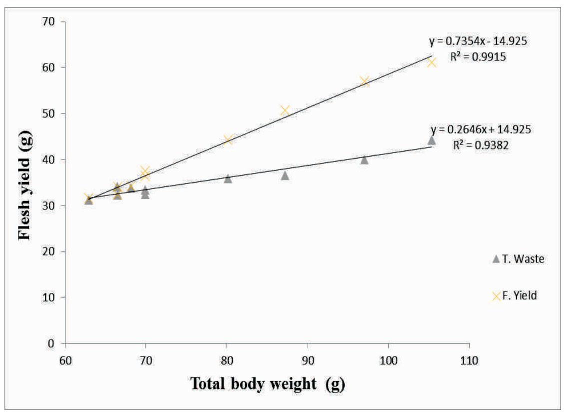

Figure 2: Relationship between body weight, flesh yield and total waste of female *C. kingsleyae*

Figure 2 shows that the linear regression model of total body weight and flesh yield relationship had the highest coefficient of determination R^2 (0.991) while that of total body weight and total waste relationship had the lowest R^2 (0.938).

Results also revealed a direct relationship between size of flesh and waste yield (as shown in Figures 1 and 2). The weight or length of *C. kingsleyae* was positively correlated which means that the habitat was suitable for the fish growth. Size was also positively correlated to waste yield (Li & Lovell, 1992). Results show that out of all the morphometric data collected from male and female specimens, it significantly showed that, there was a significant difference between bone weight of male and female *C. kingsleyae*. Apart from the utilization of waste in the production of fish meals (Balogun & Talabi, 1985; Balogun & Akegbejo-Samsons, 1991), the use of other parts of fish such as bones and scales in the production of other industrial byproducts such as Guanine was reported by Kulikov (1978).

Male and female *C. kingsleyae* are nutritive and are rich in protein and minerals. The chemical composition varied between male and female. There was a direct relationship between size and flesh yield, but size did not affect proximate composition significantly.

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