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Nutritional composition of *Synodontis nigrita* and *Tilapia mariae* from the Jamieson River, Sapele, Delta State, Nigeria

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The proximate composition of fish is important for easy formulation of both animal and human diets. The study on the proximate and mineral composition of captured *Synodontis nigrita* and *Tilapia mariae* was aimed at gaining knowledge of their consumption-associated benefits. Fish specimens were purchased on the bank of the river between February and April 2017 and transported to the laboratory where routine measurements, body and biochemical analysis for moisture content, fat, ash, protein, crude fibre, carbohydrate, sodium, potassium, calcium, and magnesium were performed using the standard methods of AOAC. The result of the proximate composition of *Synodontis nigrita* and *Tilapia mariae* showed moisture content of 79.00% and 78.87%, fat value of 3.43% and 0.67%, ash content of 6.22% and 6.68%, protein value of 7.09% and 8.84%, crude fibre value of 0.40% and 1.80%, carbohydrate content of 3.86% and 3.14%, respectively. The mineral composition of *Synodontis nigrita* and *Tilapia mariae* revealed sodium values of 32.90 mg/kg and 30.20 mg/kg, potassium values of 171.70 mg/kg and 175.60 mg/kg, calcium values of 13.50 mg/kg and 9.20 mg/kg, magnesium content of 15.00 mg/kg and 13.40 mg/kg, respectively. The results obtained in this study provided scientific knowledge of the nutritional composition of these commercial fish species.

Keywords: Proximate composition, mineral content, *Synodontis nigrita*, *Tilapia mariae*, Jamieson River

INTRODUCTION

Fish is an essential resource to humans globally as its production plays an important role in nutrition and contributes to food security, especially in many developing countries where reliable access to nutritious food is on the decline. Fish is one of the healthiest and inexpensive sources of animal protein and other important nutrients required in human diets in Africa (Amiengheme, 2005; Sadiku, Oladimeji, 1991). It has a lot of food potential and can therefore be expected to provide relief from malnutrition, especially in the developing countries (Adeniyi et al., 2012; Ashraf et al., 2011). In Nigeria, the demand for fish in the market has risen due to an increase in the population's awareness of the nutritional value of fish.

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Information on the chemical composition of fish is vital as the nutritional and medicinal value of fish products depends on its proteins, lipids, minerals, and vitamins. The knowledge of such fish constituents as moisture, crude protein, ash, lipids, carbohydrates, amino acids and minerals, and factors affecting them allow for the assessment of fish health status and the quality of the nutrients available to the consumer (Shearer, 1994). Proximate composition is the analysis of moisture, fat, protein and ash content of fish. It is used as an indicator of fish quality and it varies with diet, feeding rate, age, and genetic strain (Love, 1980; Adewumi et al., 2015). The most important mineral elements in fish are potassium, calcium, sodium, iron, phosphorous, and chlorine, while other mineral elements are needed in trace amounts (Mills, 1980; Womeni et al., 2014; Salma, Nizar, 2015).

The Jamieson River is rich in commercially important fish species such as *Arius gigas*, *Synodontis nigrita*, and *Tilapia mariae*. Although several biological studies have been carried out on various aspects of these fish species in the Jamieson River, investigations on their proximate and mineral composition are limited. Therefore, the aim of this study was to determine the proximate and mineral composition of *Synodontis nigrita* and *Tilapia mariae* from the Jamieson River, Sapele, Delta state.

MATERIALS AND METHODS

Study area. This study was carried out in the Jamieson River that is located in the Niger-Delta region of Nigeria. The Jamieson River is a tributary of the Benin River and lies between 5°41′ to 5°58′′E and 5°54′ to 6°08′′N.

Fish collection and identification. Selected fish species for this study were *Synodontis nigrita* and *Tilapia mariae*. *Synodontis nigrita* (Curvier, Valenciennes, 1840) and *Tilapia mariae* (Boulenger, 1899) belong to the family Mochokidae and Cichlidae. The genus Synodontis is the largest genus of the catfish of the order *Siluriformes* and is most widely distributed (Friel, Vigliotta, 2006).

Fish samples were procured fresh from landing sites at the Jamieson River. A total of 54 fish specimens consisting of 27 specimens of *Synodontis nigrita* and 27 specimens of *Tilapia mariae* were collected over a period of three months, February to April 2017. The samples were preserved in ice blocks, transported to the laboratory, and properly identified using taxonomic guides of Idodo-Umeh (2003). Routine measurements of the standard length, the total length, and the body weight of all fish samples were taken to the nearest 0.1 cm and 0.1 g using a metre rule and digital electronic weighing balance Mettler Toledo, PL203 model, respectively. The fish samples were thoroughly washed with distilled water to remove any adhering contaminants and drained under folds of filter paper. The head and gut were also discarded and the samples were stored in a deep freezer prior to analysis.

Proximate analysis. The proximate composition (moisture, fat, ash, protein, crude fibre, and carbohydrate) and mineral content of *Synodontis nigrita* and *Tilapia mariae* were determined using the standard methods of the Association of Official Analytical Chemists (AOAC, 2010).

Data analysis. Statistical analyses were computed using Microsoft Excel and the Statistical Package for Social Sciences (SPSS 16.0). Analysis of variance (ANOVA) was used to test for significant difference ($p < 0.01$) between means, and the source of significant differences was identified using Duncan's Multiple Range (DMR) test.

RESULTS AND DISCUSSION

The results of the proximate and mineral composition of *Synodontis nigrita* and *Tilapia mariae* over the months are displayed in Tables 1 and 2. The total length of *Synodontis nigrita* ranged from 17.50 cm to 27.90 cm, the standard length from 12.7 cm to 19.50 cm, and the body weight from 31.30 to 209.08 g. The total length of *Tilapia mariae* ranged from 12.50 cm to 21.00 cm, the standard length from 10.20 to 17.80 cm, and the body weight from 41.29 g to 233.12 g.

Table 1. **Summary of the proximate composition of *Synodontis nigrita* and *Tilapia mariae* from the Jamieson River**

Proximate composition	*Synodontis nigrita*			*Tilapia mariae*			*p*-value
	$\bar{X}$ + S D	Min	Max	$\bar{X}$ + S D	Min	Max	
Moisture	79.00 ± 2.35^{c}	76.65	81.35	78.87 ± 0.66^{c}	78.21	79.53	<0.01
Fat	3.43 ± 0.46^{a}	2.97	3.89	0.67 ± 0.04^{a}	0.63	0.71	<0.01
Ash	6.22 ± 1.05^{b}	5.17	7.27	6.68 ± 0.56^{b}	6.12	7.24	<0.01
Protein	7.09 ± ±0.16^{a}	6.93	7.25	8.84 ± 0.40^{a}	8.44	9.24	<0.01
Crude Fibre	0.40±0.02^{a}	0.38	0.42	1.80 ± 0.20^{a}	1.60	2.00	<0.01
Carbohydrate	3.86 ± 0.70^{a}	3.16	4.56	3.14 ± 1.06^{a}	2.08	4.20	<0.01

Note: Similar letters (superscripts) indicate values that are not significantly different from each other ($p < 0.01$).

Table 2. **Summary of the mineral composition of *Synodontis nigrita* and *Tilapia mariae* from the Jamieson River**

Mineral composition	*Synodontis nigrita*			*Tilapia mariae*			*p*-value
	$\bar{X}$ + S D	Min	Max	$\bar{X}$ + S D	Min	Max	
Sodium	32.90 ± 0.40^{b}	32.50	33.30	30.20 ± 2.90^{b}	27.30	33.10	<0.01
Potassium	171.70 ± 0.50^{c}	171.20	172.20	175.60 ± 9.10^{c}	166.50	184.70	<0.01
Calcium	13.50 ± 0.60^{b}	12.90	14.10	9.20 ± 0.60^{a}	8.60	9.80	<0.01
Magnesium	15.00 ± 0.50^{c}	14.50	15.50	13.40 ± 0.26^{b}	13.10	13.60	<0.01

Note: Similar letters (superscripts) indicate values that are not significantly different from each other ($p < 0.01$).

The moisture content of the muscles of fresh samples for *Synodontis nigrita* (79%) and *Tilapia mariae* (78.87%) were within acceptable levels of 60% to 80% (Gallagher et al., 1991). Similar high moisture content values were reported in fresh samples of *T. guineensis* (79.50%) and *T. melanotheron* (79.50%) by Adejonwo et al. (2010), and in *Tilapia zilli* (78.11%) and *Sarotherodon galilaeus* (79.63%) by Adewumi et al., (2014).

Fish lipids are rich in polyunsaturated fatty acid, particularly omega-3-fatty acids which have an important role in disease prevention and health promotion (Omotosho et al., 2011; Omoruyi et al., 2017). A comparison of the fat content of *Synodontis nigrita* with that of *Tilapia mariae* indicates that *Synodontis nigrita* has a higher fat content. Similar values were reported by Bombata-Fashina et al. (2013) for *T. mariae* (0.65%) and by Omoruyi et al. (2017) for *Synodontis clarias* (2.73%). Ackman (1989) stated that fish can be grouped into four categories according to their fat content: lean (<2%), low fat (2 to 4%), medium fat (4 to 8%), and high fat (>8%). Results obtained from this study showed that fresh samples of *S. nigrita* and *T. mariae* belong to the low fat and lean categories, respectively.

The ash content is a measure of the total amount of minerals present in a food. It is the inorganic residue that remains after the organic matter has been burnt off (Adewumi et al., 2014). The ash content was higher in fresh samples of *T. mariae* (6.68%) than in those of *S. nigrita* (6.22%). The observed range of the ash content in *S. nigrita* and *T. mariae* indicates that the species are a good source of such minerals as potassium, calcium, sodium, and magnesium. The difference in the ash content could be attributed to the fish species, season, sex, or food availability (Effiong, Mohammed, 2008).

Low protein content in fresh samples of *S. nigrita* (7.09%) and *T. mariae* (8.84%) was recorded. In contrast, high protein content values of 18.08%, 11.79%, and 19.13% were reported

in fresh samples of *T. mariae* (Bombata-Fashina et al., 2013), *S. schall* (Oyase et al., 2016), and *S. clarias* (Omoruyi et al., 2017), respectively. This could be attributed to variation in fish size, age, and seasonal variations.

Fish generally have very low levels of carbohydrates because glycogen does not contribute much to the reserves in the fish body tissue (Das and Sahu, 2001). The percentage of 1.80% of crude fibre content in fresh samples of *T. mariae* (1.80%) was higher than that observed in fresh samples of *S. nigrita* (0.40%). A higher crude fibre content for fresh samples of *Synodontis nigrita* (2.07%) and *Synodontis clarias* (2.10%) were reported by Ndome et al. (2010) and Omoruyi et al. (2017), respectively. A comparison of the carbohydrate content of *S. nigrita* and *T. mariae* indicate that *S. nigrita* has higher carbohydrate content. Ndome et al. (2010) and Salihu-Lasisi et al. (2013) reported similar values of 3.49% and 3.67% for fresh samples of *S. nigrita* and *T. nilotica*.

Although fish is very unlikely to be the only source of an essential mineral in human diet, it provides a well-balanced supply of minerals in a readily usable form (Ako, Salihu, 2004). Sodium participates in acid-base balance and isotonicity and plays an important role in the metabolic and neuromuscular systems. The richness in sodium (Na^+) concentrations boosts the osmoregulatory activities in organisms (Bentley, 1971). The concentration of sodium in fresh samples of *Synodontis nigrita* (32.90 mg/kg) was higher than in fresh samples of *Tilapia mariae* (30.20 mg/kg). The concentration of sodium in fresh samples of *S. nigrita* and *T. mariae* could be attributed to the concentration of sodium in the water body or the capacity of the fish to absorb the elements from their diets and the water bodies.

Overall results showed that potassium was the most abundant element in both fish species when compared to all minerals analysed. A similar trend was reported in *T. guineensis* by Adeniyi et al. (2012). The highest potassium content (175.60 mg/kg) was recorded in *T. mariae*. In contrast, Adeniyi et al. (2012) reported low potassium content in fresh samples of *Tilapia guineensis* (91.51 mg/kg). Potassium is involved in protein synthesis, nerve conduction, regulation of the blood pressure; in addition, it contributes to the maintenance of the intracellular osmotic pressure (Soetan et al., 2010).

S. nigrita had a higher calcium content of 13.50 mg/kg than the value of 9.20 mg/kg recorded in *T. mariae*. Higher calcium content in fresh samples of *S. nigrita* over *T. mariae* can be attributed to its benthic nature and its relative preference for consumption of fish scales, crustaceans, insect parts, and larvae. Fresh samples of *S. nigrita* had higher magnesium content (15.00 mg/kg) than *T. mariae* (13.40 mg/kg). In contrast, Adeniyi et al. (2012) reported high magnesium content of 41.44 mg/kg in fresh samples of *T. guineensis*.

CONCLUSIONS

A large percentage of consumers eat fish because of its flavour, availability, and palatability, and a smaller percentage eat fish because of its nutritional value. This study shows that *S. nigrita* does not exceed *T. mariae* in nutritional quality. Although *S. nigrita* has a higher content of calcium and magnesium, both fish species are of a high nutritional value and a good source of minerals, and therefore are highly recommended for consumption.

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SYNODONTIS NIGRITA IR *TILAPIA MARIAE* IŠ JAMIESONO UPĖS (SAPELE, DELTOS VALSTIJA, NIGERIJA) MAISTINĖ SUDĖTIS

Santrauka

Žuvies energetinė sudėtis yra svarbi gyvūnų ir žmonių mitybai. Tyrimo metu buvo nustatyta *Synodontis nigrita* ir *Tilapia mariae* energetinė ir mineralinė sudėtis, siekiant išsiaiškinti jų vartojimo naudą. Nuo 2017 m. vasario iki balandžio mėnesio upės pakrantėje buvo perkami žuvų pavyzdžiai tyrimui atlikti. Vėliau laboratorijoje buvo atlikti rutininiai kūno matavimai ir biocheminės drėgmės, riebalų, pelenų, baltymų, žaliavinių skaidulų, angliavandenių, natrio, kalcio ir magnio kiekio analizės AOAC standartiniais metodais. Energetinės sudėties rodikliai: drėgmės kiekis siekė 79,00 % ir 78,87 %, riebalų vertė – 3,43 % ir 0,67 %, pelenų kiekis – 6,22 % ir 6,68 %, baltymų vertė – 7,09 % ir 8,44 %, žaliavinių skaidulų – 0,40 % ir 1,80 %, angliavandenių kiekis – 3,86 % ir 3,14 % *Synodontis nigrita* ir *Tilapia mariae* atitinkamai. Mineralinė sudėtis: natrio koncentracijos vertė siekė 32,90 mg/kg ir 30,20 mg/kg, kalio – 171,70 mg/kg ir 175,60 mg/kg, kalcio – 13,50 mg/kg ir 9,20 mg/kg, magnio – 15,00 mg/kg ir 13,40 mg/kg *Synodontis nigrita* ir *Tilapia mariae* atitinkamai. Tyrimo rezultatai suteikė mokslinių žinių apie komercinių žuvų rūšių mitybinę sudėtį.

Raktažodžiai: energetinė sudėtis, mineralinė sudėtis, *Synodontis nigrita*, *Tilapia mariae*, Jamiesono upė