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BIOCHEMICAL PROFILING OF SOME COMMERCIAL MARINE FIN FISH SPECIES IN LAGOS (NIGERIA)

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ABSTRACT

The proximate mineral compositions of *Scomber scombrus*, *Pseudotholitus typus*, and *Chrysichthys nigrodigitatus* in Lagos were analyzed using standard methods. Moisture content was 58.12%, 75.28%, and 74.68% respectively. Crude protein content was not significantly different among the species. *Scomber scombrus* had the highest crude fat and was the only species with detectable crude fiber (2.04%). Ash contents were similar across species. Carbohydrate content was lowest in *Chrysichthys nigrodigitatus* (3.48%) and highest in *Scomber scombrus* (7.42%). *Pseudotholitus typus* had the highest total macro elements. Mineral patterns varied, with all minerals except sodium being significantly higher in *Scomber scombrus* and *Pseudotholitus typus* compared to *Chrysichthys nigrodigitatus*. This indicates that nutritional quality changes are associated with variations in mineral content.

RÉSUMÉ: Profilage biochimique de quelques espèces commerciales de poissons marins à nageoires à Lagos.

Les compositions proximales et minérales de *Scomber scombrus*, *Pseudotholitus typus* et *Chrysichthys nigrodigitatus* à Lagos ont été analysées en utilisant des méthodes standards. La teneur en eau était respectivement de 58,12%, 75,28% et 74,68%. La teneur en protéines brutes n'était pas significativement différente entre les espèces. *Scomber scombrus* avait la plus forte teneur en matières grasses brutes et était la seule espèce avec des fibres brutes détectables (2,04%). Les teneurs en cendres étaient similaires d'une espèce à l'autre. La teneur en hydrates de carbone était la plus faible chez *Chrysichthys nigrodigitatus* (3,48%) et la plus élevée chez *Scomber scombrus* (7,42%). *Pseudotholitus typus* avait les macro-éléments totaux les plus élevés. Les profils minéraux varient, tous les minéraux sauf le sodium étant significativement plus élevés chez *Scomber scombrus* et *Pseudotholitus typus* que chez *Chrysichthys nigrodigitatus*. Cela indique que les changements de qualité nutritionnelle sont associés à des variations de la teneur en minéraux.

REZUMAT: Profilul biochimic al unor specii de pești marini comerciali din Lagos.

Compozițiile proximale și minerale ale speciilor *Scomber scombrus*, *Pseudotholitus typus* și *Chrysichthys nigrodigitatus* din Lagos au fost analizate utilizând metode standard. Conținutul de umiditate a fost de 58,12%, 75,28% și respectiv 74,68%. Conținutul de proteine brute nu a fost semnificativ diferit între specii. *Scomber scombrus* a avut cea mai mare cantitate de lipide brute și a fost singura specie cu fibre brute detectabile (2,04%). Conținutul de cenușă a fost similar între specii. Conținutul de carbohidrați a fost cel mai scăzut la *Chrysichthys nigrodigitatus* (3,48%) și cel mai ridicat la *Scomber scombrus* (7,42%). *Pseudotholitus typus* a avut cele mai multe macroelemente totale. Structura tuturor mineralelor a variat, cu excepția sodiului, fiind semnificativ mai mare la *Scomber scombrus* și *Pseudotholitus typus* comparativ cu *Chrysichthys nigrodigitatus*. Acest lucru arată că modificările calității nutriționale sunt asociate cu variații ale conținutului de minerale.

INTRODUCTION

The malnutrition situation is intense in developing countries with low levels of protein and mineral intake. As a result there is an urgent need to find a way of raising the protein and mineral intake of the average citizen from 5.5 g/head/day to 35 g/head/day (Moratiel et al., 2020). The World Health Organization reported that about two billion people across the globe are suffering from mineral and vitamin deficiencies and the majority of these cases are in third world countries (WHO, 2014). Chronic malnutrition (protein energy malnutrition, micronutrient deficiencies, and over nutrition) was found to impact 38% of Nigeria's population (Rufai et al., 2022). Meanwhile, more than 41% of the total animal protein intake is obtained from fishery products because it is relatively cheaper than other animal meat. and the total fish consumption rate has risen to 2.66 million metric tons annually (Moruf et al., 2019). Fish is one of the most affordable sources of protein, micro-nutrients, and other essential nutrients crucial to human health. According to Ogundiran et al. (2014), marine fish are generally cheaper and much more abundant than fresh water fish in Nigeria.

The nutritional characteristics of fish and fishery products are of vital interest to consumers. The nutritional value of fish comprises of the contents of moisture, dry matter, protein, lipids, vitamins, and minerals plus the caloric value, while minerals are essential nutrient components of many enzymes and metabolism and it contributes to the growth of fish (Opeyemi, 2020). Fish of various species provide different levels of nutrients to their consumers and nutritive values of a fish varies with season (Opeyemi, 2020).

In human nutrition, chemical elements that are required for the normal maintenance of human body are refered to as essential elements (Jiang et al., 2015). These elements (K, Ca, Mg, Na, Fe, Zn, Cu, and Mn) participate in several biochemical reactions. Calcium, magnesium and phosphorus are crucial in formation of bones and teeth, sodium and potassium work together in transmission of nerve impulses and keeping electrolyte balance, zinc is mostly found as a catalyst in enzyme reactions, and iron forms part of the hemoglobin molecule which transports oxygen around the body (Cobas et al., 2022). When these elements are not adequately provided to the human body through dietary intake, the individual suffers from mineral deficiency diseases such as anemia, osteoporosis, goiter, stunted growth, and genetic disorders (Shrestha et al., 2021).

Several scientific studies on the chemical components of fish have been conducted on for different freshwater and marine fish species around the world. In Nigeria, Opeyemi (2020) conducted a study on comparative analysis of the proximate and elemental composition of five fish species, *Clarias gariepinus, Lates niloticus, Sarotherodon galilaeus, Heterotis niloticus,* and *Oreochromis niloticus*, which were collected from Ero Reservoir Ikun Ekiti. Ayeloja et al. (2023) focused their study on *Auchenoglanis occidentalis, Labeo parvus*, and *Chrysichthys nigrodigitatus*. Biochemical assays of the moisture, ash, crude protein, fibers, lipid, and different elements (Fe, Na, K, Ca, Mg, Zn, Mn, and Cu) of the fillets were carried out. All the fish species examined turned out to be rich sources of protein, moisture, lipid, ash, and minerals and met important requirements for human nutritional needs. They belong to the high-protein, (18-23%), high moisture, and low oil category. Information on the nutritional value of local key species before common postharvest processing and preservation methods in the country is limited or often missing from nutrient composition databases (Fakoya et al., 2019). Hence, the present research aimed to provide a preliminary assessment of the proximate composition, some minerals and their relationship in raw marine fin fish species in Lagos, Nigeria.

The Lagos area is a well known Nigerian zone for fishing and fish trade (Fola-Matthews et al., 2024) and for environment related problems (Uwadiae and Chidolue, 2024).

MATERIAL AND METHODS

Sample collection

The fish samples used for this study include *Scomber scombrus, Pseudotholitus typus,* and *Chrysichthys nigrodigitatus*. They were obtained from Makoko Jetty of the Lagos Lagoon. The lagoon lies between latitudes 6º26' and 6º39'N and longitudes 3º29' and 3º50'E. Lagos Lagoon is a part of a continuous system of lagoons and creeks' lying along the coast of Nigeria and it is an open tidal estuary situated within the low-lying coastal zone of Nigeria (Moruf and Lawal-Are, 2017). The samples were transported in a 20 L bucket to the laboratory and processed within four hours of the collection. The fresh samples were identified using Identification Guides (Schneider, 1990).

Chemical analysis

The determination of the percentage proximate composition was analyzed chemically according to the method of analysis described by the Association of Official Analytical Chemist (AOAC, 2006) while the percentage mineral elemental concentration was determined using (AAS) Atomic Absorption Spectrophotometer and calculated in ppm (μg/g dry weight).

Statistical data analysis

Data were analyzed by descriptive analysis and Duncam multiple range test (DRMT). Statistical software package (SPSS version 17, Chicago, USA) was employed in the analysis. Differences were considered significant at an alpha level of 0.05. All means were given with ± standard error.

RESULTS AND DISCUSSION

Proximate composition

The proximate composition of some selected commercial marine fin fish species in Lagos is shown in table 1. It includes moisture, protein, fat, fibre, ash, and carbohydrate content. The result of the proximate compositions obtained in the present investigation clearly demonstrate that, the proportion of protein content was dominating over carbohydrates and lipid contents in all the studied marine fin fish species. The percentage moisture content in *S. scombrus, P. typus*, and *C. nigrodigitatus* were 58.12 ± 0.37%, 75.28 ± 1.22% and 74.68 ± 0.35% respectively. These values were higher than what was reported by Lawal-Are et al. (2018) for the whole body (69.55 ± 2.93%) of *Squilla aculeata calmani* from the same habitat. The crude protein contents of *S. scombrus* (15.01 ± 0.60%), *P. typus* (13.87 ± 1.38%) and *C. nigrodigitatus* (4.51 ± 0.72%) are similar to that reported for raw (16.02 ± 2.24%) but higher than that in the grilled specimen (14.98 ± 1.12%) *Cardisoma armatum* (Moruf et al., 2021a). The protein content of the studied fish species showed no significance difference ($p > 0.05$) when compared among the three species. The higher lipid content (16.57 ± 1.05%) of *S. scombrus* reveals involvement in energy production at the cellular level. Crude fiber was only detected in *S. scombru*s with the value of 2.04 ± 0.02% similar to 2.47% reported for flesh of *Panulirus regius* from Lagos area Atlantic Ocean (Moruf et al., 2021b).

The ash content in the present study was not significantly different among the marine fin fish species and ranges from 0.85 ± 0.06% (*S. scombrus*), 0.90 ± 0.03% (*C. nigrodigitatus*) and 1.20 ± 0.61% (*P. typus*). The lowest carbohydrate content was recorded in *C. nigrodigitatus* (3.48 ± 0.77%) and significantly different from what was recorded for *S. scombrus* (7.42 ± 0.56%) and *P. typus* (7.29 ± 1.28%), which were all lower than 37.55-42.8% obtained in whole organism of *Squilla aculeata calmani* (Lawal-Are et al., 2018).

In this study, the proximate compositions of the investigated marine fin fish species show a significant difference especially in crude fat and crude fiber. Generally, the biochemical composition of any organism is known to reflect its nutritional quality and is being influenced by several biotic and abiotic factors including species, season, size of the animal, food, temperature, and stage in the life cycle (Banu et al., 2016).

Table 1: Proximate composition of some commercial marine fin fish in Nigeria; Mean ± Standard, values with different superscripts across row are significantly different at ($p < 0.05$).

Parameters (%)	*Scomber scombrus*	*Pseudotholitus typus*	*Chrysichthys nigrodigitatus*
Moisture	58.12 ± 0.37^{a}	75.28 ± 1.22^{b}	74.68 ± 0.35^{b}
Protein	15.01 ± 0.6^{a}	13.87 ± 1.38^{a}	14.51 ± 0.72^{a}
Crude fat	16.57 ± 1.05^{a}	2.35 ± 0.55^{b}	6.43 ± 0.04^{c}
Crude fibre	2.04 ± 0.02^{a}	0.00 ± 0.00^{b}	0 ± 0.00^{b}
Total ash	0.85 ± 0.06^{a}	1.20 ± 0.61^{a}	0.90 ± 0.03^{a}
Carbohydrate	7.42 ± 0.56^{a}	7.29 ± 1.28^{a}	3.48 ± 0.77^{b}

Mineral concentrations

The result of the mineral content is contained in table 2. The highest total macro element was recorded in *P. typus* (790.23 mg 100 g-1) while the lowest in *C. nigrodigitatus* (366.26 mg 100 g-1). Potassium was the highest concentrated mineral in *S. scombrus* and *P. typus* with values of 371.72 ± 1.06 mg 100g-1 and 328.61 ± 0.61 mg 100g-1 while phosphorus was the highest concentrated mineral in *C. nigrodigitatus* with the value of 101.75 ± 7.64 mg 100g-1. The pattern of mineral contents in *S. scombrus* and *P. typus* was potassium > phosphorus > sodium > magnesium > calcium; while for *C. nigrodigitatus*, it was phosphorus > sodium > potassium > magnesium > calcium. All the investigated minerals (except sodium) were significantly higher ($p < 0.05$) in *S. scombrus* and *P. typus* compared to that in *C. nigrodigitatus*. This result is similar and conforms to the report of Ogundiran et al. (2014), which indicates that the marine fish species in southwestern Nigeria can be a good source of macro minerals for human health.

Table 2: Proximate composition of some commercial marine fin fish in Nigeria; Mean ± Standard, values with different superscripts across row are significantly different at ($p < 0.05$).

Parameters (mg $100g^{-1}$)	*Scomber scombrus*	*Pseudotholitus typus*	*Chrysichthys nigrodigitatus*
Calcium	12.43 ± 3.18^{a}	12.96 ± 3.30^{a}	8.86 ± 25.85^{b}
Magnesium	78.31 ± 1.6^{a}	86.31 ± 1.52^{a}	67.34 ± 6.03^{b}
Potassium	371.72 ± 1.06^{a}	328.61 ± 0.61^{a}	90.23 ± 7.33^{b}
Phosphorus	215.11 ± 3.55^{a}	267.21 ± 2.24^{a}	101.75 ± 7.64^{b}
Sodium	89.17 ± 27.97^{a}	95.14 ± 15.51^{a}	98.08 ± 4.74^{a}
Total	766.74	790.23	366.26

Relationship between proximate and mineral compositions

Tables 3, 4 and 5 shows the correlation matrixes between the proximate and mineral compositions of *S. scombrus* and *P. typus* compared to that of *C. nigrodigitatus* respectively. In each case, there were approximately perfect positive relationships between proximate and mineral components. In *S. scombrus*, a perfect relationship was exhibited by crude fiber with Ca (0.99), Mg (1.00), K (0.95), P (1.00), and Na (0.97) at 0.05 significance level. The same was applicable to ash content. In *P. typus*, fat and carbohydrate contents showed positive relationships with all the minerals except potassium (–0.11). In *C. nigrodigitatus*, protein contents showed positive relationships with calcium (0.58), phosphorus (0.54), and sodium (0.72). This finding is comparable to the report on the macro and micro-nutrients of the flesh of *Callinectes amnicola* from Southwest Nigeria (Moruf et al., 2019).

Table 3: Correlation coefficient among the proximate and mineral compositions in *Scomber scombrus*.

	Moi.	Prot.	Fat	Fibre	Ash	NFE	Ca	Mg	K	P	Na
Moisture	1	–	–	–	–	–	–	–	–	–	–
Protein	0.94	1	–	–	–	–	–	–	–	–	–
Crude Fat	–0.92	–0.72	1	–	–	–	–	–	–	–	–
Crude Fibre	0.12	–0.24	–0.50	1	–	–	–	–	–	–	–
Total Ash	0.74	0.46	–0.95	0.75	1	–	–	–	–	–	–
NFE	–0.02	–0.37	–0.37	0.99	0.65	1	–	–	–	–	–
Ca	–0.04	–0.39	–0.36	0.99	0.64	1.00	1	–	–	–	–
Mg	0.20	–0.16	–0.57	1.00	0.80	0.98	0.97	1	–	–	–
K	0.41	0.07	–0.74	0.95	0.91	0.90	0.90	0.97	1	–	–
P	0.07	–0.28	–0.46	1.00	0.72	1.00	0.99	0.99	0.94	1	–
Na	0.36	0.02	–0.70	0.97	0.89	0.92	0.92	0.98	1.00	0.96	1

Table 4: Correlation coefficient among the proximate and mineral compositions in *Pseudotholitus typus*.

	Moi.	Prot.	Fat	Ash	NFE	Ca	Mg	K	P	Na
Moisture	1	–	–	–	–	–	–	–	–	–
Protein	–0.55	1	–	–	–	–	–	–	–	–
Crude Fat	–0.93	0.82	1	–	–	–	–	–	–	–
Total Ash	0.95	–0.78	–1.00	1	–	–	–	–	–	–
NFE	–0.42	–0.53	0.05	–0.11	1	–	–	–	–	–
Ca	0.85	–0.90	–0.99	0.97	0.12	1	–	–	–	–
Mg	0.82	–0.93	–0.97	0.96	0.17	1.00	1	–	–	–
K	0.95	–0.78	–1.00	1.00	–0.11	0.97	0.96	1	–	–
P	0.89	–0.87	–0.99	0.99	0.05	1.00	0.99	0.99	1	–
Na	0.85	–0.91	–0.98	0.97	0.13	1.00	1.00	0.97	1.00	1

Table 5: Correlation coefficient among the proximate and mineral compositions in *Chrysichthys nigrodigitatus*.

	Moi.	Prot.	Fat	Ash	NFE	Ca	Mg	K	P	Na
Moisture	1	–	–	–	–	–	–	–	–	–
Protein	–0.21	1	–	–	–	–	–	–	–	–
Crude Fat	0.99	–0.35	1	–	–	–	–	–	–	–
Total Ash	0.56	0.69	0.43	1	–	–	–	–	–	–
NFE	–0.34	–0.85	–0.20	–0.97	1	–	–	–	–	–
Ca	–0.92	0.58	–0.97	–0.19	–0.06	1	–	–	–	–
Mg	–0.20	–0.92	–0.05	–0.92	0.99	–0.20	1	–	–	–
K	0.31	–0.99	0.44	–0.62	0.79	–0.66	0.87	1	–	–
P	–0.94	0.54	–0.98	–0.24	–0.01	1.00	–0.15	–0.62	1	–
Na	–0.83	0.72	–0.90	0.00	–0.25	0.98	–0.38	–0.79	0.97	1

CONCLUSIONS

The proximate parameters of the studied marine fin fish species are similar to mineral element concentrations in *Scomber scombrus* and *Pseudotholitus typus*, with calcium, magnesium, potassium, phosphorus and sodium, contributing significantly to the nutritional qualities of the fishes.

The positive relationship in the nutritional quality indicates that changes in proximate composition are associated with changes in the mineral contents of the marine fish species.

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