Proximate and mineral Composition of *Pseudotolithus senegalensis* and *Pseudotolithus typus* from Lagos Lagoon, Nigeria

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Abstract

Two commercially important species of croaker; *Pseudotolithus senegalensis* and *Pseudotolithus typus* were analyzed for their proximate and mineral composition using standard methods. In the proximate composition, the protein, fat, ash, fiber, carbohydrate and moisture contents of *P. senegalensis* were found to be 21.21%, 0.86%, 2.01%, 1.19%, 5.05% and 69.70% respectively while in *P. typus* the composition was found to be 20.28%, 1.05%, 1.85%, 1.81%, 8.66% and 66.35%, respectively. There was significant difference (p>0.05) in percentage crude protein, ash and moisture content. The concentration of the macro and micro mineral elements in the fish fillets of *P. senegalensis* and *P. typus* followed the same pattern in the following order- Ca> K> Na >P > Mg and Fe > Zn > Mn respectively. *P. senegalensis* and *P. typus* belonged to high- protein lean fish category and are a good source of minerals. The fish have good nutritive values which could serve as an ideal dietetic fish food as well as play a significant nutritional role in human health.

Key words: Proximate composition, minerals, *Pseudotolithus senegalensis, Pseudotolithus typus*.

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1. Introduction

Fish is known to be highly nutritious and an important component of the diet of the populace. It is an excellent source of protein and other essential nutrients for human diets (Fawole *et al*., 2007). It is one of the cheapest sources of animal protein and accounts for about 40% of the total animal protein intake of the average Nigerian (Sadiku and Oladimeji, 1991). It is consumed by the larger percentage of the populace because of its availability, flavor and palatability while a few consume it because of its nutritional value (Foran *et al*., 2005). Fish is basically composed of water, lipid, and protein, which create the nutritional value, functional aspects, and sensory characteristics of the flesh. It also contains vitamins and minerals which plays an important role in post-mortem biochemical changes Gokoglu, and Yerlikaya, 2015).

The knowledge of proximate composition of fishery species is essential in estimating the quality of the raw material and for its maximum utilization which has fundamental importance in the application of different technological processes in fish preservation, processing and product development (Mridha *et al*., 2005). The processing and preservation of fresh fish are of utmost importance, in view of the fact that, fish is highly susceptible to deterioration immediately after harvest and also to prevent economic losses (Okonta, and Ekelemu, 2005).

The study of mineral elements present in living organisms is of biological importance. Fish flesh contains most of the minerals necessary for a balanced diet. The most important mineral salts are that of calcium, sodium, potassium, phosphorous, iron, chlorine while many others are also needed in trace amounts. Many of such elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974; Hei, and Sarojnalini, 2012). The minerals are responsible for skeletal formation, maintenance of colloidal systems, regulation of acid-base equilibrium and for biologically important compounds such as hormones and enzymes hence the need for humans to ingest it from diet or through supplements. Mineral deficiencies can cause biochemical, structural and functional pathologies which depend on several factors, including the duration and degree of mineral deprivation (Watanabe et al., 1997).

Pseudotolithus is a genus of croaker which is a ray-finned fish in the family Sciaenidae (Edwards *et al*., 2001). *Pseudotolithus senegalensis (*cassava croaker*)* and *Pseudotolithus typus* (longneck croaker) are economically important demersal fish and are widely distributed along the Atlantic coast of tropical West Africa (Edwards *et al*., 2001). They are primarily marine but also occurs seasonally in brackish water areas. These fish species inhabit both the coastal inshore waters and the creeks over muddy, sandy or rocky bottoms. They feed on

small fish, shrimps, crabs and Cephalopods (Nunoo *et al*., 2013). They are of high market value and usually caught by artisanal and industrial fisheries.

Fish plays an important role in food security and poverty alleviation in both rural and urban areas of Nigeria, however the present knowledge of proximate and mineral composition of fish species in the Nigerian coastal waters is very limited despite their economic importance and high consumption rate. The aim of this study is to assess the proximate composition and mineral composition from the fillet of *P. senegalensis* and *P. typus.*

2. Materials and Methods

2.1 Sample collection

In this study, about thirty fresh samples each of *P. senegalensis* and *P. typus* were purchased during the rainy season, from Makoko fish market, situated very close to Lagos Lagoon in Yaba Local Government Area of Lagos, state, Nigeria. Its geographical coordinates are 6° 29' 46" North and 3° 23' 16" East. The fish were placed in ice in an aseptically insulated ice bag and were transported to the laboratory within two hours for sample preparation and analysis.

A standard graduated fish measuring board was used to measure the standard length in centimeters. The standard length was measured from the tip of the snout to the posterior end of the mid lateral portion of the fish. The weight was measured using Ohasus top loading digital electronic weighing scale to weigh the fish samples to two decimal places in grammes. The proximate and mineral compositions were analyzed in triplicate for each fish specie.

2.2 Sample preparation

Fish samples were filleted with skin from the left and right side of the fish, with a sharp stainless steel knife. Large pieces of fillet were cut in to smaller pieces with a stainless steel knife on a cutting board and homogenized using a stainless steel blender. The homogenized samples of each specie were stored at -18°C for subsequent analysis.

2.3 Proximate composition determination.

The total nitrogen was determined by the Kjeldahl method as described by AOAC, (1994). Crude lipid determination was carried out using the modified Bligh and Dyer procedure (AOAC, 1994), the ash content of the fish was determined by igniting the sample at 550°C for 5–6 hours until the sample was completely free from carbon particles in a carbolite Sheffield LMF3 muffle furnace. The crude fibre was determined using the method described by AOAC

(1994) while the total carbohydrate was determined by the Androne method as described by Hedge and Hofreiter (1962). The moisture content was estimated by drying samples to constant weight at 105±2°C using the oven drying method (AOAC, 1994).

2.4 Determination of mineral elements

The fish samples were first digested with nitric acid, perchloric acid and sulphuric acid in ratio 3:2:1 using the wet-ashing method of Gorsuch (1959). After the digestion, the content of the flask was filtered and the digested material was kept in a dust proof glass chamber. The samples were digested with the disappearance of brown fumes, diluted to 100ml for atomic absorption spectrophotometer (AAS) Analysis using suitable hallow cathode lamp. Appropriate blanks and the standards were also run along with the samples (aliquots) to be analysed to validate the results obtained.

2.5 Data analysis

Data were analysed using Prism version 5.03 statistical software programmes to calculate the mean, standard deviation (SD) and two tailed T-test. Significance was established at $P<0.05$

3. Results and Discussion

The mean standard length for *P. senegalensis* and *P. typus* was 24.56 ± 1.60cm and 28.12±1.24cm and mean body weight was 200.17± 15.60 g and 232.86±12.64g respectively. The fish species stage of growth are post juvenile which is the popular grade sold in the market.

The result of the proximate composition of *P. senegalensis* and *P. typus* is shown in Table 1. Analysis on the fish fillet showed that *P. senegalensis* had 21.21±0.06% crude protein, 0.86±0.01% crude fat, 2.01±0.04% total ash, 1.19±0.04% crude fiber, 5.05±0.05% carbohydrates and 69.70±0.03% moisture, while *P. typus* had 20.28±0.09% crude protein, 1.05±0.01% crude fat , 1.85±0.01% total ash, 1.81±0.07% crude fiber, 8.66±0.11% carbohydrates and 66.35±0.04% moisture. *P. senegalensis* had a relatively higher protein, ash and moisture content while *P. typus* relatively was richer in crude fat, crude fibre and carbohydrate content. There was significant difference ($p>0.05$) in percentage crude protein, ash and moisture content.

Table 1. Proximate analysis of *P. senegalensis* and *P. typus*

Fish specie	Protein (%)	Crude fat (%)	Ash (%)	Crude fiber (%)	Carbohydrate (%)	Moisture (%)
P. senegalensis	21.21±0.06	0.86±0.01	2.01±0.04	1.19±0.04	5.05±0.05	69.70±0.03
P. typus	20.28±0.09	1.05±0.01	1.85±0.01	1.81±0.07	8.66±0.11	66.35±0.04

The mineral contents of both fish species are shown in Table 2. *P. senegalensis* had a relatively higher content of Mg, Na, Mn, K as compared to *P. typus*, while *P. typus* was richer in Ca, Fe, P and Zn in comparison to *P. senegalensis*.

The results showed that the most abundant macro element present in both the fish samples was calcium followed by potassium while Iron was the most abundant micro element present for both species.

Table 2. Mineral composition of *P. senegalensis* and *P. typus*

Parameters (mg/100g)	*P. senegalensis*	*P. typus*
Ca	220.40±1.96	226.38±0.47
K	125.60±0.40	110.40±0.41
Na	111.20±0.09	98.90±1.65
P	27.80±0.07	32.29±0.04
Mg	18.40±0.16	16.88±0.23
Fe	56.80±0.44	68.65±0.47
Zn	20.42±0.07	22.40±0.05
Mn	1.18±0.21	0.59±0.05

Fish meat is basically composed of water (66–81%), protein (16–21%), carbohydrates (<0.5%), lipids (0.2–25%) and ash (1.2 to 1.5%) (FAO, 1999). The proximate composition of *P. senegalensis* and *P. typus* were within this range except for the carbohydrate content. In this study, proximate composition of *P. senegalensis* and *P. typus* showed that the fish belongs to high-protein (15–20%) and lean (<2%) category. However *P. senegalensis* had a relatively higher protein content than *P. typus.* The high tissue protein content could be traced to the carnivorous nature and the high protein content of their diets (small fish, shrimps, crabs and Cephalopods). It may also be attributed to the fish consumption or absorption capability and conversion potentials of essential nutrients from their diet or their local environment into such biochemical attributes needed by the organisms' body (Adewoye and Omotosho, 1997). According to the result reported by other authors, the protein content of both species were relatively higher than that of *Tilapia guineensis* and *Tilapia melanotheron* (Adejonwo *et al*., 2010); *Pseudotolithus elongatus* (Abraham-Olukayode *et al.,* 2013)*; Clarias gariepinus, Tilapia zilli , Pentanemus quinquarius and Pseudotolithus typus* (Osibona, 2011); and *Chrysichthys nigrodigitatus* (Oramadike, 2015).

According to Ackman (1999), generally fish can be grouped into four categories according to their fat content: lean fish (<2%), low fat (2 to 4%), medium fat (4 to 8%) and high fat (>8%) hence *P. senegalensis* and *P.typus* can be classified as lean fish. The low concentration of lipids in the muscle of the fish species in this result could also be attributed to poor storage mechanism and the use of fat reserves during spawning activity (Ackman, 1989). It may also be as a result of the environment and the type of diet the fishes feed upon (Onyia *et al*., 2010). The Lipid content of both species were relatively higher than that of *T. guineensis* and *T. melanotheron* reported by Adejonwo *et al*., 2010; *P. elongatus* (Abraham-Olukayode *et al.,* 2013)*; T. zilli, P. quinquarius* and relatively less than that of *C. gariepinus* (Osibona, 2011) and *C. nigrodigitatus* (Oramadike, 2015). However the lipid content of *P. typus* was similar to the result of Osibona, 2011 on *P. typus.*

Ash is a measure of the mineral content of any food including fish. *P.senegalensis* had a relatively higher ash content compared to *P. typus.* The concentration of minerals and trace elements that contribute to the total ash content can be influenced by a number of factors such as seasonal, biological differences (size, age, sex and sexual maturity), food source and physicochemical parameters of the water where the fishes were caught (Akande and Faturoti, 2005). The observed range of ash content indicated that the species are a good source of minerals such as calcium, potassium, sodium, zinc, iron and magnesium. The ash content of both species were relatively higher than that of *T. guineensis* and *T. melanotheron* reported by

Adejonwo *et al*., 2010; *P. elongatus (*Abraham-Olukayode et al., 2013)*; T. zilli , P. quinquarius*, *C. gariepinus* and *P. typus* (Osibona, 2011) and *C. nigrodigitatus* (Oramadike, 2015).

The main composition of fish muscle is moisture. Moisture content was within previously reported range in other fishes, as the percentage moisture in fish muscles was within the acceptable level (60–80 %) in both fish samples. Osibona (2011) also reported moisture content also within the same range in *C. gariepinus*, *T. zillii*, *P. quinquarius* and *P. typus.* Food intake and amount of fat in the body of an animal are said to influence moisture level (Maynard *et al*., 1984). According to FAO (1999), moisture and lipid contents in fish fillets are inversely related to the total composition of the fish with approximately 80% and other components accounting for the remaining 20%. However, this inverse relationship was not well defined in the present study because the fish species are non- fatty fish. The moisture content of both species were relatively lower than that of *T. guineensis a*nd *T. melanotheron* reported by Adejonwo *et al*., 2010; *P. elongatus* (Abraham-Olukayode et al., 2013)*; Tilapia zilli, P. quinquarius*, *C. gariepinus* and *P. typus* (Osibona, 2011) and *C. nigrodigitatus* (Oramadike, 2015).

The crude fiber contents in the flesh of both fish species were low. Fiber is responsible for the absorption of water as well as in the provision of assistance to food matter during transit in the alimentary system (Krzynowek, et al., 1982). The crude fiber of *Citharinus citharus, Clarias anguillaris* and *Hemisynodontis membranaceus* reported by Effiong and Mohammed 2008 were relatively lower than that of *P. senegalensis* and *P. typus* in this study, however, Adeniyi *et al*., 2012 observed a relatively higher crude fibre content in *Clarias gariepinus*, *Malapterurus electricus* and *Tilapia guineensis*.

The carbohydrate in flesh of *P. senegalensis* and *P. typus* was quite high. The implication may be that the fish would yield glucose, galactose, fructose and mannose when digested; these sugars are energy producers (FAO, 2005). It may also be traced to the carbohydrate (cellulose shell) nature of the diet (shrimps, crabs and Cephalopods) of the fish species. Adeniyi *et al*., 2012 reported carbohydrate content of 3.85% for *Clarias gariepinus* which is comparatively lower than the values of the *Pseudotolithus* species studied, They also reported 8.86% of carbohydrate for *Malapterurus electricus* which is relatively higher than both species of *Pseudotolithus* and 6.85% for *Tilapia guineensis,* which is relatively higher than the value obtained for *P. senegalensis* but lower than that of *P. typus*.

The mineral elemental content of each fish specie is a function of the availability of these elements in the water body where they live and the fish physiological state (Ako and Salihu, 2004). The mineral composition content examined indicates that the species are good sources of macro elements such as calcium, potassium, sodium, phosphorus, and magnesium

and micro elements such as iron, zinc, and magnesium. The pattern of macro elements concentration in the fillets of *P. senegalensis* and *P. typus* followed the following order Ca> K> Na >P > Mg.

Calcium was observed to have appreciably dominated other minerals analysed in both *P. senegalensis* and *P. typus.* It could be inferred from the high concentration of calcium (Ca^{+}) in the tissues of the fish species that the water body from which the fishes were collected is rich in calcium (Ca^{+}). Also, the demersal nature of these species and their relative preference for consumption of hard structure organisms such as shrimps, crabs and Cephalopods could be a contributing factor. It could also probably be due to preferential accumulation and calcification of scales and hard tissues. This finding conforms to the study of Andem and Ekpo (2014) on *Periophthalmus Babarus* and the submission of Adewoye *et al.,* (2003) and Boyd and Davis (1978) on *H. niloticus* and *C. Angullaris* on calcium concentration being the highest in the tissues of the fish species. However , Adeniyi et al., 2012 reported that potassium as the most abundant macro element present in *Clarias gariepinus Malapterurus electricus* and *Tilapia guineensis.*

The concentration of Phosphorus in the fish samples examined ranked second among the mineral elements analyzed. It could be as a result of the rate at which phosphorus 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 (Adewoye and Omotosho, 1997). The richness in phosphorus level in the two species may also be attributed to the fact that phosphorous is a component of protein (Taylor, *et al*., 2002).

The concentration of the other minerals in fish muscles examined could have been as a result of the rate in which they are available in the water body and the ability of the fish to absorb these inorganic elements from their diets and the water bodies where they live (Adewoye and Omotosho, 1997; Yeannes and Almandos, 2003). This is supported by the findings of (Adewoye *et al.*, 2003; Fawole et al., 2007). It could be inferred that the mineral elemental levels of each fish species is a function of its availability in the water body in which the fish lives and the preferential accumulation of the minerals by the fish.

The micro elements such as iron, zinc and manganese varied in concentration among the two fish species studied. Iron was the predominant micro element in both fish species. This observation conformed to the findings of Adeniyi *et al*., 2012 for *Clarias gariepinus, Malapterurus electricus* and *Tilapia guineensis.* The concentration of the microelement were in this order Fe > Zn > Mn. However, it was discovered that, microelements recorded very low values; this may be due to the fact that the body needs them in trace amounts and perhaps the concentrations in the water body is very low. Most of these microelements that are present

in trace amount are equally important in body but in trace amounts as observed; but they tend to become harmful when their concentrations in body tissue exceeds metabolic demands (Ako and Salihu, 2004).

4. Conclusion.

This present study elucidates the importance of *P. senegalensis* and *P.typus* as an ideal dietetic food due to the high protein and lean quality of the raw fillet. They are also good sources of minerals and its consumption would help prevent nutritional deficiencies in humans and other consumers.

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