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Research Article
Proximate Composition and Mineral Contents of African Snakehead (*Parachanna obscura*, Gunther 1861) from Eleyele Lake, Nigeria

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Abstract

Background and Objective: *Parachanna obscura* is a member of African Channidae with great aquaculture potential in west Africa. The knowledge on chemical composition of *P. obscura* as food is very poor. Therefore, this study was carried out to determine the proximate composition and mineral contents of *P. obscura* from Eleyele reservoir, Nigeria. **Materials and Methods:** Three live samples of each sex (382.42±59.41 g) were collected monthly for one year. Samples were segregated according to sex and season and analyzed for proximate composition and mineral contents using AOAC and Atomic Absorption spectrophotometry methods. Data were analyzed using descriptive statistics and one-way ANOVA at $\alpha_{0.05}$. **Results:** The biochemical profile of *P. obscura* revealed high crude protein (23.19±1.06%), low fat (1.09±0.06%) and good level of carbohydrate (5.13±0.20%) and ether extract (7.00±0.26%). The results showed significant seasonal variation ($p>0.05$) in biochemical compositions but no marked variation ($p<0.05$) between sexes for all the samples examined. The highest proximate composition and mineral contents were recorded in wet season samples except for plasma ions (Na and K). **Conclusion:** The study showed that *P. obscura* has good nutritional contents with better nutritional value in wet season samples.

Key words: *Parachanna obscura*, proximate composition, nutritional contents, atomic absorption spectrophotometry, biochemical profile

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The African snakehead, *Parachanna obscura* is a highly priced freshwater food fish species found in West Africa. This species has a very good potential for fresh water aquaculture in this region just like Snakeheads aquaculture in Asia. The quality and taste of the fish ranks it as an edible fish hence the great interest and efforts are being enhanced in bringing African snakehead into culture in Africa[1]. Fish consumption provides important nutrient to a large number of people worldwide and thus makes a very significant contribution to nutrition[2]. Fish remain a highly nutritious, tasty and easily digested food with protein digestibility[3] of between 90 and 98%. It is also reported that most fishes based on their low fat content and high protein provide nutritional and therapeutic benefits for health problems like asthma, diabetes, cancer, coronary heart disease, hypertension, obesity, osteoporosis and iron deficiency[3,4].

Proximate composition and mineral content of fishes are used as basic indicator of fish quality. This usually involved percentage composition of basic constituents such as water, protein, lipids and ash. Also, macro elements such as sodium, potassium, calcium, magnesium and phosphate are very important mineral elements found in the form of soluble salts in the sarcoplasm of the muscular cells and intercellular fluid, blood and plasma[5]. The biochemical composition of fishes varies with diet, feed rate, genetic strain and age[6]. It has been reported that fish body constituents and energy resources vary with seasonal life cycles, climate condition and industrial growth[7]. In addition, determination of potential benefits to the consumers, the knowledge of the proximate composition of freshwater fishes in general is essential for the estimation of their energy value and for planning the most appropriate industrial and commercial processing[8]. There is very limited information on the proximate composition and mineral contents of African snakehead despite its potentials as promising aquaculture candidate in West Africa[1,2]. Hence, this study investigated the biochemical composition of *P. obscura*, which form important fisheries of Eleyele reservoir with regards to sex and season.

MATERIALS AND METHODS

Study area and sample collection: Eleyele reservoir is located in south-western part of Nigeria at Latitude 7°25'0''-7°26'15'' N and Longitude 3°50'45''-3°52'15'' E. The dam receives water during the rainy season principally from the River Ona and other associated small streams in addition to water from run-offs. Fish samples were collected on a monthly basis for 1 year (April 2015 to March, 2016) covering dry (November-March) and wet (April-October) seasons. *Parachanna obscura* (3 males and 3 females) with size range of 28.6-35.9 cm (382.42±59.41 g) were procured from the landing site.

Sample preparation: The fish samples morphometric parameters were immediately taken. After these, samples were dissected by removing the heads and viscera with a cleaned stainless steel knife. The remaining muscle tissues were chipped into small bits and minced. For proteins, ash and mineral analyses, the samples (edible part or clean central vertebra) were dried in an oven at 45°C for 48 h. These were made uniformed and mixed thoroughly in a food blender with stainless steels cutters.

Proximate composition: The percentage moisture, crude protein, ash, lipid and total carbohydrate were determined according to AOAC[9]. For the moisture content, hot air oven was used to dry the sample at 105±2°C until a constant weight was obtained. Crude protein content was determined by converting the nitrogen content obtained by Kjeldahl's method (Nx6.25). Total lipids were determined by Bligh and Dyer method using chloroform/methanol (1/1, v/v). Ash content was determined after combustion for 20 h at 550°C. Total carbohydrates were calculated by subtracting the sum of fat content, protein content, ash content and moisture from 100. All analyses were carried out on three different fish.

Mineral contents: The mineral contents were obtained from a shed sample at 550°C treated with nitric acid (HNO_3), $HClO_4$ and deionized water. Mineral content Magnesium (mg), calcium (Ca), potassium (K), phosphate (PO_4) and sodium (Na) of the digested samples was determined by flame atomic absorption spectrophotometry (PYE UnicamSp 9, Cambridge, UK). The results obtained were expressed in mg g^{-1}.

Statistical analysis: The laboratory analysis were carried out in triplicate for each item monthly and data obtained analyzed for their central tendencies, variances and correlations by analysis of variance (one-way ANOVA) using Statistical Package for Social Sciences (SPSS for Windows version 20). A probability value of $p<0.05$ was considered as significant for the components.

RESULTS

Variations in proximate and mineral compositions of male and female *P. obscura*: The variation in proximate and mineral compositions of male and female *P. obscura* is given in Table 1. The values obtained for female samples were higher than the males except for following values which were higher in males: Fiber (1.25±0.14%), magnesium (60.54±2.24%) and sodium (66.34±2.83%). However, the values obtained for all investigated parameters were not statistically significant (p>0.05) between sexes.

Seasonal variations of proximate and mineral compositions: The results in Table 2 showed the seasonal statistics of proximate and mineral compositions of *Parachanna obscura* measured during the study period. Most of the investigated parameters were significantly higher (p<0.05) in the wet season than in the dry season, i.e., protein, fibre, ash, magnesium, calcium and phosphate. Lipid (7.59±0.37), Carbohydrates (5.54±0.26), Potassium (271.25±41.05 mg g^{-1}) and Sodium (68.60±2.68 mg g^{-1}) were higher in the dry season but with no significant variation (p>0.05) between seasons.

Inter-seasonal and sexual changes in proximate compositions: There was noticeable inter-seasonal variation in proximate composition between individual sexes (Table 3). Male *P. obscura* exhibits low carbohydrate (4.41±0.42%) and lipid (6.19±0.46%) in the wet season. Female however, had high moisture (66.89±1.28%), ash (2.03±0.30%), protein (21.02±0.59%) and lipid (7.78±0.45%) than male in dry season. For mineral contents, female had higher potassium (283.11±63.49 mg g^{-1}) and sodium (66.28±3.64 mg g^{-1}) during dry season.

Correlation matrix of the proximate compositions and mineral contents: Correlation analysis of the proximate composition and mineral contents obtained in *P. obscura* is presented in Table 4. The Pearson's correlation analysis shows that some components were significantly positively or negatively correlated between themselves while some others show no marked correlation. Protein and ash showed positive significant correlation (r = 0.267, p<0.05). However, negative significant correlation was recorded between lipid and protein (r = - 0.236, p<0.05).

Table 1: Variations in proximate and mineral compositions of male and female *Parachanna obscura*

	Male		Female		
Proximate composition	Range	Mean±SE	Range	Mean±SE	Significant value
Moisture (%)	53.19-73.60	65.50±0.89	56.90-76.40	67.48±0.80	0.10
Ash (%)	1.01-8.80	3.39±0.63	1.05-9.18	3.46±0.58	0.93
Protein (%)	13.86-36.65	22.85±1.47	15.77-38.89	23.54±1.53	0.75
Fibre (%)	0.01-2.81	1.25±0.14	0.01-2.74	1.20±0.13	0.84
Carbohydrate(%)	2.31-8.82	5.07±0.30	2.43-7.88	5.19±0.27	0.77
Lipid (%)	2.41-12.72	6.79±0.38	2.31-11.55	7.21±0.35	0.42
Mg (mg g^{-1})	31.76-81.64	60.54±2.24	29.57-80.37	59.37±2.39	0.72
Ca (mg g^{-1})	65.43-358.54	157.05±12.97	44.09-371.23	164.90±14.75	0.69
K (mg g^{-1})	71.08-615.6	228.03±31.57	50.58-631.05	243.13±36.19	0.75
PO_4 (mg g^{-1})	0.13-2.16	0.98±0.10	0.22-2.05	1.03±0.09	0.69
Na (mg g^{-1})	31.72-92.26	66.34±2.83	37.19-89.31	65.78±2.18	0.86

Table 2: Seasonal variations in proximate and mineral compositions of *Parachanna obscura*

	Dry season		Wet season		
Proximate composition	Range	Mean±SE	Range	Mean±SE	p-value
Moisture (%)	53.19-76.40	65.60±0.96	56.90-75.30	67.38±0.72	0.15
Ash (%)	1.01-6.21	1.99±0.22	1.11-9.18	4.86±0.75	0.00*
Protein (%)	13.86-28.51	20.49±0.51	15.77-38.89	25.90±1.96	0.01*
Fibre (%)	0.01-2.09	0.82±0.10	0.04-2.81	1.63±0.14	0.00*
Carbohydrate(%)	2.43-8.82	5.54±0.26	2.31-7.88	4.71±0.30	0.04*
Lipid (%)	3.26-12.72	7.59±0.37	2.31-10.49	6.42±0.34	0.02*
Mg (mg g^{-1})	29.57-80.37	56.30±2.44	38.59-81.64	63.61±2.00	0.02*
Ca (mg g^{-1})	44.09-288.42	131.88±12.29	67.85-371.23	190.07±13.69	0.00*
K (mg g^{-1})	60.92-631.05	271.25±41.05	50.58-607.19	199.90±23.51	0.14
PO_4 (mg g^{-1})	0.13-2.16	0.86±0.09	0.18-2.11	1.16±0.09	0.02*
Na (mg g^{-1})	37.19-92.26	68.60±2.68	31.72-91.38	63.52±2.29	0.16

*Significant at 5% level (p>0.05)

Table 3: Inter-seasonal and sexual variations in proximate and mineral compositions of *Parachanna obscura*

	Male		Female	
Proximate composition	Dry	Wet	Dry	Wet
Moisture (%)	64.31±1.40	66.67±1.07	66.89±1.28	68.08±0.99
Ash (%)	1.96±0.33	4.82±1.13	2.03±0.30	4.90±1.03
Protein (%)	19.96±0.82	25.74±2.70	21.02±0.59	26.05±2.93
Fibre (%)	0.89±0.15	1.60±0.21	0.76±0.12	1.65±0.20
Carbohydrate (%)	5.73±0.38	4.41±0.42	5.35±0.36	5.02±0.42
Lipid (%)	7.39±0.59	6.19±0.46	7.78±0.45	6.65±0.53
Mg (mg g^{-1})	55.09±3.60	65.99±2.06	57.52±3.39	61.22±3.41
Ca (mg g^{-1})	133.69±15.20	180.41±19.96	130.07±19.77	199.74±19.03
K (mg g^{-1})	259.40±53.77	196.66±33.15	283.11±63.49	203.14±34.28
PO_4 (mg g^{-1})	0.81±0.14	1.15±0.13	0.90±0.11	1.16±0.13
Na (mg g^{-1})	70.91±3.95	61.77±3.87	66.28±3.64	65.28±3.64

Table 4: Correlation matrix of the proximate compositions and mineral contents of *Parachanna obscura*

Proximate compositions	Moisture	Ash	Protein	Fibre	CHO	Lipid	Mg	Ca	K	PO_4	Na
Moisture (%)	1										
Ash (%)	0.214	1									
Protein (%)	0.103	0.267*	1								
Fibre (%)	0.023	0.317**	0.137	1							
Carbohydrate (%)	0.356**	0.080	0.093	0.066	1						
Lipid (%)	0.106	0.017	0.236*	0.055	0.387	1					
Mg (mg g^{-1})	0.070	0.139	0.012	0.131	0.067	0.242*	1				
Ca (mg g^{-1})	0.145	0.081	0.169	0.399**	0.161	0.052	0.187	1			
K (mg g^{-1})	0.171	0.009	0.135	0.097	0.068	0.134	0.350**	0.047	1		
PO_4 (mg g^{-1})	0.233**	0.218	0.077	0.316**	0.132	0.424**	0.140	0.126	0.283*		
Na (mg g^{-1})	0.016	0.252*	0.085	0.082	0.190	0.139	0.059	0.085	0.151	0.109	1

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The range values obtained for proximate and mineral contents in this study fell within FAO[10] standard recommended limits. However, significant variation in proportion of proximate composition and mineral contents between seasons were observed. According to Zenebe *et al.*[11], the variation in the proximate composition among individuals of the same species is a common phenomenon in fish. The current moisture content corresponds with the value reported for *P. obscura*[2] in Osinmo reservoir, Nigeria. The moisture content was higher in female than male during the dry season. This was similar to Shingadia[12] on *Harpodon nehereus*, who reported higher moisture content in wet season. The protein content obtained in this study was comparatively higher than some of the Asian channidae species. Paul *et al.*[13] recorded 18.24±1.3% for *Channa striatus* and 20.50±1.20% for *Channa marulius* from Kushtia, Bangladesh. Seasonal variation in the protein content was statistically significant ($p<0.05$) while there was no significant variation between sexes. This result concurs with the findings of Nargis[14] for *A. testudineus* and Shingadia[12] for *H. nehereu.*

Generally, fibre content was higher in wet season than dry season. This was consistent with the finding of Adeniyi *et al.*[15] on *Clarias gariepinus*. The variation in lipid concentration also reflects significant seasonal difference. The lipid content obtained in this study was higher than value reported for *C. micropeltes*, *C. lucius* and *C. striata* by Firlianty *et al.*[16]. However, the mean fibre concentration recorded in the present study can be compared well with findings of Adewumi *et al.*[2] on *Sarotherodon galileaus*. Carbohydrate recorded for the present study was similar to that reported by Fapohunda and Ogunkoya[17] but higher than the values obtained by Paul *et al.*[13]. The sex and seasonal trend is similar to the findings of Nargis[14] and Shingadia[12]. Ash content showed considerable annual variation and differences within sexes were mostly insignificant ($p>0.05$). Nargis[14] reported a similar sex and seasonal variation in body flesh of *Anabas testudineus* from different areas of Rajshahi. The average ash contents were in congruence with the findings of Adewumi *et al.*[2] and Adeniyi *et al.*[15]. The range recorded for ash content indicated that *P. obscura* are a good source of minerals. Magnesium and sodium in male were slightly higher than in female. Seasonally, higher values of potassium and sodium were obtained during the dry season. Generally,

all the macro-elements investigated were higher in values than reported by Job *et al.*[18] for *Gymnarchus niloticus* and Adewumi *et al.*[2] for *P. obscura*.

CONCLUSION

The biochemical investigations revealed that *P. obscura* possesses high nutrient profile containing relatively high protein, low fat and could serve as a good source of carbohydrate, ash and essential minerals. However, the nutrient composition of the species was observed to be higher in wet season than dry season.

SIGNIFICANCE STATEMENT

This study provided important statistics on nutrient profile among sexes and seasonal changes in proximate and mineral compositions of African snakehead caught in the Eleyele Lake. The study noticed availability of high nutrients in *P. obscura* with no seasonal influence on the nutritional quality of the species. This study will help researchers to uncover the critical areas of mineral contents of *P. obscura* that many researchers were not able to explore. Thus, the species can serve as a good source of nutritional and economic value in case of vigilant handling and domestication.

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