Original article

Proximate composition, mineral content and fatty acid profile of two marine fishes from Cameroonian coast: *Pseudotolithus typus* (Bleeker, 1863) and *Pseudotolithus elongatus* (Bowdich, 1825)


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A B S T R A C T

Background: Knowledge of chemical composition of fish from Cameroon is poor. The genera *Pseudotolithus* are nutritionally and economically important in Cameroon. Thus the knowledge on their chemical composition could help in functional food elaboration.

Purpose: In this study, Proximate composition, fatty acid profiles and mineral composition were determined in two fish species, *Pseudotolithus typus* and *Pseudotolithus elongatus* from Cameroonian coasts.

Basic procedure: AOAC standard method was used. Fatty acids were identified by GC/MS as N-acylpyrrolidines. Mineral compositions were determined by atomic absorption spectrophotometry for Ca, Na, K, Mg, Fe, Zn, Cu, Mn, and by UV spectrophotometry for phosphorus (P).

Main findings: Results indicated that chemical composition was not similar in the two fish species. Results also showed that water is the main constituent in the edible parts and in the bones with 76.17% to 78.24% and 51.21% to 55.28% respectively. *Pseudotolithus typus* and *Pseudotolithus elongatus* were good sources of proteins with 16.17% and 13.4% respectively. All the fish analyzed for fat were lean with fat contents less than 0.5%. These species of fish were poor in ω6PUFA and were rich in ω3PUFA with about one third of total fatty acids. The main ω3 fatty acids were eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The most abundant main elements were the potassium in the edible parts (1.39%) and calcium in the bones (18.26%). The most abundant trace elements were Zn and Fe in the edible parts and in the bones.

Principal conclusion: The Na/K ratio values and ω3 fatty acids contents suggest that consumption of these two fish species could be recommended to prevent cardiovascular diseases.

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1. Introduction

Cameroon is a country of central Africa, situated in the heart of the gulf of guinea, with 402 km of coasts approximately. In Cameroon, fish production has been estimated to be nearly 180,000 tones/year [18]. Marine fish are widely used as food in the littoral region. The demand for fish on the market has increased due to an increase in population and their perceived nutritional values by the local populations. The nutritional and medicinal values of fish products depend on their proteins, lipids, minerals and vitamins. Fish proteins have high biological values because they are characterized by the presence of essential amino acids in good proportions [22,43,46,47]. Fishes are also richest sources of ω3 polyunsaturated fatty acids [2]. Many studies have shown that eicosapentaenoic acid (EPA or 20:5ω3) and docosahexaenoic acid (DHA or 22:6ω3) are present in important amounts in fish tissues [30, 40]. These polyunsaturated fatty acids have been shown to play a vital role in human nutrition [45]. They also have curative and preventive effects on many human diseases such as cardiovascular diseases, cancers, rheumatoid arthritis, and inflammation [12,39]. Minerals play an important role in maintaining body functions because they maintain acid–base balance, and help bond formation (hemoglobin formation) [14]. They also control the water balance in the body, help bones formation and teeth structure, and catalyze many metabolic reactions [27]. The importance of minerals as food ingredients is not only their nutritional and physiological roles, but they also contribute to food flavor and also activate or inhibit enzyme-catalyzed and other metabolic reactions, and they affect the texture of food [16]. Fish muscle and bones serve as good sources of essential minerals [15,31]. Fish minerals are mainly stocked in the skeleton and essentially in the vertebra with about 65%.

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Unfortunately, bones and heads are discarded parts of fish. Fish’s bones were analyzed for their content in minerals and for a potential valorization of sub products from fish’s flesh processing. More to that, there are people who eat both bones and flesh during their meal. Knowledge of chemical composition of fish from Cameroon is very limited. There are few reports on the genera Pseudotolithus genera which are economically and nutritionally important in Cameroon [18]. The aim of this study was to evaluate the nutritive value of two fish species belonging to the genera Pseudotolithus: P. typus and P. elongatus which are important product of fishery [28] from Cameroonians coasts and to compare the two species of fish in terms of their proximate composition, mineral composition and fatty acid profiles.

2. Materials and methods

2.1. Materials

The two fish species Pseudotolithus typus and Pseudotolithus elongatus were chosen and purchased fresh on the boats as soon as they arrived in the Douala fishing seaport in July 2014. The fish samples were put in icebox containing ice with a fish/ice ratio of 1:2, (w/w) and transported to the Laboratory of Foods Sciences and Nutrition at the Faculty of Sciences of the University of Douala, Cameroon. The average weight and length of the fish used in this study were: 293.14 ± 12.13 g and 31.68 ± 2.41 cm; 176.46 ± 4.96 g and 29.96 ± 1.56 cm for P. typus, and P. elongatus respectively, which are sizes above those consumed in many households.

2.2. Sample preparation

After morphometric measurement, fishes were dissected with a cleaned stainless steel knife. The heads and viscera were discarded. The edible part meaning flesh and skin which represent the parts consumed by the local population, was cut into small pieces and minced. Central vertebra was removed thoroughly. For lipids analyses, fresh edible part was used immediately. For proteins, ash and mineral analyses, the samples (edible part or clean central vertebra) were dried in an oven (Blender, 140–78532) at 45 °C for 48 h and were homogenized thoroughly in a food blender with stainless steel cutters.

2.3. Proximate analysis

For proximate composition, moisture content was determined using the hot air oven, by drying the sample at 105 °C ± 2 °C until a constant weight was obtained [7]. Total lipid was determined by Bligh and Dyer method using chloroform/methanol (1/1, v/v) [10]. Crude protein content was determined by converting the nitrogen content obtained by Kjeldahl’s method (Nx6.25) [4,6,11]. Ash content was determined after combustion for 20 h at 550 °C [7]. Total carbohydrate was determined by subtracting the sum of fat content, protein content, ash content and moisture from 100 [35]. All analyses were carried out on three different fish.

2.4. Fatty acid analysis

The total lipids obtained were saponified by refluxing with KOH/EtOH, 2 M for 2 h. The fatty acids obtained were converted into methyl esters by reaction with methanolic hydrogen chloride (3%) under reflux for 45 min, dissolved in hexane and purified by silica gel column chromatography with hexan/diethyl ether (10:1, v/v) as eluent or by Thin Layer Chromatography (TLC) with the same eluent. N-aclypyrolidides were prepared by direct treatment of methyl esters with pyrrolidine/acetic acid (10:1, v/v) for 2 h under reflux and purified by TLC on 0.5 mm silica gel layer, using hexane/diethyl ether (1:2, v/v) as developing solvent. GC/MS analyses of methyl esters and N-aclypyrolidides were performed on a Hewlett Packard, HP-5890 (GC) and 5989A (MS) Instrument linked to a HP 9000/345 integrator. The GC column was a DB1 (30 m × 0.32 mm × 0.25 μm). Column temperature was programmed from 170 °C to 300 °C at 3 °C/min. Carrier gas was helium. The detector and injector temperatures were at 250 °C.

2.5. Mineral analysis

Some main minerals (Ca, Na, K, P, Mg) and some trace minerals (Fe, Cu, Mn, Zn) were analyzed in the edible parts and bones of the two fish species. For mineral analysis accurately weighted ash samples were treated with nitric acid (HNO3), HClO4 and deionized water [37]. Mineral content of the digested samples was determined by flame atomic absorption spectrophotometry using a BUCK Scientific 200A apparatus for Ca, Na, K, Mg, Fe, Zn, Cu, and Mn [49] and by spectrophotometric colorimetric method using a UV spectrophotometer for phosphorus [29].

2.6. Statistical analysis

All the results expressed are the mean of three measurements. Data were presented as mean ± standard deviation. To test the differences between species, one way ANOVA was performed. Significance was established at P < 0.05. Statistical analyses were performed using SPSS 16.0 for windows (SPSS, Chicago, IL, USA).

2.7. Results and discussion

2.7.1. Proximate composition

The average weight and length (total length) of the samples used in this study: 293.14 ± 12.13 g and 31.68 ± 2.41 cm; 176.46 ± 4.96 g and 29.96 ± 1.56 cm for P. typus, and P. elongatus respectively. That shows that the fishes were of adult size. The average length at first maturity for the Pseudotolithus is approximately 23 cm; [13]. Table 1 gives the moisture, fat, protein, ash and carbohydrate contents of the edible parts and eventually bone of the two fish species.

Table 1 Proximate composition of P. typus and P. elongates.

<table>
<thead>
<tr>
<th></th>
<th>P. typus n = 3</th>
<th>P. elongus n = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Edible part</td>
<td>Bones*</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>76.17 ± 0.57a</td>
<td>51.21 ± 1.11b</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.46 ± 0.05</td>
<td>nd</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>16.17 ± 0.31</td>
<td>nd</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>7.28 ± 0.25a</td>
<td>39.30 ± 0.44c</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>0.19</td>
<td>nd</td>
</tr>
</tbody>
</table>

For the same line the values with the same letter are not significantly different (P < 0.05).
* Bones mean in this study the central vertebra.
** Not determined.
were less than those reported by [5] in P. elongatus respectively) compared to other nutrients. These values 0.36 ± 0.06 in P. typus 45.54 ± 0.35%) than in the edible parts (7.28 ± 0.25% and 7.17 ± fi

Values affected with lettera are signi
dications of Na and higher of K were observed and makes ours (1.39 ± 0.07) and calcium in the bones (18.26 ± 1.57). Lower concen-
tations of Ca, P, Mg, and Na were higher in edible parts. However, the levels of potassium (K) were higher in edible parts. Among the main elements, the most abundant were potassium in the edible part and in the bones. The level of Cu and Zn found in the edible parts of P. elongatus is lower than those reported by Ogundiran and Ojo in P. elongatus of Nigeria [33]. The microelements can be harmful in high concentrations. The concentrations of Cu, Zn, Mn and Fe in our fishes are lower than the toxic levels described by FAO/WHO, [17]. The microelements are not only toxic but also essential for human nutrition [20].

2.10. Trace elements

Trace elements are higher in bones than in the edible parts in the two fish species. Among the microelements, the most abundant were the Zn and Fe in the edible part and in the bones. The level of Cu and Zn found in the edible parts of P. elongatus is lower than those reported by Ogundiran and Ojo in P. elongatus of Nigeria [33].

2.11. Fatty acid profiles

The fatty acid profiles are presented in Table 3. Thirty eight fatty acids were identified in the two fish species as N-acyl pyroliroldides, with 33.8 ± 0.23% saturated fatty acids (SFA), 32.43 ± 0.27% monounsaturated fatty acids (MUFA), and 33.41 ± 0.23% polyunsaturated fatty acids (PUFA) in P. typus and 50.93 ± 0.45% SFA, 18.9 ± 0.33% MUFA and 29.57 ± 0.54% PUFA in P. elongatus. The SFA were higher in P. elongatus than in P. typus. The MUFA and PUFA were higher in P. typus than in P. elongatus. There were significant differences (P < 0.05) between SFA and MUFA, and no significant differences (P > 0.05) among the PUFA in the two fish species. The results showed significant differences among SFA, MUFA and PUFA in P. elongatus. All the polyunsaturated fatty acids belonged to ω3 and ω6 series. The content found for ω3 PUFA ranged from 22.9 ± 0.2 for P. elongatus to 28.8 ± 0.26% for P. typus. These two species of fish were poor in ω6PUFA with about 5%, and were rich in ω3PUFA with about one quarter and one third of total fatty acids percentage in P. elongatus and P. typus respectively. This characterizes the marine fish species which have high percentages of ω3PUFA and less of ω6PUFA compared to fresh water fish which have high percentages of ω6 and less of ω3PUFA [21,41]. The most abundant ω3PUFA were eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) with 10.47 ± 0.15% and 9.17 ± 0.70% for EPA, 7.47 ± 0.15% and 6.2 ± 0.62% for DHA. Another important result obtained was the high levels of the PUFA/SFA ratio at 0.99 and 0.58 in P. typus and P. elongatus respectively, and the ω3/ω6 ratio 6.24 and 3.44 in P. typus and P. elongatus respectively ranging in the ideal ratio [24]. These findings make these two fish species or their oils important to prevent or to fight against cardiovascular diseases [12,39,42].

2.12. Conclusion

There was a lack of information about the chemical composition of Pseudotolithus typus and Pseudotolithus elongatus from Cameroonian coasts. In the present study, the nutritional values of both species were evaluated. This study shows that the investigated fish species are good sources of many major nutrients and essential elements. They

2.8. Mineral content

Table 2 gives the mineral content (main and trace elements) in the edible part and bones of P. typus and P. Elongatus.

<table>
<thead>
<tr>
<th>Element</th>
<th>P. typus Edible part</th>
<th>P. typus Bones</th>
<th>P. elongatus Edible part</th>
<th>P. elongatus Bones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ca (%)</td>
<td>0.19 ± 0.10</td>
<td>0.02 ± 0.05</td>
<td>0.04 ± 0.05</td>
<td>0.02 ± 0.05</td>
</tr>
<tr>
<td>Mg (%)</td>
<td>0.12 ± 0.02</td>
<td>0.13 ± 0.01</td>
<td>0.03 ± 0.01</td>
<td>0.03 ± 0.01</td>
</tr>
<tr>
<td>K (%)</td>
<td>1.39 ± 0.07</td>
<td>1.12 ± 0.05</td>
<td>0.31 ± 0.01</td>
<td>0.31 ± 0.01</td>
</tr>
<tr>
<td>P (%)</td>
<td>0.70 ± 0.19</td>
<td>0.77 ± 0.35</td>
<td>0.11 ± 0.04</td>
<td>0.11 ± 0.04</td>
</tr>
<tr>
<td>Na (%)</td>
<td>0.27 ± 0.00</td>
<td>0.01 ± 0.01</td>
<td>0.01 ± 0.01</td>
<td>0.01 ± 0.01</td>
</tr>
<tr>
<td>Na/K ratio</td>
<td>0.19 ± 0.00</td>
<td>0.19 ± 0.00</td>
<td>0.23 ± 0.01</td>
<td>0.23 ± 0.01</td>
</tr>
<tr>
<td>Zn (μg/g)</td>
<td>12.49 ± 0.80</td>
<td>17.00 ± 1.87</td>
<td>14.70 ± 1.87</td>
<td>14.70 ± 1.87</td>
</tr>
<tr>
<td>Cu (μg/g)</td>
<td>0.53 ± 0.02</td>
<td>2.74 ± 0.86</td>
<td>2.64 ± 0.25</td>
<td>2.64 ± 0.25</td>
</tr>
<tr>
<td>Mn (μg/g)</td>
<td>1.34 ± 0.03</td>
<td>27.53 ± 4.21</td>
<td>15.21 ± 0.24</td>
<td>15.21 ± 0.24</td>
</tr>
<tr>
<td>Fe (μg/g)</td>
<td>18.93 ± 2.93</td>
<td>34.24 ± 1.14</td>
<td>30.94 ± 8.21</td>
<td>30.94 ± 8.21</td>
</tr>
</tbody>
</table>

Values affected with lettera are significantly different (P < 0.05).

* Bones mean in this study the central vertebra.
are rich in proteins and in ω3 polysaturated fatty acids including high percentage of eicosapentaenoic acid and docosahexaenoic acid. These species can be recommended for human consumption and health.

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Conflicts of interest

None.

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References


[18] FAO, Profile de La pêche Au Cameroun, FAO, Rome, Italy, 2007 (33 pp.).


