Proximate composition and organoleptic assessment of Snakehead (*Parachanna obscura* Gunther, 1861) smoke-dried with different processing materials

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Abstract

This study examined the effects of three different drying/processing materials (sawdust, charcoal and electric oven) on the proximate composition and organoleptic properties of *Parachanna obscura*. Samples of *P. obscura* with mean weight of 283±74.80 g were procured from fish mongers at the fishermen’s landing site at Ode Ekiti, Gbonyin Local Government Area, Ekiti State, Nigeria and were transported to the laboratory of the Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko, Nigeria. In the laboratory, the fishes were cleaned, gutted, sorted, rinsed thoroughly with water, divided into three groups of five fish, soaked in 10 % brine solution for 2 min, drained and placed on wire gauze. Each group was dried for 4 hours at 60 ℃ with sawdust, charcoal and electric oven respectively. The proximate compositions were determined using standard methods while the organoleptic properties of the samples were determined by subjecting the labelled processed fish samples to sensory evaluation by a trained test panel on a five-point hedonic scale. The proximate analyses revealed that fish samples dried with sawdust and charcoal had higher scores for ash than oven dried fish in comparison with the control. The protein content of oven dried sample was higher than smoke-dried samples. The results of the organoleptic evaluation obtained revealed that there was no significant difference among the sensory parameters and concluded that electric oven could be a suitable method of fish processing without the loss of the major nutrients and sensory qualities.

Keywords: *Parachanna obscura*; Smoking; Oven drying; Proximate; Organoleptic

1 Introduction

Fish is an important foodstuff especially in the developing countries because it contains a high content of protein required in the diets of man and other essential nutrients, such as, Vitamins, fats, minerals and nutritional value of unsaturated fatty acid which help in the maintenance of life [1, 2; 3]. Fish, beef and poultry meat are staple animal protein foods but fish forms a cheap source of protein for the poor households in urban or semi – urban areas [4; 5]. Fish is generally appreciated as one of the healthiest and cheapest source of protein and it has essential amino acids (Lysine, Methionine, Cysteine, Threonine and Tryptophan), micro and macro elements (Calcium, Phosphorus, Fluorine, Iodine) that among other benefits have a hypcholesterotemic effect (antiarteriosclerosis [6; 7]. Apart from its food value, fish has been reported to possess medicinal values for treatment of different ailments as reported by [8]. This calls for studies on the nutritional status of different fish species for its maximum utilization since fish nutritional composition varies and is based on age, source, feeding habit, size, sex and sexual variations due to spanning, environment and season. The proximate profile and other nutritional contents of fish must also be within the range of

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dietary requirement and commercial specification before it can be generally be acceptable for consumption [3; 9; 10; 12; 13; 14; 15]. In spite of the valuable nutrients derivable from fish, fish is an extremely perishable food commodity as it is highly susceptible to autolysis, rancidity as a result of oxidation of fat which creates unpleasant odours and flavours. Smoke drying contributes greatly to fish preservation by acting as an effective antioxidant, microbiocidal agent, protective film on fish surface, longer shelf-life, desirable coloration, taste, odour and preventing spoilage [1;16]. Smoked fish products are common and possess the largest volume in the processed fish markets in many developing nations in the world. Their finished forms can be packaged, stored and shipped which explains their long lasting presence especially in many less developed countries of, the world, including Nigeria. The objectives of fish processing procedures should be to impact the desired sensory characteristics to the product uniformly, without undue variation from batch to batch and to extend product shelf life [17]. Snakehead (Parachanna obscura Gunther, 1861), of the Family Channidae, is among the species of freshwater fishes commonly utilized in fish culture especially in developing countries where they are cultivated for food. The species is considered as a potential aquaculture species in Africa for its high quality flesh and nutritional value [18]. Victor and Akpocha and others [19; 20; 21] worked on some aspects of the biology of the species and found out that the species fed mainly on insects, fish and other invertebrates. The proximate analyses of a variety of fish species in Nigeria have been reported [18; 22; 23; 24; 25; 26; 27] while the effects of some processing methods on such analyses had been documented in earlier literatures [28; 29]. This study, which assessed the proximate composition and organoleptic assessment of Snakehead exposed to different processing materials, is an effort to provide information on one of the important fish species in Egbe Reservoir, Ode-Ekiti, Gbonyin Local Government Area of Ekiti State, Nigeria

2 Materials and methods

2.1 Sample collection

Samples of Parachanna obscura with the mean weights of 283±74.80 g were obtained fresh from the landing site of artisanal fishermen operating on Egbe Reservoir, Ode-Ekiti, Gbonyin Local Government Area of Ekiti State. The fish were collected in ice inside plastic containers and immediately transported to the laboratory of the Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. The standard length and total length of the samples were determined. Charcoal and sawdust used for the generation of heat and smoke were obtained from sawmill at Oka-Akoko, Ondo State.

2.2 Preparation of fish for smoking

The fish samples were eviscerated, carefully washed with water to remove blood and mucus, split in half and their dressed weight calculated. The samples were randomly grouped into three batches of equal size: Sawdust (Group A), Charcoal (Group B) and Electric oven (Group C). The fish were laid out on trays, covered with cartons to keep flies and dust out, and then smoked for further investigation. The mean total length (26.74±1.14 cm) and standard length (23.13±1.04 cm) and other measurements of the samples are as shown in Table 1.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>All samples (n=15)±STD</th>
<th>Group A (Sawdust) (n=5)±STD</th>
<th>Group B (Charcoal) (n=5)±STD</th>
<th>Group C (Electric oven) (n=5)±STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length (cm)</td>
<td>26.74± 1.14a</td>
<td>26.58± 0.99a</td>
<td>26.64± 1.16a</td>
<td>27.00± 1.45a</td>
</tr>
<tr>
<td>Standard length(cm)</td>
<td>23.13± 1.04a</td>
<td>23.30± 1.20a</td>
<td>22.90± 0.74a</td>
<td>23.20± .1.30a</td>
</tr>
<tr>
<td>Body weight (g)</td>
<td>283± 74.80a</td>
<td>280± 83.66a</td>
<td>290± 74.16a</td>
<td>280± 83.66a</td>
</tr>
<tr>
<td>Dressed weight (g)</td>
<td>202± 76.73a</td>
<td>194± 82.34a</td>
<td>212± 77.91a</td>
<td>200± 86.89a</td>
</tr>
<tr>
<td>Weight after processing (g)</td>
<td>79.66± 4.84a</td>
<td>82.40± 3.66a</td>
<td>76.60±6.22a</td>
<td>80.00± 2.94a</td>
</tr>
<tr>
<td>Total weight</td>
<td>107.66±1.33a</td>
<td>103.6±0.27a</td>
<td>117.4±0.66a</td>
<td>102±0.79a</td>
</tr>
<tr>
<td>Loss (g) % weight loss</td>
<td>7.59±1.21</td>
<td>7.4±0.93</td>
<td>8±0.25</td>
<td>7.28±0.36</td>
</tr>
</tbody>
</table>

Means with the same letter horizontally are not significantly different. (P > 0.05)
2.3 Brine preparation

The three groups of fish (each comprising five pieces) and were soaked in 10% brine solution for 2 min, drained and placed on wire guaze in preparation for smoking.

2.4 Smoking process

The firing section of the smoking kiln was filled with saw-dust to generate heat for smoking. Fish was introduced into the smoke house (pre heated for 15 minutes). The temperature of the smoking chamber was maintained at 60 °C using a thermometer and by adjusting the burning saw dust. The fish was smoked for 4 hours accompanied with turning over of the fish at intervals to prevent charring, thereby obtaining uniformly smoked fish. Smoked samples were removed from the kiln. The same procedure was followed in the drying of the second batch of the fish using charcoal. The third group was oven dried with an electric oven (model No: S-94S22OVV 50HZ 1280W) at 60 °C for 4 hours. All smoked samples were allowed to be cooled overnight.

2.5 Proximate Analysis

The proximate composition was assayed as described by AOAC (2005). All reagents used were of analytical grade and supplied by Sigma Co (St. Louis U.S.A). Each analysis was carried out in triplicate.

2.6 Sensory (Organoleptic) Evaluation

The organoleptic evaluation of the smoked samples was carried out using a using a semi trained panel comprised of 20 individuals, after the third day of storage. Parameters, such as, flavour, texture, odour, appearance and general acceptability were used to compare the organoleptic characteristics of the products. The questionnaires were prepared using a 5-point hedonic scale [30]. The points are as outlined below: Very good (5), Good (4), Moderate (3), Bad (2), and Very bad (1). Each panellist was requested to rinse the mouth with water after tasting for each fish sample to avoid bias in judgment or evaluation.

2.7 Data analysis

The data obtained were analysed using SPSS version 20.0 software. One-way analysis of variance (ANOVA) test was used to find the difference between the means at significance level of p<0.05.

3 Results and discussion

3.1 Biometric and processing yields

The body weight of the fish samples of *P. obscura* used for this study ranged from 200 g- 400 g with a mean of 283±74.80 g. The samples were sorted into three groups of equal size (Sawdust for Group A, Charcoal for Group B and Electric oven for Group C). The mean total and standard lengths were 26.74± 1.14 and 23.13± 1.04 cm respectively for all samples as shown in Table 1. The body weight for all sample ranged from 280±83.66 g to 290±74.16 g with a mean of (283±74.80 g) while the dressed weight ranged from 194±82.34 g to 212±77.91 g for the groups with a mean of (202±76.73 g). The fish weight after processing ranged from 76.60±6.62 g to 82.40±3.66 g with a mean of (8±0.25 %) obtained for sample B processed with charcoal was the highest, followed by the percentage weight loss (7.4±0.93 %) recorded for group A. Group B had the least percentage weight loss (7.28±0.36 %). The percentage moisture content (64.06 %) of fresh *P. obscura* obtained in this study was lower than the value (68.61 %) (Table 1) obtained by [31]. The percentage crude protein of fresh fish sample was (22.66 %) which might be attributed to the fact that the fish species is a piscivore. The lowest ash content (1.41 %) found in the fresh fish was statistically different in comparison to the other processed samples. A comparison of the fat content of *P. obscura* with *Synodontis* and *Clarias* indicated that *P. obscura* had a higher fat content. Zuraini et al., 2006 [32] reported a high fat content in *Channas traitus* and showed that the genus Channa seemed generally to have a high fat content. Ama-Abasi and Ogar, [18] in support of the above statement recommended that *P. obscura* should be a major constituent in the meals of post natal and recuperating patients. The percentage crude fibre content of the fresh fish sample (1.84 %) was significantly low when compared with the processed samples. It was observed that the percentage moisture content of *P. obscura* processed with charcoal was 6.62 % (Table 2). The moisture value was higher than that observed in oven dried (4.20%). This trend is similar to what was observed by early Researchers [34; 35] in *C. gariepinus*. Abolagba et al., [36] stated that the high level of protein in fish is as a result of the high quality diet with protein rich ingredients, such as, fish meal, soya bean cake, groundnut cake. The quality of fish protein is superior to that which could be obtained from milk, meat and eggs. It is reported in literature that fishes have a well-balanced amino acid profile and the needed minerals, as well, as fatty
acids [37]. The results obtained in this study showed that oven dried *P. obscura* had a crude protein of 60.24% which was significantly higher than 53.18% found in *P. obscura* processed with charcoal induced smoke. The protein composition of fish is affected by a diversity of factors such as size, sexual maturation, temperature, salinity,

**Table 2** Mean proximate compositions of *Parachanna obscura* smoked with different materials

<table>
<thead>
<tr>
<th>Samples</th>
<th>Moisture</th>
<th>Ash</th>
<th>Fat</th>
<th>Protein</th>
<th>Crude fibre</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Wet) fish</td>
<td>64.06±0.01d</td>
<td>1.41±0.02a</td>
<td>7.80±0.01a</td>
<td>22.66±0.05a</td>
<td>1.84±0.01a</td>
<td>2.20±0.04a</td>
</tr>
<tr>
<td>Sawdust dried fish</td>
<td>5.84±0.00b</td>
<td>10.23±0.1c</td>
<td>22.09±0.01c</td>
<td>54.11±0.01c</td>
<td>3.41±0.02c</td>
<td>4.30±0.03c</td>
</tr>
<tr>
<td>Charcoal dried fish</td>
<td>6.62±0.01c</td>
<td>11.09±0.1d</td>
<td>23.11±0.02d</td>
<td>53.18±0.02b</td>
<td>2.32±0.03b</td>
<td>3.66±0.02b</td>
</tr>
<tr>
<td>Electric oven dried</td>
<td>4.20±0.00a</td>
<td>8.67±0.03b</td>
<td>16.40±0.02b</td>
<td>60.24±0.02d</td>
<td>5.07±0.01d</td>
<td>5.42±0.03d</td>
</tr>
</tbody>
</table>

Values in columns with different superscripts are significantly different at (p<0.05)

exercise, ration, time and frequency of feeding, starvation, type and amount of dietary ingredients [38]. The percentage crude fibre content was highest (5.07 %) in the sample processed with electric oven while the samples processed with charcoal had the least (2.32%). The result also showed that the percentage ash content (11.09 %) of the studied fish processed with charcoal ranked highest in comparison to sample smoked with sawdust smoke (10.23 %) and oven dried (8.67 %). The samples of *P. obscura* exposed to charcoal smoke yielded the highest crude fat value of 23.11 % compared with the values (22.09 % and 16.40 %) observed in the samples dried with sawdust and oven respectively. This is in agreement with the work of Akinneye et al., [39] on *Sardinella* spp and Ogbonnaya, (40) on *Oreochromis niloticus* and *C. gariepinus*. The trend observed in this study is in contrast with what was observed by [35] on *C. gariepinus*. The relatively low values of carbohydrates could be due to higher values of moisture and the relatively high value of protein contents. The low carbohydrate values could be due to the fact that glycogen does not contribute much to the reserves in the fish body tissue [33; 41]. A good source of instant energy is found in the carbohydrates, which are also useful in body development and growth. It was observed that the percentage nitrogen free extract or carbohydrate observed in oven dried sample (5.42 %) ranked statistically higher than the sample processed with sawdust (4.30 %) and charcoal (3.66 %), which is in agreement with the observations of [41] and [42]. Ash is a measure of the mineral content of any food, including fish [43]. Ash is the inorganic residue that remains after the organic matter has been burnt off which was found in little non-significant traces in the fish studied. The ash content of smoke dried *P. obscura* processed with charcoal (11.09%) was significantly different from the ash content of oven dried sample (8.67%). This was similar to the works [39; 44] on Bonga spp., *Sardinella* spp. and *Heterotis niloticus*. The concentrations of minerals and trace elements that contribute to the total ash contents are known to vary in fish depending on their feeding behaviour, environment, ecosystem and migration even within the same area [45; 46].

### 3.2 Organoleptic assessment/Sensory evaluation

The sensory evaluation showed that *P. obscura* processed with the three different materials was organoleptically acceptable. According to the panel’s evaluation, there was no significant difference (P<0.05) in terms of appearance, aroma, taste, texture, as well as general acceptability (Table 3). The result in Table 3 showed that the taste of the batch of *P. obscura* dried with electric oven was distinctively better than the other samples dried with charcoal and sawdust.

**Table 3** Sensory evaluation of *P. obscura* processed with three different materials

<table>
<thead>
<tr>
<th>Attributes A(n=20)±SD</th>
<th>Sawdust</th>
<th>Charcoal B (n=20)±SD</th>
<th>Electric oven (n=20)±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>4.00±0.79a</td>
<td>4.20±0.76a</td>
<td>4.25±0.91a</td>
</tr>
<tr>
<td>Aroma</td>
<td>4.00±1.07a</td>
<td>3.85±0.98a</td>
<td>4.15±0.81a</td>
</tr>
<tr>
<td>Taste</td>
<td>4.00±0.72a</td>
<td>4.15±1.03a</td>
<td>4.40±1.14a</td>
</tr>
<tr>
<td>Texture</td>
<td>3.75±0.71a</td>
<td>4.00±0.72a</td>
<td>4.1±0.91a</td>
</tr>
<tr>
<td>Acceptability</td>
<td>4.35±0.58a</td>
<td>4.40±0.94a</td>
<td>4.50±0.93a</td>
</tr>
</tbody>
</table>

Means with the same letter horizontally are not significantly different (P > 0.05)
According to Karim et al. [47], flavour is an important factor in consumer’s acceptability. The factors that influence the quality of smoked fish products include the properties of fish flesh, maturity, age, sex, seasonal variations, smoking procedure/wood type, composition of smoke, temperature, humidity, velocity and density of the smoke [48]. The most important contributions of sensory attribute to eating quality are tenderness with flavour and juiciness (49). The taste of smoked fish could be attributed to the fuel source and the controlled drying rate as reported by [50] who studied the influences of two different drying methods (smoking kiln and electric oven). The mean appearance/colour observed in species dried with electric oven was significantly higher than that obtained in the charcoal and sawdust. The trend observed in all the drying facilities were similar to the values observed by Akande et al., [51] for smoked Pseudotolithus senegalensis and Obande et al., (52) for C. gariepinus. The mean texture for P. obscura dried in the electric oven was significantly higher than the samples processed with charcoal and sawdust. Also, the mean aroma of sample processed with electric oven had a higher value than the values obtained from drying with sawdust and charcoal. The aroma perceived could be attributed to the type of smoke generated by the source of energy of the smoking kiln (charcoal and sawdust) [52]. In this study, the acceptability of P. obscura processed with electric oven appeared to have influenced the scores by the panelists that supported that the fish so processed had the best of the attributes studied.

4 Conclusion

The study showed that there were significant influences on the proximate composition of P. obscura processed with electric oven making it nutritionally suitable. The organoleptic assessment showed that oven drying was more acceptable by the consumers for taste, aroma, colour /appearance, texture and general acceptability as it was more preferred to samples processed with charcoal and sawdust. The appropriate processing method of fish samples could lead to improvement in revenue generation, sustainable development in rural communities, poverty alleviation and proper utilization of fish product. The cultivation of P. obscura and its proper processing would create income, boost sustainable development, and aid in poverty alleviation in rural communities.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

No conflict of interest declared.

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