

Effect of Traditional smoking Method on Nutritive Values and Organoleptic Properties of Sarotherodon galilaeus and Oreochromis niloticus

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Abstract

Fish deterioration or spoilage is one of the greatest problems facing the fishing industry in Nigeria, and since ancient times, smoking has been used to preserve fish products and improve their taste, aroma and colour. The present study was carried out to determine and compare the effects of traditional smoking kiln on nutritional properties and sensory characteristics of Sarotherodon galilaeus and Oreochromis niloticus. A drum type smoking kiln was used for fish smoking. Raw and smoked fish samples were subjected to nutritional analysis and sensory evaluations. Nutritional analysis showed that the crude protein value of smoked O. niloticus ($47.69 \pm 0.13\%$) was significantly ($P < 0.05$) lower than the smoked S.galilaeus ($50.12 \pm 0.31\%$) while the crude fat values of S.galilaeus was slightly higher than the O. niloticus. The value of nitrogen free extract of S.galilaeus was higher than the value of O.niloticus with mean values of $18.00 \pm 0.02\%$ and $0.32 \pm 0.01\%$ recorded respectively while the metabolizable energy value of S. galilaeus was significantly ($P < 0.05$) higher than O.niloticus. Sensory evaluation results revealed that smoked S. galilaeus was better in terms of juiciness and overall acceptability while O. niloticus had higher values in term of flavour, tenderness and texture. Based on the results of the study, smoked S. galilaeus and O. niloticus were nutritionally comparable. The results also showed that traditional smoking method is an important preservation method which could enhance the nutritive values of fishes and possibly reduce post-harvest losses.

Keywords: Proximate composition, *Sarotherodon galilaeus*, *Oreochromis niloticus*, smoking, sensory evaluation.

Introduction

Nigeria is richly blessed with an extensive network of rivers/tributaries, natural and man-made lakes, coastal waters and offshore waters, which are abundant in fin-fish and shell-fish resources (Arawomo, 2004). Yet, fish supply in Nigeria is in a crisis because of post-harvest losses. Akande *et al.* (1998) reported that about 40% of fish caught in Nigeria is lost

to post-harvest losses which do not get to customers in a wholesome state.

Preservation of fishes is a very important part of commercial fisheries (Pandey and Shukla, 2005). Currently, smoking is the main method of fish preservation in the artisanal sector. According to FAO (1977), smoke curing includes all the processes starting from the raw material stages to the final smoking

which result in changes in colour, flavour and texture of the fish. It is a method of preservation effected by combination of drying and decomposition of naturally produced chemical resulting from thermal breakdown of wood (Tobor, 2004).

Smoking activities are carried out using locally constructed oven such as the traditional oven such as the traditional (open fire banda), mud ovens and cut-up barrels (Essuman, 1992). Traditional fish smoking kilns are poorly constructed and lack mechanisms for the control of smoke and heat production, all of which affect the efficiency of smoking and the quality of the final products.

However, little is known about the nutritional values of the fish that are smoked with those locally constructed ovens. According to Eyo (2001) most of the works on the nutritional value of smoked has centered on lysine. As consumers are becoming more aware of their food, better understanding and analysis of the variations in quality and safety have become essential. It is against this background that this study

Smoking was done using red hot charcoal obtained from camelena (*Gmelera aborea*) wood with the traditional smoking kiln (oil drum) (Eyo, 2001). Fish samples were smoked whole because of their sizes. Smoking of fishes was carried out for 4 hours, with smoking temperature ranging between 60⁰ C and 100⁰ C. For each species, 100 g of smoke –dried fish flesh, which was cut from the left side of the fish between the

Organoleptic Assessment

After the smoking operation, sensory evaluations of the samples from the

aimed at determining and comparing the nutrient composition and organoleptic characteristics of two economic important fish species in Oyan dam; *Oreochromis niloticus* and *Sarotherodon galilaeus*, smoked in a locally constructed oven.

Materials and Methods

Samples of the fish species (*Oreochromis niloticus* and *Sarotherodon galilaeus*) that were used for this study were purchased from a landing site of Oyan Dam, Ogun State. Twenty samples of each species with average body weight of 181.25±12.71 g and length of 17.13±0.29 cm were collected in polyethylene bags early in the morning, cold stored and transported to the Fishery Laboratory of College of Agricultural Sciences, Olabisi Onabanjo University, Yewa Campus, Ayetoro. The fish were then gutted and thoroughly washed with clean tap water, brined and ready for smoking while fresh samples from raw materials for chemical analysis were immediately prepared.

dorsal fin and the operculum, were analyzed.

Proximate Analysis

The proximate components and metabolizable energy (M.E) of raw and smoked fish samples were carried out in triplicates in accordance with the methods of AOAC (1995) . The fat content was extracted by the Bligh and Dyer (1959) method as modified by Kates (1986).

two fish species were carried out with twenty trained individuals. The panelists evaluated each of the 2 species (*O. niloticus*

and *S. galilaeus*) for colour, flavour, tenderness, juiciness, texture and overall acceptability. A five-point hedonic scale (Clucas, 1981) describing the score of attributes of the smoked fish samples as: very bad (1 point), bad (2 points), satisfactory (3 points), good (4 points), very good (5 points), excellent (6 points) was used. .

Statistical Analysis

Data collected for the proximate analysis in triplicate are expressed in means (\pm SD) and compared by student's t- test ($P < 0.005$) of SAS (1998).

Results

Proximate composition of raw and smoked *O. niloticus* and *S. galilaeus*

The mean proximate compositions of raw *S. galilaeus* and *O. niloticus* are given in Table 1. The crude protein contents of the two fish species were comparable (18.00 ± 0.15 vs. 17.53 ± 0.28 %). The ash content (2.59 ± 0.06 %), nitrogen free extract (95.71 ± 0.10 %) and metabolizable

energy (888.1 ± 0.09) of *S. galilaeus* were significantly ($P < 0.05$) higher than the corresponding values for *O. niloticus*. The moisture content of (74.47 ± 0.09) and fat content (0.41 ± 0.09 %) of raw *O. niloticus* were, however, significantly ($P < 0.05$) higher than the corresponding values for *S. galilaeus*. Smoked *S. galilaeus* had significantly ($P < 0.05$) higher crude protein content (50.12 ± 0.35 %), ash content (8.68 ± 0.09 %), nitrogen free extract (18.00 ± 0.02) and metabolizable energy (3387.29 ± 1.10 cal/g) (Table 2).

Table 3 shows the organoleptic characteristics of smoked and *O. niloticus*. The panelists assessment rated smoked *O. niloticus* was rated higher than *S. galilaeus* in terms of flavour (3.75 ± 0.23 vs. 2.80 ± 0.18), tenderness (5.10 ± 0.38 vs. 4.50 ± 0.38), texture (4.10 ± 0.37 vs. 3.70 ± 0.43) and colour (2.55 ± 0.37 vs. 1.95 ± 0.26). In terms of general acceptability and juiciness scores however, smoked *S. galilaeus* were rated higher smoked *O. niloticus*.

Table 1: Proximate composition of Raw *S. galilaeus* and *O. niloticus*

Variables	<i>S. galilaeus</i>	<i>O. niloticus</i>
Crude protein content %	18.00 ± 0.15	17.53 ± 0.28
Crude fat content%	0.19 ± 0.14^a	0.41 ± 0.09^b
Crude fibre content %	0.03 ± 0.06^a	0.35 ± 0.02^b
Ash content %	2.59 ± 0.06^a	1.53 ± 0.03^b
Moisture content %	72.34 ± 0.17^a	74.47 ± 0.90^b
Nitrogen free extract%	5.71 ± 0.10^a	5.09 ± 0.05^b
M. Energy (cal/g)	888.29 ± 0.09^a	874.30 ± 3.84^b

*Means in the same row with similar superscripts are not significantly different

Table 2: Proximate composition of smoked *S. galilaeus* and *O. niloticus*

Variables	<i>S. galilaeus</i>	<i>O. niloticus</i>
Crude protein content %	50.12 ± 0.35 ^a	47.69 ± 0.13 ^b
Crude fat content%	10.44 ± 0.16	10.21 ± 0.31
Crude fibre content %	0.10 ± 0.03 ^a	0.52 ± 0.07 ^b
Ash content %	8.68 ± 0.09 ^a	6.03 ± 0.02 ^b
Moisture content %	11.21 ± 0.16 ^a	38.36 ± 0.44 ^b
Nitrogen free extract%	18.00 ± 0.02 ^a	0.32 ± 0.01 ^b
M. Energy (cal/g)	3387.29 ± 1.10 ^a	2651.30 ± 0.99 ^b

*Means in the same row with similar superscripts are not significantly different

Table 3: Sensory evaluation of the Smoked *S. galilaeus* and *O. niloticus* by sensory panelist

Variables	<i>S. galilaeus</i>	<i>O. niloticus</i>
Colour	1.95 ± 0.26	2.55 ± 0.37
Flavour	2.80 ± 0.18	3.75 ± 0.23
Tenderness	4.50 ± 0.38	5.10 ± 0.38
Juiciness	4.40 ± 0.48	3.75 ± 0.19
Texture	3.70 ± 0.43	4.10 ± 0.37
Overall acceptability	7.00 ± 0.36	6.30 ± 0.24

Discussion

The nutritional value of fish meat comprises the contents of moisture, dry matter, protein lipids, vitamins and minerals plus the caloric values of the fish (Chandrahekar and Deosthade, 1993). The crude protein content of *S. galilaeus* was higher than the crude protein content of *O. niloticus*, both in raw and smoked forms. The nutritional value of the freshwater fish has been reported (Zenebe *et al.*, 1998) to differ between species, sexes, sizes, season and geographical localities. The protein contents of the two species in this study were 17.53 % and 18.00%. These values are similar to those reported by Fashina-Bomobata and Megbewon (2012) for *Tilapia* species. The fat contents of raw experimental fish species were low; 0.19 ± 0.14 and 0.41 ± 0.09 % for *S. galilaeus*

and *O. niloticus* respectively. Similar results were obtained by Ali *et al.* (2011). The moisture contents of the raw fish species also agreed with values ranging from 74.37% to 78.11% reported by Afolabi *et al.* (1984) for *Tilapia zillii*, *Hemichromis fasciatus*, *S. galilaeus*, *Oreochromis niloticus* and *Tilapia mossambicus*. These reports further support the fact that higher moisture and lower protein and fat contents are characteristic of wild fish populations.

The crude protein and crude fat contents of smoked fish samples were higher than the corresponding values for raw fish samples. This could be attributed to the extent of drying which lowered moisture and concentrated proteins. Similar results were obtained by Thot and Pothast (1984). Relative lipid content of fish has been

reported by Eyabi-Eyabi (1998) to increase with smoking. The crude protein of the smoked fish species were 47.69 ± 0.13 and 50.12 ± 0.35 %. These compare with similar values reported by Clifford *et al.* (1980) and Eyo (2001). However, the fat content of smoked samples (*S. galilaeus*, 10.44 ± 0.16 %; *O. niloticus*, 10.21 ± 0.31 %) were higher than the corresponding values of 5.09 and 5.42 % reported by Souza *et al.* (2005) for smoked fillet of the Nile tilapia. The distribution of fat on the surface of the fish is known to change during the smoking process and with a possible modification of smoke absorption (Ikeme and Gugnani, 1988). The moisture content of raw samples was higher than smoked samples. According to Sigurgisladottir *et al.* (2000), the weight loss is due to dehydration during smoking. This is known to vary, depending on several factors such as, origin of raw material, final product characteristics and parameters used in the process, time and temperature. Smoked fish samples were higher in ash than raw samples. Karra (1978) found that ash content increased in dog fish from 1.19 – 4.75% after smoking. The significant increase in metabolizable energy values in smoked *S. galilaeus* when compared with the smoked *O. niloticus* indicates a higher concentration of calories. The results of sensory evaluation rated *O. niloticus* higher than *S. galilaeus* in terms of colour, flavor, tenderness and texture. Food colour helps to determine quality, degree of processing or spoilage level (Clifford *et al.*, 1980). Flavour is a combination of odour and taste and is considered an important factor in consumer acceptance of smoked fish. In terms of juiciness and overall acceptability however, *S. galilaeus* was rated higher than *O. niloticus*.

Conclusion

S. galilaeus and *O. niloticus* possessed comparative nutritive values. In terms of organoleptic properties, *O. niloticus* had an edge over *S. galilaeus* while the trend was reversed in terms of juiciness and overall acceptability. The results however indicate that traditional smoking method is an important preservation method which could enhance the nutritive values of fishes and possibly reduce post-harvest losses.

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