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PROXIMATE AND MINERAL COMPOSITION OF SPICED, SMOKED CATFISH *Clarias gariepinus* (Burchell, 1822)

[1]A. A. AYELOJA; [2] F. O. A. GEORGE; [2]A. A. AKINYEMI AND [3]O. O. ATANDA

[1]Fisheries Technology Department
Federal College of Animal Health and Production Technology Moor Plantation, Ibadan
[2]Department of Aquaculture and Fisheries Management
[3]Department of Food Service and Tourism
Federal University of Agriculture, Abeokuta

***Corresponding author:** ayeloja2@gmail.com

ABSTRACT

Effect of spices on the chemical properties of hot-smoked catfish *Clarias gariepinus* (Burchell, 1822) was examined. A Completely Randomized Design (CRD) was used for the study. Freshely harvested catfish were spiced with garlic, ginger, garlic-ginger homogenate- spiced and the control without spices before smoking. Proximate and mineral content analysis were carried out using standard experimental procedures. There were significant differences ($p < 0.05$) in the proximate composition of the spiced smoked fish. Smoked catfish without spices had the highest mean values of moisture and protein contents with mean values of 6.18 % $\pm$ 0.13 and 79.44 % $\pm$ 0.13respectively. Similar trend was also observed for the lipid and ash contents of the fish products. There existed significant differences ($p < 0.05$) in the mineral content in the various fish products with the exception of magnesium. The products were rich in calcium and other minerals with garlic-ginger homogenate-spiced product having the highest level of calcium (0.980 % $\pm$0.02).

Keywords: Spices, organoleptic properties, chemical properties, hot-smoked, *Clarias gariepinus*

INTRODUCTION

Fish constitutes a very important component of diet for many people, and often provides much needed nutrients for a healthy living. Its characteristic as a cheap source of animal protein, which is now evident throughout the world makes it an excellent component of human diet (Iheagwara, 2013**)**. Fish protein now takes precedence over other protein of animal origin, and compares favorably with those of milk, egg and meat in its amino acid composition (Iheagwara, 2013**)**. Fish serves as a principal source of dietary animal protein, which is very inexpensive in relation to other protein foods (Fawole *et al.*, 2007). Fish protein is indispensable to many people for diet supplementation in developing countries such as Nigeria, where the staple diet consists primarily of starchy foods (Idris, 2010). As important as fish is, high degree of fish spoilage still occurs in Nigerian due to the absence of storage facilities, this serves as a major constraint to the development of the

fishing industry in Nigeria (Akinpelu *et al.*, 2013). Akinola *et al.* (2006) reported that some of the different types of preservation methods employed to reduce fish spoilage include: drying, smoking, freezing, chilling and brining. Bellagha *et al.* (2007) reported that due to the perishable nature of fish, traditional methods of preservation have been developed over the years which include salting, drying and smoking. Fish smoking is particularly relevant in the artisanal fisheries sector, as a method of processing and preservation . It enhances the flavour and increases utilization of the fish in addition to reducing wastes when catches are good and and influences protein availability to rural people (Jallow, 1995; Kumolu-Johnson and Ndimele, 2011). Igene (1983) as reported by Kiin-Kabari *et al.* (2011) opined that smoke-dried fish is an important ingredient in the Nigerian traditional diet; and is relished for its appetizing taste and flavour. The traditional smoked fish, though popular, suffer from some inherent problems, including un-even cooking of the product, scorching and burning due to direct heating, bitterness, unattractive appearance, rancidity development, limited shelf-life and insect infestation (Bellagha *et al.*, 2007). *Clarias gariepinus*, one of the species of catfish is highly nutritious. It contains high amount of vitamins, proteins, minerals, no saturated fat, and is low in carbohydrates (Idris *et al.*, 2010). It is an economically important freshwater fish, and enjoys wide acceptability. It is extensively cultivated in ponds but is sometimes under-priced (Kumolu-Johnson *et al.*, 2010). *Clarias gariepinus* is a very important fresh water fish in Nigeria as it enjoys wide acceptability in most parts of the country because of its unique taste, flavour and texture (Ayeloja *et al.*, 2011).

Nigeria is rich in indigenous spices. However, their food and other uses such as antimicrobial and preservative properties have not been widely exploited. The spices (aromatic in nature), can be classified into fruits, seed leaves or floral parts and bulbs (Kiin-Kabari *et al.*, 2011). Spices are edible plant materials that possess anti-oxidant, antiseptic and bacteriostatic properties. They are added to foods for seasoning, flavouring and to delay the onset of deterioration (Abdel-Hamied *et al.*, 2009). Ginger is a popular spice. It has a geographical spread that covers every part of the globe; and it is consumed whole as a delicacy, used in traditional oriental medicine (Onyeagba *et al.*, 2004). Garlic (*Allium sativum*), is one of the most used food flavours. It has a wide spectrum of properties, which include: antibacterial, antifungal and anti-oxidative. It also has a beneficial effect on cardiovascular and immune system of human (Sallam *et al*, 2004). Ginger contains a spectrum of biologically active compounds, such as curcumin, 6-gingerol, 6-shagaols, zingiberene, bisabolene and several other types of lipids that confer on it the properties of being pungent and a stimulant. These compounds are responsible for the unique aroma and flavour of ginger, and account for about 1-3% of the weight of fresh ginger (Akram *et al.*, 2011). This study was, therefore, carried out to investigate the effect of garlic and ginger on the chemical properties of hot-smoked catfish (*Clarias gariepinus*).

MATERIALS AND METHODS

Twelve live catfish (*Clarias gariepinus*) were selected from an earthen pond of Korede fish farm Omi-Adio second gate, Ibadan Oyo state. The average weight of the fish was 226$\pm$23g. They were transported by road within 43 min. to the fish processing unit of the Federal College of Animal Health

and Production Technology (FCAH&PT), Moor Plantation Ibadan where they were prepared in the sequence presented on Fig 1. Six kilogram of dried garlic bulb (*Allium sativum*) and 10kg of dried ginger rhizome (*Zingiber officinale*) were bought from Bodija market in Ibadan, Oyo State, Nigeria and ground using sterile explosion proof blender (Waring Products, New Hartford, CT) and later applied as spices to the fish at ratio 5:100g in accordance with the recommendation of Kumolu-Johnson and Ndimele (2011). Seventy gram each of powdered garlic (*A. sativum*) and ginger (*Z. officinale*) were manually homogenized in ratio 1:1. This was applied as spices on the catfish (treatment four) prior to smoking. The experiment was Completely Randomized Design where the treatments were the variously spiced catfish (garlic, ginger and mixture of garlic and ginger) with a control (without spices).

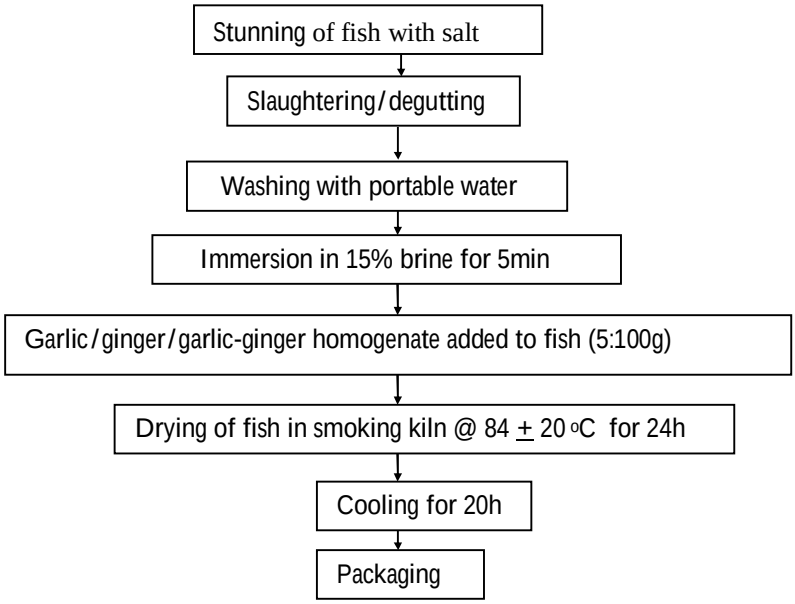

Fig. 1: Flow chart for the preparation of smoked spiced-catfish (*Clarias gariepinus*)

Chemical Analyses

The samples of smoked fish products (comprising 3 samples each of the differently spiced smoked fish product) were collected for chemical analysis at the Chemistry Laboratory of the Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Ibadan, Nigeria. The samples used for the analysis were assayed in triplicates. The fish samples was homogenized after which proximate composition (moisture, protein, lipid ash and crude fibre) of fish samples was determined using the standard methods of AOAC (1995); and mineral content (calcium, magnesium, potassium, sodium, phosphorus, manganese, iron, zinc and copper) ware also determined using Atomic Absorption Spectrophotometer (AAS Buch Scientific Accusys 211).

Statistical analysis

Analysis of variance (ANOVA) was used to determine differences between means; and

Duncan Multiple Range Test (DMRT) was used to compare differences among means. Significant level was chosen at $p<0.05$.

RESULTS AND DISCUSSION

The result shown on Tables 1 and 2 indicated significant differences ($p < 0.05$) in proximate and mineral compositions of differently spiced hot-smoked catfish. The smoked catfish with no spice had the highest moisture content with a mean value of 6.18 $\pm$ 0.13% which reduced significantly ($p < 0.05$) with the application of different garlic and ginger . Smoked catfish spiced with garlic-ginger homogenate had the lowest moisture content of 5.73 $\pm$ 0.14%. The differences in moisture content could be due to variation in the moisture absorbing properties of the spices applied prior to smoking. The resultant reduction in the moisture content of the smoked fish products will prolong the shelf life of the products. This is line with the findings of Fapohunda and Ogunkoya (2006) that the removal of moisture content increased the shelf life of fish products. Similar opinion was also expressed by Daramola *et al.* (2007) that water activity determined the storage life of fish. The result of this study indicated that the crude protein composition formed the largest quantity of the dry matter in all the fish products; this is in line with the report of Ajani *et al.* (2013). Also, there was significant difference ($p < 0.05$) in the percentage crude protein contents of the differently spiced hot-smoked catfish. The control (smoked catfish without spices) recorded the highest protein content with a mean value of 79.44 $\pm$ 0.13% . The garlic-ginger spiced smoked catfish had the lowest percentage crude protein content (75.69 $\pm$ 0.13). The reduction in the percentage crude protein of the spiced fish could be as a result of the increase in the fibre content from the spices applied to the fish. Similar trend was also observed for the lipid and ash contents of the fish products. However, the result of the crude fibre content indicated that the control had the lowest value with a mean value of 0.16 $\pm$ 0.13% which was significantly different ($p < 0.05$) from other spiced fish products wile garlic spiced hot-smoked catfish had the highest percentage crude fibre content with a mean value of 10.54 $\pm$ 0.13. The result of the mineral composition presented on Table 2 indicated that there was no significant difference ($p > 0.05$) in magnesium content of the various fish products. However, there were significant differences ($p < 0.05$) in other mineral contents. The spiced smoked fish were rich in calcium with garlic-ginger homogenate- spiced product having the highest value of calcium (0.980±0.02%), while the control had the lowest calcium value (0.539±0.04%). Calcium is required in maintaining and building bone and tooth, and also performs the functions of adjusting the acid-base balance, blood coagulation and transportation of nerve impulses (Meta *et al.*, 2010). Similar report of trace metals was reported by Fawole *et al.* (2007) giving mean mineral compositions (%) of 0.34 (P), 0.33 (Ca), 0.36 (K), 0.30 (Mg), 0.12 (Fe), 0.80 (Na) and 0.02 (Cu) in C. gariepinus. Generally, the minerals occurred at levels within international limits, thereby making this fish product safe for consumption, most especially with FAO/ APHCA (1998) standards.

Table 1: Proximate composition of differently spiced hot-smoked catfish

Treatments	%Moisture	%Protein	%Lipid	%Ash	%Crude Fibre
Control	6.18 + 0.15a	74.99 + 0.13a	6.31 + 0.19a	7.04 + 0.17a	0.16 + 0.16d
Garlic	6.10 + 0.14b	71.00 + 0.07d	6.04 +0.22b	6.06 + 0.23b	10.54 + 0.23a
Ginger	5.90 + 0.16c	76.06 + 0.15b	3.85 +0.11d	5.14 + 0.22c	8.54 + 0.13b
Garlic/Ginger homogenate	5.73 + 0.14d	75.69 + 0.12c	4.83 + 0.14c	5.14 + 0.23c	8.49 + 0.13b

Values in the same column with different superscripts are significantly different ($p<0.05$).

Table 2: Mineral composition of differently spiced hot-smoked catfish

Treatments	% Calcium	% Magnesium	% Potassium	% Sodium	% Phosphorus	% Manganese	% Iron	% Zinc	% Copper
Control	0.539±0.04d	0.328±0.02	0.209±0.04c	0.267±0.02b	0.471±0.02b	0.382±0.01bc	0.246±0.04b	0.350±0.02b	0.128±0.01d
Garlic-spiced	0.619±0.06c	0.334±5.03	0.399±0.05b	0.319±0.01a	0.431±0.30c	0.367±0.03c	0.130±0.11c	0.370±0.04b	0.966±0.04a
Ginger-spiced	0.826±0.04b	0.453±0.02	0.305±0.07bc	0.326±0.04a	0.548±0.04a	0.442±0.05a	0.328±0.02a	0.360±0.02b	0.739±0.05b
Garlic/Ginger homogenate	0.980±0.02a	0.525±0.05	0.416±0.05ab	0.335±0.02a	0.519±0.02a	0.434±0.02ab	0.322±0.03a	0.406±0.01a	0.627±0.01c

Values in the same column with different superscripts are significantly different ($p<0.05$).

CONCLUSION

The result of this study indicated significant differences ($p < 0.05$) in the proximate composition and mineral contents of variously spiced smoked fish products. The moisture content on account of the addition of spices suggested the possibility of prolonging the shelf-life of fish by reducing water activity. The addition of spices also enriched the mineral contents of the products. Generally, the use of spices (garlic and ginger) in the present study added quality value to smoked fish products.

REFERENCES

Abdel-Hamied, A. A.; Nassar, A. G. and El-Badry, N. (2009). Investigations of antioxidant and antibacterial activities of some natural extracts. *World Journal of Dairy and Food Sciences 4: 1-7.*

Ajani, F.; Adetunji, V. O. and Oyedokun, J. O. (2013). Biophysicochemical changes that occur in fish during different stages of traditional processing. *African Journal of Food, Agriculture, Nutrition and Development*, AJFAND, 13 (3): 7840 – 7852.

Akinola O. A.; Akinyemi, A. A. and Bolaji, B. O. (2006). Evaluation of traditional and solar drying systems towards enhancing fish storage and preservation in Nigeria (Abeokuta Local Government as Case study). *Journal of Fisheries International*, 1 (2): 44-49.

Akinpelu, O. M.; Ayeloja A. A.; George, F. O. A.; Adebisi, G. L.; Jimoh, W. A. and Idowu, S. D. (2013). Gender analysis of processing activities among commercial catfish processors within Ibadan Metropolis, Oyo State South-Western Nigeria. *Journal of Aquaculture Research and Development* 4 (3): 176-180 doi:10.4172/2155-9546.1000176

Akram, M.; Shah, M. I.; Usmanghan, K.; Mohiuddin, E. and Sami, A. (2011). *Zingiber officinale* roscoe (A medicinal plant). *Pakistan Journal of Nutrition*, 10: 399-400.

Association of Official Analytical Chemists, AOAC (1995). Official Methods of Analysis of the Association of Official Analytical Chemist, Vols. I & II, Association of Analytical Chemist, Arlington. 1298pp.

Ayeloja, A. A.; George, F. O. A.; Obasa, S. O. and Sanni, L. O. (2011). Effect of post-slaughter time intervals on the quality of the African catfish, *Clarias gariepinus* (Burchell, 1822). *American Journal of Food Technology*, 6 (9) 790 - 797.

Bellagha, S.; Sahli, A.; Farhat, A.; Kechaou, N. and Glenza, A. (2007). Studies on salting and drying of Sardine *(Sardinella aurita*): Experimental kinetics and modeling. *Journal of Food Engineering,* **78**: 947- 952.

Bhandary, C. S. (1991). Effects of Spice Treatment on lipid oxidation in smoked mackerel (*Scomber scombrus)*. FAO Fisheries Report, 1991; pp. 108-133.

Daramola, J. A; Fasakin, E. A. and Adeparusi, E. O. (2007). Changes in physicochemical and sensory characteristics of smoke-dried fish species stored at ambient temperature. *African Journal of Food, Agriculture, Nutrition and Development,* AJFAND 7 (6): 1 – 16.

FAO/APHCA. (1998). The use of palm kernel cake as Animal feed. FAO/APHCA Publication 1998; No.8.

Fapohunda, O. O. and Ogunkoya, M. (2006). Effect of smoke-drying on the proximate composition of *Tilapia zillii*, *Parachanna obscura* and *Clarias gariepinus* obtained from Akure, Ondo-State, NIGERIA. *Animal Research International,* 3(2): 478 – 480.

Fawole, O.; Ogundina, M.; Ayandiran, T. and Olagunju, O. (2007). Proximate and mineral composition in some selected fresh water fishes in Nigeria. *Internet Journal of Food Safety,* 9: 52-55.

Idris, G. L.; Omojowo, F. S.; Omojasola, P. F.; Adetunji, C. O, and Ngwu, E. O. (2010). The effect of different concentrations of ginger on the quality of smoked dried catfish (*Clarias gariepinus*). *Nature and Science*, 8: 59-63.

Igene, J. O. (1983). Drying of Fish, Factors to Consider, Proceedings of the 3rd Annual Conference of the Fisheries Society of Nigeria, FISON, Maiduguri, Nigeria, p. 123.

Iheagwara, M. C. (2013). Effect of Ginger extract on Stability and Sensorial Quality of Smoked Mackerel (*Scomber scombrus*) Fish. *Journal of Nutrition and Food Sciences*, 3: 199-. doi:10.4172/2155-9600.1000199.

Jallow, A. M. (1995). Contribution of improved Chorkor oven to artisanal fish smoking in The Gambia. Proceedings of the workshop on seeking improvements in fish technology in West Africa, Nov. 7-9. 1994, Congo, pp: 22 – 28.

Kiin-Kabari, D. B.; Barimalaa, I. S.; Achinewhu, S. C. and Adeniji, T. A. (2011). Effects of extracts from three indigenous spices on the chemical stability of smoke-dried catfish (*Clarias lazera*) during storage. *African Journal of Food, Agriculture, Nutrition and Development,* AJFAND, 11 (6)**:** 5335 – 5343.

Kumolu-Johnson, C. A. and Ndimele, P. E. (2011). A review on post-harvest losses in artisanal fisheries of some African countries. *Journal of Fisheries and Aquatic Science,* 6 (4): 365-378.

Kumolu-Johnson, C. A.; Aladetohun, N. S. and Ndimele, P. E. (2010). The effects of smoking on the nutritional qualities and shelf-life of *Clarias gariepinus* (LACEPEDE). *African Journal of Biotechnology*, 9 (1): 073 – 076.

Nielsen, S. S. (2003) Food analysis. 3rd Edition, Kluwer Academic/Plenum Publishers, New York, USA.

Meta, M; Tuflikha, P. P.; Indrastuti, F. B. and Abu-Bakar, T, (2010). Development of seasoning powder as flavor enhancer made from fish paste. A paper presented at the International Conference, Short Course and Exhibition on Nutraceutical and Functional Foods. Pp. 1 – 12.

Onyeagba, R. A.; Ugbogu, O. C.; Okeke, C. U. and Iroakazi, O. (2004). Studies on the antimicrobial effects of garlic (*Allium sativum* Linn), ginger (*Zingiber officinale* Roscoe) and lime (*Citrus aurantifolia* Linn). *African Journal of Biotechnology,* 3: 552-554.

Salaudeen, M. M.; Akande, G. R.; Oguntade, O. R.; Afolabi, O. O.; Olusola, A. O. and Ezekiel M. O. (2010). Effect of preservatives on microbial safety and quality of smoked catfish (*Clarias gariepinus*) during ambient storage. *ACTA SATECH* 3(2): 81 – 86.

Sallam, K. H. I.; Ishioroshi M. I. and Samejima (2004). Antioxidant and antimicrobial effect of garlic on chicken sausage, *Lebenson Wiss Journal of Technology*, 37(8): 849 - 855.

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