Assessment of Cinnamon (Cinnamomum verum) Bark Extract on Proximate Composition and Sensory Qualities of Smoked-Dried African Catfish Clarias gariepinus (Burchell, 1822)

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study determined the effect of Cinnamon (Cinnamomum verum) bark extract solution on proximate composition and sensory evaluation of smoke-dried catfish stored at ambient temperature (37±2°C) for 28 days. The experimental treatments are the control, 0.5%, 1% and 1.5% (w/v) cinnamon bark extract solutions. Thirty-nine fish of average mean weight of 24.87±1.25g were gutted, washed and randomly assigned to the treatments. Thereafter, the fish were soaked into the treatments for 30 minutes and later hot smoked for 12 hours. After smoking, the fish were stored in boxes and placed on laboratory table for one month. The catfish Clarias gariepinus treated with 1% solution of Cinnamon bark extract had the highest moisture content with mean value 13.65±0.82%, followed by 6.93±1.66% recorded in fish sample treated with 1.5% solution of the extract, lowest percentage crude protein content 38.15±0.82% was observed in fish treated

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1. INTRODUCTION

Fish is one of the most important foods on the planet [1]. Its flesh is a source of high-quality protein, and for many, in less developed parts of the world, it represents a significant proportion of the animal protein in their diet. It is either taken as fresh fish or cured in a variety of ways such as smoking, salting, drying, charring, icing, and chilling [2]. Fish is relatively cheaper and readily available, therefore making quality protein sufficient to the poor people in most advancing countries of the world including Nigeria [3]. Fish is an important source of essential nutrients which includes; protein, lipids, vitamins and minerals [4]. However, fish is one of the most perishable essential commodities; it gets deteriorated rapidly because of inherent and extrinsic factors [5]. A major constraint that has been identified in the storage of smoked fish in Nigeria is that of rapid spoilage as a result of high ambient temperatures, inferior postharvest handling, lack of processing, and storage facilities, thereby initiating the cliffs between the demand and supply of fish and fish product resulting in shortage of fish and posing great challenge to food security of the increasing population of the entire nation [5,6]. A greater proportion is preserved by smoking and sun-drying to prevent the growth of spoilage organisms [7]. Freshly caught fish spoils easily and therefore requires adequate preservation and storage in order to increase its shelf life. Fish begins to deteriorate as soon as they have been taken out of water. Besides, poor handling, inadequate processing facilities, lack of ice or storage facilities, remoteness of fishing villages to urban market, and poor distribution channels may serve as factors that contribute to reduction in its utilization in the tropics [8]. The preservation of fish is therefore considered to be a major hindrance to its production, utilization and consumption especially in the tropical countries in Africa. The African catfish, *Clarias gariepinus,* remains the most farmed catfish species in Africa [9] and is of major economic importance among aquaculture species in Nigeria. It provides income to farmer, creates employment opportunities, and contributes towards Gross Domestic Product (GDP) [10]. One of the natural spices usually used in food preservation include cinnamon (*Cinnamomum verum*). Cinnamon is a spice obtained from the inner bark of several trees from the genus *Cinnamomum* that is used in both sweet and savory foods. The word cinnamon comes from the Greek kinnamon [11]. It is a small classic tree, with a 11-16 meters’ height which is (32.8-49.2 feet). It is belonging to the family *Lauraceae,* native to Sri Lanka and South India. Cinnamon is a good preservative with high in antioxidant and antibacterial activity. The major concern is what happens to the nutritional quality parameters of the fish after smoking, therefore this study was conducted to evaluate the nutritional quality of catfish smoked with cinnamon bark extract solution and sensory evaluation.

2. MATERIALS AND METHOD

2.1 Study Area

The study was conducted in the University of Maiduguri. Borno, Nigeria. It is located at latitude 11°15’N and longitude 13°15’E. The mean monthly temperature is highest (40.2°C) prior to the onset of the rain in June and the lowest (31.3°C) during the peak of the rainy period of August. The area has an average mean annual rainfall of about 550mm² [12]. The experimental studies were carried out in National Agency for Food and Drugs Administration Commission (NAFDAC) Maiduguri branch.
2.2 Procurement of the Cinnamon Bark

Fresh air-dried cinnamon bark were purchased from the Maiduguri Monday market, Borno state Nigeria. The bark was grounded into powdered form; a solution was prepared by adding separately specific quantity (5g, 10g and 15g) of the cinnamon bark powder extracts to 1000ml of distilled water to 0.5%, 1% and 1.5% respectively and allows to stay for 1 hour. No additive was added to the control treatment.

2.3 Fish Preparation

Freshly caught catfish (Clarias gariepinus) of 4500g was purchased from Gamboru fish market Maiduguri; they were transported within an hour in a cooler to the fish processing unit of the department of fisheries.

The processing and smoking of the catfish was carried out in this unit. The fish were killed by striking the spinal cord, gutting using sharp knife by cutting laterally from the end of the gill cover through the belly portion to the anus. Thereafter was thoroughly washed and rinsed. The total length (ranging from 22-27cm) and weight of the fish were noted after gutting.

2.4 Experimental Set-Up

The fish were randomly assigned to four experimental treatments. These are the treatments, 0%, 0.5%, 1% and 1.5% of cinnamon bark extract solution. Each treatment was replicated thrice with 500g weight fish/treatment. The fish were soaked into the solution for 30 minutes. Thereafter, set in the smoking kiln consisting of three trays and subject to hot smoking for 12 hours using hard wood and wood chaffs to ignite the smoke. The smoked-dried fish was stored in carton to prevent flies’ contamination and placed in the laboratory at a room temperature for 28 days.

2.5 Proximate Analysis

Proximate composition (moisture content, crude protein, fat, carbohydrate and ash content) was determined according to [13].

2.6 Sensory Evaluation

The sensory evaluation was assessed by a 10 (Ten) man panel consisting of staff and students using the 7-point hedonic scale (7 = excellent; 6 = very good; 5 = good; 4 = fair; 3 = poor; 2 = very poor; 1 = extremely poor) for colour, appearance, flavour, taste and general acceptability.

2.7 Statistical Analysis

Data were subjected to the analysis of variance and a significance test for difference among sample variance using the least significance difference (LSD) in the mean comparison of means at p<0.05 level of significance with the aid of statistical analysis (statistix 10.0).

3. RESULTS

Table 1 shows the mean proximate composition of fresh and smoked-dried fish treated with a solution of Cinnamon bark extract at different level of concentration.

Table 2 shows the sensory evaluation of Clarias gariepinus smoked with cinnamon bark extract solution.

4. DISCUSSION

From the result obtained in (Table 1), the proximate composition of fish smoked-dried with cinnamon bark extract solution was obtained, the smoked catfish with 1% solution of Cinnamon bark extract treatment has the highest moisture content with mean value 13.65±0.82, followed by

| Parameters    | Cinnamon concentration level (%) |
|---------------|----------------------------------|
|               | 0%  | 0.5% | 1%  | 1.5% |
| Moisture      | 6.52±1.62c | 7.99±0.01b | 13.63±0.82a | 6.93±1.66c |
| Crude protein | 68.05±1.64a | 44.98±0.32b | 38.15±0.82c | 49.53±0.83b |
| Fat           | 8.19±0.03c | 13.82±0.83b | 21.74±0.83a | 19.66±0.84c |
| Carbohydrate  | 1.92±0.01c | 4.82±1.63b | 3.41±0.01b  | 15.73±1.64a |
| Ash           | 4.82±0.02c | 28.4±3.27a | 23.07±0.82b | 8.16±1.65c |

Mean value with the same letter in a row are not significantly different (p>0.05)
The result of the percentage carbohydrate content agreed with the results in this study. However, the result of the percentage carbohydrate content indicates that the control has the lowest carbohydrate content with mean value 1.92±0.01 which is significantly different (p<0.05) from other treated sample while sample treated with 1.5% solution of the Cinnamon bark extract have the highest percentage carbohydrate with mean value 15.73±1.64.

The result in Table 2 shows mean scores of the sensory evaluation form 10 men test panel which reveals that the smoked catfish retained very good score for appearance, colour, flavour, texture and general acceptance after 28 days of storage and the overall acceptability mean score in fish treated with 5g and 15g cinnamon bark extract solution indicate the product is were generally accepted. The results of the sensory evaluation agreed with these researchers that, deterioration in eating quality in smoked fish was best tested by organoleptic methods, as it shows a more definite pattern of reduction in acceptance with time and using hedonic scale of 1 to 5 scoring and 2 being regarded as unacceptable [22,23]. Decline in flavour was observed in the product probably due to microbial effect and degradation of protein in the muscle coupled with onset of oxidative rancidity that might have produced hypoxanthine and trimethylamine [24]. The texture in all the sensory parameters of the test sample indicates that the spices inherit chemical compounds such as carbonyl, phenols and syringol and these compounds are responsible for the pleasant colour, texture and flavour/aroma in smoked products [10]. The improved shelf lives up to 28 days may be due to activities of the spices, smoke and heat which reduces water activity and impaired the action of spoilage microbes [25]. It is a very crucial value in marketing strategy to have value addition in order to attract the consumer’s attention [25; 22] also expressed that incorporating natural spices to fish before smoking has favorable effects on the overall quality of the final products such as enhanced taste, color, flavor, and general acceptance during storage [26]. Food qualities are an important variable in foreholding consumers' preference in food selection decision [27].
5. CONCLUSION AND RECOMMENDATION

In conclusion Cinnamon (Cinnamomum verum) Bark Extract can be utilized in fish smoking at various concentrations and fish smoked with cinnamon was more attractive in colour and texture, compared with those smoked with other spices and better proximate composition content. Using the extracts may be useful in maintaining the nutritional quality and improving the shelf life and consumer acceptability of smoked-dried African Catfish C. gariepinus. This will guide to enhancement of the fish value chain, minimize deterioration damages of smoked fish, and provide supplemental business chances for investors as well as improving the export value of smoked-dried African catfish. Further studies should be carried out to determine the effect of the oil extracted from the spice on microbial stability of smoke-dried catfish stored for longer period of time under ambient temperature.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ahmed AA. Sensory quality of smoked Clarias gariepinus (Burchell, 1822) as affected by spices packaging methods. International Journal of Food Properties. 2019;22(1):704–713.
2. Ikenwewe NB, Bolaji BO, Bola GA. Fabrication and Performance Assessment of a Locally Developed Fish Smoking Kiln. Ozean J. Appl. Sci. 2010;3(4):1–12.
3. Akinbode SO, Dipeolu AO. Double-Hurdle Model of Fresh Fish Consumption among Urban Households in South-West Nigeria. Current Research Journal of Social Sciences. 2012;4(6):431–439.
4. Tsado JH, Adeniji OB, Ojo MA, AdebayoCO, AbdulazeeezR. Perception of women knowledge on the nutritive value of fish in kaduna north local government area of kaduna state, Nigeria. Journal of Agriculture and Social Research. 2012;12(1):162–169.
5. Adeyeye SAO, Oyewole OB, Obadina OA, Omemu AM, Adeniran OE, Oyedele HA, Olugbile A, Omoniyi SA. Effect of Smoking Methods on Quality and Safety of Traditional Smoked Fish from Lagos State, Nigeria. J. Culinary Sci. Technol. 2017;15(1):17–35.
6. Akinola OA, Akinyemi AA, Bolaji BO. Evaluation of Traditional and Solar Drying Systems towards Enhancing Fish Storage and Preservation in Nigeria (Abeokuta Local Government as a case study). J. Fish. Int. 2006;1(2–4):44–49.
7. Ihuahi JA, Omojowo FS, Ugoala AE. Effect of spice treatment on the quality of hot-smoke catfish (Clarias gariepinus) National Institute for Freshwater fisheries research NIFFR, In: Fish Processing, Quality control and Package for International Markets. 2005;363–368
8. Ames G, AboludeDS, EgaRA. Nutrient quality of four ovens dried freshwater catfish species in Northern Nigeria. Journal of Tropical Biosciences. 2001;1:70–76.
9. African Union. African Union Handbook on Fisheries and Aquaculture. No. 1093; 2015.
10. Eyo AA. Fish processing Technology in the Tropics. National Institute for Freshwater Fisheries Research, New Bussa, Nigeria. ISBN-13: 9781770857, 2001;1–403.
11. Arima H. Isolation of antimicrobial compounds from guava (Psidium Guajava L.) and their structural elucidation. Biosci Biotechnol Biochem. 2002;66(8):1727–30.
12. Shettima MK, Ikusemoran M, Daura MM. Geospatial Assessment of the Impact of Topography on Flood Vulnerability in Maiduguri, Nigeria. Jalingo Journal of Social and Management Sciences. 2018;1(4):129–145.
13. AOAC (2006). Association Official Analytical Chemist. Official Methods of Analysis 17th edition Washington D.C.
14. Ayeloja AI, Bhandary CS. Effect of spice treatment on the quality of hot-smoke mackerel (Scomber scomber) presented at the seventh FAO expert consultation in Africa, Senegal. 2013;2001;1–10.
15. Fapohunda OO, Ogunkoya M. Effect of Smoke-Drying on the Proximate Composition of Tilapia Zilli, Parachanna Obscura and Clarias gariepinus obtained from Akure, Ondo State, Nigeria. Animal Research International. 200;3(2):478–480.
16. Daramola JA, Fasakin EA, Adeparusi EO. Changes in physicochemical and sensory characteristics of smoke-dried fish species stored at ambient temperature. African Journal of Food Agriculture Nutrition and Development. 2007;7(6):1–16.
17. Modibbo UU, Osemeahon SA, Shagal MH, Halilu M. Effect of moisture Content on the drying rate using traditional open sun and shade drying of fish from Njuwa Lake in North-Eastern Nigeria. Journal of Applied Chemistry. 2014;7:1:41-45.

18. Ninawe AS, Rathnakumar K. Fish processing technology and product development, impact of curing (1st edition). 2009;5:142.

19. Akinneye JO, Amoo LA, Arannilewa ST. Effects of drying methods on the nutritional composition of three species of fish (Bonga species, Sardinella species and Heterotis niloticus) Journal of Fisheries International. 2007;2(1):99-103.

20. Omojowo FS, Raji A. Assessment of the use of sodium benzoate on the safety and shelf life of smoked Tilapia. New York Science Journal. 2010;3:6:48-54.

21. Bello MM, Mohammed AM, Jajere BA, Ayo-Dada OB. Quality and Appearance of Clarias gariepinus (Burchell, 1822) and Oreochromis niloticus (Linnaeus, 1758) Smoked with Sugarcane Bagasse. NIWARD 2018 Conference Proceedings. 2018;173-184

22. Johnson WA, FJ Nicholson and A Roger, (1994). Freezing and refrigerated storage in fisheries.Stroud.Series.FAO Fisheries Technical Paper 340: 143.

23. Abolagba OJ, Osifo SJ. The effect of smoking on the chemical composition and Keeping qualities of catfish (Heterobranchus bidorsalis) using two energy sources. Journal of Agric. Forestry and Fisheries (JAFF). 2004;5(1):27-30.

24. Idris GL, Omowowo FS, Omojasola PF, Adejunle CO, Nguw EO. The Effect of Different Concentrations of Ginger on The Quality of smoked Dried Catfish (Clarias gariepinus). J. Nat. Sci. 2010;8(4): 59–63.

25. Jang SSC, Ha A, Silkes CA. Perceived Attributes of Asian Foods: From The Perspective of the American Customers. Int. J. Hospitality Manage. 2009;28(1):63–70.

26. Adeniyi JP. Fish Consumption in Nigeria. Implication for fishery development policies. Journal of West African Fisheries. 1987;3(2):151-161

27. Daramola AK, Odedeji JO. Osmotic dehydration of catfish: Effect of temperature and time. Pak. J. Nutr. 2008;7(1):57-61.

28. Edah B, Bankole NO, Akande GR, Adeyemi S, Ayo-Olalusi CI. Organoleptic Characteristics, Length-Weight Relationship and Condition Factor of Oreochromis niloticus in Egah River at Idah L.G.A of Kogi state, Nigeria. Int. J. Food Saf. 2010;12: 62–70.

29. Kumolu-Johnson CA, Ndimele PE. Anti-Oxidative and Anti-Fungal Effect of Garlic (Allium sativum) Treatment on The Shelf Life of Hot-Smoked Catfish (Clarias gariepinus, Burchell 1822). World Appl. Sci. J. 2011;13(7):1628–1634.

30. Ogbonnaya C, Shaba IM. Effects of drying methods on proximate composition of Catfish (Clarias gariepinus). World Journal of Agric. Sci. 2009;5(1):114-116.

31. Oladosu OH, Akande GR, Tobor JG. Technology needs assessment and Technology assessment in the Conceptualization and design of Magbon-Alade fish smoked drying equipment in NIOMR In: FAO: Expert consultation of fish technology in African Kisumu, Kenya. 1992;76.

32. Osibona AO, Kusemiju K, Akande GR. Proximate composition and fatty acids profile of the African Catfish Clarias gariepinus acta SATECH 3(1): In Press; 2006.