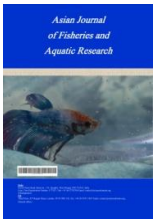

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Assessment of Cinnamon (*Cinnamomum verum*) Bark Extract on Proximate Composition and Sensory Qualities of Smoked-Dried African Catfish *Clarias gariepinus* (Burchell, 1822)

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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 (Cinnamonum 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 30minutes and later hot smoked for 12hours. 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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with 1% concentrate of the extract and percentage carbohydrate content indicate that the control have 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%.Sensory evaluation was also assessed using 7-point hedonic scale and reveals that the smoked catfish retained very good score for appearance, colour, flavour, texture and general acceptance after 28days of storage and the overall acceptability mean score in fish treated with 5g and 15g cinnamon bark extract solution indicate the product is being generally accepted (2.87±0.59%) and (2.34±0.56%) respectively**.** Cinnamon (Cinnamonum verum) bark extract solution could be used to protect stored smoke-dried catfish from loss of nutritional value and general acceptability thus limiting economic loss and possible health risk to consumers.

Keywords: Cinnamon bark; sensory quality; catfish; smoke-dried; proximate composition.

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 kinnamomon [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 $11^{o}15'$N and longitude $13^{o}15'$E. The mean monthly temperature is highest (40.2^{o}C) prior to the onset of the rain in June and the lowest (31.3^{o}C) during the peak of the rainy period of August. The area has an average mean annual rainfall of about 550mm^3 [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 1hour. 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

Table 1.Proximate composition of fish smoked with a different concentration level of Cinnamon bark extract

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

Mean value with the same letter in a row are not significantly different (p>0.05)

Table 2. Sensory evaluation of the fish smoked-dried with a solution of Cinnamon bark extract

	Cinnamon concentration level (%)			
Parameters	**0.0**	**0.5**	**1.0**	**1.5**
Appearance	1.58 ± 0.08^{d}	2.80 ± 0.25^{a}	1.87 ± 0.62^{b}	1.63 ± 0.15^{c}
Colour	1.97 ± 0.07^{b}	1.78 ± 0.01^{d}	1.87 ± 0.43^{c}	2.83 ± 0.92^{a}
Flavour	1.91 ± 0.10^{b}	1.03 ± 0.90^{d}	1.99 ± 0.05^{a}	1.47 ± 0.65^{c}
Texture	2.07 ± 0.23^{d}	2.22 ± 0.54^{c}	2.57 ± 0.81^{b}	3.47 ± 0.52^{a}
General acceptance	1.40 ± 0.06^{c}	2.87 ± 0.59^{a}	1.09 ± 0.39^{d}	2.34 ± 0.56^{b}

The values with different superscript letters vertically in rows significantly different at (P< 0.05).

6.93±1.66 recorded in fish product treated with 1.5% solution of the extract which is similar with the work of Ayeloja [14] who reported 6.10±0.14 moisture loss in smoked fish spiced with garlic. The observed differences in the loss of moisture could be due to variation in the moisture absorbing properties of the various concentrations level applied prior to smoking, this resultant reduction in moisture content of the smoked fish product will reduce rate of spoilage and in turn elongate the shelf life of the smoked products, this is in line with opinion of [15] that the removal of moisture content increases shelf life of fish products, similar opinion was also expressed by [16] that water activity determines storage life of fish. [17] reported that a reduction in moisture content resulted in an increase in crude protein. [18] reported that dried fish had higher protein content than fresh fish. The result of this study indicated that the crude protein in the mean proximate composition formed the largest quantity of the dry matter in all fish product, this is in line with the report of [19] that crude protein formed the largest quantity of the dry matter in all fish. Also, there is significant difference ($p<0.05$) when compared with other treatment, catfish treated with 1% solution of the Cinnamon bark extract had the lowest percentage crude protein content 38.15±0.82. The reduction in the percentage of treated fish product could be as a result of the increase in the fibre content of the product which is a function of fibre content of the bark extract applied to the fish products. A similar trend was also observed in lipid and ash content of the fish product and agreed with the work of [20] who recorded 7.8 % in *Clarias gariepinus* [21]. reported 27.23 % as ash content in smoked bonga species which 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 28days 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 - 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.

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