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EFFECTS OF EXTRACTS FROM THREE INDIGENOUS SPICES ON THE CHEMICAL STABILITY OF SMOKE-DRIED CATFISH (*CLARIAS LEZERA*) DURING STORAGE

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ABSTRACT

Fishes are the cheapest source of animal protein and it plays an important role in the diet of many people in both developed and developing countries. It is an important ingredient in the Nigerian traditional cuisine, cat fish being one of the most valued and very diverse groups of bony fish. The catfishes are a monophyletic group, belonging to the super-order called the *Ostariophysi*. Freshly caught fish spoil easily and therefore requires adequate preservation and storage. Of all flesh foods, fish is the most susceptible to tissue decomposition, development of rancidity, and microbial spoilage. Fish begin to deteriorate as soon as they leave the water. The preservation of fish is therefore considered to be a major hindrance to its production and utilisation especially in the tropical countries in Africa. The four most popular methods of fish preservation are freezing, canning, smoking and pickling, the major preservation method being pickling or salting, which has been used for centuries. In this present study, the effect of extracts from three indigenous spices; *Piper guinensis* (uziza*), Xylopia aethiopicum* (okada) and *Myrustica monodora (*ehuru) on the preservation of smoked-dried catfish stored for six weeks were evaluated using brine solution as control. Samples treated with uziza showed the lowest moisture content of 6.5% and lowest mean FFA formation of 0.55%, which was significantly different ($p<0.5$) from the other spices. The mean peroxide value range of 5.8-15.1 meq/kg was observed throughout the storage period for all the spices used. Thiobarbituric acid values ranged from 0.6mg/kg-1.4mg/kg with the lowest mean value of 0.37 mg/kg recorded in fish samples treated with uziza while the highest mean TBA value of 1.14mg was obtained in ehuru treated samples. This new research reveals that the three indigenous spices used, including *Piper guinensis, Myristica monodora and Xylophia aethiopicum* had chemical preservative and antioxidant properties. Among the three spices, *Piper guinensis* (uziza) was found to have the most effective preservation potential of smoked-dried fish during storage. This new result is anticipated to provide a simple, cheaper, healthier and safer method of fish preservation in developing countries.

Key words: Spices, smoked, catfish, stability, storage

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INTRODUCTION

Smoke-dried fish is an important ingredient in the Nigerian traditional diet and is relished for its appetizing taste and flavour [1]. Igene [1] estimated that over 95% of the artisanal landings are preserved by smoke drying. Catfish are a very diverse group of bony fish which have inhabited all continents at one time or another, and they have been widely caught and farmed for food for hundreds of years in Africa, Asia, Europe and North America [2]. Salting has been used for centuries as a method of fish preservation [3]. The marinating process is one of the oldest methods of conservation of fish popular in Europe. The term marinades or marinated fish are used to name fish products which consist of fresh, frozen, or salted fish or portions of fish processed by treatment with an edible organic acid, usually acetic acid and salt and put into brines, sauces, or oil [4]. Fish being the cheapest sources of animal protein, play a significant role in the diet of many people in developing countries [5]. However, the preservation of this scarce and perishable food is a major problem in the tropical countries in Africa.

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 [5]. The use of traditional fish smoking ovens and direct use of firewood is laborious, resulting in low quality fish of low market value. Attempts have been made to develop improved ovens for fish smoking in Africa [6]. The limitation of this has been the high cost involved, operational inconveniences and low level of dryness. Rancidity development may also affect the nutritional value, keeping quality, as well as consumer acceptance of the fish product. Igene [1] reported fungal spoilage, lipid oxidation with attendant production of off-flavours and poor storage stability of smoked-dried fish as some of the problems of the fish industry in Nigeria.

Herbs and spices consist of the dried leaves, flowers, buds, fruits, seeds, barks or rhizomes of various plants [7]. The antimicrobial and preservative activities of conventional spices on fish products have been known for sometime and these have been exploited in the preservation of smoked-dried fish. For example, Bhandary [5] used a mixture of red pepper, turmeric, black pepper, garlic, onion and ginger, in powder or fresh form at different levels of formulations and observed that the spice applications on some mackerel reduced mould growth considerably. Ikeme [8] applied hot water onion extract to control rancidity development during storage of hot smoked mackerel. Nigeria is rich in indigenous spices, their food and other uses as well as anti-microbial and preservative properties have not been widely exploited. The spices (aromatic in nature), depending on the part of the plant being used can be classified into fruits, seed leaves or floral parts and bulbs. Achinewhu [9] investigated the chemical composition of thirty wild spices indigenous to Nigeria and observed that they contained high amounts of fats as well as essential oils.

This present study was, therefore, carried out to investigate the preservative properties of hot water extracts from three indigenous spices namely; *Piper guinensis*, (uziza),

Xylopia aethiopicum (okada) and *Myristica monodara* (ehuru) on the chemical stability of smoke-dried catfish *(Clarias lezera).*

MATERIALS AND METHODS

Materials

Samples of fresh river catfish *(Clarias lezera)* were purchased live from local markets in Port Harcourt, Nigeria. The spices, *Piper guinensis,* (uziza), *Xylopia aethiopicum* (okada) and *Myristica monodara (ehuru)* dry seeds were also purchased from local markets in Port Harcourt and environs, all in Rivers State, Nigeria.

Fish Preparation

The fresh water catfish (*Clarias lezera*) were selected, washed to remove external dirt, dried with disposable towel paper, measured and weighted. The average length of the fish was 32cm while their average weight was 105g (fresh weight). These measurements were taken to ensure that they were all of the same mass. The fish samples were then eviscerated and washed again in clean distilled water and left to drain. Disposable towel paper was used to facilitate the draining process.

Preparation of the Spice Extracts

Twenty grams (20g) of ground spice each was weighed into a round bottom flask and 300ml of distilled water added. The mixture was heated to boil and refluxed for 5 minutes. The mixture was filtered hot through a clean grease-free cheese-cloth (300mu). The filtrate was then cooled to room temperature (29 ± 1^{o}C).

Treatments

The samples prepared above were soaked in the warm ($45^{o}\pm1^{o}$C) spice extracts for 10 minutes, drained and smoke-dried using the hot smoking process until two consecutive weighing gave readings that differed by less than 5%. A control sample was also smoke-dried after soaking in 75% brine solution.

Storage studies

The smoke-dried fish were packaged in sterile low-density polyethylene (LDPE) bags, sealed to prevent dust, dirt and flies using a heat sealer (POLY-pack, U.K. Reg. No., 1004306) and stored at room temperature (29 ± 1^{o}C) for 6 weeks.

Determination of chemical stability

Chemical stability of the stored smoke-dried fish products were determined by evaluating the percentage moisture content and free fatty acid using [10] methods. Peroxide value (mEq/kg) and thiobabituric acid (mg/kg) were determined using the method of Egan *et al* [11]. Samples were analyzed on weekly basis in triplicates.

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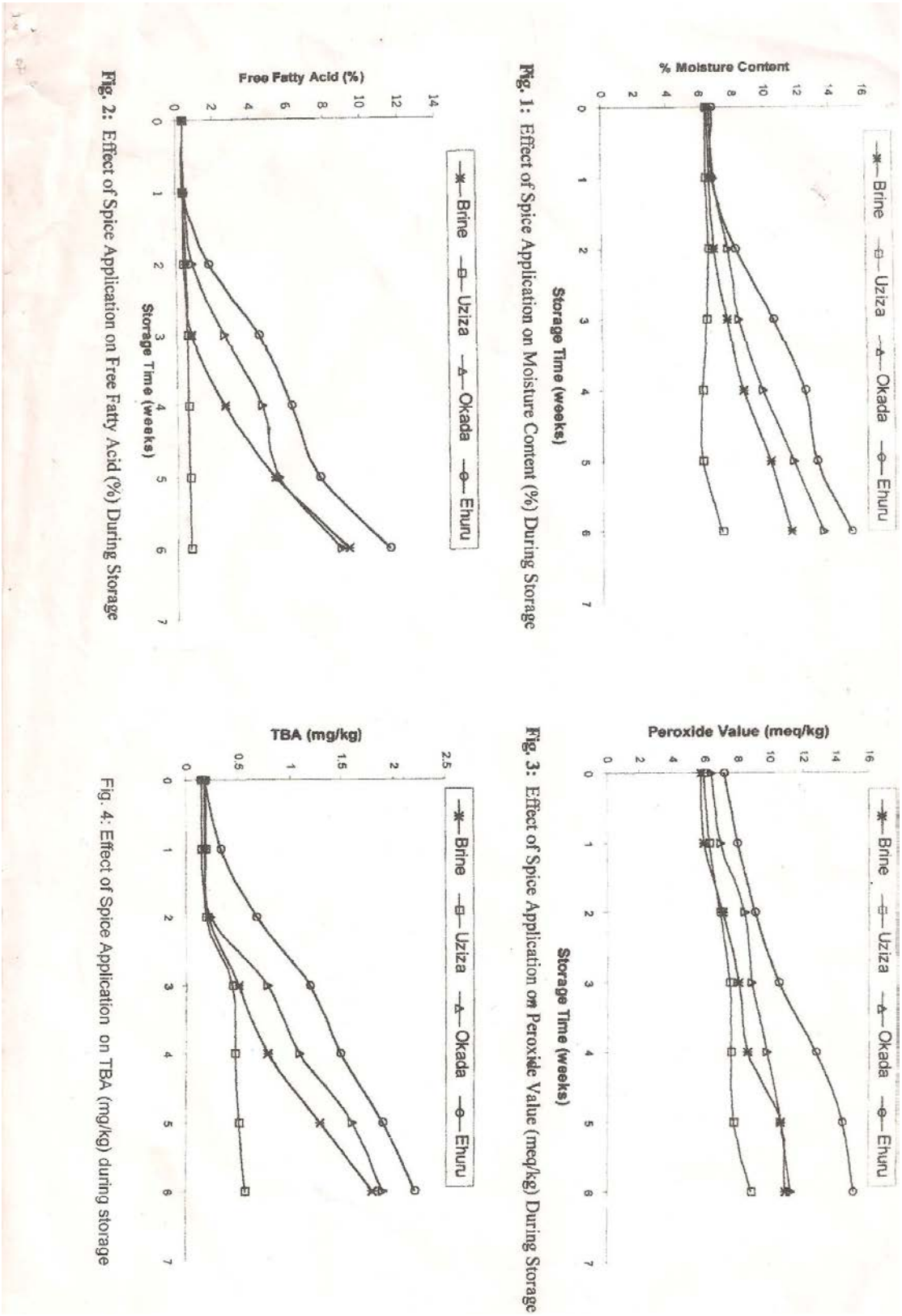

Fig. 1: Effect of Spice Application on Moisture Content (%) During Storage

Fig. 2: Effect of Spice Application on Free Fatty Acid (%) During Storage

Fig. 3: Effect of Spice Application on Peroxide Value (meq/kg) During Storage

Fig. 4: Effect of Spice Application on TBA (mg/kg) during storage

RESULTS

The results presented in Figure 1 show the effects of hot water extracts of different local spices on the moisture content of smoke-dried catfish during storage for a period of 6 weeks. The average moisture content of the smoke-dried fish at the start of storage was 6.6% which rose to 13.5% and 15.2% during storage in okada and ehuru-treated smoke-dried fish samples, respectively. A slight but progressive decrease in moisture was observed in uziza extract-treated smoke-dried fish up to the fifth week of storage before increasing to 6.8% in the sixth week. The rate of increase in moisture (Figure 1) coincides with the effect of spice treatment on free fatty acid (FFA) presented in Figure 2, which shows a period of induction in the fish treated with brine, okada and ehuru. The induction period was shortest in the ehuru-treated fish while those treated with brine was the longest.

Figure 3 shows the effect of spice treatment on peroxide value of the stored smoke-dried catfish samples. The antioxidant effect of the spices was clearly shown in the first two weeks of storage for Ehuru, while there was gradual increase in peroxide value in the okada treated sample. The difference was significant when compared with the control (brine). Of the three indigenous spices used, uziza showed the best antioxidant activity. There was a rapid increase in peroxide value in the ehuru-treated samples from the third to sixth week and the results were significantly different ($P<0.05$) from the values obtained from okada and uziza-treated fish samples. The mean PV observed in this study ranged from 7.3 mEq/kg in uziza to 11.0mEq/kg in ehuru.

Thiobarbituric acid value (TBA) evaluates second stage of autodixation during which the peroxides are oxidized to the aldehydes and ketones which impart the disagreeable fishy or rancid odours and flavours. Figure 4 highlights the results of such determination on smoke-dried catfish, which were treated with extracts of spices before storage. The antioxidant effects of the different spices were high in the first 2 weeks, when a slight increase in TBA value was observed in all the samples. After 2 weeks, a sudden increase in TBA value was observed in all the ehuru-treated sample, while the other samples treated with okada and brine (control) increased but at a slower rate. The uziza-treated smoke-dried catfish samples also showed an increase in TBA value after 2 weeks, but at a significantly lower rate than ehuru and okada. The results show that uziza extract was the most effective as an antioxidant compared to ehuru and okada. The antioxidant effect was highest in the first 2 weeks of storage for ehuru and okada- treated catfish samples.

DISCUSSION

Moisture determination is one the most important and most widely used measurements in the processing and testing of foods. In the present study, the moisture content of okada and ehuru-treated smoke-dried fish rose to 13.5% and 15.2%, respectively from the initial 6.6%. The storage potential of the fish samples can be enhanced during storage if the moisture content is maintained during storage. The progressive moisture reduction observed in fish samples may be due to

penetration of active preservative ingredients of uziza into the dried fish, preventing the binding of water molecules, which is then lost during storage. Under the traditional method of fish preservation, the dried fish is constantly heated to keep it dry. This practice involves the expenditure of resources in the form of firewood. Moreover, firewood leads to forest depletion, and health hazard as a result of the smoke entering the eyes and lungs of fish smokers, their fingers being burnt and exposure to direct heat. These problems can be minimised using uziza, which was found to have the most effective preservation potential of smoked-dried fish during storage in this present study. The moisture content of uziza and okada were stable with a slight increase in the moisture content of the ehuru during storage. Reduction in moisture content of smoke-dried mackerel during storage had been reported by [5]. The reduction in moisture content is beneficial in terms of product stability (chemical and microbial) but also detrimental because it reduces protein solubility, lending to lower biological value [12, 13].

The induction period exhibited in the fish treated with brine, okada and ehuru was shortest in the ehuru-treated fish while those treated with brine was the longest. Little or no FFA was produced in the smoke-dried fish treated with uziza extract suggesting that uziza could therefore be a good preservative for smoke-dried fish. Lypolysis is enhanced by water, and moreover, the increase in moisture could also lead to proliferation of microorganisms, with attendant production of lipase and hydrolysis of the fats. Little or no FFA was produced in the smoke-dried fish treated with uziza extract suggesting that uziza could therefore be a good preservative for smoke-dried fish.

The antioxidant effect of the spices was clearly shown in the first two weeks of storage for Ehuru, while there was gradual increase in peroxide value in the okada treated sample. Brine, which is known to be a pro-oxidant [14, 15] also showed a gradual increase in peroxide value in the samples treated by it but was minimal compared with okada ($P<0.05$). The mean PV observed in this study (7.3 meq/kg in uziza to 11.0meq/kg in ehuru) are in consonance with the report (2-18 meq/kg) of [16] while monitoring the antioxidant activities of some local spices (uziza and ehuru) on soybean oil for six weeks. Similar values (5-20 meq/kg) for spiced minced fish cakes had also been reported by *Akande et. al.* [17], in which it was concluded that values above 20 meq/kg gave rise to noticeable rancid tastes. These results of antioxidants effect on fish samples are similar to the pattern reported by [5] for smoked mackerel (*Schomber scombus).*

CONCLUSIONS

This new study shows that the three indigenous spices used in this study *Piper guinensis, Myristica monodora and Xylophia aethiopicum* had chemical preservative and antioxidant properties. *Piper guinensis* (uziza) was found to have the most effective in the overall preservation of smoked-dried during storage.

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