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Research Article

Processing and packaging of smoked *clarias gariepinus* in Niffr

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Abstract

Fish is the cheapest and common source of animal protein in the country, and traditional processing of fish in Nigeria is an important means of making fish available to consumers, especially those living in rural areas. The artisanal sector is the major producer of cured fish as about 40% is marketed and consumed smoked and/or dried. Post-harvest losses are high, estimated at 20-30%.The processing and marketing for smoked fish is expanding, although inadequate packaging and storage information among producers and traders limit the efficiency of the trade. The aim of this study is to investigate the effects of additives (ginger and garlic)on the shelf life of smoked and packaged fish and to carry out proximate composition, microbiological and sensory qualities of a commercially important freshwater fish species, *Clarias*gariepinus. The fish samples were collected from Monia reservoir in Borgu Local Government Area of Niger State. Three different spices were prepared to treats the fish before smoking. The fish were smoked dried and stored. After five weeks of storage, the proximate composition and sensory assessments of the smoked fish was analyzed. Also after 8 and 10weeks the microbiological analysis of stored fish were carried out to determine the lifespan of the products. The results shows that the fish samples treated with spices A and B as additives or preservatives prior to smoking indicates the effectiveness of these preservatives in controlling mold growth and capable of inhibiting microbial growth in stored fish products. Such products can be stored for more than fourteen (14) weeks without any growth of mold.

Key words: *Clarias*gariepinus, Niger State, *clarias gariepinus*

INTRODUCTION

Traditional preserving methods such as salting, fermenting, drying and smoking are still widely acceptance around the world because of their specific taste and aroma (Kse, 2010). However these methods still differ from country to country and within each country in the amounts of additives, percentage of salt or vinegar and maturing temperatures (Egbal, et al., 2013). Fish is a highly perishable commodity, deterioration set in some few hours after being caught depending on the specie and the prevailing ambient temperature. This may render it unacceptable and unfit for human consumption. Proper preservation starts the moment it is harvested until it reaches the consumer's table (Oluborode, et al., 2010). Treatment of fish with spices prior to smoking will prolong the shelf life of the products during storage.The Nigerian Export Promotion Council (NEPC) has identified adequate training programmes, quality packaging and innovative technology as a way that will promote Nigerian fish export.According to NEPC (2011), poor processing and packaging of smoked fish from Nigeria have made the product unacceptable to the international market. It was said that the rate at which sea food from Nigeria was rejected at the international market was alarming, this has caused revenue loss to the country and the exporters.Packaging is the enclosure of products for the purpose of preventing contamination and providing protection for the products. Packaging forms an important part of fish processing and preservation because it facilitates handling during storage and distribution within the marketing chain. In addition, high quality products and good

packaging can gain greater consumer acceptability, which will increase demand, providing producers with additional income (Nautilius, 1997).The improvement of packaging (using low cost local effective packaging materials) and good storage conditions can protect fish products against spoilage and damage, and is a silent salesman that drags the consumer to the shelves.Packaging facilitates the distribution and display of information on the product and also provides employment and profitability for investors.If an aggressive investor can smoke and package up to 50 tons of fish per annum. Suppose a minimum profit of N150, 000 is realized from a ton. This translates to N7.5 million profits per annum. This is no doubt a good means of livelihood and profitable venture for Nigerians.

Recent survey carried out has shown that traditional packages and packaging of smoked fish products are generally not impermeable to moisture, insects and microorganisms, and also offer little protection from physical damage and microbial invasion which often lead to post harvest losses.

Traditional packages and packaging of smoked fish products are generally not hygienic, therefore, this project was designed to process and package fish hygienically to ensure high quality smoked fish products for consumers.

MATERIALS AND METHOD

Packaging materials

Polyamide/polyethylene (PA/PE) packing rolls and cartons were obtained from Oluyole estate, Ring Road, Ibadan, Oyo state.The above packaging materials were used for the preparation of packages of 9×7 cm (PA/PE) and 9x7x7cm cartons as shown below.

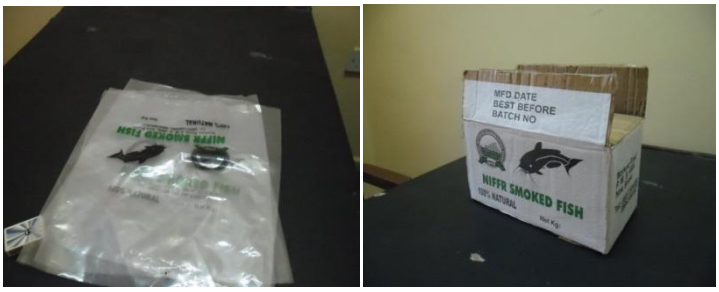

Figure 1. Niffr packaging materials

Fish samples preparation

A total of fifty five (55) healthy fresh fish sampleseach weighing between 700g-1kg were obtained from a pond in Monai, Borgu Local Government Area of Niger State. They were conveyed to the laboratory where they were sorted according to sizes. Bigger size fish were gutted and cut into chunks, medium and small sizes wereskewered.
Three different spices were prepared using Onion, Maggi, Salt, Ginger and Garlic.
The fish samples were properly washed, gutted and separated into three plastic bowls. The bowls were labeled treatment. A, B and C

Figure 2. Preparation of spices for brining of fresh fish

Treatment A was treated with Ginger in brine solution, treatment B contained Garlic in brine solution while treatment C contained combination of Garlic and Ginger in brine solution.
After washing, gutting and skewering, fish were placed in a brine solution containing the spices for two hours for the

fish tissue to absorb significant quantities of salt and spices. The samples were allowed to drip for 30munites before they were smoked using NIFFR Multipurpose smoking kiln as shown below.

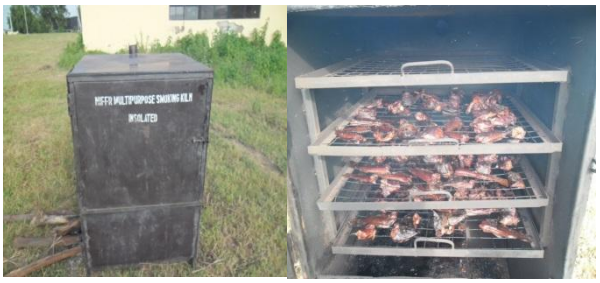

Figure 3. Showing the smoking kiln and smoking process

The different stages involved in fish smoking and packaging process are graphically illustrated below:

Washing
↓
Gutting
↓
Brining
↓
Dripping
↓
Smoking
↓
Cooling
↓
Packaging

After this process, the fire was lowered, the fish uncovered and left to cool. After cooling, the products were unloaded and were packaged in two ways;
1. Products were hygienically packaged and sealed in nitrocellulose-coated cellophane.
2. Products were packaged in cartons covered and sealed with transparent cellophane as shown below;

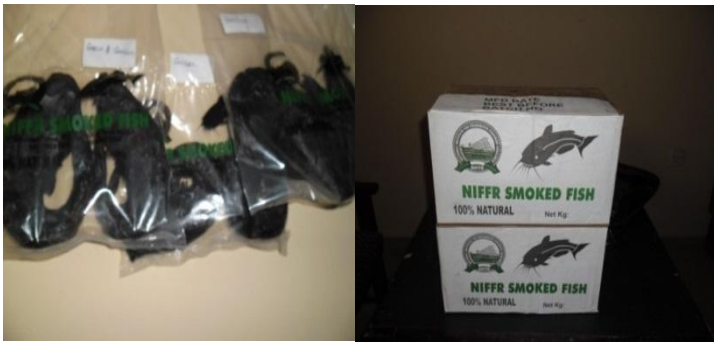

Figure 4. Showing packaged Fish Products

Sensory Evaluation

After five weeks of storage, a ten man untrained panelist was constituted comprising members of staff from NIFRR to evaluate the three samples for Taste, Aroma, Color, Texture and General Acceptability on a 5 point hedonic scale of preference. The scales of preference were ranked 5 – 1 which translates to very good (5), good (4), acceptable (3), poor (2) and very poor (1). The data collected were subjected to ANOVA (Analysis of variance) to determine the significant differences between the samples.
All measurements were performed in triplicate and the value expressed as the mean ± standard deviation (SD). Statistical analyses were performed using SPSS 17.0 for windows. Analysis of variance (ANOVA) was used and statistical significance was set at $p > 0.05$.

Proximate and Microbial analysis

After eight (8) weeks of shelf life study the three samples were taken to the laboratory for proximate analysis. The analysis was carried outin triplicate to determined crude protein, crude fibre, crude fat, ash and moisture contents of the smoked fish according to AOAC (1990). The moisture content was determined by oven drying at 105^{o}C overnight. The dried samples were milled into homogenous powder. The ash content were determined by placing 2g of powder sample into a crucible and ignited in a furnace maintained at 600^{o}C for 3hours. The value of the total organic matter was obtained according to Lingstein and Oginsky (1965).The crude protein, crude firbre, and crude fat were determined according to AOAC 1990. Thenitrogen concentrations were determined by Micro-Kjeidal method of AOAC 1990 by multiplying by 6.25 to estimate the crude protein content.

Microbiological analysis of the three samples was also carried out according to Harrigan(1998) after 8 and 10 weeks of storage to determine the storage lifespan. Total viable counts of bacteria (TVC) were determined using Plate Count Agar (PCA) (37±1oC, 48 hours). Presence of *Escherichia coli* was determined by applying IMVIC tests to the typical dark colonies from Violet Bile Agar. *Staphylococcus* spp was determined using Mannitol Salt Agar (MSA) (37±1oC, 48 hours),*Staphylococcus aureus*was determined by applying coagulase test on bright yellow halo colonies on (MSA). *Salmonella* spp was determined using Salmonella and Shigella Agar (SSA) (37±1oC, 72hours). Potato dextrose agar (mark 0130) was used for counting mold and yeast (22±1oC 5days).All colonies were counted and the data was reported as colony forming units (CFU) per gram.

RESULT AND DISCUSSION

Table 1 below shows the percentage of proximate composition of the treated and smoked fish after 8 weeks of storage. The proximate compositions of fish (Table 1) showed higher average crude protein in treatment C and lower average in crude fibre. The percentage of total protein, lipid and ash contents increased due to loss of moisture during smoking.Here results of moisture content of all the samples were less than standard value. This might be due to the treatments with spices prior to smoking.The higher protein content of samples A, B and C (48.50±0.26, 48.88±0.28 and 52.59±0.26) respectively was as a result of decreased in moisture contents of the products after some weeks of storage. Decrease in water content increased protein content as expected.

Table 1. Proximate composition of the smoked fish products

Samples	% Moisture content	% Ash content	% Crude fibre	% crude protein	% Crude fat	% Nitrogen free extract
A	10.93±0.35	7.30±0.60	1.22±0.05	48.50±0.26	15.76±0.88	16.31±1.34
B	6.95±0.46	5.63±0.56	1.09±0.01	48.88±0.28	15.27±0.40	22.20±0.01
C	6.95±0.81	8.27±0.87	0.98±0.03	52.59±0.26	15.96±0.53	15.27±1.97

Sensory parameter such as taste, texture, aroma, colour and general acceptability were examined after five weeks of storage and their results are presented in Table 2. Results for all the parameters in samples A B and C follows a similar trend while scores for sample B was slightly lower than A and B. However, statistically there was no significant difference (P > 0.05) in all the parameters of the samples. This agrees with the findings of Bilgin et al. (2008).

Table 2. Showing sensory evaluation of the samples

Samples	Taste	Aroma	Color	Texture	General Acceptability
A	4.14±1.1^{a}	4.29±0.8^{b}	4.43±0.5^{c}	4.29±0.8^{d}	4.29±0.8^{e}
B	3.71±1.4^{a}	3.86±0.9^{b}	3.86±1.3^{c}	3.86±1.3^{d}	3.71±1.4^{e}
C	4.43±0.8^{a}	4.57±0.5^{b}	4.43±0.5^{c}	4.29±0.5^{d}	4.29±1.9^{e}

Mean in the same column with the same superscript $^{a\,b\,c\,d}$ and ^{e} are not significantly different@ (P> 0.05)

The scores recorded for the three samples (ABC) may be because the three samples were treated with same concentration of saline solution. The slight difference in the scores of Sample B compared to samples A and B may be due to the odour of garlic that seem repulsive to the panelist.

The microbial analysis of three treated samples after 8 weeks of storage was presented in Table 3. It shows that the Total Viable Counts (TVC) as well as bacterial species was negative. The results revealed that no (TVC) was detected in the Fish samples after smoking. Karra(1978) reported that smoking caused a decrease in total microbial count by an average of 94.7% of the original number in dogfish fillets. No pathogenic micro-organisms like *E. coli*, *Salmonella* spp and *Staphylococcus aureus*were found. This result was in agreement with the work of Bilgin et al(2008) in which there

was significant decrease in the quantities of *Staphylococcus* after smoking. No yeast or mould was detected in the samples.

Table 3. Microbial population (cfu/g) in the smoked fish samples after 8 weeks of storage

Microbial populations	Treatment A	Treatment B	Treatment C
Yeast-Moulds	Negative	Negative	Negative
Staphylococcus aureus	Negative	Negative	Negative
Escherichia coli	Negative	Negative	Negative
Salmonella spp	Negative	Negative	Negative
Total Viable Counts (TVC)	Negative	Negative	Negative

Negative = Not detected

The results after 10 weeks were presented in Table 4. The results revealed that E. coli,*Staphylococcus* and *Salmonella* spp were no detected in all the samples except sample B with the growth of mold.

Table 4. Microbial population (cfu/g) in the smoked fish samples after 10 weeks of storage

Microbial populations	**Treatment A**	**Treatment B**	**Treatment C**
Total Viable Counts (TVC)	negative	Negative	Negative
Staphylococcus aureus	Negative	Negative	Negative
Escherichia coli	Negative	Negative	Negative
Salmonella spp	Negative	Negative	Negative
Yeast-Moulds	Negative	Positive	Negative

Negative = Not detected, Positive =Detected

The results shows that the fish samples treated with spices A and B as additives or preservatives prior to smoking indicates the effectiveness of these preservatives in controlling mold growth and capable of inhibiting microbial growth in stored fish products. Such products can be stored for more than 14 weeks without any growth of mold.The characteristic smell of garlic that often repels bacteria and insects when applied fresh vanishes when stored for a long period of time. This might be responsible for the growth of moulds on the sample B.

CONCLUSION

This study revealed that the application of spices (garlic, ginger, onions and salts) on *clariasgariepinus* and packaging of same hygienically can prolong the shelf life of the fish for duration of between eight (8) to ten (10) weeks of storage life. Proper packaging as shown in this work will help to promote sub regional trade of fishery products as well as enhance reliable information network for effective marketing in an organized industry.

The improvement and development of packaging (using low cost local effective packaging materials) and good storage conditions will protect the products against spoilage and breakage.

References

AOAC (1995).Official Methods of Analysis (16th Ed.). Association of Official Analytical Chemist, Arlington, VA, pp., 125-878.

Bilgin S, Unlusayin M, Izci L, Gunlu A (2008).The determination of the shelf life and some nutritional components of gilthead seabream (*Sparusaurata*L., 1758) after cold and hot smoking.Turk. J. Vet. Anim. Sci. 32(1): 49-56.

Egbal O, Mohammed E, Regiah A, Hana M, Asgad A. (2010). Investigation the Quality Change of Raw and Hot Smoked *Oreochromisniloticus*and Clariaslazera. Pak. J. Nutr. 5:481-484.

Harrigan WF (1998). Laboratory Methods in Food Microbiology.3rded.,London:Academic Press.

Hood MA, Ness GE, Rodrick GE, Blake NJ (1983). Effects of storage on microbial loads of two commercially important shellfish species, *Crassostreavirginica*and *Mercenariacampechiensis.*Appl. Environ. Microbiol. 45(4): 1221-1228

Karra HA (1978). Chemical and technological studies on the utilization of dogfish.M. Sc. Thesis, Fd. Yech. Dept. Faculty of Agriculture, University of Alexandria, Egypt.

NEPC **(2011).**How to boost Nigeria's fish export **sector,** Nigerian Export Promotion Council, Thursday, 04 August 2011, Guardian Newspaper, Pp. 2.

Oluborode GB, Omorinkoba WS, Bwala RL (2010): Development and Construction of an Electric Furnace and Control System for fish drying. *Afr. J. Eng. Res.Dev. (Devon Science Publication)*. 3(2): 123-128