AFM -07

Effects of Natural Ginger Products on the Shelf-Life of Farmed Smoked Fish [*Clarias gariepinus*, Burchell, 1822]

G.S. Adaka, E.O. Unegbu and C.N. Anyanwu
Department of Fisheries and Aquaculture Technology, Federal University of Technology PMB.1526, Owerri, Imo State, Nigeria
Corresponding author: G.S. Adaka; E-mail: revadaka@gmail.com; Tel: +2348037838049

Abstract
This study was conducted to determine the effectiveness of ginger (Zingiber officinale); powder and paste spice mixture on the shelf-life of smoked *Clarias gariepinus* at different concentrations (0g of ginger kg-1 of fish (control), 5g of ginger kg-1 of fish, 10g ginger kg-1 of fish and 15g of ginger kg-1 of fish for ginger powder and paste respectively). Microbial proliferation and organoleptic qualities were used to assess the efficacy of ginger as an antioxidant and antimicrobial in smoked catfish. The microbial count indicated that the control has more microbial load than the other concentrations. In the sensory evaluation, a significant difference ($p<0.05$) was indicated in the ginger powder and paste at 10g/kg. Ginger has antioxidative and antifungal properties; this can extend the shelf-life of smoked *Clarias gariepinus*.

Keywords: microbial, powder, paste, organoleptic

Introduction

In recent years, the fishery sector has been a source of income and livelihood for millions of people around the world. Fish is a highly perishable commodity and needs significant capacity for processing and preservation to lengthen its shelf life, availability and relevance to consumers. Fish constitutes a very important component of the meal for many people and often provides much-needed nutrients for healthy living, its characteristics as a cheap source of animal protein which is now evident throughout the world, makes it an excellent component of the human diet (FAO, 2010).

The production and consumption of catfish (*Clarias gariepinus)*, has experienced a drastic growth in the last two decades. The high cost of beef has made low-income earners to patronize fish as an alternative source of cheaper animal protein; this accounts for the growth recorded in the fishery industry, particularly in aquaculture in recent years in a country like Nigeria (FAO, 2003). Some processing methods have been used over the years to extend the shelf-life of fish in Nigeria and other parts of the world; chilling, freezing, salting, drying, canning and smoking (kumolu-Johnson and Ndimele, 2011; Akintola and Bakare, 2011). Smoking has enjoyed the widest acceptance and usage in Nigeria (Eyo, 2000). Smoked fish offers an alternative high-quality animal protein required by man, in most traditional dishes in Nigeria. According to Eyo (2001), 45% of the total fish catch in Nigeria are utilized as smoked fish. In spite of the relative success of fish smoking especially in terms of increasing the shelf-life and nutritional quality of fish, the volume of post-harvest losses is quite worrisome. It becomes imperative to put measures in place that will prevent lipid oxidation and further deter microbial proliferation.

Spices are edible plant materials that have antioxidative, antiseptic and bacteriostatic properties. They are added to foods such as fish, meat to delay the onset of rancidity and microbial proliferation (Eyo, 2001). Ginger (*Zingiber officinale*) is enjoying wider usage in the local food industries as it is added to local delicacies to improve their flavour, shelf-life and consumer acceptability (Osuntogun and Aboaba, 2004). Ginger has some medicinal values such as analgesic, sedative, antipyretic and antibacterial, which have encouraged their cultivation in many parts of the world (Patrick-Iwuanyanwu *et al*., 2007).

This research is aid at using ginger to increase the shelf-life and nutritional quality of smoked fish (*Clarias gariepinus)*.

Materials and Methods

The experiment was conducted in the Fisheries and Aquaculture Technology Departmental Laboratory in the School of Agriculture and Agricultural Technology, Federal University of Technology Owerri located between latitude 50:23^{1} and 50:28^{1}N and longitude 60:58^{1} and 70:30^{1}E in Owerri West Imo State, Nigeria, annual rainfall is between 192-194mm and mean annual temperature 32^{0}C (Geology Department, School of

Sciences, FUTO 2005). Live catfish (*Clarias gariepinus*) of 1kg size was purchased from a private fish farm in Owerri West, Imo state. They were washed properly to eliminate traces of sand and dirt and degutted. However, natural fresh ginger (Zingiber *officinale*) was purchased from Relief market in Owerri, Imo state. The ginger that was used as the powder was washed with clean water and sun-dried for 7 days and ground into powder according to (Adedire and Lajide, 2000). The ginger for paste was also washed with clean water and ground into a paste. These forms of ginger were applied as a spice mixture to the fish samples before smoking. The fish samples were smoked using a smoking kiln for 6-8hours. Uncontrolled burning of charcoal was avoided by regulating and ensuring even distribution of heat. The smoked samples were cooled, packaged and stored at ambient temperature of 25-30^{o}C for 8weeks and subjected to organoleptic analysis part were kept for 12weeks and subjected to microbiological analysis.

For organoleptic analysis, a panel of 16 persons was selected based on their knowledge of the product to be tested. A room for the assessment was designed in such a way as to ensure maximum privacy and reduce the distraction of passer-bys. A form that contained instructions (guide) was issued to each panellist so that every evaluation was carried out with care to avoid bias. During the taste evaluation, every individual rinsed their mouth properly with clean water after each sample of the smoked fish taste evaluation was carried out. The fish samples were transported to Federal Medical Centre (FMC), Owerri where the analysis on the fish samples for microbial load was done. In the laboratory, the fish samples were inoculated into peptone; (5g of the sample was added into 20ml of peptone water in a sterile universal container). The samples were incubated at 37^{0}C for 2hours and inoculated/sub-cultured using wire loop unto the different media i.e. Nutrient Agar (NA), MacConkey Agar (MAC), Deoxycholate Citrate Agar (DCA), Saubroud Dextrose Sugar Agar (SDA). Sterilizing and cooling the wire loop after each inoculation was done. Inoculated plates were incubated at 37^{0}C for 24hours. The bacteria were counted and identified.

Results

The organoleptic analysis values are presented in table 1 and 2. The table 1 showed there was significant ($p<0.05$) difference between the control and the 5g treatment in the taste of the experimental fish. No significant ($p>0.05$) difference was noted between the control and the 10g and 15g treatment in the taste of the fish. In texture there was significant ($p<0.05$) difference between the control and the 10g treatment but no significant ($p>0.05$) difference was observed between the control and the 5g and 10g treatment. For the colour and smell, no significant ($p>0.05$) difference was noted between the control and the 5g, 10g and the 15g treatment.

Table 1: Effects of different concentrations of ginger powder on the colour, taste, texture and smell of the experimental smoked fish.

Parameters	A(control)	B(5g)	C(10g)	D(15g)
Colour	3.81^{a}	3.50^{a}	3.31^{a}	3.50^{a}
Taste	3.50^{a}	3.94^{b}	3.69^{a}	3.51^{a}
Texture	3.75^{a}	3.88^{a}	4.06^{b}	3.69^{a}
Smell	3.63^{a}	3.69^{a}	3.61^{a}	3.36^{a}

Table 2: Effects of different concentrations of ginger paste on the colour, taste, texture and smell of the experimental smoked fish.

Parameters	Control	A(5g)	B(10g)	C(15g)
Colour	4.13^{a}	4.00^{a}	4.01^{a}	3.69^{b}
Taste	4.07^{a}	3.94^{a}	3.82^{b}	3.81^{b}
Texture	4.13^{a}	4.19^{a}	3.94^{a}	3.82^{b}
Smell	3.57^{b}	3.63^{b}	3.94^{a}	3.32^{b}

The values in table 2 indicated that in texture there was no significant ($p>0.05$) difference between the control, the 5g and 10g treatments. There was significant ($p<0.05$) difference between the control and the 15g treatment, while the Colour showed no ($p>0.05$) significant difference between the control, the 5g and 10g treatments. Significant ($p<0.05$) difference occurred between control and the 15g treatment.

Discussion

The microbial load measured after 12 weeks of storage revealed that the untreated sample (control) had higher growth of microbes than the treated samples. However the samples treated with 5g of ginger powder and paste showed the least detectable mould growth after 12 weeks storage, thus indicating that ginger extract as a natural spice has antimycotic properties that can be compared with synthetic anti microbial agents like potassium sorbate, citric acid and sodium metabisulohate (Omojowo *et al*., 2008). The samples treated with 10g and 15g of ginger powder had lower microbial growth than the 10g and 15g of ginger paste. This could be due to storage temperature which was chosen in order to simulate what happens in the local communities where there is no refrigerator to preserve perishable products. A lower storage temperature of 3-4^{0}C may produce much lower microbial load as reported by Sallem *et al*., (2004). The microbial flora associated with fish could be from the environment in which the fish are harvested and not specific to a particular species (Shewan, 2000 and Sowumi, 2007).

In the study, the fish samples which were smoked on charcoal were either displayed on dirty or open containers or untidy tables during processing. According to da Silva (2002), a combination of smoking and treatments with antimicrobial agents and antioxidants have been found to retard microbial spoilage, extend shelf-life and enhance the safety of smoked catfish. The microbial study revealed that the microbial count of the smoked fish treated with ginger powder is much when compared to ginger paste. There is a significant difference in the microbial count between the control, the 5g, 10g and 15g treatment in the ginger powder. The fish sample treated with 15g ginger pastes revealed much microbial count of *Aspergillus*. This could be as a result of the moisture content from both the fish and fresh ginger paste. Again, the result of this study revealed that the common pathogenic bacteria of the treated fish samples are*; E.coli*, *Aspergillus* and *proteus.* These organisms occur as natural microflora of fish and shellfish. In a similar study carried out by Moshood *et al*. (2012), *Bacillus subtilis*, *Staphylococcus aureus, Proteus mirabilis, Klebsiella spp., Salmonella typhii and Streptococcus spp*. were all found to be associated with smoked fish. The presence of *Aspergillus* in this study could be as a result of the smoked fish absorbing moisture from the storage environment. This corresponds with the report of Christianah *et al*. (2010) which state that the occurrence of *Aspergillus* sp*., Rhizopus sp., Fusarium sp*., and *Penicillium sp*., in the smoked fish species could be due to the fact that during storage, the fish sample reabsorbed moisture from the environment which then supported the growth of the microorganisms in addition to the contamination during processing, handling and display on the market stalls. The organoleptic assessment of food processing technology is very important in determining consumer acceptability (Mohammed *et al*., 2011).

The results of the sensory analysis for the farmed smoked *Clarias gariepinus* showed no significant difference in the colour. The organoleptic quality of the samples decreased with time but they were still acceptable after 8 weeks of storage. This showed that ginger powder and pastes not only increased the sensory quality of the fish but it also prolonged the shelf life.

Conclusions

The study has shown that ginger (*Zingiber officinale*) has some anti-oxidative and anti-fungal effects which can retard oxidative rancidity, inhibit fungal growth, impact acceptable flavour and thus extend the shelf-life of fish like *Clarias gariepinus.* The organoleptic assessment has shown that the treated fish do not exhibit evidence of decay, fragmentation, taint, bad smell and change in colour.

Recommendation

The organoleptic assessment has shown that the ideal dosage of ginger (10g/kg) powder and pastes should be used for effective result.

References

Adedire, C.O. and Lajide, L. (2000). Effect of pulverized plant materials on fish damage and growth performance of the fish beetle *Dermestes maculatus* (Degeer). *Entomol. Soc. Niger. Occ. Publ*. 32:215-221.

Akintola, S.L. and Bakare, B.S. (2011). Microbiological changes in Freshwater Prawn (*Macrobranchium vollenhovenii*, Herklots 1857) stored in ice. *Am. J. Food Technol.,* 68: 500-506.

Christianah, I., Ayolabi, O. and Fagade, O.E. (2010). Mycological Evaluation of Smoked Fish from the Retail Outlets in Ago-Iwoye, Ogun State, Nigeria. *Journal of Life and Physical Science*, 3(2): 65-66

da Silva, L.V.A. (2002). Hazard analysis critical control point (HACCP), microbial safety and shelf-life of smoked blue catfish (*Ictalurus furcatus*) M.Sc Thesis, Graduate Faculty of the Louisiana State University, Agricultural and Mechanical College, U.S.A.

Eyo, A.A., (2000). Fish ProcessingTechnology in the Tropics. University of Ibadan Press, Ibadan, 165-168pp.

Eyo, A.A., (2001). Fish Processing Technology in Tropics. National Institute for Freshwater. *Cameroon Journal of Experimental Biology* 2:1-29.

FAO, (2003). A study of the trade in smoke-dried Fish from West Africa to the United Kingdom. *Food and Agricultural Organization.* Fisheries Circular No. 981, 17pp.95

FAO, (2010). The State of World Fisheries and Aquaculture. *Food and Agricultural Organization.* Fisheries and Aquaculture Department, Rome. 46pp.

Kumolu-Johnson, C.A. and Ndimele, P.E. (2011). A review on Post-harvest Losses in Artisanal Fisheries of some African Countries*, J. Fish. Aquat. Sci.,* 6:365-378.

Mohammed, G.F., Hegazy, E.M. and Abdellatef, M. (2011). Physical chemical properties and mycotoxins contents of Tilapia fish-fillets after solar drying and storage*. Global Veterinana,* 7: 138-148.

Moshood, A.Y. and TengkuHaziyamin, A.A. (2012). *Isolation and Identification of Bacteria in Retailed Smoked Fish within Bauchi Metropolis. Journal of Pharmacology and Biological Sciences*. 3 (1): 1-5.

Omojowo, F.S., Omojasola, P.F. and Ihuahi, J.A. (2008). Microbial quality of Citric Acid and Potassium Sorbate as Preservatives in Smoked Catfish (*Clarias gariepinus*). In: *Biological and Environmental Science Journal for the Tropics*. 5(3): 130-134.

Osuntogun, B. and Aboaba, O.O. (2004). Microbiological and Physico-chemical Evaluation of some Non-alcoholic Beverages. *Pak. J. Nutri*. 3:188-192.

Patrick- Iwuanyanwu, K.C., M.O. Wegwu, E.O. Ayalog, (2007). The Protective Nature of Garlic, Ginger and Vitamin E on CCl_4-Induced Hepatotoxicity in Rats. *Asian J.Biochem.* 2:409-414.

Sallam, K.I, M. Ishioroshi, K. Samejima, (2004). Antioxidant and Anti-microbial Effect of Garlic on Chicken Sausage. *Lebenson Wiss Technol.* 37: 849-855

Shewan, J.M. (2000). The microbiology of seawater fish. In: Fish as Food [Ed. Borgstrom, I.] New York Academic Press. 487pp.

Sowumi, A.A (2007). Fin-fishes in Yoruba national healing practices from southwest Nigeria. *J. Ethno-Pharmacology*.113(2): 72-78.