MICROBIAL LOAD ANALYSIS OF FRESH MUD CATFISH (*Clarias anguillaris*) AND TILAPIA (*Oreochromis niloticus*) IN LAKE GERIO, ADAMAWA STATE, NIGERIA USING TWO DIFFERENT SMOKING KILNS

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ABSTRACT

Fresh mud catfish (Clarias anguillaris) and Tilapia (Oreochromis niloticus) collected from Lake Gerio in Adamawa State were smoked using two different smoking kilns in order to evaluate the microbial load in the fish samples. Variations were observed in the microbial composition contained in the samples. The samples from the traditional smoking drum had higher microbial load, higher peroxide values and higher moisture loss when compared to the FUTY improved processor. In terms of the microbial composition, gram-positive and gram-negative bacteria were identified for samples from both processors. Fungi identified include Aspergillus niger, Pennicillium spp, Rhizopus spp, Mucor spp and Neurospora spp. The quality of the smoked Clarias anguillaris and Oreochromis niloticus with reference to their various peroxide values were obtained after a 28 day storage period. The physico-chemical parameters of the four samples were also obtained. In conclusion, the FUTY Improved Processor (FIP) were of better quality products than the Traditional Smoking Drum (TSD) and was recommended for fish processors in Adamawa State.

Keywords: *Fishes, Quality, Traditional Smoking Drum, FUTY Improved kiln.*

INTRODUCTION

Smoking of fish is a traditional method of processing fish around the globe, thereby extending the shelf-life of the smoked fish. Although its acceptance is based primarily upon the sensory characteristics, it impacts on the fish products. Eyo (2001) reports that fish smoking in the tropics is conducted in smoke houses and smoking ovens or kilns with varying equipment and designs from place to place. He categorically classified various smoking kilns into three: the traditional, the improved traditional and the mechanical smoking kilns. Ugwumba (1992) notes some of the traditional smoking kilns that are used in various localities to include the coal-pot kiln, the whole-drum kiln, the box kiln, chorkor oven and smoking platform.

According to Eyo (1991) the need to improve these smoking kilns is necessary in order to minimize losses due to chemical changes and microbial activities. As such, this will enhance the shelf-life and increase consumers preference. Haruna (2003)

notes that traditional smoking techniques vary widely and improving fish processing technology becomes necessary in other to reduce post-harvest loses, provide employment, and make the product more desirable. Moreover, fish processors can increase their income as the quality of their products attracts consumers.

There are so many incidents of fish spoilage across the world, particularly in the tropics, which facilitate microbial activities and chemical changes, with a resultant deterioration and spoilage. Haruna (2003) reports that fish is a low-acid food that supports the growth of pathogens if not carefully handled and rapidly processed after harvesting. Ugwumba (1992) states that the changes are characterized by a series of biochemical changes such as glycolysis caused by enzyme action, rigor mortising the muscle (stiffening of muscle), muscle tendering by post-rigor, autolysis caused by the action of proteinases (muscle protein enzymes) and finally, spoilage due to microbial action and release of mucus. A large amount of fish is lost after harvesting with respect to quality and quantity which is due to hot weather, low levels of post harvest technologies and poor handling methods (Ugwumba, 1992).

Ogbondemdimu, Omorinkoba, Madu and Ibikunle (1996) state that modern aquacultural practices are quite new in Nigeria. Therefore, basic information on the bacterial populations and types associated with cultured fish species are not available for the development of preventive measures to safeguard against infectious agents which could cause disease and eventually, financial losses. Microorganisms such as bacteria, mould and yeast are known to be responsible for putrefaction and development of poor marketing appearance and toxic substances in fish sold to consumers. However, the role of bacterial flora as a major causative agent of post-harvest losses in fish especially in landing fish has not been given full attention. The activities of microbial organisms can be reduced through fish processing.

ICMSF (1986) found that subsequent changes in the microbial population and storage instability depend on fish type, smoking method, duration of smoking and post-storage conditions. Although, smoking of fish and the associated effects have been of interest to several workers, yet no work has been done on the microbial changes and quality of the smoked fish in relation to different kilns. As such, this study aimed at contributing to the knowledge of fish smoking using different kilns and the quality of their products.

MATERIALS AND METHODS

Freshly caught *Clarias anguilaris* and *Oreochromis niloticus* were collected from Lake Gario area, Jimeta in Adamawa State, Nigeria. They were measured and weighed. The total number of *Clarias anguillaris* and *Oreochromis niloticus* collected for this study was 60. The samples were transferred within an hour after capture to the laboratory in sterile polythene bags and then killed by severing the spinal cord with a sterile scalpel and aseptically eviscerated, washed and rinsed in sterile water before drip-drying. Two of the samples were analyzed for microbial and other quality attributes while the remaining samples were divided into two and smoked using the

traditional smoking drum and the Federal University of Technology Yola (FUTY) improved processor. The fish samples were smoked and properly dried on the first day, with occasional turning of the fish during the smoking process to avoid charring/ smoldering. The smoking was replicated for an hour on the second day in order to improve the shelf stability of the fish samples. After cooling, the samples were packaged in perforated high density polythene bags and stored at ambient temperature of 25^{o}C to 33^{o}C for analysis.

A representative fish sample was obtained aseptically to prepare serial dilution using 0.1% peptone water as diluents. An aliquot of 0.1ml were spread-plated using appropriate dilutions ranging from 10^{-1} to 10^{-4} for fungal enumeration and 10^{-2} and 10^{-7} for bacterial count to give countable plates and, MacConkey agar for coliform bacteria, sabouraud dextrose agar (with 500mg of streptomycin for fungi count). The plates were then incubated as follows: MacConkey agar at 37^{o}C for 24hours, while Sabouraud dextrose agar at 27^{o}C and colonies formed were enumerated. Representative microbial colonies were isolated, characterized presumptively by gram staining before biochemical tests were carried out. The biochemical tests for identification of bacterial isolates includes the following: the catalase test, citrate utilization tests, urease test and carbohydrate fermentation test. The isolated fungi were identified using cultural characteristics and the morphology of the sporing structures: philiades, conidiophores (septate and non-septate).

The Peroxide Value (PV) measured the level of lipid oxidation in fats and oils but not their stability. It was defined as the equivalent (meg) of peroxide per kg fat. It was a measure of the formation of peroxide or hydroperoxide groups that are the initial products of lipid oxidation. The pH of the samples was determined using a standardized pH meter. Processed fish samples were stored over a 28 day storage period and weight loss or gain recorded. Analysis of variance and t-test were employed to determine the significance of the mean difference.

RESULTS AND DISCUSSION

The results obtained from this study indicate a higher incidence of micro-organisms on the fish samples smoked using the Traditional Smoking Drum (TSD) as compared to the samples processed using FUTY Improved Processor (FIP). In analyzing the bacteria growth, organisms such as *Staphylococci spp, Escherichia coli, Pssuedomonas spp, Klebsiella spp.* and *Salmonella spp. Staphylococci spp* were identified during the catalase test counted in the media for the TSD amount to 58 cfu/g, while those of the FIP is 31cfu/g. This shows that both products are destined for human consumption and it may be considered hazardous with staphylococcal counts of 106cfu/g and above. The amount of staphylococcal count may emanate from the water body, the landing site and from the handling process. The amount of *E. coli* in TSD samples emanated to 79cfu/g, *Pseudomonas spp* counted is 116cfu/g, *Klebsiella spp* is 79cfu/g *Salmonella spp* counted was 97cfu/g. Those of of the FIP *E. coli* accounted for 26cfu/g, *Pseudomonas spp* 35cfu/g, *Klebsiella spp* 42cfu/ and

Salmonella spp 53cfu/g. It has been reported on table 2 that *Staphylococci spp* causes localized infection like boils. *Pseudomonas spp* is likely to cause wound infection and *Klebsiella spp* leads to histamine poisoning to human consumers. Fungi counts on samples processed using TSD and FIP include *Rhizopus sp*, *Apergillus niger*, *mucor spp, pennicillium sp* and *Neurospora sp*. From the counts, higher numbers were recorded from samples (*Clariass anguillaris* and *Oreochromis niloticus*) that are processed using TSD when compared to those processed using FIP. This is an indication of the performance of the processors.

Meanwhile, it is important to note that real food poisoning emanates from moulds. This fact is supported by the Encyclopedia of Food Science and Technology (1992) that the possible production of Mycotoxin form fungi such as *Aspergillus flavus* and *A. parasiticus* tends to be carcinogenic and thus are of concern to regulatory agencies. The occurrences of the same bacteria and fungi on the fish samples are indications of being contaminated at one point or another but the variations during the storage period of 21 days in relation to their various counts is a function of the efficiency of the processors. This study also indicated the various peroxide value (PV) level of *Clarias anguillaris* and *Oreochromis niloticus* using two different processors,which are the TSD and FIP after a storage period of 28 days (Table 3).

Huss (1995) reports that large amount of polysaturated fatty acid found in fish lipids makes them susceptible to oxidation by an auto catalytic mechanism, this leadsto production of higher peroxides. It is important to state here that there are variations seen in the PV of each sample because *Clarias anguillaris* is a fatty fish, while *Oreochromis niloticus* is a lean fish. On the other hand, their variations may also emanate from the type of processor used, the storage period and the onset of rigor mortis before processing. The oxidation reaction though a catalytic reaction has been shown from the study to occur faster in dead tissues than living tissues. This is in line with the report of Accuff, Izat and Finne (1984) that rigor mortis starts immediately or shortly after death of a fish and the exhaustation of the glycogen reserves.

The methods used in catching the fish and in killing the fish have also been considered in this study, live fishes were used for this work which were collected from the fisher folks using gillnet, and a blow/hit on the head of the fish placed the fish on an unconscious mood before killing. This was adopted in order to give time before the onset of rigor mortis. The peroxide production obtained from *Clarias anguillaris* was higher than that of *Oreochromis niloticus* because *C. anguillaris* is a fatty fish, while *O. niloticus* is a lean fish. The variation obtained from the type of processor used on a particular fish species can be attributed to the efficiency of the processor in the removal of moisture and oil in the course of processing and the storage period of 28 days. This study also showed the various peroxide value (PV) level of *Clarias anguillaris* and *Oreochromis niloticus* using two different processors, which are the TSD and FIP after a storage period of 28 days.

The variation obtained from the type of processor used on a particular fish species can be attributed to the efficiency of the processor in the removal of moisture and oil in the course of processing and the storage period of 28 days (table 3). The physico-chemical analysis indicates that the pH values gotten from the products of the FIP are less to those of the TSD, as shown on the various microbial loads (table 2). This agrees with the findings of Omojowo and Sogbesan (2003) who report that many spoilage organisms find the low pH so hostile that they die during storage, and that the growth of mould brings about a rise in pH and that the pH of fish tissues is 5.6 or more. According to Haruna (2003), fish is a low acid food, the pH values obtained from this study is an indicator of fish being a low acid food.

CONCLUSION

From the microbial load analysis drawn from various samples, the most efficient processor between the two processors was FUTY improved processor. The peroxide value was a clear indicator of the shelf-life of the products, which showed the level of deterioration with time of the various products, that is the higher the peroxide value the higher the level of deterioration of the quality of the fish. Other parameters like the physical appearances of the various products dictate the efficiency of the processor that is involved thus the FUTY Improved processor is the most effective processor in this study. In conclusion, the use of this two processors in this study have shown how profitable it will be for fishermen and women, marketers and aquaculturists in the utilization of the FUTY Improved Processor (FIP) compared to the Traditional Smoking Drum (TSD) as losses incurred in the use of it is minimal.

Table 1: pH Values of Samples using FIP and TSD

Fish Species	Smoking Processor	Values
Clarias Anguillaris	TSD	5.92
Clarias Anguillaris	FIP	5.80
Oreochromis niloticus	TSD	6.03
Oreochromis niloticus	FIP	5.70

Source: Experimentation, 2009

Table 2: Total bacterial count (cfu/g) using FUTY improved processor and traditional smoking drum of samples collected from Lake Gerio.

Processing kiln	Clarias anguillaris 10^{-2}	Clarias anguillaris 10^{-7}	Oreochromis niloticus 10^{-2}	Oreochromis niloticus 10^{-7}
Traditional smoking drum(TSD)	4.18×10^{6}	4.0×10^{4}	1.70×10^{6}	7.0×10^{4}
FUTY improved processor (FIP)	1.93×10^{6}	2.0×10^{4}	0.01×10^{6}	0.001×10^{4}

Source: Experimentation, 2009

Table 3: Peroxide values of samples using FIP and TSD in 28 days storage period

SD Clarias Anguillaris (PV)mg/kg	TSD Oreochromis niloticus (PV)mg/kg	FIP Clarias Anguillaris (PV)mg/kg	FIP Oreochromis niloticus (PV) mg/kg
38.7	32.90	36.6	30.4

Source: Experimentation, 2009

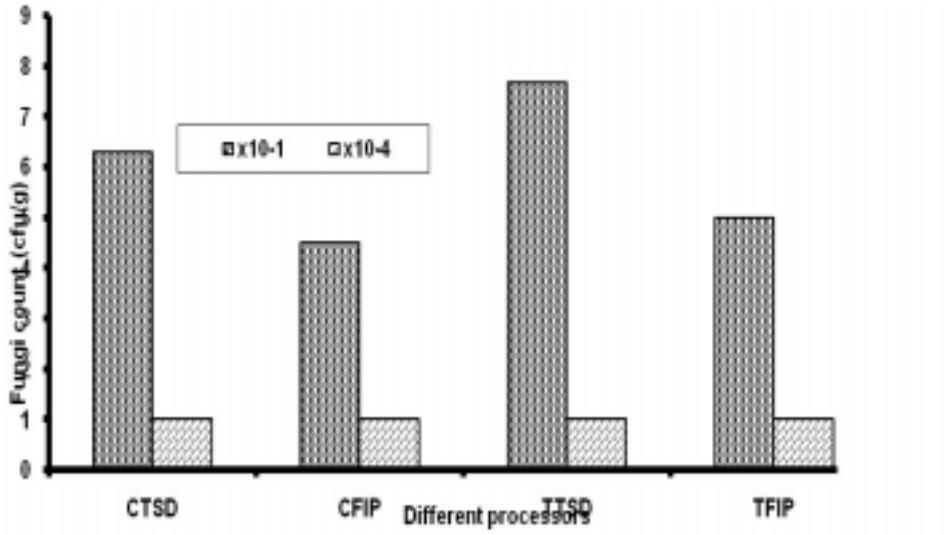

Figure 1. Fungi count in fish samples processed by two different processors at different serial dilution

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