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Preliminary Study on the Antioxidative and Antimicrobial Effects of Fresh Garlic (*Allium sativum*) on the Shelf Life of Hot-smoked Catfish (*Clarias gariepinus*)

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ABSTRACT

Clarias gariepinus is a fish that is of high demand in Nigeria. However, a lot of the output from wild and aquaculture deteriorate in quality because of improper preservation methods. This study investigated the effects of fresh garlic (*Allium sativum*) on lipid oxidation and microbial growth of hot-smoked catfish (*Clarias gariepinus*). Three garlic concentrations and control (0 (control), 10, 30 and 50 g garlic kg^{-1} fish) were prepared, hot-smoked and stored for 28 days at ambient temperature of 20-26°C. During the storage period, the samples were subjected to weekly chemical and microbial analyses. The highest Thiobarbituric acid (TBA) (4.32±0.39 mg malonaldehyde kg^{-1} sample), peroxide (12.31±2.06 milliequivalent peroxide kg^{-1} of sample) and microbial load (12.03±0.56 Log_{10} CFU g^{-1} fish) were recorded in the control while the lowest peroxide (6.91±1.08) and microbial count (11.15±0.43 Log_{10} CFU g^{-1} fish) occurred in sample with 50 g garlic kg^{-1} fish. However, the lowest TBA (3.06±0.26 mg malonaldehyde kg^{-1} sample) was observed in sample containing 30 g garlic kg^{-1} fish. The results of analyses suggest that fresh garlic possesses antioxidant and antimicrobial properties, which can extend the shelf life of *Clarias gariepinus*.

Key words: Thiobarbituric acid, rancidity, total coliform counts, peroxide value

INTRODUCTION

Fish is an important source of animal protein in Nigeria. It is readily available in most markets in various processed and preserved forms like smoked, sun-dried, canned, chilled or frozen. Fish muscle contains four basic nutrients in varying proportions; water 70-80%, protein 16-25%, lipid 1-5% and vitamins (Clucas, 1982). Only a negligible proportion of fresh fish caught in lakes and rivers in Nigeria is sold fresh. Great portion is preserved by smoking and sundry (Ikeme and Bhandary, 2001). Heat generated by the smoking process removes water, inhibits bacterial growth, retard enzymatic action, imparts aroma, taste and colour on processed fish. However, fish quality can deteriorate during storage due to lipid oxidation and microbial growth. While lipid oxidation is responsible for reduction in nutrient quality as well as changes in flavors (Kumolu-Johnson and Ndimele, 2001); microbial contamination could cause public health concern as well as economic and physical loss in terms of fish spoilage.

Synthetic anti-oxidants such as Butylated Hydroxytoluene (BHT) were used to retard rancidity in fish and other animal products. However, their use has been banned in many countries because

of their negative effects on the enzymes of the liver and lungs (Sallam *et al*., 2004). This necessitated the need to use natural anti-oxidants such as spices in the prevention of rancidity in smoked fish (Watts, 1962; Kumolu-Johnson and Ndimele, 2001). Two of the common spices that could be used as anti-oxidants to compliment smoking are ginger and garlic.

Garlic, (*Allium sativum*) is one of the most commonly used spices to enhance flavour in food. It has a wide spectrum of actions which include antibacterial, antifungal and antioxidative as well as beneficial effects on the cardiovascular and immune system of human (Sallam *et al*., 2004). Thus, this research is aimed at studying the effectiveness of fresh garlic at different concentrations on the qualities and shelf life of hot smoked *Clarias gariepinus*.

MATERIALS AND METHODS

A total of 50 African catfish, *Clarias gariepinus*, of average weight of 100 g were obtained from Lagos State University Hatchery, Lagos Nigeria. The samples were stunned with salt and eviscerated. Fresh garlic, (*Allium sativum*) was purchased from a local market in Oke-Odo, Lagos. The fresh garlic outer coats were removed, cloves peeled and crushed finely with a kitchen blender. The fish samples were cleaned and dipped in 15% brine solution for 10 min, drained and divided into four batches labeled A, B, C and D. Fish samples in batch A (control) were not treated with garlic. The fish samples in batches B, C and D were treated with the garlic paste at 10, 30 and 50 g kg^{-1} of fish. Then, the fish were smoked with tropical hardwood at 80-85°C for 6 h. The smoked samples were cooled, packaged in labeled plastic buckets and stored at ambient temperature of 20-26°C for 28 days. Samples were subjected to chemical and microbiological analyses.

Chemical analysis

Thiobarbituric acid reactive substance (TBA-RS) determination: The oxidative stability of smoked catfish was measured by TBA-RS according to AOAC (1995).

Peroxide value: The oxidative stability of smoked catfish was also measured using titrimetric determination of the amount of peroxide and hydro peroxide group (the initial product of lipid oxidation).

Microbiological analysis: The total coliform counts were determined according to the method of Fawole and Oso (1995).

Statistical analysis: Statistical analysis was performed using SPSS v. 17.0 for windows. Analysis of Variance (ANOVA) was used and statistical significance was set at $p<0.05$. Fisher's Least Significant Difference (LSD) was used to separate differences in treatment of means.

RESULTS AND DISCUSSION

The TBA, peroxide and microbial load decrease with increase in the concentration of the garlic (Table 1). The highest Thiobarbituric acid (TBA) (4.32±0.39 mg malonaldehyde per kg sample), peroxide (12.31±2.06 milliequivalent peroxide per kg of sample) and microbial load (12.03±0.56 Log_{10} CFU g^{-1} fish) were recorded in the control while the lowest peroxide (6.91±1.08) and microbial count (11.15±0.43 Log_{10} CFU g^{-1} fish) occurred in sample with 50 g garlic kg^{-1} fish. However, the lowest TBA (3.06±0.26 mg malonaldehyde per kg sample) was observed in sample

Table 1: Mean thiobarbituric acid, (mg malonaldehyde kg^{-1} sample) value, peroxide values (milliequivalent peroxide kg^{-1} sample) and microbial growth (Log_{10} CFU g^{-1} fish) during 28 days of storage period

Treatments	TBA	Peroxide	Microbial counts
Garlic conc. (g kg^{-1} fish)			
A: 0	4.32±0.39^{a}	12.31±2.06^{a}	12.03±0.56^{a}
B: 10	3.62±0.31^{ab}	11.35±1.86^{b}	11.58±0.51^{a}
C: 30	3.06±0.26^{ba}	7.78±1.49^{bc}	11.24±0.41^{a}
D: 50	3.09±0.18^{ba}	6.91±1.08^{bc}	11.15±0.43^{a}

Values in the same column and with the same superscript values are not significantly different (p>0.05)

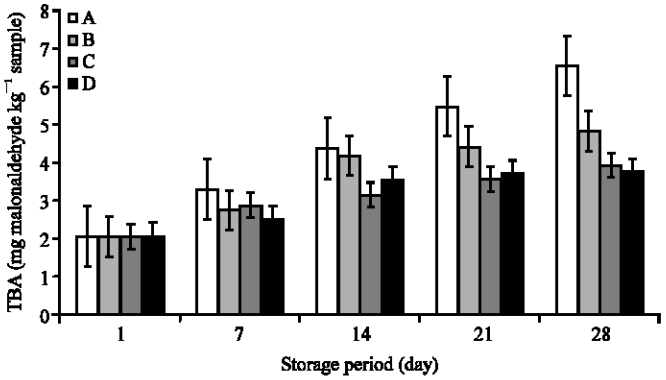

Fig. 1: Thiobarbituric acid (TBA) value during the 28 days of storage period

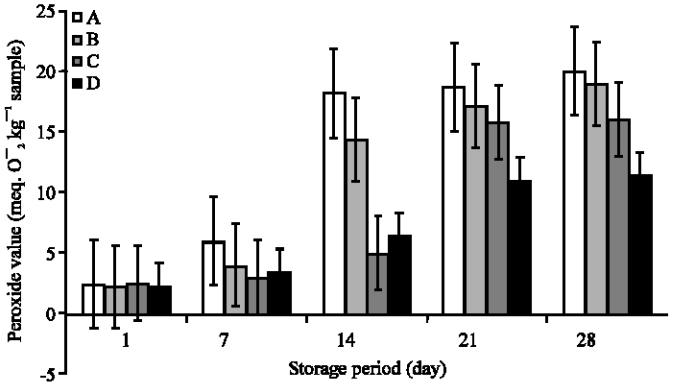

Fig. 2: Peroxide value during the 28 days of storage period

containing 30 g garlic/kg fish (Table 1). The oxidative stability of the smoked catfish samples *Claris gariepinus* measured using Thiobarbituric acid (TBA) reaction and peroxide value during the 28 day storage period as showed in Fig. 1 and 2 revealed an increase in (TBA) and peroxide values with time but samples with higher concentration of fresh garlic treatment had lower figures in comparison to untreated samples. The weekly microbiological analysis measured in Log_{10} CFU g^{-1} fish (Table 1), reveal that treated samples {B (11.58±0.51), C (11.24±0.41) and D (11.15±0.43)} had lower microbial growth than the untreated sample {control (A) (12.03±0.56)}.

The statistical analysis of the Thiobarbituric acid value (TBA) and peroxide value in Table 1 showed that there was significant difference ($p<0.05$) in the lipid oxidation between the untreated samples and treated samples which is in agreement with the study by Ikeme and Bhandary (2001)

and (Sallam *et al*., 2004) in which ginger and garlic pastes were effective in retarding the development of oxidative rancidity in mackerel, *Scomber scombrus* and in chicken sausage, respectively. They also reported that the effectiveness of spices as an antioxidant is directly related to their concentration. However, the microbial growth among the treatment did not show any significant difference ($p>0.05$) but there was a noticeable trend; the treatment with the highest microbial growth was the control (A), which was not treated with garlic while the treatment with the highest concentration of garlic (50 g of garlic kg^{-1} of fish) had the least microbial growth.

CONCLUSION

This study has shown that garlic (*Allium sativum*) has some antioxidative and antimicrobial properties, which can retard the growth of micro-organisms and thus, extend the shelf life of fish like *Clarias gariepinus*. However, the insignificance ($p>0.05$) of microbial growth among the treatments suggests that the storage period of the experiment should be extended for a clearer result since there was a trend.

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