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Ginger as an Antimicrobial Agent in the Preservation of Smoke Dried *Clarias Gariepinus*

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Abstract

Freshly caught fish were treated with ginger roots extracts at various levels of dilution, 25% (T2), 50%(T2), 75% (T4) while T1, the control was 10% saline solution and then smoked in separate chambers of smoking kiln. Smoking temperatures ranging between 100 and 200^{0}C. Products were packaged in labelled sterile paper bags and assessed biweekly for spoilage and organoleptic properties. Results showed that peroxide value was lowest in 75% Ginger (6.04m/Eq/kg) treatment and highest (7.86mEq/kg) in 10% saline solution. Microbial load reduced with increasing concentration of extract. Similar trend was observed the peroxide values. Ginger preserved products were accepted by consumer even after six weeks of storage. Gingerroot extracts could serve as preservative for smoked Clariasgariepinus.

Introduction

Fish is a perishable biomaterial especially in the tropics where high temperature and humidity accelerate spoilage and bio-deterioration of fish immediately after catch (Okonta and Ekelemu, 2005). Deterioration sets in immediately after fish dies because of the presence of resident bacterial flora on the flesh, enzymatic activities that continue even after death and other biochemical reactions that follow. These cause fish to lose its organoleptic qualities, and generally become unacceptable for human consumption. It is this perish ability of fish that makes it to be processed into fish based products, such as smoked, canned fish, fish cake, fish meal and fish burger. The reduction of these losses can only be achieved by systematic improvements in handling, processing, storage and distribution.

This necessitated the need to use of natural anti-oxidants and antimicrobial agents such as herbs and spices to prevent rancidity in smoked fish (Kumolu *et al*, 2013) and the entry of pathogens to food. Ginger *Zingiberofficinale* is a common spice that could be used as anti-oxidants and anti-bacterial on stored food materials. The antioxidant and antimicrobial ability of this spice has been reported in various studies.

Ginger, *Zingiberofficinale* as a spice has a geographical spread that covers every part of the globe and it is consumed whole as a delicacy, used in traditional oriental medicine, or as spice in foods, such as fish (Onyeagba *et al*, 2004; Abdul *et al*, 2008; Akram *et al,* 2011; Prasad and Tyagi, 2015). Ginger contains a number of biologically active essential oils such aszingiberene, β-bisabolene, β-farnesene, β-sesquiphell and rene, and β-curcumene which are terpenes, and phenols which include gingerol, paradols, and shogaol. These essential lipids constitute about 1-3% of the wet weight (Akram *et al*, 2011;Shalaby, and Hamowieh, 2010). These compounds make it a stimulant and give it its characteristic pungent aroma and flavour. The terpenes are responsible for the aromatic flavour while the phenols cause the pungency.

This study was designed to investigate the preservative potentials of ginger extracts as a potential preservative and organoleptic quality enhancer for *Clariasgariepinus.*

Methodology

Fresh ginger (*Zingiberofficinale*) roots were washed, their skin removed and ground the juice was extracted at a weight ratio of 1:3, 1:2, 3: 1 ginger to water representing 25%, 50% and 75% dilution the control was 0% of ginger of 10% saline solution. The mixtures were heated (100^0c) and later centrifuge (2200rpm) to remove the filtrate and then cooled in room temperature. Whole fresh *Clariasgariepinus* weighing 250g±10 were obtained from Osun State University fish farm gutted, cleaned and soaked for 90minutes in each of the extracts the experiment was a complete randomised design labelled respectively as T1, T2, T3, T4 in triplicates of 9 fish per set up making 27 fish per treatment. The fish were smoked in separate chambers of smoking kiln for 8hours at temperatures ranging between 100 and 150^0C to mean moisture content of 10.0±2.21g/100g of sample. The products were packaged in sterile paper bags, kept at room temperature and assessed biweekly for bacterial, fungal, and organoleptic properties. Organoleptic assessment was carried out using a 5-point hedonic scale. The peroxide value and aflatoxin content were measured after the sixth week. Results using descriptive statistics and One Way Analysis of Variance (ANOVA). Duncan Multiple Range test was used to separate the mean of all treatments at the 5% level of significance. SPSS version 23 for Microsoft windows was employed for the analysis.

Results and Discussion

Bacteria load was visible on the flesh of fish in treatment T1 (1.0 $X10^5Log_{10}$Cfu/g) first, in the second week it was observable in T4 (20.00±0.58 $X10^{5c}$) but not visible in the flesh of *C. gariepinus* in treatment T2 and T3 until fourth week (Table 1). Bacteria load was however visible in the second week in all the head samples by the second week (Table 2).Generally apart from T1 which is the control bacterial population decreased significantly ($P<0.05$) in the sixth week after an increase which was observed between the first and the fourth week.

Table 1. **Mean population of Bacterial in the flesh of ginger extract preserved smoked C. *gariepinus* ($(X10^5Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	1.00±0.00 $X10^{5a}$	10.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5ab}$	80.00±0.58 $X10^{5a}$
T2	0.00±0.00^b	0.00±0.00^b	10.00±0.58 $X10^{5b}$	5.00±0.58 $X10^{5b}$
T3	0.00±0.00^b	0.00±0.00^b	10.00±0.58 $X10^{5b}$	3.50±0.00 $X10^{4c}$
T4	0.00±0.00^b	20.00±0.58 $X10^{5c}$	3.0.00±0.58 $X10^{5c}$	1.00±0.58 $X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

Table 2. **Mean population of Bacterial in the head of ginger extract preserved smoked C. *gariepinus* ($(X10^5Log_{10}$Cfu/g)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	4.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5b}$	60.00±0.58 $X10^{5a}$	7.50±0.00 $X10^{6a}$
T2	0.00±0.00	20.00±0.00$X10^{5b}$	7.50±0.58$X10^{5b}$	6.50±0.58 $X10^{5b}$
T3	0.00±0.00	10.00±0.00$X10^{5b}$	20.00±0.00$X10^{5c}$	2.50±0.00$X10^{4c}$
T4	0.00±0.00	3.00±0.58$X10^{5b}$	20.00±0.58$X10^{5c}$	2.21±0.58$X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

Similar trend was observed with fungal population, there was an initial increase in population in the first four weeks which was later followed by a decrease in the sixth week (Table 3 and 4).The results for treat varied significantly with treatment at $p<0.05$.

Table 3. **Mean population of fungi in the flesh of ginger extract preserved smoked C. *gariepinus* ($X10^5Log_{10}Cfu/g$)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	4.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5a}$	60.00±0.58 $X10^{5a}$	20.00±0.00 $X10^{5a}$
T2	0.00±0.00	20.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5\,b}$	2.00±0.58 $X10^{5b}$
T3	0.00±0.00	10.00±0.00 $X10^{5b}$	20.00±0.00 $X10^{5\,b}$	1.00±0.00 $X10^{5b}$
T4	0.00±0.00	0.00±0.00^{c}	20.00±0.58 $X10^{5\,b}$	2.60±0.58 $X10^{5b}$

Means of values with same superscripts along column are not significantly different (P>0.05)

The result obtained is similar to that of observed by Vwioko *et al* (2013) ginger treated soursop fruit juice were found to have less microbial flora than the control(no treatment).

Table 4. **Mean population of fungi in the head of ginger extract preserved smoked C. *gariepinus* ($X10^5Log_{10}Cfu/g$)**

Treatment	Week 0	WEEK 2	WEEK 4	WEEK 6
T1	0.00±0.00	30.00±0.00 $X10^{5a}$	20.00±0.58 $X10^{5a}$	20.00±0.00 $X10^{5a}$
T2	0.00±0.00	10.00±0.58 $X10^{5a}$	20.00±0.58 $X10^{5\,b}$	12.00±0.58 $X10^{5b}$
T3	0.00±0.00	30.00±0.58 $X10^{5b}$	30.00±0.58 $X10^{5\,b}$	11.00±0.00 $X10^{5b}$
T4	0.00±0.00	0.00±0.00^{c}	20.00±0.58 $X10^{5\,b}$	22.00±0.58 $X10^{4c}$

Means of values with same superscripts along column are not significantly different (P>0.05)

The heads were observed to have more microbial flora than the flesh this could be because the head has a direct contact with external environment through the gills and the mouth. Spores of microbes suspended in water could be swallowed during the normal process of respiration.

The general decrease in growth which was observed with higher concentration of ginger is an indication of the potency of ginger as an antibacterial agent. However, higher potency of synthetic antimicrobial agents were was linked to the probability that the active agents in the natural spices may not be completely soluble hence the reduction in their potency. There is also the possibility that the volatile ones escaped, thus reducing the potency against microbes.

Peroxide value and Acceptability

At the end of six weeks the peroxide value was highest in T1(7.86mEq/kg) and lowest in T4 (6.04mEq/kg), the higher the peroxide value the higher the extent of rancidity, the implication is that antioxidant components of ginger were able to retard oxidative rancidity in the samples (Ikeme and Bhandary, 2001; Sallam*et al*., 2004; Johnson *et al*., 2013). Panellists preferred the colour of T1 (one without ginger) followed by T4. The texture of T1 and T2 were preferred. T2 was the best accepted followed by T4, ginger treated smoked *Clariasgariepinus* is acceptable to consumers (Table 5).

Table 5. **Mean population of fungi in the flesh of ginger extract preserved smoked C. *gariepinus* ((X10^{5}Log$_{10}$Cfu/g)**

Treatment	Colour	Texture	Flavour	Taste	Peroxide valuemEq/kg	acceptability	Aflatoxin level%
T1	2.8	3.5	2.7	3.1	7.86	2.7	35.22
T2	2.3	3.3	2.9	3.1	6.67	3.5	26.25
T3	2.2	2.9	2.7	2.5	6.25	2.6	25.25
T4	2.7	2.8	3.2	2.9	6.04	2.9	18.21

Means of values with same superscripts along column are not significantly different (P>0.05)

Conclusion

The study shows that ginger extract could control microbial invasion on smoked dried *Clarias gariepinus* the extract is best for the control of bacteria and fungi at 75% dilution with water. Acceptability of the ginger preserved products was better at the end of weeks for in the 25% dilution followed by 75% dilution. Garlic treatment of fish products could be a good additive for preservation of *Clarias gariepinus*.

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