THE EFFECT OF DIFFERENT CONCENTRATIONS OF GINGER ON THE QUALITY OF SMOKED DRIED CATFISH (*Clarias gariepinus*)

Idris, Garba Libata*, Omojowo, Funso Samuel.;* Omojasola Patricia Folake**, Adetunji Charles Oluwaseun***, and Ngwu Emmanuel onyebuchi*

*NATIONAL INSTITUTE FOR FRESHWATER FISHERIES RESEARCH, (NIFFR) P.M.B. 6006, NEW-BUSSA, NIGER STATE. NIGERIA.
** DEPARTMENT OF MICROBIOLOGY, UNIVERSITY OF ILORIN, ILORIN, NIGERIA.
***NIGERIAN STORED PRODUCTS RESEARCH INSTITUTE, ILORIN, KWARA STATE, NIGERIA.
idrisgarbalibata@yahoo.com; jowosam@yahoo.com; folakejasola@yahoo.co.uk, charliguitar@yahoo.com and ngwuemma@yahoo.com

Abstract: Fresh, live catfish (*Clarias gariepinus*) were obtained from Private pond in NIFFR, New-Bussa. The samples were divided into five groups. Four groups were dressed and dipped in a solution of 2.5%, 5%, 7.5% and 10% of Ginger respectively for thirty (30) minutes and smoked dried. The fifth group acts as control. They were examined microbiologically, chemically and organoleptically. The Ginger reduced the free fatty acid (FFA) values, trimethylamine (TMA) values, and the fungi load of the processed fish. Ten percent of ginger had the best result in terms of reduction in fungi load, FFA and TMA values and followed by 7.5 and 5%. However, from the organoleptic results of overall acceptability, taste, colour and texture of the products, 5% ginger concentration had the best acceptance and significantly different ($P<0.05$) when compared to the non treated control after 8 weeks of storage. [Nature and Science. 2010; 8(4), 59-63] (ISSN: 1545-0740)

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1. INTRODUCTION

World fish production was estimated at 100 million tons in 1989, 15% of which was cured in one or another way. One third of the cured fish was smoked and about 20% of the smoked fish goes into international trade. Smoking of fish and/or meat products is one of the most ancient processing technologies. It has been for centuries used for preservation, and is still widely used for this purpose among several communities in the third world where up to 70% of the catch is smoked for preservation (Ward, 1995). In industrialized countries, however, smoking of fish is done for enhancement of flavor and texture (Dillon *et al*., 1994); often producing value added products whose preservation is achieved by other means. Nutritionally, fish proteins are noted for a high degree of digestibility and as a rich source of lysine and sulfur containing amino acids. Therefore it is suitable for complementing high carbohydrate diets especially in developing countries (Kent, 1984). Much attention is being directed at fresh water fish because of its health benefits, as a result of the presence of omega-3-fatty acids in the fish oil (Vileg and Body, 1988; Negbenebor, 1990). The reduction of these losses can only be achieved by systematic improvements in handling, processing, storage and distribution (FAO, 1990).

Catfish live in both freshwater and saltwater; however, the species cultured by fish farmers are raised in fresh water. About 1,250 species of catfish exist; and attracts more value than other fish species of its size (Lee, 1991). The common species are usually differentiated by colour and arrangement of external features. The most prominent feature is the fins. *Clarias gariepinus*, one of the species of catfish is a highly nutritious fish that contain high amount of vitamins, proteins, minerals and a little or no saturated fat, and is low in carbohydrates. Smoked catfish may have some appeal as a special catfish product. Spices such as Ginger are grown locally and have been known to enhance aroma and flavor of foods (Purseglove et al., 1981). Such spices like ginger could also have anti-microbial properties. The concentration of the ginger to be used should be effective and acceptable by consumers by actually enhancing the quality of such processed fish products.

The objective of this study is therefore to investigate the percentage concentration of ginger that will be very effective microbiologically and at the same time acceptable by consumers.

2.0 MATERIALS AND METHODS

Collection of sample

Fresh live catfish samples *(Clarias gariepinus*) were obtained from Private fish pond in National Institute for Freshwater Fisheries Research (NIFFR) New Bussa, Niger-State. However, the garlic and ginger were obtained from Monday market, New-Bussa.

2.1 Preparation of the samples

The Ginger samples were ground using a hammer mill, wrapped in aluminum foil and autoclaved at a 121^{o}C for 15 min and plated out on Nutrient agar and Sabouraud dextrose agar to ensure there was no mould and bacterial growth.

Twenty-five fish samples with weight ranges from 170-210g each were selected for each of the seven groups. The fish samples were headed gutted and cleaned with water. The first, second, third and fourth group was soaked in 2.5%, 5%, 7.5% and 10% Ginger solution respectively. The fifth group however, was soaked in Sterile distilled water for 30mins at ambient temperature (29-35°C). The samples were smoked dried according to the methods described by Omojowo and Ibitoye (2005). The samples were submitted to microbiological, chemical and sensory scores following processing.

2.2 Microbiological Analyses

The Fungal count were evaluated according to the methods described by Harrigan and McCance 1976; Speck 1984 and Sneath *et. al*., 1986). All samples were done in triplicates. Sensory evaluation was carried out according to the method of Afolabi et. al. (1984).

2.3 Chemical Analyses

The trimethylamine (TMA) values were measured by the AOAC (1984) method, while the free fatty acid (FFA) was determined using the method of Pearson (1981). The pH values were determined directly by using the pH probe (Negbenebor *et al*., 1995).

2.4 Sensory Evaluation

A taste panel of ten members made of Staff of National institute For Freshwater Fisheries Research (NIFFR), New-Bussa. They rated the samples for color, texture, taste and overall acceptability using a hedonic scale of 1- 5 with 5 representing "like much" and 1 representing "dislike much"(Afolabi, *et al.,* 1984).

2.5 Statistical Analyses

Statistical analysis was according to SAS, Institute, Inc, (1992) at $P < 0.05$.

3.0 RESULTS AND DISCUSSION

The Fungi count of the Fresh treated samples ranged from mean log 1.65 to 2.28 Cfu/g while the control is 2.76 Cfu/g. Also the treated smoked samples ranged from 0.70 to 1.35 Cfu/g on Day 0 as against the 2.30 Cfu/g of the control (Table 1). The 5% ginger concentration is significantly higher than 2.5% at $P < 0.05$. Likewise, both 7.5% and 10% which are not significantly different from each other at $P > 0.05$ are both significantly different from 5% respectively. This result shows that the higher the concentration of ginger the higher the antifungal effects. This result agrees with earlier results of (Negbenebor, *et.al.,* 1996) where clove and ginger individually and in combination reduced the fungal loads of smoked fish. This results also indicates that the ginger which is natural spice clearly have anti fungal properties that can compare with synthetic antimicrobial agents like Potassium sorbate, Citric acid and Sodium metabisulphite which antifungal agents as reported earlier (Omojowo *et. al*., 2008, Omojowo *et. al.*, 2009a, Omojowo *et. al.*, 2009b). Samples treated with both 7.5% and 10% ginger had no detectable mould growth after four weeks of storage. Mould rather than bacterial growth is the major problem in this type of product because of its low water activity (Negbenebor et al., 1995; FAO, 1992). The ability of the ginger to inhibit mould growth would in a way enhance the over-all quality of the product.

Table 1. The Effect of Different Concentration of Ginger on the Fungi count (Cfu/g in Log10) of smoked Catfish during storage.

Duration (Week)	Samples	TREATMENTS				
		Control	2.5% Ginger	5% Ginger	7.5% Ginger	10% Ginger
	Fresh	2.76±0.05a	2.28± 0.04b	2.10± 0.04b	1.92± 0.04c	1.65± 0.04c
Day 0	Smoked	2.30±0.03 a	1.35± 0.03b	1.21± 0.04c	0.84± 0.03d	0.72± 0.10d
Week 2	Smoked	2.18±0.03 a	1.38± 0.04b	1.14± 0.06c	0.45± 0.01d	0.32± 0.03d
Week 4	Smoked	2.24±0.07 a	1.50± 0.03b	1.08± 0.02c	0.42± 0.05d	0.36± 0.03d
Week 6	Smoked	4.28±0.04 a	1.64± 0.01b	1.30± 0.03c	ND	ND
Week 8	Smoked	6.02±0.06 a	1.83± 0.12b	1.46± 0.21c	ND	ND

Means in the same rows with different letters are significantly different ($p < 0.05$).
ND = Not Detected

3.1Trimethylamine Value

The trimethylamine (TMA) value of the fresh fish sample was 15.43 mg N/100 g. following processing the TMA values of the treated samples were significantly (P<0.05) lower than that of the non-treated controls, and remained so after 2 months of storage at ambient temperature (29-35°C) (Table 2).

Table 2. The Effect of Different Concentration of Ginger on Trimethylamine (mg N/100g) Value of Smoked Catfish Samples.

Duration (Week)	Samples	TRIMETHYLAMINE VALUES (mg N/100 g)				
		Control	2.5% Ginger	5% Ginger	7.5% Ginger	10% Ginger
	Fresh	15.50a	15.52a	15.41a	15.24a	15.27a
Day 0	Smoked	12.76a	9.67b	8.56c	8.45c	8.45c
Week 2	Smoked	10.57a	7.45b	6.24c	5.50d	5.43d
Week 4	Smoked	8.65a	6.43b	6.35b	5.12c	5.04c
Week 6	Smoked	8.22a	5.48b	5.37b	4.10c	4.02c
Week 8	Smoked	6.69a	3.43b	3.39b	3.28b	3.26b

Means in the same rows with different letters are significantly different ($p < 0.05$).

This result suggests that all the concentration of ginger inhibited the production of TMA from trimethylamine-oxide (TMAO) (Jay, 1987). However irrespective of treatment there was a decrease in TMA values of all samples after 7 weeks of storage at room temperature. This may be related to the high temperature and low relative humidity leading to the decrease in water activity, microbial activity and hence decrease in TMA values (Jay 19870). This result agrees with earlier results of (Negbenebor, *et.al.,* 1996) where 2.5% clove and ginger individually and in combination reduced the TMA values. Storage time seems to have more significant effects on the TMA values since at the eight weeks of storage there was no significant difference at P< 0.05 in TMA values of the treated samples.

3.2 Free Fatty Acids (FFA)

Following treatment the FFA values in the fresh fish ranged from 0.18-0.30% and was not significantly affected (P>0.05) by treatment (Table 3). However following smoke drying there was an increase in FFA values of all samples irrespective of treatment. However the control samples showed higher FFA values and it is significantly different (P<0.05) when compared with the treated samples. Results suggest that the various concentration of ginger used in this experiment inhibit FFA production. The FFA content in a product is an indication of the quality of the product (Clucas and Ward, 1996).

Table 3. The Effect of Different Concentration of Ginger on the Free Fatty Acid (FFA) of Smoked Catfish Samples.

Duration (Week)	Samples	FREE FATTY ACID				
		Control	2.5% Ginger	5% Ginger	7.5% Ginger	10% Ginger
	Fresh	0.30±0.05a	0.22±0.06 a	0.18±0.02a	0.21±0.03a	0.20±0.01a
Day 0	Smoked	4.30±0.03 a	3.66±0.02 b	3.60±0.03 b	3.51± 0.05b	3.50±0.03 b
Week 2	Smoked	4.28±0.03 a	3.64±0.01 b	3.59± 0.04b	3.52±0.12 b	3.38±0.05 b
Week 4	Smoked	4.24±0.07 a	3.51±0.03 b	3.60±0.07 b	3.32±0.03 c	3.25±0.01 c
Week 6	Smoked	4.68±0.04 a	3.57±0.06 b	3.46±0.04 b	3.12±0.02 c	3.05±0.03 c
Week 8	Smoked	3.82±0.06 a	2.34±0.04 b	2.39±0.01b	2.12±0.12 b	2.38±0.05 b

Means in the same rows with different letters are significantly different ($p < 0.05$).

3.3 Organoleptic Analysis

In the freshly smoked samples treated with 2.5% ginger was not significantly (P>0.05) different from the control in terms of taste, colour, and texture (Table 4). However the samples treated with 2.5% ginger was slightly more accepted than the control. In all the treated samples however, the 2.5% ginger is significantly rated higher (P<0.05) than the 5%, 7.5% and 10% respectively in the overall-acceptability. In the eight week, the control was already covered with moulds

Table 4. Organoleptic Attributes of Freshly Smoked and 8th Week Stored Catfish Treated with Different concentration of Ginger.

Treatment	Taste	Flavour	Texture	Appearance	Overall-acceptability
CONTROL	4.5a	4.4a	4.7a	4.5a	4.5a
FRESHLY SMOKED-2.5%	4.6a	4.5a	4.7a	4.6a	4.6a
5%	3.7b	3.8a	3.6b	3.7b	4.0b
7.5 %	3.2c	2.3b	3.0c	3.7b	2.4c
10 %	1.9d	1.9c	2.8c	3.6b	1.8d
CONTROL (8^{TH} WK)	**	**	**	**	**
8^{TH} WEEK OLD - 2.5%	4.2a	4.2a	3.9a	4.0a	4.1a
5%	4.3a	4.2a	4.0a	4.1a	4.3a
7.5%	3.7b	3.6b	3.5b	4.0a	3.0b
10%	1.8c	2.0c	3.8b	3.8a	2.3c

Means in a column with unlike letters differ significantly (P<0.05), **= Moldy, hence not tasted

4.0 CONCLUSION

The dipping of fish in a concentration of ginger before smoking has beneficial effects on the overall quality of the final products. This in a way will not only reduce the substantial losses associated with this type of product estimated at billions of naira but would also increase the rate of turn over as consumers would now find increased satisfaction with the processed fish as indicated by the sensory quality of the product. This would substantially improve fish protein intake in Nigeria and reduce protein malnutrition and its associated problems in the country.

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Correspondence to:
Omojowo Funso Samuel,
National Institute for freshwater Fisheries Research (NIFFR). P.M.B. 6006, New-Bussa, Niger-State, Nigeria.
E-mail: jowosam@yahoo.com, G.S.M:08073536126

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