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Assessment of Some Plant-Derived Insecticides on the Organoleptic Properties of Smoked Catfish, *Clarias gariepinus* Burchell

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Abstract: An investigation of the effect of natural insecticides obtained from four plant materials, *Dennettia trip*etatala Baker, *Eugenia aromatica* Hook, *Piper guineense* (Schum and Thonn) and *Monodora myristica* (Dunal) on the keeping quality of smoked African mud catfish, *Clarias gariepinus* Burchell, 1822 was carried out. In separate experiments, 100 g smoked *C. gariepinus* was treated with plant powders at 2.5, 5.0 and 10.0 g and 5 ml of extracts at 2.5, 5.0 and 10% for the control of *Dermestes maculatus* De Geer and *Necrobia rufipes* De Geer at 30 days storage period. The treated fish was evaluated for palatability and aesthetic acceptable by sensory assessment. The general appearance, colour of fish flesh, odour and flavour, taste, texture and fragmentation of the protected smoked fish were rated as having no adverse effect on the acceptability and palatability of the treated fish. The result obtained in the study has revealed the consumer's tolerability of the plant products as preservatives for smoked fish in Nigeria and hence they could be integrated into insect pest management strategies of fish beetles.

Key words: Organoleptic, sensory quality, natural insecticides, clove, pepper fruit, black pepper, African nut-meg, dried fish, stored produce

INTRODUCTION

Smoked fish offers an alternative high quality animal protein source required by man. Anonymous (2005) and Eyo (2001) reported that smoked fish is one of the most widely distributed and the cheapest sources of protein and micronutrients in Nigeria. According to Eyo (2001), 45% of total fish catch in Nigeria are utilized as smoked fish. However, studies have shown that a high proportion of dried fish in Nigeria is usually infested by insect pest, such as *Dermestes maculatus and Necrobia rufipes* (Odeyemi *et al*., 2000; Osuji, 1974). Osuji (1974) further reported that about 71.5% of dried fish infestation in most of the producing areas was caused by *D. maculatus*.

Some synthesized insecticides, for example, pyrethroid, deltamethrin and permethrin have proved to be effective against stored product pests, if used at the right time, quantity and with the correct application (Golob *et al*., 1987). However, the general use of such chemicals to protect stored fish has been hampered by reports of health hazards and high cost of purchase. Odeyemi *et al*. (2000) reported that fish treated with chemical insecticides adversely affected consumers, causing blurred vision, dizziness and vomiting. In addition, Amusan and Okorie (2002) noted that dermestid larvae and adults, unlike many other beetles, are less susceptible to synthesized insecticides that normally attack pests of stored products. Therefore, attention is currently being focused on the use of natural preservation materials that are cheap, easily accessible and that have long term protecting ability. In this regard, a host of plant materials are presently considered as a promising alternative to synthetic insecticides in

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the control of pests of crops of plant origin (Onifade and Alabi, 1998; Saxena, 1989; Ivbijaro, 1983). However, information on the use of plant materials to control insect pests of stored fish is recent and is just growing.

In view of reports of the unattractive nature of stored product treated with some plant materials (Boeke *et al*., 2001; Amusan and Okorie, 2002; Onu and Baba, 2003) and because dried fish is often eaten without further processing by most people in the tropics, this study sought to evaluate the effect of powders and extracts of four plant materials, *Dennettia tripetala, Eugenia aromatica, Monodora myristica* and *Piper guineeense* on the palatability and acceptability of smoked fish, *Clarias gariepinus* by fish consumers.

MATERIALS AND METHODS

Preparation of Plant Materials, Insect Culture and Fish Samples

Dry fruits of four commonly-eaten species and locally-used medicinal plants: pepper fruit (*D. tripetala:* Annonaceae), clove (*E. aromatica:* Myrtaceae), black pepper (*P. guineense:* Piperaceae) and African nut-meg (*M. myristica:* Annonaceae) which were obtained from Erekesan Market in Akure, south western Nigeria were processed into powders and extracts according to the methods described by Adedire and Lajide (2000). To obtain the plant powders, each of the plant materials was washed with clean tap water, oven-dried at 40°C for 8 h, ground thoroughly in an electric 5.0 HP grinder and sieved through a 40 holes mm^{-2} mesh screen. The plant powder was then kept in a plastic container with a tightly fitted lid at ambient laboratory conditions before use. To obtain the plant extracts, 100 mL of absolute ethanol was added to 10 g of each plant powder in a round-bottomed flask and soaked for 24 h. The mixture was boiled at 60°C for 30 min in UNISCOPE SM801A Laboratory Water Bath. The solution was filtered with Whatman No. 1 filter paper and the resulting filtrate was kept in a tightly covered dark brown bottle prior to use.

Samples of 100 g smoked fish used for the experiments were obtained from Erekesan Market in Akure, Nigeria and disinfested by treatments in the Gallenkamp oven at 60°C for 1 h and allowed to cool at room temperature before use. The initial source of culture of *D. maculatus* and *N. rufipes* was obtained from naturally infested smoked *C. gariepinus*. New insect generations were obtained after 2-3 weeks oviposition period and were kept in Kilner jars covered with muslin cloth and maintained at 30±2°C and relative humidity 65±5 %.

Investigation of Plant Materials on the Organoleptic Properties of Smoked Fish

Each of the plant powders at 2.5, 5.0 and 10.0 g and 5 mL of extracts at 2.5, 5.0 and 10% was thoroughly rubbed onto the body of a 10 g disinfested smoked fish. The treated fish was placed in a plastic jar, ten 45 h starved *D. maculatus* and *N. rufipes* larvae were introduced and the perforated lid covered with muslin cloth and was left on the shelf for 30 days. Disinfested fish without plant treatments served as the control. The protected fish at each concentration level was examined for palatability and physical attractiveness by a panel of three fish consumers within 24 h of exposure to plant products and also at 30 days post-treatment using the modified criteria of Okonkwo and Okoye (2001) and Clucas (1982) (Table 1). Tests were in triplicates for each treatment.

The percentage acceptable was calculated as follows:

$$\text{Acceptance (\%)} = \frac{\text{Score obtained}}{\text{Score obtainable}} \times 100$$

The sensory evaluation of the treated fish was classified according to the criteria in (Table 2). Data obtained were subjected to analysis of variance (ANOVA) and where significant differences existed at 0.05 significance level, the treatment means were separated using Tukey's Test.

Table 1: Description of the sensory quality used in grading treated smoked fish

Score	Term	Definition
1	Very bad	Appearance looks very rough; unappealing to the eye; a different look from most common dried fish; unpleasant pungent odour; bitter taste; unusual taste; too pepperish; soft and flaky in texture.
2	Bad	A little bit better than the definitions or the parameters described above. Generally intolerable and unpalatable.
3	Satisfactory	Just average. It looks better in appearance; taste acceptable; odour tolerable; not too soft or hard in texture.
4	Good	Having the right or desired features. Appealing looks, pleasant odour, nice taste; not brittle but hard fragment
5	Very good	Very good appearance/inviting look; pleasant odour; very palatable.
6	Excellent	A perfect product. Very good appearance; very pleasant odour; very good to taste.

Table 2: Quality classification of treated fish based on sensory evaluation

Grade score (%)	Assessment of quality
A >70	Excellent
B 60-69	Good
C 50-59	Satisfactory
D 40-49	Fair
E <40	Poor

Table 3 : Sensory evaluation of smoked fish treated with plant powers at 1 day post-treatment

		Concentration (g/100 g fish)			
Plant powder	*Quality parameter	0.00	2.50	5.00	10.00
D. tripetala	GA	5.00±0.00cb	5.33±0.33c	4.67±0.33	3.67±0.67a
	CF	5.33±0.33b	5.00±0.00b	5.00±0.00b	3.33±0.33a
	OF	5.00±0.00a	5.00±0.00a	5.00±0.00a	5.00±0.00a
	TA	5.00±0.00b	4.67±0.33b	3.67±0.33a	3.33±0.33a
	TE	5.00±0.00a	5.33±0.33a	5.00±0.00a	5.00±0.00a
	FG	5.00±0.00a	5.00±0.00a	5.00±0.00a	5.33±0.33a
Acceptability (%)		84.23±0.44c	84.27±1.15c	78.73±0.44b	71.30±1.15a
E. aromatica	GA	5.33±0.33b	4.67±0.33a	4.33±0.67a	4.00±0.58a
	CF	5.33±0.33b	5.33±0.33b	5.00±0.00b	4.00±0.58a
	OF	5.00±0.00b	5.00±0.00b	5.33±0.33b	4.33±0.33a
	TA	5.33±0.33c	4.67±0.33b	4.00±0.58ab	3.33±0.33a
	TE	5.00±0.00a	5.00±0.00a	5.33±0.33a	5.00±0.00a
	FG	5.33±0.33a	5.33±0.33a	5.00±0.00a	5.00±0.00a
Acceptability (%)		86.10±0.76d	83.33±0.76c	80.53±0.75b	71.30±1.90a
P. guineense	GA	5.00±0.00b	5.33±0.33b	4.33±0.33a	4.33±0.33a
	CF	5.33±0.33b	5.33±0.33b	4.67±0.33a	4.33±0.67a
	OF	5.33±0.33b	5.00±0.00b	5.00±0.00b	4.67±0.33a
	TA	5.67±0.33d	5.00±0.00c	4.00±0.00b	3.33±0.33a
	TE	4.67±0.33a	5.67±0.33d	5.00±0.00b	5.33±0.33cd
	FG	5.33±0.33a	5.33±0.33a	5.00±0.00a	5.00±0.00a
Acceptability (%)		87.03±0.88b	87.97±0.44b	77.80±0.76a	75.00±1.52a
M. myristica	GA	5.33±0.33d	4.67±0.33bc	4.33±0.33a	5.00±0.58cd
	CF	5.67±0.33d	5.33±33cd	5.00±0.00b	4.65±0.33a
	OF	5.00±0.00b	5.00±0.00b	5.33±0.33b	4.33±0.33a
	TA	5.67±033c	4.67±0.33b	4.00±0.58b	3.33±0.33a
	TE	5.67±0.33c	5.00±0.00a	5.00±0.33bc	5.33±0.33bc
	FG	5.33±0.33a	5.33±0.33a	5.00±0.00a	5.33±0.33a
Acceptability (%)		90.77±0.44d	87.97±0.88c	82.40±1.15b	77.77±2.27a

Values are means of triplicate samples followed by standard error of means; Means in the same row with different superscripts are significantly different ($p<0.05$) by Tukey's Test; * GA: General Acceptance; CF: Colour of fish; OF: Odour and flavour; TA: Taste; TE: Texture; FG: Fragmentation

RESULTS

The sensory evaluation and consumers' acceptance of smoked fish treated with plant powders at 1 day post-treatment and at 30 days' storage period are shown in Table 3, 4, respectively. The results (Table 3) showed that irrespective of powder concentration, smoked fish treated with each of

the plant powders was generally ranked excellent by fish consumers. Generally, the percentage acceptance declined as the dosage of powers increased. The organoleptic rating of the treated fish at 30 days post-treatment was significantly high ($p<0.05$) in comparison with untreated fish (control) (Table 4). The values obtained at the concentration levels in each admixture showed significant differences.

The acceptability of smoked fish protected with plant extracts when freshly applied (Table 5) and at 30 days post-treatment (Table 6) was rated excellent. There was a significant difference between the ratings of the extract-protected fish and the control at 30 days post-treatment. In general, high values were recorded for General Acceptance (GA), Colour of Flesh (CF), Odour and Flavour (OF), Texture (TF) and Fragmentation (FG) of fish protected with all the plant products.

Table 4: Sensory evaluation of smoked fish treated with plant powders at 30 post-treatment

		Concentration (g/100 g fish)			
Plant powder	*Quality parameter	0.00	2.50	5.00	10.00
D. tripetala	GA	1.33±0.33a	5.00±0.00c	4.33±0.33b	4.67±0.33b
	CF	2.00±0.58a	4.67±0.33b	5.00±0.00c	4.67±0.33b
	OF	1.33±0.33a	5.00±0.00b	5.00±0.00b	5.00±0.00b
	TA	1.33±0.33a	4.67±0.33c	3.33±o.33b	3.00±0.00b
	TE	1.67±0.33a	4.67±0.33b	5.33±0.33c	5.00±0.00c
	FG	1.67±0.33a	4.67±0.33b	5.00±0.00c	5.33±0.33c
Acceptability (%)		25.90±2.43a	79.63±1.15d	77.77±1.30c	76.87±0.44b
E. aromatica	GA	2.00±0.00a	4.33±0.33b	4.67±0.33b	5.00±0.00c
	CF	1.67±0.33a	4.67±0.33b	4.33±0.33b	4.67±0.33b
	OF	1.00±0.00a	4.33±0.33c	5.00±0.00c	4.33±0.33b
	TA	1.33±0.33a	3.67±0.33b	3.33±0.33c	2.67±0.33b
	TE	1.33±0.33a	5.00±0.00b	5.33±0.00b	5.00±0.00b
	FG	1.00±0.00a	5.33±0.33b	5.33±0.33b	5.33±0.33b
Acceptability (%)		23.13±0.44a	75.93±1.16b	76.87±1.16b	75.00±0.76b
P. guineense	GA	2.33±0.33a	5.00±0.00d	4.67±0.33c	3.67±0.33b
	CF	2.33±0.33a	5.33±0.33c	5.00±0.00c	4.33±0.67b
	OF	1.67±0.33a	5.67±0.33c	5.00±0.00b	5.00±0.00b
	TA	1.00±0.00a	4.33±0.67c	3.67±0.67b	3.33±0.33b
	TE	1.33±0.33a	5.33±0.33b	5.33±0.33b	5.00±0.00b
	FG	1.00±0.00a	5.33±0.33b	5.33±0.33b	5.33±0.33b
Acceptability (%)		26.87±0.44a	86.10±0.76d	80.57±0.75c	74.07±1.57b
M. myristica	GA	2.00±0.00a	4.67±0.33c	4.00±0.58c	3.67±0.33b
	CF	1.33±0.33a	5.00±0.00b	5.00±0.00b	5.00±0.00b
	OF	1.67±0.33a	4.67±0.33b	5.33±0.33c	4.67±0.33b
	TA	1.33±0.33a	3.33±0.33b	3.67±0.33b	3.33±0.33b
	TE	1.67±0.33a	5.67±0.33b	5.00±0.00c	5.67±0.33b
	FG	1.00±0.00a	5.33±0.33b	5.33±0.33b	5.33±0.33b
Acceptability (%)		25.00±0.00a	86.13±1.51b1	78.70±1.15c	76.87±0.44b

Values are means of triplicate samples followed by standard error of means; Means in the same row with different superscripts are significantly different ($p<0.05$) by Tukey's Test; * GA: General Acceptance; CF: Colour of fish; OF: Odour and flavour; TA: Taste; TE: Texture; FG: Fragmentation

Table 5: Sensory evaluation of smoked fish treated with plant extracts at 1 day post-treatment

		Concentration (5 mL/100 g fish)			
Plant powder	*Quality parameter	0.00	2.50	5.00	10.00
D. tripetala	GA	5.33±0.33ab	5.00±0.00a	5.67±0.33b	5.67±0.33b
	CF	5.00±0.00a	5.33±0.33ab	5.57±0.33b	5.33±0.33a
	OF	5.33±0.33b	5.00±0.00ab	4.67±0.33a	4.33±0.33a
	TA	5.00±0.00b	4.67±0.33b	4.67±0.33b	3.33±0.33a
	TE	5.33±0.33a	5.67±0.33ab	6.00±0.00b	5.67±0.33ab
	FG	5.67±0.33ab	5.33±0.33a	5.57±0.33ab	6.00±0.00b
Acceptability (%)		88.00±0.44c	86.10±1.15b	89.83±0.44d	84.23±0.44a
E. aromatica	GA	4.67±0.33a	4.67±0.33a	5.33±0.33b	5.33±0.33b
	CF	4.67±0.33a	5.00±0.00a	4.67±0.33a	5.00±0.00a

Table 5: Continued

Plant powder	*Quality parameter	Concentration (5 mL/100 g fish) 0.00	2.50	5.00	10.00
	OF	5.33±0.33c	4.33±0.33b	3.67±0.33a	3.33±0.33a
	TA	5.00±0.00c	4.00±0.00b	3.33±0.33a	2.67±0.33a
	TE	6.00±0.00c	5.33±0.33ab	5.67±0.33bc	5.00±0.00a
	FG	5.67±0.33c	5.00±0.00a	5.33±0.33ab	5.67±0.33c
Acceptability (%)		87.03±0.88d	78.70±0.76c	77.80±0.00b	75.00±0.76a
P. guineense	GA	5.67±0.33b	5.00±0.00a	5.33±0.33ab	5.33±0.33ab
	CF	5.33±0.33ab	5.33±0.33ab	5.00±0.00a	5.67±0.33b
	OF	5.57±0.33c	4.67±0.33b	4.00±0.58b	3.33±0.33a
	TA	5.33±0.33c	4.33±0.33b	4.00±0.58b	3.33±0.33a
	TE	5.33±0.33a	5.67±0.33ab	6.00±0.00b	5.67±0.33ab
	FG	5.67±0.33a	5.33±0.33a	5.67±0.33a	5.33±0.33a
Acceptability (%)		91.70±0.00d	84.23±0.44b	83.33±0.75b	80.57±0.75a
M. myristica	GA	5.67±0.33a	5.33±0.33a	5.33±0.33a	5.33±0.33a
	CF	5.67±0.33b	5.00±0.00a	5.67±0.33b	5.33±0.33ab
	OF	5.00±0.00c	4.67±0.33bc	4.33±0.33b	4.00±0.58a
	TA	5.67±0.33d	5.00±0.00c	4.00±0.58b	3.00±0.00a
	TE	5.00±0.00a	5.33±0.33ab	5.00±0.00a	5.67±0.33b
	FG	5.33±0.33a	5.67±0.33ab	6.00±0.00b	5.67±0.33ab
Acceptability (%)		89.77±0.44d	86.07±0.88c	84.27±1.57b	80.56±0.75a

Values are means of triplicate samples followed by standard error of means; Means in the same row with different superscripts are significantly different ($p<0.05$) by Tukey's Test; * GA: General Acceptance; CF: Colour of fish flesh; OF: Odour and flavour; TA: Taste; TE: Texture, FG: Fragmentation

Table 6: Sensory evaluation of smoked fish treated with plant extracts at 30 days post-treatment

Plant powder	*Quality parameter	Concentration (5 mL/100 g fish) 0.00	2.50	5.00	10.00
D. tripetala	GA	1.33±0.33a	4.67±0.33b	5.00±0.00b	4.67±0.33b
	CF	1.33±0.33a	4.33±0.33b	5.00±0.00c	4.33±0.33b
	OF	1.67±0.33a	4.33±0.67b	3.67±0.33b	4.00±0.58b
	TA	1.67±0.33a	4.33±0.33b	4.00±0.00	3.67±0.33b
	TE	1.67±0.33a	4.33±0.33b	4.67±0.33b	4.33±0.33b
	FG	1.33±0.33a	5.33±0.33b	5.00±0.00b	5.33±0.33b
Acceptability (%)		24.07±1.16a	75.93±1.59b	75.93±0.88b	73.13±1.16b
E. aromatica	GA	1.00±0.00a	5.00±0.58b	4.67±0.33b	4.67±0.33b
	CF	1.67±0.33a	5.00±0.00c	4.33±0.33b	4.00±0.58b
	OF	1.00±0.00a	3.67±0.33b	3.67±0.33b	3.33±0.33b
	TA	1.33±0.33a	3.67±0.33b	3.67±0.33b	3.33±0.33b
	TE	1.67±0.33a	5.00±0.00c	5.00±0.58c	4.33±0.33b
	FG	1.67±0.33a	4.67±0.33bc	5.00±0.33c	4.33±0.33b
Acceptability (%)		23.12±0.44a	75.00±0.76d	73.13±0.44c	66.67±0.75b
P. guineense	GA	1.67±0.33a	4.67±0.67b	4.67±0.33b	5.00±0.00b
	CF	2.00±0.00a	4.33±0.33b	4.33±0.33b	4.33±0.33b
	OF	1.33±0.33a	3.67±0.33b	4.00±0.00b	3.67±0.33b
	TA	1.33±0.33a	3.33±0.33b	4.00±0.00c	4.33±0.33c
	TE	2.33±0.33a	5.00±0.58c	4.33±0.33b	4.33±0.33b
	FG	1.67±0.33a	4.33±0.33b	4.67±0.33b	4.67±0.67b
Acceptability (%)		28.70±1.15a	70.37±0.86b	72.20±0.76c	73.13±1.16d
M. myristica	GA	1.33±0.33a	4.67±0.33b	4.33±0.33b	4.33±0.33b
	CF	1.67±0.33a	4.33±0.67b	5.00±0.00b	4.67±0.33b
	OF	1.67±0.33a	3.67±0.67b	3.67±0.33b	4.33±0.33b
	TA	1.33±0.33a	3.67±0.33b	3.67±0.33b	4.33±0.33b
	TE	1.67±0.33a	4.67±0.33b	4.67±0.33b	4.33±0.33b
	FG	1.33±0.33a	4.67±0.33b	5.00±0.00b	4.00±0.00c
Acceptability (%)		25.00±0.76a	71.27±0.88b	73.13±0.44c	71.27±0.44b

Values are means of triplicate samples followed by standard error of means; Means in the same row with different superscripts are significantly different ($p<0.05$) by Tukey's Test; * GA: General Acceptance; CF: Colour of fish flesh; OF: Odour and flavour; TA: Taste; TE: Texture; FG: Fragmentation

DISCUSSION

The treated fish were accepted by the fish consumers, as there was no adverse evidence of taint, smell or change in taste, texture or flavour of fish. This is in contrast to Onu and Baba (2003) who observed that the use of some plant insecticides rendered the fish unattractive to the consumers. In this study, the admixtures were all highly accepted but preference for fish treated with low dosages of plant materials was demonstrated. The hedonic scores of all fish samples treated with the lowest dosage were high, in contrast to lower scores obtained in fish protected with higher dosages. The score for taste, which was generally ranked average at higher dosages, was considered good in fish treated with the lowest dosage. The average rating of the taste of all treated fish also confirms the peppeerish and pungency characteristics of the plant materials. The pungency is caused by the presence of ligname, cubebin and several other related compounds, such as hinokinin, clusin, dihydroclusin, dihydrocubebin, sylvatine and trichostachine (Oliver-Bever, 1986).

It was evident that the application of the studied plant materials prevented the unwholesomeness of the smoked fish during storage and thus its acceptance by fish consumers. On the other hand, the unprotected fish (control) became unhygienic and therefore unfit for human consumption, thus its low hedonic rating. According to Elhag (2000), the unfit nature of such a spoilt fish is attributable to the presence of high amounts of uric acid. Insect infestation could also cause an increase in the anti-nutritional factors, such as phytic acid, trypsin inhibitor activity and crude fibre as well as a decrease in starch and proteins contents of stored produce, thereby affecting the nutritional quality and consumers' acceptability of stored products (Modgil and Mehta, 1996; Clucas, 1982).

In this study, each of the plant products is organoleptically assessed as a palatable and acceptable protectant of smoked *C. gariepinus* against dermestid and clerid infestation by fish consumers, thus enhancing the consumer friendliness of the studied material.

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