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USE OF SOME PLANT OIL EXTRACTS AS SURFACE PROTECTANT AGAINST STORAGE INSECT PEST, *Dermestes maculatus* Degeer, ON SMOKED FISH

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ABSTRACT

Crude oil extracts obtained from the seeds and leaves of some plants which are commonly used as spices and food condiments in the tropics; *Piper* guineense, *Monodora myristica, Aframomum* melegueta, *Tithonia diversifolia and Nicotiana* tabacum were evaluated as protectants against different stages (adults, pupae, larvae and eggs) of fish beetle(Dermestes maculatus Degeer). The oil extracts were applied to disinfected muscle of smoked fish at 10% (wlv). Newly emerged (0 -24 hour old) adults, pupae, larvae, and eggs of *D.maculatus* were introduced into kilner jar each containing treated and untreated fish samples. Insect infected fish without any crude oil treatment served as control. All the treatments were in triplicates. Evaluation of the potency of the oil extracts was based on the insect mortality, pupae formation and percentage egg hatchability. The weight losses in fish muscle in the treated and untreated samples were compared as index of fish damage during storage. The results showed that oil extracts from P.guineense, *M. myristical and A.melegueta* were significantly (P <_ 0.05) effective in killing all the adults, pupae and eggs of *D.maculatus* while the effect of oil extracts from *N.tabacum* and *T. diversifolia* were not significantly different (P ? 0.05) from the untreated (control) smoked fish infected with the storage insect pest. The percentage weight loss in fish during storage was significantly reduced (P <_ 0.05) in fish treated with the plant oil extracts from P.guineense, *M.myristical* and *A.melegueta* compared with fish treated with oil extracts and the control fish. This study showed that oil extractives from P.guineense, *M.myristical* and *A.melegueta* were capable of controlling different stages of *D.maculatus* in smoked fish during storage. However, further studies are needed to evaluate the active ingredients, toxicity and concentrations of these oil extracts for effective use in controlling insect pests of fish during storage.

Key Words: Oil extracts, plant materials, protectant, smoked catfish, storage.

INTRODUCTION

Fish is a perishable biomaterial especially in the tropics where high temperature and humidity accelerate spoilage and biodeterioration of fish immediately after catch. As a result of this, efforts are primarily directed towards the preservation of fish for human food. However, poor handling, inadequate processing facilities, lack of ice or storage facilities, remoteness of the fishing villages to urban market centers, poor transportation system and poor distribution channels have drastically reduced fish utilization in the tropics (Ames, 1992). The rate at which fish spoils does not only depend on microbes, enzymes and fat oxidation but also on insect pests especially in cured fish during storage (Clucas, 1982; Balogun, 1992). A number of simple high temperature preservation techniques suitable for smallscale preservation in the tropics such as sun-drying and smoking have been reviewed (Maas-van Berkel *et al.* 1996). However, smoking is the most commonly used method for fish preservation in the tropics (Ames, 1992). often, smoke dried fish are eaten without further cooking (Asita, 2000). Smoke has been reported to impact some characteristics aromatic flavour on cured fish (Clucas, 1982) which is highly relished by the people in the tropics.

In spite of the desirable effects of smoke on fish quality, high incidence of insect pest infestation has been reported to cause substantial losses in the nutritive value of fish during storage (Odeyemi, *et al*. 2000; Fasakin and Aberejo, 2002). Fish beetles, *Dermestes maculates* and *Necrobia rrrfrpes* are common insects in the tropics (Osuji, 1985). Efforts to reduce losses through insect infestation by the use of insecticides and pesticides have not been fully adopted due to the hazardous nature of these chemicals to health and toxicity at high doses to users (Balogun, 1992). In order to eliminate much of these problems, plantderived pest insecticides which are biodegradable, environment friendly, cheap, available and affordable to fish farmers and processors have been proposed (Lale, 1995; Adedire and Lajide, 1999).This approach could be of tremendous benefit in enhancing fish utilization in the tropics. This study is therefore aimed at evaluating the efficacy of some plant oil extracts of some locally available plant materials commonly used as spices and condiments to control fish beetlee, *Dermestes rnaculatus* in dried catfish, *Claricrs gariepinus* during storage.

MATERIAL AND METHODS

Preparation o; Plant Extracts

Seeds of *Piper guineense* (Black pepper), *Monodora myristical* (Grains of pleasure) and *Afr-•amomum melegueta* (Abolakoshe); leaves of *Tithonia diversifolia* (Tree marigold) and *Nicotiana labacum* (Tobacco) (Table 1) were procured from central market in Akure. Nigeria and dried in a laboratory drying cabin at 40°C for 8hrs, ground to fine powder using a Resch Gimbtt (J657 HAAN) electric grinder. Oil extracts from the plant materials were obtained in a Sohxlet apparatus using petroleum ether at 40-60°C BP as the solvent (Adedire and Lajide, 1999). The extraction was filtered using Whatman No. 1 filter paper, cooled in dessicator and the resulting filtrate was kept in deep freezer at -5°C prior to use.

Effect on Adult Insects

The oil extracts obtained from the plant filtrate were applied to disinfected muscle of smoked fish (35±2.4 g) at 10% (w/v) in a kilner jar. Ten adults (5 females and 5 males) of newly emerged *D. maculates (0*24hrs old) were introduced into each kilner jar containing the treated and untreated smoked fish. The kilner jars were covered immediately with muslin cloth to prevent the insects from . escaping and ensuring aeration. Insects infected smoked fish in kilner jar without any of the oil extract served as control. The experiment was in triplicates and carried out at the ambient temperature (27- 29°C) with relative humidity at 60% for 30 days. Insect survival was monitored daily for the first 14 days (adult life span) and at the end of 30`x1 day in storage to determine weight loss in fish as quality index of damage.

Effect on Egg Hacchability and Larvae Survival

In order to determine the effects of oil extract on egg hatchability and larvae survival of *D. rnaculc.iti's* during storage, an aliquot of lml of each of the plant oil extract was added to 20 grams of minced muscle of smoked fish in glass Petri dishes and thoroughly mixed with the aid of a glass rod. The fish muscles were air dried for 1-2 hour after which 20 eggs and larvae of pure bred F3 generation of *D. maculatus*

Table I. Description of plant parts used for evaluation of insecticidal activities on smoked fish during storage

Scientific Name	Common Name	Family Name	Common uses	Parts of plant used for oil extracts
Piper guineense	Black pepper	*Piperaceae*	Culinary spice	Seeds
Aframomum melegueta, *Monodora myristical*	Grains of Pleasure Abolakoshe	*Zingiberaceae* *Annoraceae*	Condiments Soup spices	Seeds Seeds
Tithonia diversifolia	free Marigold	*Asteracae*	oil	Leaves
Nicotiana rubacum	Tobacco	*Solanaceae*	Stimulant	Leaves

were introduced into the Petri dishes and then covered. Insect infected fish muscle without application of any of the oil extract served as control. Each treatment was replicated thrice and kept in an open air shelf in the laboratory at room temperature and pressure

Biological evaluation

The biological evaluation of efficacy of oil extracts from plant seeds and leaves were based on the percentage weight loss during storage, number of surviving larvae after treatment, pupae formation and eggs hatchability. The percentage weight loss in fish after 30 days of storage was calculated as the difference between initial and final weight of fish divided by initial weight and multiplied by 100.

Statistical analysis

The biological data were subjected to oneway analysis of variance (ANOVA) and Duncan Multiple Range test was used for mean separation at 5% probability level (Duncan, 1955).

RESULTS

The effects of oil extracts from five indigenous plant materials commonly used as spices and food condiments, P. *guineense, M. myristical, A. melegueta. N. tabacum* and *T. diversifolia* on different stages of *D. maculatus* (adults, pupae, larvae and eggs) in smoked fish during storage are summarized in Table 2. The results showed that oil extracts from P.

Tablet. Effect of plant oil extracts on adults, pupae and eggs stages of *D. maculatus* on smoked catfish during storage

Type of plants	Adult mortality (%)	No of pupae formed (%)	Larvae mortality (%)	Egg hatchability (%)P
Piper guineense	100 t 0.00`	0.00 f 0.00[a]	100 ± 0.00	0.00 ± 0.00°
Afromomum inelegueta	100 t 0.00`	0.00 ± 0.00°	100 f 0.00[6]	0.00 ± 0.OO[a]
Monodora myristica	100 f 0.00`	0.00 f 0.00[a]	66.67 f 3.3[a]	0.00 ± O.OO[a]
Tithonia diversifolia	60.0 + 1.53[6]	20.0 ± 1.15[6]	40.00 ± 0.67°	36.70 t 0.33[6]
Nicotiana tabacum	80.0 f 0.58[6c]	36.70 f I .V	16.67 f 0,67[a]	50.00 ± 0.58[6]
Control	16.7 f 0.33[a]	63.30 f 0.67'	16.67 f 0.33[a]	86.67 f 0.33

Each value is a mean of triplicate samples (± SE). Means followed by the same superscript(s) in the same column are not significantly different (P > 0. 05).

guineense, M, myristica and *A. inelegueta* were significantly effective (P < 0.05) in killing all the adults, pupae and eggs of *D. maculatus* in smoked fish during storage. The larvae stage of the insect pest were susceptible to oil extracts of *P. guineense* and *M. inyristica* which accounted for 100% mortality while oil extract from A. *melegueta* caused 66.7 % mortality of the insect larvae.

The oil extract from *N. tabacum was* least effective (60%) in controlling adults of *D. maculatus* while oil extract from *T. diversifolia* was least effective as surface protectant against egg hatchability, larvae and pupae development of the storage insect pest. However, the effect of oil extract from the two plant materials were not significantly (P > 0.05) different from the untreated (control) smoked fish infested by insect pest.

The percentage weight loss of smoked fish infested by *D. maculatus* either treated or untreated with oil extracts during storage is presented in Table 3. The damage caused by storage insect pest *(D. maculatus)* to smoked fish was significantly (P < 0.05) reduced in fish treated with oil extracts from *A. melegueta, P. guineense* and *M. inyristica* to 4.43, 3.72 and 8.46% respectively. There was no significant difference (P > 0.05) in the percentage weight loss of fish treated with oil extract from *T. diversifolia* and the untreated (control) smoked fish.

DISCUSSION

The results obtained in this study showed that the oil extracts obtained from P. *guineense, M myristica.and A. melegueta* were highly effective in controlling various stages of *D. maculatus* in smoked fish during storage. Insect mortality in fish treated with the oil extracts of these plant materials was 100% effective compared with 16.7% in the untreated (control) smoked fish. The effect of oil extracts from *N. tabacum* and *T. diversifolia* on *D. maculatus* were milder and did not show any significant different (p >_ 0.05) from the untreated smoked fish. The use of oil extracts from plant materials as insect pest control and management in stored food products have been reported by several research workers (Ofuya, *et al.* 1992; Lale, 1995; Adedire and Lajide, 1999; Odeyemi,

Table'). Percentage weight loss of insect infected smoked catfish treated with or without plant oil extracts

Plant oil extracts	Mean initial weight (g)	Mean final weight (g)	Weight loss (%)
Piper guineense	*35.53 ± 0.52* a ~~	*37.10 + 0.56*c	*4.43*a
Afromomum melegueta	*39.90 ± 0.49*a	*41.00 + 1.02*°	*2.72* a
Monodora myristica ;	*36.07 ± 4.03* a	*39.37 +5.63`*	*8.46*a
Tithonia diversifolia	*35.23 + 2.43*a	*24,27 1~ 11"*	*30.91t'*
Nicotiana tabacum	*38.63 + 1.45*a	*20.20 + 2.35*a	*47.42*c
I Control ~~	*39.93 +3.46* a	*15.00 + 1.69* a	*49.58*c

Each value is a mean of triplicate samples (± SE). Means followed by the same superscript(s) in the same column are not significantly different (P ? *0.05).*

2000). Crude extracts of M. *myristica* and *A, meleguela* have been tested on storage bruchids attacking legume seeds with varying degrees of success (tale, 1995; Adedire and Lajide, 1999). Similarly, underutilized forest products such as *Parkia clappatoniana* oil extraction were tested on storage pest of smoked fish with partial success in eliminating insect pest of fish during storage (Odeyemi, 2000).

In this present study, oil extracts from P. *gttineense, Wyrislica* and A. *melegueta* showed high potency in killing all the adults, pupae, larvae and also deterring egg hatchability of *D. maculatus* in smoked fish during storage. The oil extracts from these plant materials appear to be snore potent in controlling various stages of *D. maculatus* in smoked fish compared with similar application of oil extracts from the same plant materials on cowpea storage bruchid, *C'allosobruchus* (Adedire and Lajide, 1999). However, plant families; *Piperaceae, Zingiberaceae* and *Ammoe aceae* into which these plant species belong are commonly used as spices and condiments (Table 1) in food preparation in the tropics (Sofowora, 1982). Some of these plants are known to contain some insecticidal activities (Ivbijaro, 1984) which can impair the physiological development of the various stages of insect pests. Most plant oils have been reported to have surface tension (Bhadari *et al.* 1990), which may cause reduction in oxygen supply to the insect and consequently lead to suffocation and death. The effectiveness of these plant oil extracts in controlling insect pest during storage is. probably a reflection of their insecticidal activities which have been found to include nicotine, pyrethrum and rotenone (Horn, 1989).

In smoked fish treated with oil extracts from *P. guineense, M myristica* and *A. melegueta_* there was a significant ($P < 0.05$) reduction in percentage weight loss in fish compared to other plant materials and the untreated fish (Table 3). This result showed the effectiveness of oil extracts from the three plant materials in controlling fish beetles thus reducing damage to the quantity and quality of the fish biomaterial. Osuji (1985) reported that more than 50% of smoked fish in Nigeria are lost to insect pest attack during storage. Smoked fish are known to be relished by storage pest, D. *maculatus,* devouring voraciously on the nutritive content of the fish during storage and thus reducing the nutritive value of fish products. However, fish species have been reported to exhibit variability in their resistance to insect pest of stored products (Fasakin, 2003).

The use of plant extractives from P. *guineense, M. myristica,* and *A. melegueta* investigated in this study, could be a plausible means of controlling insect pest attack on smoked fish during storage which is capable of reducing wastage and damage to fish during storage. The optimum concentrations and active ingredients of these plant materials which are toxic to the various stages of insect development in *D. maculatus* need further investigation.

REFERENCES

Adedire, C. O. and Lajiue, L. 1999. Toxicity and oviposition deterency of some plant extracts on cowpea storage bruchId, *Ccrllosobruchus maculatus* Fabricus. *Journal of Plant Diseases and Protection 106 (6):* 647- 653.

Ames. G.R. 1992. Traditional and modern post harvest technologies for increased food and supply from Inland Fisheries in Africa. In: Proceedings of

the symposium of post harvest fish technology, Cairo, Egypt. *FAaCIFA Technical Paper, 19,* pp. I1-17.

Asita Asita 2000. Protection of smoke dried fish from fungi infestation by wood smoke differing iu mutagenic potencies. *Discovery and innovation 12* (1/2): 85-87.

Balogun, A. M. 1992. Fish handling and quality control. In: Aquaculture Development in Africa: Training and References Manual for Aquaculture Extensionists. (I.G. Cowx, Ed.) Published by Commonwealth Secretariat, London. Pp.290-318.

Bhaduri, N., Gupta, D.P. and Ram, S. 1990. Effect of vegetable oils on the oviposition behaviours of *Callosobrucus maculatus* (Fabricus) In: Fuju, K, Gatehouse, A.M., Johnson, C.D., Mitchell, R. and Yosida, T. (Eds.): Bruchids and legumes: Economics, Ecology and Co-evolution pp.81-84.

Clucas, J. J. (compiler). 1982. Fish handling, preservation and processing in the tropics. Part 2. Report of the Tropical Products Institute G145, viii + 144pp.

Duncan, D. B. 1955. Multiple Range and Multiple F.-Test. *Biometrics 11:* 1-12.

Fasakin, E. A. and Aberejo, O. 2000. Effect of some pulverized plant materials on the developmental stages of fish beetle, *Dermestes maculatus* Degeer in smoked catfish *(Clarias gariepinus)* during storage. *Bioresource Technology* 85:173-177

Fasakin, E. A. 2003. Resistance status of some commercially smoked fish species to storage insect pest, *Dermestes maculatus* Deeger in the tropics. *Nig. J. Appl. Biology 4 (1):* 41-45.

Horn, D. J. 1988: *Ecological approach to pest management.* Elsevier, London. 345pp.

Ivbijaro, M F. 1984. Toxic effect of groundnut oil on the weevil, *Silophiluis oryzae (L). Insect Science and its Application* 51:251-252.

Lale, W. E. S. 1995. An overview of the use of plant products on the management of stored products, *Coleoptera,* in the tropics. *Post harvest News and Information 6:* 69-75.

Mass-van Berkel van den Bogaard, B., Heijucen, C. 1996. Preservation of fish and rneat.pp.2-7. *Agrodok-series No 12,* Agromisa, Wageningen, The Netherland.

Odeyemi, O. O. and Daramola, A. M. 2000. *Storage practices in the tropics.Vol.I:* Food storage and pest problems. Dave Collins Publications, Akure. 253 pp.

Odeyemi, O. 0., Owode, R. A. and Akinkurolere A. 2000. Toxicity and population suppression effects of *Parkia clappertomiana* on dried fish pests *(Dermestes maculatus* and *Necrobia ra Pipes). Global Journal of Pure and Applied Sciences 6(2):* 191-195.

Ofuya, T. I., Okoye, B. C. and Olola, A. S. 1992. Efficacy of crude extracts from seeds of *Monodora myristica* (Gaetn) Dunnal as surface protestant against *Callosobruchus maculatus* attacking legume seeds in storage. *Journal of Plant Diseases and Protection. 99 (5):* 528-532.

Osuji, F. W. C. 1985. Recent studies on the infestation of dried fish in Nigeria by *Dermestes maculatus* and *Necrobia rufipes* with special reference to Lake Chad District. *Tropical Stored Product Information.29:* 21-32.