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Evaluation of *Piper guineense* Fruit Powder as a Short Term Protectant against *Dermestes maculatus* (Degeer) in Dry Fish

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Abstract
The efficacy of *Piper guineense* fruit powder in protecting dried fish against *Dermestes maculatus* infestation was investigated in the Zoology laboratory of Nnamdi Azikiwe University Awka, Nigeria. Piper fruit powder was applied at various concentrations of 0g (control), 10g and 20g as short preservative of dried fish (*Clarias* sp) against *D. maculatus*. The weight loss and the mortality of adult and larvae of *D. maculatus* at 7, 14 and 21 days after treatment were recorded and compared with the control. All concentrations of Piper fruit powder used recorded higher mortality than the control. However, there was significant difference between the mortality of adult *D. maculatus* between the powder concentrations and the control. The various powder concentrations of *P. guineense* seed powder gave the highest mortality (5.67±4.933; 4.67±4.163) of both adult and larvae respectively at 14days after treatment. The powder concentration of 20g caused the highest mortality of adults and larvae of *D. maculatus* on tested dried fish and was therefore recommended as appropriate dosage for the preservation of dried fish against this dried fish insect pest.

Keywords: Evaluation, *Dermestes maculatus*, Dry fish, *Piper guineense*.

1. Introduction
Fish protein is known to be one of the best and cheapest sources of animal protein [1]. Cured fish with low moisture content provides food for beetles, particularly the larvae and to a lesser extent, the adults of *Dermestes* sp. and *Necrobia* sp. The damage caused by insect infestation is an important cause of economic and physical loss of dried fish in tropical countries [2]. Loss of cured fish can be as much as 40% during storage and up to 30% as a result of beetle and mite infestation [3]. However, loss of up to $500,000 per annum was reported by [4]. In addition, the infestation of dry fish when not controlled could lead to total loss of resources especially by farmers who have spent so much in raising the fish.
The devastation of dry fish by *D. maculatus* had prompted several control measures by man. [5] reported that the control of pest by the routine use of chemical insecticides are practiced in dried fish but it creates several problems in agro-ecosystem such as direct toxicity to beneficial insects, fishes and man [6], pesticides resistance, health hazard and increased environmental and social costs. Sometimes persistent pesticides accumulate in the higher food chain of both wild life and human and become concentrated by biomagnification [7]. In Nigeria, [6] reported that the abuse and misuse of chemical pesticides have several repercussions including acute and chronic poisoning in man, sudden deaths, blindness and skin irritation. Based on these problems, botanical insecticides are the alternative to synthetic chemical pesticides since the botanical compounds are biodegradable and less persistent in the environment. Plants are the rich source of insecticidal compounds and the effectiveness of these compounds has been demonstrated against many stored product insects [8]. *Piper guineense* spice powder has been reported to be effective in preventing oviposition in *Callosobruchus maculatus* and *D. maculatus* [9], and reducing the longevity of the insect. Similarly, [10] noted that both the powder and extract of *P. guineense* and *D. tripetela* inhibited adult emergence of *C. maculatus* and *Sitophilus zeamaize* completely. [11] reported that *P. guineense* seed powder performed best in the control of *C. maculatus.* There is a pressing need to preserve fish using safer means better than the toxic and unsafe chemical means. It is pertinent therefore to evaluate the efficacy of *P. guineense* fruit powder against adults and larva of *D. maculatus* in dry fish.

2. Materials and Methods

2.1 Insect Culture

D. maculatus adults were cultured in the Zoology laboratory of Nnamdi Azikiwe University, Awka at a temperature of 27.5 ºC and relative humidity of 85%. *D. maculatus* adults were paired, sexed and placed in the specimen jars with the top fitted with 1mm mesh wire gauze to prevent escape. Large intact pieces of dried *Clarias* fish were placed in the specimen jar to serve as food and oviposition site. Wet cotton wool was then introduced into the jar to induce oviposition. Copulation commenced after 24 hours.

2.2 Preparation of Plant Powder

The dry fruits of *P. guineense* were bought from a local market (Eke Awka) in Anambra State Nigeria. The fruits were washed and dried in the sun and then ground to fine powder using an electric blender.

2.3 Experimental Design

60g of dry *Clarias* fish were measured into each of the white transparent plastic vials covered with muslin cloth to let in air, but prevent the escape and entry of insect pest. 10g and 20g concentrations of the Piper fruit powder were added separately into the containers holding 60g of dry fish and shook vigorously to admix thoroughly. 60g of dry fish not treated with the *P. guineense* fruit powder were also measured into the same type of container and used as control. Each of the treatments was replicated three times.

14 pairs of adults and 20 pairs of larva of *D. maculatus* were introduced separately into each of the experimental containers including the control. The set up was kept in the Zoology Laboratory of Nnamdi Azikiwe University, Awka, Nigeria, at a temperature of 27.5 ºC and 85% relative humidity. The time for the infestation was noted and recorded properly. All treatments were arranged in completely randomized design (C.R.D).

2.4 Data Collection and Statistical Analysis

The mortality counts of *D. maculatus* adult and larvae at 7, 14 and 21days of post treatment were recorded. Dead weevils were removed and discarded after every count. The data on the mortality counts of the weevils caused by the *P. guineense* fruit powders were subjected to analysis of variance (ANOVA) using SPSS computer Software package (version 20) at 0.05 significant levels.

3. Results

Table 1 show that the highest concentration of 20g of *P. guineense* seed powder caused the highest mortality (5.33±3.215) of adult *D. maculatus* followed by concentration of 10g (4.33±4.041) and control (0.33±0.577). The analysis of variance result revealed there was no significant difference in the mortality of adult *D. maculatus* between the two powder concentrations and the control at 5% significant level (P>0.05). It further shows that highest concentration (20g) of *P. guineense* seed powder caused the highest mortality (6.00±2.000) of *D. maculatus* larvae. The Analysis of variance result revealed that there was significant difference in the mortality of *D. maculatus* larvae between the two powder concentrations and the control (P>0.05).

Table 2 show that the various powder concentrations of *P. guineense* seed powder gave the highest mortality (5.67±4.933; 4.67±4.163) of both adult and larvae respectively at 14days after treatment while lowest at 7days (1.00±1.732; 3.67±3.512) respectively. However, the analysis of variance result showed that no significant difference exist between the days of exposure at P>0.05.

Table 1: Mean Mortality of Adult and Larvae of *D. maculatus* at various concentrations of *P. guineense* seed powder

Concentration of PSP	Mean Mortality of *D. maculatus*	
	Adult	Larvae
10g	4.33±4.041	6.00±2.000
20g	5.33±3.215	6.67±1.528
Control	0.33±0.577	0.00±0.000

The values represent mean± S.D.

Table 2: Mean Mortality of Adult and Larvae of *D. maculatus* at various exposure periods

Days of Exposure	Mean Mortality of *D. maculatus*	
	Adult	Larvae
7days	1.00±1.732	3.67±3.512
14days	5.67±4.933	4.67±4.163
21days	3.33±2.082	4.33±4.041

The values represent mean± S.D.

4. Discussion

The results obtained from the present investigation on evaluation of the efficacy of *P. guineense* fruit powder showed that mortality of *D. maculatus* in treated dry fish at various concentrations varied in a dose dependent manner. The powder treatments caused significantly higher mortality of *D. maculatus* (adult and larvae) than the control. This supports other researches on the use of plant materials as bioinsecticides in protecting stored products. Plant powders such as *P. guineense* and *Z. officinale* can be used in suppressing the population of storage pests [12, 13, 14, 11]. Similarly, *P. guineense* spice powder has been reported to be effective in preventing oviposition on *C. maculatus* and *D. maculatus* [9]. [15] also reported that *P. guineense* has shown to posses phytochemicals that confer on it significant insect repellent and insecticidal value.

The results obtained from this study imply that for better results, higher concentrations of *P. guineense* should be used against both adult and larval stage of *D. maculatus*. Time of exposure of *D. maculatus* to plant powders of *P. guineense* is a factor to be considered in the control of *D. maculatus*. The highest concentration (20g) used caused more larval mortality when compared to the adult indicating that adults can withstand environmental stress more than the larva of *D. maculatus*. Plant powders are safer as control measures and should be used in preserving dry fish. *P. guineense* fruit powder was effective in the control of both adult and larva of *D. maculatus*. However the dosage of 20g powder concentration per 60g of dried fish is recommended in the control of adult and larval stages of *D. maculatus*. *P. guineense* fruit powder should be renewed fortnightly for effective control. Protein supply is lower than its demand, therefore to boost animal protein (especially fish) proper control measures should be taken against insect pests' infestation at the larval and adult stage.

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