

**Salting of Fish as a Means of Reducing Damage by  
*Dermestes maculatus* (Coleoptera: Dermestidae)**

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**ABSTRACT**

The damage by the beetle *Dermestes maculatus* on salted and unsalted fish species namely *Tilapia galilae*, *Chrysichthys nigrodigitatus*, *Clarias gariepinus* and *Decaptera* species was investigated in Benin, Nigeria.

There was a significant difference between the attack of *D. maculatus* on the salted and unsalted fish species ( $P > 0.05$ ). The beetle affected scaleless fish more than scaly fishes. Beetles on the salted fish live for about  $12 \pm 2$  days while the longevity for those in the unsalted samples was  $40 \pm 2$  days. It is suggested that fishes be salted before smoking or drying since this reduces the attack of *D. maculatus*.

**INTRODUCTION**

Fish is a very nutritious food rich in animal protein with amino acid composition comparable with that of egg, milk and meat in nutritional value (Waterman, 1976). Fish is nevertheless highly perishable which necessitates its processing and preservation especially in the tropics with favourable high temperatures for spoilage agents. Most fish landings preserved in various forms are spoilt through improper handling, autolytic spoilage and attack by bacterial, fungi, insects, mites, birds and other animals. However, of all these agents of fish spoilage, insect infestation is the most serious (Frank, 1977). Green (1967) reported that flies such as *Chrysomya marginalis* and *Wohlfatia* species are attracted to fish from time of harvest.

Blatchford (1962) observed that insect infestation is more likely to occur on fish under the influence of warm temperature and high moisture content. Kordyl (1977) identified two stages of insect infestation namely the relatively short period when different species of flies infest the wet fish and the second is the long term when different species of *Dermestes*, *Chrysomya* and *Necrobia* infest the dried or drying fish. The beetle, *Dermestes* spp. are the most important insect pests of dried fish. They invade fish from the earliest stages of drying but unlike flies, will continue to infest and breed in the dried fish product (Proctor, 1977; Osuji, 1974 and 1975). Fish is processed in order to prevent contamination and spoilage (Bostock et al., 1987; Clucas, 1981). Fish spoilage leads to loss of stored fish and consequent reduction of fish available for consumption.

This study therefore looks into the ways of reducing the damage caused by *Dermestes maculatus* adults in variously processed fish species in Benin City, Nigeria, using common salt, to ensure availability of fish for consumption in the area.

Common salt was chosen because it is not harmful to human beings and as such fishes preserved in it can be freely consumed. It is also used for preserving food by acting as a dehydrating agent, unfavourable to microbial growth and other organisms including insects.

## MATERIALS AND METHODS

### Materials

105 live adult *Dermestes maculatus* were collected at the New Benin Market (Benin City, Edo State, Nigeria) from infested fish displayed for sale. Four different species of fish were brought from the same market out of which only one (i.e. sample A: *Decaptera* spp) was salt water species while the other three (i.e. B: *Tilapia galileae* L. C: *Chrysichthys nigrodigatatus* L.D: *Clarias garepinus* L.) were freshwater species.

Other materials included yeast used as buffer to the culture medium, plastic containers, muslin cloth, drum smoker, wood, common salt and a sensitive Metler Balance Model PE 360.

### Experimental Procedure

*D. maculatus* larvae were reared on whole crumbs of fish. Four plastic paint containers (4 literes each) were two-third filled with dried fish products, each containing a sample of salted and unsalted fish from the four species, while the base of the container contained yeast.

Fifty adults beetles were introduced into each container which were then tightly covered with white muslin cloth for adequate aeration. The adult insects were left for two weeks to allow time for oviposition on the substrate and larval emergence, after which the adults were discarded. The insect larvae were then left for another four weeks to allow the adult to emerge.

Prior to processing, the fish samples were washed with clean tap water and weighed using the sensitive Metler Balance. Half of the fish from each species were salted. Both the salted and unsalted fish species were smoked dried using a half drum smoker with temperature check range of 55-60°C. The fishes were smoked for 4.5 hours after which they were re-weighed. Each fish species (salted and unsalted smoked fishes) were placed in each of the four plastic containers. The four containers served as the four replicates so that each container had two smoked-dried-salted and two smoked dried-unsalted fish for each species. Four adult *Dermestes maculatus* were introduced into each container. After six weeks, the insects were discarded and the fish were finally re-weighed. The experiment was conducted at the Faculty of Agriculture, University of Benin, laboratory.

### Experimental Design

The experiment was conducted as a factorial experiment with completely Randomised Design. It was a 4 x 2 factorial experiment with fish species as a first factor namely *Decaptera* sp. *Tilapia* sp. (Scaly fishes), *Chrysichthys* sp. and *Clarias* sp. (Scaleless fishes) and the second factor was the salt treatment (i.e. salted and unsalted fish species).

### Statistical Analysis

A test for significant difference on the attack of *D. maculatus* on the salted and unsalted, scaly and scaleless fish species were carried out at 5% probability level using Analysis of Variance Table (ANOVA). Mean comparison was also done using Least Significant Difference at 5% probability level.

## RESULTS AND DISCUSSION

Table 1 indicated that *D. maculatus* affected the unsalted fish samples more than the salted samples for all the fish species. The percentage average weight losses due to insect attack for unsalted smoked fish sample were *Decaptera* sp. 15.83%, *Tilapia galilae* 21.84%, *Chrysichthys nigrodigitatus* 30.57% and *Clarias gariepinus* 33.87% and for the salted smoked fish samples 3.10%, 1.97%, 2.21% and 2.44% respectively. There was a significant difference between attack on salted and unsalted fish samples at 5% probability level ( $P > 0.05$ ) (Table 2). It was observed that *D. maculatus* used in infesting the salted fish sample died between 10-14 days after the commencement of the study. Developed larvae (instars) were found in the containers of the unsalted fish samples. This signified that salt helps to deter *D. maculatus* hence it reduced the degree of damage done to the salted fish. This agreed with the assertion of Osuji (1975) and Kordyl (1977).

Furthermore, on individual species basis, the weight losses due to insect infestation of unsalted fish was higher in the freshwater fish species than the scaleless ( $P > 0.05$ ). There was a significant difference between the attack of *D. maculatus* on scaly and on scaleless fishes at 5% probability level ( $P > 0.05$ ) (Table 2). From the foregoing, it is clear that *D. maculatus* has higher preference for freshwater scaleless fish species over the scaly freshwater species. This confirmed Mallaimairs' finding in 1957 reported by Proctor (1977). It was observed that the texture of the unsalted smoked fish samples were adversely affected with openings all over the body. The fish muscle was completely reduced to skeleton. In the salted fish, damage was spotted on the eyes, nostrils and gill covers. This observation corroborates the findings of Bostock et al., (1987). It is probable that in *Tilapia* and *Decaptera* sp., the external structures were very intact due to scale covering. Unlike in unsalted fish, the internal structures were completely disintegrated.

**Table 1: Average and Percentage Weight Losses of Smoked Fish Species Due to Attack by *Dermestes maculatus***

Fish Species	Initial Average Wt (g)	Average Wt. After Smoking (g)	Average Wt. After Infestation (g)	Difference in Weights (g)	Percentage Average W. Loss Due to Insect Attack
<i>Decepera</i> sp. (S)	103.81g	25.32g	24.56g	0.76g	3.10%
<i>Decepera</i> sp. (U)	105.44	23.66	19.90	3.76	15.83
<i>Tilapia galileae</i> (S)	169.92	39.93	30.12	0.91	1.97
<i>Tilapia galileae</i> (U)	158.26	30.83	24.09	6.74	21.84
<i>Chrysichthys nigrodigitatus</i> (S)	64.44	19.88	19.43	0.43	2.21
<i>Chrysichthys nigrodigitatus</i> (U)	47.47	12.39	8.59	3.81	30.57
<i>Clarias gariepinus</i> (S)	69.62	16.29	15.76	0.38	2.44
<i>Clarias gariepinus</i> (U)	63.30	16.10	11.46	6.15	33.87

Key: S = Salted  
 U = Unsalted  
 G = Grammes

Table 2: Analysis of Variance (ANOVA TABLE)

Source Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-calculated	*F-tabulated	Remark
Treatment	7	191.373	27.339	24.992	2.49	*
Replicate	3	1.8151	0.605	0.553	3.07	*
Species	3	16.073	5.3577	4.898	3.07	*
Curing	1	161.595	161.595	141.724	4.32	*
Species x Curing	3	13.748	4.5827	4.189	3.07	*
Error	21	22.972	1.0939			
Total	38					

\*Significantly different at 5% level of significance

Curing = method of processing i.e. salted/unsalted fish.

LSD for species = 1.0877

Using L.S.D. for compare species (i.e. to determine species significantly different).

Mean for B, D, A, C,

B, D, A, C

7.65 6.53 4.52 4.05\*

\*Underlined means are not significantly different.

Based on the result of the experiment, it is advantageous to salt fishes before smoke-drying and since scaly fishes tend to store better than scaleless fishes they may be more suited for marketing.

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