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Effects of *Dermetes maculatus* (Degeer 1774) on some dried fish sold at Baga road market, Maiduguri metropolitan council

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Abstract

Fish is in the diet of most people, regardless of geopolitical, socioeconomic status and age. It is highly nutritious and provides about 50% of total protein requirements for growth and development, especially in children. Thus, fish remains one of the most important sources of food and income for many people in Nigeria and other developing countries of the world.

Materials and Methods: Two smoke-dried fish samples of cat and Tilapia were purchased from Baga Road fish market in Maiduguri to assess the effects of insect infestation caused by *Dermetes maculatus*. The samples were aseptically transported to the Microbiology laboratory of the Department of science laboratory technology Ramat Polytechnic Maiduguri Borno state for entomological analysis. The percentage weights of the fish samples were weighed before and after insect pest infestations. The infested samples were aseptically stored for a period of five (5) weeks.

Results: The results obtained in this study showed that *Dermestes maculatus* infestation was higher in fish samples stored for five weeks compared the uninfected fish obtained in the same market. However, there was no significant difference between the number of insect pests found in the fish samples at ($p>0.05$), the proximate analysis shows that the data collected after insect infestation was significance at $p=0.05$ with p value 0.00005. The carbohydrate contents for *cat Tilapia fish* before infestation were (3.34%, and 2.02%) respectively on the other hand the they was slight change in the wight of both cat and tilapia fishes after infestation 3.300 % and 2.01 % respectively.

Conclusion: It was observed that insect pest infestation causes great loss and reduces the economic and market value of smoke -dried fish because it degrades and damaged the fish thereby reducing it carbohydrate contents.

Keywords: *Dermestes Maculatus*; Baga; Cat fish; Tilapia fish and proximate analysis

1. Introduction

Fish not only has high nutritional value but is also an important source of employment and income for millions of people who live near water bodies and harvest, process, and distribute it. Nigerians, especially those living in Maiduguri and its environs near the Baga fishing center, regularly consume fish as one of the major animal protein sources. Relatively eating, fish has little or no religious bias, which gives it an advantage over other animal protein sources such as pork (Ligia, 2002). Despite the huge volume of freshwater and seawater that serves as fish habitat in Nigeria, only about 50% of fish demand is currently met by local supply. It has been reported that smoked dried fish is more easily attacked by insects during storage, especially *Dermestes maculatus*. They are the main pests of smoked fish when it is stored. Tilapia.

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Dermestes maculatus belongs to the Phylum Arthropoda, Class Insecta, Order Coleoptera, Family Dermestidae, Genus Dermestes and Species maculatus (McNamara et al., 2008). It is commonly referred to as the hide beetle. The hide beetle feeds on carrion and dry animal products. The adult beetles have forensic significance in helping to estimate the post-mortem interval in suicide or homicide cases. The species is often found among dead animals that have been decomposing for several days to weeks. Their feeding habits can result in a dead animal being nothing more than a skeleton. The beetle feeds on carrion and dry animal products, such as dried fish, cheese, and bacon. Insect infestation of traditionally cured fish by flies and skin beetles is still an important cause of postharvest losses in many developing countries. Studies on the causes and control options have been conducted for many decades. Insects of Order Coleoptera and Diptera are often found infesting cured fish during and after processing especially in tropics and subtropics. The problem exists in the curing site where insects are found to infest cured products during drying and on storage. Considerable weight loss of the product occurs. The product quality is lost and must be degraded as manure.

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It has been reported that smoked dried fish is more easily attacked by insects during storage, especially *Dermestes maculatus*. They are the main pests of smoked fish when it is stored. Tilapia. Dermestes maculatus (DeGeer 1774) belongs to the Phylum Arthropoda, Class Insecta, Order Coleoptera, Family Dermestidae, Genus Dermestes and Species maculatus (McNamara et al., 2008). It is commonly referred to as the hide beetle. The hide beetle feeds on carrion and dry animal products (McNamara et al., 2008). The adult beetles have forensic significance in helping to estimate the post-mortem interval in suicide or homicide cases (Richardson and Goff, 2001). The species is often found among dead animals that have been decomposing for several days to weeks. Their feeding habits can result in a dead animal being nothing more than a skeleton. The beetle feeds on carrion and dry animal products, such as dried fish, cheese, and bacon.

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Financial losses occur to the fisherman whose sole means of sustenance during off-season are the returns from curing activities. Cured fish can also suffer considerable loss of weight due to feeding by insect. Fish is susceptible to beetle infestation once the moisture content is lowered. Thus, fish is subject to beetle infestation throughout storage and transportation, and so the potential for losses is great. Under adverse condition quantitative losses of up to 90% due to fly damage during processing and losses ranging from 20-50% caused by the fish beetle notably*, D. maculatus* and *N. rufipes* have been reported on cured fish. These pests proliferate and grow on the dried fish, thus changing its appearance and powdering the fish making it unfit for marketing. In addition to this, insect pests of fish often transmit E coli, mold spores and heat and moisture produced by heavy infestation can create conditions suitable for mold growth on fish that has previously been dried.

Losses caused by insect infestation are enormous. They include physical loss whereby the fish available for human consumption is reduced, economical loss whereby the physical loss depletes the number of fish available for sale, and nutritional loss which is the direct consequences of the physical and economic loss and cause the retail value of fish to increase beyond the purchasing power of the poor (Moses, 1992). *D. maculatus* is the major insect pest infesting on dried fish in Nigeria, especially during its storage, transportation, and marketing stages. The larva of *D. maculates* are most numerous in form and are responsible for large proportion of damage of dried fish. About 15 insect pest species

have been recorded in cured fish this pest account for about 71.5% of dried fish infestation recorded in most of the producing areas with a substantial loss in dry weights of about 43- 62.7% from both larvae and adults. Insect infestation causes the most serious losses in quality and quantity of dried fish in Nigeria, about 50% of commercially dried fish was estimated to be lost annually to insect pest attack around the Rivers Niger and Benue fishing market. Late *et al.* (2000) estimated that 20-30% deterioration of smoked fish product was due to insect pest infestation in the tropics; therefore, reduction in post-harvest loss could add another 20-30million tone in the cured fish sector.

2. Materials and methods

2.1. The location of the study

The study was conducted at Microbiology laboratory of the Department of science laboratory technology Ramat Polytechnic Maiduguri Borno state for entomological analysis. The Maiduguri lies within latitudes 10° 43N and 0° 14N, longitude 10° 15E and 13° 17E. It occupies a total land mass of 50,778kq (MLSM,2008). It shares boundaries with Konduga local government area to the North and Northwest and Jere Local Government Area to the south.

2.2. Market survey and sample collection

The two markets, Baga and Custom noted for their sale of dried fish in Borno State were surveyed. Questionnaires and interviews were administered to obtain demographic information of the dry fish vendors and their fish processing methods. The studies was conducted within the period of two months under control environmental factors (i.e., temperature (30ºC), relative humidity (65±5 %) and light- to-darkness regimen of 12:12 hours). Fish from four species – the Trigger fish (*Balistes capriscus* Gmelin), Catfish (*Synodontis* sp.), African catfish (*Clarias gariepinus* Burchel) and Nile tilapia (*Oreochromis niloticus* Linnaeus)

2.3. Entomological experimental setup insect culture and maintenance

The initial source of *D. maculatus* culture used for this study was obtained from natural infested smoked catfish (*C. gariepinus*) that was collected from smoked fish market stall in the Baga road markets, Maiduguri, Borno state, Nigeria. It was maintained in a clean jar covered with muslin cloth in entomology laboratory and kept at a temperature 30 °C under relative humidity 70 5%. All bioassay jars were disinfected in an oven at 80°C for 2 hours and was allowed to cool at room temperature. Fresh generations were prepared by removing newly emerged (0-72h old) larvae from a stock culture, and placed on fresh uninfected fish, while the parent adult was removed after 2-3 weeks oviposition period. Smoked samples of the fish species (*Clarias gariepinns*) were obtained from smoked fish market stall at the two markets. The fish samples showed no visible presence of neither adult nor larvae of *D. maculatus* infestation. The cured fish species were sterilized thermally by heating at 10°C for one hour in a hot air oven (Gallenkamp Oven) in the laboratory to kill any insect pests that may be present (Atijegbe, 2004), and allow to cool at room temperature in the laboratory.

The obtained fish samples were weighed, oven dried at 60 °C and then allowed to cool at room temperature. 50g of each dried fish sample would be weighed and placed in experimental jars with 10 pairs of adult male and female adult *D. Maculatus,* covered with muslin cloth held tightly with a rubber band to allow aeration but prevent the escape of insects. Uninfested fish samples of each species (50g) served as control for the experiment. Jars were examined twice daily between 10:00 and 11:00am, and temperature and relative humidity readings were recorded for 35 days corresponding with the life cycle duration of *D. maculatus.* The pre-infestation weight of fish, post-infestation weight of fish would recorded to determine loss (Ajao, Segun and Barakat, 2017).

3. Results

Table:1 shows the mean weight of dried *Catfish and Tilapia fish.* The result shows that *Cat fish C9* has the highest weight (12.97) followed by weight of C8 *Cat fish* (12.74)

Table 1 Percentage weigh lost observed for the ten different cat and tilapia fishes am

.	Weight before infestation (g)	1st Week weight after infestation (g)	2nd Week weight after infestation (g)	3rd Week weight after infestation (g)	4th Week weight after infestation (g)	5th Week weight after infestation (g)
C1	13.7	15.72	14.32	14.15	13.53	13.47
C2	12.45	10.66	10.36	10.36	10.22	10.19
C3	10.95	9.92	9.66	9.59	9.38	9.27
C4	14.0	11.56	11.23	11.20	11.17	11.14
C5	11.2	9.75	9.62	9.53	9.50	9.49
C6	10.18	8.32	8.14	8.12	7.99	7.93
C7	9.70	8.13	7.94	7.90	7.87	7.82
C8	19.02	15.25	13.60	13.43	12.74	12.50
C9	16.24	13.34	13.01	13.00	12.97	12.98
C10	19.5	10.99	10.80	10.79	10.76	10.75
C11	4.71	4.61	4.51	4.58	4.53	4.46
C12	4.81	4.43	4.40	4.46	4.38	4.31
C13	5.44	4.93	4.90	4.93	4.88	4.84
C14	5.76	5.19	5.12	5.07	5.70	5.06
C15	5.79	5.04	4.95	4.93	4.89	4.87
C16	5.15	4.80	4.78	4.75	4.76	4.67
C17	5.25	4.80	4.76	4.74	4.62	4.61
C18	5.91	5.12	5.06	5.04	5.64	5.03
C19	5.16	4.04	3.98	3.97	3.93	3.92
C20	4.41	4.05	4.01	3.99	3.94	3.94

*Mean of fish samples were not statistically significant (P>0.05) x^2 = 0.1161 P = 0.9984 P=0.9961 P= 0.9941

Table 2 Illustrated the proximate carbohydrate contents of insect pests in the two species of fishes analyzed

Table 2 The carbohydrate content of infested and infested cat and tilapia fish

Cat fish	**Tilapia fish**
3.201	2.100
3.335	2.024
Cat fish (infested)	**Tilapia fish (infested)**
3.300	2.00
3.368	1.86

4. **Discussion**

Based on the results obtained, the effects of infestation *Dermetes maculatus* (degeer 1774) on smoke- dried fish was influenced by moisture content, physical structures, nutrient availability, temperature and relative humidity. This agrees with the report of (Bala*et al*., 2000) who reported that in tropical climates under highly humid conditions, heavy infestation of smoke- dried fish by beetles may cause up to 30% loss of the product. The insect pests that infested smoked fish all the samples in this study were *Dermestesmaculates.* It was observed that the two smoked fish samples do not vary in their susceptibility to infestation by beetles. This was due to the physical structures, moisture content and nutritional composition and provision of conditions suitable for fish infestation.

This study indicates that improper handling of fish causes lots of damage which account for easy infestation of *Dermestesmaculatus* on the smoked- dried fish which agrees with the result of (Ames *et al*., 1990) who reported that careless handling can result in the fragmentation of fish, which might make the fish to become unsalable.

It was also observed that damaged of smoked - dried fish is caused as a result of insects' infestation which contributes to the economic losses and reduces the market value of the fish. This agrees with the report of (Ames 1990) who stated that damaged fish infested by insects are less attractive to consumers than undamaged fish and this will affect its market price.

5. Conclusion

Tissue degradation and weight loss of smoked fish sample was related to the infestation levels and exposure time. The longer the periods of storage of infested smoked fish, the more the tissues are degraded. There were much influences of *Dermestes maculatus* infestation of *Cat and Tilapia fishes* on their proximate compositions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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