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The Effect of Fish Species and Curing Method on the Susceptibility Index and Losses Caused by Insect (*Dermestes maculates,* Degeer 1774*)* to *Clarias gariepinus* (Burchell, 1822), *Synodontis nigrita* (Valenciennes, 1840) *and Oreochromis niloticus* (Linnaeus, 1758)

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ABSTRACT
The effect of fish species and curing methods on the susceptibility index and losses cause by *Dermestes maculates* was carried out in Entomology laboratory, Department of Crop Protection University of Maiduguri. The aim was to investigate the progeny production, length of developmental period, weight loss and susceptibility index in *Clarias gariepinus, Synodondis nigrita* and *Oreochromis niloticus* cause by *D. maculatus*. Insects were produced by culturing in a culture jar to raise their population. Fish substrates were collected and sterilized to kill off any infestation. The studies revealed that, *Clarias gariepinus* has the highest number of progeny production, length of developmental period, weight loss and susceptibility index as 43.3,57.8,13.8 and 3.3 followed by *O. niloticus* (40.5,53.8,10.3 and 3.1) and *S. nigrita* (33.0,50.3,6.1 and 2.6) respectively. *C. gariepinus and Oreochromis niloticus* are not to be encouraged to be stored for longer period in order to prevent infestation by *D. maculates*.

Key words: *Dermestes maculatus, C. gariepinus, S. nigrita*, *O. niloticus*, Susceptibility index Fish, Curing

INTRODUCTION

Fish is very rich in essential amino acids, vitamins and minerals (FAO, 2004). Fish is also very important in term of employment income generation, poverty alleviation, foreign exchange earnings and provision of raw materials for the animal feed industry (FDF, 2005). Fish consumption in Nigeria is high, annually reaching 1.2 million metric tons (FDF, 2005). The high susceptibility and deterioration of smoked fish products put storage losses to be higher. Microbial and insect pest infestation in the tropic is put at between 20% and 50% (Lale and Sastawa, 1996; Odeyemi *et al*., 2000).

Fish is one of the cheapest protein sources and accounts for about 40% of the total animal protein intake of an average person in the tropics (Sadiku and Oladimeji, 1991). Fish is highly perishable and susceptible to bio-deterioration due to microbial attack and insect pest infestation. Ostid (1988) estimated post-harvest losses of fish in many developing countries at 50% of landing catch. Fish tend to spoil immediately after catch, especially in the tropics, where high temperature and humidity accelerate the spoilage and bio-deterioration. Because of this, efforts are primarily directed towards the preservation of fish for human food. However, poor handling, storage facilities, remoteness of the fishing villages to urban market centers, a poor transportation system and poor distribution channels drastically reduced fish utilization in the tropics (Ames, 1992). The rate at which fish spoil does not only depend on microbes, enzymes and fat oxidation, but also on insect pest, especially in curing fish during storage (Clucas, 1982; Balogun, 1992). Several preservation techniques suitable for small scale preservation in the tropics, such as sun drying and smoking have been reviewed (Mass *et al.,* 1996). However, smoking is the commonly used method for fish preservation in the tropics (Ames, 1992).

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Smoke imparts some characteristic aromatic flavor on cured fish (Clucas, 1982). This is highly relished by the people in the tropics. The major drawback with fish availability and utilization is the destruction of fish by insect pests especially during storage. *Dermestes maculatus* (Degeer, 1774) is one of the most problematic pests that attack and deteriorate smoked and sun dried fish. The activities of such pest on fish reduce the nutritive quality and market price. Therefore, there is a need for effective control measures. This research is aimed at investigating the effects of fish species and curing methods on the susceptibility and losses caused by *D maculatus* to *Clarias gariepinus, Synodontis nigrita and Oreochromis niloticus*

MATERIALS AND METHODS

The experiment was conducted in the Entomology Laboratory of Department of Crop Protection, Faculty of Agriculture University of Maiduguri. All experiments were conducted under ambient conditions of temperature and relative humidity which 29^{o}C and 49% respectively. During the period of experimentation, daily record of temperature and relative humidity were taken as 27- 29^{o}C and 38-49% using thermometers and wet dry bulb hygrometer respective. The insects used for the experiment (*Dermestes maculatus*) (plate 1and 2) were obtained from Baga Road fish market Maiduguri. Adult insects were collected from fish sellers and later cultured in the laboratory to raise population for the experiment. Culturing procedure entailed placing 20 unsexed adults on 100 g of smoked fish containing in 1.5 liter capacity culture jars. Cultures were set up weekly for three consecutive weeks to ensure availability of experimental insect. In every experiment, same aged adults (1 to 7 days old) were used.

Three fish species were used in the experiment, these are; *Oreocromis niloticus* (Linnaeus, 1758), *Synodontis nigrita* (Valenciennes, 1840) and *Clarias gariepinus* (plate 3) which was subjected to smoking as a method of curing. These fish, substrates were also obtained from the Baga Road fish market. The substrates used were checked that they are free from any insecticide. Collected fish substrates were sterilized in the laboratory by exposing to temperature at 70^{o}C for 3 hours in an air circulated electric oven to kill off any insect infestation. The sterilized substrates were preserved in plastic containers to prevent insect and mite infestation, until required for experimentation.

Experimental design

Three treatments were used and for each treatment, 25 g of fish, substrate were placed in a jar. Five pairs of adults *Dermestes maculatus* were introduced into the jars and were closed with wire mesh (plate 4). The adult insects were allowed to oviposit for 7 days and then removed from the bottle and discarded. Each treatment was replicated three times. The infested substrates were kept until the emergence of F_1 progeny. Daily observations were begun as from 30 days after infestation. Progeny produced were removed and counted every other day until no progeny emergent was observed for three consecutive days. The number of larvae, adult and weight of substrate were recorded. The following parameters were estimated:

i. Progeny production, which is the mean number of emerging adults divided by mean number of adult per treatment.

ii. Day to the first emergence of adult which is the number of days after infestation on which first adult emerged in any treatments

iii. Length of development period, which is the period of the middle day of oviposition period until 50% progeny has emerge

iv. Susceptibility Index (SI) as calculated as described by Dobie (1986) SI = loge $F_1 \div 100 \times D$ Where; Loge is the logarithm of emerging F_1 progeny, D is the Length of developmental period.

v. Weight loss in substrates which is the reduction in weight of substrates after completion of adults emergent was determined for each treatment using the formulae $W_2 - W_1$. Where W_1 and W_2 are the initial and final weights of the substrate.

Statistical analysis

All the data obtained were subjected to two-way analysis of variance (ANOVA) with fish species and curing method as treatment variables and number of adults, days to first adult, emergence, length of developmental period, and weight loss in the substrate and susceptibility index as response variables. Differences between treatment means were determined using the Turkey Krammer HSD test at the 5% level of probability (Harder, 2007).

RESULTS

Progeny production

Higher mean number of progeny was produced in *Clarias gariepinus* followed by *Orechromis niloticus* with mean values of 43.3 and 40.5 respectively. *Synodontis nigrita* produces the least value of 33.0. No significant differences (P > 0.001) were observed between the mean number of progeny produced by *D. maculatus* in *Clarias gariepinus* and *Oreochromis niloticus* (Table 1).

Table 1: Effects of *Dermestes maculatus* on number of progeny and length of developmental period on *Clarias gariepinus, Oreochromis niloticus and Synodontis nigrita*

Fish species	Number of progeny	Length of developmental period (Days)
Clarias gariepinus	43.3[a]	57.8[a]
Synodontis nigrita	33.0[b]	50.3[c]
Oreochromis niloticus	40.5[a]	53.8[b]
SEM (p≤0.05)	0.16	0.04

Mean followed by the same letters within the column are not significantly different (p>0.01)

Length of developmental period

It was observed that the length of development of *D. maculatus* in the three (3) fish species was significantly different from each other (p<0.001). The highest mean of development period of 57.8 days was recorded in *Clarias gariepinus* followed by *Oreochromis niloticus* with 53.8 days and *Synodontis nigrita* with lower mean value of 50.3 days (Table 1).

Weight loss in *C. gariepinus, O. niloticus and S. nigrita* to *D. maculatus*

Mean percentage weight loss due to the activities of *Dermestus maculates* was higher in *Clarias gariepinus* with a value of 13.80 %, followed by *Oreochromis niloticus* and *Synodontis nigrita* with the values of 10.30 and 6.10 %, respectively. There were significant differences (p<0.001) in the weight loss of the fishes to *Dermestes maculates* (Table 2).

Susceptibility index of *D. maculatus* to *C. gariepinus, O. niloticus and S. nigrita*

The susceptibility index is higher in *Clarias gariepinus* (3.30 %) followed by *Oreochromis niloticus* (3.10 %). *Synodontis nigrita* recorded the least value of 2.60 %. There were significant differences (p<0.001) in the susceptibility index of the fishes to *Dermestes maculates* (Table 2).

Table 2: Weight loss and susceptibility index of *D. maculatus* to *C. gariepinus, O. niloticus and S. nigrita*

Fish species	Weight loss (%)	Susceptibility index (%)
Clarias gariepinus	13.80[a]	3.30[a]
Synodontis nigrita	6.10[c]	2.60[c]
Oreochromis niloticus	10.30[b]	3.10[b]
SEM (p≤0.05)	0.05	0.02

Mean followed by the same letters within a column are not significantly different using turkey-krammer HSD test at 1% level of probability.

DISCUSSION

Progeny production

Based on the results obtained, it was found that the number of progeny obtained was higher in *Clarias gariepins* (43.3). The higher value of progeny production recorded in this study is lower than the numbers recorded by James (1984) and Lale (1996) as 38 and 42 respectively. The result is lower than the findings of Azab *et al*. (1972) that reported 75 % as a percentage number of progeny. The difference in the number of progeny produced could be as a result of environmental conditions during curing or storage, particularly temperature and relative humidity and length of storage, the major factors that influence the development of *Dermestes maculatus*.

Length of developmental period

The length of development period of *D. maculatus* on the three (3) fish species was found to range from 50 – 57 days after infestation. The value obtained in this study is in divergent with the finding of Azab *et al.* (1972) that found the length of the developmental period of 42.7 days. This might be as a result of the food availability and favorable condition of temperature and humidity.

Weight loss in *C. gariepinus, O. niloticus and S. nigrita* to *D. maculatus*

The weight loss obtained in this study (13.80 %) is lower than the finding of Osuji (1974) that 71.5 % losses on curing fish are coursed by adult *D. maculates*. The study is in closed to the findings of Gelengu (1987) who observed 13.50 % as a loss in curing fish due to the activities of *D. maculatus*. The similarities of the results might be brought about by the scarification as well as the partial or complete consumption of the fish tissues by the *Dermestes maculatus*.

Susceptibility index of *D. maculatus* to *C. gariepinus, O. niloticus and S. nigrita*

The scarification of *Clarias gariepinus* tissue by *Dermestes maculatus* confirms that the fish is most susceptible to infestation by *Dermestes maculatus*. The result (3.30 %) obtained in the present study on the susceptibility is lower than the result reported by Watanabe and Cabrita (1971) who reported the susceptibility index of 5 %. It was noticed that, the extensive boring behavior of the larvae of *Dermestes maculatus* caused damage and resulted in weight loss. The high infestation levels observed in *Clarias gariepinus* might be due to the composition, texture and flavor of the fish which makes them favorable to infestation.

Conclusion

Clarias gariepinus gave the higher (43.3 and 51.8) number of progeny production and length of developmental period, respectively, followed by *Oreochromis niloticus* with about 40.5 and 53.8, respectively. The least value of the number of progeny and length of developmental period was recorded in *Synodontis nigrita* (33.0 and 50.3, respectively). Weight loss and susceptibility index were also higher (13.80 and 3.30, respectively) in *Clarias gariepinus* than in *Oreochromis niloticus* and *Synodontis nigrita*.

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