

Development of Larvae and Adult Populations of *Dermestes maculatus* on Three Smoked Fish Species



Ete^{1*}, J. A., Alamu¹, O. T. Ayandokun¹, A. E., George-Onaho¹, J. A. and Agboola¹, I. S.

¹Department of Forest Conservation and Protection,
Forestry Research Institute of Nigeria, Ibadan.

* Corresponding author: johnnetel8@gmail.com_08033770613



Abstract

Fish is one of the major sources of protein in Nigeria and world-wide. Great losses to fish in storage have been attributed to insect pests and some other pathogenic organisms. In this study, laboratory experiments were conducted to analyze the growth of *Dermestes maculatus* (Coleoptera: Dermestidae) and its influence on smoked *Clarias gariepinus* Burchell, *Tilapia niloticus* Linnaeus and *Synodontis nigrata* Cuvier, in storage under, ambient conditions. The experiment was laid using a Completely Randomized Design and replicated three times. The population of *D. maculatus* at different days after infestation and the respective damage on each fish species was analyzed using one way analysis of variance (ANOVA) and differences in means were separated using LSD at $p \leq 0.05$. The results revealed that the population of *D. maculatus* was significantly higher on *S. nigrata* than on *T. niloticus* and *C. gariepinus*. The population of *D. maculatus* and damage caused on each fish species increased with increase in the number of days after infestation. A significantly higher damage was recorded on *S. nigrata* while *T. niloticus* suffered the least damage. The population of *D. maculatus* significantly correlated positively with the damage recorded on the three fish species.

Key words: Population, Weight loss, Susceptibility, Smoked fish, *Dermestes maculatus*

INTRODUCTION

Fish is a valuable source of high quality protein (Barrie *et al.*, 2003; Widjaja *et al.*, 2009) comparing favourably with eggs, milk and meat in the nutritional value of its protein (FAO, 1998). It contains fats, minerals and it is a major source of protein in West Africa constituting about 40% of animal protein intake (Eyo, 2001). In Nigeria, it serves as an important source of animal protein (Akande, 1997) as well as a source of income (Amusan and Okorie, 2002).

In view of its importance as a source of food, the demand for fish has been on the increase. Fish farming in commercial quantities has been gradually appreciating in the recent past in Nigeria, in the quest for meeting the needs of fish consumers across the West African sub-region. Fish production, handling, processing and distribution provide means of livelihood for millions of people as well as foreign exchange earnings (Al-Jufaili and Opara, 2006).

The processing and preservation of fresh fish prevents economic losses and deterioration of fish (Okonta and Ekelemu, 2005). It has been reported that, 10% weight loss by fish is as a

result of poor handling, processing, storage and distribution (Akande *et al.*, 1998, Madison *et al.*, 1998). The longer the processor leaves the fish in conditions favourable to spoilage, the greater the destruction. Most processed fish are susceptible to damage by insects such as blow fly larvae and beetles (Procter, 1972; Madison *et al.*, 1998).

Under ambient conditions, it is estimated that; between 25 -75% of the nutritional value of fish is lost due to insect attack (Johnson and Esser, 2000). Losses caused by insect infestation include, physical, economic and nutritional. These losses often lead to an increase in the retail cost of fish beyond the purchasing power of the poor (Moses, 1992). Fish farmers and or sellers began to develop various means of storing fish in order to preserve it for a longer period. Smoking is one of the commonest methods of preserving fish in Nigeria. However, the responses of different smoked fish species to pest infestation are not clearly understood. Therefore, the objectives of this study were to compare the population growth and the level of damage caused by *D. maculatus* to *T. niloticus*, *S. nigrata* and *C. gariepinus* in storage.

Data analysis

The data obtained were analyzed using two way analysis of variance (ANOVA) and significant means were separated using Least Significant Difference at $p \leq 0.05$. A regression analysis was carried out to determine the relationship between the population of *D. maculatus* and the damage caused on each of the fish species.

RESULTS

The population of *D. maculatus* observed on *S. nigrita* at different periods after infestation was significantly higher than the numbers recorded on *T. niloticus* and *C. gariepinus* which were not significantly different from each other (Table 1). The differences in the populations of *D. maculatus* recorded on *S. nigrita* increased from 119 at 40 days after infestation to 155.45 at 100 days after infestation, but the differences in the populations between these periods were not significantly different from one another. On the contrary, the population of *D. maculatus* on *T. niloticus* and *C. gariepinus* increased significantly with increase in the number of days of infestation (Table 1).

Table 2 showed that the damage due to *D. maculatus* infestation recorded on the three fish species increased with increase in the days of infestation. The damage suffered by *S. nigrita* was significantly higher than the damage observed in *T. niloticus* and *C. gariepinus*. The differences in the percentage damage inflicted by *D. maculatus* on *S. nigrita* were significantly different from one another between 40 and 100 days after infestation. Similarly, *T. niloticus* and *C. gariepinus* were observed to suffer significantly higher damage with increase in days of infestation. The population of *D. maculatus* significantly correlated positively with the percentage damage on *T. niloticus* ($R^2 = 0.895$, $p = 0.004$), *S. nigrita* ($R^2 = 0.882$, $p = 0.005$) and *C. gariepinus* ($R^2 = 0.991$, $p < 0.00001$) (Figures 1, 2 and 3).

DISCUSSION

The results of this study indicated that a substantial loss in smoked fish occur due to infestation by *D. maculatus*, although, fish species differ in their susceptibility to *D. maculatus*. Loss in weight results from scarification and partial or complete consumption of the fish tissues. Damage and weight loss are mostly caused by the tunneling

and feeding activities of the larvae and adults (FAO, 1998).

The lowest and highest weight loss were recorded in *T. niloticus* and *S. nigrita*. This is not unconnected with the higher density of *D. maculatus* on *S. nigrita* compared to the other two fish species. The weight loss in *S. nigrita* is at variance with the findings of Medugu and Kabir, (2013), who recorded highest weight loss in smoked *C. gariepinus*. Furthermore, it could be explained that higher weight loss recorded in *S. nigrita* was due to the multiplication of *D. maculatus* over a prolonged period of (100 days) of exposure. Awoyemi (1991) reported that fishes were reduced to frass and bones after 60 days of exposure to insect infestation. The study showed a significant positive correlation between the population of *D. maculatus* and the damage caused on the three fish species. The *S. nigrita* species was highly susceptible to infestation in comparison to *T. niloticus* and *C. gariepinus*. It provided a more suitable substrate for the culture, growth and development of *D. maculatus*. Nevertheless, the high infestation rate of *D. maculatus* in the three fish species was an indication that the insect constitutes a serious threat to stored fish product. The considerable loss of the three fish species substrates led to fragmentation and loss of quality. This is also attributable to extensive feeding habit of *D. maculatus* on fish substrates. Atijegbe (2004), evaluated quality loss during storage and noted that, damage severity may partly be a function of moisture content and lipid contents of the fish at the time of storage.

Similar findings were also reported in previous investigations by Osuji (1974) that different fish genera may vary in their susceptibility to attack by beetles. In some cases high lipid content may increase susceptibility to insect infestation. In addition to weight loss, infestation by insect can cause mould development, loss in nutritional and aesthetic values of fish (Osuji, 1974; Adedire and Lajide 2000).

CONCLUSION

This study has clearly shown that population and length of infestation are two important factors predisposing *T. niloticus*, *S. nigrita* and *C. gariepinus* to damage by *D. maculatus*. Efforts are required to reduce *D. maculatus* population on these fish species in order to limit damage.

Table 1. Population of *D. maculatus* (±S.E) on three fish species on different days after infestation

Fish species	Days after infestation						LSD (0.05)
	40	54	68	72	86	100	
<i>T. niloticus</i>	24.00±3.63 ^c	30.88±3.39 ^b	35.13±5.13 ^b	39.63±3.67 ^b	41.75±5.31 ^c	44.75±3.51 ^c	11.94 ^b
<i>S. nigrita</i>	119.50±15.75 ^a	122.50±19.73 ^a	135.25±21.01 ^a	129.25±24.45 ^a	146.13±26.91 ^a	155.25±18.96 ^a	61.76 ^a
<i>C. gariepinus</i>	22.88±1.53 ^b	28.25±1.92 ^c	33.00±2.50 ^c	38.13±1.85 ^b	43.00±3.04 ^b	46.88±2.22 ^b	6.36 ^c
LSD(0.05)	27.26	34.15	36.98	43.77	46.86	32.96	

Table 2. Mean damage (±SE) (%) of three fish species infested with *D. maculatus* at different days after infestation

Fish species	Days after infestation						LSD (0.05)
	40	54	68	72	86	100	
<i>T. niloticus</i>	6.54±1.04 ^c	9.68±1.22 ^c	11.79±1.16 ^c	13.73±1.06 ^c	15.66±1.11 ^c	18.91±1.17 ^c	3.22 ^b
<i>S. nigrita</i>	18.72±1.34 ^a	26.83±0.95 ^a	33.12±0.88 ^a	38.85±1.10 ^a	44.15±1.00 ^a	50.79±0.85 ^a	2.95 ^a
<i>C. gariepinus</i>	15.40±0.98 ^b	18.19±1.14 ^b	20.62±1.15 ^b	22.89±1.18 ^b	25.17±1.30 ^b	28.46±1.23 ^b	3.34 ^b
LSD(0.05)	3.32	3.27	3.16	3.28	3.37	3.22	

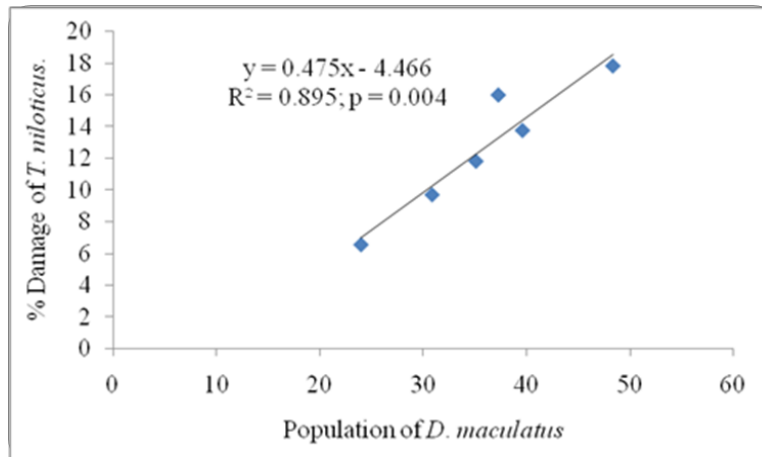


Figure 1. Relationship between population of *D. maculatus* and percentage damage of *T. niloticus*

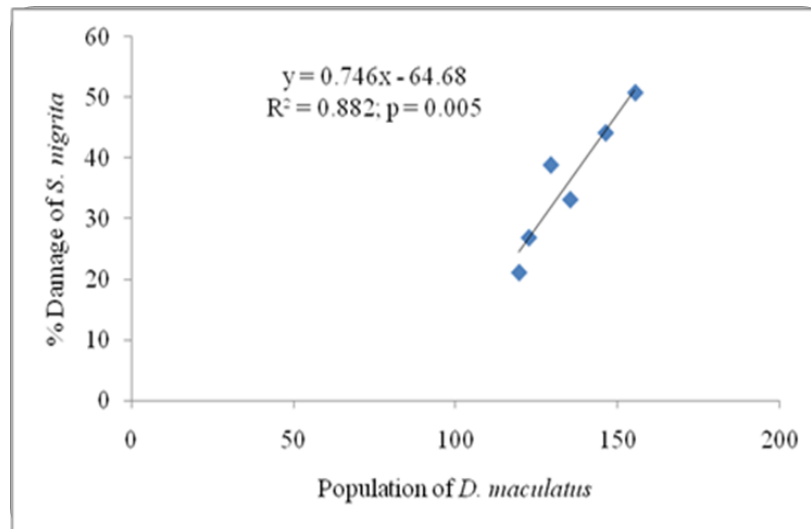


Figure 2. Relationship between population of *D. maculatus* and percentage damage of *S. nigrita*

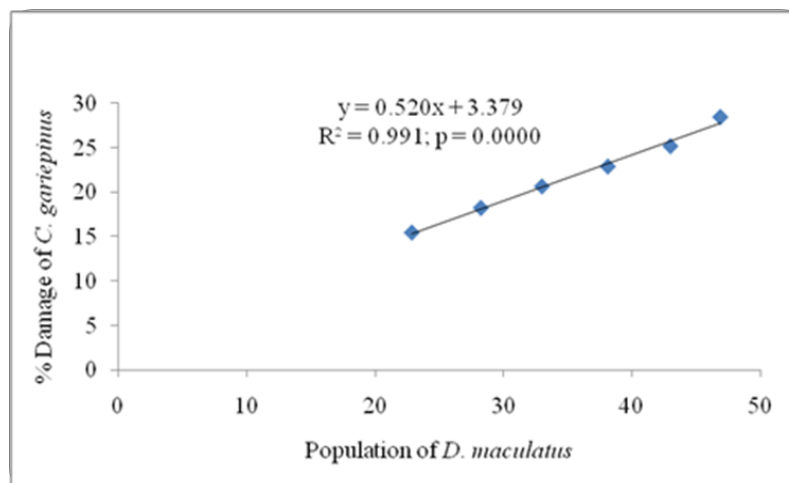


Figure 3. Relationship between population of *D. maculatus* and percentage damage of *C. gariepinus*

REFERENCES

- Adedire, C. O. and Lajide, L. (2000). Effect of pulverized plant materials on fish damage and growth performance of the fish beetle *Dermestes maculatus* (Degeer). *Entomological Society of Nigeria Occasional Publication*, 32: 215-221
- Akande, G. R. (1997). Technical and Economic Dry Kilns. A Consultancy Report Commission. 2lp.
- Al-Jufaili, M. S. and Opara, L. U. (2006). Status of Fisheries Postharvest Industry in the Sultanate of Oman: Part 1 Handling and Marketing System of Fresh Fish. *Journal of Fisheries International*, 1(2-4): 144-149.
- Amusan, A. A. S. and Okorie, T. G. (2002). The use of *Pipper guineese* fruit oil (PFO) as protectant of dried fish against *Dermestes maculatus* (Degeer) infestation. *Global Journal of Pure and Applied Sciences*, 8(2):197-201.
- Atijegbe, S. R. (2004). Infestation of smoked fish in Ghana. Mphil. Thesis, University of Ghana, 103pp.
- Awoyemi, M. D. (1991). Some experiments on the control of pest of dried fish in Kainji Lake. In: National Institute of Fresh Water Fisheries Research, 1998, Annual report, New Bussa, Nigeria 110-118pp.
- Barrie, A., Fellow, P., Gedi, L. and Lubin, H. (2003). Opportunities in Food Processing: Sea Meat or Fish Processing Enterprises CTA Netherlands.
- Eyo, U. (2001). Effect of Seasonal variation on the Nutrient Composition in selected fish species in Lake Kainji, Nigeria. pp13
- FAO (1998). Responsible Fish Utilization. *FAO Technical Guidelines for Responsible Fisheries* 7: 52-55.
- Johnson, C. and Esser, J. (2000): A review of insect infestation of traditionally cured fish in the tropics. Department for International Development, London 92pp.
- Medugu, O. and Kabir, K. (2013): Studies on the Susceptibility of different genera of dried fish to infestation by *Dermestes maculatus* and *Necrobia rufipes* *Nigerian Journal of Entomology*, (1): 63-68.
- Okonta, A. A. and Ekelemu, J. K. (2005). A preliminary study of microorganisms associated with fish spoilage in Asaba, Southern Nigeria. Proceedings of the 20th Annual Conference of the Fisheries Society of Nigeria (FISON), Port Harcourt, 14th-18th November, 557-560pp.
- Osuji, F. N. C. (1974). Comparative studies on the Susceptibilities of different genera of dried fish to infestation by *D. maculatus* and *N. rufipes*. *Nigerian Journal of Entomology*, 1(1): 63-68.
- Proctor, D. L. (1972). The protection of smoke-dried freshwater fish from insect damage during storage in Zambia. *Journal of Stored Product Research*, 8: 139-149.
- Widjaja, W. P., Abdulamir, A. S., Saari, N. B., Abu Bakar, F. B. and Ishak, Z. B. (2009). Fatty acid profile of tropical bagridae catfish (*Mystus nemurus*) during storage. *American Journal of Food Technology*, 4: 90-95.