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Effects of Ginger (*Zinjiber Officinale*) on Losses Cause by *Dermestes maculatus* (Degeer, 1758) in Smoked Nile Tilapia (*Orechromis niloticus,* Linneeus 1758)

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Abstract: *The experiment was carried out at Research and Teaching Farm, under post harvest shade, to determine the effect of ginger in losses cause by Dermestes maculatus on smoked Oreochromis niloticus. The main objective of the study was to determine the effect of ginger on the loss cause by Dermestes maculatus to smoked Nile tilapia (Oreochromis niloticus). The experiment was laid out in completely randomized design (CRD) with five treatment in replicate, the treatment were 0g (control), 10, 20, 30 and 40g of ginger respectively. The parameters observed were adult mortality, progeny production weight loss after 42 days of exposure. High mortality, progeny production and weight loss were recorded in the control. While reduced effects of Dermestes maculatus activities were better in the fish treated with 10g of ginger. Therefore, it is concluded that, application of ginger at 10g/500g of fish is recommended for the control Dermestes maculatus activities.*

Key words: *Effects, Ginger, Dermestes maculatus, Orechromis niloticus, Tilapia.*

Introduction

Fish is widely accepted on the menu table of the most inhabitant of the earth irrespective of socio-economic status, age and religious background, and it constitutes about 50% of the total animal protein needed for growth (Adesina *et al.,* 2014; Ileke *et al.,* 2020). Fish is one of the most important sources of food and income to many people in developing countries (Osarenren and Ojor, 2014). Over the years, the fishery sector has been a source of income and livelihood for millions of people around the world, and Nigeria accounts for 30-40% of post-harvest losses of landed fish catches thus, promoting the subjection of landed fish catches to a variety of processing methods, such as smoking and drying. However, the smoked dried fish is prone to insect infestation during storage mainly by *Dermestes maculatus*. They are considered to be the major pests on smoked fish when stored. Tilapia

are freshwater cichlid fish that, while native to Africa, were introduced into many tropical, subtropical and temperate regions of the world during the second half of the twentieth century (Pillay,1990; El-Sayed, 2006). Attributes that make them excellent aquaculture species include fast growth, high tolerance to a wide range of environmental conditions, resistance to stress and disease, the ability to reproduce in captivity, in a short generation time, the ability to feed at low trophic level, and the acceptance of artificial feeds immediately after yolk-sac absorption. Traditional preserving methods such as salting, drying and smoking are still widely accepted around the world (Ksc, 2010 ; Egbal *et al.,* 2013). However, the method still differs from countries to county and, within each county, in amounts of additives, percentage of salt and maturing temperatures (Egbal *et al.,* 2013). Smoking is one of the oldest food preserving methods: with certain temperature and humidity, smoke sourced from plant materials is applied to food. Smoking not only increases the resistance of food but also changes appearances, taste and smell of foods. However, smoking is not an absolute preserving method. For this reason, the quality of raw materials, the concentration of salt, the water activity of the fish, heat through the smoking process, the quantity of smoke, the way of packaging, hygienic circumstance and heat of storage have important effects in reducing the risk of deterioration and infestation. *Dermestes maculatus* is a species of beetle with a worldwide distribution, being present on all continents except Antarctica. In Europe, it is present in all countries. *Dermestes maculatus* belong the family of Dermestidae and genus Dermestes. The beetle is a black or dull and usually hairy. The species is often found underneath dead animals that have decomposed for several days to weeks. Their eating habits can cause a dead animal to become just a skeleton. The beetle feeds on carrion and dry animal products, examples are dried fish, cheese, and bacon and so on. Ginger (*Zingiber officinale)* is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine. It is a pseudo stems about one meter tall bearing narrow leaf blades. The inflorescences bear flowers having pale yellow petals with purple edges, and arise directly from the rhizome on separate shoots. In 2018, global production of ginger was 2.8 million tones, led by India with 32% of the world total, followed by China, Nigeria, and Nepal also had substantial production. Ginger is used as a preservative due to its antimicrobial activity. Ginger contains some phyto-chemical properties such as zingerone, gingerdiol, zingibrene, gingerols and shogaols, which are known to possess anti-oxidant activities (Chrubasik *et al.,* 2005). This antioxidant activity in ginger is due to the presence of polyphenol compounds (6-gingerol and its derivatives) (Herrmann, 1994). *Dermestes maculatus* is one of the insects that affect stored smoked fish in Nigeria, synthetic chemicals and insecticides have been used as an important part of *Dermestes maculatus* management and control for many years. The use of synthetic insecticides was found to be highly toxic to consumers, with irritating odor and residual effects on the environment coupled with the high cost of purchase, such as benzene hexachloride and otapiapia a locally mixed pesticide. Interest is however growing fast in the possible way to use plants as traditional control of stored products and as alternatives to use of highly persistent synthetic chemicals with their attendant dangers and high cost. Therefore, this research is looking at the possibilities of ginger for the control of *Dermestes maculates,* determine the effect of ginger on the loss caused by *Dermestes maculatus* to smoked Nile tilapia (*Oreochromis niloticus*), investigate the reproductive capacity of *Dermestes maculatus* on Nile and the effect of ginger on mortality of *Dermestes maculatus* adult.

Materials and Methods

Study area

The study was carried out at Research and Teaching Farm of the Department of Fisheries University of Maiduguri. The study area is Maiduguri metropolis Borno state Nigeria. It lies within latitudes 10^{o} 43N and 0^{o} 14N, longitude 10^{o} 15E and 13^{o} 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.

Collection and preparation of ginger

Dried ginger (*Zingiber officinale)* was purchased from Monday market Maiduguri and was placed in a black polyethen bag and taken to the fish processing laboratory of the Department of Fisheries. Three hundred (300 g) of the ginger was ground into powdered form. The powdered ginger was stored in an airtight container until required.

Collection of Experimental fish

One Hundred and ten (110) *Oreochromis niloticus* of the average weight of 70g in weights were procured from Gamboru fish market and were transported to Research and Teaching Farm, of Department of Fisheries University of Maiduguri. They were transported in a ice box containing ice block to prevent the fish from spoilage.

Preparation of the fish for smoking

The fish (*Oreochromis niloticus)* were washed, de-scaled, and de-gutted using a kitchen knife. They were washed again with tap water, spread on a wire mesh and allowed to drip under a shade. A modified drum kiln with a size of 400 liters, length of 90cm, and diameter of 58cm was used for smoking the fish (*Oreochromis niloticus).* The fish were arranged in a different compartment of the smoking kiln, firewood was ignited in the firebox and smoke was generated from the burning wood. The fish were allowed to smoke and checked at intervals until it is completely smoked-dried.

Collection of *Dremestes maculatus*

The adult *Dermestes maculatus* were obtained from the fish sellers in Baga market. The insect were gotten in numbers from the market. Two hundred (200 adults of the insect were selected and were inserted into a 1 litre capacity transparent bucket and the bucket was covered to prevent the insect from escaping. The cover of the bucket was perforated in order to have good ventilation. The insects were transported to the Department of fisheries, University of Maiduguri and kept in fish processing laboratory until needed for the experiment.

Experimental procedure

The fish were grouped into five treatments. That is (1.5) kg per treatment (500g per replication). The ground ginger was mixed with Five hundred (500 ml) of tap water at a concentration 0, 10, 20, 30 and 40g. The fish samples in each group were dipped into the mixtures and allowed for Five (5) minutes, they were removed from the mixtures, and shade dried finally packed in a 2 litre capacity transparent buckets. The covers of the containers were perforated to allow air circulation. Ten adults *Dermestes maculatus* were introduced

into the containers and kept in fish processing laboratory for 42 days. The experiments was conducted in complete randomize design (CRD).

Weight loss in the stored fish

At the end of the experiment, the weight loss of the fish due to the activities of the *Dermestes maculatus* were determined using the formular; W_1-W_2 where

W_1 is the initial weight of the fish sample (g)

W_2 is the final weight of the fish sample (g)

Number of Insect Mortality

At the end of the experiment, the numbers of survived insects were counted. The mortality of the insects was determined by subtracting the number of survived insect from the initial number.

That is, insect mortality = initial number of insects – survived number of insects.

Number of Larvae

The larvae number was estimated by counting the number of larvae observed in each treatment.

Data analaysis

Data obtained on the weight loss, insect mortality and number of larvae were subjected to one way analysis of variance (ANOVA) and the differences in mean were separated using LSD at ($P > 0.05$) level of significant difference.

Results

Effects of Ginger on the loss cause by *Dermestes maculatus*

Table 1 shows the effect of ginger on *Derrmestes maculatus*. Initial weight of fish used ranges from 166.6 to 150.33. Higher value of the initial weight was in treatment 3 that is fish treated with 30g of ginger, followed by the control, with 162.67 and the fish treated with 10g of ginger with the value of 151.33 while the least value was in fish treated with 20g of the ginger. There is a significant difference ($P < 0.05$) between fish treated with 30g of ginger with fish treated with 10, 20 and 40g of ginger. Fish treated with 10, 20 and 40g doesn't vary significantly ($P>0.05$). Subsequently fish treated with 0 and 10g of ginger also does not vary statistically ($P>0.05$). The higher value of weight loss was observed in the control, that is fish treated with 0g of ginger followed by fish treated with 20,30 and 40g of ginger as 31.33, 23.33 and 18.32g respectively. While the least value was in the fish treated with 10g of ginger with a value of 17.33g. Fish treated with 0, 20 and 30g of ginger has no significant variation that is ($P > 0.05$) but differs ($P<0.05$) from fish treated with 10 and 40g of ginger. Fish treated with 10, 30 and 40g of ginger also does not vary between themselves. Subsequently, fish treated with 20, 30 and 40g of ginger also have no significant variation ($P>0.05$). The numbers of adult used for the experiment are 10 for each treatment with no statistical variation throughout the treatment ($P > 0.05$). On the adult mortality after the experiment, it was observed a higher value of mortality in fish treated with 0g of ginger as 9.33 followed by 4.66, 3.33 and 1.33 in fish treated with 10, 40, 30 and 20g of ginger. Fish treated with 0g of ginger differs ($P < 0.05$) from the other treatment. Fish treated with 20 and 30g of ginger shows no significant variation ($P > 0.05$). Similarly, fish treated with 10, 30 and 40g of ginger

presented no significant variation (p> 0.05). A higher number of progeny production was observed in the control (117.33) followed by values of 91.0, 42.66, 30.0 and 13.00 in fish treated with 20, 30, 10 and 40g respectively. Fish treated with 0 and 20g of ginger are not significantly different (P>0.05). Fish treated with 20 and 30g of ginger also did not vary (p> 0.05). Consequently, fish treated with 10, 30 and 40g of ginger shows no significant variation (p> 0.05).

Table 1: Effects of Ginger on losses cause by *Dermestes maculatus*

Parameters	0g	10g	20g	30g	40g	SEM
NADU	10.00^{a}	10.00^{a}	10.00^{a}	10.00^{a}	10.00^{a}	1.15^{ns}
ADM	9.33^{a}	4.66^{b}	1.33^{c}	3.33^{bc}	4.33^{b}	1.25^{*}
PP	117.33^{a}	30.00^{c}	91.00^{ab}	42.66^{bc}	13.00^{c}	23.56^{*}
IW	162.67^{ab}	151.33^{bc}	149.67^{c}	166.6^{a}	150.33^{c}	5.29^{*}
WL	32.66^{a}	17.33^{c}	31.33^{ab}	23.33^{abc}	$18.32b^{c}$	5.98^{*}

SEM = Means with the same row with different superscript differs significantly (p> 0.05). Key; NADU= Number of adult *Dermestes maculates*; ADM= Adults mortality; Progeny production = Number of larva; IW= Initial weight; WL= Weight loss.

Discussion

Based on the results obtained, the mortality of adult *Dermestes maculates* observed at the end of (42 days) has the highest value of 9.33 mortality observed in smoked *Oreochromis niloticus* with (20g) of ginger concentration. This finding disagrees with that of Akunne *et al*. (2014) who added a mixture of (20g) of *Piper guineense* seeds to *Clarias gariepinus* (60g), causing the highest mortality of 5.33 adults *Dermestes maculatus.* Weight loss was recorded to be a higher 32.66 in the 0g (control) of ginger concentration due to the consumption of the fish tissue by the progeny and adult *Dermestes maculatus*. This finding disagrees with that of Mohammad *et al*. (2017) who worked on the effects of fish species and curing methods on the susceptibility index and losses caused by an insect (*Dermestes maculatus*) to *Clarias specie* with a weight loss of 13.8%. The result indicates a higher number of progeny productions as 117.33 in the 0g (control) and the lowest number of progenies in 40g of ginger concentration. This result is similar to Don-pedro. (1985), on the toxicity of some citrus peels to *Dermestes maculatus* that high doses suppressed progeny development.

Conclusion

Based on the result of this study it was observed that at 10g application rate of ginger gave suppression of adult *Dermestes maculates,* showes reduced progeny production and weight loss in the smoked Nile talipia.

Recommendation

The powdered ginger is recommended for the protection of smoked dried fish against loss cause by *Dermestes maculatus*, as a good alternative to synthetic insecticides. It is also easily available to fish farmers. Therefore, farmers, fish processors and fish marketers are advised to use ginger powder as a preservative for the storage of their fish products.

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