



**The Effect of Black Cumin (*Nigella sativa* L.) Seed Oil on Hide Beetle (*Dermastes maculatus* De Geer) Found in Smoked Catfish Obtained from Mayo-Gwoi and Jalingo Main Markets Taraba State**

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**Abstract**

Short Communication

A study was carried out in 2022 at the Department of Biological Sciences Taraba State University, Jalingo to determine the effect of black cumin seed oil on *Dermastes maculatus* found in smoked fish. black cumin seed oil applied at 1, 2 and 3ml served as the treatments replicated three times. The experiment was done in plastic containers of 30 cm in length, 15 cm in height, 30 cm in breadth and 15 cm in width covered with wire gauze. The experiment was set up in four treatments. With equal 15 *Dermastes maculatus* introduced to an equal portion of smoked dried fish for each replicate. Analysis of variance was performed by one-way ANOVA procedure, and the differences between the mean values of the treatments were determined by F-statistics at 95% level of significance. Generally, the responses indicated that the higher the level of treatment, the higher the effect of black cumin seed oil on larvae and adult *Dermastes maculatus* found in smoked fish; an indication that the oils performed differently ( $p < 0.05$ ) on the *D. maculatus*. The highest mortality was recorded at a treatment level of 3 mL and the lowest was recorded at a treatment level of 1 mL for the larvae of *D. maculatus*. Similarly, the highest mortality was recorded at a treatment level of 3 mL and the lowest at 1 mL for both the larvae and adult of *D. maculatus*. The effect of black cumin seed oil on the life cycle of the insect (*Dermastes maculatus*) indicated that the highest mortality was recorded at a treatment level of 3 mL/15 pests in the first month of the experiment.

**Keywords:** Black cumin seed oil; *Dermastes maculatus*; Smoked catfish; Mayo-Gwoi.

**Introduction**

The African catfish of the Genus *Clarias* has very high commercial value in Nigeria owing to its flavour and taste. The good quality coupled with its ability to feed on virtually anything makes the fish a highly recommended species for aquaculture development in Nigeria (Burits and Bucar, 2000; Luther *et al.*, 2007). The phenomenon of fish preservation is enunciated by the simple principle of making fish unfavourable for the growth of spoilage organisms. In Nigeria, fish drying is the most adopted technique since it is within the socio-economic levels of artisanal fishermen contributing over 90% of

domestic fish supply (Zivotofsky & Amar, 2006). Many materials subjecting fish to different preservation techniques notably: traditional smoking, traditional solar drying, oven and Ife solar drying have been carried out (Kykkidou *et al.*, 2009). Analyses of the preserved fish showed the occurrence of a high proportion of predominantly unsaturated fatty acids in the oven and Ife solar-dried fish compared to the traditionally smoke-dried fish. Despite these shortcomings, there is an insatiable market for dried fish products in the country.

The major pests on smoked catfish (*Clarias gariepinus*) include *Dermestes maculatus* (hide beetle) and *Necrobia rufipes* (copra beetle) (Osuji, 1974; Awoyemi, 1989) which could be controlled by synthetic chemicals (Boeke *et al.*, 2001). The dermestes beetle, *Dermestes maculates*, is a very important pest of smoked-dried fish which destroys the flesh of stored fish. Chemical insecticides such as malathion and pirimiphos methyl used traditionally in pest control cause pest resistance, environmental and food contamination and toxicity to non-target organisms.

However, in recent years, there have been increasing and concerted efforts directed at developing natural pest management control agents that are relatively cheap, safe, biodegradable and environment-friendly as alternatives to synthesized insecticides (Boeke *et al.*, 2001; Akinwumi *et al.*, 2007). Although many of the natural protectants are regarded as safe because they are also commonly used traditionally as spices and herbal medicines, studies have shown that some of such plants contain noxious compounds which may render them unsafe for man's consumption. Plant extracts and essential oils have traditionally been used to kill or repel stored product insects, for example, *Nigella sativa* L.

*Nigella sativa* L. is a member of the Family Ranunculaceae commonly called black cumin. It is locally called 'Alhabah' in Hausa language. The cumin plant grows to 30–50 cm (12–20 In) tall and it is harvested by hand. It is an annual herbaceous plant, with a slender, glabrous, branched stem that is 20–30 cm (8–12 In) tall and has a diameter of 3–5 cm (1 1/4–2 In). It is widely distributed in Pakistan, India, Uzbekistan, Tajikistan, Iran, Turkey, Morocco, Egypt, Syria, Mexico, Chile, and China and sparsely found in the Mambila Plateau Nigeria. The seeds contain volatile

oils, fixed oils, fatty acids, proteins, amino acids and many minerals (Hutchings, 1996).

In addition, vegetable and fish oils are also used in West Africa as protectants from pest infestation. Nigerian fish merchants also rub groundnut on smoked fish for either protective or cosmetic effects. It was reported that examining the repellency of cashew nut shell liquid and oils of coconut, neem, palm, gingelly, mustard, sunflower, safflower, castor seed, rice bran, and groundnut when applied to dried Silver belly fish showed that mustard oil-treated fish was the most repellent, keeping-off the fish from insects after 40 days (Khan *et al.*, 2003). The insecticidal constituents of many essential oils against stored product insects are mainly monoterpenoids such as terpineol, limonene, lupleol and Carvacrol (Khan *et al.*, 2003).

The present study was carried out to determine the effect of black cumin (*Nigella sativa*) seed oil on hide beetle (*Dermestes maculatus*) found in smoked catfish from Mayo-Gwoi and Jalingo Markets, Taraba State, Nigeria.

## Materials and Methods

### *Description of the Study Area*

Jalingo is the capital city of Taraba State in Northeastern Nigeria with an estimated population of 118, 000. Jalingo Local Government Area is one of the sixteen Local Government Areas of Taraba State. The Local Government shares borders with Yorro Local Government in the east Ardo-kola local government in the south-west and also Zing local Government in the northern east area. The prominent ethnic groups in Jalingo Local Government Area are *Mumuye*, *Jukun*, *Kona*, *Fulani* and some *Wurkum* and Hausa as well; the local government covers 5875 km<sup>2</sup>, Jalingo Local Government and the state capital, it lies on latitude 8<sup>o</sup> 54 North and longitude 11<sup>o</sup> 22 East. The three main religions in the local government area are Christianity, Islam and

Traditional. This traditional religion is practised by the *Jukun-Kona* and *Mumuye*, the *Fulanis* are 100 % Muslims in addition to the Hausas. Jalingo Local Government Area has about five months of rainy season with an average rainfall of 1000 mm and an average temperature of about 27 °C. The vegetation spread of the area is predominantly guinea savannah to the north. Different types of soil that are found in the area determine agricultural practices. It has been estimated that about 75 % of the total population are farmers. The major crops grown are yam, groundnut, maize, guinea corn and millet. The major source of water is the rivers and lakes; about 90% of the population gets their water from the surface lakes the rivers and only 10% get theirs from the groundwater source (NPC, 2006).

#### ***Collection and Identification of Smoked Fish, Hide Beetle and Black Cumin Seed Oil***

Heavily infested smoked catfish were bought from Jalingo's main market and Mayo-Gwoi market Jalingo and transferred to the Biology laboratory, Taraba State University, Jalingo. The larval and adult stages of hide beetle (*D. maculatus*) were then collected from infested smoked catfish. The larval stage was put in a plastic container to complete its life cycle to the adult stage. Black cumin seeds were also purchased from seed sellers in Jalingo's main market. All samples were properly authenticated by Mr. M.S. Bingari of the Department of Biological Sciences, Taraba State University, Jalingo. The black cumin oil was obtained by crushing the seeds with a wooden mortar and pestle and pressing them to release the oils.

#### ***Evaluation of Effects of *N. sativa* seed oil on *D. maculatus* Found in Smoked Catfish***

The experiment was done in plastic containers 30 cm in length and 15cm in height, covered with wire gauze. Undiluted oils of black cumin were applied to smoked catfish by smearing the fish with the oil using a brush into different

concentrations. The experiment was set up in four groups. Smoked catfish were allotted four equal treatments, that is 15 *D. maculatus* larvae per group, and were replicated for the adult *D. maculatus*. They were grouped as follows:

Group I was the control group containing *D. maculatus* larvae without treatment,

Group II was smoked catfish with larvae treated with 1 mL of black cumin seed oil (BCSO),

Group III was smoked catfish with larvae treated with 2 mL of BCSO,

Group IV was smoked catfish with larvae treated with 3 mL of BCSO.

The larvae (15) in each group were introduced by the sides of the containers containing smoked catfish smeared with various concentrations of oil using a brush. The same treatments were repeated with the introduction of the adult *D. maculatus*. The mortality rates in the treated fishes were then recorded after seven weeks of study.

#### **Statistical Analysis**

Data obtained were expressed as mean  $\pm$ SE (n = 3). The value of  $p < 0.05$  was statistically significant using analysis of variance (one-way ANOVA) followed by Dunnett's post hoc test. Statistical analysis was carried out using IBM's SPSS version 23 software.

#### **Results and Discussion**

The results of the experiments carried out using fifteen (15) larvae of hide beetle in three (3) replicates at the treatment levels 1 mL, 2 mL and 3 mL of black cumin seed oil to determine the effects of black cumin seed oil on larvae stage of *Dermestes maculatus* showed interesting findings. A comparison of the performance of cumin seed oils at 1 mL/15 pest, 2 mL/15 pest and 3 mL/15 pest concentrations showed that the oils performed significantly different ( $p < 0.05$ ) for larvicidal effect as presented in Table 1. The results

showed a dose-dependent activity from 1 to 3 mL of black cumin seed oil (BCSO). The result showed that the treatment effect of BCSO was significant ( $p < 0.05$ ; one-way ANOVA). This implied that the treatment effect was significant in repelling the larvae of *D. maculatus*. From the result in Table 1, it was seen that treatment is very effective at 3 mL of cumin seed oil per 15 pests.

The results used fifteen (15) adult hide beetles in three (3) replicates at similar treatment levels of BCSO to determine the effects of the seed oil on adult *Dermestes maculatus*. A comparison of the performance of cumin seed oils at these concentrations showed that the oils performed significantly differently ( $p < 0.05$ ) on the adult *D. maculatus* presented in Table 2. The effectiveness of the BCSO on mortality of adult *D. maculatus* was witnessed at the highest concentration (3 mL /15 pest). Similarly, the BCSO significantly ( $p < 0.05$ ) elevated the mortality rates of both the larval and adult stages life cycle of the beetle (Figure 1). It was reported that the larval stage had periods ranging from 38 to 48 days (7 weeks maximum) to grow and ready for population. The larvae moult 5 to 11 times and stop feeding 4 days before pupation. The pupation is done in hiding where the larvae burrow into the powder of the destroyed fish flesh while the adult beetles typically live between 4 and 6 months. In this study, the BCSO was able to effectively inhibit the complete development of the insect due to the presence of

phytoconstituents contained in the seed oil such as fatty acids like linoleic and oleic acids (Ramadan, 2007). These plant-derived fatty acids have been reported to possess larvicidal and insecticidal properties against numerous insects (Emir, 2010). This was the case in the present study with black cumin seed which contains essentially volatile oil, fixed oil and fatty acids like linoleic and oleic acid. This indicates that they excellently repelled the larvae and adults of *D. maculatus* from treated smoked catfish thereby preserving the fish. The repellent effect increased with increasing concentration of the oils from cumin seed as was also reported by Jilani and Iqbal (2018) and Osuji (1985). Similarly, Stoll (2000) and Akinwumi *et al.* (2007) reported repellence as a major mechanism by which plant products control insect damage to stored grains, and also, that the extract of black cumin seed exhibited repellency against *D. maculatus*.

The result of the study indicated that *Nigella sativa* (black cumin) seed oil was lethal to the insect by causing the insect to die within hours of introduction into the experiment set-up in the first week of the experiment which brings the life cycle of the insect to a halt after an hour. The life cycle of *D. maculatus* on the smoked catfish took approximately 5 to 7 weeks to complete under optimum conditions. Therefore, the oil extracted from *N. sativa* seed greatly inhibited the life cycle of *D. maculatus* which infests the smoked catfish.

**Table 1: Effect of *N. sativa* seed oil on *D. maculatus* larvae in smoked catfish.**

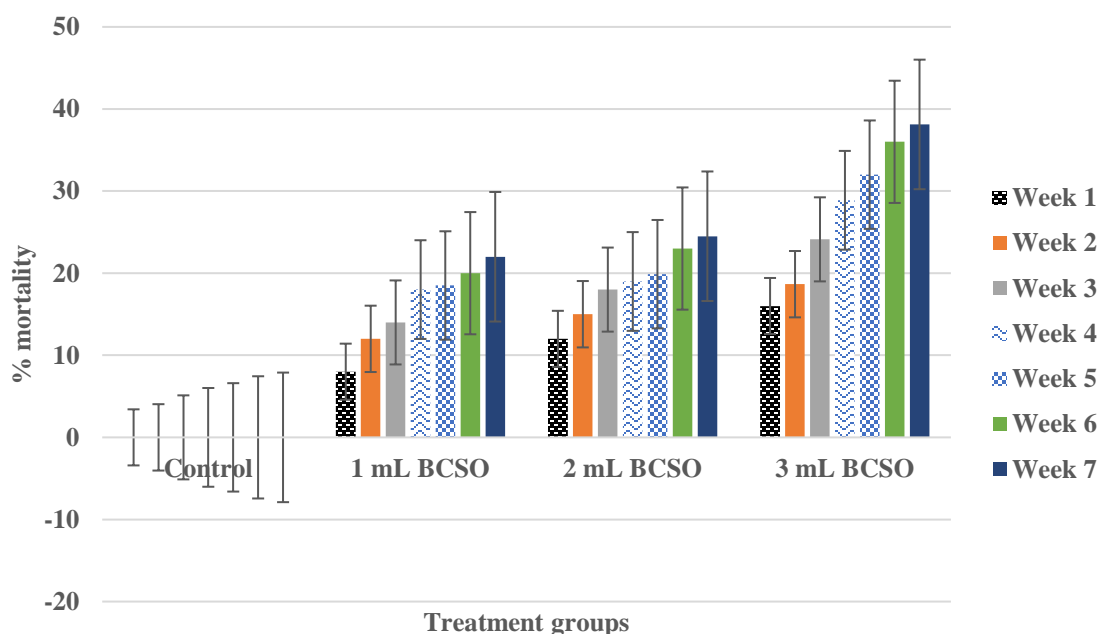
Group (treatment)	Mortality rate (%)			N	±SE
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>		
Normal control	0(0)	0(0)	0(0)	45	0.0 ±0.0*
1 mL BCSO	5(33.3%)	6(40%)	8(53.5%)*	45	7.7 ±1.1
2 mL BCSO	12(80%)	13(86.7%)	11(73.3%)*	45	27.5±4.1*
3 mL BCSO	14(93.3%)	15(100%)	14(93.3%)*	45	39.4±5.9*

BCSO: black cumin seed oil; n = 3; \*  $p < 0.05$  is statistically significant using one-way ANOVA followed by Dunnett's post hoc test.

**Table 2: Effect of *N. sativa* seed oil on *D. maculatus* adults in smoked catfish.**

Group (treatment)	Number of mortality rate (% mortality)				
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	N	±SE
Normal control	0(0)	0(0)	0(0)	45	0.0 ±0.0*
1 mL BCSO	13(86.7%)	12(80%)	14(93.3%)*	45	32.3±4.8
2 mL BCSO	14(93.3%)	13(86.7%)	14(93.3%)*	45	35.7±5.3*
3 mL BCSO	15(100%)	15(100%)	15(100%)*	45	43.0±6.4*

BCSO: black cumin seed oil; n = 3; \* p < 0.05 is statistically significant using one-way ANOVA followed by Dunnett's post hoc test.



**Figure 1: Effect of *N. sativa* (black cumin) seed oil on *D. maculatus* life cycle in seven weeks. Results are mean ±SE (n = 3) while p < 0.05 was statistically significant when compared with control using split-plot ANOVA followed by Dunnett's post hoc test.**

### Conclusion and Recommendations

The study showed that black cumin seed oils possessed repellent and mortality effects on the adult and larvae of *D. maculatus* and retained their potency even at 96 h exposure, confirming the residual nature of the effects of the oil. Hence, black cumin seed oil could form the basis for the successful formulation

and commercialization of biopesticides against *D. maculatus*. It can provide a valuable alternative to synthetic insecticides in the management of storage insect pests of smoked fish in Nigeria.

It recommended that more research on other natural methods for preserving smoked fishes in homes and commercial places be carried out

to avoid the potential hazardous effects of synthetic preservatives.

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