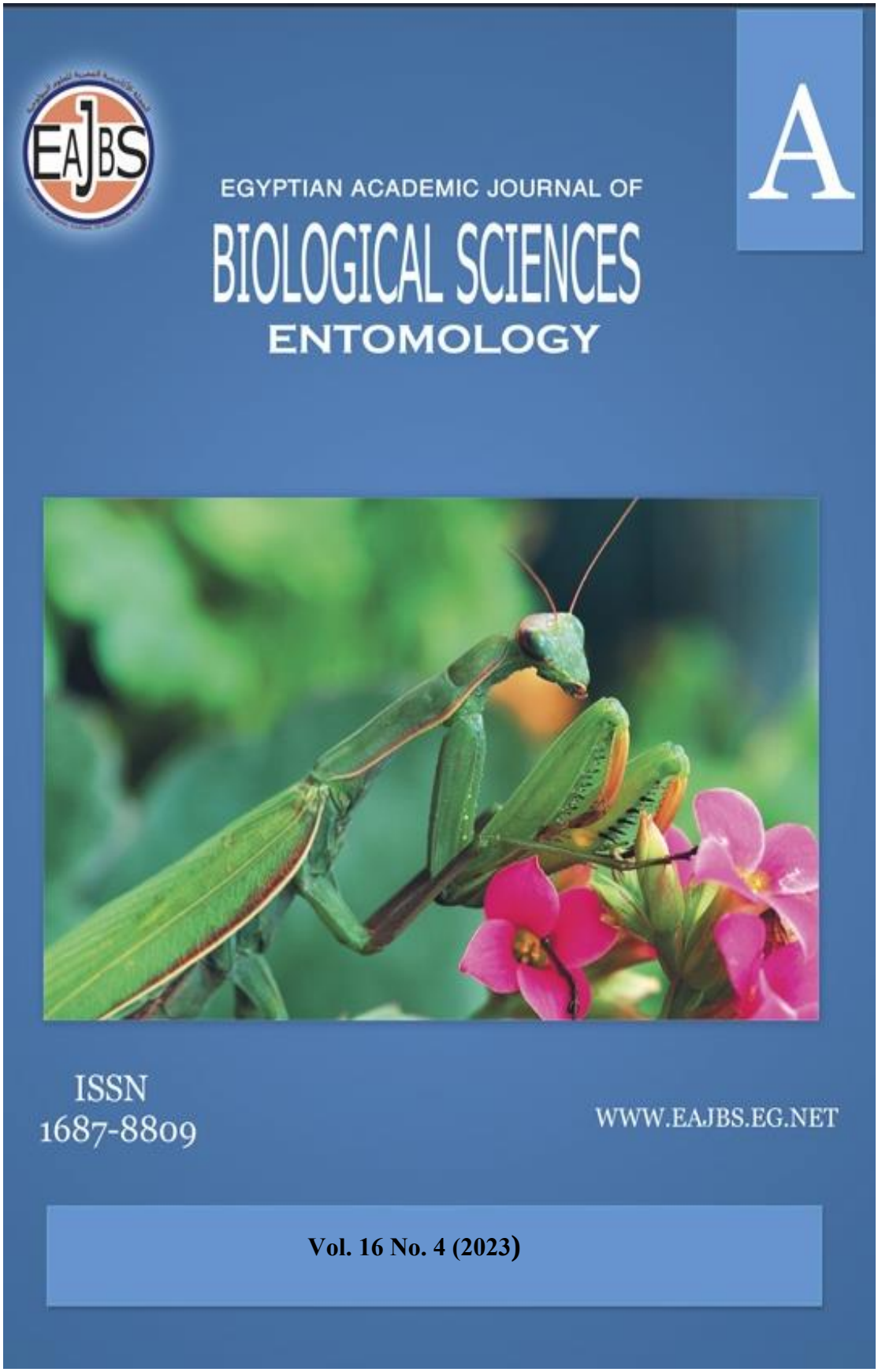

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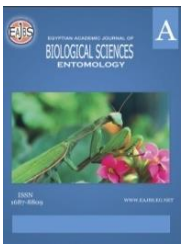

Digestive Effect of Aqueous Extract of *Nigella sativa* Seeds on The Larval and Adult Mortality of The Red Flour Beetle, *Tribolium castanium*

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ABSTRACT

The red flour beetle *Tribolium castanium* was rearing in the laboratory on its natural food, which is mainly composed of flour or rice, with laboratory temperature (28 + 2) and humidity (50 + 10%) and various life stages were obtained for this insect. The results of the current study showed that the aqueous sweet cumin seed extract affected the increase in the mortality percentages of red flour beetle larvae and adults with the increase in the concentrations used, and there was a direct relationship between the concentrations used (5, 10, 15, 20) mg/ml for the aqueous extracts of *Nigella sativa* seeds and the adults and larval mortality percentages of the red flour beetle. The highest larval mortality was 100% when using the concentration of 20 mg/ml after 192 hours of treatment, while the highest mortality percentage for adults was 100% when using the concentration of 20 mg/ml after 192 hours of treatment. The highest mortality percentages were recorded for adults and larvae on the first day of treatment.

INTRODUCTION

Cereals are of great importance in global agriculture because they are linked to the food security of people. Cereals, their products, and stored foods provide the calories that the habitat consumes, and they are also considered one of the main sources that provide the protein necessary for human food (Al-Azami and Abdullah, 2115). Corn grains of all kinds and wheat grains are grain crops of economic importance in many countries of the world, where corn or wheat are used separately as food for humans in the manufacture of bread and pancakes or after mixing them together in different proportions, as well as their use in the manufacture of concentrated feed to feed Animals, and that their seeds are rich in vitamin A, B (Ogendo *et al.*, 2008). Rice is also used in feeding many countries, especially East Asian countries. Brown rice is rich in vitamins, but when the rice or other grains are husked, it loses the vitamins found in the husk and lacks vitamin B, which is important in vitality and reproduction. Stored grains and their products are exposed to many pests that cause great economic damage, and cause damage to approximately 10-11 percent of the

stored grains of crops in the world (Sana *et al.* 2014). 2Despite the widespread use of insecticides, insecticides may cause poisoning to farmers since they are specially made to kill certain types of organisms. The red flour beetle *Tribolium castanium* is one of the important insect pests in Sudan and many regions of the world, as it attacks many food products such as flour, cereals, biscuit chips, chocolate, spices, cakes and dried fruits. The red flour beetle is considered one of the most important warehouse insects, as there are grocery stores in homes (Nadeem *et al.*, 2013). The flour affected by this insect gives a distinctive undesirable smell and a moldy taste as a result of the secretions of quinone compounds. The flour also loses many of the properties that make it unsuitable for making bread, such as viscosity and rubberyness. The beetles lead to a decrease in the quantity and quality of food, as well as a change in the chemical composition of the infested grains (Mohammed and Waddah, 2114). The red flour beetle, *Tribolium castaneum* (Herbst, 1797) (Coleoptera: Tenebrionidae) is a cosmopolitan and the most widespread insect pest of wheat flour and cereals in Pakistan (Nadeem *et al.*, 2013) and worldwide (Ogendo *et al.*, 2008). The aim of this study is to evaluate the usefulness of aqueous and alcoholic extracts in controlling the larvae and adults of the red flour beetle.

MATERIALS AND METHODS

1- Collection and Rearing of The Red Flour Beetle:

The flour infected with the red flour beetle was obtained from the local markets, where 10 pairs (10 males + 10 females) were isolated from them and added to the amount of 500 grams of healthy flour for the purpose of obtaining a pure colony of the insect, then placed in clean plastic bottles and covered with a tulle cloth and tied with a rubber band and placed at the temperature of the laboratory.

2 - Obtain of the *Nigella sativa:*

The black seed or the sweet seed *Nigella sativa* was obtained from the local markets and it was preserved in the laboratory.

3 - Prepare the Aqueous Extract of Sweet Seed, *Nigella sativa*:

The black bean *Nigella sativa* was ground using the electric home blender to make black seed powder and put in a glass box and then weighed 20 g on the sensitive scale and then 400 ml distilled water was placed in a beaker and the ground black bean was added to it and then it was mixed and stirred continuously and left the solution for 24 hours And then it was filtered using medical gauze.

4 - Prepare Concentrations of The Aqueous Extract of Sweet Seed, *Nigella sativa*:

Weigh 5 g of the powder resulting from the aqueous extract of the sweet seed, dissolved in 100 ml of distilled water to obtain a solution. The aqueous extract of the sweet seed is diluted:

N1 V1 = N2 V2

N1: first concentration.

V2: first volume

N2: second concentration

V2: second Volume

From this equation, the concentrations (5, 10, 15, 20) mg/ml are obtained and the concentrations are kept separately in a clean plastic bottle after recording the information about the plant and the type of aqueous extract of the sweet seed, then keeping the concentrations in the refrigerator.

5 - Treatment of Adults with A Concentration of Aqueous Extract of Sweet Seed:

10 adults and 10 larvae of the red flour beetle were isolated and placed in a clean Petri dish as one out of three replicates.

It was used for each of the concentrations mentioned above, and using a hand sprayer, the larvae and adults with their natural food (Rice or flour) were sprayed in 2ml of the aqueous extract and at a certain concentration. In the laboratory temperature over a period of 192 hours, larval and adult mortality are recorded daily in a special register.

6 - Statistical Analysis:

The results were analyzed according to the factorial experiments model using the completely randomized design, and the least significant difference L.S.D was used at the probability level (0.05) to test the significance of differences between the transactions (Al-Rawi and Khalaf Allah, 2000).

RESULTS AND DISCUSSION

The results of Table (1) indicated an increase in the mortality percentages of adults of the red flour beetle with the increase in the concentrations used in the experiment, where the highest mortality percentage was 40% after 24 hours (one day) of treatment with the aqueous extract of sweet seeds, and the statistical analysis showed percentages with the concentrations used in the experiment. The results of the same table indicated an increase in the mortality percentages of adults at the time of exposure to the aqueous extract of the sweet seed, and the highest mortality percentage was 100% after 192 hours of treatment with the aqueous extract of the sweet seed at a concentration of 20 mg/ml. There were no clear significant differences in the mortality percentage for adults with exposure time for each of the concentrations used in the experiment. Results of Makai *et al* (2019) revealed that all the plants' extracts had a lethal effect against adults and larvae of both stored pests as compared to the control treatment. *Rosmarinus officinalis* extract was the most efficient against the adults of both stored grain pests, causing 58.67% mortality in *Tribolium castaneum* and 80.00% mortality in *Trogoderma grananium*. In another study, Rozman *et al.*, (2007) reported that no oil compounds of *Rosmarinus officinalis* achieved more than 20% mortality after exposure of 24 hours, even with the highest dose against *Tribolium castaneum.*

Table 1: the mortality rates of red rusty flour beetle adults over eight days of exposure to concentrations of the aqueous extract of the sweet bean.

LSD 0.05	Mortality percentage after 192 hours	Mortality percentage after 168 hours	Mortality percentage after 144 hours	Mortality percentage after 120 hours	Mortality percentage after 96 hours	Mortality percentage after 72 hours	Mortality percentage after 48 hours	Mortality percentage after 24 hours	Time exposure hours / Conc. mg\ ml
0	0	0	0	0	0	0	0	0	Control
18.7	60	50	40	40	30	30	20	20	5
18.6	70	60	50	50	40	40	40	30	10
19.4	80	60	50	40	40	30	30	30	15
19.9	100	80	70	60	50	40	40	40	20
	18.4	12.2	11.4	8.3	7.1	4.4	4.9	5.6	LSD 0.05

The results of Table (2) indicated that there was an increase in the larval mortality percentages of the red flour beetle with an increase in the concentration used in the experiment, where the highest mortality percentage was 30% after 24 hours (one day) of treatment with the aqueous extract of the sweet seed, and the statistical analysis showed that there are differences Statistical significance in adult mortality percentages with the concentrations used in the experiment. The results of the same table indicated an increase in the adult mortality percentages with the time exposure of the aqueous extract of the sweet seed, and the highest mortality percentage was 100% after 192 hours of treatment with the aqueous extract of the sweet seed at a concentration of 20 mg/ml. There were no clear significant differences in adult mortality percentages with an exposure time between the concentrations of the aqueous extract of the sweet seed used in the experiment Makai *et al* (2019) showed that *Rosmarinus officinalis* extract was the most efficient against the adults of both stored grain pests, causing 58.67% mortality in *Tribolium castaneum* and 80.00% mortality in Trogoderma grananium. Hameed *et al.* (2012) evaluated the insecticidal activity of bio-based insecticide spinosad and two extracts, neem (*A. indica*) and *Nerium oleander* L., against *T. castaneum*. Mortality values of *T. castaneum* were up to 50%. Slight differences may be due to differences in new chemistry insecticide.

Table 2: The larval mortality percentages of red flour beetle over eight days of exposing them to concentrations of the aqueous extract of the sweet seed**.**

LSD 0.05	Mortality percentage after 192 hours	Mortality percentage after 168 hours	Mortality percentage after 144 hours	Mortality percentage after 120 hours	Mortality percentage after 96 hours	Mortality percentage after 72 hours	Mortality percentage after 48 hours	Mortality percentage after 24 hours	Time exposure hours / Conc. mg\ ml
0	0	0	0	0	0	0	0	0	Control
13.2	50	30	30	30	20	20	20	20	5
20.8	70	40	40	40	20	10	0	0	10
19.9	90	30	30	30	20	20	40	20	15
19.6	100	50	50	40	30	40	40	30	20
	14.5	8.2	8.3	5.4	5.4	7.2	7.4	6.7	LSD 0.05

We conclude from this study the possibility of using aqueous and alcoholic extracts in a specific way to control this insect pest

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