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A study of the effect oil extract of Trigonella foenum-graecum and Peganum harmala seeds on the life of Tribolium castaneum

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Trigonella foenum-graecum, Peganum harmala oil, seeds, extract and Tribolium castaneum.

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ABSTRACT

This study was conducted to investigate the effect of different concentrations of Trigonella foenum-graecum and peganum harmala seeds oil on the life of Tribolium castaneum.

The results showed: With a concentration of 8% after 48 hours of treatment, T. foenum-graecum and Peganum harmala seed oil had the highest mortality rate for the fourth instar larvae, reaching 96.7%, and 73.7% respectively, the lowest mortality rate for the first larval instar, 26.7% and 16.7% respectively at a concentration of 2% after 24 hours of treatment, the highest mortality rate for adults was 96.7% and 87.7% respectively at a concentration of 8% after 72 hours of treatment, and the lowest mortality rate was 16.7% and 10.7% respectively after 24 hours at a concentration of 2%.

INTRODUCTION

studies, the plant oils had therapeutic uses and weren't toxic to vertebrates (Al Qahtani *et al*.,2012).

Trigonella foenum-graecum L., or also commonly known as fenugreek, is known to be one of the plants with these traits. It is from the family of Fabaceae and is a self-pollinating annual herbaceous aromatic crop, also known as bird's foot, Greek hayseed, halba, and methi (Gu *et al*., 2017).

A perennial glabrous plant, harman (*Peganum harmala* L., family *Zygophyllaceae*) is native to the eastern Mediterranean region, it grows spontaneously in semi-arid conditions, steppe areas, and sandy soils, measuring 0.3 to 0.8 m tall, with short creeping roots, white flowers, and round seed capsules holding more than 50 seeds, the shrub is well-known in Iran and is widely distributed throughout Central Asia, North Africa, and the Middle East (Branch, 2012; Wanntorp and De Craene, 2011).

-The study aimed the following:

Effect of Different Concentrations of *Trigonella foenum-graecum* and *Peganum harmala* seeds oil extract on life of *T. castaneum*.

Materials and Methods

- Collection and breeding of the *T. castaneum*

T. castaneum was created as a laboratory colony by sterilizing 20 pairs of entire male and female insects for 48 hours in the freezer before putting them in glass bottles with intact wheat grains and pasta that were 15 cm tall and 8 cm in diameter, before the studies were conducted on the bottles, they were bred and multiplied in the incubator under the aforementioned circumstances, to keep adults from escaping the bottles, the lips were closed with muslin cloth and secured with a rubber band, the colony was carefully watched as it regenerated after each generation (Al-Hadithi, 2016).

Grains and their products are the main and important source of human food, where they constitute the main part as a main material for many peoples, the rust – Red flour beetle (*Tribolium castaneum* (Herbst) caused severe losses and damage to many grains and their products during storage operations in stores and shops, ranging between 5-10% and may reach more than 20- 30% in some tropical areas and the percentage of damage may reach approximately 10-40% of the crops stored in the world, the insect causes great damage to stored materials in addition to unacceptable and foulsmelling secretions, which are benzoquinones, these compounds are carcinogenic and cause a number of allergic diseases in humans (Angadi *et al*., 2014).

The main issue that worries all countries in the globe is how to prevent pest infestations in grain products and stored grains, *T. castaneum* and *T. confusum* are two economically significant bugs that target several stored goods, in order to safeguard stored goods against an infestation of these beetles, it is crucial to look for effective protective materials (Al Qahtani *et al*., 2012).

Finding suitable substitutes to remove them is essential as their extensive use has resulted in problems with the development of genetic resistance to the effects of chemical pesticides and the hazard that their residues pose to people, animals, and important insect enemies (Soujanya *et al*., 2016), that each of them needs to return to safe substitute techniques, including utilizing plant extracts (Pavela, 2016), the plant derivatives are thought to be less poisonous or not hazardous to mammals, vertebrates, and invertebrates, they are also thought to be a source of food for insects and to be repulsive or enticing to them (Cox, 2006).

The therapeutic plant oils used in this study were selected for their potential outcomes after a review of the literature, according to

From the lab colonies, 10 whole minor were isolated and reproduced three times, due to the males' lower size than the females', as well as their antennae, it was possible to tell the males from the females, separate Petri dishes containing the pupae were sprayed with three of replicates each of the three oil concentrations, the average lifespan of the females was observed when they were incubated at a distance of 15 cm under the prior incubation circumstances, after 24, 48, and 72 hours, observations were made from each dish by dumping the contents onto white paper to identify the dead individuals.

- **Statistical analysis**

Using the ANOVA test, complete random design (CRD), and Dunkin's multiple range test with a probability threshold of 0.05% and 0.01%, the findings were statistically assessed (SAS, 2012).

Results and discussion

-Effect of *T. foenum-graecum* and *Peganum harmala* seeds oil on fourth instar larvae of *T. castaneum*

Table 1 and 2, shows the mortality percentages of *T. foenum-graecum* and *Peganum harmala* seeds oil after 24, 48 hours of treatment of fourth instar larvae at concentrations 2%, 4%, 8%, if the results showed an effect of each concentration in causing mortality rates for fourth instar larvae, in addition to the presence of variation and differences significant in the mortality rates among the treatment concentrations on fourth instar larvae, as the concentration of 8% gave the highest mortality rate for fourth instar larvae, reaching 46.7% and 96.7% for *T. foenum-graecum* and reaching 37.7% and 73.7% for *Peganum harmala* respectively during 24 and 48 hours, respectively and shows notable variations from the control treatment, when no mortality occurred, and lowest death rate was 26.7% and 56.7% for *T. foenum-graecum* and reaching 17.7% and 47.7% for *Peganum harmala* respectively, during 24 and 48 hours at a concentration of 2%, while the mortality rates at a concentration of 4% were 36.7% and 76.7% for *T. foenum-graecum* and reaching 23.7% and 66.7% for *Peganum harmala* respectively, during 24 and 48 hours, it is concluded that increasing the concentration and length of exposure causes an increase in the mortality rates of the insect since the data demonstrate a substantial difference in the mortality rates compared to the control treatment, in which no mortality occurred.

-Isolation and identification fourth instar larvae of *T. castaneum*

While the head capsule does not grow and the Camp deiform of the first-age larvae is flattened, the larval stages of *T. castaneum* were differentiated based on shape under a light microscope at 40x magnification.

- Isolation and identification of *T. castaneum*

Since the infestations were removed from the food medium containing infected wheat grains using a soft brush and without the use of a light microscope and transferred to dishes for experimentation, the procedure for isolating the integuments of *T. castaneum* minor grain borer beetle is less involved than the isolation of other roles.

-Preparing *T. foenum-graecum* and *Peganum harmala* seeds for the study

Then get *T. foenum-graecum* and *Peganum harmala* seeds oil from the local markets, produced by Al-Emad Herbal Oil Factory - Mosul - Industrial District / Left Coast, with a concentration of 100% and in a special packaging for the product.

- Studying the effect of different concentrations of *T. foenum-graecum* and *Peganum harmala* seeds oil on the fourth instar larvae of *T. castaneum* after 24 and 48 hours.

For every concentration of the fourth instar larvae and each of the three duplicates, 10 larvae were collected, by separating the eggs, until they reach the required larval stage, you should keep an eye on their progress and count the number of skins that are shed, the fourth instar larvae were acquired, for each of the three concentrations, they received three milliliters of oil to guarantee thorough covering. Spraying 10 larvae with three milliliters of sterile distilled water served as the control treatment, following the spraying procedure, 5 gm of food made for lab use and feeding larvae was added to each plate containing the identical amounts of the aforementioned oil, each dish was placed 15 cm away from the control treatment, under incubator conditions, the dishes were incubated at 30+2° C and 5 70% relative humidity, after 24 and 48 hours, the dishes were checked, and the number of dead lightning strikes was noted.

- **A study of the effect of different concentrations of *T. foenum-graecum* and *Peganum harmala* seeds oil on adult of *T. castaneum* after 24, 48 and 72 hours.**

Table 1: Percentage percentages of fourth instar larvae of *T. castaneum* treated with *T. foenum-graecum* seeds oil

Concentration	Time / hour		Average concentration
	24	48	
2 %	26.7	56.7	41.7 c
4 %	36.7	76.7	56.7 b
8 %	46.7	96.7	76.7 a
Average time	36.7 B	76.7 A	

** Similar lowercase letters indicate no discernible distinctions when they are grouped together in a column.

*Similar capital letters indicate that there are no substantial distinctions between them when they appear in the same row.

Table 2: Percentage percentages of fourth instar larvae of *T. castaneum* treated with *Peganum harmala* seeds oil

Concentration	Time / hour		Average concentration
	24	48	
2 %	17.7	47.7	41.5 c
4 %	23.7	66.7	45.2 b
8 %	37.7	73.7	55.7 a
Average time	26.3 B	62.7 A	

mortality females, reaching 26.7%, 50.0% and 96.7% for *T. foenum-graecum* and reaching 23.7%, 47.0% and 87.7% for *Peganum harmala* respectively during 24, 48 and 72 hours, and the lowest percentage, mortality of adults reached 16.7%, 23.3% and 76.7% for *T. foenum-graecum* and reaching 10.7%, 23.7% and 87.7% for *Peganum harmala* respectively, during 24, 48 and 72 hours at a concentration of 2%.

While the mortality rates at the concentration of 4% for adults reached 23.3%, 36.7%, and 86.7% for *T. foenum-graecum* and reaching 17.3%, 36.7% and 77.7% for *Peganum harmala* respectively, during 24, 48, and 72 hours, according to the findings, the Mortality rates differ significantly from those of the control treatment, in which no mortality took place, insect mortality rates increase as exposure time increases.

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-Effect of *T. foenum-graecum* and *Peganum harmala* seeds oil on adults of *T. castaneum*

Table 3 and 4, shows the mortality percentages of *T. foenum-graecum* seeds oil after 24, 48, and 72 hours of treatment of females at concentrations 2%, 4%, and 8%, if the results showed an effect of each concentration in causing mortality rates for females, in addition to the presence of significant differences in mortality rates between the treatment concentrations of female adults, as the concentration of 8% gave the highest percentage of

Table 3: Mortality percentages of adults of *T. castaneum* treated with *T. foenum-graecum* seeds oil.

Concentration	Time / hour			Average concentration
	24	48	72	
2 %	16.7	23.3	76.7	**38.9 c**
4 %	23.3	36.7	86.7	**51.1 b**
8 %	26.7	50.0	96.7	**57.8 a**
Average time	**22.2 C**	**36.6 B**	**86.7 A**	

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Table 4: Mortality percentages of adults of *T. castaneum* treated with *Peganum harmala* seeds oil.

Concentration	Time / hour			Average concentration
	24	48	72	
2 %	10.7	23.7	66.7	**33.7 c**
4 %	17.3	36.7	77.7	**43.9 b**
8 %	23.7	47.0	87.7	**52.8 a**
Average time	**17.2 C**	**35.8 B**	**77.3 A**	

employed to manage insect pests including the rust-red flour beetle *Tribolium castaneum* (Herbst), with an average killing rate of 78.4%. Saker *et al*. (2018) employed a variety of extracts and vegetable oils derived from garlic cloves, hot pepper fruits, olive fruits, and thyme seeds to combat adult Trogoderma granarium (Everst) and rice weevil Sitophilus oryzae L.

Numerous plants, including *A. squamosa*, *L. camara*, *C. inermis*, *C. fistula*, *A. indica*, and *C. procera*, have been shown to be lethal for a variety of stored grain pests and to delay the developmental stages by interfering with their apolytic and molting process (Deka and Singh, 2005). Leatemia and Isman (2004) have already reported on the ovicidal, larvicidal, and molt inhibiting properties of *L. camara* extract on Corcyra cephalonica (Staint.) and *T. castaneum*. In addition, plant oil vapors may have an indirect effect by masking the stimulatory effects of the intended stored product (Papachristos and Stamopoulos, 2002).

Essential oils are inexpensive and less harmful to the environment and healthy animals (Alagawany *et al*., 2021, El-Tarabily *et al*., 2021), they also affect the biology, physiology, and nervous system of insects (Mann and Kaufman, 2012), as a result, using essential oils could contribute to environmentally friendly farming practices (Isman, 2006).

As oil concentrations and exposure times increased, the current study found that mortality increased dramatically as well; these findings are consistent with those of Abdel-Rahman *et al*. (2011) and Alagarmala *et al*. (2016).

Because plant extracts are widely used as safer natural chemicals for anti-viral, anti-bacterial, anti-parasitic, anti-fungal, and insecticidal purposes, they offer a solution to this problem. Natural plant oils and extracts from over 30 botanical families are used to control insect pests of stored grains (Perez *et al*., 2010), plant extracts are also a natural remedy for the infestation of stored grain insects, such as neem, deet, and pea flour (Hou *et al*., 2004), various plant extracts have been shown to have repellent properties against *T. castaneum* (Arthur *et al*., 2007).

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This results agreement with results Mohamed *et al*. (2016) Which showed that fenugreek plant oil has a significant effect on the death of the insect, as the mortality rate reached to 96.9 and 92.5% respectively when used at a concentration of 700 ppm and after 72 hours of treatment, and Khalaf (2016) found that *Peganum harmala* oil extract is effective in killing adults of *Trogoderma granarium* and the killing rate was 87.74%. The seed extracts have both toxic and antifeedant properties (Leatemia and Isman, 2004), the variation of oils in their repellent effect is due to the fact that they contain toxic substances or active compounds that act as insect repellents, that vegetable oils have a toxic effect by contact and fumigation and act as repellent substances for many officinal insects (Tripathi *et al*., 2002). The effectiveness of rue oil as toxic substances is due to the containment of its seeds terpene compounds in the form of volatile oils and fixed oils (Muhi-Eldeen *et al*, 2008) and also contains unsaturated fatty acids such as oleic, linaulic and palmatique (Al-Husseini, 2009).

The difference in the effect of these vegetable oils is due to their different biological effects, they may be lethal antifeedant or fluids fed toxicant or have a sterilization effect as the effect of oils is due to the occurrence of nervous shock to the insect paralyzing its movement and then death through the effect on the cover of the nerve cell, or because of lack of oxygen through the entry of oil into the respiratory stomata (Done-pedro, 1989), Some researchers stated that the effectiveness of rue oil is due to the fact that it contains flavonoids, glycosides and phenols, which are toxic substances that affect the nervous system and the work of digestive enzymes (Banks, 1977).

According to AL-Bayati *et al*. (2013), they are regarded as growth regulators, repellents, or nutritional inhibitors. They have been

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