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Toxic Effect of Some Plant Extracts on the Mortality of Flour Beetle *Tribolium confusum* (Duval) (Coleoptera: Tenebrionidae)

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Abstract

The study was carried out in the Entomology Laboratory of the Department of Biology, College of Science, Salahaddin University, Erbil, Kurdistan Region, and Iraq. Methanol extracts of six local plants (*Anethum graveolens, Apium graveolens*, *Eucalyptus glauca*, *Malva parviflora*, *Mentha longifolia* and *Zingiber officinale*) were studied for their toxicity effect on mortality of the last larval stage of *Tribolium confusum* by assessing the mortality value of the larvae for different plant extracts and different exposure times (1-5 hrs) and estimating the value of LT_{50} for each plant extract. The mortality were varying from plant to plant as follows: *Anethum graveolens* reached its maximum value of 56.67% at 4.5 hrs, for *Eucalyptus glauca* it was 90% at 2 hrs., for *Apium graveolens* it was 93.33% at 5 hrs exposure and *Mentha longifolia* it was 93.33% at 4 hrs, while for *Malva parviflora* reached 96.67% at 3 hrs, and for *Zingiber officinale* reached its maximum value of 100% at 2 hrs. The LT_{50} values for *T. confusum* ranged from 1.111 for *Zingiber officinale* to 3.146 for *Anethum graveolens* whiles the obtained LT_{50} values were 2.451, 1.392, 1.364 and 1.143 for *Apium graveolens*, *Mentha longifolia***,** *Malva parviflora* and *Eucalyptus glauca* respectively. The results indicate that *Zingiber officinale* was the most toxic plant and *Anethum graveolens* the least toxic.

Keywords: Plant extract; *Tribolium confusum;* Mortality; LT_{50}

Introduction

Wheat suffers heavy losses during storage due to insect pests. According to the FAO estimate 10 to 25% of the world's harvested food is destroyed annually by insects and rodent pests [1]. Insect pests cause damage to stored grains and processed products by reducing their dry weight and nutritional value [2]. The confused flour beetle, *Tribolium confusum* is one of the most serious pests of stored cereals and processed cereal products worldwide [3-5].

Around the world, residual chemical insecticides and fumigation are currently the methods of choice for the control of insects of stored-products [6]. Their widespread use has led to some serious problems, including the development of insect strains resistant to insecticides [7], toxic residues on stored grains, and health hazards to grain handlers. Increased public concern over the residual toxicity of insecticides applied to stored products, the occurrence of insecticide-resistant insect strains, and the precautions necessary to work with traditional chemical insecticides stress the usage of botanicals to control insects of stored product [8].

Insect pests have mainly been controlled with synthetic insecticides in the last fifty years and the protection of stored grains from insect damage is currently dependent on synthetic pesticides. Botanicals are a promising source of pest control compounds. The plant kingdom can be a rich source of a variety of chemicals with the potential for development as successful pest control agents [9,10]. Secondary compounds from plants including alkaloids, terpenoids, phenolics, and flavonoids can affect insects in several ways. They may disrupt major metabolic pathways and cause rapid death, act as attractants, deterrents, phago-stimulants antifeedants or modify oviposition. They may also slow down or accelerate development [11-13].

There is, therefore, an urgent need to develop environment friendly alternatives with the potentials to replace the highly toxic chemicals. On the basis of experimental studies it was found that the mixture of plant materials with their rapid and slow action, proved to be very effective for the protection of stored grains. It has also been well recognized internationally that some plants derived insecticides can affect a limited range of insect pests, but have no harmful effect on non targeted organisms and the environment. Many of the plant derived materials possess repellant and insecticidal activities against the insects of stored food products, and also confirm their usefulness as potent control agent [14]. The aim of this study is to evaluate the insecticidal activity of ethanolic extracts from *Anethum graveolens, Apium graveolens, Eucalyptus glauca, Mentha longifolia, Malva parviflora and Zingiber officinale* plants on the last larval stage of *Tribolium confusum.*

Materials and Methods

Insect cultures

Mass culture of the confused flour beetle, *T. confusum* was maintained in the laboratory over 2 years without exposure to insecticides in glass containers (20 cm length×14 cm width×8 cm height) containing wheat flour mixed with yeast (10: 1, w/w) which were covered by a fine mesh cloth for ventilation. The cultures were maintained in an incubator at 30°C and for evaluation of larvicidal activity newly molted last instar larvae of *T. confusum* insects were utilized for toxicity test.

Plant materials

Fresh leaves of *Anethum graveolens*, *Apium graveolens*, *Eucalyptus glauca*, *Mentha longifolia*, *Malva parviflora*, and *Zingiber officinale* were collected from Erbil city. Leaves of these plants were washed

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with water, shade dried and ground to a fine powder with an electric blender. About 12.5 gm of the powdered material from each plant was soaked separately, in the dark, in a solution of 12.5 ml water and 50 ml ethanol solvent. After one day the solutions were filtered and stored in the refrigerator prior to use [15]. The extracts were tested for their effects on the last larval stage of *T. confusum* to determine percentage mortality.

Mortality test

To test the mortality rate of *T. confusum* last instar larvae, the crude plant extracts, (the residue) was used, in which 1 mL solution of each plant extract was dropped on filter paper (whatman No.1) placed inside a petri dish (6 cm diameter) with the help of a pipette. The filter paper was then air dried for a few minutes. Ten last instar larvae (1-2 days old) were released into each petri dish, and the same number was also confined to filter papers treated with water and ethanol as an untreated check. Three replications were made for each treatment and control [16]. The mortality of beetles was recorded at 0.5, 1.0, 1, 5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, and 5.0 hours after treatment. The mortality was assessed by means of direct observation, and when no leg or antennal movements were observed, the insects were considered dead [17].

Statistical analysis

The mortality (%) was corrected by Abbott's formula [18] and then subjected to probit analysis from the SPSS software (V. 17.0.0) [19] with time as the explanatory variable to derive the estimated hours for 50% mortality (LT_{50}).

Results and Discussion

This experiment was conducted in order to determine the insecticidal activity of the plant extracts used on *Tribolium confusum*. In all cases, considerable differences in insect mortality were shown with different plant extracts.

The efficiency of the plant extracts on mortality of *Tribolium confusum* is shown in Table 1 for the different time periods. The value of maximum mortality differs from plant to plant. As observed in this study, the result reached its maximum value in the case of *Anethum graveolens*, it was 56.67% at 4.5 hrs exposure, *Apium graveolens*: 93.33% at 5 hrs, *Eucalyptus glauca*: 90% at 2 hrs, *Malva parviflora*: 96.67% at 3 hrs, *Mentha longifolia*: 93.33% at 4 hrs, and *Zingiber officinalis* 100% at 2 hrs.

Mortality was noted with different plants and exposure times. *Anethum graveolens* was able to induce 50% mortality at 3.5 hrs, whiles *Apium graveolens* was able to induce more than 50% mortality after 0.5 hrs, and achieved 93.33% at 5 hrs after treatment and *Eucalyptus glauca* induced more than 50% mortality after 1 hr, and 90% at 2 hrs after treatment. On the other hand, the result of *Malva parviflora* showed toxicity to *Tribolium confusum* and induced more than 50% mortality at 0.5 hrs, and reached its maximum value of 96.67% at 3 hrs. *Mentha longifolia* extract was able to induce more than 50% mortality at 1 hr, and reached its maximum value of 93.33% at 4 hrs. As shown in Table 1 *Zingiber officinale* was able to induce more than 50% mortality at 0.5 hrs, and reached its maximum value of 100% at 2 hrs. These results agree with those of Chiasson et al. [20] Which showed that the products are generally broad-spectrum, due to the presence of several active ingredients that operate by means of several modes of action? On the other hand, our results didn't agree with those of Ahmad et al. [21] who studied the insecticidal activity of *Zingiber officinale* rhizome extracts against *Trogoderma granarium* (E). At the highest concentration of (6%) *Z. officinale* was found to be comparatively toxic and killed 9.81% to 22.05% of the larvae after 24 and 96 hrs and they concluded that the extract did not give encouraging results when tested against *T. granarium* larvae. However, our results indicate that *Zingiber officinale* was able to induce more than 50% mortality at 0.5 hrs, and reached its maximum value of 100% at 2 hrs. This contradiction and difference could be attributed to the high concentration of the crude plant extract that we used for the Mortality test. Also the results obtained for the other plant extracts against the larvae of *T. confusum* gave encouraging results.

The toxicity of these crude plant extracts against *T. confusum* could depend on several factors among which are the chemical composition of the crude plant extract and insect susceptibility. Also Khoshould and Khayamy [22] refer to the insecticidal effects of ethanolic extract from *Verbascum cheiranthifolium* Boiss against two insect pest species of stored-products and indicated that the mortality of the exposed insects increased with the increase of the exposure interval and dose rate. It was clear from their results that the botanical extract on insects was effective and Iram et al. [23] indicated that the ethanol extract was found to be remarkably more potent than the powder form of same plant. Some other different findings were reported by different scientists. Fang et al. [24] indicated that *Tribolium* species are classified among the least susceptible insect pests of stored-producst and often more difficult to kill than other stored-product beetles, though the order of toxicity often varies depending on the particular insecticide. The insecticidal activity of monoterpenes, the major component of essential oils, has been reported against insects of stored-products [25,26]. Table 2 shows the LT_{50} values for the different plants extracts of *Tribolium confusum*. The LT_{50} values of *T. confusum* ranged from 1.111 for *Zingiber officinale*, and 3.146 for *Anethum graveolens* but the LT50 values for *Apium graveolens*, *Mentha longifolia*, *Eucalyptus glauca*, and *Malva parviflo* were 2.451, 1.392, 1.143 and 1.364 respectively .The most toxic plant was *Zingiber officinale* and the least toxic *Anethum graveolens*. The results of the present study are in agreement with some earlier studies [16], where it was found that mortality attained was 100% after 12 hrs and LT_{50} value ranged from 5.83 to 22.14 hrs. From the above results it can be

Treatments	Exposed periods (hour) (Mortality %)									
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
Anethum graveolens	16.67	26.67	33.33	36.67	36.67	46.67	50	53.333	56.67	56.67
Apium graveolens	36.67	60	73.33	76.67	83.33	86.67	86.67	90	90	93.33
Eucalyptus glauca	13.33	73.33	86.67	90	90	90	90	90	90	90
Malva parviflora	73.33	83.33	90	93.33	93.33	96.67	96.67	96.667	96.67	96.67
Mentha longifolia	43.33	63.33	73.33	76.67	86.67	90	90	93.333	93.33	93.33
Zingiber officinale	93.33	96.67	96.67	100	100	100	100	100	100	100

*Total of 3 replication

Table 1: Cumulative percent mortality of *Tribolium confusum* with different plant extracts at exposed periods

Treatments	LT_{50}	Simple Linear Regression			
Anethum graveolens	3.146	y =	3.538	- 0.966	x
Apium graveolens	2.451	y =	4.070	- 1.457	x
Eucalyptus glauca	1.143	y =	1.388	- 0.777	x
Malva parviflora	1.364	y =	4.017	- 2.579	x
Mentha longifolia	1.392	y =	4.021	- 2.529	x
Zingiber officinale	1.111	y =	3.423	- 2.631	x

Table 2: LT_{50} values for different plants extracts of *Tribolium confusum*

concluded that the insecticidal activity varied with plant species and exposure time.

Conclusion

The findings of the present investigations indicate that botanical derivatives might be useful as store insect control agents for commercial use. All tested plant extracts were effective to some degree in reducing the number of *T. confusum*. The results of the present study indicated that by considering the mean mortality as a main index, *Zingiber officinale* proved to be the most effective of the six test plants materials against the larvae followed by *Malva parviflora*, *Apium graveolens*, *Mentha longifolia*, *Eucalyptus glauca* and *Anethum graveolens*. A study to improve the effectiveness of botanical derivatives as insecticides will benefit the agricultural sectors of developing countries, as these substance are not only of low cost, but also have less environmental impact in terms of insecticidal hazard.

References

1. Anonymous (1980) Introduction to Detia. Fumigation Detia export GmH, 3.
2. Sinha RN, Watters FL (1985) Insect pests of flour mills, grain elevators, and feed mills and their control. Agriculture Canada. Publication 1776, Ottawa, ON, Canada.
3. Aitken AD (1975) Insect Travelers, I: Coleoptera. Techn. Bull. 31. London. 190.
4. Champ BR, Dyte CE (1976) Report of the FAO Global Survey of Pesticide Susceptibility of Stored Grain Pests. FAO, Rome. 297.
5. Hill DS (1990) Pests of Stored Products and Their Control. Belhaven Press, London. 274.
6. White NDG (1995) Insects, mites, and insecticides in stored grain ecosystems, in: Jayas D.S., White N.D.G., Muir W.E. (Eds.), Stored Grain Ecosystem. Marcel Dekker, Inc., New York 123-168.
7. Zettler JL, Cuperus GW (1990) Pesticide resistance in Tribolium castaneum (Coleoptera: Tenebrionidae) and Rhyzopertha dominica (Coleoptera: Bostrichidae) in wheat. J Econ Entomol 83: 1677-1681.
8. Su HCF (1991) Toxicity and repellency of chenopodium oil to four species of stored product insects, J. Entomol. Sci 26: 178-182.
9. Arnason JT, Philogene BJR, Morand P (1989) Insecticides of Plant Origin. American Chemical Society, Washington, D.C 387
10. Rahman MM, Schmidt GH (1999) Effect of Acorus calamus (L.) (Araceae) essential oil vapours from various origins on Callosobruchus phaseoli (Gyllenhal) (Coleoptera: Bruchidae) J. stored Prod Res 35: 285-295.
11. Smet H, Van-Mellaert H, Rans M, De-Loof A (1986) The effect of mortality and reproduction of beta-asarone vapours on two insect species of stored grain: Ephestia kuehniella (Lepidoptera) and Tribolium confusum Duval (Coleoptera). Mededeligen Van de Faculteit Landbouwwentenschappen Rijksuniversiteit Gent 51: 1197-1204.
12. Bell EA (1986) Plants as sources of novel pest and diseases control agents. Proc. British Crop Protection Conf. on Pest and Diseases 661-666.
13. Houghton PJ (1996) Compounds with anti-HIV activity from plants. Trans R Soc Trop Med Hyg 90: 601-604.
14. Hill JM, AV Schoonhoven (1981) The use of vegetable oil in controlling insect infestations in stored grains and pulses. Recent Advances in Food Science and Technology 1: 473-481.
15. Al-Lawati HT, Azam KM, Deadman ML (2002) Potential of Omani Flora as Source of Natural Products for Control of Pulse Beetle, *Callosobruchus chinensis* Agri Sci 7:59-63 .
16. Sahaf BZ, Moharramipour S, Meshkatalsadat MH (2008) Fumigant toxicity of essential oil from Vitex pseudo-negundo against *Tribolium castaneum* (Herbst) and *Sitophilus oryzae* (L) Asia-Pacific Entomology 11: 175-179.
17. Muhammad HH (2008) Toxicity Effect of Four Plants Extracts against The Oak Leaf Cut Worm Euproctis melania Staud. (Lymantriidae: Lepidoptera) Zanko 20: 83-88.
18. Abbott WS (1925) A method of computing the effectiveness of an insecticide. J Econ Entomol 18: 265-267.
19. Finny DJ (1971) Probit analysis, Cambridge University Press, London, 333.
20. Chiasson H, Vincent C, Bostanian NJ (2004) Insecticidal properties of a Chenopodium based botanical. J Econ Entomol 97: 1378-1383.
21. Ahmad F, Muhammad S, Ahmad H, SM Mizanur Rahman, Masoor-Ul-Hasan (2013) Insecticidal Activity of Some Plant Extracts Against Trogoderma granarium (E.). The Agriculturists 11: 103-111.
22. Khoshnoud H, Khayamy M (2008) Insecticidal Effects of Ethanolic Extract from Verbascum cheiranthifolium Boiss. Against Two Stored-Product Insect Pests Species. Journal of Biological Sciences 8: 191-195.
23. Iram N, Muhammad A, Naheed A (2013) Evaluation of Botanical and Synthetic Insecticide for the Control of Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Bio Assay 8: 3.
24. Fang L, Subramanyam B, Arthur FH (2002) Effectiveness of spinosad on four classes of wheat against five stored-product insects. J Econ Entomol 95: 640-650.
25. García M, Donadel OJ, Ardanaz CE, Tonn CE, Sosa ME (2005) Toxic and repellent effects of Baccharis salicifolia essential oil on Tribolium castaneum. Pest Manag Sci 61: 612-618.
26. Habig WH, Pabst MJ, Jakoby WB (1974) Glutathione S-transferases. The first enzymatic step in mercapturic acid formation. J Biol Chem 249: 7130-7139.