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STUDY OF THE REPELLENT ACTIVITY OF SOME MEDICINAL HERBS POWDER AGAINST ADULTS OF *TRIBOLIUM CONFUSUM* DUV. (TENEBRIONIDAE: COLEOPTERA)

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ABSTRACT

This study was conducted with the aim of evaluating the repellent activity of twenty medicinal herb powders against the adults of *Tribolium confusum* Duv. When exposed to these powders at concentration of 1 g/10 g of flour after 24 hours of treatment under normal laboratory conditions, using Six-arm glass olfactometer tool. Powders of herb divided into four groups (A, B, C, D), Each group contains five powders in addition to the control treatment. The results y showed the superiority of the Malaysian propolis powder in group (C) over all used powders with a percent repellency 75.20%, followed in repellent activity powder of *Commiphora wightii* within the same group by 50.37% percent repellency. While the powders of *Senna acutifolia, Fumaria officinalis* included in group (B) gave the lowest percent repellency was 1.70%.On the other hand, the powders of *Thuja orientalis*, *Alchemilla vulgaris* and *Juniperus phoenicea* within group (A) did not show any repellent activity, as they gave negative results that were -5.77%, -2.97%, -2.97%, respectively. Which indicates the possibility of using these herbs as repellent powders or attractive grafts used in various traps within the integrated pest management.

***Keywords*:** *Tribolium confusum*, Propolis, Multi-arm glass olfactometer.

Introduction

Insect pests are among the most important factors that cause damage to grains and stored products worldwide, as these products are exposed during storageto attack group of insects that cause losses of varying degrees ranging between (5-50%) and may sometimes reach complete damage to these products and It dependson the type of grain, type of insect, storage method, storage period, water content of the grain and storage conditions (Iraqi, 2010). Among the most important and dangerous of these pests is *Tribolium confusum* Duv. which is characterized by high ability to reproduce and cause rapid injury in stored materials if the optimum conditions are available, this insect causes losses ranging between 10-15% of stored materials in one season as well as polluting the rest material as it becomes unfit for human or animal consumption due to various secretions, such as the unacceptable smells and their old skins (Al-Abadi *et al*., 2008), Also, the insect prevails in tropical ,warm and in temperate regions (Al-Iraqi, 2010). The affected flour with this insect characterized by smell and moldy taste due to the insect's secretion of Guanin compounds, in addition to losing many of the properties that make it unfit for baking such as viscosity and rubber (Lyon, 2002; Karunakaran *et al*., 2011). The use of chemical pesticides in control of pests has become one of the things that are taken on because of the health and environmental damage they cause, especially on the ozone plate (Leesch *et al*., 2000). World Health Organization report indicated that more than 200,000 people are die annually due to the use of these pesticides, in addition to the slow poisoning that may cause cancer and major birth defects in humans (Muhammad, 2003; Bassil *et al*., 2007), These pesticides also contribute to the elimination of beneficial pests and insects (Skukla *et al*., 2008), Therefore, it is necessary to return to nature and search for natural and biological alternatives. The plant kingdom includes many plants that contain different chemical substances that can contribute to the biological defense system of plants against pests. These materials are the products of the secondary metabolism of the plant and consist of a number of plant compounds such as Terpenoids, Alkaloids, Saponins, Coumarins and Phenols, such compounds are found in various parts of the plant such as stems, roots, leaves, flowers and fruits as they have no specific function in the plant and can be used as natural pesticides as they are inexpensive, safe and environmentally friendly materials (Ratnasekera and Rajapakse, 2009; Thorayia *et al*., 2012), They are used either directly by using their powders after drying, grinding and mixing with grains or after extracting toxic compounds in various ways and mixing with organic solvents (Aly and Ahmed, 2011), Such compounds cause various effects on insects, as they may be toxic or alter the insect's nutritional behavior, repellants, inhibitors, impede the growth and development of the insect or make it sterile (Al-Dajwi, 1996 and Olivera *et al*., 1999). Therefore, the present study aimed to test the efficacy of number herbs powders in repellent adults of *Tribolium confusum* Duv after 24 hours of exposure using Six-arm glass olfactometer tool.

Materials and Methods

Insect culture

The *T. confusum* was collected from the local market and diagnosed by a Swiss Wild M7A microscope established in Entomology Laboratory/College of Science/University of Mosul, then placed in clean glass bottles (5 cm in diameter and 15.5 cm in height) with 200-400 g of flour and kept in the incubator at temperature 30+2°C until the study was conducted.

Source of herbs

Table 1 : Medicinal herbs used in study

Plants	Family	Part Used
Thuja orientalis	Cupressaceae	Fruits
Ammi visnaga	Apiaceae	Seeds
Alchemilla vulgaris	Rosaceae	Leaves & Stem
Dittrichia viscosa	Asteraceae	leaves
Juniperus phoenicea	Cupressaceae	Fruits
Commiphora myrrha	Burseraceae	Myrrh
Senna acutifolia	Fabaceae	leaves
Fumaria officinalis	Papaveraceae	Leaves & Flower
Phyllanthus emblica	Euphorbiaceae	Fruits
Urtica dioica	Urticaceae	Seeds
Commiphora wightii	Burseraceae	Gum
Pistacia lentiscus	Anacardiaceae	Mastic resin
Ruta graveolens	Rutaceae	leaves
Panax schinseng	Araliaceae	Roots
Malaysian Propolis	-	Propolis
Chrysanthemum cineraiaefolium	Asteraceae	leaves
Matricaria chamomilla	Asteraceae	Flower
Coriandrum sativum	Apiaceae	Seeds
Boswellia serrata	Burseraceae	Boswellia
Sorbus domestica	Rosaceae	Fruits & Seeds

Twenty medicinal herbs prepared by the Department of Horticulture and El-Emad Factory for production of herbal oils and cosmetics in Nineveh, which included:

Preparation of herbs powders

50 grams of plant parts used in study were taken, and put in electric oven at temperature 35 °C for three days to drying and facilitate their grinding process, then, grinded using a grindertype (289 GEEPAS). The resulting powder was sifted with a metal sieve (600 microns) to obtain flour powder. Then the powders were placed in glass bottles with a tight lid and thus ready to be used in the study as a powder mixed with flour directly.

Repellency assay

The six-arms glass olfactometer modified from the multi-arm glass olfactometer tool described by (Pugazhvendam *et al*., 2009) was used. The tool consists of a central cylinder with a diameter (10 cm) and a height (5 cm) containing an opening from the top for inserting insects from them**,** connects to the bottom of cylinder with six glass arms distributed radially, each arm of (25 cm) in length and (2.5 cm) in diameter (Figure 1). Each arm represents a type of powder, while the sixth arm represents the treatment (flour), For test, the powders used are divided into four groups. Each group included five powders (Table 1). A sample of flour mixed with herb powders (1 g powder / 10 g flour)and placed at the end of the five arms. Arm end closed with a piece of cotton to prevent insect escape. One hundred adult released in the center of cylinder and left under normal laboratory conditions for 24 hours, after treatment the number of insects at the end of each arm was calculated. Then the Percent repellency was calculated using the following equation: $\%R = Nc - Nt / Nt + Nc \times 100$, NC: the number of insects attracted to a control treatment, Nt: number of insects attracted to flour treated with herb powder (Nerio *et al.,* 2009).

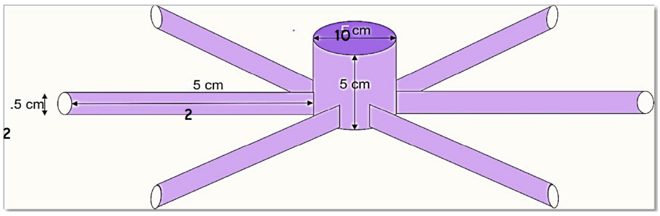

Fig. 1: Six-arms glass olfactometer

Table 2 : Represents the herbs under each group

Group A	Group B
Thuja orientalis	*Commiphora myrrha*
Ammi visnaga	*Senna acutifolia*
Alchemilla vulgaris	*Fumaria officinalis*
Dittrichia viscosa	*Phyllanthus emblica*
Juniperus phoenicea	*Urtica dioica*
Group C	**Group D**
Commiphora wightii	*Chrysanthemum cineraiaefolium*
Pistacia lentiscus	*Matricaria chamomilla*
Ruta graveolens	*Coriandrum sativum*
Panax schinseng	*Boswellia serrata*
Malaysian Propolis	*Sorbus domestica*

Statistical analysis

The standard used by (Benzi *et al*., 2009) was adopted in data analysis as follows:

The Index of repellency was calculated using the following equation: $IR = 2G / G + P$, (G) represents the number of insects in the treatment, (P) the number of insects in control, and the values were classified as follows: less than 1 = repellents, 1= Neutral, more than 1 = attraction (Mazzonetto, 2002).

Results and Discussion

The results intable (3) showed that herbs in group (A) did not cause a strong repellent effect to insect, as the highest insect percent repellency was 4.24% caused by *D. viscose* then effect *A.vinaga* with a weak repellent rate also reached 3.15%, and they were within the same taxonomic rank (I), while the plants of *T. Orientalis*, *A. vulgaris* and *J. phoenicea* gave negative (attractive) results for the insect of -5.77, -2.97 and -2.97%, respectively, and also fell within the same taxonomic rank (0),On the other hand, the values of index repellency in Figure (2) confirm the above results, where we note that the plants that gave percent repellency had values less than 1, while those that gave percent attractive were more than 1,The results are consistent with what (Rotundo et al. 2019) observed when studying the biological efficacy of three different extracts (N-hexane, methanol, and distilled water) from the aerial part of the *D. viscosa* against adults of *Sitophilus granarius* L, using the methods of ingestion and contact, Where they found that the method of ingestion caused weak death rates and repellent effect, while only a slight decrease was recorded in some nutritional parameters (the relative growth rate, the relative consumption rate, the conversion of food efficiency) for the aqueous extract, and they noticed a high contact toxicity only in the case of hexane extract Where the mean LD50 = 53.20 =g / adult after 24 hours.(Fairouz et al., 2016) studied the effect of alcoholic (methanol) extracts of *A. visnaga* on *Toxoptera aurantii* in different stages of growth (before flowering, flowering, after flowering) using concentrations ranging from 250-30000 ng / g, They found that the highest rate of insect death was 98.33% at concentration of 30000 ng / in the case of alcoholic extract of stem before flowering after 24 hours of exposure, and the death rate was 100% after 48 hours.

Table 3 : Percent repellency and their classification for group (A) herbs against *Tribolium confusum*

Group A				
Plant powder	**Part used**	**Number of Attractive Adults**	**Percent repellency (%)**	**Classification**
Thuja orientalis	Fruits	18.33	-5.77	0
Ammi visnaga	Seeds	15.33	3.15	I
Alchemilla vulgaris	Leaves& Stem	17.33	-2.97	0
Dittrichia viscosa	leaves	15	4.24	I
Juniperus phoenicea	Fruits	17.33	-2.97	0
Control	Flour	16.33	-	-

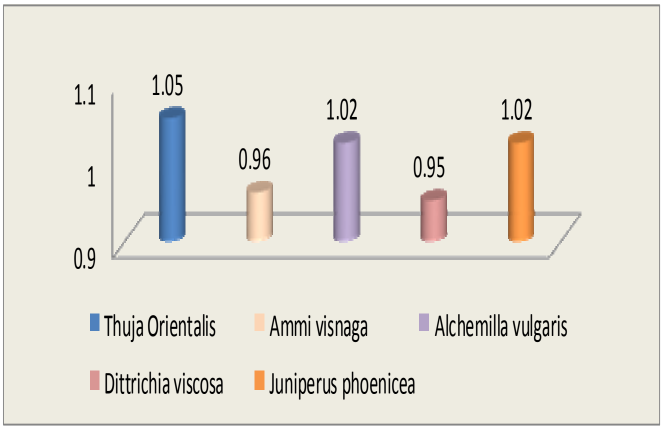

Fig. 2 : Shows index repellency values for group (A) herbs.

On the other hand, the herbs in group B (Table 4) showed superiority over the herbs of group A in insect repellent effect, so the *U. dioica* plant was the most influential among the herbs of the group with percent repellency of 30.46% and the index of repellency was 0.69 (Figure 3), while the *S acutifolia* and *F. officinalis* herbs showed weakly repellent effects and fell within the same taxonomic rank (I), James et al., (2015) studied the association of parasitic, predatory and beneficial insects with *U. dioica* in three locations in Washington during the spring and summer of 2011-2013 using viscous transparent traps connected to the top of the plant, The study concluded that the stinging nettle in the Yakima Valley in eastern Washington may provide an important habitat for beneficial insects, and may have a role to play in promoting biological control to conserve agricultural crops.

Table 4 : Percent repellency and their classification for group (B) herbs against *Tribolium confusum.*

Group B				
Plant powder	**Part used**	**Number of Attractive Adults**	**Percent repellency (%)**	**Classification**
Commiphora myrrha	Myrrh	15.66	12.17	I
Sennaa cutifolia	leaves	19.33	1.70	I
Fumaria officinalis	Leaves& Flower	19.33	1.70	I
Phyllanthus emblica	Fruits	15	14.28	I
Urtica dioica	Seeds	10.66	30.46	II
Control	Flour	20	-	-

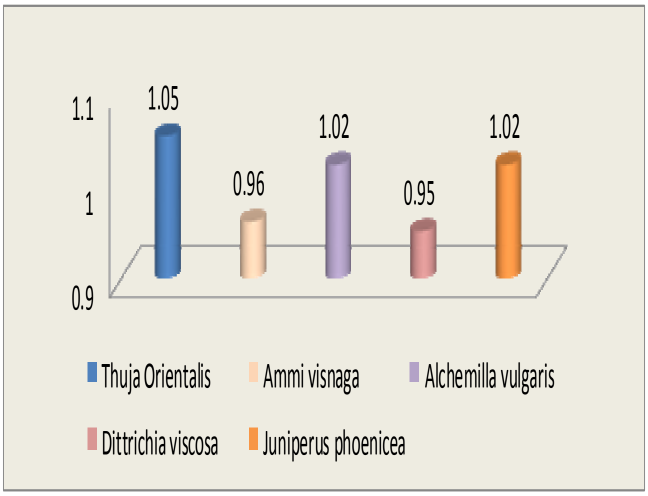

Fig. 3 : Shows index repellency values for group (B) herbs.

The data shown in Table (5) indicate that herbs in group (C) are the most insect repellent of the four groups, we also note that the Malaysian propolis is the highest insect repellent effect with a percent of 75.20% and index of repellency0.24 (Figure 4), outperforming all the powders used in the study, this result is identical to many previous studies that show the bioactivity of propolis against insects, Al-Gazali *et al.* (2018) found that the aqueous and alcoholic extract of propolis caused the mortality of the second larvae instar of the *Trogoderma granarium* (83.33%**)**, and the fifth larvae instar 66.67% and 70% respectively, and the pupal stage 66.66 and 76.67%respectively, Adult 83.33 and 63.33% for both aqueous and alcoholic extracts at concentration 3 mg/ml^{-1} respectively. While (Sanad and Mohanny, 2015) observed that the Chinese propolis caused a mortality of 60% for *Galleria mellonella* L., outperforming the Egyptian propolis, which caused a 40% mortality at 4% (V/ V) concentration after three days of exposure, Note also that the Chinese propolis caused the shortening of the larval, pupal and adult stages, reducing the egg laying period, increasing the incubation period of eggs and reducing the insect's susceptibility to laying eggs with increasing the concentration used. Osipitan (2010) found that the population density of *Prostephanus truncates* reduced due totreatment with alcoholic extract for propolis.

Table 5 : Percent repellency and their classification for group (C) herbs against *Tribolium confusum.*

Group C				
Plant powder	**Part used**	**Number of Attractive Adults**	**Percent repellency (%)**	**Classification**
Commiphora wightii	Gum	11.66	50.37	III
Pistacia lentiscus	Mastic resin	13.33	45.21	III
Ruta graveolens	leaves	22	23.25	II
Panax schinseng	Roots	12.66	47.23	III
Propolis	-	5	75.20	IV
Control	Flour	35.33	-	-

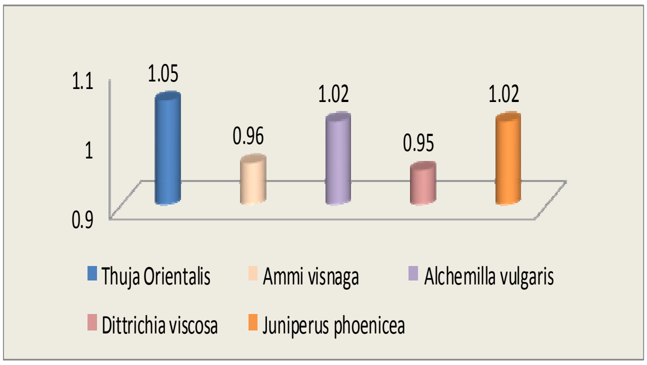

Fig. 4 : Shows index repellency values for group (C) herbs.

From the observation of percent repellency in table (6)shown by the herbs of group (D), we find that the percent repellency ranged between the highest percent of 49.09% for the *C. sativum* and the lowest percent of 15.48% showed by the *S. domestica*. The current result is closely related to what Al-Khafaf (2011) found that the aqueous and hexane extract of *C. sativum* seed powder caused a percent repellency of 51.67% for *T. granarium* larvae at concentration of 4%, and Al-Hadidi *et al.* (2014) also found that *C. sativum* seed powder caused the repellents *Tribolium castaneum* of 8% at concentration 4%, The herbs of this group were of medium in repellents effect between the herbs of groups A, B and the herbs in group C.

Table 6 : Percent repellency and their classification for group (D) herbs against *Tribolium confusum.*

Group D				
Plant powder	**Part used**	**Number of Attractive Adults**	**Percent repellency (%)**	**Classification**
Chrysanthemum cineraiaefolium	leaves	19.33	17.14	I
Matricaria chamomilla	Flower	13.33	34.43	II
Coriandrum sativum	Seeds	9.33	49.09	III
Boswellia serrata	Boswellia	11.33	41.38	III
Sorbus domestica	Fruits& Seeds	20	15.48	I
Control	Flour	27.33	-	-

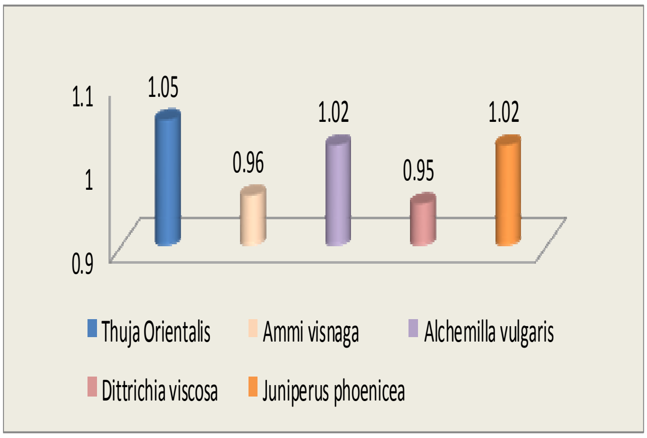

Fig. 5 : Shows index repellency values for group (D) herbs.

The variation in percent repellency in the past may be due to the chemical content of the herbs under study, and therefore the exposure of insect to these powders may affect on behavioral reactions to insect, making it attractive or repellent. In order for the insect to respond, its vapor concentration must be sufficiently effective to generate the response Olfactory of the insect, and some herbs contain chemicals that repel insect by effect on olfactory organs since the insect's response depends primarily on concentration, degree of permeability, and the physiological state of the insect and age (Rockstein, 1978; Dawood and Al-Mallah, 1993).

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