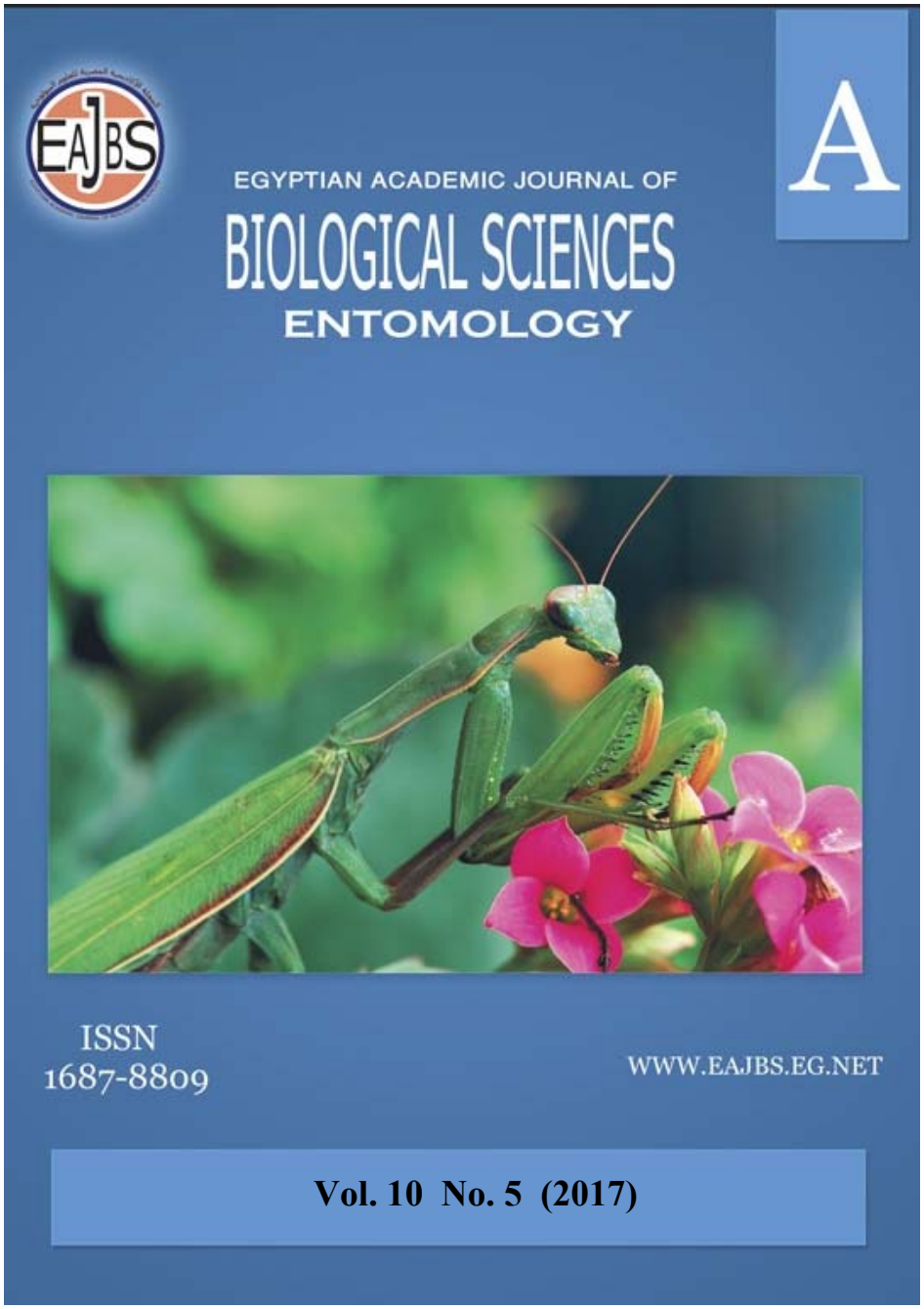

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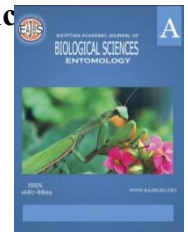

Protection of Stored Grains from Insect Infestation by Treating Packaging Material with Fennel and Anise Oils.

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ABSTRACT

Anise (*Pimpinella anisum*) and Fennel (*Foeniculum vulgare*) oils are used to protect stored cereals from infestation with The rice weevil (*Sitophilus oryzae*) and larvae of The Mediterranean flour moth (*Ephestia kuehniella*) by treating packaging material (polyethelene) with two different thickness with five different concentrations(100,75,50,25 and 12.5%) using acetone and chloroform as solvents. The results showed that in all treatments the percent mortality increased by increasing concentration and time of exposure to oils from 24 to 48 and 72 hours and in most cases the Lc_{50} of the rice weevils exceeds that of The Mediterranean flour moth larvae and the lethal effect of fennel oil is more than that of Anise oil and chloroform is effective as solvent than acetone

INTRODUCTION

Stored products of agricultural and animal origin are attacked by more than 600 species of beetle pests, 70 species of moths and about 355 species of mites causing quantitative and qualitative losses (Rajendran, 2002) and insect contamination in food commodities is an important quality control problem of concern for food industries.

The control of these pests in storage systems mainly depends on fumigants such as methyl bromide or phosphine. However, methyl bromide was banned in many countries starting in 2004 because of its ozone depleting properties (Hansen and Jensen 2002). There is an urgent need to develop safe alternatives that have the potential to replace the toxic fumigants, yet are effective, economical and convenient to use (Ayvaz *et al.,* 2008).

Botanical insecticides are naturally occurring insecticides that are derived from plants (Isman, 2000). The insecticidal activity of essential oils and plant extracts against different stored-product pests has been evaluated (Shaaya *et al.,* 1991; Asian *et al.,* 2005; Cetin and Yanikoglu, 2006; Negahban *et al.,* 2007, Ayvaz *et al.,* 2009).

Botanical pesticides have many advantages over synthetic pesticides, such as high selectivity, low or non-toxicity to non-target organisms and the environment, rapid degradation, low residue, local availability, little cross-resistance due to their natural complex agents, and novel modes of action against insects (Isman, 2006, 2008; Kudom *et al*., 2011; Lv *et al*., 2012; Ladhari *et al*.,

2013) .Fennel (*Foeniculum vulgare*) is a flowering plant species in the carrot family perennial herb It is a highly aromatic and flavorful herb with culinary and medicinal uses.

Anise absinthe , anise has been in use as a spice and flavoring agent for food stuffs and beverages.The essential oil of anise is toxic to insects and smaller animals, therefore its smell keeps insects away. For this reason, this oil can be employed to drive away insects by using it in fumigants, vaporizers, and sprays.

The rice weevil, *Sitophilus oryzae* (L.), Order – Coleoptera; Family – Curculionidae, is a serious pest not only of paddy and rice but almost of all cereals and their products. In fact, it is the commonest pest that one encounters in all kinds of stores. This pest is particularly called as "rice weevil" because it's breeding habits and life cycle was first of all studied in rice.

The Mediterranean flour moth (*Ephestia kuehniella*) is a moth of the family Pyralidae. It is a common pest of dry plant products especially cereals and found around the world.

The aim of this work is to evaluate the effectiveness of anise oil and fennel oil as natural component against adults of *Sitophilus oryzae* and *Ephestia kuehniella* larvae , and to contribute to the possibility of using natural oils as alternatives of pesticides .

MATERIALS AND METHODS

Rearing technique:

The Mediterranean flour moth was reared on wheat flour in plastic jars in darkness at 25 ± 1ºC and 65 ± 5% relative humidity. A stock culture was kept in Natural Products Department, National Centre for Radiation Research and Technology. Experiments were conducted under the same conditions .

Adult *S. oryzae* used in this study were obtained from a laboratory strain reared on wheat, Weevil cultures were initiated by introducing 200 unsexed adults into 200 g of wheat (13.5% moisture content) in 800 ml glass jars that had screen/filter paper lids. Jars were held at 30 ± 1ºC and 70 ± 5% relative humidity

Evaluation of Susceptibility of *the two insects* (*Ephestia kuehniella and Sitophilus oryzae*) to fennel and Anise oils:

Five concentrations of each plant oils were prepared from their stock (100,75,50 ,25,and 12.5 %) by diluting each oil using acetone and chloroform as solvents, .polyethelene with thickness 0.025 and 0.06 millimeter were treated with 0.2 ml of the oil and leave for complete dryness then *Ephestia kuehniella* larvae were exposed to treated. Polyethelene. Also adults of *Sitophilus oryzae* were exposed to Polyethelene treated with 0. 05 ml of the oil after complete dryness. Mortality was recorded daily for three days, for each concentration and for the solvent treated controls. Percent mortality was calculated in larvae for the different concentrations and for larvae treated with solvent only (control). Experiments were repeated when more than 20% mortality of the control was obtained.

Statistical analysis:

The data obtained from the present study was statistically analyzed, whenever the calculated "F" values were significant at 5% level **(**Snedecor and Cochran, 1980).

RESULTS

In (Table 1) When *E. Kuehniella* larvae exposed to polyethelene with less thickness (0.025 millimeter) treated with Fennel oil at concentrations (0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both the concentration and time of exposure from 24 to 48 and 72 hours being 26.1% and 47.8%and increased at the concentration 100% to be 82.1 and 100% for 24 and 72h respectively.

Statistical analysis showed significant difference between control and all concentrations except the concentration 12.5% after 24 h.

In the other hand when *S. Oryzae*_weevils exposed to polyethelene with small thickness

(0.025 millimeter) treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent,the percent mortality was increased by increasing both the concentration and time of exposure from 24 to 48 and 72 hours being 2.2 % and 15.8% at 24 and 72h respectively and increased at the concentration 100% to be 94.9 and 100% for at 24 and 72h respectively. From the above results we noticed that weevils were more tolerant than larvae.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24 and 48h while at 72h significant difference was found between control and concentrations 50, 75 and 100%

Table(1): Percent Mortality of *E .kuehniella* larvae and *S. oryzae* weevil after exposing to thin polyethylene treated with different concentrations of Fennel oil diluted by chloroform

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{d}	0^{d}	0^{d}	0^{c}	0^{b}	00^{b}
12.5	26.1^{dc}	43.5c	47.8^{c}	2.2^{c}	13.1^{ba}	15.8^{ba}
25	38.2^{c}	50^{c}	70.6^{bc}	19.5^{bc}	27.4^{ba}	45.1^{ba}
50	48.7^{bc}	67.6^{bc}	81.1^{ba}	35.4^{bc}	74.7^{ba}	96.9^{6a}
75	69.2^{ba}	87.2^{ba}	89.7^{ba}	85.4^{ba}	100^{a}	100^{a}
100	82.1^{a}	97.4^{a}	100^{a}	94.9^{a}	100^{a}	100^{a}

In (Table 2) When *E. Kuehniella* larvae exposed to polyethelene with more thickness treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 9.7% and 19.4% at 24 and 72h at concentration 12.5% respectively and increased at the concentration 100% to be 100 % for both 24 and 72h respectively.

Statistical analysis showed significant difference between control and all concentrations except the concentration 12.5 and 25% at 24h and 12.5% at 72h

In the other hand when *S. oryzae* weevils exposed to polyethelene with more thickness treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 1.4 % and 2.9 % at 24 and 72h respectively and increased at the concentration 100% to be 98.26 and 100% at 24 and 72h respectively.

Statistical analysis showed significant difference between control and all concentrations except the concentration 12.5 and 25% at both 24h and 72h

Table (2): Percent Mortality of *E. kuehniella* larvae and *S. oryzae* weevils after exposing to thick polyethelene treated with different concentrations of Fennel oil diluted by chloroform

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{c}	0^{d}	0^{c}	0^{d}	0^{b}	0^{b}
12.5	9.7^{c}	19.4^{dc}	19.4^{dc}	1.4^{d}	2.2^{b}	2.9^{b}
25	19.4^{c}	25.8^{c}	35.5^{b}	15^{cd}	23^{b}	31^{b}
50	48.4^{b}	67.7^{b}	83.9^{a}	41.9^{cb}	65.1^{a}	72.1^{a}
75	76.7^{a}	86.7^{bc}	90^{a}	48.8^{b}	67.5^{a}	83.8^{a}
100	100^{a}	100^{-a}	100^{a}	98.26^{a}	100^{a}	100^{a}

In (Table 3) When*E. kuehniella*larvae exposed to thin polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 20.5% and 43.6% respectively and increased at the concentration 100% to be

82.4 % and 100% for 24 and 72h respectively. Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h while at 48h and 72h significant difference was found between control and concentrations 50, 75 and 100%

In the other hand when *S. oryzae* weevils exposed to thin polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both the concentration and time of exposure from 24 to 48 and 72 hours being 6.1% and 48.1% at 24 and 72h respectively and increased at the concentration 100% to be 87.3and 100% for at 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h while at 72h significant difference was found between control and all concentrations while no significant difference found between different concentrations.

Table (3): Percent Mortality of *E. kuehniella* larvae and *S. oryzae* weevils after exposing to thin polyethelene treated with different concentrations of Anise oil diluted by chloroform

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{b}	0^{d}	0^{b}	0^{b}	0^{c}	0^{b}
12.5	20.5^{ba}	33.3^{dc}	43.6^{ba}	6.1^{b}	22.4^{bc}	48.1^{a}
25	28.1^{ba}	42.9^{bdc}	59.4^{ba}	12.4^{b}	49.5^{bc}	77.1^{a}
S0	33.3^{ba}	50^{bac}	69.05^{a}	19.9^{b}	74.5^{ba}	83.7^{a}
75	74.2^{a}	87.1^{ba}	100^{a}	87.1^{a}	89.3^{ba}	96.8^{a}
100	82.4^{a}	100^{a}	100^{a}	87.3^{a}	100^{a}	100^{a}

In (Table 4) When *E. kuehniella* larvae exposed to thick polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 0.05% and 10.5% respectively at concentration 12.5% and increased at the concentration 100% to be 86.7% and 100% at 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 50, 75 and 100% at 24h while at 72h significant difference was found between control and all concentrations except 12.5%,

In the other hand when weevils exposed to thin polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using chloroform as a solvent ,the percent mortality was increased by increasing the both concentration and time of exposure from 24 to 48 and 72 hours being 3.9% and 8.7% at 24 and 72h respectively at conc. 12.5% and increased at the concentration 100% to be 100% and 100% for 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h while at 72h significant difference was found between control and all concentrations except 12.5 and 25%

Table (4): Percent Mortality of *E .kuehniella* larvae and *S. oryzae* weevils after exposing to thick polyethelene treated with different concentrations of Anise oil diluted by chloroform

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{c}	0^{c}	0^{d}	0^{c}	0^{c}	0^{c}
12.5	0.05^{c}	0.05^{c}	10.5^{dc}	3.9^{c}	6.3^{cb}	8.7^{c}
25	16.7^{c}	27.8^{c}	33.3^{c}	13.1^{c}	21.3^{cb}	31.2^{cb}
50	47.6^{b}	61.9^{b}	76.2^{b}	23.3^{bc}	30.2^{b}	39.6^{b}
75	64^{a}	84^{a}	96^{a}	66.4^{ba}	80.9^{a}	93.6^{a}
100	86.7^{a}	96.7^{a}	$100b^{a}$	100^{a}	100^{a}	100^{a}

Table (5) show that When *E. kuehniella* larvae exposed to thin polyethelene treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 15% and 35% at concentration 12.5% respectively and increased at the concentration 100% to be 81.5 % and 100% for at 24 and 72h respectively .Statistical analysis showed significant difference between control and concentrations50, 75 and 100% at 24h while at 72h significant difference was found between control and all concentrations while no significant difference found between different concentrations except between the dose 12.5 and other doses.

. In the other hand when *S. Oryzae* weevils exposed to to thin polyethelene treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both the concentration and time of exposure from 24 to 48 and 72 hours being 13.4 % and 30.9% at 24 and 72h respectively and increased at the concentration 100% to be 97.95 and 100% for at 24 and 72h respectively. Statistical analysis showed significant difference between control and concentrations 50. 75 and 100% at 24h while at 72h significant difference was found between control and all other concentrations.

Table (5): Percent Mortality of *E. kuehniella* larvae and *S. oryzae* weevils after exposing to thin polyethelene treated with different concentrations of fennel oil diluted by acetone

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{c}	0^{c}	0^{c}	0^{d}	0^{d}	0^{e}
12.5	15^{cb}	25^{bc}	35^{b}	13.4^{d}	20.6^{dc}	30.9^{d}
25	20^{cb}	40^{b}	70^{a}	15.8^{dc}	32.3^{c}	45.7^{cb}
50	42.9^{b}	64.3^{ba}	78.6^{a}	32.03^{c}	64.1^{c}	91.4^{cd}
75	46.2^{b}	65.4^{ba}	80.8^{a}	66.7^{b}	97.4^{b}	100^{b}
100	81.5^{a}	100^{a}	100^{a}	97.95^{a}	100^{a}	100^{a}

Table (6) show that When *E. kuehniella* larvae exposed to thick polyethelene treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 0% and 8.7% respectively and increased at the concentration 100% to be 90.6% and 100% at 24 and 72h respectively

Statistical analysis showed significant difference between control and all concentrations except 12.5% at 24h and at 72h. In the other hand when *S. oryzae* weevils exposed to to thick polyethelene treated with Fennel oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent, the percent mortality was increased by increasing the both concentration and time of exposure from 24 to 48 and 72 hours being 3.6 % and 9.1 % respectively and increased at the concentration 100% to be 100 % and 100% for at 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h and 72h .

Table (6): Percent Mortality of *E .kuehniella* larvae and *S. oryzae* weevils after exposing to thick polyethelene treated with different concentrations of fennel oil diluted by acetone

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{d}	0^{c}	0^{c}	O^{b}	0^{b}	0^{b}
12.5	0^{d}	3.13^{c}	8.7^{c}	3.6^{b}	8.6^{b}	9.1^{b}
25	22.2^{c}	44.4^{b}	47.2^{b}	11.7^{b}	14.9^{b}	22.7^{b}
50	62.5^{b}	78.1^{ba}	78.1^{ba}	22.7^{b}	36.6^{b}	45.9^{b}
75	76.7^{a}	90.0^{a}	90.0^{a}	53.8^{a}	68^{a}	77.8^{a}
100	90.6^{a}	100^{a}	100^{a}	100^{a}	100^{a}	100^{a}

Table (7) show that When *E. kuehniella* larvae exposed to thin polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 6.9% and 31.03% at concentration 12.5% respectively and increased at the concentration 100% to be 82.4 % and 100% at 24 and 72h respectively

Statistical analysis showed significant difference between control and all concentrations except 12.5% at 24h. In the other hand when *S. oryzae* weevils exposed to to thin polyethelene treated with Anise oil at concentrations (0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 4.8% and 28.8% at concentration 12.5% respectively and increased at the concentration 100% to be 96.7 % and 100% at 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h and 50,75 and 100% at 72h .

Table(7) : Percent Mortality of *E .kuehniella* larvae and *S. oryzae* weevils after exposing to thin polyethelene treated with different concentrations of Anise oil diluted by acetone

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{d}	0^{c}	0^{c}	0^{c}	0^{d}	0^{c}
12.5	6.9^{cd}	24.1^{b}	31.03^{b}	4.8^{c}	11.5^{cd}	28.8^{bc}
25	17.7^{cb}	29.4^{b}	41.2^{b}	10.3^{c}	34.5^{bcd}	40.2^{bc}
50	$20c^{b}$	45^{b}	60^{b}	30.8^{cb}	73.1^{bc}	89.9^{ba}
75	65^{a}	95^{a}	100^{a}	65^{b}	78.3^{ba}	100^{ba}
100	82.4^{a}	100^{a}	100^{a}	96.7^{a}	100^{a}	100^{a}

Table (8) show that When *E. kuehniella* larvae exposed to thick polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 14.3% and 38.1% at 24 and 72h at concentration 12.5% respectively and increased at the concentration 100% to be 81.8 % and 100% for at 24 and 72h respectively

Statistical analysis showed significant difference between control and all concentrations. In the other hand when *S. Oryzae* weevils exposed to to thick polyethelene treated with Anise oil at concentrations(0,12.5,25,50,75 and 100%) using acetone as a solvent ,the percent mortality was increased by increasing both concentration and time of exposure from 24 to 48 and 72 hours being 3.9% and 8.7% at at concentration 12.5% at 24 and 72h respectively and increased at the concentration 100% to be 100 % and 100% for at 24 and 72h respectively.

Statistical analysis showed significant difference between control and concentrations 75 and 100% at 24h and between control and 50,75 and 100 at 72h .

Table (8): Percent Mortality of *E. kuehniella* larvae and *S. oryzae* weevils after exposing to thick polyethelene treated with different concentrations of Anise oil diluted by acetone

	%Mortality of *E .kuehniella* larvae			Mortality of *S. oryzae* weevils		
	24h	48h	72h	24h	48h	72h
0	0^{f}	0^{d}	0^{d}	0^{c}	0^{c}	0^{c}
12.5	14.3^{e}	19.1^{c}	38.1^{c}	3.9^{c}	6.3^{cb}	8.7^{c}
25	36.99^{d}	57.5^{b}	57.5^{b}	13.1^{c}	21.3^{cb}	31.2^{cb}
50	50^{c}	62.5^{b}	70.8^{b}	23.3^{bc}	30.2^{b}	39.6^{b}
75	57.7^{b}	76.9^{a}	88.5^{a}	66.4^{ba}	80.9^{a}	93.6^{a}
100	81.8^{a}	90.9^{a}	100^{a}	100^{a}	100^{a}	100^{a}

Table 9 show that Lc_{50} of *E. kuehniella* larvae exposed to thin or thick polyethelene treated with fennel oil dissolved in chloroform or acetonewas less than that of *S. oryzae* adultsexcept when thin polyethelenetreated withfennel oil dissolved inacetone,alsoLc_{50} of *E. kuehniella* larvae exposed to thin or thick polyethelene treated with Anise oil dissolved in chloroform or acetone solvent was less than that of *S. oryzae* adults in case of chloroform and acetone in thick polyethelene while LC_{50} of *E. kuehniella* larvae exposed to thin polyethelene treated with anise oil dissolved in acetone was more than that of *S. oryzae* adults .

Table (9): LC_{50} of *E .kuehniella* larvae and *S. oryzae* weevils after exposing to thin or thick polyethelene treated with different concentrations of fennel oil or Anise oil diluted by chloroform or acetone

Type of packaging	LC_{50}							
	E. kuhniella				*S. oryzae*			
	Fennel oil		Anise oil		Fennel oil		Anise oil	
	chloroform	acetone	chloroform	acetone	chloroform	acetone	chloroform	acetone
Thin polyethelene	36.8679	57.4507	45.0327	59.5251	46.5092	48.0585	52.2421	53.7837
Thick polyethelene	41.5482	43.6556	52.6743	44.7329	57.8655	58.5315	53.8804	53.8804

DISCUSSION

Our study showed that the percent mortality was increased by increasing both concentration of the oil and time of exposure from 24 to 48 and 72 hours in all treatments this agree with that obtained by Rizk (1998) stated that ethanol extract of *Thevatia nerifolia* has contact toxicity to *Corcyra cephalonica* larvae and the mortality was directly proportional to the level of concentration and to time of treatment Zewar (1987) mentioned that, some plant oils (castor, olive, paraffin and maize) are efficient against adults of cowpea seed beetle *Callosobruchus maculatus*. When exposing adult insects to higher concentration (12ml/kg seeds) caused 100% mortality after two days of exposure to the treated grains of castor and paraffin oils, whereas in the case of maize oil caused 90% mortality at the same concentration. Dey and Sarup (1993) investigated the effect of eight different vegetable oils viz; mustard, soybean, coconut, neem, groundnut, cotton seed, sesame and castor against to 7 days old adults of *Sitophilus oryzae* which infested three maize varieties. The highest percent mortality of *Sitophilus oryzae* adults, recorded after one day from treatment grains with oils. Khanam *et al.* (2005) tested toxicity of 7 plant extracts against the adults of *Sitophilus oryzae* and found that all the extracts were toxic to this beetle Mikhaiel and Rizk (2008) studied the efficiency of certain plant oils (Soybean, Peppermint and Cotton seed) and gamma radiation as protectants of dried fruits (Figs, Raisins and Dates) against the Indian meal moth. *Plodia interpunctella* and Saw toothed grain beetle (*Oryzaephilus surinamensis)* and found that all treatments caused high mortality within one week of exposure and prevented the infestation of dried fruits and Ebadollahi *et al*. (2010) found that the essential oil isolated from aerial parts of *A. foeniculum* by Clevenger apparatus was analyzed by gas chromatography mass spectrometry. Methyl chavicol was main component of oil. Insecticidal activity of this essential oil was evaluated by fumigation method against *E. kuehniella*and *P. interpunctella*. Mortality was recorded daily for four days after treatment. *P. interpunctella* (LC_{50} = 16.535 µlL-1) was more susceptible than *E. kuehniella*(LD_{50} = 23.075 µlL-1) at 24 h after treatment. In general, mortality, increased as the doses of essential oil and exposure period increased. These results showed that the *A. foeniculum* oil could be used in grain storage in order to decrease detrimental effects and risk of utilization synthetic insecticides.

Also chloroform was more effective as a solvent this agree with that obtained by McMillian

et al, (1969) investigated chloroform extract from leaves of chinaberry tree *Melia azedarach L.* against larvae of both corn cut worm *Heliothis zea* and fall army worm *Spodoptera frugiperda* yielded substance that caused their mortality. Also Lc_{50} *of E. kuehniella* larvae and *S. oryzae* adults exposed to polyethelene treated with fennel oil or anise oil most cases fennel oil was more effective than anise oil this was in harmony with that obtained by Ali *et al*, (1983) tested a number of plant oils (Neem oil, *Melia azaderach*; Coconut oil, *Cocos nucifera*; Turnip oil *Brassica sp.;* Sesame oil, *Sesanum indicum* and Palm oil, *Elaeis guineensis*) on adults of the cowpea seed beetles breading on chickpea plant which were used at concentrations 0.05 and 1ml/100 gm seeds. They found that both neem and coconut oils caused high rates of mortality could reach 100% after three days from the treatment at 1ml/100 gm seeds .Olotuah (2014) stated that some plant oils, Palm kernel, Coconut and Eucalyptus, was evaluated against rice weevils *S. oryzae* in a local variety of rice "Ofada". The trial involved exposing adult rice weevils *S. oryzae* to various levels of concentration of oils. The ability of the plants oils to protect rice grains was assessed in terms of mortality rates after 5, 10 and 15 minutes of post treatments.. In handling of the extracts, there was no phytochemical effect on human. Essential oil of Eucalyptus camaldulensis was the most effective, with the fastest insecticidal effect. In this study, it was affirmed that the use of plant oils can serve as alternative biopesticide to synthetic insecticides. El-lakwah *et al*. 2004) assayed plant extracts activity of acetone and petroleum ether of Poinciana seeds *Delonix regia*, *Cinnamomum zeylanicum*, cloves flowering buds *Syzygium aromaticum*, mustard seeds *Brassica alba* and radish seeds *Raphanus sativus* against three insect species infesting stored maize grains, *Sitophilus oryzae*, *Tribolium castaneum* and *Rhyzopertha dominica*. The adults of *T.castaneum* were the least susceptible to the various tested plant extracts, followed by *R.dominica*and *S. oryzae*adults, which were the most sensitive Lc_{50} of *E. kuehniella* larvae exposed to thin polyethelene treated with fennel oil or anise oil dissolved in acetone was less than that of *S. oryzae* adults while when exposed to thick polyethelene it was less than that of *S. oryzae* adults the current results are found to be in harmony with that obtained by El-lakwah *et al.* (2004) assayed plant extracts activity of acetone and petroleum ether of Poinciana seeds *Delonix regia*, *Cinnamomum zeylanicum*, cloves flowering buds *Syzygium aromaticum*, mustard seeds *Brassica alba* and radish seeds *Raphanus sativus* against three insect species infesting stored maize grains, *Sitophilus oryzae*, *Tribolium castaneum* and *Rhyzopertha dominica*. The adults of *T. castaneum* were the least susceptible to the various tested plant extracts, followed by *R. dominica* and *S. oryzae* adults, which were the most sensitive.

Also the different packaging thickness affect the mortality of the two insects these in harmony with that obtained by Hamad (2011) who stated that the data obtained in tables indicated that polypropylene packaging treated with different concentrations of plant extracts were more effective on *Oryzaephilus surinamens* than treated jute packaging in some solvent. At polypropylene packaging the acetone extract was active than petroleum ether followed by chlorophorm then ethyl alcohol while at jute packaging the petroleum ether extract was active than ethyl alcohol followed by chlorophorm finally acetone.

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ARABIC SUMMARY

حماية الحبوب المخزونه من الأصابه بالحشرات وذلك بمعاملة المواد المغلفة بكل من زيت الشمر وزيت اليانسون

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تم استخدام كل من زيت الينسون وزيت الشمر لحماية الحبوب المخزونه من الأصابه بسوسة الأرز ويرقات فراشة دقيق البحر الأبيض المتوسط وذلك بمعاملة المواد المغلفة من البلاستيك بسمكين مختلفين بواسطة التركيزات 100و75و50و25و12.5% وذلك باستخدام كل من الأسيتون والكلوروفورم كمذيبات ومن النتائج تلاحظ ان نسبة موت الحشرات تزداد بزيادة تركيز الزيت وكذلك بزيادة فترة التعرض للزيت من 24 الى 48 ثم 72 ساعة وفى اغلب المعاملات كان التركيزا لذى يقتل 50% من سوسة الأرزاعلى من التركيزا لذى يقتل 50% فى حالة يرقات فراشة دقيق البحر الأبيض المتوسط وكان زيت الشمر اكثر سمية من زيت الينسون والكلوروفورم كان المذيب الاكثر فاعليه مقارنة بالأسيتون .