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Effect of Some Essential Oils on American Cockroach *Periplaneta Americana* L

Sawsan Ahmed Al-Hadithi[1], Nidaa Saua Al Shammari[2], Miqdad Ali Abdullah[3*]

Abstract

Essential oils were extracted from *Syzqiumoramac* clove, *Nigella sativa* and eucalyptus oil for purpose of studying effect of these oils on adult cockroaches as repellents and extent of their attraction to them by treating biscuits with three concentrations (0.5, 0.25,1%). The results showed that clove oil was significantly more repellent than black seed oil at a concentration (1%), as average for five days was (0.32) compared to black seed oil (1.36). Insects attracted towards lunch averaged 7.58, 14 and this indicates fading of repellent effect due to penetration of the aroma of volatile clove oil. Results also showed that clove oil has a more lethal effect by direct spraying on nymphs and adults than black seed oil, as mortality in a specific time period of death for adults was 11.93 and nymphs 6.57, compared to black seed oil, the death rate of adults was 6.66, while for nymphs it was 3.46, which leads to the consideration of oil Clove oil has a more repellent and deadly effect than black seed oil.

Key Words: Essential Oils, American Cockroach, *Periplaneta Americana* L.

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Introduction

American Cockroach *P. americana* belongs to the order Dictyoptera, family of cockroaches Blattidae, A widespread insect of medical and economic importance, as it is an effective mechanical vector for many pathogens. Six allergens transmitted by the American cockroach have been recorded and diagnosed. (Pumhirun, 1997: Gore and Schal, 2007; Rust, 2008). In urban areas of Thailand, asthma, allergic rhinitis and eczema (skin disease) are common diseases among children caused by species of cockroach (Vichayanond et al., 1998).

At least 22 species of human pathogenic bacteria, viruses, fungi, protozoa and nematodes have been isolated from different cockroach species (Rust et al., 1991), More than 40% of children with asthma have been allergic to allergens caused by cockroaches as shown by skin prick tests (Kongpanichkul et al., 1997). The American cockroach is prevalent among types of cockroaches in residential buildings, and its main presence is in sewage areas (Lee and Lee 2000; Tee et al., 2011), And measures to control American cockroach include use of manufactured chemical pesticides, which are effective in reducing the insect population, but may be harmful to humans and beneficial organisms and may cause environmental risks, in addition to possibility of resistance to it, and most pesticides are insect repellent, which may cause its distance and avoidance of pesticide, Therefore, most of traditional pesticides can be replaced with botanical pesticides, which are characterized by their limited side effects to the environment, beneficial organisms and less dangerous pesticides (Wooster et al., 1989).

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Use of botanical pesticides has become common in pest control (Coats, 1994), so study aimed to evaluate the effect of some Essential oils on American cockroach by testing their effectiveness in mortality adults and nymphs by direct exposure and treating food with oils and knowing their repellent and fatal effect on adults and nymphs.

Materials and Methods

Nymphs and adults of American cockroach were collected from one of areas of Baghdad by placing a glass bottle containing some biscuits in sewers so that insects are attracted to them. Insect was reared in biological control laboratory of College of Agricultural Engineering Sciences / University of Baghdad in cages with dimensions of 27 x 27 x 27 cm. These cages were placed in incubator at a temperature of 25 ± 2. Dried carnation flowers and black seed seeds were brought from local market and ground separately to prepare them for extraction, which was carried out in Medicinal Plants Unit at College of Agricultural Engineering Sciences / University of Baghdad by extracting fixed oil from the seeds of black seed using a continuous extraction device (soxhlet), The volatile oil is extracted from cloves using a Clevenger device. And eucalyptus oil in the same way as before.

Concentrations (5, 10 and 15%) for each oil were prepared by taking 0.5 g of oil resulting from extraction process and adding to 9.5 ml of acetone, so concentration becomes 5%, and 1 g of oil is taken and added to 9 ml of acetone, so concentration becomes 10% and then 1.5 is taken A g of extracted oil is added to 8.5 ml of acetone, so concentration becomes 15%. This dilution method is applied to all oils used in the study.

The effectiveness of oils was tested in mortality, adults and nymphs of American cockroach by direct exposure, as 10 individuals (nymphs and adults of American cockroach) were collected separately and placed in a plastic box and then sprayed with oils at a rate of 2 ml of oil for each replicate and three replicates for each treatment, then food (pieces of biscuits) in the box, then cover opening of box with cloth and tie cloth with a rubber band, then monitor insects to see effect of oils on insects. The food (biscuits pieces) were treated with oils, and repellent and fatal effect was determined for adults and nymphs. Medium-sized biscuit pieces were taken and sprayed with duplicates for all three concentrations of oils and placed in them before treatment, then placed in the olfactory system with four sides and sprayed with different concentrations of oils used in the study at a rate of 3 ml for each then insects (nymphs and adults each separately) are released in middle of olfactory system, then, percentage of expulsion and the fatal effect of the oils is calculated.

Results and Discussion

Effect of Essential Oils on Cockroach Nymphs by Direct Spraying Method

It is clear from Table No. (1) that the highest mortality rate of nymphs resulting from clove oil for a concentration of 1% was 12.45%, after that concentration was 0.5, as it reached 4.16%, higher than concentration of 0.25, as the mortality was 3.12%, which gives clove oil a repellent effect, but at two concentrations 0.5 and 0.25 have an effect of 0% after 90 minutes and 120 minutes, As for black seed oil, mortality increased with increasing concentration and its effect decreased over time. At concentration 0.25, mortality reached 8.33 within 30 minutes after that, mortality became 0, which indicates fading of effect of black seed oil, and concentration 0.5 gave an effect He fought until 60th minute, with a mortality of 8.33% and 4.16%, after which effect faded by 0% for the 90th and 120th minutes. As for concentration (1%) it gave mortality that extended until 90th minute, reaching 4.16, 4.16, and 12.50%, but at 120th minute it reached ratio is 0%. As for eucalyptus oil, mortality rate, during time for concentrations of 0.25%, 0.5% and 1%, amounted to 0.33, 0.33 and 1.41, respectively, it was decreasing with progression of time, its rate reached 1.55, 0.44, 0.33 and 0.33 for times 30, 60, 90 and 120 minutes, which indicates It was least effective among oils.

Table 1. The effect of Essential oils on mortality of cricket nymphs by direct spraying

Treat.	Con%	% mortality rate in fourth instar nymphs/time				
		30 m	60 m	90m	120 m	Average
Clove oil	0.25	4.16	8.33	0	0	3.12
	0.5	12.50	4.16	0	0	4.16
	1%	8.33	24.83	12.50	4.16	12.45
	Average	8.33	12.44	4.16	1.38	6.57
black seed oil	0.25	8.33	0	0	0	2.08
	0.5	8.33	4.16	0	0	3.12
	1%	4.16	4.16	12.50	0	5.20
	Average	6.94	2.77	4.16	0	3.46
eucalyptus oil	0.25	1.00	0.33	1.00	0.33	0.33
	0.5	1.00	0.33	0	0	0.33
	1%	2.66	0.66	0	0.66	1.41
	Average	1.55	0.44	0.33	0.33	0.69

The Effect of Oils on the Death of Adults of the American Cockroach by Direct Spraying Method

The results of Table (2) show the highest mortality rate by effect of clove oil over time, which was 10.83, 13.32 and 19.14% for concentrations of 0.25, 0.5 and 1%, respectively. The oil with its strong smell has an effect on mortality of insect, greater concentration to which insect is exposed. Mortality rate by effect of time factor was 21.11, 11.1, 8.85 and 6.66% within 30, 60, 90 and 120 minutes, which indicates that effect of oil decreases over time. As for black seed oil, mortality was 2.5, 7.49 and 9.99% for concentrations of 0.25, 0.5 and 1%, respectively, and mortality rate with effect of time was 11.11, 3.33, 11.1 and 1.11% during 30, 60, 90 and 120 minutes. As for eucalyptus oil, its percentage was volatile and it reached 0.66, 0.33 and 0.99% for concentrations of 0.25, 0.5 and 1%, and percentages with effect of time were 1.55, 0.44, 0.33 and 0.33 within 30, 60, 90 and 120 minutes, which means that it is least oil Influence on adults of American cockroach.

Table 2. Effect of Essential oils on the death of adult cockroaches by direct spraying method

Treat.	**Con%**	**% mortality rate in fourth instar nymphs/time**				
		30 m	**60 m**	**90m**	**120 m**	Average
Clove oil	0.25	30	0	6.66	6.66	10.83
	0.5	30	13.3	3.3	6.66	13.32
	1%	3.33	20	16.6	6.66	19.14
	Average	21.11	11.1	8.85	6.66	11.93
black seed oil	0.25	10	0	0	0	2.5
	0.5	3.33	3.33	23.3	0	7.49
	1%	20	6.66	10	3.33	9.99
	Average	11.11	3.33	11.1	1.11	6.66
eucalyptus oil	0.25	1.00	0.33	1.00	0.33	0.66
	0.5	1.00	0.33	0	0	0.33
	1%	2.66	0.66	0	0.66	0.99
	Average	1.55	0.44	0.33	0.33	0.66

The Repellent and Attractive Effect of Clove Oil and Black Seed Oil on Adult Cockroaches by Food Treatment Method

The results in Table (3) showed that treatment of lunch (biscuits pieces) with clove oil had a repellent effect by % at a concentration of 1%, as numbers that were attracted to it were (0). This effect starts to fade and the attracted insects decrease at a rate of (1.6) This effect may be attributed to reduction of effect of active substances present in the oil as a result of either their volatilization, lack of concentration reaching below surface exposed to biscuit pieces, which leads to a reduction in their efficiency. The effect of repellent oil was also observed, but less at a concentration of (0.5) compared to a concentration of (0.25) on the rate of insect attraction at a rate of (2.6) on the first day compared to a concentration of (0.25) so that number of attracted insects reached (18), which leads to no contact between extract and body of insect. Insect and showing effect and low oil concentration, leading to a lack of volatile repellents.

When comparing clove oil with black seed oil, black seed oil had little repellent effect on insects, and its effectiveness differed according to the concentration. When concentration was 1%, the rate of insects on the first day was (0.6), and this can be considered a repellent, but effect also faded after the fifth day of treatment. Insect attraction increased after a week at a rate of (3.3) and there was a significant and significant difference with a concentration of (0.5%). The rate of insect attraction was (3.6) less than a concentration of (0.25%). The average after the first day was 9.0, 6.3 and 0.6, respectively.

Table 3. The repellent and attractive effect of clove oil and black seed oil on adult cockroaches by food treatment method

Oils	The rate of insects attracted to lunch by feeding method						
	Conc.	Day 1	Day 3	Day 5	Day 7	Day9	average
Clove oil	0.25	18	11.3	11.3	10	22.6	14.64
	0.5	2.6	1.3	3	10.3	7.3	4.9
	1%	0	0	0	0	1.6	0.32
control		2.6	3.3	2	7.3	7.6	6.3
The effect of time		6.68	4.2	4.7	6.7	10.5	6.68
Black seed oil	0.25	9.0	9.3	11.3	3.3	5	7.58
	0.5	3.6	8.6	7.3	7.6	6.3	6.68
	1%	0.6	0.6	1.3	1	3.3	1.36
control		5.6	3.3	5.3	8.6	6	5.76
The effect of time		4.4	6.1	6.5	3.9	4.8	

(Sharawi et al, 2013) found that clove oil is more effective than rosemary oil, as (Sharawi 2012) indicated in her university thesis that the use of five oils, including clove, rosemary, black seed, sesame and ginger, found that clove oil is more expelling and that black seed oil Not effective on first instar nymphs. Clove oil gave 100% expelling rate on first and fourth instar nymphs when treated 4.8% after 24h. It was proved that ginger oil and black seed oil were not effective on the American cockroach

Periplaneta americana (L.) as mortality rate of clove oil was At a concentration of 1.06 µmol/L. The mortality rate of the phases was 8.20, that the effect of black seed oil increases with increasing concentration and this is in agreement with (Sharififard et al 2016), who used five Essential oils to study their effect on the brown striped cockroach *Supellalongipalpa*, which is rosemary, oregano, yams, eucalyptus and mint, which recorded the highest and lowest repellent effect in oil Oregano and eucalyptus oil, respectively, oregano oil caused an expulsion of 96.5-99.1%.

As for eucalyptus oil, the repellency rate was 27.7-49.8%. This is also what (Manzoor et al 2012) found. It recorded less repellency with eucalyptus oil when used on the American cockroach compared to lemongrass oil, which gave results after 4 hours with lemongrass oil and eucalyptus oil, respectively, 4.8-7.50. It has been proven that eucalyptus oil is less toxic due to the high content of oxides.

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