



Oregano (*Origanum Vulgare*) and Lemongrass (*Cymbopogon Citratus*) Crude Extracts with Virgin Coconut (*Cocos Nucifera*) Oil: Pesticide for American Cockroaches (*Periplaneta Americana*)

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ABSTRACT

This study was conducted to determine the potential of Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) crude extracts with Virgin Coconut (*Cocos nucifera*) Oil as pesticide for American (*Periplaneta americana*) cockroaches. This study used the Completely Randomized Design. This study had four treatments: one (1) control and three (3) experimental. There are four (4) replicates for each treatment and three (3) samples for each replicate amounting to 12 samples per treatment. Treatments were applied directly to the cockroaches by spraying 5 times. After 12 hours of being sprayed by treatments, the dependent variable – mean number of cockroaches died, was measured. Based on the results, treatments 1, 3, and 4 have a mean of 3.00 with a standard deviation of 0.00, while treatment 2 has a mean of 2.75 with a standard deviation of 0.50. It was found out that there is no significant difference among the treatments in terms of the mean number of cockroaches died. Therefore, Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) crude extracts with Virgin Coconut (*Cocos nucifera*) Oil has the potential to be pesticide for cockroaches after 12 hours of being sprayed.

Keywords: Crude Extracts, Pesticide, Completely Randomized Design, Oregano (*Origanum vulgare*), Lemongrass (*Cymbopogon citratus*), Virgin Coconut (*Cocos nucifera*) Oil, American (*Periplaneta americana*) cockroaches

1. Introduction

Cockroaches are insects that serve as disease vectors and sources of bacterial infections found in homes. It spread at least 33 kinds of bacteria, 6 kinds of parasitic worms, and 7 other kinds of human pathogens (Drive-Bye Exterminators, 2018) that are very dangerous to humans. It can spread diseases such as gastroenteritis, dysentery, cholera, and typhoid fever (Garfield Pest Control, 2021). In the Philippines, American cockroaches are commonly found inside and outside homes (Rentokil, 2023). Pesticides are used to kill and protect people from cockroaches. Pesticides are loaded with toxic chemicals, including DDT (Coppock, 2011), which is poisonous and very dangerous to human health. Recently, there have been many reports of allergic and toxic effects from using pesticides. In addition, it causes vomiting, tremors or shakiness, seizures, and diseases in humans (Kabasenche & Skinner, 2014). Lemongrass (*Cymbopogon citratus*) and Oregano (*Origanum vulgare*) are indigenous plants that have been used commonly in the Philippines for their medicinal uses. Oregano is a rich source of vitamin C that helps reduce cough. It also helps fight against some bacteria and viruses to the human health. Lemongrass helps prevent the growth of some bacteria that also helps reduce fever. It provides certain vitamins such as Vitamin A and C that treat stomach-aches, high blood pressure, etc. (RxList, n.d.). These two indigenous plants contain active ingredients and compounds that have the potential to be pesticide. This study aimed to determine the activity of Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) crude extracts with Virgin Coconut (*Cocos nucifera*) Oil on American (*Periplaneta americana*) cockroaches. Furthermore, this study sought to determine the following: mean±SD number of cockroaches died in each of the 4 treatments [Treatment 1 - Commercial pesticide (control); Treatment 2 - 0.6g Oregano Crude Extract (OG) / 5mL Virgin Coconut Oil (CO) + 0.6g Lemongrass Crude Extract (LG) / 5mL Virgin Coconut Oil (CO); Treatment 3 - 0.4g OG / 5mL CO + 0.8g LG / 5mL CO; and Treatment 4 - 0.8g OG / 5mL CO + 0.4g LG / 5mL CO] after 12 hours; and significant difference among the 4 treatments in terms of mean±SD number of cockroaches died. The significance of this study is that it will help family members ensure that it is much safer than chemical pesticides. It can help lessen the number of reports due to the toxic effects of pesticides on humans. This study is only delimited to determine pesticidal activity of oregano and lemongrass crude extract with virgin coconut oil on cockroaches to the four treatments and the mortality of the cockroaches. The researchers acquired the cockroaches wherein characteristics such as the age and sex of the cockroaches are not considered in this study.

2. Methods

This study was conducted at the Biology Laboratory in Don Pablo Lorenzo Memorial High School – Junior High School, Sta. Maria, Zamboanga City, Philippines. The experimental research design was used in this study is Completely Randomized Design (CRD), as shown in Table 1 below. This study has a total of 4 treatments [Treatment 1 - Commercial pesticide (control); Treatment 2 - 0.6 Oregano Crude Extract (OG) / 5mL Virgin Coconut Oil (CO) + 0.6g Lemongrass Crude Extract (LG) / 5mL Virgin Coconut Oil (CO); Treatment 3 - 0.4g OG / 5mL CO + 0.8g LG / 5mL CO; and Treatment 4 - 0.8g OG / 5mL CO + 0.4g LG / 5mL CO]. In each treatment it has 4 replicates, and each replicates have 3 samples of cockroaches. A total of 48 samples of cockroaches were used in this study.

Table 1. Experimental lay-out (CRD) of the randomly selected 48 cockroaches.

T ₂ R ₄ S ₁	T ₂ R ₁ S ₃	T ₂ R ₃ S ₃	T ₃ R ₂ S ₃	T ₂ R ₃ S ₁	T ₄ R ₃ S ₁	T ₁ R ₃ S ₁	T ₃ R ₁ S ₃
T ₄ R ₁ S ₁	T ₃ R ₃ S ₃	T ₁ R ₃ S ₃	T ₁ R ₄ S ₃	T ₄ R ₂ S ₂	T ₄ R ₂ S ₁	T ₂ R ₄ S ₃	T ₄ R ₄ S ₃
T ₃ R ₂ S ₁	T ₄ R ₄ S ₁	T ₁ R ₄ S ₁	T ₃ R ₄ S ₂	T ₂ R ₁ S ₂	T ₃ R ₄ S ₃	T ₁ R ₄ S ₂	T ₃ R ₃ S ₂
T ₁ R ₂ S ₂	T ₃ R ₁ S ₁	T ₄ R ₄ S ₂	T ₄ R ₂ S ₃	T ₁ R ₁ S ₃	T ₂ R ₄ S ₂	T ₃ R ₂ S ₂	T ₁ R ₂ S ₁
T ₃ R ₃ S ₁	T ₄ R ₁ S ₃	T ₂ R ₂ S ₃	T ₁ R ₂ S ₃	T ₄ R ₁ S ₂	T ₂ R ₂ S ₂	T ₁ R ₃ S ₂	T ₄ R ₃ S ₂
T ₂ R ₂ S ₁	T ₃ R ₄ S ₁	T ₁ R ₁ S ₁	T ₄ R ₃ S ₃	T ₂ R ₁ S ₁	T ₁ R ₁ S ₂	T ₂ R ₃ S ₂	T ₃ R ₁ S ₂

Oregano (*Origanum vulgare*) leaves were visually identified and validated, and were collected from a local farm in Pasonanca, Zamboanga City, Philippines. Proper protocols for collecting oregano were followed. One sack of oregano was collected. The collected oreganos were then washed three times and placed in a container. Afterwards, oregano was sliced into pieces using a knife and chopping board. Sliced oregano was placed in an empty container and labelled “OG”. Lemongrass (*Cymbopogon citratus*) leaves were visually identified and validated, were collected from a local market in Sta. Maria, Zamboanga City, Philippines. Lemongrass leaves were washed three times in running water and placed in a container. Afterwards, it was sliced into pieces using a knife and chopping board. Sliced lemongrass was placed in an empty container and labelled “LG”. Commercially available Virgin Coconut Oil, labelled as “CO”, as well as commercial pesticide were secured from a local market in Sta. Maria, Zamboanga City, Philippines. Four (4) 120 mL empty spray bottles were bought at local store in Sta. Maria, Zamboanga City, Philippines. Afterwards, it was washed with running tap water and air-dried. Sixty (60) small round containers, specifically 250 ml, were used in this study. It was bought at local store in Sta. Maria, Zamboanga City, Philippines. All the small, round containers were washed with running tap water and air-dried. Afterwards, ten (10) holes were pricked using a nail heated by fire on the sides and the lid of each container. Household cockroaches, identified and validated as American (*Periplaneta americana*) cockroaches, were used in this study. Cockroaches were collected at Veterans Avenue, Zamboanga City. Each cockroach that was collected was placed in a small, round container. This study employed the simple random sampling, specifically the use of the lottery method to randomly select 48 cockroaches from the population. Each cockroach was placed in a 250 ml round container.

The treatments were prepared as follows: for treatment 1, commercial liquid pesticide was transferred to the empty spray bottle and labeled as “T₁”; for treatment 2, 36 grams of OG and LG was measured using a weighing scale, and 120 mL of coconut oil was measured using a measuring cup. Afterwards, the 120 mL of coconut oil was transferred to the pot. The 120 mL of coconut oil was stirred with a spoon for 30 seconds. Afterwards, the 36 grams of sliced OG and LG were placed in the pot. It was then stirred for 30 minutes using a spoon. After that, it was filtered using a muslin cloth and a funnel, placed on the opening of the spray bottle. It was filtered alone for 4 hours. Afterwards, it was set aside and labeled “T₂”; for treatment 3, 48 g of OG and 24 g of LG was measured using a triple beam, and 120 mL of coconut oil was measured using a measuring cup. Afterwards, the 120 mL of coconut oil was transferred to the pot. The 120 mL of coconut oil was stirred using a spoon for 30 seconds. Afterwards, the 48 g of OG and 24 g of LG were placed into the pot. It was then stirred for 30 minutes using a spoon. After that, it was filtered using a muslin cloth and a funnel, placed on the opening of the spray bottle. It was filtered alone for 4 hours. Afterwards, it was set aside and labeled “T₃”; and for treatment 4, 24 g of OG and 48 g of LG was measured using a triple beam, and 120 mL of coconut oil was measured using a measuring cup. Afterwards, the 120 mL of coconut oil was transferred to the pot. The 120 mL of coconut oil was stirred using a spoon for 30 seconds. Afterwards, the 24 g of OG and 48 g of LG were placed into the pot. It was then stirred for 30 minutes using a spoon. After that, it was filtered using a muslin cloth and a funnel, placed on the opening of the spray bottle. It was filtered alone for 4 hours. Afterwards, it was set aside and labeled “T₄”.

Using the spray bottles, treatments were applied through spraying the samples 5 times. After 12 hours, the researchers measured the dependent variable – number of cockroaches died, based on absence of motion for at least 1 hour. The data collected was subjected to data analysis. The researchers made use of the statistical analysis software – IBM Statistical Package for Social Sciences (SPSS) version 25. The following were the statistical tools used for analysis: Mean±SD, and One-way Analysis of Variance (ANOVA) at 0.05 level of significance and 95% confidence interval.

All the solid waste materials that were used in the experiment were gathered, separated, and disposed properly in the trash bin by the researchers. The liquid wastes were thrown at the sewages, following the Philippine Law on Ecological Solid Waste Management Act of 2000 (RA 9008).

3. Results and Discussion

Objective 1. Mean±SD number of cockroaches died in each of the 4 treatments [Treatment 1 - Commercial pesticide (control); Treatment 2 - 0.6 Oregano Crude Extract (OG) / 5mL Virgin Coconut Oil (CO) + 0.6g Lemongrass Crude Extract (LG) / 5mL Virgin Coconut Oil (CO); Treatment 3 - 0.4g OG / 5mL CO + 0.8g LG / 5mL CO; and Treatment 4 - 0.8g OG / 5mL CO + 0.4g LG / 5mL CO] after 12 hours.

Table 2. Mean±SD number of cockroaches died in each of the 4 treatments.

Treatment	n	Mean ± SD
1 (Control)	12	3.00 ± 0.00
2 (0.6g OG / 5mL CO + 0.6g LG / 5mL CO)	12	2.75 ± 0.50
3 (0.4g OG / 5mL CO + 0.8g LG / 5mL CO)	12	3.00 ± 0.00
4 (0.8g OG / 5mL CO + 0.4g LG / 5mL CO)	12	3.00 ± 0.00
Total:	48	

The table 2 shows the mean number of cockroaches died after 12 hours in each of the four treatments. Based on the results, treatment 2 has the lowest mean number of cockroaches died ($M = 2.75$, $SD = 0.50$), while treatments 1, 3 and 4 has the highest mean number of cockroaches died ($M = 3.00$, $SD = 0.00$).

Objective 2. Significant difference among the 4 treatments in terms of mean±SD number of cockroaches died.

Table 3. Determining significant differences among treatments using One-way Analysis of Variance (ANOVA).

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.188	3	.063	1.000	.426*
Within Groups	.750	12	.063		
Total	.938	15			

* $p - value = 0.426 > \alpha = 0.05$; statistically insignificant

In Table 3, since $p - value = 0.426 > \alpha = 0.05$, then null hypothesis is accepted. Thus, there is no significant difference among the four treatments in terms of the number of cockroaches died.

In this study, Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) crude extracts with Virgin Coconut (*Cocos nucifera*) Oil was used as pesticide for American (*Periplaneta americana*) cockroaches. A total of four (4) treatments with 12 samples each were used in this study. Treatments 1, 3 and 4 have a mean of 3.00 while treatment 2 has a mean of 2.75. Based on the results, treatment 2 (0.4g OG / 5mL CO + 0.8g LG / 5mL CO) has the lowest mean number of cockroaches died, which is 2.75, while treatments 1 (control), 3 (0.4g OG / 5mL CO + 0.8g LG / 5mL CO), and 4 (0.8g OG / 5mL CO + 0.4g LG / 5mL CO) have the highest mean number of cockroaches died, which is 3.00. Oregano (*Origanum vulgare*) contains carvacrol (Bayir, Kiziltan, & Kocyigit, 2019) which is a natural compound that has been found to have insecticidal properties. Carvacrol has high antioxidant activity causing paralysis and ultimately death to insects, including cockroaches. It also contains thymol, a natural compound which has also insecticidal properties (Borgarello, Mezza, Pramparo, & Gayol, 2015). Lemongrass (*Cymbopogon citratus*) contains several chemical compounds that have insecticidal properties, including citral and geraniol (Mukarram, et al., 2022). It also contains limonene (National Horticulture Board, n.d.) which is a natural compound that could kill cockroach due to its distinctive aroma. Virgin coconut (*Cocos nucifera*) oil contains a high content of fatty acids (JayLea, 2023) that can suffocate pests including cockroaches. The use of Oregano (*Origanum vulgare*) as pesticide for American (*Periplaneta americana*) cockroaches have been always recommended because of the compounds it contains that is enough to kill American (*Periplaneta americana*) cockroaches. Carvacrol at high concentration kills insects including American (*Periplaneta americana*) cockroaches by disrupting the cell membrane and leads to its death (Phillips, 2009) and thymol affects the nervous system and reduces its mobility. The strong aroma of Oregano (*Origanum vulgare*) oil also affects American (*Periplaneta americana*) cockroaches (DeAngelis, 2023) that can also lead to death. Including the citrusy scent of Lemongrass (*Cymbopogon citratus*), it acts as a pesticide to American (*Periplaneta americana*) cockroaches. Lemongrass (*Cymbopogon citratus*) is effective in exterminating the American (*Periplaneta americana*) cockroaches (Darvin, 2019). Citral, geraniol, and limonene are natural compounds that can kill American (*Periplaneta americana*) cockroaches. These three compounds have a distinctive aroma (Avoseh, Oyedeji, Rungqu, Nkeh-Chungag, & Oyedeji, 2015) that affects the behaviour of the American (*Periplaneta americana*) cockroaches and leads to death. Also, Virgin coconut (*Cocos nucifera*) oil comprises fatty acids that can kill American (*Periplaneta americana*) cockroaches by disrupting the cell membranes of American (*Periplaneta americana*) cockroaches. This causes the cells to collapse, and it destroys respiratory function that results in death of an insect (Cloyd, 2020). In addition, Virgin coconut (*Cocos nucifera*) oil does not evaporate easily that can easily suffocate insects, including American (*Periplaneta americana*) cockroaches, and may lead to their demise. When subjected to statistics analysis using One-Way Analysis of Variance at 0.05 level of significance and 95% confidence interval, it was found out that the experimental treatments specifically treatments 2, 3 and 4 has no significant difference on the mean number of cockroaches died compared to the commercial pesticide. Meaning, the treatments performed significantly same with the commercial pesticide. It was also found out that treatments 3 and 4 have the highest mean ± SD of 3.00 ± 0.00. This signifies that among all the treatments 3 and 4 performs the best similarly with the commercial pesticide.

4. Conclusions and Recommendations

Based on the gathered data and upon its analysis, Treatments 1, 3 and 4 have the highest mean \pm SD (3.00 ± 0.00) of the mean number of cockroaches died. Treatments 1, 3 and 4 performed the best in terms of the number of cockroaches died. Therefore, Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) crude extracts with Virgin Coconut (*Cocos nucifera*) Oil has the potential to be pesticide for American (*Periplaneta americana*) cockroaches after 12 hours of being sprayed. Based on the conclusions of the study, it is recommended to: conduct further studies on the use of Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) various extracts with Virgin Coconut (*Cocos nucifera*) Oil as pesticide for American (*Periplaneta americana*) cockroaches and other species of cockroaches; it is further recommended that there should be similar studies on larger samples to further assess the potential of Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) various extracts with Virgin Coconut (*Cocos nucifera*) Oil as a pesticide; and determine the mode of action of the pesticidal activity of the synergy of Oregano (*Origanum vulgare*) and Lemongrass (*Cymbopogon citratus*) various extracts with Virgin Coconut (*Cocos nucifera*) Oil.

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