



Citronella (*Cymbopogon Nardus*) and Peppermint (*Mentha x Piperita*) Oil Extracts as Ant-Repelling Spray

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ABSTRACT

Our goal was to make a repellent that is not cost-effective and safe. To mitigate the negative effects of using commercialized ant repellents, we developed a non-toxic ant repellent using Citronella (*Cymbopogon Nardus*) and Peppermint (*Mentha x Piperita*) Oil Extracts that are of high quality and assured to be safe. To achieve the results, 20 ants per treatment per replication were used and placed inside the container. We also placed a bait and applied the spray to its surroundings. The ants' activity was observed every 30 minutes until one entered the bait. Their repellence activity and effectiveness were acquired through the mean percentage according to the number of ants it has repelled. ANOVA was used to validate the significant difference between the Experimental and Control Groups. The findings presented that after the 6-hour observation, the Experimental Treatments had an overall mean of 15, 70.01% - 85.00% $\equiv$ Quite Effective, which means it produces and works well according to the intended product. Moreover, the ANOVA showed that the F-computed value of 70.95 > the F-tabulated value of 3.48 at a 0.05 significance level, showing a significant difference between the tested Experimental and Control Groups. The mixture of Citronella and Peppermint Oil Extracts can be a natural substitute for ant repellents.

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1. INTRODUCTION

Ants are colonial social ants. The majority of them consume food containing sugar and carbohydrates. Ants may be incredibly tenacious as they pose a hazard to the quality and quantity of food and human health (Janzen, 1966). Yet people don't exactly know how to get rid of these insects. The majority of popular insect-repellent plants are non-native to the Philippines, and when propagated for commercial purposes, they might represent an ecological concern (Faria et al., 2021).

Its useful indigenous knowledge includes a lot of information on native plants. Insect-repellent plants from the Fabaceae family, such as the hybrid plant citronella (*Cymbopogon nardus*) and peppermint (*Mentha x Piperita*), have a long history of usage for personal protection against biting insects (Debboun & Strickman, 2013).

Controlling and removing these insects is difficult due to their small size and the wide variety of biology, behaviors, and general characteristics across species. To get rid of ants, people ought to buy commercialized products. The dangers of exposure to pesticides are of increasing concern as they pose a threat to human health.

It is for this reason that using alternatives such as plant-based ant repellents are advertised. Hence, we conducted the study using Citronella (*Cymbopogon nardus*) and Peppermint (*Mentha x Piperita*) oil extracts an ant-repellent spray.

2. METHODS

This research study made use of a quantitative research design. A quantitative research design entails gathering and analyzing numerical data. With specificity, for the study to collect and gather data by conducting experiments, a true-experimental research design was also used. It aims to control or manipulate an independent variable to measure its effect on a dependent variable which we normally design. It systematically examines whether there is a cause-and-effect relationship between variables (Schneck et al., 2021).

2.1. Materials

The foremost materials used in this study were divided into two. One includes the plant materials which consist of Citronella and Peppermint plants. Another is the materials used for extraction. The essentials are Slow-Cooker or Crock-Pot; Water; a Container on where the experiment was observed, a timer, and the food as bait.

2.2. Experimental design and treatment

As this study focused on the effectiveness of the Citronella and Peppermint Oil Extract as an organic ant repellent, this study also utilized the two-group design as shown in **Figure 1**. It is a process in which the ants will be treated in two (2) ways; two (2) control groups that did not receive the treatment, and three (3) that received the treatments that contain intervention.

The variables are separated and marked as Treatment 1, Treatment 2, Treatment 3, Control Group 1, and Control Group 2. Each treatment was replicated thrice to ensure its effectiveness which varied on the number of ants repelled.

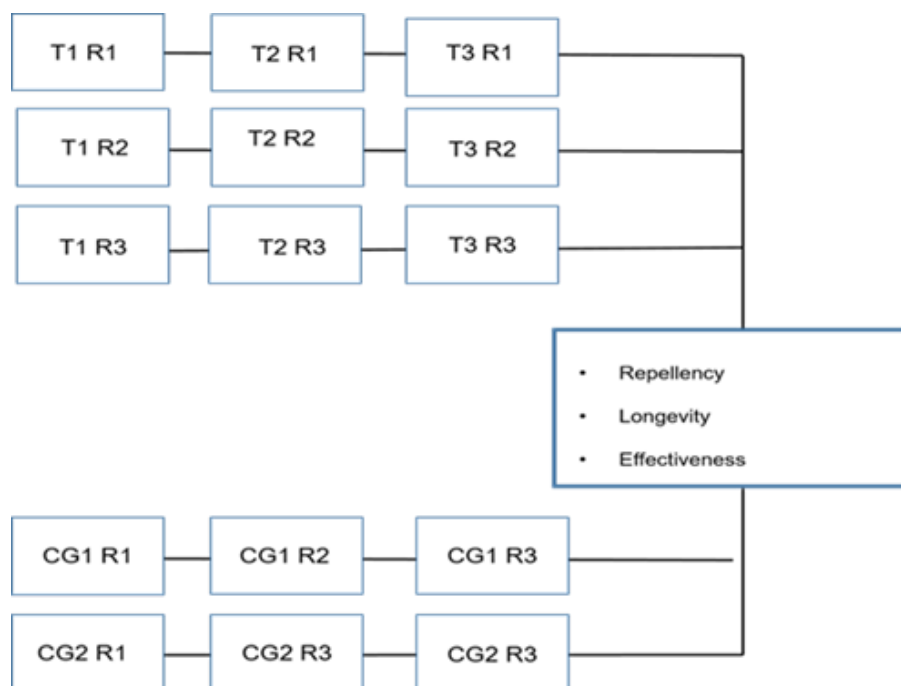


Figure 1. Experimental layout of the study.

2.3. Methods

2.3.1. Identifying and collecting different ant (hymenoptera: formicidae) species

Ants (Hymenoptera: Formicidae), specifically the red fire ants (*Solenopsis invicta*) species were collected from a mound at the base of a tree to be found at Tacurong City, Sultan Kudarat, as well as at different households of each researcher (Sutherst & Maywald, 2005). Approximately 500 ants were collected to ensure that there would be enough specimens for identifying and testing. The ants are separated from any dirt that had been collected and divided into 15 groups for replications.

2.3.2. Preparation process

50 estimated amounts of Citronella leaves and 50 Peppermint Plant leaves were collected to proceed to the extraction process. The collected plant materials were thoroughly washed to remove all the other substances that may cause issues during the extraction.

2.3.3. Extraction process

The method used to extract the oil was following the improvised set-up of Steam Distillation. This procedure involves forcing hot steam through a raw material matrix, which opens the holes in which the oil is contained and volatilizes the oils.

2.3.4. Making of ant repellent

The extract of Citronella and Peppermint oils was combined according to the measurements given for the treatments. The making of ant repellent was according to the consideration of the Lethal Dose of natural ingredients.

2.3.5. Placing of subject in the trial area

The container is measured 6x10 inches to ensure the distance between the bait and the entrance area. The plastic container has a small opening in the front for the ants to enter. The gap between the bait and repellent will be 2 inches from the edge.

2.3.6. Observation of treatments

Following the experimental layout of the study, the ants were divided into five groups according to the treatments they received that will be labeled accordingly as; Group A, B, C, D, and E. All set-ups will have 20 ants for each treatment per replication to ensure that all conditions are followed. The ants' activity was observed every 30 minutes until one entered the bait area. This was repeated for five trials using different ants in each time in different oil containers. Each treatment will be repeated 3 times at 30 to 60 minutes intervals.

3. RESULTS AND DISCUSSION

Table 1 shows the results of the Experimental Group and Control Groups' effectiveness in terms of the number of ants it has repelled. As illustrated, Treatment 1 showed a moderate result with 12 mean control. Meanwhile, Treatment 2 displayed an effective result with 15 mean control. Among all the Experimental Treatments, Treatment 3 presented an acceptable result with the highest mean control of 18. On the other hand, the first Control Group which holds 100% Water as its component, also showed a good performance higher than the first treatment which has a mean control of 13 ants repelled. Contrarily, the second Control Group shows the lowest performance of being a repellent as it ended up killing all the ants in the first 30 minutes of observation. **Table 2** shows level of effectiveness of Citronella (*Cymbopogon nardus*) and Peppermint (*Mentha x Piperita*) oil extracts as an ant repellent.

Table 1. Effectiveness of various treatments as an ant repellent.

Treatments	N	Number of Hours	R1	R2	R3	Mean
T1 (50% Citronella, 30% Peppermint Oil Extract, and 20% Water)	20	6	13	12	11	12
T2 (40% Citronella, 40% Peppermint Oil Extract, and 20% Water)		6	14	15	16	15
T3 (50% Citronella, and 50% Peppermint Oil Extract)		4	18	19	17	18
CG1 (100% Water)		3	12	11	16	13
CG2 (Commercial Ant Repellent)		0.5	0	0	0	0

Table 2. The level of effectiveness of Citronella (*Cymbopogon nardus*) and Peppermint (*Mentha x Piperita*) oil extracts as an ant repellent.

Treatments	Mean	Percentage of Repellency	Descriptor
T1 (50% Citronella, 30% Peppermint Oil Extract, and 20% Water).	12	60%	Less effective
T2 (40% Citronella, 40% Peppermint Oil Extract, and 20% Water)	15	75%	Quite effective
T3 (50% Citronella, and 50% Peppermint Oil Extract)	18	90%	Effective
Overall Mean	15	75%	Quite effective

Tables 3 and 4 show the mean of the number of ants repelled and effectiveness in terms of the lowest count of ants that have reached the treated area over 6 hours along with its corresponding percentage. As shown in the table above, Treatment 1 showed a percentage

of 60% repellency which is less effective. Treatment 2 showed its effectiveness with 75% repellency. Lastly, treatment 3 showed the best result of 90% repellency. Meanwhile, Control Group 1 which is 100% water has a 65% repellency. Control Group 2 which is the Commercial Ant Repellent showed 0% repellency thus making it not effective at all.

Five trials were done to test the difference between the Experimental and Control Groups. Since the F-computed value of 70.95 is greater than the F-tabulated value of 3.48 at a 0.05 significance level, the null hypothesis of the study is rejected (H_0). The results have found that there is a significant difference in using different treatments of Citronella and Peppermint Oil Extract when compared to the efficacy of the Control Variables; Water and Commercial Ant Repellent. Therefore, it means that the mixture of Citronella and Peppermint Oil Extracts can be an alternative and proven to become a natural substitute for ant repellents.

Table 3. The level of effectiveness of water and commercial spray as an ant repellent.

Treatments	Mean	Percentage of Repellency	Descriptor
CG1 (100% Water)	13	65%	Less effective
CG2 (Commercial Ant Repellent)	0	0	Not effective
Overall Mean	13	65%	Less effective

Table 4. Result of the ANOVA for the significant difference between the experimental and control groups

Sources of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F-Values		
				F-Computed	F-Tabulated	
Treatments	4	567.60	141.90	70.95**	0.05	0.02
Error	10	20.00	2.00		3.48	5.99
Total	14	587.60				

**significant at 5% level

4. CONCLUSION

As observed, the pure concentration of Citronella and Peppermint Oil Extract showed the highest level of effectiveness at 90%, which showed the least number of ants that have reached the treated area, followed by Treatment 2 with 75%, which lasts at about 6 hours. The data clearly shows that there is a significant difference when adding water to the mixture. The effect is lessened by up to 15%. However, it also makes the repellent longer lasting due to its diluting properties. After examining the results of the five trials, ANOVA showed a noticeable difference between the control and experimental groups. The repellent is also cost-effective, edible, and does not ruin the quality of the food. In terms of the current study, the Chocolate Chip Cookie remains to be in its condition. It reduces the harmful effects on health and helps people reveal another element of this plant that can alleviate certain illnesses and illnesses. It helps digestion, suppresses appetite, and improves memory. There are also no interventions unless medically necessary, and was advised not to intake or have contact with the plants.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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