

# POTENTIAL ANTI-INSECT LIME EXTRACT OF MINT LEAF (*Mentha piperita* L.) AND EXTRACT SOKA FLOWER (*Ixora paludosa* L.) ON RED FIRE ANT (*Solenopsis invicta*) ACTIVITY

Anggraini W. N. Boham<sup>1\*</sup>, Maurits H. Sumampouw<sup>2</sup>, Mercy M. F. Rampengan<sup>3</sup>

<sup>1</sup>Biology Departement, Faculty of Matehematics and Natural Science, Universitas Negeri Manado, Indonesia

Corresponding Author: [anggrainiboham59@gmail.com](mailto:anggrainiboham59@gmail.com)

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## Abstract

The mint plant (*Mentha piperita* L.) is one of the many aromatic herbal plants that produce essential oil commonly known as peppermint oil. Meanwhile, the soka flower plant (*Ixora paludosa* L.) is an ornamental plant that fills the planting elements with fast growth and beautiful, vigorous plants. This study aimed to assess the effect of lime insecticides combined with mint leaf extract (*Mentha piperita* L.) and soka flower extract (*Ixora Paludosa* L.) on red fire ants (*Solenopsis invicta*). This study used four red fire ant samples (*Solenopsis invicta*), which were divided into five treatment groups: X1 (75% mint leaf extract and 25% soka flower extract); X2 (75% soka flower extract and 25% mint leaf extract); X3 (50% soka flower extract and 50% mint leaf extract); Negative control (lime base); and Positive control (branded lime). The sample size for this study was 80 red fire ants (*Solenopsis invicta*), with each control group consisting of four fire ants, and the experiment was repeated four times. The Kruskal-Wallis test was used to analyze the data, revealing significant differences between the treatment groups. Therefore, the researchers concluded that the administration of 50% mint leaf extract and 50% soka flower extract effectively disrupted the activity of red fire ants.

**Keywords:** Lime Insect, Red Fire Ant (*Solenopsis invicta*), Mint Leaf Extract, Soka Flower.

## INTRODUCTION

Ants are social insects with various castes. Like bees and wasps, ants maintain their populations by dividing into workers, soldiers, guards, males, and queens. There are over 12,000 ant species globally, with a relatively high number found in tropical regions. Ants inhabit nests of thousands of ants per colony (Ningsih, 2019).

Tarumingkeng 2001 states that the larvae and eggs of the red fire ant (*Solenopsis invicta*) bear a strong resemblance to caterpillars. Fire ants belong to one of the most socially organized insect families, living in well-structured societies known as colonies. A single colony can control and utilize extensive areas to support its activities (Taib, 2012). Ants harm other organisms due to their omnivorous nature. The red fire ant (*Solenopsis invicta*) is a harmful pest that can cause damage to plants. The structure of their nests can harm agricultural plant roots, leading to plant death. Additionally, red fire ants (*Solenopsis invicta*) can potentially transmit diseases to humans and livestock by contaminating food with bacteria.

To address the issues caused by these insects, people have traditionally relied on synthetic chemical insecticides containing hazardous substances. The use of synthetic pesticides has been continuously increasing in both quantity and variety. One commonly used synthetic insecticide for ant control is magic lime or insect repellent lime, which contains 0.6% deltamethrin. *Deltamethrin* is a broad-spectrum insecticide that acts as both a contact and stomach poison. Prolonged skin contact with deltamethrin can result in itching and irritation. Excessive indoor use of these chemicals harms indoor air quality, including chest pain when exposed to lime strips.

Additionally, the powder can become airborne and inhaled, causing weakness. An alternative, safe method for controlling red fire ants (*Solenopsis invicta*) is to replace deltamethrin lime with lime insect repellent derived from natural phytochemicals. Insect lime, made from eco-friendly plants that do not harm other organisms, serves as both a repellent and an insecticide.

Peppermint leaves (*Mentha piperita* L.) are among the aromatic herbal plants that produce essential oils (Hardiyanto, 2021). Mint leaves do not flower in tropical regions; the stems grow vertically or slightly creepily. The plant typically reaches a height of 30-60 cm, with superficial branches and elongated stems (Karlina *et al.*, 2016). The main components of peppermint leaf oil (*Mentha piperita* L.) include essential oil, menthol, menthone, and methyl acetate rich in menthol (73.7-85.8%). Mint leaves (*Mentha piperita* L.) have medicinal properties and are also used to add a refreshing aroma to food and beverages. They also possess antibacterial properties (Fitria, 2019; Hadipoentyanti, 2012).

*Ixora paludosa* L. belongs to the group of multi-branched shrubs in ornamental plants (Hidayati, 2019). The phytochemical test results of soka flower extract (*Ixora paludosa* L.) indicate the presence of flavonoids, saponins, alkaloids, tannins, and triterpenoids, which exhibit antibacterial activity (Munira *et al.*, 2016). Therefore, peppermint leaves and soka flowers have the potential to address the issues caused by red fire ants and the health problems associated with excessive chemical use.

Considering the problems above, the researchers are interested in conducting a study titled "Anti-Insect Potency of Lime Leaf Extract (*Mentha Piperita* L.) and Soka Flower Extract (*Ixora Paludosa* L.) Against the Activity of Red Fire Ants (*Solenopsis Invicta*)".

## RESEARCH METHODS

### Place and time

The research was conducted from July to August 2022 at the biology laboratory of Manado State University, located in Koya, South Tondano, Minahasa Regency, North Sulawesi. The experimental method was employed for this study.

### Tools and materials

The tools used in this study included scales, scissors, plastic bags, sealed containers, shading rods, blenders, vacuum rotary evaporators, glass funnels, filter paper, measuring cups, pipettes, beakers, chalk moulds, mint leaves, Soka flowers, 96% ethanol, red fire ants, and lime material derived from calcium carbonate.

## Research Procedure

### Making Simplisia Powder

Mint leaves (*Mentha Piperita* L.) and soka flowers (*Ixora paludosa* L.) were separated from the leaves and stems, producing approximately 2.6 kg of plant material. The collected samples were thoroughly washed. The samples were then dried for approximately five days until they became brown. After drying, each sample had a dry weight of 1 kg. Subsequently, the dried samples were separately crushed using a blender. Five hundred grams of finely weighed mint leaves (*Mentha Piperita* L.) and 500 grams of finely weighed soka flowers (*Ixora paludosa* L.) were obtained

### Extract Creation

The extraction process used the maceration method with 96% ethanol as the solvent. 500 g of mint leaf powder (*Mentha Piperita* L.) and Soka flower (*Ixora paludosa* L.) were used. The simplisia powder was soaked in the solvent for 24 hours with occasional stirring. This maceration process was repeated three times. After the soaking process, the sample was obtained as filtrate and supernatant. The supernatants and filtrates were soaked with the simplisia powder and filtered using a glass funnel covered with filter paper to ensure complete separation of the filtrates. The obtained filtrate was then subjected to evaporation using a vacuum rotary evaporator. The evaporation process was carried out at a speed of 90 rpm and a temperature of 27°C.

### Concentration Making

Mixing mint leaf extract (*Mentha Piperita* L.) and Soka Flower (*Ixora paludosa* L.) into a beaker using the concentration dose in each treatment 53ml using the calculation as a table:

**Table 1.** Concentration

No	Concentration	Treatment (X)
1	75% mint leaf and 25% soka flower	X1 = 12.5 ml mint leaf extract + 4.1 ml soka flower extract
2	25% mint leaf and 75% flower	X2 = 4.1 ml mint leaf + 12.5 ml soka flower extract
3	50% mint leaf and 50% soka flower	X3 = 8.3 ml leaf extract + 8.3 ml soka flower extract

### Lime Making

The gypsum powder lime material was weighed to be 25 grams. Then, the lime material and extract ingredients were mixed according to their respective concentrations and stirred until they were evenly distributed, similar to the consistency of porridge. The resulting lime dough, containing the mint leaf extract and soka flowers, was placed into a prepared mould. The lime preparation was then dried in the sun for approximately 36 hours or until the lime began to dry and solidify. Once the lime preparation had completed the drying process, it was carefully removed from the mould and ready for use.

### Anti-Ant Lime Test Stage

The lime preparations were applied in each treatment container by scraping them around the

container's edges. Food was placed in the center of the lime scratch to attract the red fire ants (*Solenopsis invicta*). Each container contained four red fire ants introduced into the treatment container using a clear water hose. The temperature and humidity of the air in the room were measured. Afterwards, the abnormal activity of the red fire ants (*Solenopsis invicta*) was observed using a flashlight after 1 hour. The number of red fire ants exhibiting abnormal activity was counted. Following the 1-hour observation, tweezers carefully transferred the red fire ants into paper cups.

### Data analysis

The data obtained from the research results were analyzed using the SPSS 26 application. The data analysis employed a nonparametric test, specifically the Kruskal-Wallis test. This test was chosen because the data did not follow a normal distribution.

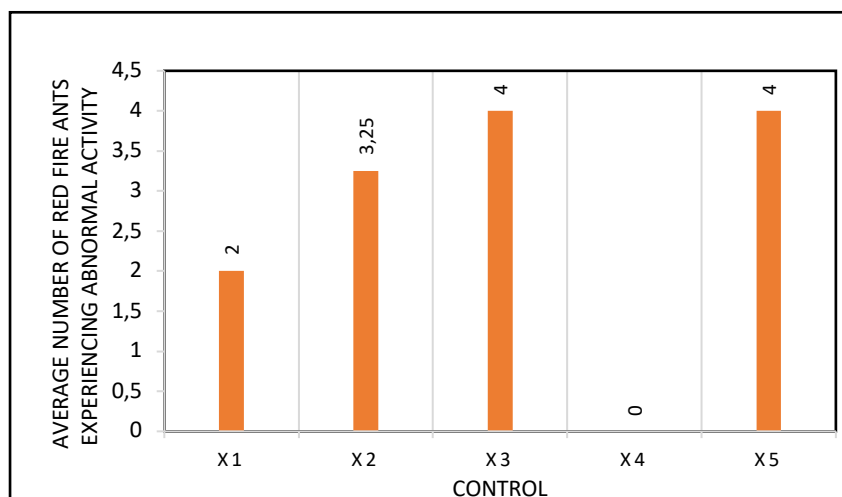
## RESULTS AND DISCUSSION

The preliminary results of the concentrated lime preparation showed that the lime had a semi-solid form. In Control 1, the lime appeared green; in Control 2, it was brown; in Control 3, it had a bright green color. Additionally, the lime had a distinct aroma of mint leaves and softwoods. After the lime preparation had dried and solidified, the ready-made lime took on a solid shape. Control 1 had a brownish-yellow color; in Control 2, it was dark brown; in Control 3, it appeared light brown. The ready-made lime retained the distinctive spicy aroma of mint leaves and soft-shelled flowers.

Regarding the treatment using 75% Mint Leaf Extract and 25% Soka Flower Extract, the aroma was not overpowering. On the other hand, the smell was slightly pungent in the treatment with 25% Mint Leaf Extract and 75% Soka Flower Extract. In the treatment with 50% Mint Leaf Extract and 50% Soka Flower Extract, the aroma exhibited the typical scent of mint leaves and soka flowers.

The data obtained from the research was analyzed using SPSS 26. The analysis began with testing the normality of the data to determine if it followed a normal distribution. The purpose of this test was to ensure the validity of parametric tests. Based on the results of the normality test, it was found that the significance value was less than 0.05, indicating that the research data did not follow a normal distribution. Therefore, non-parametric tests were used for further analysis. The Kruskal-Wallis test was conducted on the data. The results showed a significance value of 0.000, indicating a significant difference between the treatment groups. This suggests that the application of different concentrations of mint leaf extract and soka flower extract had a significant impact on the activity of red fire ants.

The test subjects for this experiment were red fire ants (*Solenopsis invicta*), which were observed to swarm and feed on the provided food. Red fire ants use pheromones, chemical signals released by other ants of the same species, to locate food sources. Pheromones are typically produced in specialized glands and are detected and received through Odorant Binding Proteins (OBP) located in the antenna region of the ants (Mifianita *et al.*, 2015).



**Figure 1.** Graph of the Average Number of Ants

In control X1, which consisted of 75% mint leaf extract and 25% soka flower extract, after 60 minutes, 13 red fire ants exhibited abnormal activity. The observed behaviours included occasional stillness, staggering movements to avoid the lime scratches, and some ants were found dead. However, some ants continued normal activities such as eating and active walking. In control X2, which contained 75% soka flower extract and 25% mint leaf extract, after 60 minutes, eight red fire ants showed abnormal activity. The observed behaviours included moving away from the lime, losing control in walking, being silent, and only moving their legs. Some ants died, while others remained active. In control X3, consisting of 50% soka flower extract and 50% mint leaf extract, after 60 minutes, the ants exhibited avoidance behaviour towards the lime, slow and uncoordinated movements, silence, and death. However, some ants continued with everyday activities. The total number of red fire ants exhibiting abnormal activity in this control was 16. In the negative control, all ants showed no signs of avoiding the lime and exhibited normal activities, focusing only on consuming the available food. In the positive control, all red fire ants were found dead, indicating the effectiveness of the control treatment in eliminating the ants.

The lime preparations in Control 1 to Control 3 contain essential oils that possess various effects on pests. These effects include repelling pests, attracting them, acting as contact poisons (toxic), functioning as respiratory poisons (fumigants), reducing their appetite for food (antifeedants), inhibiting the laying of eggs (oviposition deterrents), hindering development, interfering with the insect's hormone system, leading to decreased fertility, and acting as insect repellents (Hasyim *et al.*, 2014). Moreover, the flavonoid compounds in mint leaves and soka flowers have toxic effects. According to Utami *et al.* 2010 flavonoid compounds act as antimicrobials and antifeedants, which serve as poisons that inhibit insects' appetite (Ningsi, 2019).

The researcher used a lime base composed of  $\text{CaCO}_3$  (calcium carbonate) in the negative control.  $\text{CaCO}_3$  does not contain active ingredients, so the ants do not feel disturbed by the presence of chalk scratched in the research container. On the other hand, in the positive control, the researcher used a branded lime called magic chalk, which is commonly used and sold in the market. This branded lime

contains an active ingredient called Deltamethrin. Deltamethrin is a pyrethroid compound with advantages such as requiring small amounts for application, having a broad spectrum of control, being non-persistent, and causing effective paralysis (Indriati, 2014).

Lime preparations with active ingredients derived from mint leaves and soka flowers can effectively be an insect repellent, specifically for controlling red fire ants. This alternative lime preparation can reduce the reliance on synthetic lime, providing a safer long-term solution.

Based on the results of the Kruskal-Wallis test, significant differences were observed between the treatment groups. Therefore, the researchers concluded that applying 50% mint leaf extract and 50% soka flower extract effectively induced abnormal activity in red fire ants.

## CONCLUSION

Based on the research findings and the analysis of the data using the Kruskal-Wallis test, it can be concluded that the administration of a mixture of 50% Mint Leaf extract and 50% Soka Flower extract was effective in inducing abnormal activity in Red Fire Ants (*Solenopsis invicta*).

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