

## Effectiveness of Lime Leaves (*Citrus aurantifolia*) as a Natural Mosquito Repellent

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### ABSTRACT

The tropical climate gives rise to various kinds of tropical diseases, one of which can be caused by mosquitoes. The aim of this research was to determine the effectiveness concentration of lime leaf extract (*Citrus aurantifolia*) in repelling the *Aedes aegypti* mosquito. The research method used was an experiment by observing the effect of lime leaf extract as a natural mosquito repellent. Data processing used the one way anova statistical test, namely by using treatment plus 1 control in each treatment with 3 repetitions of the experiment. The results of this research were that there were differences in the treatment of orange leaf extract with a p-value (0.0005). The conclusion of the research is that the significant extract group is the 60 mg - 40 mg, 60 mg - 50 mg treatment, meaning that 60 mg of orange leaf extract treatment is the most effective as a natural insecticide.

**Keywords:** Lime Leaves, Mosquitoes, Repellent

### INTRODUCTION

Indonesia is one of the largest countries in the world with a tropical climate. The tropical climate gives rise to various kinds of tropical diseases, one of which can be caused by mosquitoes, for example Malaria, Dengue Fever, Elephantiasis, Filariasis and Chikungunya. Some of these diseases often occur in the community, giving rise to widespread and rapid epidemics. The main cause of the emergence of epidemics of various tropical diseases is due to the uncontrolled spread of mosquitoes as vectors (Andriana et al., 2013). Based on statistical data, the number of dengue fever cases in South Sumatra Province in 2020 was 2,359 cases, in 2021 there were 1,135 cases, and in 2022 there were 2,854 (BPS South Sumatra, 2023).

Insecticides used to control the *Aedes aegypti* mosquito use organophosphate class insecticides, because they are considered very effective, the results are known quickly

and without considering the environmental impact. Vector insects are resistant to synthetic insecticides and cause environmental pollution and can kill other (non-target) biota. Therefore, it is deemed necessary to look for environmentally friendly plant-based insecticides that are easy to obtain and effective in killing dengue vector mosquitoes. One way is to use plants in residential areas to become plant-based insecticides, both for adult mosquitoes and immature mosquitoes (larvae) (Boesri et al, 2015).

Packaged anti-mosquito products are widely used by the public with various kinds and active ingredients containing different types and concentrations such as dichlorvos, propoxur, and pyrethroid. These ingredients are toxic to the human body, ranging from the mildest effects (dizziness, headaches) to the most severe effects (carcinogenic, damaging the hormonal, respiratory and reproductive

systems). Even in cases of severe poisoning it can cause coma and death (Cakra, 2016).

The essential oil in lime peel (*Citrus aurantifolia*) at a concentration of 20% has a protective power of 86.66% (Baskoro, 2010). Lime is widely used because of the nutritious chemical content in the plant. Lime peel can be used to contain chemical compounds which are secondary metabolites such as essential oils, flavonoids, saponins, steroids and terpenes. The essential oil content in lime peel such as limonene or limonoid inhibits skin change in larvae and can enter the bodies of mosquito larvae as poison (Ekawati, 2017).

Based on the results of research by Wahyuni (2019) regarding the effectiveness of lime peel extract (*C. aurantifolia*) on mosquito protection, the results showed that the higher the concentration of essential oils derived from orange peel extract, the more effective it was on mosquito protection, up to 98% at a concentration of 45 % for 8 hours. Based on the description above, the author wants to conduct research on the use of lime leaves (*Citrus aurantifolia*) as a natural anti-mosquito repellent.

## MATERIAL AND METHOD

The research method used was an experiment with an activity design consisting of 4 treatments with lime leaf extract concentrations of 30 mg/mL, 40 mg/mL, 50 mg/mL and 60 mg/mL for 3 repetitions plus 1 control. This research was carried out in a laboratory by observing various types of lime leaf extract concentrations that are most effective as a natural anti-mosquito agent. Lime leaf extract with various concentrations was smeared on the volunteers' hands, then put in a cage containing 20 mosquitoes and counted the number of mosquitoes that landed for 30 seconds, 3 repetitions of each

concentration with a total of 230 mosquito samples needed, then the number was recorded. mosquitoes that land and data processing is carried out using the one way anova statistical test to see the most effective concentration.

## RESULT AND DISCUSSION

### 1. Univariate Analysis

This analysis shows the effect of the independent variable (lime leaf extract in various concentrations, namely 30 mg, 40 mg, 50 mg, 60 mg). And the dependent variable (the number of *Aedes aegypti* mosquitoes that land). Based on the research results, the effect of the extract on the *A. aegypti* mosquito was obtained as follows.

Table 1. Description of the use of lime leaves (*Citrus aurantifolia*) as a repellent for *Aedes aegypti* mosquitoes

Treatment	Repetitions			Total	Average
	1	2	3		
P0 (Control)	13	12	14	39	13
P1 (30 mg)	11	8	8	27	9
P2 (40 mg)	9	9	7	25	8
P3 (50 mg)	5	5	4	14	5
P4 (60 mg)	0	0	1	1	0

Based on table 1, it can be seen that the average mosquito that landed on P0 (control) was 13 mosquitoes, in treatment P1 (first treatment) the average mosquito landed on 9 mosquitoes, on P2 (second treatment) the average mosquito that landed 8 mosquitoes landed, in P3 (third treatment) the average number of mosquitoes landed was 5 mosquitoes, while in P4 (fourth treatment) the average number of mosquitoes landed was 0 mosquitoes.

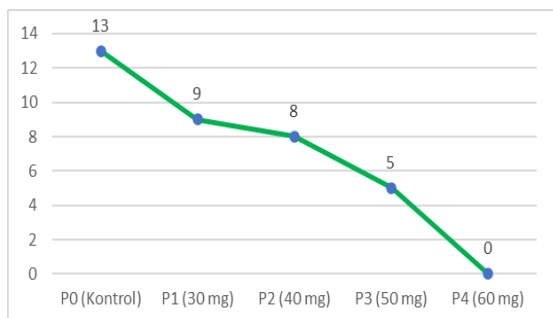


Figure 1. Average decrease in the number of mosquitoes

## 2. Bivariate Analysis

This analysis shows the effectiveness of lime leaves (*Citrus aurantifolia*) as a natural mosquito repellent can be seen using the anova test with a significance level of  $\alpha = 0.05$  provided that the relationship is said to be significant if the  $p\text{-value} \leq 0.05$  and the relationship is said to be not significant if the  $p\text{-value} \geq 0.05$ .

Table 2. Statistical test results of lime leaf extract against the *Aedes aegypti* mosquito

Variabel	Mean	SD	95%CI	P value
Treatment				
1. 30 mg	9,00	1,732	4,70-13,30	0,0005
2. 40 mg	8,33	1,155	5,46-11,20	
3. 50 mg	4,67	0,577	3,23-6,10	
4. 60 mg	0,33	0,577	-1,10-1,77	

The average number of mosquitoes in the 30 mg treatment was 9 with a standard deviation of 1.732. In the 40 mg treatment the average number of mosquitoes was 8.33 with a standard deviation of 1.155. In the 50 mg treatment the average number of mosquitoes was 4.67 with a standard deviation of 0.577. In the 60 mg treatment the average number of mosquitoes was 0.33 with a standard deviation of 0.577. The statistical test results obtained a  $p\text{ value} = 0.0005$ , meaning that at an alpha of 5% it could be concluded that there was a difference in the number of mosquitoes between the

four treatments of orange leaf extract as a natural mosquito repellent.

The statistical test results to determine the effectiveness of lime leaves (*Citrus aurantifolia*) as a natural mosquito repellent are in the Post Hoc test with 'Multiple Comparisons Bonferroni'. The results of the Bonferroni test showed that there was a difference in the treatment of orange leaf extract with a  $p\text{-value} \leq 0.05$ . The significant group is the 60 mg – 40 mg, 60 mg – 50 mg treatment, meaning that 60 mg of orange leaf extract treatment is the most effective as a natural insecticide.

## 3. Discussion

Based on the results of research conducted by researchers in bivariate analysis, it can be seen the effectiveness of lime leaves (*C. aurantifolia*) as a natural mosquito repellent. Based on the results of previous research conducted by Hayana et al. (2020), selected lime leaves were also effective in inhibiting the growth of *A. aegypti* mosquito larvae. Lime leaf extract can suppress the growth of larvae into pupae. Plant compounds such as alkaloids, turpentine, phenols and others have anti-eating potential (compounds that inhibit the eating process but do not kill them directly). Thus, lime leaf extract can have larvicidal properties. The larvicidal ability of lime leaf extract results from the chemical compounds contained in the plant, namely flavonoids, saponins, tannins and triterpenoids (Hayana, Maharani and Sari, 2020)

Based on previous research conducted by Berliana Naomi Rumondang Sari Aritonang and Kenny Carolina, the results showed that lime peel infusion (*Citrus aurantifolia*) has potential as an anti-mosquito *Aedes aegypti*. It was proven that mosquitoes died after being exposed to the infusion after 60 minutes. In addition, a graph was obtained showing that the higher the

concentration of the extract, the higher the number of *A. aegypti* mosquitoes that died (Figure 1). Concentration of 25%, the death of *A. aegypti* mosquitoes reached 90% (Terhadap et al., 2017).

Based on previous research conducted by Muh. Saleh, Andi Susilawaty, Syarfaini, Musdalifah that, data analysis from the results of the one way ANOVA test in this study obtained a p value = 0.004 ( $p < 0.05$ ), which means that there is a significant relationship or it can be stated that lime peel extract (*Citrus aurantifolia*) is effective as a biological insecticide against the *Aedes aegypti* mosquito. This is in line with research conducted by Ikhsan in 2014 entitled "Effectiveness of Lime (*Citrus aurantifolia*) Peel Extract on the Death of *Aedes* sp Larvae". The results of the research show that there is a relationship between increasing the concentration of lime peel extract and the number of deaths of *Aedes* larvae. sp. Research similar to this research but with other extracts was also carried out by Wibawa, R (2012) entitled "Potential of Mahkota Dewa (*Phaleria macrocarpa*) Seed Extract as an Insecticide against *A. aegypti* Mosquitoes using the spray method. The research results showed  $p = 0.003$  ( $p < 0.05$ ), then the crown of god seed extract (*Phaleria macrocarpa*) has potential as an insecticide (Saleh and Susilawaty, 2015).

Based on research conducted by Urianti (2021), lime leaves have been proven to have potential as a mosquito larvicide. The essential oil content in lime peel such as limonene or limonoid inhibits skin change in larvae and can enter the bodies of mosquito larvae as poison. *C. aurantifolia* has many branches and twigs. The stems are woody, thorny and hard and about 0.5-3.5 m high. The outer surface of the skin is dark green and dull. The leaves are compound, elliptical in shape with a

rounded base, blunt tip and serrated edges. The leaves reach 2.5-9 cm in length and 2-5 cm in width. The leaves are pinnate with winged stems, green and 5-25 mm wide. The flowers are compound/single which grow in the leaf axils or at the end of the stem with a diameter of 1.5-2.5 cm.

## CONCLUSION

The conclusion of this research is a difference in the number of mosquitoes between the four treatments of orange leaf extract as a natural mosquito repellent.

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