Medical and Health Journal
Volume 5, Issue 1, 2025, pp. 164-175
e-ISSN: 2807-3541
Open Access: https://jos.unsoed.ac.id/index.php/mhj

Biopotensi Ekstrak Etanol Daun Rasamala (*Altingia excelsa*) Sebagai Insektisida Nabati Terhadap Nyamuk *Aedes aegypti*

Octavia Permata Sari[1*], Suci Ihtiaringyas[1], Lieza Dwianasari Susiawan[1], Rizma Haidif Firinda[1], Wahyudin[2], Faza Nur Wijaya[3]

[1]*Department of Parasitology, Faculty of Medicine, Jenderal Soedirman University*, Purwokerto, Indonesia
[2]*Department of Pharmacology, Faculty of Medicine, Jenderal Soedirman University*, Purwokerto, Indonesia
[3]*Faculty of Medicine, Jenderal Soedirman University*, Purwokerto, Indonesia

ARTICLE INFO

Article history:
Received August 8, 2025
Revised August 10, 2025
Accepted August 11, 2025
Available online August 14, 2025

Keywords:
Altingia excelsa, Aedes aegypti, botanical insecticide, biopotency

ABSTRACT

*Aedes aegypti is the primary vector of dengue hemorrhagic fever (DHF), which remains a major public health concern in Indonesia. Continuous use of synthetic insecticides has led to the emergence of resistance and adverse environmental impacts. This study aimed to evaluate the biopotential of ethanol extract from Altingia excelsa (rasamala) leaves as a botanical insecticide against *Aedes aegypti* mosquitoes. The experiment was conducted by exposing female Aedes aegypti mosquitoes aged 3–5 days to vapor from rasamala leaf extract at three concentrations (25%, 50%, and 75%) using an electric liquid vaporizer device. Mortality percentages were recorded at 8, 16, and 24 hours and subsequently analyzed using statistical and probit methods. The results demonstrated that rasamala leaf extract possesses insecticidal activity. However, the LC_{50} value of 182% indicated low efficacy, as it exceeded the highest concentration tested. Moreover, the LT_{50} value could not be reliably determined within the observed time frame. These findings suggest that while Altingia excelsa extract exhibits insecticidal potential, further optimization of its formulation or an increase in concentration is required to achieve greater effectiveness*

1. INTRODUCTION

Dengue hemorrhagic fever (DHF) is a mosquito-borne viral disease caused by the dengue virus and transmitted primarily by the Aedes aegypti mosquito. The disease continues to be a significant public health issue, particularly in tropical and subtropical regions. According to data from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC), more than 400 million people are infected annually, with approximately 21,000 deaths reported worldwide (Karwur et al., 2023; Lema et al., 2021; Santi & Sunarsih, 2023). Indonesia is among the most vulnerable countries in Southeast Asia, with Java Province, especially Central Java, recording a consistently high number of cases. Banyumas Regency has been identified as one of the regions with the highest incidence of DHF up to 2024 (Mentari & Hartono, 2023; Sofiana & Wuliandari, 2023; Wuliandari et al., 2023).

Aedes aegypti is a small mosquito, about 4–7 mm long, identifiable by white markings on its legs. Its entire life cycle includes four stages: egg, larva, pupa, and adult, with the process from egg to adult occurring in as little as 7–12 days depending on conditions. Aedes aegypti typically inhabit tropical and subtropical urban areas, preferring habitats close to human dwellings where stagnant water collects. They thrive in water containers found in houses or outdoors, including water barrels, pots, and discarded objects. Behaviorally, only female Aedes aegypti bite, primarily during the day with peaks in early morning and late afternoon. Regarding insecticide effectiveness, Aedes aegypti populations increasingly show resistance to common insecticides like pyrethroids and organophosphates due to genetic and metabolic mechanisms (Sutarto & Syani, 2018). Vector control is a crucial strategy in preventing the spread of dengue infection. Currently,

*Corresponding author
E-mail addresses: octavia.sari@unsoed.ac.id (Octavia Permata Sari)

many communities rely on chemical insecticides through fogging or ultra-low volume (ULV) spraying methods. However, prolonged and uncontrolled use of synthetic insecticides has raised concerns about vector resistance, environmental pollution, and potential toxicity to humans. In several areas across Indonesia, Aedes aegypti populations have shown significant resistance to compounds such as malathion and alpha-cypermethrin, with resistance rates reaching up to 34.63% in Yogyakarta and 5.88% in Semarang (Sartika et al., 2020; Hary et al., 2024).

To address this issue, plant-based insecticides, also known as botanical insecticides, are being explored as environmentally friendly alternatives. These natural insecticides are derived from plant extracts that contain secondary metabolites capable of disrupting the biological systems of insects. Compounds such as flavonoids, saponins, and tannins are known to interfere with digestion, respiration, or the nervous system of mosquitoes (Embrikawentar & Ratnasari, 2019; Nabillah & Chatri, 2024). Botanical insecticides degrade more rapidly in the environment and are less likely to cause long-term ecological harm or resistance. Several plants like clove (Syzygium aromaticum) and basil (Ocimum basilicum) have been studied for their insecticidal properties, although their effectiveness varies and often requires prolonged exposure times (Handito et al., 2014; Ramayanti et al., 2017).

One potential candidate for botanical insecticide development is the Rasamala tree (Altingia excelsa), an endemic species in Indonesia. As a local natural resource, it holds potential as a sustainable and environmentally friendly solution for vector control, especially in regions prone to Dengue Hemorrhagic Fever (DHF). Utilizing Rasamala for mosquito control aligns with the emphasis on local biodiversity and resource-based approaches to managing Aedes aegypti populations in vulnerable Indonesian areas. The leaves of this plant are known to contain bioactive compounds such as flavonoids, saponins, tannins, and alkaloids. (Anwar et al., 2018; Anwar et al., 2021; Lailaty et al., 2024). Although many studies have explored plant-based insecticides for controlling Aedes aegypti, research on Rasamala (Altingia excelsa) as an insecticide remains very limited. This makes studying Rasamala a novel contribution to this field. While clove and basil have well-documented insecticidal effects, Rasamala's potential is still largely unexplored, offering new opportunities for environmentally friendly mosquito control. This novelty adds value to ongoing research aiming to develop diverse and sustainable natural insecticides. Previous studies have demonstrated the plant's antibacterial and antiproliferative effects, but empirical evidence regarding its insecticidal activity against Aedes aegypti remains limited. Considering its rich phytochemical content, Altingia excelsa has the potential to serve as a safer and more sustainable alternative to synthetic insecticides.

Ethanol was used for the extraction of Rasamala (Altingia excelsa) because of its ability to dissolve polar compounds such as flavonoids effectively. Additionally, ethanol is easy to obtain, relatively safe, and environmentally friendly, making it a suitable solvent for extracting bioactive compounds from plants. This research aims to investigate the insecticidal effect of Altingia excelsa leaf extract on Aedes aegypti mosquitoes and to determine the most effective concentration that causes mosquito mortality within a given exposure period. The findings are expected to contribute to the growing body of knowledge on plant-derived insecticides and provide a scientific basis for their potential application in vector control strategies.

2. METHOD

This study employed a laboratory-based experimental design with a *post-test only with control group* approach. The research was conducted from June to December 2024 at the Pharmacy Laboratory, Faculty of Health Sciences, Universitas Jenderal Soedirman, and the Parasitology Laboratory, Faculty of Medicine, Universitas Gadjah Mada. This research employed a quantitative experimental approach to determine the insecticidal efficacy of *Altingia excelsa* leaf extract against *Aedes aegypti*. The study was conducted in a controlled laboratory setting using a post-test only with control group design. The methodology encompassed several key stages, including material preparation, mosquito exposure, data collection, and statistical analysis, as detailed below.

Tools and Materials

Materials included *Altingia excelsa* leaves obtained from Baturraden Botanical Garden, 70% ethanol, distilled water, and a commercial liquid electric repellent containing 0.1% transfluthrin. Equipment used in this study comprised a rotary evaporator for extract concentration, electric vaporizers, sealed glass chambers for exposure, thermohygrometers for monitoring ambient conditions, as well as mosquito rearing and observation tools such as cups, sugar solution, sieve cloths, and stopwatches.

Sampling Methods

This study employed a true experimental design using a post-test only control group approach to evaluate the insecticidal activity of *Altingia excelsa* leaf extract against adult *Aedes aegypti* mosquitoes. The research was conducted under laboratory conditions at the Parasitology Laboratory, Faculty of Medicine, Universitas Gadjah Mada.

Adult female *Aedes aegypti* mosquitoes, aged 3–5 days and previously unfed, were selected for the experiment. The mosquitoes were reared in controlled conditions with a temperature of 26–28°C and relative humidity of 70–80%. They were maintained in netted cages and fed a 10% sugar solution until the experiment.

A total of 500 mosquitoes were used, divided into five treatment groups, each consisting of 25 mosquitoes with four replications per group, determined using the Federer formula:

$$(r - 1)(t - 1) > 15$$

where r is the number of replications and t is the number of treatment groups. With $t = 5$, the minimum r required was 4.

The groups were organized as follows:

- Group A (Positive Control): Exposed to commercial electric repellent containing 0.1% transfluthrin
- Group B (Negative Control): Exposed to distilled water only
- Group C (Treatment 1): Exposed to 25% *A. excelsa* leaf extract
- Group D (Treatment 2): Exposed to 50% *A. excelsa* leaf extract
- Group E (Treatment 3): Exposed to 75% *A. excelsa* leaf extract

The extract was prepared using the maceration method. Air-dried *A. excelsa* leaves were ground into powder and soaked in 70% ethanol for 72 hours. The solution was filtered, and the filtrate concentrated using a rotary evaporator at 40°C. The resulting thick extract was then diluted with distilled water to obtain concentrations of 25%, 50%, and 75%.

Prior to exposure, mosquitoes were transferred to glass exposure chambers connected to electric vaporizers. Each group was exposed to the treatment for 60 minutes. Afterward, mosquitoes were placed into observation cups containing sugar solution and monitored at 8, 16, and 24 hours post-exposure. A mosquito was considered dead if it showed no movement and did not respond to mechanical stimulation with a blunt probe.

Data Analysis

Data obtained from observations of *Aedes aegypti* mosquito mortality following exposure to various treatments were first processed using univariate analysis to determine the mean and standard deviation for each treatment group. Prior to conducting comparative analysis, the data were tested for normality using the Shapiro-Wilk test to assess whether the distribution met parametric test assumptions. If the data were found to be normally distributed, a One-Way Analysis of Variance (ANOVA) was used to determine the presence of statistically significant differences in mortality among the five treatment groups. However, if the data did not meet normality assumptions, the non-parametric Kruskal-Wallis test was applied as an alternative to assess differences between groups.

To identify specific differences between the treatment groups, a post-hoc analysis was performed using the Mann-Whitney test. This step allowed for pairwise comparisons to determine which treatment concentrations significantly differed from each other and from the control groups in terms of mosquito mortality. Additionally, to evaluate the toxicity level of *Altingia excelsa* leaf extract, probit analysis was conducted. This analysis provided LC_{50} (lethal concentration for 50% of the population) and LT_{50} (lethal time for 50% mortality) values, which are standard parameters used to describe the potency and time-based effectiveness of an insecticidal agent. All statistical analyses were carried out using IBM SPSS Statistics version 23.0. A significance level of $p < 0.05$ was used for all hypothesis testing, indicating that the observed differences were considered statistically significant if the p-value fell below this threshold.

Limitations

This study was conducted under controlled laboratory conditions, which, while ensuring consistency and minimizing external variables, may not accurately replicate real-world environmental factors such as fluctuating temperature, humidity, wind, or interaction with other organisms. Consequently, the insecticidal effectiveness of *Altingia excelsa* leaf extract observed in this study may vary under natural field conditions.

Furthermore, the study utilized a laboratory-reared strain of *Aedes aegypti* mosquitoes, which might respond differently to insecticidal agents compared to wild-type populations that are genetically diverse and potentially more resistant due to prior exposure to chemical insecticides in the environment. Therefore, the results may not fully represent the extract's efficacy on field mosquitoes.

Another limitation lies in the exposure method. The extract was administered using an electric vaporizer in a sealed glass chamber, which ensures uniform exposure but does not consider mosquito behavior such as avoidance or spatial distribution that occurs in open environments. Moreover, only a single mode of exposure was tested, and alternative application methods such as spraying or residual contact were not explored.

Finally, the observation period was limited to 24 hours post-exposure. Delayed mortality effects or potential sublethal impacts, such as behavioral or reproductive changes in surviving mosquitoes, were not assessed. These aspects are important for understanding the long-term effectiveness and ecological safety of *A. excelsa* extract as a botanical insecticide and warrant further investigation in future studies.

.

3. RESULT AND DISCUSSION

This study began with the extraction of bioactive compounds from *Altingia excelsa* (rasamala) leaves, which are known to contain phytochemicals such as flavonoids, tannins, and saponins with potential insecticidal properties. The extraction process was carried out using the maceration method, a widely used and effective protocol for obtaining thermolabile compounds from plant material. This technique involves soaking dried plant powder in a suitable solvent under room temperature conditions, allowing active constituents to diffuse into the solvent over time without the need for heat, which could degrade sensitive compounds.

In this research, 70% ethanol was selected as the solvent due to its polarity and effectiveness in extracting a broad spectrum of phytochemicals, particularly semi-polar compounds like flavonoids. The dried leaves of *A. excelsa* were first ground into fine powder to increase surface area and enhance solute-solvent interaction. The powdered leaves were then soaked in 70% ethanol for 72 hours with periodic stirring, a standard duration to ensure optimal extraction. The resulting filtrate was collected and concentrated using a rotary evaporator at a controlled temperature of 40°C, yielding a thick, crude extract. This extract was subsequently diluted with distilled water to achieve three concentrations: 25%, 50%, and 75%, which were then used in the insecticidal bioassays.

After the extract was prepared, the insecticidal efficacy of *Altingia excelsa* leaf extract was tested by observing the mortality of *Aedes aegypti* mosquitoes at 8, 16, and 24 hours post-exposure. The results showed a concentration- and time-dependent pattern of mortality.

Table 1. Mortality of *Aedes aegypti* after 8 Hours of Exposure

Group	Mosquito mortality					
	Rep 1	Rep 2	Rep 3	Rep 4	Mean	%
Positive Control	25	25	25	25	25	100
Negative Control	0	0	0	0	0	0
25% Extract	2	3	2	5	3	12
50% Extract	8	9	12	10	9,75	39
75% Extract	4	6	4	4	4,5	18

Mosquito mortality was highest in the 50% extract group after 8 hours (39%), while the 25% and 75% groups showed lower efficacy. This suggests that higher concentrations do not always guarantee increased lethality, possibly due to compound saturation or bioavailability issues. The 0% mortality in the negative control validates the test environment.

Table 2. Mortality of *Aedes aegypti* after 16 Hours of Exposure

Group	Mosquito mortality					
	Rep 1	Rep 2	Rep 3	Rep 4	Mean	%
Positive Control	25	25	25	25	25	100
Negative Control	0	0	0	0	0	0
25% Extract	2	3	2	5	3	12
50% Extract	8	9	12	10	9,75	39
75% Extract	4	6	4	4	4,5	18

The pattern of mortality at 16 hours was consistent with that at 8 hours. The 50% extract remained the most effective, possibly due to optimal concentration of bioactive components like flavonoids and tannins.

Table 3. Mortality of *Aedes aegypti* after 24 Hours of Exposure

Group	Mosquito mortality					
	Rep 1	Rep 2	Rep 3	Rep 4	Mean	%
Positive Control	25	25	25	25	25	100
Negative Control	0	0	0	0	0	0
25% Extract	2	3	2	2	2,25	9
50% Extract	9	12	8	10	9,75	39
75% Extract	5	6	4	5	5	20

At 24 hours, the 50% extract again caused the highest mortality (39%). Notably, the 75% group (20%) was less effective than the 50% group, possibly due to viscosity or reduced evaporation affecting vapor exposure in the test chamber.

This study aimed to further explore whether the leaf extract of *Altingia excelsa* (rasamala) possesses insecticidal effects against *Aedes aegypti* mosquitoes. The testing of *Altingia excelsa* leaf extract as an insecticide was carried out using an electric liquid vaporizer device commonly available to the public. In this study, the liquid insecticide carrier inside the vaporizer was replaced with cotton. The use of cotton aimed to prevent contamination, as the original carrier might still contain residual chemical insecticides that could influence the mortality of *Aedes aegypti* mosquitoes. Additionally, the liquid container was sterilized in advance by soaking it in alcohol for 24 hours before use. This was also intended to avoid contamination, as the container might retain traces of previously used chemical insecticides.

The distance between the mosquitoes and the electric liquid device in this experiment was controlled by placing the mosquitoes in a cage located at the center of a glass chamber. This setup ensured that all mosquitoes had relatively equal distance from the exposure source, preventing any from flying to the corners of the chamber and becoming too distant from the vapor source. If the mosquitoes are too far from the vaporizer, the amount of vapor reaching them would decrease, making it harder to achieve mortality (Novasari & Sasongkowati, 2017).

Temperature and humidity were measured using a thermohygrometer, with results showing a temperature range of 25–28°C and humidity between 74–76%. These environmental conditions meet the standard for mosquito testing, which recommends a temperature of 25–29°C and humidity of 72–80%. This measurement was important to maintain stable water vapor levels in the air during the experiment so that the mosquitoes could develop optimally according to their life cycle. Based on these results, it can be concluded that the mortality of *Ae. aegypti* was not caused by environmental factors such as temperature and humidity (Dheasabel & Azinar, 2018).

Mosquito age was controlled by using *Ae. aegypti* mosquitoes aged 3–5 days, ensuring that they were in a productive stage with good physical resistance. Mosquitoes younger than 3 days may not yet have fully developed immunity, while those older than 5 days may have begun to experience physical decline, making them more susceptible to death (Nikmah et al., 2016). The insecticidal effect was assessed by observing mosquito mortality, defined by the absence of life signs, mosquitoes that fell, could no longer fly, and remained motionless after vapor exposure in the paper cup, and confirmed after tapping the container. Univariate analysis was conducted to determine the percentage of *Ae. aegypti* mortality after contact with *Altingia excelsa* leaf extract at each concentration.

Based on the results in Table 3, differences in *Altingia excelsa* leaf extract concentrations produced different effects on the number of *Ae. aegypti* mosquitoes that died in each treatment and repetition. The data presented showed the order of average mosquito mortality after 24 hours, with the highest being at 50% concentration (9.75 mosquitoes or 39%), followed by 75% concentration (5 mosquitoes or 20%), and the lowest at 25% concentration (2.25 mosquitoes or 9%). This finding contradicts the study by Meyrita et al. (2020), which reported that higher extract concentrations lead to higher mosquito mortality.

In this study, the increase in mortality from 25% to 50% may have been due to a hormesis phenomenon. Hormesis is a biological dose-response where low-dose exposure enhances performance, while high-dose exposure reduces it, resulting in stimulation at low doses and inhibition at high doses. Sublethal doses have complex effects, which may reduce direct mortality but increase reproduction or resistance in pests such as *Ae. aegypti*, making mosquitoes exposed to low insecticide doses more resistant to subsequent exposure (Aldridge et al., 2024).

The decrease in the average mosquito mortality observed at the 75% concentration level (5 mosquitoes or 20%) is presumed to be associated with the increased viscosity of the extract solution at higher concentrations. As the concentration of the extract increases, so does the viscosity of the liquid, which may in turn affect the evaporation rate of the extract (Bachtiar et al., 2022).

Normality Test

Before conducting inferential statistical analysis, a normality test was performed using the Shapiro-Wilk method to determine whether the mortality data in each treatment group were normally distributed. The Shapiro-Wilk test is particularly suitable for small sample sizes and is widely applied in biological and experimental research settings due to its robustness and sensitivity in detecting departures from normality.

In this study, the Shapiro-Wilk test was conducted separately for each group comprising the positive control, negative control, and treatment groups with 25%, 50%, and 75% concentrations of *Altingia excelsa* extract. The test results revealed that the mortality data for the positive and negative control groups did not meet the assumption of normal distribution, as indicated by a p-value less than 0.05, suggesting significant deviation from normality. Conversely, the treatment groups showed p-values greater than 0.05, indicating that their data distributions were not significantly different from normal.

This pattern of results highlights the heterogeneity in data behavior across groups, which may be influenced by varying modes of action between the synthetic insecticide (positive control) and the plant-based extract. Consequently, due to the violation of normality assumptions in some groups, particularly the controls, the data analysis proceeded with non-parametric statistical methods, namely the Kruskal-Wallis and Mann-Whitney U tests, which do not rely on the assumption of normal distribution and are suitable for analyzing ordinal or skewed data.

Table 4. Saphiro-Wilk Normality Test Result

	Saphiro Wilk		
Group	Statistic	df	Sig.
Positive Control	.	4	<0,05
Negative Control	.	4	<0,05
25% Extract	0.260	4	>0,05
50% Extract	0.198	4	>0,05
75% Extract	0.250	4	>0,05

The results showed that the data for positive and negative control groups were not normally distributed ($p < 0.05$), while the data for the three extract concentrations did not deviate significantly from normality ($p > 0.05$). However, due to the presence of non-normal distribution in the control groups, the researchers chose to proceed with a non-parametric test, namely the Kruskal-Wallis test, which does not require normal distribution assumptions.

Kruskal-Wallis Test

Due to the non-normal distribution found in the control groups as indicated by the Shapiro-Wilk test, the Kruskal-Wallis test was applied as a non-parametric alternative to ANOVA. This test is appropriate for comparing more than two independent groups when data do not meet parametric assumptions. The Kruskal-Wallis test evaluates whether the median values across groups differ significantly, which is particularly relevant in biological experiments involving different treatment levels. The Kruskal-Wallis test was conducted based on the following decision criteria: H_0 is accepted if the Asymp. Sig. value is greater than 0.05; H_0 is rejected if the Asymp. Sig. value is less than 0.05. The null hypothesis (H_0) indicates that there is no significant difference in the mean mortality of *Aedes aegypti* mosquitoes across the different concentrations of *Altingia excelsa* leaf extract. Conversely, the alternative hypothesis (H_1) implies that there is a significant difference in mosquito mortality among the various extract concentrations.

Table 5. Kruskal-Wallis Test Results

Variable	Sig. (Asymp. Sig.)
Mosquito Mortality	0.001

Based on the results of the Kruskal-Wallis test presented in Table 5, the test yielded a significant result, as indicated by an Asymp. Sig. value of < 0.05. Therefore, it can be concluded that the null hypothesis (H_0) is rejected, indicating that there is a significant difference in the mean mortality of *Aedes aegypti* mosquitoes across the various concentrations of *Altingia excelsa* (rasamala) leaf extract.

Post Hoc Test

A post hoc test was performed following the rejection of the null hypothesis in the Kruskal-Wallis analysis, in order to identify which specific differences in mean mortality of *Aedes aegypti* mosquitoes were statistically significant across the different concentrations of *Altingia excelsa* (rasamala) leaf extract.

Table 6. Post Hoc Test

Groups Compared	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.

Negative Ctrl vs 25%	-4.500	4.156	-1.083	.279	1.000
Negative Ctrl vs 75%	-7.500	4.156	-1.804	.071	.702
Negative Ctrl vs 50%	-12.000	4.156	-2.887	.004	**.038**
Negative Ctrl vs Positive Ctrl	16.000	4.156	3.849	.000	**.001**
25% Extract vs 75% Extract	-3.000	4.156	-.722	.470	1.000
25% Extract vs 50% Extract	-7.500	4.156	-1.804	.071	.702
Positive Ctrl vs 25% Extract	11.500	4.156	2.767	.006	.055
50% Extract vs 75% Extract	4.500	4.156	1.803	.279	1.000
Positive Ctrl vs 75% Extract	8.500	4.156	2.045	.041	.402
Positive Ctrl vs 50% Extract	4.000	4.156	.962	.336	1.000

Based on the results of the post hoc test presented in Table 6, it was found that the group pairs negative control vs. 50% extract and negative control vs. positive control had Adjusted Sig. values<0.05. These results indicate that there were **statistically significant differences in *Aedes aegypti* mosquito mortality between the negative control group and the 50% extract group, as well as between the negative control group and the positive control group.

The results of the post hoc analysis showed that only two group comparisons demonstrated statistically significant differences in the mortality of *Aedes aegypti* mosquitoes: between the negative control group and the 50% extract group (p = 0.038), and between the negative control group and the positive control group (p = 0.001). Among the extract concentrations, the 50% concentration exhibited the highest mean mortality value, which was 14.5, surpassing both the 25% and 75% concentrations. This suggests that the 50% extract concentration exerted a greater insecticidal effect compared to the other concentrations tested.

Probit Analysis

To quantify the lethal effect of *Altingia excelsa* extract, a **probit analysis** was conducted. This statistical method is commonly used to estimate the lethal concentration (LC_{50}) and lethal time (LT_{50}) parameters which describe the toxicity of a substance and its time-dependent action.

Table 7. *Lethal Concentration* (LC50)

95% Confidence Limit for Dosis		
Probit	Probability	Estimate
	0.1	.630
	0.2	1.283
	0.3	2.014
	0.4	2.828
	0.5	3.726
	0.6	4.712
	0.7	5.79
	0.8	6.962
	0.9	8.233
	1.0	9.607
	1.5	18.201
	2.0	30.245
	2.5	46.761
	3.0	69.153
	3.5	99.375
	4.0	140.183
	4.5	195.552
	5.0	271.353
	5.5	376.537
	6.0	525.258

6.5	740.955
7.0	1064.775
7.5	1574.664
8.0	2434.519
8.5	4045.558
9.0	7664.782
9.1	8943.956
9.2	10576.658
9.3	12717.937
9.4	15625.729
9.5	19761.886
9.6	26040.618
9.7	36555.969
9.8	57382.217
9.9	116791.796

Based on Table 7, the calculated LC_{50} value was 271.353%, indicating that a concentration of 271.35% of *Altingia excelsa* (rasamala) leaf extract is required to kill 50% of the *Aedes aegypti* mosquito population within 24 hours. Meanwhile, the LC_{90} value was 7664.782%, meaning that a concentration of 7664.78% is needed to achieve 90% mortality of the mosquito population within the same exposure period.

Tabel 8. *Lethal Time* (LT50)

Parameter Estimate				
Probit	parameter	estimate	Std. error	Sig.
	time1	0.121	0.233	0.603
	Intercept	-0.858	0.276	0.002

Based on Table 8, the parameter estimate for the time variable had a significance value greater than 0.05, indicating that the data could not be reliably used for Probit analysis results. The LC_{50} and LT_{50} values in this study were measured to evaluate the lethality of *Altingia excelsa* (rasamala) leaf extract against *Aedes aegypti* mosquitoes. Based on the Probit analysis, the LC_{50} value was found to be relatively high, at 271.35%, indicating that a concentration of 271.35% is required to kill 50% of the *Ae. aegypti* population within 24 hours. The LC_{90} value was calculated at 7664.782%, which means that 7664.78% concentration would be necessary to achieve 90% mortality within the same duration. The lower the LC_{50} and LC_{90} values, the higher the toxicity of an insecticide. An insecticide is considered toxic if it has an LC_{50} value greater than 31 ppm and less than or equal to 1000 ppm, which is approximately equivalent to 0.1%. Based on this criterion, the *Altingia excelsa* extract used in this study demonstrates very low toxicity (Lesdiana & Usman, 2021).

A botanical insecticide is considered to exhibit insecticidal activity if the mortality rate falls between 10% and 90%, but it is only considered effective if the mortality rate ranges between 80% and 90%. In this study, the 50% concentration of *Altingia excelsa* extract produced the highest average mosquito mortality rate at 39%. However, this mortality rate is still below the World Health Organization (WHO) effectiveness threshold of 80%–90%. Therefore, it can be concluded that *Altingia excelsa* leaf extract is not effective as an insecticide against *Aedes aegypti* mosquitoes.

4. CONCLUSION

Based on the result of this study, it can be concluded that ethanol extract of *Altingia excelsa* (rasamala) leaves exhibits insecticidal activity against *Aedes aegypti* mosquitoes; however, its effectiveness remains low. The highest mean mortality rate was observed at the 50% concentration, reaching only 39%, which does not meet the WHO criteria for effective insecticides. The Probit analysis revealed a high LC_{50} value of 271.35% and an LC_{90} of 7664.78%, indicating very low toxicity. Additionally, the LT_{50} could not be determined significantly, suggesting that the extract's lethal effect is not achieved within the observation period. Thus, while *Altingia excelsa* leaf extract demonstrates potential as a botanical insecticide, further optimization of formulation and concentration is necessary to enhance its efficacy.

5. REFERENCES

Aji, R., Yamistada, G., Aji, S. R. F. S., Ayunningtyas, R. A., Sari, J. N. 2020. Pendampingan Kader Dalam Pembuatan OVITRAP Fermentasi Perangkap Nyamuk. *Jurnal Kesehatan Pengabdian Masyarakat*. 1(2) : 62-66.

Amelia, A.R., Putri, S.N., Burhanuddin, N.H., Yusuf, R.A. 2023. Pengaruh Perasaan Daun Kemangi (Ocium sanctum) Terhadap Kematian Nyamuk Aedes aegypti Dengan Menggunakan Metode Evaporasi. J*urnal Ilmiah Permas : Jurnal Ilmiah STIKES Kendal*. Vol. 13(3):1001-1010

Anwar, R., Setiawan, A., Suprianto, Supratman, U. 2018. Dua Senyawa Flavonoid Sebagai Aktivitas Antiproliferatif Terhadap SP-C1 Sel Lidah Kanker dari Daun Rasamala (*Altingia excelsa Nornha*). *Jurnal Penelitian dan Pengembangan Ilmu*. 4(2) : 75-78.

Anwar, R., Wirda, S. K., Harniati, E. D. 2021. Perbandingan Aktivitas Antibakteri Ekstrak Etil Asetat Daun Rasamala (*Altingia excelsa noronha*) dan Bahan Pengisi 3 Mix terhadap Enterococcus faecalis. *Indonesian Journal of Dentistry*. 1(1) : 14-19.

Anwar, R., Hajardhini, P. 2022. Aktivitas Antibakteri Asam Gallic dari Daun *Altingia excelsa Noronha* terhadap *Enterococcus faecalis. Jurnal Ilmu Kedokteran Makedonia.* 10(1) : 1-6.

Artikasari, E., Suistyorini, L. 2018. Pengendalian Vektor Nyamuk *Aedes aegypti* Di Rumah Sakit Kota Surabaya. *The Indonesian Journal Public Health*. 13(1) : 71-82.

Badaring, D. R., Sari, S. P. M., Nurhabiba, S., Wulan, W., Lembang, S. A. R. 2020. Uji Ekstrak Daun Maja (*Aegle marmelos L.*) terhadap Pertumbuhan Bakteri *Escherichia coli* dan *Staphylococcus aureus. Indonesian Journal of Fundamental Sciences (IJFS)*. 6(1) : 16-26.

Berri, D. W. S., Almet, J., Wuri, D. A. 2020. Aktivitas Ekstrak Rimpang Temulawak (*Curcuma xanthorrhiza Roxb*.) Sebagai Larvasida Terhadap *Aedes aegypti* di Kecamatan Kelapa Lima Kota Kupang. *Jurnal Kajian Veteriner*. 8(1) : 54-68.

Caroline, I. R. 2022. Kajian Pustaka : Efektivitas Penggunaan Minyak Atsiri Sebagai Aromaterapi. *Jurnal Farmasi dan Kesehatan*. 11(2) : 263-275.

Dewi, R. S. 2020. Efektivitas Ekstrak Daun Lidah Buaya (*Aloe vera* (L) Burm.f.) Sebagai Larvasida *Aedes aegypti. Jurnal Endurance.* 5(2) : 331-337.

Embong, N. B., Sudarmaja, I. M. 2016. Pengaruh Suhu Terhadap Angka Penetasan Telur *Aedes aegypti*. *E-Jurnal Medika*. 5(12) : 1-8.

Embrikawentar, Z. C., Ratnasari, E. 2019. Efektivitas Ekstrak Daun Sukun (Artocarpus altilis) terhadap Mortalitas Hama Walang Sangit (Leptocorisa acuta). LenteraBio. 8(3) : 196-200.

Febritasari, T., Hariani, N., Trimurti, S. 2016. Mortalitas Larva Nyamuk Aedes aegypti (Cullicidae : Diptera) Instar III yang Dikoleksi Dari Kelurahan Loa Bakung, Dadi Mulya dan Sempaja Timur Kota Samarinda Terhadap Abate. Bioprospek. 11(2) : 25-31.

Handito, S., Setyaningrum, E., Handayani, T. T. 2014. Uji Efektivitas Ekstrak Daun Cengkeh (Syzygium aromaticum) Sebagai Bahan Dasar Obat Nyamuk Elektrik Cair Terhadap Nyamuk Aedes aegypti. Jurnal Ilmiah : Biologi Eksperimen dan Keanekaragaman Hayati. 2(2) : 91-96.

Hasanah, Y.N., Wahyuningsih, N.E., Hanani, Y. 2015. Perbedaan Daya Hidup Nyamuk Aedes aegypti Setelah Dipapar LC50 Ekstrak Bangle (Zingiber purpureum) dan Anti Nyamu Cair Berbahan Aktif D-Allethrin dan Transflutrin. Jurnal Kesehatan Masyarakat. Vol. 3(1):599-609

Hasan, H., Aris, M., Pribadi, F. W., Ghozaly, M. R., Paturusi, A. A. E., Utami, Y. P., ... & Rita, R. S. (2024). Farmakognosi Dan Fitokimia: Dasar Pengobatan Herbal. REPOSITORI KAKINAAN.

Hersila, N., Chatri, M., Vauzia., Irdawati. 2023. Senyawa Metabolit Sekunder (Tanin) pada Tanaman sebagai Antifungi. Jurnal Embrio. 15(1) : 16-22.

Husna, P. A. U., Kairupan, C. F., Lintong, P. M. 2022. Tinjauan Mengenai Manfaat Flavonoid pada Tumbuhan Obat Sebagai Antioksidan dan Antiinflamasi. Jurnal eBiomedik. 10(1) : 76-83.

Karwur, T. G., Bernadus, J. B. B., Pijoh, V. D. 2023. Survei Tingkat Kepadatan Jentik Nyamuk Aedes spp. pada Tempat Penampungan Air (TPA) di Kelurahan Paal Dua Kota Manado. Medical Scope Journal. 5(1) : 129-135.

Khoirunnisa, I., Sumiwi, S. A. 2019. Review Artikel : Peran Flavonoid pada Berbagai Aktivitas Farmakologi. Jurnal Farmaka. 17(2) : 131-142.

Lema, Y. N. P., Almet, J. Wuri, D. A. 2021. Gambaran Siklus Hidup Nyamuk Aedes sp. Di Kota Kupang. Jurnal Veteriner Nusantara. 4(1) : 1-13.

Mathesius, U. 2018. Flavonoid Functions in Plants and Their Interactions with Other Organisms. Journal Plants. 7(2) : 30-33.

Mawardi, Busra, R. 2019. Studi Perbandingan Jenis Sumber Air Terhadap Daya Tarik Nyamuk Aedes aegypti Untuk Bertelur. Serambi Engineering. 4(1) : 593-602.

Mentari, S. A. F. B., Hartono, B. 2023. Systematic Review: Faktor Risiko Demam Berdarah di Indonesia. Jurnal Manajemen Kesehatan Yayasan RS. Dr. Soetomo. 9(1) : 22-36.

Nabillah, A., Chatri, M. 2024. Peranan Senyawa Metabolit Sekunder Untuk Pengendalian Penyakit Pada Tanaman. Jurnal Pendidikan Tambusai. 8(1) : 15900-15911.

Ningsih, I. S., Chatri, M., Advinda, L., Violita. 2023. Senyawa Aktif Flavonoid yang Terdapat Pada Tumbuhan. Jurnal Serambi Biologi. 8(2) : 126-132.

Nurmumpuni, D., Kurniawan, B., Suharmanto. 2024. Efektivitas Program Pemberantasan Penyakit Demam Berdarah Dengue. Jurnal Penelitian Perawat Profesional. 6(3) : 1009-1016.

Perum Perhutani. 2021. Rasamala Pohon yang Selalu Hijau. Duta Rimba. 92(15) : 74-78.

Putri, P. A., Chatri, M., Advinda, L., Violita. 2023. Karakteristik Saponin Senyawa Metabolit Sekunder Pada Tumbuhan. Jurnal Serambi Biologi. 8(2) : 251-258.

Ramayanti, I., Layal, K., Pratiwi, P. U. 2017. Efektivitas Ekstrak Daun Kemangi (Ocimum basilicum) Sebagai Bioinsektisida Sediaan Antinyamuk Bakar Terhadap Kematian Nyamuk Aedes aegypti. Journal of Agromedicine and Medical Sciences. 3(2) : 6-10.

Sartika, A., Novita, E., Asri, E. 2020. Status Kerentanan Nyamuk Aedes aegypti terhadap Malathion 5% dan Alfa-sipermetrin 0,025% di Wilayah Kerja Puskesmas Belimbing Kecamatan Kuranji Kota Padang. Jurnal Kesehatan Andalas. 9(1) : 22-28.

Sofiana, D., Wuliandari, J. R. 2023. Survei Nyamuk Aedes aegypti Menggunakan Ovitrap di Kelurahan Mersi dan Desa Ledug. Jurnal Sainteks. 20(1) : 49-59.

Srinita, G., Nurlaela, F., dan Nazarudin, N., 2016. Perbandingan efektivitas obat nyamuk listrik mat yang mengandung D-Allethrin-Transfluthrin dengan Dimefluthrin terhadap nyamuk Aedes aegypti sebagai vektor demam berdarah dengue. Universitas Jendral Achmad Yani. Fakultas Kedokteran. Jawa Barat diakses pada 27 November 2024.

Suhari, I. P., Suprijandani, Marlik, Sulistio, I. 2022. Daya Bunuh Anti Nyamuk Bakar Daun Kemangi (Ocimum basilicum) Pada Nyamuk Aedes aegypti (Studi Pengaruh Konsentrasi Terhadap Kematian Nyamuk Tahun 2022). Jurnal Vektor Penyakit. 16(2) : 135-144.

Susanto, Suharyo. 2017. Hubungan Lingkungan Fisik dengan Keberadaan Jentik Aedes Pada Area Bervegetasi Pohon Pisang. Unnes Journal of Public Health. 6(4) : 271-276.

Sutarto, Syani, A. Y. 2018. Resistensi Insektisida pada Aedes aegypti. J Agromedicine Unila. 5(2) : 582-586.

Utami, Y. P., Imrawati, I., Mus, S., Mustarin, R., Jariah, A. 2024. Identifikasi dan Penetapan Kadar Flavonoid Ekstrak Etil Asetat Daun Mimba (Azadiractha indica A. Juss) Metode Spektrofotometri UV- Vis. Journal of Experimental and Clinical Pharmacy (JECP). 4(2) : 72-81.

Utami, I.W., Cahyati, W.H. 2017. Potensi Ekstrak Daun Kamboja Sebagai Insektisida Terhadap Nyamuk Aedes aegypti. Higeia. Vol.1(1):22-28

Wuliandari, J. R., Mulia, D. S., Susanto. 2023. Surveiland Aedes aegypti Menggunakan Ovitrap Di Desa Endemis Demam Berdarah Kabupaten Banyumas. Jurnal Ilmiah Biologi. 11(2) : 1420-1434.

Yulianti, E., Juherah, Abdurrivai. 2020. Perilaku Bertelur dan Siklus Hidup Nyamuk Aedes aegypti pada Berbagai Media Air (Studi Literatur). Jurnal Solulipu : Media Komunikasi Sivitas Akademika dan Masyarakat. 20(2) : 227-239.