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SOLUTION OF SUNGKAI LEAVES (*Peromena canescens*) AS A LARVICIDE AGAINST THE AEDES AEGYPTI MOSQUITO

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ABSTRACT

Solution of Sungkai Leaves (*Peromena canescens*) as a larvicide against the *Aedes aegypti* mosquito. The dengue virus causes Dengue hemorrhagic fever (DHF), an infectious disease that a mosquito vector spreads. In 2021 (ABJ), the larvae-free rate in South Kalimantan is 87.15%; in Banjarbaru City, it is 86%, so it has not yet reached the national standard, which is > 95%. This study aims to reduce mosquito larvae using sungkai leaves, a vegetable larvicide. This plant contains many active substances, such as alkaloids, flavonoids, saponins, steroids, triterpenoids, phenolics, and tannins. This type of research involves the application of the True Experiment Design method. The pThird-instar Aedes aegypti larvae make up the population. We used 600 Aedes aegypti larvae with varying concentrations of 0%, 0.1%, 0.3%, 0.6%, 0.9%, 1.2%, 1.5%, and 1.8% in 1000 mL of water, with a contact time of 24 hours. esults of the Kruskal-Wallis Asymp.Sig test were 0.002<a (0.05). The concentrations that effectively killed larvae were 0.3% and 0.6%. At 24 hours of contact, the LC50 value was 1.941%. The toxid unit value was 51.5. Therefore, we can deduce that the sungkai leaf solution plays a significant role in managing Aedes aegypti larvae. It isWe hope the community will grow plants in the river to combat mosquito larvae. h agencies can interact with the public about how to make larvicides. We hope that future researchers will progress from a solution to an extract.

INTRODUCTION

Surabaya reported the first dengue case in Indonesia in 1968. Every year since its discovery, the number of cases has continued to rise. Dengue disease is transmitted by the mosquito types Aedes aegypti and Aedes albopictus [1]. The infectious vector's characteristics determine the spread and timing of infection. The Aedes mosquito's habitat is generally tropical, with high rainfall and hot and humid temperatures. Aedes mosquitoes prefer to nest in puddles or water reservoirs like gutters, vases or plant pots, pet drinking bins, swimming pools, or trash cans. [1]

The South Kalimantan Provincial Health Office (2021) reported that the larvae-free rate (ABJ) was 87.15% and the House Index (HI) was 12.85%, while in the Banjarbaru City area, ABJ was 86% and HI was 14%. Based on the environmental health quality standards for Aedes aegypti larval vectors with ABJ parameters, the percentage of houses or buildings that are negative for larvae must be ≥95%. As a result, ABJ South Kalimantan and Banjarbaru City did not meet the requirements. To prevent vector-borne diseases or vector-induced disorders, vector control aims to reduce the vector population. The purpose of controlling dengue vectors is to reduce the density and population of vectors to a certain index, which is a level that is no longer dangerous for public health. Therefore, vector control urgently needs community participation. [2] [3]

Plant-based insecticides provide an alternative for controlling the number of cases. The advantage of this control is that the material is easy to find because many are found in yards and close to residential areas. In addition, using plant-based larvicides does not leave residues in the environment. Sungkai leaf (Peronema canesces Jack) is one of the natural larvicides. We choose sungkai leaves because they contain numerous active substances, including alkaloids, flavonoids, saponins, steroids, triterpenoids, phenolics, and tannins. Secondary metabolite compounds from sungkai leaves (Peronema canesces) influence the physiology of the larvae. [4] The Aedes aegypti mosquito is the primary carrier of the virus, while the Albopictus mosquito is a secondary carrier. The larvae used are instar III larvae because of their large size and more stable body condition than instar I and II larvae. Researchers rarely use instar IV larvae as research targets because they nearly transform into pupae. [5] Based on the background description above, this study aims to determine the effectiveness of sungkai leaf solution as a larvicide against Aedes aegypti mosquitoes.

MATERIALS AND RESEARCH METHODS

We conducted preliminary tests to establish the concentration for acute toxicity tests. The concentrations set in this preliminary test were 6 concentration variations, namely 0% (control), 3%, 6%, 9%, 12%, and 15% in 100 ml of water with observation for 24 hours, while the number of larvae used was 25 heads per container. Table 2 displays the preliminary test results.

Table 2 Data on preliminary test results of Aedes aegypti larval mortality

24-hour time	Concentration							
	0%	3%	6%	9%	12%	15%	pH	Temperature
Sungkai leaf	0	8	8	10	13	15	5,3	28,8C°

The average larval mortality *of Aedes aegypti* is the highest at a concentration of 15% as many as 15 heads, the lowest larval mortality is 3% and 6% as many as 8 heads. The average pH is 5.3 and the temperature = 28.8oC. After the preliminary test, an experiment was carried out with 8 concentrations, namely 0% (control), 0.1%, 0.3%, 0.6%, 0.9%, 1.2%, 1.5%, 1.8% in 1000 ml of water with observation for 24 hours and 3 repetitions. The number of larvae used is 25 heads/container. The results of the toxicity test of the variation in the concentration of sungkai leaf solution (*Peronema canescens*) on the death of *Aedes aegypti larvae* are presented in table 3.

Table 3. Toxicity Test Results of Variation in Concentration Effectiveness of Sungkai Leaf Solution (Peronema canescens) on Aedes aegypti larval death

Concentration larutan	Sum larva	Repetition			Average larval mortality	Average %
		R1 (Tail)	R2 (Tail)	R3 (Tail)		
0%	25	0	0	0	0	%
0,1%	25	2	2	1	2	7%
0,3%	25	3	2	3	3	11%
0,6%	25	5	4	4	4	17%
0,9%	25	8	7	8	8	31%
1,2%	25	9	9	8	9	35%
1,5%	25	9	10	9	9	37%
1,8%	25	9	11	10	10	40%

Table 3 shows that the Aedes aegypti larvae have the highest average mortality at an 18% concentration of 10 larvae. Meanwhile, the lowest average Aedes aegypti larval mortality was at a 0% (control) concentration of 0%. Figure 1 provides a clearer view of the larval mortality results.

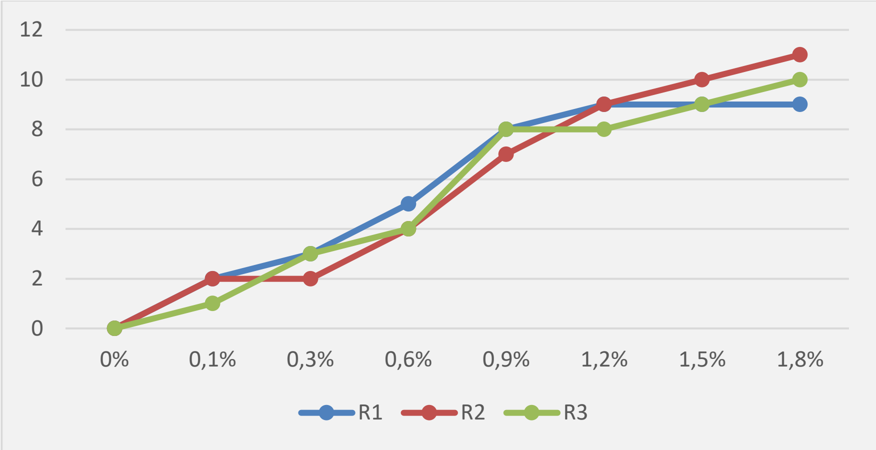

Figure 1. Larval death graph of Aedes aegypti

Figure 1 shows that the mortality of Aedes aegypti larvae increases as the concentration increases. The higher the concentration level of the solution, the higher the mortality of Aedes aegypti larvae. Table 4 illustrates the variation in pH and water temperature in the toxicity test, demonstrating the effectiveness of the sungkai leaf solution in killing Aedes aegpyti larvae. It indicates that the pH range for Aedes aegypti larval death falls between 6.4 and 6.9, while Table 5 displays the temperature range for Aedes aegypti larval death between 27.0°C and 27.5°C.

Table 4. Results of the pH measurement of the sungkai leaf solution toxicity test
The larvae of Aedes aegpyti have died.

Concentration Sungkai leaf solution	pH			pH range
	R1	R2	R3	
0%	6,8	6,9	6,9	6,9-6,8
0,1%	6,7	6,7	6,7	6,7
0,3%	6,7	6,6	6,7	6,7-6,6
0,6%	6,6	6,7	6,6	6,7-6,6
0,9%	6,5	6,5	6,6	6,6-6,5
1,2%	6,5	6,5	6,5	6,5
1,5%	6,5	6,4	6,5	6,5-6,4
1,8%	6,4	6,4	6,5	6,5-6,4

Table 5. Results of water temperature measurement, toxicity test
of sungkai leaf solution on the death of Aedes aegypti larvae

Concentration Sungkai leaf solution	Temperature			Temperature Range °C
	R1	R2	R3	
0%	27,0	27,1	27,1	27,0-27,1
0,1%	27,0	27,0	27,2	27,0-27,2
0,3%	27,1	27,2	27,2	27,1-27,2
0,6%	27,2	27,2	27,3	27,2-27,3
0,9%	27,3	27,2	27,4	27,2-27,4
1,2%	27,3	27,3	27,4	27,3-27,4
1,5%	27,4	27,3	27,5	27,3-27,5
1,8%	27,4	27,4	27,5	27,4-27,5

After obtaining the results of larval death with observation for 24 hours, it was followed by an SPSS test. The following are the results of the larval death spss test.

Table 6 Results of the Normality Test of Sungkai Leaf Solution (Peronema canescens)

Concentration of sungkai leaf solution	Shapiro-Wilk Statistic	df	Mr.
0,1%	.750	3	.000
0,3%	.750	3	.000
0,6%	.750	3	.000
0,9%	.750	3	.000
1,2%	.750	3	.000
1,5%	.750	3	.000
1,8%	1.000	3	1.000

Based on the results of the normality test in Table 6, the Shapiro-Wilk sig value of 0.000 or less than a (0.05) indicates that the data is not normally distributed. At a concentration of 1.8%, we obtained a Shapiro-Wilk sig = 1,000 or > a (0.05), indicating a normal distribution of the data. Next, we conducted a homogeneity test to verify the homogeneity of the two data sets, specifically by contrasting the two variants.

Table 7 Homogeneity Test of Sungkai Leaf Solution on Aedes aegypti Larval Death

Levene Statistic	df1	df2	Mr.
1,486	7	16	,241

Based on the results of the homogeneity test in Table 7, if sig = 0.241 or > a (0.05), then the data is homogeneous. The One-way Anova requirements state that all data must be normal and homogeneous, failing to meet these requirements. We continued the data analysis with the Kruskal-Wallis test to ascertain the impact of variations in the concentration of sungkai leaf solution (Peronema canescens) on the control of Aedes aegypti larvae.

Table 8. Kruskal-wallis test of sungkai leaf solution

Test Statisticsa,b

	Larval death *of Aedes aegypti* (Sungkai leaf solution)
Chi-Square	22.127
df	7
Asymp. Sig.	.002

The Kruskal-Wallis test showed that Asymp.Sig is 0.002 ± 0.05, which means that there is an effect of changing the concentration of sungkai leaf solution on the death of Aedes aegypti larvae. Furthermore, we conducted a Kruskal-Wallis test to ascertain the difference between concentration variations. The follow-up test results showed a significant difference between the control group at concentrations of 1.5% and 1.8%, as indicated by the sig. values of 0.002 and 0.001, which are less than the significance level of 0.05. We first carried out a probit analysis using the SPSS application to determine the LC50 (lethal consent) value of the Leaf Sungkai (Peronema canescens) solution on the death of Aedes aegypti larvae. Here are the results of the probit analysis to determine LC50. [7]

Table 9. Results of the Probit Analysis Concentration Test

No	Lethal Consentration	Estimated	95% Trust Limit MIN	95% Trust Limit MAX
1	LC50	1,941	1,680	2,390
2	LC99	5,256	4,253	7,140

Table 9 estimates the concentration required to kill 50% of Aedes aegypti larvae at 1.941%, with an upper limit of 2.390% and a lower limit of 1.680%. On the other hand, we estimate the concentration required to kill 99% of Aedes aegypti larvae to be 5.256%, with an upper limit of 7.140% and a lower limit of 4.253%.

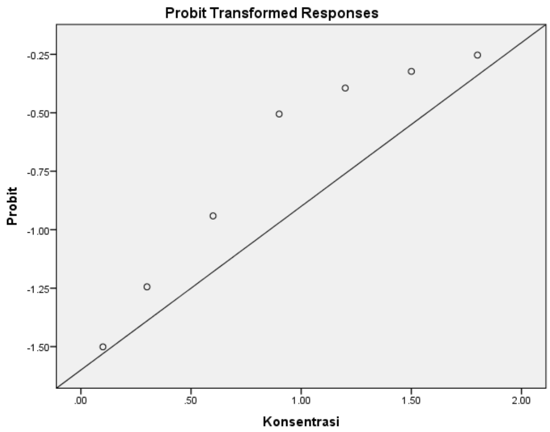

Figure 2. Probit analysis curve

The following formula calculates the value of TU (toxic unit), which relates the amount of concentration to the larvae of Aedes aegypti.
TU (Toxic Unit) is equal to 100 / 24 jam, and LC50 is equal to 100 / 1,941 = 51,5.
The calculation yielded a value of 51.5 for the TU (toxic unit), which correlates the number of concentrations with larval mortality. The Kruskal-Wallis test showed that the asymptote value (Sig) is 0.002 ± 0.05, which means that there is an effect of how well the sungkai leaf solution kills Aedes aegypti larvae. Aedes aegypti larvae absorb more toxins when the concentration of sungkai leaf solution (Peronema canescens) increases. This means that Aedes aegypti larvae died more quickly when there was more vegetable larvicide in the solution of sungkai leaves (Peronema canescens). [8–12]
According to Pindan's (2021) research, the phytochemical results of sungkai leaves contain alkaloids, flavonoids, steroids, triterpenoids, phenolics, and saponins. According to the GC-MS results from the ethyl acetate fraction of sungkai leaves (Peronema canescens), it is known that it only predominantly contains fatty acid compounds consisting of decanoic acid, dedecanoic acid, tetradecanoic acid, methyl 11-octadecenoate, and 1,2-benzenedicarboxylic acid [13]. According to research (Ramayanti 2016), papaya leaves are another plant material that contains active metabolites in the form of flavonoids, alkaloids, and tannins that can inhibit the growth of Aedes aegypti larvae. [14]
We analyzed the effectiveness of the vegetable larvicide in the sungkai leaf solution at concentrations of 0% (control), 0.1%, 0.3%, 0.6%, 0.9%, 1.2%, 1.5%, and 1.8% by counting the number of larval deaths using tail units. At the highest concentration, which is 1.8%, it is able to kill 30 larvae out of 75% of the experimental larvae, or 40%. According to the Regulation Number 50 of 2017 by the Minister of Health of the Republic of Indonesia, which pertains to Environmental Health Quality Standards and Health Requirements for Vectors and Animals Carrying Diseases and Their Control, an agent is considered effective if it can kill 80% or more of the target animals. According to this study, it has not been able to kill 80% because sungkai leaves are vegetable materials, so the length of contact time is different from chemicals. If you add concentration and observation time of more than 24 hours, you are likely to kill up to 80% of the larvae. [15–17]
Sungkai leaves contain compounds that have the same toxic power as larvicides. Even in low concentrations, toxic compounds or elements can cause death in larvae if they enter the body. Lethal concentration (LC) is a standard measure of a medium's toxicity that can kill Aedes aegypti larvae. LC50 is the concentration required to kill 50% of the larval population. We

did a probit test and found that the LC50 value of the sungkai leaves (Peronema canescens) solution was 1.941. This means that the concentration of sungkai leaves (Peronema canescens) that can kill 50% of the larvae is 1.941%, with a range of 2.390% to 1.680%. To kill 90% of the larvae, the solution of sunkai leaves (Peronema canescens) has an LC value of 5.256%. This means that the solution of sunkai leaves (Peronema canescens) must have a concentration of 7.140%, with a range of 7.140% to 4.253%. [15,16,18–20]
Due to the use of a vegetable-based insecticide solution, which has a lower environmental impact than synthetic insecticides, the concentration required to kill the test animal is quite large and the time required is not fast. Several advantages of plant-based insecticides include their biodegradability in nature, their inability to cause insect immunity even at high concentrations, and their rarity on dead plants. [21–24] Taslimah (2014) states that a toxic unit (TU) measures the intensity of toxins in a mixture of ingredients. The toxic unit for a particular compound is determined by a concentration where there is a 50% (LC50) effect for a given biological endpoint. The toxic unit data from this study are presented below. The value of TU (toxic unit) at the time of treatment for 24 hours was 51.5. This indicates that the solution of sungkai leaves (Peronema canescens) contains sufficient poison to kill the test animal unit. The toxic unit is based on a concentration where there is a 50% (LC50) effect for a given biological endpoint [25, 26].

CONCLUSIONS AND RECOMMENDATIONS

The study concluded that variations in the concentration of sungkai leaf solution (Peronema canescens) have an effect on the death of Aedes aegypti larvae. The variation in the concentration of sungkai leaf solution (Peronema canescens) has not been able to kill 80% of the larvae. If you add concentration and observation time of more than 24 hours, you are likely to kill 80% of the larvae. The Lethal Concentration 50% (LC50) probit test results indicate that a concentration of 1.941%, with an upper limit of 2.390% and a lower limit of 1.680%, is required to kill 50% of Aedes aegypti larvae. Sungkai leaf solution (Peronema canescens) has a TU (toxide unit) value of 51.5.

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