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Assessing the Larvicidal Efficacy of Basil Leaf Extract (*Ocimum sanctum Linn*) Against *Aedes aegypti* Mosquito Larvae

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A B S T R A C T

Dengue Hemorrhagic Fever is an illness caused by the Dengue virus which is transmitted to humans through the bite of Aedes Aegypti and Aedes Albocpictus mosquitoes. Aedes Aegypti is a species of mosquito that is commonly found in tropical and subtropical regions of the world. These mosquitoes are known to be efficient vectors for arboviruses, as they are very anthropophilic and tend to live in close proximity to humans, often inside houses. Basil (Ocimum sanctum Linn) is a plant that is well-known in Indonesia. It contains flavonoid compounds and saponins, which can be used as insecticides and larvicides. The objective of this study was to determine the effectiveness of basil leaf extract in killing Aedes Aegypti larvae in RT 03 RW 03 Citamiang Sub-district, Citamiang Urban Village, Sukabumi, in 2018. The research type was an experiment with 10ml, 15ml, 20ml, and 25ml doses, each repeated four times. The population used was 250 Aedes Aegypti larvae, with 10 larvae in each container, taken from RT 03 RW 03 Citamiang Sub-district, Citamiang Urban Village, Sukabumi, in 2018. Data analysis involved Univariat Analysis and Bivariat Analysis using SPSS.

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INTRODUCTION

Dengue Hemorrhagic Fever is a disease caused by the Dengue virus transmitted to humans through the bite of Aedes Aegypti and Aedes Albopictus mosquitoes. Indonesia is one of the endemic areas with distribution throughout the country. Symptoms include sudden fever, headache, eye pain, nausea, and manifestations of bleeding such as nosebleeds or bleeding gums, as well as redness on the body surface in patients (Ministry of Health, 2017).

Aedes Aegypti is a species of tropical and subtropical mosquitoes found on Earth. Aedes Aegypti is one of the most efficient mosquito vectors for arboviruses because these mosquitoes are highly anthropophilic and live close to humans, often within households. A complicating factor in vector control is that Aedes Aegypti eggs can withstand desiccation (drying out) for long periods, sometimes over a year (WHO, 2014).

According to data from the Ministry of Health of the Republic of Indonesia in 2017, there were 201,885 cases of Dengue Hemorrhagic Fever (DHF) and 1,585 deaths from the disease nationwide, while in West Java there were 36,631 DHF cases with 270 deaths.

LITERATURE REVIEW

Dengue Hemorrhagic Fever is a disease caused by the Dengue virus transmitted to humans through the bite of Aedes Aegypti and Aedes Albopictus mosquitoes. Indonesia is one of the endemic areas with distribution throughout the country. Symptoms include sudden fever, headache, eye pain, nausea, and manifestations of bleeding such as nosebleeds or bleeding gums, as well as redness on the body surface in patients (Ministry of Health, 2017).

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According to data from the Ministry of Health of the Republic of Indonesia in 2017, there were 201,885 cases of Dengue Hemorrhagic Fever (DHF) and 1,585 deaths from the disease nationwide, while in West Java there were 36,631 DHF cases with 270 deaths. According to data from the Sukabumi City Health Office, in 2015 there were 793 cases of DHF. Meanwhile, in 2016 the number of DHF cases reached 854, and in 2017 there were 879 cases.

According to data obtained from the Gedong Panjang Community Health Center in Sukabumi City from January 2017 to January 2018, there were 54 cases of DHF, with 22 cases in RT 03 RW 03, Citamiang Sub-district, Citamiang Urban Village, Sukabumi City.

Based on preliminary studies, from the overall analysis of observation data on larvae inspections in RT 03 RW 03, Citamiang Sub-district, Citamiang Urban Village, Sukabumi City, it can be concluded that out of 48 households examined, 25 of them had positive larvae. Based on data analysis (ABJ, HI, CI, and BI), the larval density level is classified as very high.

To address the problem of Dengue Hemorrhagic Fever in Indonesia, one method is to break the mosquito's life cycle at the larval stage. Larval control can be done in two ways: by eliminating larval breeding sites and by using insecticides. Larva eradication using insecticides can be done naturally or chemically. Vector control using chemical substances can suppress the larval population but can also cause environmental pollution, poisoning, and the death of animals other than larvae. On the other hand, natural vector control is currently a beneficial alternative because it is environmentally friendly, easily degradable, and does not cause the death of other animals.

Basil (Ocimum sanctum Linn) is a plant widely known to the Indonesian people. This plant is easily accessible and often grown in home gardens. Basil contains compounds such as tannins, eugenol, flavonoids, triterpenoids, essential oils, hexauronic acid, saponins, pentose, xylose, homosianic acid, molludistin, and ursolic acid. Flavonoids and saponins can be used as insecticides and larvicides. Saponin compounds can act as larvicides by reducing the surface tension of the larval mucosal membrane, making the tract wall corrosive, while flavonoids are toxic to insects. The essential oil of basil leaves shows lethal effects on Aedes Aegypti larvae. Ethanol extract of basil leaves also exhibits antifungal and antibacterial effects (Kartika, 2014).

METHODOLOGY

This study is an experimental research type. In terms of its purpose, this research is classified as Verificative research aimed at verifying the results of previous research to determine the effect of Basil Leaf Extract (Ocimum Sanctum Linn) on the mortality of Aedes Aegypti larvae. Variables are characteristics, attributes, or measurements possessed or obtained by research units regarding a particular concept (Notoatmodjo, 2019).

Population refers to the generalization area consisting of objects/subjects with specific qualities and characteristics defined by the researcher for study and subsequent conclusion drawing (Sugiyono, 2011). The population in this research consists of 250 Aedes Aegypti larvae taken from RT 03 RW 03, Citamiang Sub-district, Sukabumi City, and then placed in each container.

Sample refers to a part, number, or characteristics possessed by the population. When the population is large and the researcher cannot study all of them due to limitations in funds, personnel, and time, the researcher will take a sample from the population. The conclusions drawn from the sample will be applied to the population. Therefore, the sample taken from the population must be truly representative (Sugiyono, 2011).

The research samples include:

1. Five containers were used for the study.
2. Four containers treated with Basil Leaf Extract (*Ocimum Sanctum Linn*).
3. Each container treated with doses of 10ml, 15ml, 20ml, and 25ml.
4. One container as a control without Basil Leaf Extract (*Ocimum Sanctum Linn*) treatment.
5. Each container is filled with 10 Aedes Aegypti larvae.
6. Observation conducted with 5 repetitions.

Equipment

The equipment used in this research includes:

a) pH/Stick indicator
b) Thermometer
c) Filter paper
d) Measuring glass
e) Blender
f) Dropper pipet
g) Containers

Materials

The materials used in this research include:

a. 96% Ethanol
b. Basil leaves (*Ocimum Sanctum Linn*)
c. Basil Leaf Extract (*Ocimum Sanctum Linn*)
d. Aedes Aegypti larvae

RESEARCH RESULT

The research findings are presented in the following table:

Univariate Analysis Results

Table 1. Number of Aedes aegypti Larvae Deaths at 10ml Dose

Replication	Dose	Time (minute)	∑ Larvae Deaths	pH	Temperature
Control	-	60	0	7	25^{o}C
1	10ml	60	3	5	25^{o}C
2	10ml	60	3	5	25^{o}C
3	10ml	60	4	5	25^{o}C
4	10ml	60	4	5	25^{o}C
			X_1 = 14		

Based on the research findings presented in the table above, with the treatment of 10ml Basil Leaf Extract (*Ocimum Sanctum Linn*) conducted over 5 replications, it was observed that 14 larvae of Aedes aegypti died.

Table 2. Number of Aedes aegypti Larvae Deaths at 15ml Dose

Replication	Dose	Time (minute)	∑ Larvae Deaths	pH	Temperature
Control	-	60	0	7	25^{o}C
1	15ml	60	6	5	25^{o}C
2	15ml	60	7	5	25^{o}C
3	15ml	60	6	5	25^{o}C
4	15ml	60	8	5	25^{o}C
			X_1 = 27		

Based on the research findings presented in the table above, with the treatment of 15ml Basil Leaf Extract (Ocimum Sanctum Linn) conducted over 5 replications, it was observed that 27 larvae of Aedes aegypti died.

Table 3.Number of Aedes aegypti Larvae Deaths at 20ml Dose

Replication	Dose	Time (minute)	∑ Larvae Deaths	pH	Temperature
Control	-	60	0	7	25°C
1	20ml	60	9	5	25°C
2	20ml	60	8	5	25°C
3	20ml	60	7	5	25°C
4	20ml	60	10	5	25°C
			X_1 = 34		

Based on the research results presented in the table above, with the treatment of 20ml Basil Leaf Extract (Ocimum Sanctum Linn) conducted over 5 replications, it was found that 34 larvae of Aedes aegypti died.

Table 4. Number of Aedes aegypti Larvae Deaths at 25ml Dose

Replication	Dose	Time (minute)	∑ Larvae Deaths	pH	Temperature
Control	-	60	0	7	25°C
1	25ml	60	9	5	25°C
2	25ml	60	9	5	25°C
3	25ml	60	10	5	25°C
4	25ml	60	10	5	25°C
			X_1 = 36		

Based on the research results presented in the table above, with the treatment of 20ml Basil Leaf Extract (Ocimum Sanctum Linn) conducted over 5 replications, it was found that 36 larvae of Aedes aegypti died.

Bivariate Analysis Results
Homogeneity Test Results

Table 5.Results of Variance Homogeneity Test of Basil Leaf Extract (Ocimum Sanctum Linn) Against the death of Aedes Aegypti larvae

Levene Statistic	df1	df2	Sig.
1.833	3	12	192

Primary Data Analysis Results Using SPSS in 2016

ANOVA Test

Table 6.Analysis of Variance (ANOVA) Results for Treatment Doses of Basil Leaf (*Ocimum Sanctum Linn*) on the Death of Aedes Aegypti Larvae

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	83.188	3	27.729	34.128	.000
Within Groups	9.750	12	.812		
Total	92.938	15			

Primary Data from SPSS Calculations in 2016

From the table above, the obtained significance value of 0.000, which is less than α = 0.05, indicates that the research hypothesis is accepted. This signifies that with 5 repetitions at dosages of 10ml, 15ml, 20ml, and 25ml, there is a significant impact on killing Aedes Aegypti larvae.

Based on the analysis of the ANOVA calculation results, since the null hypothesis (H0) is rejected and the alternative hypothesis (Ha) is accepted, indicating differences between groups, this test is followed by a Post Hoc Test to compare the mean values among treatment groups at a significance level of α = 0.05, as shown in the following table:

Results of the Post Hoc Test

Table 7. Analysis of Dosage Differences of Basil Leaf Extract (*Ocimum Sanctum Linn*) Across Various Treatments

No	Treatment Group	Treatment Group	Mean Difference	P –Value
1	10ml	Dose 15ml	-3.25000*	.002
		Dose 20ml	-5.00000*	.000
		Dose 25ml	-6.00000*	.000
2	15ml	Dose 10ml	-3.25000*	.002
		Dose 20ml	-1.75000*	.106
		Dose 25ml	-2.75000*	.006
3	20ml	Dose 10 ml	-5.00000*	.000
		Dose 15ml	1.75000*	.106
		Dose 25ml	-1.00000*	.856
4	25ml	Dose 10 ml	6.0000*	.000
		Dose 15 ml	2.7500*	.006
		Dose 20ml	1.0000*	.856

Based on the results presented in the Post Hoc Test analysis following ANOVA:

- The 10 ml treatment exhibited a coefficient p-value of 0.02, indicating a statistically significant effect (p-value < 0.05) on larval mortality.
- Similarly, the 15 ml treatment showed a coefficient p-value of 0.02, demonstrating a significant impact (p-value < 0.05) on larval mortality.
- Notably, the 20 ml treatment displayed a coefficient p-value of 0.000, revealing a highly significant influence (p-value < 0.05) on larval mortality.
- Likewise, the 25 ml treatment yielded a coefficient p-value of 0.000, indicating a substantial effect (p-value < 0.05) on larval mortality.

DISCUSSION

Based on the data presented in Table 5.1, this study establishes that the use of basil leaf extract (Ocimum sanctum Linn) has a significant impact on the mortality of Aedes aegypti mosquito larvae. The presence of flavonoids, which are toxic compounds in basil leaf extract, is responsible for its effectiveness as an insecticidal agent.

The research indicates that basil leaf extract (Ocimum sanctum Linn) can effectively act as a larvicide against Aedes aegypti mosquitoes by inhibiting their growth and causing mortality. The study used four repeated treatments of different concentrations of basil leaf extract, which resulted in varying larval mortality rates. At 10 ml, the extract led to the death of 14 Aedes aegypti larvae; at 15 ml, 27 larvae died; at 20 ml, 34 larvae died; and at 25 ml, 36 larvae died. The control group, which received no basil leaf extract, showed no mortality among Aedes aegypti larvae.

The differences among the concentrations are highlighted in Table 5.2, which shows the analysis conducted using SPSS software. The ANOVA results for doses of 10 ml, 15 ml, 20 ml, and 25 ml yielded an F-value of 42.180 with a significance value of 0.000. Since the significance value is less than $\alpha=0.05$, the research hypothesis is accepted.

CONCLUSIONS AND RECOMMENDATIONS

The outcomes derived from the 10 ml basil leaf extract, as assessed through the post hoc test and ANOVA, demonstrated a coefficient p-value of 0.02 ($p < 0.05$), indicating a statistically significant association between the 10 ml basil leaf extract and larval mortality. Consequently, the research hypothesis is upheld.

Similarly, findings from the 15 ml basil leaf extract, analyzed using the post hoc test and ANOVA, revealed a coefficient p-value of 0.02 ($p < 0.05$), signifying a substantial correlation between the 15 ml basil leaf extract and larval mortality. As a result, the research hypothesis is affirmed. Moreover, outcomes from the 20 ml basil leaf extract, examined via the post hoc test and ANOVA, exhibited a coefficient p-value of 0.000 ($p < 0.05$), underscoring a notable relationship between the 20 ml basil leaf extract and larval mortality. Thus, the research hypothesis is substantiated.

Lastly, results from the 25 ml basil leaf extract, analyzed using the post hoc test and ANOVA, yielded a coefficient p-value of 0.000 ($p < 0.05$), highlighting a significant link between the 25 ml basil leaf extract and larval mortality. Therefore, the research hypothesis is validated.

ADVANCED RESEARCH

The findings of this research are expected to enrich the reference materials available in the library of Poltekes Yapkesbi Sukabumi. Utilize this research to enhance field activities such as health awareness campaigns or health promotions, integrating educational content on traditional plants that can serve as alternatives for mosquito or larvae control. Increase awareness about plants like basil (kemangi) which are easily accessible, environmentally friendly, and safe for human health.

Future studies should consider using a larger sample size of larvae to ensure more representative data. Further research is needed to explore the duration of the effects of basil leaf extract on Aedes aegypti larvae. Investigate more practical methods for preparing basil leaf extract solutions that can be easily adopted by the community.

Encourage the community to use basil leaf extract solutions in mosquito breeding areas such as water containers, discarded tires, etc. Disseminate information to the public through posters or brochures highlighting the utilization of basil leaf extract as a botanical insecticide for controlling the population of Aedes aegypti mosquitoes.

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