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POTENTIAL EXTRACTS OF LAVENDER (Lavandula angustifolia) AND LEMONGRASS (Cymbopogon citratus) AS PLANT-BASED INSECTICIDES FOR Aedes aegypti MOSQUITOES

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ABSTRACT
Lavender flowers (Lavandula angustifolia) and Lemongrass leaves (Cymbopogon citratus) contain chemicals, namely essential oils which can be used for insect control. The purpose of this study was to examine the potential of Lavender and Lemongrass plant extracts as vegetable insecticides against Aedes aegypti mosquitoes. Aedes aegypti is a vector carrying the DEN virus that causes dengue hemorrhagic fever (DHF) in humans. The experiment was carried out in a treatment box. The design used in this experiment was a completely randomized design with three replications. The factors tested were the types of plants which included Lavender and Lemongrass, as well as the doses which consisted of 0, 25, 50, 75 and 100%. The parameter measured was mosquito mortality within 48 hours. Based on the analysis of diversity, it turned out that the extract dose had a very significant effect, while the types of vegetable insecticides made from Lavender and Lemongrass plants had no significant effect on mosquito mortality within 48 hours, and there was no interaction between the two. Mosquito mortality tended to increase after 40 hours. The smallest significant difference test showed that the 100 dose of extract had potential as an insecticide with a mortality rate for Lavender of 100%, while for Lemongrass 78.35%.

KEYWORDS *repellent; mortality; Lavender; Lemongrass; Aedes aegypti*

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I. INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is one of the infectious diseases in the community. DHF transmission occurs through the bite of adult female Aedes aegypti mosquitoes that have previously carried the Dengue virus in their bodies from other dengue fever sufferers. Prevention of DHF can be done in various ways but depends on their vector control (1).

Aedes aegypti mosquitoes are the main vector of dengue hemorrhagic fever (DHF). This type of mosquito is found in almost all Indonesia's rimland, except in places with an altitude of 1000 meters above sea level, because at that altitude the temperature is low so it is not possible for mosquitoes to live and breed (2). Aedes aegypti mosquitoes like other types of mosquitoes undergo complete metamorphosis, namely eggs - larvae - pupae - mosquitoes. Over 9 – 10 days, the eggs developped in to adult mosquitoes. The lifespan of female mosquitoes can reach 2-3 months (3).

Vector control is an effort to reduce risk factors for vector-borne transmision by minimizing vector breeding habitats, reducing density and age, reducing contact between vectors and humans and breaking disease chain transmission (3).

Prevention and control of vector still depend on the use of insecticides. Today, commonly efforts to control Aedes aegypti mosquitoes are by spraying them using chemical insecticides, including mosquito repellent, by disrupting important processes in their lives. Insects can be exposed to insecticides by direct

contact, ingestion, or through breathing. Insecticide as a contact poison, stomach, respiratory poison depends on the mode of entry (mode of entry) of the insecticide into the body of the insect (3).

In coil shaped mosquito coil, there are 0.3% d-aletrin as active ingredient, mat electric mosquito repellent contains d-aletrin 40 mg and transflutrin 3 mg each mat as active ingredients. Active ingredients of mosquito repellent spray are proletrin 0.2% and d-aletrin 0.15%. Paper mosquito coils have contains 1% transfluthrin (0.04 gr/pcs). In magic chalk there is 0.6% deltamethrin. Most of the active ingredients of such household insecticides belong to the synthetic class of pyrethroids (4). Excessive and repeated use of chemical insecticides can lead to environmental pollution effects and endanger human health (5).

The impact of chemical insecticides is residues of active ingredients that are difficult to decompose in nature. These negative impacts need to be avoided by replacing chemical insecticides with natural / vegetable insecticides (6). One of the way to reduce the side effects and resistance of mosquitoes to chemicals contained mosquito repellent, is the need to develop alternative mosquito repellents made from plants that are found and widely available in nature. Indonesia with very high plant biodiversity, has a great opportunity to utilize vegetable insecticides as mosquito repellent. Usage of natural insecticides in mosquito eradication will be easily decomposed so it will not contaminate the environment, and relatively safer for human health (7).

Among the types of plants that can be used as vegetable insecticides are Lavender (Lavandula angustifolia) and Lemongrass (Cymbopogon citratus) which contain essential oils that can kill, attract, or repel insects. Purple Lavender flowers, contain essential oils composed of linaly acetate (40.76%), linalool (24.60%), cis-β-Ocimene (4.85%), β-caryophyllene (4.40%), lavendulyl acetate (3.83%), transβ-Ocimene (3.64%), terpinene 40-ol (3.57%), 1.8 cineole (0.71), lavandulol (0.71%), and camphor (0.30%) (8). Uniyal et al., (2014) found that lavender flower oil with a concentration of 5% has the effect of inhibiting chemical receptors in mosquito antennae so that mosquitoes become lost contact with humans with a protective power of 83% for one hour. The essential oil contained in the stem of lemongrass consists of 3 main components, which are citronellal, citronellol and geraniol (10). Citronellol and geraniol are active ingredients that insect, including mosquitos, disliked and strongly avoided, so using these ingredients is very useful as a mosquito repellent.

On this occasion, research was carried out to examine the potential of Lavender and Lemongrass plant extracts at various doses as vegetable insecticides to kill adult stage mosquitoes, with mortality benchmarks.

II. METHODOLOGY

This experiment was carried out using a complete randomized design with three replicates. The factors studied were the types of plants which are Lavender and Lemongrass, as well as the extracts dosage consist of 0, 25, 50, 75 and 100%. The parameter measured was the mortality of adult stage mosquitoes within 48 hours. The data obtained were analyzed using Anova α 5%. If there is a significant difference, proceed with the BNT test α 5%.

The first stage is the manufacture of test plant extracts as the parent solution, then dillute in to the desired dose using aquades. The next stage of research was spraying extracts against 20 heads mosquitoes for each treatment, which were placed in a box with mosquito nets, with sugar feeding. Spraying process is carried out using a hand sprayer with a capacity of 500 ml with droplet size ± 40 μ and a diffuse spray pattern. Each box is sprayed 4 (four) times from 4 (four) sides. Every 2 (two) hours the mosquito behavior is observed within 48 hours. The parameters observed were mosquito mortality, humidity and room temperature.

III. RESULT

Exposure of Lavender and Lemongrass plant extracts to adult stage Aedes aegypti mosquitoes at various doses for 48 hours, obtained varying mosquito mortality rates. More are presented in Table 1.

Table 1. Mortality of Aedes aegypti mosquitoes in various treatment and dose of plant-based insecticide within 48 hours

Replication	Mortality (%) of *Aedes aegypti* mosquitoes each treatment									
	Lavender Extract					Lemongrass Extract				
	0%	25%	50%	75%	100%	0%	25%	50%	75%	100%
1	0	2	3	4	20	0	3	2	10	17
2	0	3	2	6	20	0	1	2	2	11
3	0	2	4	5	20	0	1	6	5	19
Average	0	2.33	3.00	5.00	19.33	0	1.67	3.33	5.67	15.67
Mortality (%)	0	11.65	15	25	96.65	0	8.35	16.65	28.35	78.35

Source: Primary Data, 2022

Table 1 illustrates that mosquitoes that were not sprayed with plant-based insecticides within 48 hours remained alive. This shows that mosquitoes are not disturbed either physiologically or behaviorally. This result is similar to research by Mahmudi et al., (2019), on the control treatment (without vegetable insecticides) mortality is 0%. In contrast to mosquitoes sprayed with Lavender and Lemongrass extracts, mosquito deaths occur. The essential oils contained in the extracts of Lavender and Lemongrass plants successfully disrupt important processes in the mosquito's body (3). (Djojosumarto, (2008) added that insecticides sprayed on insects can enter the body by direct contact, ingestion, or breathing. Furthermore, Mudjino, (2013) added, insects will respond as an effort to maintain their lives by changing the consumption rate of digestive efficiency and metabolism. The effect can be seen from growth, development and mortality, thus impacting insect populations (mosquitoes) in nature.

Lavender extract is able to kill more mosquitoes compared to Lemongrass extract. Within 48 hours of dosing, a dose of 100% lavender extract can kill mosquitoes entirely (20 individuals), but lemongrass extract with the same dose only kills mosquitoes as much as an average of 78.35%, so there are still 2-3 individuals of mosquitoes still alive. This is related to the chemical content in the plant. Šoškić et al., (2016) in their research found that lavender flowers have a chemical composition of linaly acetate (25.3%), 4-ol terpenene (16.4%), ocimen (3.6%), linalool (13%), lavandulol acetate (7.1%), and β-caryophyllene (6.5%). This Linalool compound increases the activation of insect sensory nerves resulting in seizures and paralysis. While Acetate contains corrosive and odorous vapors, so it can damage the digestive system. The essential oil contained in lemongrass extract contains 3 main components, namely citronellal, citronellol and graniol (10).

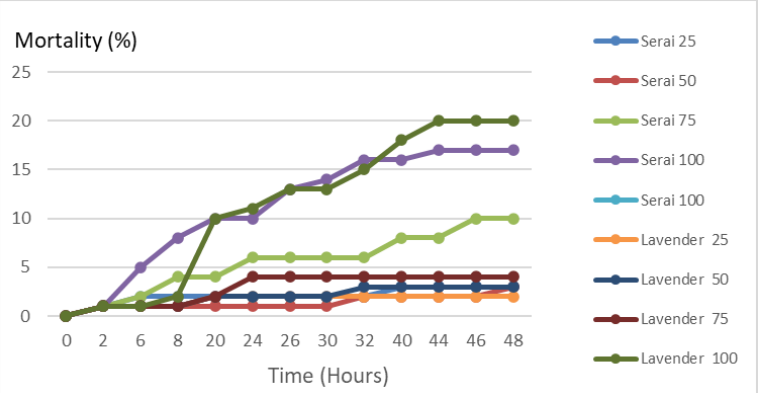


Figure 1. The death incidence of Aedes aegypti mosquitoes in various types and doses of botanical insecticides within 48 hours

Another conditions occur at doses of 75% and 100%, at the 20th hour significant mortality occur, peak mortality startis at the 40th hour. Within 44 hours the dose of 100% Lavender extract was successful in killing all mosquitoes, while at dose 100% lemongrass extract up to 48 hours only reach 78.35% so it takes more time to kill all mosquitoes. In contrast to the research conducted by Mahmudi et al., (2019), that mosquito mortality using Zodia insecticide is 28%; mosquito mortality with lemongrass insecticide as much as 16.4%; and mosquito mortality using lemongrass and Zodia combination insecticides can reach 43.2%.

Eradication of adult mosquito is applied by spray dosage form. This method causes plant-based insecticides to enter through the respiratory tract, which further inhibits the growth process that leads to death. Another possibility is that the material enters through oral route which results in decreasing the activity of digestive enzymes and food absorption so that it can inhibit growth, and leads to death as well. Because plat-based insecticides are easily decomposed and volatile, their toxicity is low, so it takes a long time for mosquitoes to die.

The pattern of mosquito mortality in the use of plant-based insecticides will differ between spray and lotion. Using lotion to control mosquito has a faster effect, because the chemicals contained in it are ingested, so they directly affects the digestive process. In 2018, Werdiningsih & Amalia researched on the use of Zodia (Evodia suaveolens) leaf extract lotion. The results were obtained at a concentration of 30% repellent power reaching the fourth hour, for a concentration of 40% repellent power for Aedes sp. mosquitoes on the arm of the treatment subject until the fourth hour, for a concentration of 50% the repellency of Aedes sp. on the arm of the treatment subject until the sixth hour while at a concentration of 60% the percentage of Aedes sp. on the arm of the treatment subject after applying Zodia leaf extract lotion reached the sixth hour. The essential oils in the lotion will evaporate and emit a distinctive aroma that interferes with the ability of mosquito receptors to recognize the attractant released by the proband's skin so that mosquitoes are oriented to avoid them. This

behavior occurs because the mosquito's chemical receptors receive stimulation from the essential oil of Zodia leaves. When the aroma of Zodia leaf essential oil is detected by the olfactory receptors, the receptors will convert it into an impulse, and it will be transmitted by nerve axons to the central nerve, then integration will occur with the motor nerves to the brain so that mosquitoes avoid it.

Table 2. Analysis of variation in mortality of Aedes aegypti mosquitoes in various types and doses of botanical insecticides within 48 hours

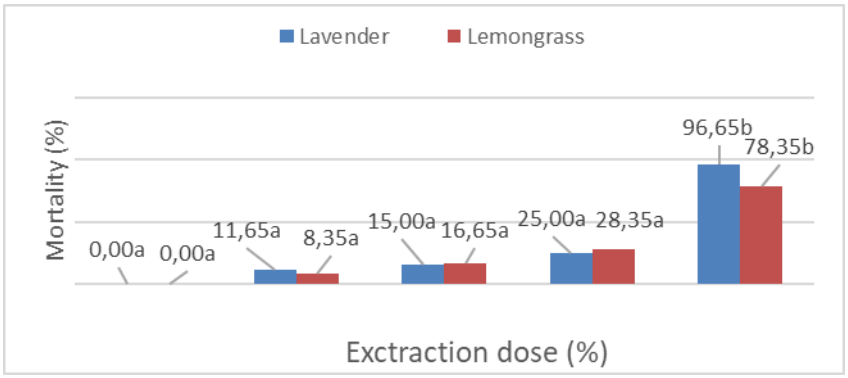
Varian	DoF	SQ	MS	F count	F Table	
					α 5%	α 1%
Replicates	2	351,67	175,83			
Treatment	9	30733,33	15366,67	17,25**	2,46	3,6
• Type PBi	1	120,00	60,00	0,07tn	4,41	8,28
• Dose PBi	4	29991,67	14995,83	16,83**	2,93	4,58
• Type * Dose	4	621,67	14995,83	0,35tn	2,93	4,58
Error	18	1781,67	310,83			
Common	29	32866,67	16433,33			

Note: PBI: plant-based insecticides' DoF: degree of freedom' SQ: Squared sum' MS: Middle Square

IV. DISCUSSION

Based on diversity analysis, generally treatment has a very significant effect on mosquito mortality within 48 hours. Among the type of ingredients and doses of plant insecticides, the dose of ingredients is the dominant effect, while the type of ingredients are not significantly different. This is possible because both ingredients contain the same oil, namely essential oils, even though the content and composition differ from one another.
The essential oil of Lavender contains linaly acetate (40.76%), 20 linalool (24.60%), cis-β-Ocimene (4.85%), β-caryophyllene (4.40%), lavendulyl acetate (3.83%), transβ-Ocimene (3.64%), terpinen40-ol (3.57%), 1.8 cineole (0.71), lavandulol (0.71%), and camphor (0.30%) (8). Meanwhile Šoškić et al., (2016) in their research found that Lavender flowers contains linaly acetate (25.3%), 4-ol terpenene (16.4%), ocimen (3.6%), linalool (13%), lavandulol acetate (7.1%), and β-caryophyllene (6.5%). Main essential oil compound of lemongrass is citronellal components 32-45%, geraniol 12-18%, citronellol 11-15%, geranyl acetate 3-8%, citronellyl acetate 2-4%, citral, cavikol, eugenol, elemol, kadinol, kadinen, vanilla, lemon, kamfen (10).

Dilution of the material results in a small chemical content in the material, so that its function as a mosquito repellent is also reduced. On the other hand, the concentrate extract of vegetable insecticide has high chemical content, therefore it is more effective as mosquito killer.



Note: The same small letters behind the mean numbers indicate that there is no real difference between one another based on the BNT α 5% test.

Figure 2. BNT α 5% test results average mortality of Aedes aegypti mosquitoes at various types and doses of vegetable insecticides within 48 hours

Figure 2 shows the results of BNT α 5% test on the type and dose of vegetable insecticide against mosquito mortality. A 100% dose of extract is the best dose to kill mosquitoes, both for Lavender and

Lemongrass. The extract of the material without the addition of aquades causes the chemicals contained in it is pure, so that its killing power becomes high.
Yunus, (2008) said that citronelol and geraniol are active ingredients that are disliked and strongly avoided by insects, including mosquitoes so that the use of these ingredients is very useful as a mosquito repellent.

At the time of the study, the room temperature ranged from 24.2o – 27oC, and humidity between 74 – 88.6%. This condition greatly supports the life of Aedes aegypti mosquitoes, because according to Sucipto, (2011), the optimum average temperature for mosquito growth is 25o – 27oC and mosquito growth will stop together when the temperature is less than 10oC or more than 40oC. Research conducted by Oktaviani, (2009) shows that at temperatures between 28oC to 32oC Aedes aegypti will survive for a long period of time. The results of the study of Sahrir et al., (2018), concluded that there is a significant relationship between temperature and mosquito population, but humidity has no significant relationship. Based on this statement, the mortality of Aedes aegypti mosquitoes is not caused by environmental factors (temperature and humidity) and food, but due to the influence of Lavender and Lemongrass extracts as vegetable insecticides.

V. CONCLUSION

Lavender and Lemongrass extracts containing essential oils at a dose of 100% have great potential as vegetable insecticides for Aedes aegypti mosquitoes with mortality of 100% and 78.35% respectively.

VI. SUGGESTION

Socialization is needed that can increase public knowledge about the use of Lavender and Lemongrass plants as environmentally friendly vegetable insecticides.

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