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Ability Test of Jatropha Curcas (*Jatropha Curcas*) Leaf Extract Against Mortality of Culex Sp. Mosquito Larvae

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Abstract

Culex sp larvae will develop into mosquitoes which can become a vector that can transmit filariasis or commonly known as elephantiasis disease. From this case, it is necessary to carry out vector control through eradicating Culex sp larvae by using natural pesticide ingredients from Jatropha Leaves (Jatropha Curcas) because apart from being environmentally friendly, the residue is easily lost. The purpose of this study was to determine the ability of Jatropha (Jatropha Curcas) leaves on the mortality of Culex sp larvae using concentrations of 15%, 20% and 25% and for control 0% using 3 replications within 24 hours and a sample of 240 larvae. This type of research is an experimental study by observing trials of plant-based insecticides made from jatropha leaf extract on the mortality of Culex sp mosquito larvae with concentrations of 15%, 20%, and 25%. The location of this research is in the Environmental Health Campus Laboratory of the Health Ministry of Health, Makassar. The results showed that the average mortality of Culex sp larvae at 15% concentration was 10.3 (51.5%), 20% concentration was 12.3% (61.5%), and 25% concentration was 17.6 (88%). The conclusion of this study, Jatropha leaf extract (Jatropha Curcas) at a concentration of 25% was able to kill Culex Sp larvae with a percentage of 90% so it is recommended to use a 25% concentration of Jatropha leaf extract (Jatropha Curcas) to kill Culex sp mosquito larvae.

Keywords: *Jatropha leaves; Culex Sp; Larvae; Pesticide.*

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1. Introduction

Vector is an anthropod that can cause infectious disease which has become a health problem in Indonesia. Vector infectious diseases include Malaria, Dengue Fever, Filariasis (elephantiasis), Chikungunya, Plague and so on [1]. Mosquitoes are insects that can carry or transmit disease vectors, one of which is the Culex mosquito. Culex mosquitoes can transmit a disease, namely Filariasis or commonly known as Elephant Foot Disease, Culex mosquitoes also cause inflammation of the brain in humans and animals [2].

This disease is a health problem in the world which is estimated to have infected 120 million people from 83 countries in the world. It is estimated that 60% of all filariasis cases are in Southeast Asia, around 40 million people worldwide who suffer from disability or paralysis due to the filariasis disease [3]. Based on the Indonesian Health Profile Data in 2020 in Indonesia, there were 9,906 cases of filariasis spread across 34 provinces. The highest filariasis cases were found in the eastern part of Indonesia, namely in Papua with 3,615 cases of filariasis, in East Nusa Tenggara with 1,534 cases of filariasis and provinces with <5 cases in North Kalimantan, Yogyakarta and Gorontalo [4].

The filariasis elimination program is a priority health program in Indonesia. In the implementation of filariasis elimination in Indonesia, namely by implementing a program called GPELF (Lymphatic Filariasis Elimination Program), which is to break a chain of filariasis transmission by limiting, and preventing disability [5]. The strategy for eliminating filariasis in Indonesia is the Mass Filariasis Prevention Drug (POPM) program and integrated vector control [6].In South Sulawesi, there are cases of filariasis in Luwu Regency which consists of 40 cases, namely 9 cases of women suffering from filariasis and 32 cases. Filariasis cases are 4 cases of filariasis in women and 4 cases of filariasis in men.

The high number of patients with filariasis means the need for vector control, namely the control of culex mosquito larvae [7]. However, at present the control is more dominant or almost all of them use chemicals such as synthetic pesticides. Excessive use of synthetic pesticides can damage or have a negative impact on the environment such as causing pollution, increasing resistance for target insects, and increasing the mortality of non-targeted animals and may leave sediment residues that are difficult to decompose [8]. In a study conducted regarding the Effect of Giving Jatropha Leaf Filrat (Jatropha Curcas) on Mortality of Aedes Aegypti Mosquito Larvae which consisted of 6 treatments and 4 replications with a concentration of 45%, 60% and 75% [9].

The most effective concentrations in killing Aedes Aegypti mosquito larvae were concentrations of 45%, 60% and 75% because they were able to kill 100% of the test larvae, but based on the time rate, 75% concentration was the fastest concentration of 3.27 hours to kill. The results obtained at a concentration of 20% were declared capable of killing Culex sp larvae where the average mortality reached 69.8% [10]. According to Effect of Extract and Fraction of Jatropha Leaves (Jatropha curcas L.) as Aedes aegypti Larvae Instar III, namely to determine the activity of the active fraction of Jatropha leaves compared to positive control abate [11], to determine the LC50 value of the active fraction and Jatropha leaf extract against Aedes aegypti larvae, to determine the class of active compounds from Jatropha leaves contained in the active fraction [12]. treatment concentrations were 0.5%, 1%, 5%, 10%, positive control (Temefos) and each was repeated 4 times. namely the

active fraction that has the highest larvicidal activity of the three fractions is the n-hexane fraction of Jatropha leaves (Jatropha curcas L.) [13]. The active fraction and extract of jatropha leaf have lower larvicidal activity than abate, because both the n-hexane fraction and the extract had optimum concentrations of 10% and 5% with respectively being able to kill 77 and 80 Aedes aegypti larvae, while temefos at 1% concentration was able to kill 80% of Aedes aegypti larvae [14]. The LC50 value of the n-hexane fraction of Jatropha leaves which was able to kill 50% of the test larvae was 0.454% and the LC50 value of the Jatropha leaf extract which was able to kill 50% of the test larvae was 0.159%. From the research that has been done, with the title Jatropha Culcas (Jatropha Culcas) Leaf Extract with Concentration Variations on Culex quinquefasciatus Intar III Mosquito Larvae, with LC50 I values, which were given in 5 different concentrations (0%, 15%, 30%, 45%, and 60%). The results showed that there were differences in mortality of Culex quinquefasciatus mosquito larvae given Jatropha leaf extract with different concentrations based on the results of probit analysis, Jatropha leaf extract showed that the LC50 was at 35.876%. From this study, the author is interested in conducting the same research, namely about Jatropha curcas (Jatropha curcas) leaves as vegetable larvicides using Culex Sp larvae as samples, so that the title of Ability Test of Jatropha curcas Leaf Extract (Jatropha curcas) against Mosquito Larvae Mortality can be raised. Culex Sp using concentrations of 15%, 20% and 25%, to see whether with concentrations below 35.876% using clean water as a solvent can kill Culex Sp mosquito larvae with mortality reaching 80%.

2. Material and Method

2.1 Types of Research

The type of research used is Experimental Research, namely by making observations to determine the ability of Jatropha Leaf Extract on the mortality of Culex sp. General description.

2.2 Research Sites

The type of research used is Experimental Research, namely by making observations to determine the ability of Jatropha Leaf Extract on the mortality of Culex sp. The research was conducted at the Campus of the Department of Environmental Health, Poltekkes, Ministry of Health, Makassar.

2.3 Research Time

The research time is divided into two parts, namely:

1. The initial stage, namely the preparation of proposals starting from December 2021-January 2022.
2. The second stage is research conducted during April-July 2022.

2.4 Research Variable

1. The independent variable is a variable that affects the dependent variable, namely using Jatropha Leaf extract(Jatropha curcas) by using Concentration (15%, 20%, 25%).

2. The dependent variable is the variable that is influenced by the independent variable, namely the death of Culex sp.
3. Confounding variables are variables that affect the dependent variable, namely temperature and pH.

2.5 Data Collection Technique

1. Primary Data

The data obtained from the test results are the ability of Jatropha leaf extract (Jatropha curcas) to the mortality of Culex sp.

2. Secondary Data

The data obtained through the literature, books, internet, related to the object of research.

2.6 Data Processing And Analysis

Data processing in this study using computer aids and calculators. The data that has been obtained in tabular form is then described.

3. Result

From the results of research that was carried out on May 11, 2022 at the Environmental Health Campus of the Makassar Ministry of Health Poltekkes using Jatropha Leaf Extract (Jatropha Curcas) using 3 concentrations, namely15%, 20% and 25% with the aim of killing Culex sp Mosquito Larvae at each concentration. On each The concentration was given to 20 Culex sp mosquito larvae using 3 times of replication in the first 1 hour after administration of the extract. Observations were carried out then continued observations every 6 hours for 24 hours. The results can be seen in the following table:

Table 1: Ability of Jatropha Curcas (Jatropha Curcas) Leaf Extract Against Mortality of Culex Sp Mosquito Larvae With 15% Concentration

Time (O'clock)	Number of Test Larvae (Tails)	Extract Jatropha Leaves (15% Concentration) Treatment/Replication				Larval Mortality Rate
		Control	R1	R2	R3	
1	20	0	1	2	2	1,6
6	20	0	0	1	1	0,3
12	20	0	2	3	4	3
18	20	0	3	3	2	2,6
24	20	0	2	1	4	2,3
Total		0	8	10	13	10,3

Based on table 1 above, it can be seen that the mortality of larvae after being given Jatropha leaf extract with a

concentration of 15% within 24 hours, in replication 1 the average number of dead Culex sp larvae mortality was 8, in replication 2 there were 10, and In the third replication, 13 larvae died. So the total mortality of larvae in three replications was 10.3 so that the total number of larvae that died in three replications could be rounded up to 10. Therefore, at a concentration of 15% there were 10 dead Culex sp larvae.

Table 2: Ability of Jatropha Curcas (Jatropha Curcas) Leaf Extract Against Mortality of Culex Sp Mosquito Larvae With 20% Concentration

Time (O'clock)	Number of Test Larvae (Tails)	Extract Jatropha Leaves (20% Concentration) Treatment/Replication				Larval Mortality Rate
		Control	R1	R2	R3	
1	20	0	2	1	2	1,6
6	20	0	1	1	1	1
12	20	0	3	2	1	2
18	20	0	7	4	4	5
24	20	0	1	2	5	2,6
Total		0	14	10	13	12,3

Based on table 4.2 above, it can be seen that larval mortality after being given Jatropha leaf extract with a concentration of 20% within 24 hours, in replication 1 the average number of dead Culex sp larvae mortality was 14, in replication 2 there were 10, and In the third replication, 13 larvae died. So the total mortality of larvae in three replications was 12.3 tails. so it can be rounded up the total larvae that died in 3 replications, namely 12 tails. Therefore, at a concentration of 20% there were 12 dead Culex sp larvae.

Table 3: Ability of Jatropha Curcas (Jatropha Curcas) Leaf Extract Against Mortality of Culex Sp Mosquito Larvae With 25% Concentration

Time (O'clock)	Number of Test Larvae (Tails)	Extract Jatropha Leaves (25% Concentration) Treatment/Replication				Larval Mortality Rate
		Control	R1	R2	R3	
1	20	0	2	2	2	2
6	20	0	4	5	4	4,3
12	20	0	5	6	6	5,6
18	20	0	4	3	6	4,3
24	20	0	2	3	1	2
Total		0	17	19	19	17,6

Based on table 4.3 above, it can be seen that the mortality of larvae after being given Jatropha leaf extract with a concentration of 25% within 24 hours, in replication 1 the average number of dead Culex sp larvae mortality

was 17, in replication 2 there were 19, and In the third replication, 19 larvae died. So the total mortality of larvae in three replications was 17.6 individuals. so that the total larvae that died in 3 replications were rounded, namely 18. Therefore, at a concentration of 25%, there were 18 dead Culex sp larvae.

4. Discussion

Vector borne diseases continue to pose a serious global health challenge, particularly in tropical and subtropical regions such as Indonesia. Mosquitoes are the primary vectors responsible for the transmission of various infectious diseases, including malaria, dengue fever, chikungunya, and lymphatic filariasis [15]. Among mosquito species, *Culex* mosquitoes are particularly significant as they serve as vectors for lymphatic filariasis, also known as elephantiasis a debilitating disease that causes permanent disability and social stigma due to severe swelling of body parts, especially the legs [16]. Globally, over 120 million people are estimated to be infected with lymphatic filariasis, with Southeast Asia accounting for more than 60% of the total disease burden [17].

Traditionally, mosquito control programs have relied heavily on synthetic chemical larvicides such as temephos and methoprene. While these agents are effective, their long-term use has led to increasing environmental and health concerns. The repeated application of chemical insecticides has resulted in the emergence of insecticide-resistant mosquito populations, bioaccumulation of toxic substances in aquatic ecosystems, and adverse effects on non-target organisms, including fish and beneficial insects [18]. These challenges underscore the urgent need to explore environmentally friendly, sustainable alternatives for vector control. One such alternative is the use of botanical larvicides derived from locally available plants with insecticidal properties.

This study was conducted on May 11, 2022, at the Environmental Health Campus of the Polytechnic of Health, Ministry of Health Makassar. This study was conducted to assess the larvicidal potential of *Jatropha curcas* leaf extract against *Culex sp.* larvae under controlled laboratory conditions. The results demonstrated a clear dose-response relationship, where higher concentrations of the extract led to greater larval mortality. Specifically, the mortality rate increased from 51.5% at 15% concentration, to 61.5% at 20%, and reached 88% at 25%. These results are significant when considering that, according to Indonesia's Ministry of Health Regulation No. 50 of 2017, a larvicide is deemed effective if it achieves a minimum of 80% larval mortality within 24 hours.

The larvae used in this study were third-instar Culex sp. larvae collected from drainage ditches. These larvae measured approximately 4–5 mm in length, with visible thoracic spines and blackish-brown respiratory siphons [19]. Prior to the experiment, room temperature and humidity were measured using a mobile device, recording an average temperature of 30°C and humidity of 75%. Each treatment group included 20 larvae, and the test was completed in one day using three replications.

The results showed a clear trend of increasing mortality with higher concentrations of Jatropha leaf extract. At a 15% concentration, an average of 10.3 larvae died, representing a 51.5% mortality rate. At 20%, mortality increased to 12.3 larvae or 61.5%, and at 25%, the highest mortality was observed with 17.6 larvae dead, equal to 88%. In contrast, no mortality was observed in the control group, where larvae remained active throughout

the observation period.

These findings demonstrate that the effectiveness of Jatropha leaf extract as a natural larvicide increases with higher concentrations [20]. The larvicidal activity of *Jatropha curcas* can be attributed to the presence of several bioactive phytochemicals such as saponins, flavonoids, tannins, and polyphenols. These compounds are known to interfere with the physiological functions of insects. Saponins disrupt the integrity of cell membranes and cause lysis, impairing respiration and ultimately leading to death. Flavonoids act as respiratory enzyme inhibitors and interfere with feeding behavior and growth. Tannins may disrupt the digestive system of larvae, while polyphenols possess oxidative stress-inducing properties that are toxic to insect cells [21]. The results of this study align with previous findings and support the use of Jatropha curcas as an environmentally friendly larvicidal agent.

In accordance with Indonesia's Ministry of Health Regulation No. 50 of 2017, a larvicide is considered effective if it achieves at least 80% mortality. Based on this criterion, the 25% concentration met the standard with an 88% mortality rate within 24 hours. This suggests that Jatropha leaf extract at this concentration can be considered a potent natural larvicide against Culex sp.

In terms of consistency with previous literature, the findings align with and expand upon earlier studies. For instance, research has shown that Jatropha leaf filtrates at higher concentrations (45%, 60%, and 75%) were able to kill 100% of *Aedes aegypti* larvae [22]. This current study purposely used lower concentrations (15%, 20%, and 25%) to evaluate the efficacy of *Jatropha curcas* extract on *Culex sp.*, which are often less studied compared to *Aedes*. The fact that an 88% mortality rate was achieved at 25% concentration indicates that significant larvicidal activity can occur even at lower doses, making this approach more cost-effective and practical for community-based applications. Furthermore, a study on *Jatropha curcas* extract against *Culex quinquefasciatus* revealed an LC_{50} value of 35.876% [23]. The 25% concentration used in this study, which resulted in nearly 90% mortality, is notable because it achieved high efficacy at a concentration below the LC_{50} threshold. This highlights the potential of *Jatropha* extract not only in laboratory settings but also as a candidate for scaled-up field applications. Additional research has emphasized the effectiveness of water-based *Jatropha* extracts, confirming that even without organic solvents, the active components remain biologically potent. For instance, studies comparing *Jatropha* with chemical larvicides like abate have found similar or superior performance in reducing *Aedes aegypti* populations using aqueous extraction methods [24]. This study similarly utilized water extraction and confirmed its effectiveness against Culex sp. larvae.

Despite its promising outcomes, this study acknowledges several limitations. Environmental conditions such as temperature and humidity were measured using a smartphone application, which may not provide the same accuracy as dedicated instruments like digital thermometers and hygrometers [25]. These environmental factors are known to influence larval development and the efficacy of larvicides. Additionally, water pH was not measured in this experiment, though it can affect the solubility and stability of bioactive compounds, thereby influencing their larvicidal performance [26].

For future research, it is recommended to include more precise environmental measurements and examine the impact of water quality parameters such as pH and dissolved oxygen. Furthermore, exploring different formulations (e.g., granules, tablets, or slow-release pellets) of *Jatropha curcas* extract may enhance its practical application in diverse field settings. Phytochemical quantification using chromatographic techniques such as HPLC or GC-MS can also be conducted to identify and standardize the most active components responsible for larvicidal activity. The present study confirms that Jatropha curcas leaf extract has a strong larvicidal effect against Culex sp. larvae, with the highest mortality observed at 25% concentration. These results are consistent with and build upon previous studies, reinforcing the plant's potential as a botanical alternative to synthetic larvicides. Given its efficacy, accessibility, and environmental compatibility, Jatropha curcas represents a promising candidate for use in integrated mosquito control programs, particularly in resource-limited settings. Continued research and development are needed to optimize its formulation and assess long-term impacts under field conditions.

5. Limitations of the Study

Based on the results of this study, it can be concluded that Jatropha curcas leaf extract exhibits larvicidal effectiveness against Culex sp. larvae in a concentration-dependent manner. At 15% concentration, the extract caused a mortality rate of 51.5%, indicating a moderate larvicidal effect. Increasing the concentration to 20% improved the mortality rate to 61.5%, and the highest mortality was observed at 25% concentration, with 88% of larvae killed within 24 hours of exposure. These findings suggest that higher concentrations of Jatropha curcas extract are more effective in controlling mosquito larvae populations.

However, this study has several limitations that should be considered. First, the measurement of environmental parameters such as temperature and humidity was conducted using a smartphone application, which may lack the precision of specialized instruments such as digital thermometers and hygrometers. Second, important water quality parameters like pH and dissolved oxygen, which may influence larvicide effectiveness, were not monitored during the experiment. Third, the study was limited to a 24-hour exposure period under laboratory conditions, which may not fully represent the dynamics of larvicide activity in natural field environments. Finally, the phytochemical composition of the extract was not analyzed quantitatively, which limits the ability to identify specific bioactive compounds responsible for larvicidal activity.**h**Future research should address these limitations by incorporating more accurate environmental monitoring tools, measuring relevant water parameters, extending the duration of larval exposure, testing in field conditions, and analyzing the chemical profile of the extract to identify and standardize active compounds. These improvements would strengthen the scientific basis for using Jatropha curcas as a botanical larvicide in integrated vector control programs.

6. Abbreviation

LC50; Lethal Concentration 50%

7. Competing Interest

The authors declare that they have no competing interest.

Acknowledgements

These and the Reference headings are in bold. Text below continues as normal.

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