EFFECTIVENESS OF CYMBOPOGON NARDUS L. EXTRACT AS *AEDES AEGYPTI* LARVACIDE IN CONTROLLING DENGUE FEVER

Eunrike Claudia Ta'ba'[1], Erniwati Ibrahim[1], Hasanuddin Ishak[1]

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Abstract

Cymbopogon nardus L. is plant that can be utilized for its content, which is more abundant in the stems and leaves. This type of research is experimental, in which larvae receive treatment. Sampling was done by purposive sampling. The concentrations used in this study were 1.5 ml, 2 ml, 4 ml, 6 ml and 8 ml and the observation times used were 25 minutes, 45 minutes, 60 minutes and 90 minutes with 2 replicas. The results showed that citronella extract had a very high killing power against larvae which could be seen from the percentage of larvae mortality during the treatment test. The highest mortality of larvae occurred at a concentration of 8 ml/1000 ml of water in the 90th minute of the 2nd repetition with a total of 22 larvae deaths with a mortality percentage of 83%. This shows that citronella, both applied singly or in combination, has larvicidal effectiveness which is effective in killing *Aedes aegypti* larvae. The highest mortality of larvae occurred at a concentration of 8 ml/1000 ml of water in the 90th minute of the 2nd repetition with a total of 22 larvae deaths with a mortality percentage of 83%. This shows that citronella, both applied in combination, effectiveness which is effective in killing *Aedes aegypti* larvae. The highest death time was citronella extract with a concentration of 8 ml in the 90th minute. The highest mortality of larvae occurred at a concentration of 8 ml/1000 ml of water in the 90th minute of the 2nd repetition witha total of 22 larvae deaths with a mortality percentage of 83%.

Keywords : *Cymbopogon nardus L.*, Concentration, Larvicide, *Aedes aegypti*

[1]Department of Environmental Health, Faculty of Public Health, Hasanuddin University

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Introduction

Dengue Hemorrhagic Fever is a major health problem in Indonesia, because it can cause death. Dengue Hemorrhagic Fever is endemic, occurs throughout the year accompanied by extraordinary event. Dengue Hemorrhagic Fever is an infectious disease caused by the Dengue virus which is transmitted through the bite of the Aedes aegypti mosquito. The characteristics of the disease are sudden high fever accompanied by bleeding manifestations and tend to cause shock and death. The World Health Organization (WHO) estimates that every year there are around 100-400 million DHF infections globally. Asia ranks first in the number of DHF sufferers as much as 70% each year. It is known that DHF is a major cause of morbidity and mortality in Southeast Asia with 57% of the total cases of DHF in Southeast Asia occurring in Indonesia[2]. Makassar City is a DHF endemic area with the number of sufferers increasing almost every year. The Makassar City Government has designated 5 sub-districts out of 14 sub-districts in Makassar, as areas that are prone to the spread of Dengue Hemorrhagic Fever (DHF). The five sub-districts are Biringkanaya, Panakkukang, Tallo, Tamalanrea and Rappocini sub-districts respectively. DHF cases in Makassar City in the last 3 years (2017-2020) were reported as many as 353 cases. The South Sulawesi Provincial Health Office recorded 81 cases of Dengue Hemorrhagic Fever (DHF) from 1 January to 9 June 2021[3]. The five sub-districts are Biringkanaya, Panakkukang, Tallo, Tamalanrea and Rappocini sub-districts respectively. DHF cases in Makassar City in the last 3 years (2017-2020) were reported as many as 353 cases. The South Sulawesi Provincial Health Office recorded 81 cases of Dengue Hemorrhagic Fever (DHF) from 1 January to 9 June 20213. The five sub-districts are Biringkanaya, Panakkukang, Tallo, Tamalanrea and Rappocini sub-districts respectively. DHF cases in Makassar City in the last 3 years (2017- 2020) were reported as many as 353 cases. The South Sulawesi Provincial Health Office recorded 81 cases of Dengue Hemorrhagic Fever (DHF) from 1 January to 9 June 2021[3].

WHO itself has launched a program to control dengue cases. One of the steps taken is to control the dengue vector by controlling its spread. Some of the methods used for DHF control are: chemically using insecticides and larvicides, biologically using natural enemies such as predators, bacteria, environmental management such as managing or eliminating mosquito breeding habitats or the PSN (Mosquito Nest Eradication) movement, implementing laws and regulations, and increase community participation [4]. Theuse of synthetic larvicide is more often used because it is considered effective, practical, efficacious and economical, but if used continuously it can cause environmental pollution, death of various types of living things and vector resistance[5].

The side effects caused by synthetic larvicides require a more environmentally friendly alternative to control vector populations by using vegetable larvicides. One of them is by utilizing citronella plants (Cymbopogon nardus L.). Various types of plants can be used as natural larvicides, also the citronella plant (Cymbopogon nardus L.) is a plant that can be utilized for its content, which is more abundant in the stems and leaves. The main ingredient of the citronella plant (Cymbopogon nardus L.) contains essential oils which can affect secondary metabolic processes which can affect the oviposition of Aedes aegypti females, and can also damage Aedes aegypti eggs. In humans, lemongrass extract has a positive impact and is useful as a medicinal plant.

Method

This study was experimental in nature because Aedes aegypti larvae were treated and the samples were taken by purposive sampling. This research was conducted at the Entomology Laboratory, Faculty of Medicine, Hasanuddin University and the Phytochemical Laboratory, Faculty of Pharmacy from December to January 2023.

Manufacture of citronella extract

Citronella extract obtained by Rotary evaporator process. The extract obtained was then diluted to obtain the desired volume.

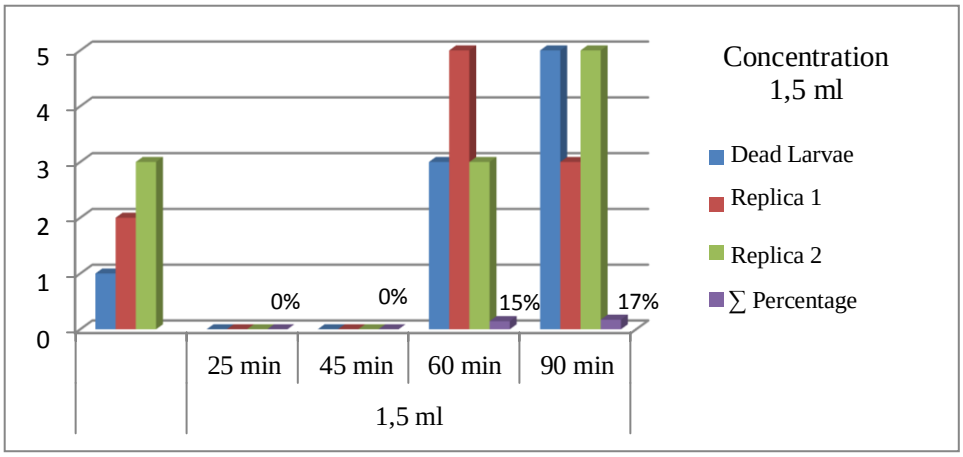
Test Treatment

The treatment test was carried out on third instar Aedes aegypti mosquito larvae by placing the larvae in a container filled with water, then observing them for 90 minutes. The larvae were grouped into 5 groups (treatment) which contained 25 Aedes aegypti larvae. The experiment wascarried out with 2 repetitions. Then observed the dead larvae at 25, 45, 60 and 90 minutes. Then, the test results were analyzed using Probit Analysis.

The test results of citronella extract in Table 1 on Ae.aegyptI larvae showed that the total mortality of Ae. aegypti reached ≥ 80% at a concentration of 8 ml/1000 ml of water at 90 minutes. The results of the kitchen lemongrass extract test showed the mortality of Ae. aegypti by 28% while the results of the biolarvicidal test on the negative control (Aquades) showed a mortality response of 0% at 90 minutes.

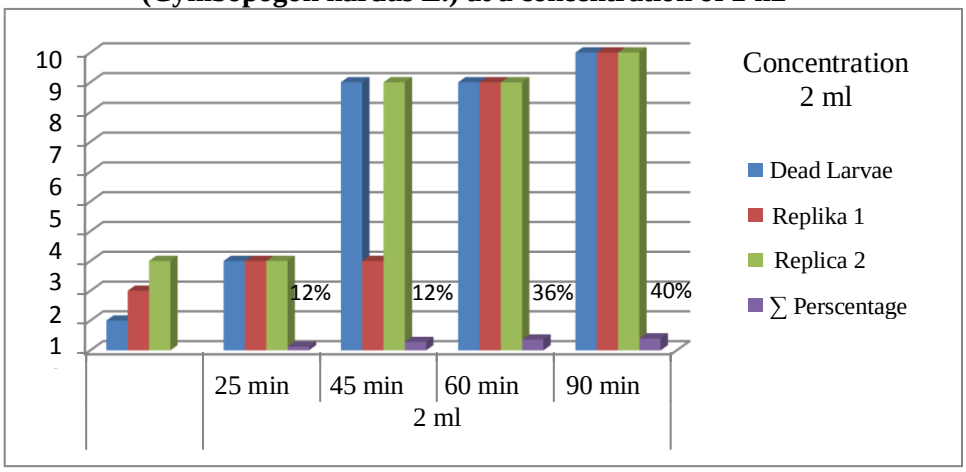
Results

Graph 1. Percentage of death of Aedes aegypti larvae by testing using citronellaextract (Cymbopogon nardus L.) at a concentration of 1.5 ml



In the graph above, it shows that the percentage of larval mortality from the treatment of concentrations of citronella plant extract at observation times of 25 minutes, 45 minutes, 60 minutes and 90 minutes, it can be seen that the number of larval deaths was 5 with the highest mortality occurring in the 90th minute with percentage (17%) . In repetition (replica) 1 the number of larvae that died was 5 individuals and in the 2nd repetition (replica) the number of larvaethat died was the same, namely 5 individuals. This amount did not have a significant effect, because the concentration of citronella plant extract and the time used in the study were the same.

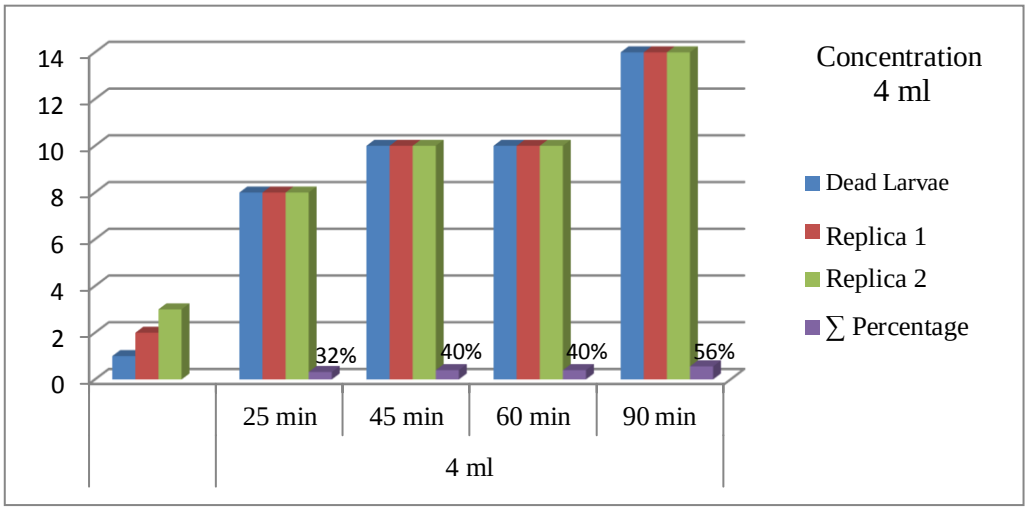
Graph 2. Percentage of death of Aedes aegypti larvae by testing using citronellaextract (Cymbopogon nardus L.) at a concentration of 2 ml



In the graph above, it shows that the percentage of larval mortality from the

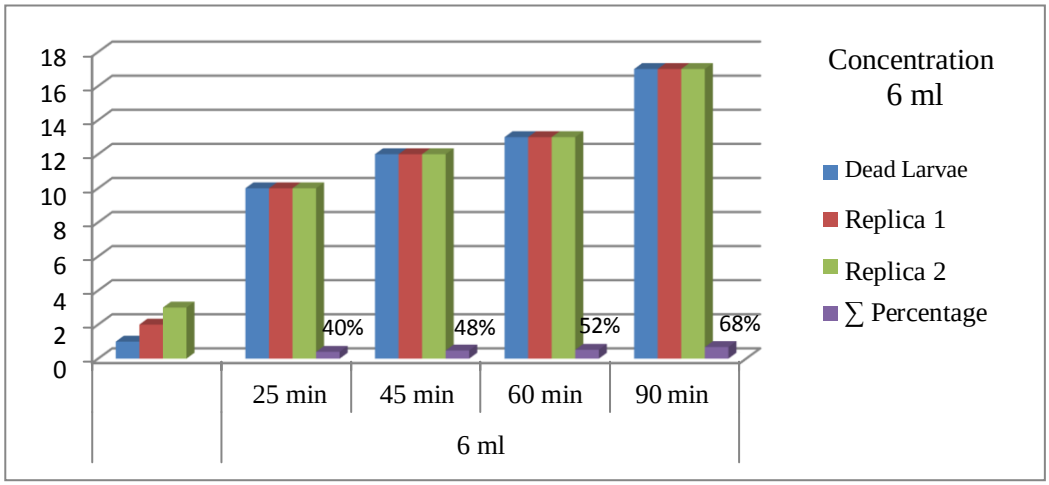
treatment of concentrations of citronella plant extract at observation times of 25 minutes, 45 minutes, 60 minutes and 90 minutes, it can be seen that the number of larval deaths was 10 with the highest mortality occurring in the 90th minute with percentage (40%). In repetition (replica) 1 the number of larvae that died was 10 individuals and in repetition (replica) 2 the number of larvae that diedwas the same, namely 10 individuals. This amount did not have a significant effect, because the concentration of citronella plant extract and the time used in the study were the same.

Graph 3. Percentage of death of Aedes aegypti larvae by testing using citronellaextract (Cymbopogon nardus L.) at a concentration of 4 ml



In the graph above, it shows that the percentage of larval mortality from the treatment of concentrations of citronella plant extract at observation times of 25 minutes, 45 minutes, 60 minutes and 90 minutes, it can be seen that the number of deaths of larvae deaths is 14 tails and the highest mortality occurs in the 90th minute with a percentage (56%). In repetition (replica) 1 the number of larvae that died was 14 individuals and in repetition (replica) 2 the number of larvae that died was the same, namely 14 individuals. This amount did not havea significant effect, because the concentration of citronella plant extract and the time used in the study were the same.

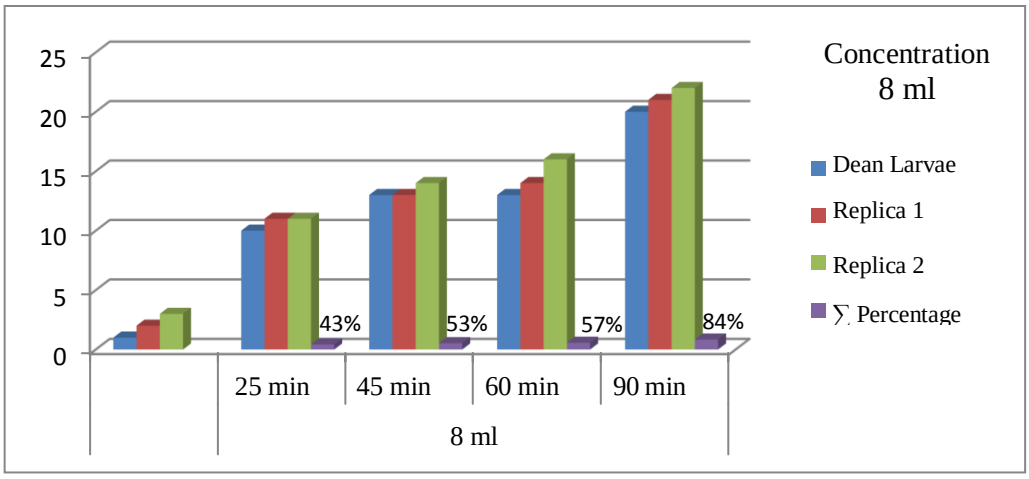
Graph 4. Percentage of Aedes aegypti Larvae Mortality by testing using citronellaextract (Cymbopogon nardus L.) at a concentration of 6 ml.



In the graph above, it shows that the percentage of larval mortality from the

treatment of concentrations of citronella plant extract at observation times of 25 minutes, 45 minutes, 60 minutes and 90 minutes, it can be seen that the number of larval deaths was 17 and the highest mortality was in the 90th minute with percentage (68%). In repetition (replica) 1 the number of larvae that died was 17 individuals and in repetition (replica) 2 the number of larvae that died wasthe same, namely 17 individuals. This amount did not have a significant effect, because the concentration of citronella plant extract and the time used in the study were the same.

Graph 5. Percentage of Aedes aegypti Larvae Mortality by testing using citronellaextract (Cymbopogon nardus L.) at a concentration of 8 ml.



In the graph above, it shows that the percentage of larval mortality from the treatment of concentrations of citronella plant extract at the observation time of 25 minutes, 45 minutes, 60 minutes and 90 minutes, it can be seen that the number of larval deaths was 20 with the highest mortality occurring in the 90th minute with percentage (84%). In repetition (replica) 1 the number of larvae that died was 21 individuals and in repetition (replica) 2 the number of larvae that diedwas the same, namely 22 individuals. This amount did not have a significant effect, because the concentration of citronella plant extract and the time used in the study were the same. Based on the results in the graph above, it can be concluded that the observation time affects the number of larvae deaths. The higher the time used, the higher the mortality rate of the larvae.

Table 1. Probit Test Results

Parameter Estimates							
	Parameter	**Estimates**	**Std. Error**	**Z**	**Sig.**	**95% Convidence Intervals**	
						Lower Bound	**Upper Bound**
PROBIT a	Concentration	.124	040	3,072	002	045	.203
	Intercepts	-1,431	.217	-6,594	.000	-1,649	-1,214

Based on Table 2 above on the results of the probit analysis test, it can beseen that the Sig value is 0.002. It can be concluded that based on the results of the probit test there is a significant difference between the concentration and the number of dead larvae.

Discussion

The death of the larvae is caused by the content of chemical compounds in this case alkaloids, saponins and essential oils contained in the extract of the citronella plant. The content of citronella essential oil is aldehyde, isovaleric, citronellal, geraniol and citrate. Secondary metabolites such as saponins and flavonoids produced are toxic to mosquito larvae by reducing their

ability to digest food6. The active substance contained in citronella serves as a toxic compound which, when in contact with the respiratory system of mosquito larvae,will kill the larvae.

Comparison of larval mortality in the experiment and the 1st and 2nd replicas at concentrations of 2 ml, 4 ml and 6 ml did not give significant results. This is in line with research conducted by Makkiah et all (2019) entitled "Effectiveness of Citronella Extract (Cimbopogon nardus L.) as Aedes aegypti Mosquito Larvicidal" which shows thatcitronella extract Replication (replication) in each treatment did not have a significant effect. The normality test results with a p value <0.05 which means that the data distribution is not normal. Furthermore, an effect test was carried out between subject variables which showed that citronella extract solution had a significant effect on the mortality of third instar larvae of Aedes aegypti mosquitoes. This can be seen from the significant value of the concentration variable p=0.000, meaning that variations in concentration affect larval mortality, and the significant value of the repeat variable p=0.993, meaning that repetitions do not affect larval mortality.

Larvae mortality began to increase at a concentration of 8 ml at each observation time (Graph 5) both in the experiment and in the 1st and 2nd replicasto give significant results. At a concentration of 8 ml is the highest concentration in this treatment test so it can be the most effective in killing the larvae. The difference in the number of deaths is due to the difference in the content of compounds contained in citronella extract using different solvents (ethanol). This is in line with research conducted by Fitri Nadifah et all (2022) with the title "Potential of Citronella Extract (Cymbopogon nardus L.) Rendl.) as Aedes Aegypti Mosquito Larvicidal" shows that citronella stem extract has potential as a larvicidal and replaces conventional larvicides by adhering to established ethical standards. This is in line with this study because the research results showedthat citronella extract was effective in killing Aedes aegypti larvae. This is evidenced by the percentage of larval mortality of 84% within 90 minutes[7].

The treatment test of citronella plant extract which was effective in killing Aedes aegypti mosquito larvae occurred at a high concentration of 8 ml. Extracts from the citronella plant are used as larvicides because they contain chemical compounds in the form of acetogenins such as annonin or annonasin, Bulatasin, Bulatasinon, squaamosin asimisin, and annonastatisn in soursop leaf extract and compounds geraniol, sitral, nerol, metal heptenone, and dipentene in citronella extract [8].These substances have a toxic effect when eaten by insects and can inhibit growth, affect the nervous system, insect reproductive development, inhibitbreathing so that they can cause death.

The citronella plant extract contains more active and toxic chemical compounds. Essential oils contain active components called Terpenoids or Terpenes. This substance gives off the distinctive aroma or odor found in many plants. Terpene compounds contained in essential oils consist of two groups, namely monoterpenes and sesquiterpenes. Monoterpenes and terpenes have larvicidal effects, namely by disrupting the nervous system in the larvae and inhibiting the growth of the larvae by inhibiting the eating power of the larvae9. In addition, citronella has secondary metabolites including saponins, tannins, quinones, steroids, coumarins and essential oils. The content of citronella essential oil is aldehyde, isovaleric, citronellal, geraniol and citrate. Secondary metabolites such as saponins and flavonoids produced are toxic to mosquito larvae by reducing their ability to digest food[6]. The active substance contained in citronella functions as a toxic compound which, when in contact with the respiratory system of mosquito larvae, will kill the citronella larvae in citronella, which works by inhibiting the acetylcholinesterase enzyme resulting in acutepoisoning such as seizures, CNS (Central Nervous System) disorders, and respiratory paralysis as a result of the accumulation of acetylcholine which leadsto death in insects.

Conclusion

Concentration gives a significant difference in effect as a larvicide. This shows that citronella, both applied singly or in combination, has larvicidal effectiveness which is effective in killing Aedes aegypti mosquito larvae. The highest death time was citronella extract with a concentration of 8 ml

in the 90th minute.

Reference

Makkiah, SC, & Berty, A. (2019). Test of Citronella Extract (Cymbopogon Nardus L) As Aedes Aegypti Mosquito Larvicidal. Sam Ratulangi University Entomology Study Program.

WHO. (2020). Dengue And Severe Dengue. Geneva : World HealthOrganization.

Department of Health. (2021). DHF Cases in South Sulawesi. Kompas, South Sulawesi Health Service.

Ministry of Health. (2020). Dengue Cases in Indonesia Reach 71 Thousand. Indonesian Ministry of Health, Jakarta. Hal.81-89

Nugroho, AD 2011. Death of Ae. aegypti after Giving Lemongrass Powder. Journal of Public Health. 7(1): 91-96.

Ishak, NI 2019. Effectiveness of Lemon Peel (Citrus amblycarpa) Extract as a Larvicidal Ae. aegypti Instar III. MKMI Journal, 15(3):302-310.

Nadifa, Fitri, Arisandi Desto, Mahmuda Siti. 2022. Potential of Citronella Extract (Cymbopogon nardus L.) Rendl.) As Aedes Aegypti Mosquito Larvicidal. SNPPKM, Yogyakarta. ISSN:2809-2767

Wahyuni, D. & Loren, I. 2015. Differences in the Toxicity of Betel Leaf Extract (Piper betle L.) and Srikaya Seed Extract (Annona squamosa L.) against Aedes aegypti L. Mosquito Larvae.