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Original Article

Effectiveness of Garlic Extract (Allium sativum L) as Larvicide of Aedes aegypti

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ABSTRACT

The problem of disease due to dengue virus infection is still a health concern, especially in tropical countries. One of the efforts made is to explore vegetable insecticides as larvicides for dengue vectors, the Aedes aegypti mosquito. Garlic (Allium sativum. L) is believed to be able to repel or inhibit and even kill the larvae of the *Aedes aegypti* mosquito because garlic has a strong aroma. This study aims to determine the effectiveness of garlic extract as a larvicide of Aedes aegypti. The research method used is a quasi-experimental with a post test only control group design. The larvae of Aedes aegypti used were instar I-IV larvae which were divided into treatment groups and control groups. In the treatment group, Aedes aegypti larvae were given garlic extract with 5 concentrations, namely 0.10% (0.2 mL extract + 200 mL water), 0.20% (0.4 mL extract + 200 mL water), 0.30% (0.6 mL extract + 200 mL water), 0.40% (0.8 mL extract + 200 mL water) and 0.50% (1 mL extract + 200 mL water), while the control group was only given 200 mL mineral water. The results of observing the effectiveness of garlic extract as Aedes aegypti larvicides in all instars showed that the higher the concentration of garlic extract, the more Aedes aegypti larvae died, and the higher the larval instar the higher the concentration needed to kill it. . In the first instar larvae, the LC50 is 0.24%, the second instar is 0.15%, the third instar is 0.16% and the fourth instar is 0.24%, so the higher the instar, the higher the LC50 or concentration needed to kill 50% of the larvae.

Key words : larvacide, Aedes aegypti, Allium sativum

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is an infectious disease that is still endemic in Indonesia. This disease is an acute febrile disease caused by the dengue virus that enters the human bloodstream through the bite of a mosquito of the Aedes genus, such as *Aedes aegypti* or *Aedes albopictus* (1). Since 1968 identified in Indonesia, this disease caused by dengue virus infection continues to spread throughout the region with an increasing number of cases. Some areas are also endemic for dengue. Incidence rates tend to follow a cyclic pattern, peaking every 6 to 8 years. In contrast, since 1980, the case fatality rate has declined by around half with each decade. Serotype alterations, genotype displacement within DENV-1 and DENV-2, and the introduction of DENV-1 and DENV-3 genotypes from other nations all occurred throughout this 50-year period (2).

Various efforts to prevent and control dengue continue to be carried out starting from chemical, biological, community-based genetics and integrated methods. Chemical methods using insecticides are still one of the main efforts to control dengue. However, there are actually several weaknesses of this chemical method, one of the most worrying is the negative impact on health and also the occurrence of insecticide resistance. Several previous studies have reported the occurrence of insecticide resistance in several synthetic chemical insecticides (3, 4). Therefore, it is necessary to explore plant-based insecticides that do not trigger insecticide resistance.

One of the potential ones is garlic (Allium sativum. L) which is one of the plant controllers that is believed to be able to repel or inhibit and even kill *Aedes aegypti* mosquito larvae because garlic has a pungent aroma. Garlic contains flavonoids and

essential oils which act as respiratory poisons for *Aedes aegypti* mosquito larvae and allicin which acts to inhibit membrane synthesis, causing the death of Ae. aegypti mosquito larvae (5).

Previous studies have investigated the effectiveness of garlic solution in killing Aedes aegypti larvae using concentrations of 1%, 5%, 10%, 25%, 50%, 75%, 100% and the results of this study the most effective concentration of killing mosquito larvae was a concentration of 10%. kill 10 IV instar larvae within 24 hours of research (6). Based on the above background, we are interested in conducting research on the effectiveness of garlic extract with different concentrations that are lower than existing research and in this study also researchers used different extraction methods from previous studies which only carried out the extraction method to the maceration process. (soaking the solution with alcohol) only. While in this study, researchers carried out the extraction to the evaporation stage (evaporation of alcohol). The purpose of this study was to determine the concentration of garlic extract (Allium sativum. L) which was most effective in killing Aedes aegypti mosquito larvae and to determine differences in mortality of Aedes aegypti mosquito larvae at different concentrations of garlic extract.

METHODS

This research is a quasi-experimental research .(quasi-experimental) with a post test only control group design. Garlic extract (Allium sativum. L) was obtained from the evaporation process at the Biochemistry Laboratory of the Faculty of Mathematics & Natural Sciences (FMIPA) Mulawarman University, Samarinda. Hatching of Aedes aegypti larvae and observation of the effectiveness of garlic extract (Allium sativum. L) as Aedes aegypti larvacide against Aedes aegypti larvae were carried out at the Public Health Laboratory (Kesmas) Widya Gama University Mahakam Samarinda.

The sample in this study was Aedes aegypti larvae instar I, II, III and IV from the population of Aedes aegypti larvae. According to the 2005 World Health Organization (WHO) reference, the sample size for larvicidal research was 20-30 Aedes aegypti larvae for each treatment with 3-4 repetitions for each treatment. In this study, the sample size was 25 larvae with 3 repetitions so that in this study a total sample of 1800 larvae was required. The concentration tested in this study was 0% control, 0.10% treatment, 0.20%, 0.30%, 0.40% and 0.50%.

Aedes aegypti larvae were taken as many as 25 in each instar. The process of taking the larvae is done using a dropper and placed in an empty plastic cup. For the first instar larvae, there were 18 glasses containing 25 first instar larvae, as well as for the II, III and IV instar larvae, which contained 18 glasses and each contained 25 larvae. The larvae that have been counted and placed in a plastic cup are then filtered and put into a plastic cup that already contains a solution of various concentrations of garlic extract. In the treatment group, Aedes aegypti larvae were given garlic extract with 5 concentrations, namely 0.10% (0.2 mL extract + 200 mL water), 0.20% (0.4 mL extract + 200 mL water), 0.30% (0.6 mL extract + 200 mL water), 0.40% (0.8 mL extract + 200 mL water) and 0.50% (1 mL extract + 200 mL water), while the control group was only given 200 mL mineral water.

The observation process was carried out for 24 hours by checking the condition of the larvae every 1 hour. The process of checking the larvae is done by touching the body of the larvae using a needle and flashlight to stimulate the larvae whether they are dead or alive.

This effectiveness test was carried out to determine the LC50 value (lethal concentration 50) and the most effective concentration level as larvacide of Aedes Aegypti larvae, treatment using garlic extract (Allium sativum. L) was only given to the experimental group as much as 200 ml of extract in each repetition, while the control group was given treatment using mineral water with a volume of 200 ml in each repetition

RESULTS

Based on the results of the study, the mortality of Aedes sp larvae after treatment can be seen in Table 1.

Table 1. Number of Aedes aegypti Larvae Mortality At Various Concentrations Of Garlic Extract (Allium sativum. L) After 24 Hours of Treatment

instar	Concentration (%)	Number of tested larvae	Number of larvae mortality (repetitions)			mean	
			1	2	3	n	(%)
I	0%	25	0	0	0	0	0%
	0,10%	25	25	25	22	24	96%
	0,20%	25	23	25	25	24	96%
	0,30%	25	25	25	25	25	100%
	0,40%	25	25	25	25	25	100%
	0,50%	25	25	25	25	25	100%
II	0%	25	0	0	0	0	0%
	0,10%	25	25	24	25	25	100%
	0,20%	25	25	23	24	24	96%
	0,30%	25	25	25	25	25	100%
	0,40%	25	25	25	24	25	100%
	0,50%	25	25	25	25	25	100%
III	0%	25	0	0	0	0	0%
	0,10%	25	25	23	25	24	96%
	0,20%	25	25	24	25	25	100%
	0,30%	25	25	25	25	25	100%
	0,40%	25	25	25	24	25	100%
	0,50%	25	25	25	25	25	100%
IV	0%	25	0	0	0	0	0%
	0,10%	25	12	9	10	11	44%
	0,20%	25	16	15	16	16	64%
	0,30%	25	24	25	25	25	100%

	0,40%	25	25	24	25	25	100%
	0,50%	25	24	25	25	25	100%

Based on the data in Table 1, it can be seen that in the control group there was no larval death in all replications, either instar I, instar II, instar III or instar IV. The larvicidal experiment of garlic extract on larvae instars I, II, and III had a mortality rate of 100% within 24 hours of observation, in the fourth instar experiment in the treatment group found the lowest mortality rate of 44% at a concentration of 0.10% and increased mortality. with increasing concentration.

Table 2. Results of Kruskal-Wallis Test on I-IV . Instar Larvae Mortality

Instar I Larvae	
Mortality	
Chi Square	11,300
Df	5
Asymp. Sig.	,046
Instar II Larvae	
Mortality	
Chi Square	11,308
Df	5
Asymp. Sig.	,046
Instar III Larvae	
Mortality	
Chi Square	11,300
Df	5
Asymp. Sig.	,046
Instar IV larvae	
Mortality	
Chi Square	13,456
Df	5
Asymp. Sig.	,019

Instar III larvae			
95% confidence limits for type of concentrations			
Probability	Estimate	Lower Bound	Upper Bound
.50	0,1609%	-	-
Instar IV larvae			
95% confidence limits for type of concentrations			
Probability	Estimate	Lower Bound	Upper Bound

.50	0,2441%	-	-

From Table 2, it can be seen that the probit test results for all instars have different LC50. In the first instar larvae, the LC50 is 0.24%, the second instar is 0.15%, the third instar is 0.16% and the fourth instar is 0.24%, so the higher the instar, the higher the LC50 or concentration needed to kill 50% of the larvae high too.

DISCUSSION

The results of observing the effectiveness of garlic extract as *Aedes aegypti* larvicides in all instars showed that the higher the concentration of garlic extract, the more *Aedes aegypti* larvae died, and the higher the larval instar the higher the concentration needed to kill it. Garlic (*Allium sativum.* L) belongs to the Liliacea family, which contains elements of chemical compounds such as essential oils, allildisulfide and allicin which can kill mosquito larvae and repel mosquitoes. Garlic (Allium sativum. L) is rich in antioxidant phytochemicals which include organosulfur compounds and flavonoids (7).

Allicin has activity as an antibacterial. The allicin content works by interfering with the synthesis of parasite cell membranes so that the parasite cannot develop further and allicin also works to damage sulfhydryl (SH) contained in proteins. The structure of the larval cell membrane consists of sulfhydryl (SH) protein, where allicin will damage the larval cell membrane resulting in lysis. Allicin toxicity has no effect on mammalian cells because mammalian cells have glutathione which can protect mammalian cells from the effects of allicin (8).

Based on this mechanism, allicin can inhibit the development of third instar larvae into IV instar larvae or IV instar larvae will not turn into pupae and eventually die because their cell membranes have been damaged. Garlic oil works by changing the surface tension of the water so that the larvae have difficulty taking air from the surface of the water. This causes the larvae to not get enough oxygen for their growth, resulting in the death of the larvae (9).

Another content of garlic that plays a role in larval death is flavonoids. The effect of flavonoids on various organisms, one of which is as a respiratory inhibitor. If flavonoids are absorbed and enter the body cavity in excess, then the vasoconstriction in the body cavity becomes damaged and hemolymph cannot be distributed perfectly. Damage to breathing and body cavities ultimately causes death. Flavonoid compounds cause respiratory inhibition in larvae so that the larvae experience convulsions and end up dying. As in this study, within hours after being treated with garlic extract, some larvae experienced slower movements compared to untreated larvae. A few hours later the larvae die. This happens because of the disruption of impulse delivery to the muscles which results in muscle spasms, paralysis occurs and ends in death (10, 11).

This study proves that within 24 hours, this larvicide can cause the death of Aedes aegypti larvae. From the results of this study, it is known that the most effective concentration is the highest concentration, namely a concentration of 0.50% because it is able to kill all I-IV instar larvae within 24 hours, but has not been tested for safety and health when applied in the community. In the opinion of the researcher, as long as there is no further research, garlic extract with a low concentration of 0.10% can be used. This concentration is able to kill 100% of the first instar larvae, so that it will break the growth chain because when *an Aedes aegypti* egg hatches into a first instar, it will die immediately and will not develop into the next instar.

The use of garlic as a vegetable larvicide is very good because it is made from natural ingredients and does not use synthetic chemicals that can affect health. The use of this vegetable larvicide can be used as an alternative to prevent or eradicate the vector of Dengue Hemorrhagic Fever (DHF), namely Aedes aegypti larvae which is an infectious disease in Indonesia. However, in the application of garlic extract as a larvicide, it is necessary to pay attention to the places where the extract will be given, namely in open water reservoirs. This means that if the community's water reservoir is closed so that it is not possible for mosquitoes to enter, then there is no need to give extract. It's the same with bathtubs, where the tub water is drained or replaced 2 to 3 times, so there is no need to add extract because the mosquito life cycle is ± 1 week, so it doesn't allow mosquitoes to lay eggs in the tub that is often drained.

The conclusion of this study is that garlic extract is effective as a larvicide of Aedes aegypti. The optimal concentration that was able to kill 100% of the test larvae in all instars was a concentration of 0.50%. There was a significant difference in mortality between Aedes aegypti larvae given garlic extract with different concentrations, with p value < 0.05 for the first instar of 0.046; instar II of 0.046; instar III is 0.046 and instar IV is 0.019.

This research is an early stage research so that for application to the community, further studies should be carried out regarding safety for public health, to remove the sharp color and odor of garlic extract (Allium sativum. L) and regarding how long the active power and dosage dosage are. the safest garlic extract so that it can be applied in the community.

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