



Proceeding SYMBION (Symposium on Biology Education)

<http://seminar.uad.ac.id/index.php/symbion>
2540-752X (print) | 2528-5726 (online)



Water type differences analysis in ovitrap to the number of *Aedes* mosquito eggs in the pagesangan baru, Mataram City

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ARTICLE INFO

Article history

Submission Dec 10th, 2022

Revision May 10th, 2023

Accepted May 17th, 2023

Keyword

Aedes

Water Type

Ovitrap

ABSTRACT

This study aim was determine the water type difference of ovitrap to the attractiveness of *Aedes* mosquitoes to lay eggs. The data collection technique used in this research purposive sampling with several criteria that include exclusion and inclusion criteria. The ovitrap is installed both indoors and outdoors, each with 3 ovitrap, consisting of rainwater, river water, and tap water. The results showed that the number of *Aedes* eggs in rainwater was 1.455, river water was 660, and tap water was 107. The One Way Anova test obtained a p-value = 0.000 ($p < 0.05$), which means that there are a significant differences to the attractiveness of *Aedes* mosquitoes to lay eggs. Ovitrap with rainwater has the highest number of eggs, compared to the river water and the tap water.

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Introduction

Mosquitoes are an insect that has an important role for humans, especially in the health sector, which can transmit several diseases. The *Aedes aegypti* mosquito is one of the mosquito species that play a role in the transmission of several Arbovirus diseases, one of which is Dengue Hemorrhagic Fever/DHF. DHF has a detrimental impact on health and often can lead to death¹.

Ae. aegypti mosquito can be found inside and outside the house². Houses with higher occupancy densities have a greater chance of mosquitoes transmitting diseases, given the habit of mosquitoes biting many times in short flight distances³. The density of vegetation also has an impact on the abundance of mosquitoes. Lush vegetation tends to provide an obstacle for sunlight to touch the ground, causing moist soil. This condition makes a dense area of vegetation an adaptive environment for mosquito life. Dense vegetation has a high potential as a breeding ground for mosquitoes⁴

The countermeasures of dengue fever are still very dependent on vector control efforts to break the chain of transmission of DHF. One of the methods that can be used in the control

of mosquito vectors is ovitrap. Ovitrap is a mosquito egg trap consisting of a container filled with water to trap mosquito eggs. Ovitrap works by exploiting the biological needs of female mosquitoes that lay eggs because the main target in ovitrap is the female mosquito *Ae. aegypti* and *Ae. albopictus*⁵

Ae. Aegypti mosquitoes is a type of mosquito that is easy to breed and can live close to the human environment, because this mosquito is known as a residential mosquito that can lay eggs in clean water reservoirs by WHO. The presence of water in this ovitrap affects the place where the mosquito *Aedes* sp. because larvae are often found in logged/stagnant water reservoirs⁶. Different types of water in the water reservoirs used are estimated to affect the percentage of larval gain.

In this study, three different types of water were used, namely river water, rainwater, and tap water, which is clean water and close to human activities. Considering that *Aedes* sp. likes clean water reservoirs, it is necessary to research about the effectiveness of different types of water sources on the attractiveness of *Aedes* sp. mosquitoes to lay eggs using ovitrap media. The use of this ovitrap medium to prove how much *Ae. aegypti* mosquito eggs are present in each type of water source.

Method

Research Location

This research was conducted in the Pagesangan Baru of Mataram City because it is a DHF endemic area for the last 5 years.

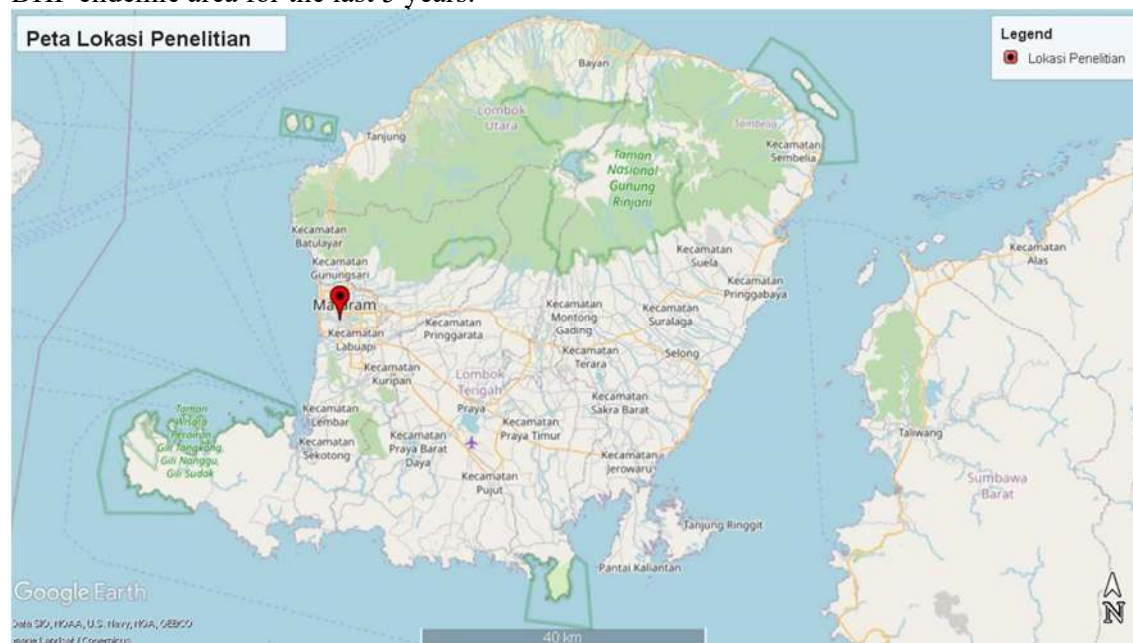


Fig 1. Map of research sites in the Pagesangan Baru, Mataram.

Research methods

This research use a case-control with an experimental quasi-approach method. Purposive sampling technique was used for data collection with several criteria that include exclusion criteria (residents' houses in the environment where the research site is located) and inclusion (active houses, houses with vegetation, and houses that willing to be sampled). The ovitrap used was made of black paper glass filled with rainwater, river water and tap water. A filter paper measuring 20x5 cm was put in the paper glass above the water and one third of filter paper touch the water. Six ovitrap were installed in each houses, 3 ovitrap were indoor and the

other 3 were outdoor. The ovitrap were placed for about 7x24 hours and after that the ovitrap were collected and will be checked for the existence of *Aedes* eggs, if *Aedes* eggs were found on the ovitrap filter paper, the number of *Aedes* eggs in each ovitrap was calculated and the ovitrap index calculated.

Data Analysis

Data on the number of *Aedes* sp. eggs are quantitatively analyzed and described descriptively, and the calculation of the number of egg abundances on ovitrap and ovitrap index is presented in the form of a table. Ovitrap Index is calculated using this formula:

$$\text{Ovitrap Index (OI)} : \frac{\text{The number of Ovitrap with eggs}}{\text{The number of Ovitrap installed}} 100\%$$

Ovitrap index as described by *Food and Environmental Hygiene Department (FEHD), Hongkong*⁷:

Ovitrap Index	Criteria	Score/Level
Level 1	Very Low	< 5 %
Level 2	Low	5 % ≤ 20%
Level 3	Moderate	20 < 40 %
Level 4	High	>40%

This Ovitrap Index value shows the distribution of mosquitoes, the higher the score/level of the Ovitrap Index, the higher the abundance of the *Aedes* sp. mosquito population in the region⁷. Then a statistical analysis of the difference in water types is provided on the number of mosquito eggs trapped using the one-way ANOVA test.

Results and Discussion

Morphology of *Aedes* sp. eggs

The eggs of *Aedes* sp. obtained during the study had an average length of $\pm 41.55 \mu\text{m}$ and a width of $\pm 11.03 \mu\text{m}$, black in coloured, oval in shape, and were deposited one by one on filter paper attached to the walls of the ovitrap. The outer wall of the egg (exochorion) has a sticky material (glycoprotein) that will harden when dry, this is what causes the *Aedes* sp. egg stick to the breeding habitat wall⁸. The *Aedes* egg morphology can be seen in Figure 2.

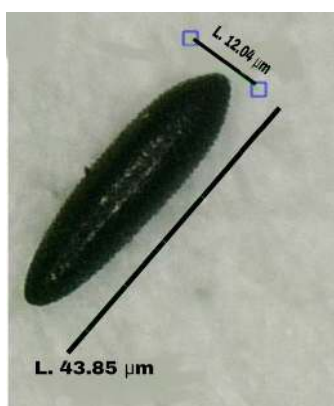


Fig 2. *Aedes* sp. eggs morphology. Magnification: 45×10 , Stereo Microscope Onglai Fixtool M-3 B-3.

The number of eggs of *Aedes* mosquitoes by water types

The number of *Aedes* eggs found in ovitrap with different types of water in the Pagesangan Baru, Mataram can be observed in table 1.

Table 1. *The number of Aedes sp. Mosquito Eggs on Ovitrap Based on Different Water Types.*

Water Type	Placed Ovitrap		Positive Ovitrap		Number of Eggs		Total (Indoors and Outdoors)
	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	
River Water	90	90	19	26	454	206	660
Rainwater	90	90	37	64	624	831	1.455
PDAM	90	90	10	13	106	61	167

According to table 1, the highest number of *Aedes* eggs found in rainwater ovitrap 1.455 eggs (indoor 624 eggs and outdoor 831 eggs). In the river water ovitrap, the number of *Aedes* eggs was 660 eggs (indoor 454 and outdoor 206). In the tap water ovitrap, the number of *Aedes* eggs found was 167 (indoor 106 and outdoor 61).

The results of one way anova test to the differences in the types of water sources with the attractiveness of *Aedes* mosquitoes to lay eggs can be seen in table 2.

Table 2. *One way Anova Test on Different Types of Water Sources Related to The Attraction of Aedes Mosquitoes for Laying Eggs.*

	Sum of Squares	Degree of Freedom	Mean Square	F	Sig.
Between Groups	9369.830	2	4684.915	20.894	0.000
Within Groups	59868.944	267	224.228		
Total	69238.774	269			

The one way anova test showed that the p value was smaller than 0.05, therefore the differences of water types in ovitrap was significantly affected the number of *Aedes* eggs laid. The results of this ANOVA test are then continued with the Tukey test which can be observed in table 3.

Table 3. *Tukey HSD test in the differences of water type to the attractiveness of Aedes for laying eggs*

	Water types	N	Subset for alpha=0,05		
			1	2	3
Tukey HSD	PDAM	90	1.86		
	River water	90		7.33	
	Rainwater	90			16.16
	Sig.		1.000	1.000	1.000

According to the Tukey test, the smallest number of *Aedes* eggs found in tap water with an average of 1.86, the highest number of *Aedes* eggs found in rainwater with an average of 16.16. The attraction of mosquitoes to certain types of water is due to the content of organic and inorganic compounds dissolved in water. These compounds affect mosquitoes through scents that are chemical senses⁸. To find a place to lay eggs, mosquitoes also rely on a combination of hygrosensation and smell, which is used to sense the volatiles produced by aquatic microbes, which serve as food for the larvae⁹.

Ovitrap with rainwater is the ovitrap with the highest *Aedes* eggs compared to the ovitrap of river water and tap water. This correspond to the research conducted⁸, which shows that the

number of *Aedes* sp. mosquito eggs found in rainwater is more than the number of *Aedes* sp. mosquito eggs found in river water. One of the factors affecting the laying of eggs is the olfactory sense of the presence of microorganisms as well as the physicochemical properties of water. The development of mosquito larvae depends on the availability of food, which is an organic and inorganic matter as well as microorganisms¹⁰.

According to the research conducted rainwater contains chemical substances such as ammonia, and inorganic chemicals such as nitrates in the form of NO_3 ¹¹. Based on research conducted, one of the chemical parameters contained in river water are nitrate (NO_3) and ammonia (NH_3)¹². The higher number of *Aedes* sp. eggs in water with a high concentration of ammonium nitrate indicates that this chemical compound can act as an attractant or stimulate mosquitoes to lay eggs¹³. Evaporation of ammonia (NH_3) in rainwater is also a chemical attraction responsible for the presence of female mosquitoes that lay eggs on the spot¹³.

Ovitrap with tap water has the least number of *Aedes* sp. mosquito eggs, because tap water using chlorine compounds for the disinfectant removing ammonia compounds in raw water, eradicates microbes in water, and cleans water from organic matter contamination which can reduce the attractiveness of mosquitoes to lay eggs in ovitrap with the water¹⁴. Chlorine in the water can also interfere with the process of egg development and hatching because it can oxidize (disintegrate) *Ae. aegypti* eggs by damaging the proteins present in the eggs, according to research conducted indicating that the higher the concentration of chlorine in water, the lower tendency of hatchability of *Ae. aegypti* eggs¹⁵.

Ovitrap index (OI) calculation is one of the ways that can be used to measure mosquito populations¹⁶ and describes the actual level of mosquito density in an area so that it becomes an indicator to find out the level of vulnerability of the region². The value of the Ovitrap index (OI) in Kelurahan Pagesangan Baru Kota Mataram based on the type of water used and based on the place where the ovitrap is placed can be observed in table 4.

Table 4. *Ovitrap Index at Kelurahan Pagesangan Baru Kota Mataram.*

OI acc. water types	OI acc. placement
River water (25%)	Indoor (24.45%)
Rainwater (56.11%)	Outdoor (38.15%)
PDAM (12.77%)	

OI value for rainwater ovitrap in Kelurahan Pagesangan Baru, Mataram City in 2022 based on the FEHD category (2014) in Fatmawati⁷ is in the high category (level 4). The Ovitrap index for river water is in the moderate category (level 3) and the ovitrap index for tap water is in the low category (level 2). This means that ovitrap with rainwater type is better at attracting female mosquitoes to lay eggs compared to ovitrap river and tap water.

The value of OI in kelurahan Pagesangan Baru, Mataram City in 2022 based on the FEHD (2014) category in Fatmawati is in the moderate category (level 3)⁷. This means it is advisable to carry out control activities to limit the development of larvae by removing all potential breeding sites. The OI value of indoor ovitrap was 24.45% and the OI from outdoor ovitrap was 38,15%. This results showed that OI value from outdoor ovitrap was greater than the OI value from indoor ovitrap. These two OI are included in the moderate level because they are in the range between 20-40%,. The results of this study are the same as the results of the study which found that the ovitrap index outside the home was greater than inside the house¹⁷. The similarity of the results of this study is related to the condition of the Pagesangan Baru, Mataram area where there is still a lot of vegetation such as trees and ornamental plants.

Conclusion

There is a significant influence on the type of water used with the number of *Aedes* sp. mosquito eggs. on ovitrap. Ovitrap with rainwater type has the highest number of *Aedes* sp. mosquito eggs at 1455, compared to river water ovitrap of 660 and tap water ovitrap of 167.

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