

# Effectiveness of Ovitrap as a Control Tool Population *Aedes* Spp. In Areas Endemic to Dengue Fever Ternate City

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## Abstract

The mosquito ovitrap is often used in dengue fever (DF) vector surveillance, but it has never been reported in control programs to reduce the vector population. This study aims to determine the ovitrap effectiveness as a vector control instrument for DF. The research was carried out from January to March 2021 in Bastiong Talangame Village, one of the DF endemic villages, which is a densed settlement in Ternate City. This research was a quantitative pre-experimental design type one group pre-test and post-test. Measurement of the density of *Aedes* spp. larvae presented in the House Index (HI), Container Index (CI), and Breteau Index (BI) were carried out four times before and after ovitrap installation. The installation of ovitraps was carried out in 100 houses, where four ovitraps were installed in each house with an installation time of four weeks. The results showed that the ovitrap index value decreased until it reached the moderate category in the last week of observation. The density of larvae based on the calculation of HI, CI, BI showed a significant decrease ( $p = 0.0001$ ) before and after ovitrap installation, with the density figure value of the high category being the medium category. The use of ovitrap was effective in reducing the population of *Aedes* spp. so it should be considered in the dengue vector control strategy.

Keywords: *Aedes* spp., ovitrap, vector control

## Introduction

Dengue Fever (DD) is an important public health problem in the world with the incidence rate continuing to increase every year. During the period 1990 to 2019 there was an increase of 85.47% 30.67 million cases in 1990 to 56.88 million cases in 2019 (Du et al. 2020). Indonesia occupies five countries in Asia and among the 30 most endemic countries in the world (WHO 2020). KDD cases in Indonesia in 2020 were reported to have reached 108,303 cases with a morbidity rate or incidence rate (IR) of 40 people per 100,000 population. Deaths caused by DD totaled 747 people with a case fatality rate (CFR) of 0.7% (Ministry of Health RI 2020). The spread of DD in 2020 was reported to have spread to 477 districts/cities or 92.8% of all districts/cities in Indonesia.

Ternate City is a city in North Maluku Province which is categorized as an endemic DD area. The incidence of DD was reported by Tomia et al. (2020) in the 2009-2018 period spread across all sub-districts in the Ternate island region with a total of 918 cases with 31 deaths or a CFR value of 3.3%. The number of DD cases occurs more frequently in males (55.2%) with an age range of 5-14 years. Various efforts to control the population of *Aedes* spp. through the Mosquito Nest Eradication (PSN) program with the 3M Plus Movement, Periodic Larv Inspection (PJB), Routine Larv Inspection (PJR) and the use of larvicide. Apart from that, focused fogging, surveillance and epidemiological investigations (PE) were also carried out. Efforts made to control this have not succeeded in reducing the population density of *Aedes* spp. in Ternate City, as shown by the Larva Free Rate (ABJ) of 79% (still below the national target of >95%).

The existence and population density of *Aedes* spp. in an area can be identified by conducting mosquito surveys at the egg, larva, pupa and adult stages (Ministry of Health of the Republic of Indonesia 2017). The use of ovitrap in egg surveys is reported to have better effectiveness compared to larval surveys

for detecting the presence of *Aedes* spp. in Brazil (Nascimeto et al. 2020). Ovitrap has many benefits in studying entomology and the spread of DD. Ovitrap can be used as a tool to measure mosquito diversity and density (Morales et al. 2021), as an early indicator of environmental health and can be used in predicting DD outbreaks in a region (Sasmita et al. 2021). Ovitrap can also be used as a tool to control mosquitoes.

The use of ovitrap in DD vector surveillance has often been carried out, but its role as a control tool related to reducing vector density has never been evaluated. The effectiveness of the ovitrap as a tool for trapping mosquito eggs has also been widely used, but the ability of the ovitrap to reduce the population of *Aedes* spp. not yet measured. This study aims to analyze the effectiveness of using ovitrap as a tool in reducing the population of *Aedes* spp. by calculating the density figure (DF) value before and after placing the ovitrap. The results of the research are expected to be the use of ovitrap in controlling *Aedes* spp. and can be done by the community independently at an affordable cost.

## **Research Methods**

### **Time and place**

This research was carried out in January - March 2021 in Bastiong Talangame Village, South Ternate City District. Bastiong Talangame sub-district is one of the endemic DD sub-districts with a high population density. This sub-district has an area of 0.38km<sup>2</sup> with a population of 5703 people and 1540 heads of families.

### **Research Sample**

Study This is a quantitative pre-experimental design research with one group pre-test and post-test type (Arikunto 2016). The sample for this research was 100 houses in Bastiong Talangame Village. Determination of houses is carried out based on the simple random sampling method. Bastiong Talangame sub-district represents an endemic DD area in Ternate City with a high population density.

### **Measurement of larval density before ovitrap intervention**

Larval density measurements were carried out every week 4 times before intervention with the ovitrap. Measurements were carried out by observing every week in 100 houses to see whether there were larvae in containers both inside and outside the house. Observation results were recorded and larval density was calculated based on the DF value obtained by calculating the house index (HI), container index (CI), and Breutou Index (BI) (Garjito et al. 2021).

### **Measurement of egg density of *Aedes* spp. on the ovitrap**

Measurement of egg density of *Aedes* spp. This was done by observing the ovitrap. The ovitrap used in this research was a simple ovitrap made from a plastic cup without any additional insecticide. 250 ml plastic cups are colored using black paint on the outside and done one week before use. Filter paper as a place for mosquito eggs to stick is placed around the walls of a glass and  $\frac{3}{4}$  of water is added.

Measurement of egg density of *Aedes* spp. carried out in the same 100 houses to observe larvae. A total of four ovitraps are placed in the house in dark places that mosquitoes like, such as under tables, chairs, under beds, and other potential places. Filter paper is taken from the ovitrap every week and the ovitrap index value is calculated.

### **Measurement of larval density after ovitrap intervention**

Larval density measurements were carried out every week 4 times after intervention with the ovitrap. Observations were carried out the same as before intervention with the ovitrap.

### **Analysis of Ovitrap Index (IO) values**

Ovitrap index value results obtained by counting the number of filter papers that were positive for mosquito eggs divided by the number of filter papers installed on the ovitrap. The ovitrap index criteria (FEDH 2014) are level 1: very low, with  $IO < 5\%$ ; level 2: low, with  $IO \geq 5\% - < 20\%$ ; level 3: moderate, with  $IO \geq 20 - < 40\%$ ; and level 4: high, with  $IO \geq 40\%$ . The ovitrap index values are presented in the form of tables and graphs which are then analyzed descriptively.

### **Analysis of larval density**

The results of the analysis of larval density are based on the Density Figure (DF) value, which is the density level of mosquito larvae in the 100 houses observed. DF results are obtained by calculating the HI, CI and BI values. The DF value is expressed on a scale of 1-9, which is categorized into three categories, namely low density (DF=1), medium density (DF=2-5), and high density (DF=6-9) (Focks 2003).

Data analysis to see differences in average larval density before and after intervention with the ovitrap was carried out using bivariate analysis on SPSS 16.00 software. TestKolmogorov Smirnov used for data normality analysis, and continued withWilcoxon test to determine the difference in average larval density before and after intervention with the ovitrap.

## Results And Discussion

### Larval density before intervention with ovitrap

The results of measuring larval density based on HI, CI and BI values before using the ovitrap in Bastiong Talangame Village, Ternate City for 4 weeks are presented in Table 1. The density figure value obtained was 8 and was categorized as high larval density.

Table 1 Larval density before intervention with ovitrap for 4 weeks in Bastiong Talangame Village, Ternate City.

Larval Density	Sunday					DF
	1	2	3	4	Average	
HI	76	64	73	66	69.8	8
CI	38.8	34.6	44.1	44.6	40.5	
BI	1.36	1.18	1.47	1.25	1.31	

*HI= House index, CI= Container Index, BI= Breutou Index, DF= Density Figure*

### Egg density in the ovitrap

The results of IO measurements in Bastiong Talangame Village, Ternate City can be seen in Figure 1. The IO value decreases every week with an ovitrap index value between 25.75 – 59.5%. Based on FEHD (2014), egg density in Bastiong Talangame Village is within the high criteria (level 4).

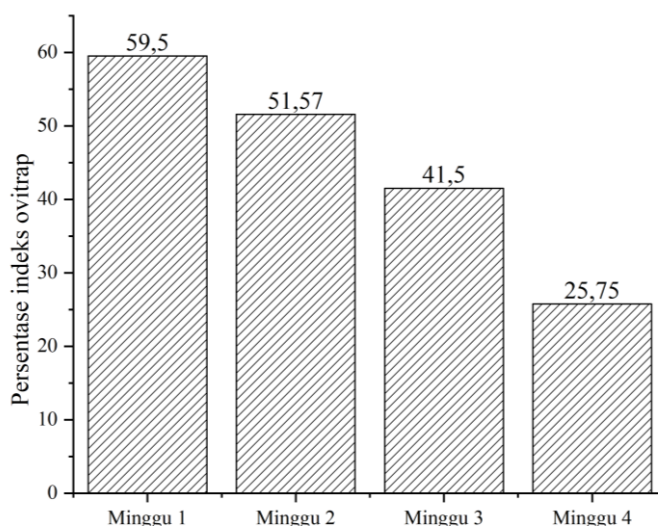


Figure 1. Ovitrap index (IO) values for 4 weeks in Bastiong Talangame, Ternate City.

### Larval density after intervention with ovitrap

The results of measuring the population density of Aedes spp mosquito larvae. in Bastiong Talangame Village, Ternate City after intervention with the ovitrap is presented in Table 2.

Table 2 Larval density after intervention with ovitrap for 4 weeks in Bastiong Talangame, Ternate City.

Larval density	Sunday					DF
	1	2	3	4	Average	
HI	47	35	24	20	31.5	5
CI	34.9	18.3	14.9	9.9	19.5	
BI	0.87	0.62	0.51	0.35	0.035	

HI= House index, CI= Container Index, BI= Breutou Index, DF= Density Figure

The larval density values obtained in Bastiong Talangame Village, Ternate City, before the intervention with the ovitrap, obtained a density figure value of 8 in the high density category, while after the intervention with the ovitrap, the density figure value of 5 was obtained in the medium density category. Larval density before intervention showed that the average positive larvae was higher compared to positive larvae after intervention with the ovitrap.

The results of larval density analysis in the Kolmogorov Smirnov test, both before intervention with the ovitrap and after intervention, were 0.0001 ( $P < 0.05$ ). The test results show that the data is not normally distributed, so followed by the Wilcoxon test. The Wilcoxon test results showed that the average container that was positive for larvae before placing the ovitrap was 2.79 and after placing the ovitrap was 1.35. This shows that there is a significant difference in larval density ( $P < 0.05$ )

## Discussion

Mosquito larvae density measurements before intervention were carried out for four consecutive weeks by looking at HI, CI and BI. The larva measurement activity aims to serve as basic data in carrying out an evaluation of the use of ovitrap as a tool in controlling mosquito populations in Bastiong Talangame Village. The results of measuring larval density at the research location before the intervention (pre-experimental) in Table 1 show HI, CI and BI values of 69.8, 40.5 and 1.31 respectively, so that a density figure of 8 is obtained and categorized into density. high larvae. Factors that influence the DD vector being in an area are the availability of places for female mosquitoes to lay their eggs and reproduce as well as the availability of hosts to suck blood (Kweka et al. 2019). These two factors are fulfilled by the Bastiong Talangame Village. The environment of Bastiong Talangame Village, which has a high population density, supports *Aedes* spp mosquitoes. to get blood sources in the house (anthropophilic and endophagic) for the egg maturation process. The activity and population density in Bastiong Talangame always provides a source of water and also has the potential to increase the number of *Aedes* breeding sites such as tires, used cans or water reservoirs provided by urbanized environments. Garjito et al. (2020) reported that there is a positive correlation between human population density and the incidence of DD in Indonesia. Density of *Aedes* spp. high levels in residential environments have the potential to worsen the risk factors for the DD epidemic.

Assessment of the effectiveness of using the ovitrap intervention can be done with vector surveillance activities. This activity aims to play a role in studying the distribution and density of vectors in an area. This ovitrap installation activity also aims to evaluate vector control performance and direct effective vector control strategies. The results obtained from measuring the ovitrap index in Bastiong Talangame Village were an average ovitrap index of 44.7% with a value of  $\geq 40\%$  of the high criteria (Figure 1). The research results showed that the IO value in weeks 1 and 2 was still high ( $>50\%$ ). In weeks 3 and 4, there was a decrease in the ovitrap value, so that the ovitrap index value in week 4 had IO  $<50\%$ . The decrease in density value based on the density figure after installation of the ovitrap became the medium category from the high category. The higher the density of eggs, the higher the density of adult mosquitoes. Control activities for *Aedes* spp. It is not only possible to use the ovitrap installation approach to control DD. *Aedes* spp. They can still oviposition in other places as long as there are water habitats that can become their brooding places. The research results of Satoto et al. (2020) that the distribution of vectors with entomological indices shows that the presence of larvae, eggs and mosquitoes play a role in the transmission of DD disease. Controlling *Aedes* is the only way to stop the transmission of the dengue virus and understanding the various factors that support the abundance of *Aedes* populations is also very important for implementing vector control programs (WHO 2011).

The successful use of ovitrap to detect the presence of mosquitoes and measure their density has been widely reported, including the use of ovitrap in DD endemic areas in Sabah, Malaysia (Fikri et al. 2021) and effective ovitrap for calculating egg density in homes in Sukabumi (Hidayati et al. 2017).



Mosquito control using ovitrap reported by Karmila et al. (2019) in Bogor City with an effectiveness of 86.7-100%. The ovitrap contains pyriproxyfen, Beauveria bassiana spores and yeasts succeeded in making eclosion failures of 63% and 83.6%. Ovitrap Kepanjen model made from a black bucket (25 cm in diameter and high 19cm) in 4 RWs (Jatimulyo, Merjosari, Summersari and Bandulan) in Malang City effectively reduces larval density and is one tool to control the population of *Ae. aegypti* (Zuhriyah et al. 2016).

The use of ovitrap in controlling DD is the simplest and cheapest method for controlling vector density, besides that information is also obtained about the density of *Aedes* spp. in a short time. Chaverri et al. (2018) reported that the ovitrap is a fairly simple sampling tool for detecting the presence of *Aedes* spp. in Heredia Province, Costa Rica Central America. The use of the ovitrap as a tool for trapping mosquito eggs to analyze the presence of ovarian transmission of the dengue virus in endemic areas. Wanti et al. (2016) reported that the dengue virus surveillance approach using ovitrap was able to detect ovarian transmission in *Ae. aegypti* in Kupang, East Nusa Tenggara. An assessment of the effectiveness of the autocidal gravid type of ovitrap was carried out in San Antonio, Texas, United States to find out the existence of *Ae. aegypti*, *Ae. albopictus*, and *Cx. quinquefasciatus* (Obregon et al. 2019).

Evaluation of an intervention to control the DD vector can use the *Stegomyia* index assessment based on HI, CI, BI and assessment of ABJ status. These two assessments have long been carried out in Indonesia (Garjito et al. 2020). The community has also carried out larval observations in each house which is a program of the Ternate City Health Service with the G1RIJ program. The main difficulty in implementing this activity is that it has not been carried out sustainably because there is still a lack of public awareness in vector control.

Larval density in Bastiong Talangame Village after the intervention had a significant decrease (Table 2). The results of the analysis of larval density before and after the intervention with the ovitrap showed that there was a decrease in the density and distribution of larvae after the intervention using the ovitrap in Bastiong Talangame Village. The HI, CI, and BI values are 31.5, 19.5, and 0.035 respectively in table 2 so that a density figure value of 5 is obtained and is categorized into medium larval density.

Long-term ovitrap intervention activities also require precise observation because they can become breeding grounds for insects or other animals (Sivagnaname and Gunasekaran 2012). However, the evaluation results of the use of the ovitrap in this study showed a decrease in egg and larval density values and there were no cases of DD in Bastiong Talangame Village. The results of this study also showed that there was a decrease in the mosquito population which has the potential to be a DD vector due to the ovitrap installation intervention. Eggs attached to filter paper in the ovitrap and timely disposal of mosquito eggs on a regular basis will reduce the mosquito population in the study area. The collection of filter paper/disposal of mosquito eggs in this study was carried out every week on a regular basis with the aim of preventing mosquito eggs from hatching into larvae and developing into adults. The use of ovitrap has proven successful in reducing the *Aedes* mosquito population in the Bastiong Talangame sub-district.

## Conclusion

Larval density in Bastiong Talangame Village showed a DF value before the ovitrap intervention of 8 in the high density category. Larval density after intervention with a DF value of 5 in the medium density category. The average ovitrap index value when observing eggs is in the high category. Ovitrap is effective in controlling the population of *Aedes* spp. in Bastiong Talangame Village, Ternate City.

## Suggestion

Ovitrap can be used as an alternative tool in vector control with good supervision. Apart from that, the ovitrap can be used as a vector surveillance tool to monitor the presence of vectors in an area.

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