



Types of Ovitrap Colors Preferred by *Aedes aegypti* Mosquitoes for Egg Laying in Mokoau Community Health Center Area

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ARTICLE INFO

Article history

Received : 31 Oct 2025

Revised : 06 Dec 2025

Accepted : 25 Dec 2025

Keyword

Aedes Aegypti

Mokoau Health Center

Ovitrap

ABSTRACT

Dengue Hemorrhagic Fever (DHF) is an acute viral infection transmitted by *Aedes aegypti* mosquitoes and remains a major public health problem in Indonesia, including Southeast Sulawesi Province. The World Health Organization (WHO) reported more than 6.5 million global dengue cases with 6,800 deaths in 2023, while Indonesia recorded over 11,000 cases with nearly 900 deaths. In Kendari City, DHF cases increased again in 2022 with 230 cases and a case fatality rate (CFR) of 2.6%. This study aimed to analyze the effectiveness of ovitrap colors most preferred by *Aedes aegypti* for oviposition in the working area of the Mokoau Health Center. This research employed a simple pre-experimental observational design without a control group or randomization, using PDAM water as the ovitrap medium. The study was conducted from July to August 2024 using 60 ovitraps in six colors (red, orange, yellow, green, blue, and black), with 10 units for each color. Ovitrap were installed for one week without position rotation and subsequently collected for egg counting in the laboratory. Data were analyzed using ANOVA to determine differences in the mean number of eggs among color treatments. The results showed that yellow ovitraps had the highest mean number of eggs with 33.8 eggs (27.37%), followed by black 25.10 (20.32%), red 19.00 (15.38%), blue 16.70 (13.52%), green 15.40 (12.47%), and orange 13.50 (10.93%). These findings indicate that ovitrap color influences the oviposition behavior of *Aedes aegypti*, with yellow providing the greatest visual attraction and effectiveness in capturing eggs. It can be concluded that yellow ovitraps are the most effective option for supporting vector control programs, and further studies are recommended to evaluate their performance under different environmental conditions.

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INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is an infectious disease that can cause death in a short time if not treated immediately. According to a WHO report, the first case of dengue fever was discovered In Indonesia, dengue fever cases continue to fluctuate, with the number of cases peaking at 138,127 in 2019 before declining to 73,518 cases in 2021. (Kemenkes

RI, 2022) However, despite the decline in cases, the mortality rate remains quite high. In Southeast Sulawesi, dengue fever was first reported in 1980 in Poasia District, and as the population grows, dengue cases continue to rise annually. In 2019, there were 1,510 cases recorded, with 5 deaths (Dinas Kesehatan Sulawesi Tenggara, 2020) Although dengue fever cases decreased in 2020, an increase in the number of cases occurred again in 2022 in Kendari City, with a total of 230 cases and a mortality rate of 2.6%. (Dinas Kesehatan Kendari, 2022)

Controlling the *Aedes aegypti* mosquito vector is an important strategy in dengue prevention. One effective control method is the use of an ovitrap, a device designed to trap female mosquitoes while they lay eggs. Ovitrap were first developed by Fay and Eliason in 1996 and have since been widely used, including in Singapore, where the installation of 2,000 ovitraps successfully reduced the mosquito population. (Kumawat et al., 2014) One tool that has proven highly efficient for *Ae. aegypti* surveillance is systematic ovitrap sampling, which can be used for entomological surveillance (Centro Nacional de Programas Preventivos y Control de Enfermedades (CENAPRECE), 2015) both to detect its presence (Baak-Baak et al., 2016) and to estimate its abundance (Tovar-Zamora et al., 2019) Ovitrap can also be used for mosquito population control. As a diurnal/day-biters mosquito, *Aedes aegypti* relies heavily on visual cues, including light intensity, shape, contrast, and object color, in its orientation, host-seeking, and oviposition site selection, with multiple studies demonstrating that vision guides mosquitoes toward small, dark containers when searching for oviposition sites, and that blocking or disrupting vision significantly impairs their ability to locate suitable sites; collectively, these findings provide a strong biological rationale for testing ovitrap color variation particularly dark or high contrast colors as visual attractants in ovitrap-based vector control strategies (Sharkey et al., 2020). Based on this background, this study aims to identify the color of the Ovitrap that is most preferred by *Aedes aegypti* mosquitoes for egg-laying in the work area of the Mokoau Health Center.

METHOD

This research method used a pre-experimental approach with a prospective observational design. The main objective was to determine the preferences of *Aedes aegypti* mosquitoes in laying eggs on ovitraps of different colors, using PDAM water as the medium. Treated tap water from the municipal supply (PDAM) is used as the ovitrap medium because it has relatively uniform physicochemical characteristics, namely clear water with a near-neutral pH, low organic content, and the presence of chlorine as a disinfectant. Chlorine is toxic to *Aedes aegypti* eggs and larvae, so it can damage cellular structures and disrupt physiological processes that are essential for egg hatching and larval development in the aquatic medium.

The material and design of the ovitrap influence the micro-environment that determines how suitable the site is for *Aedes aegypti* oviposition, because the type of material and wall colour regulate heat absorption and thermal conductivity, thereby altering the water temperature, while glossy surfaces reflect more light and appear brighter than matte surfaces, which are duller and darker and thus tend to better match the mosquito's preference for shaded oviposition sites. In addition, the opening diameter of the ovitrap affects the intensity of light entering the trap and how easily mosquitoes can reach the water surface, so an opening that is sufficiently wide is required to facilitate mosquito entry while still maintaining a dim and sheltered condition that favours oviposition.



The study was conducted in the working area of the Mokoau Community Health Center, Kendari, from July to August 2024. Researchers prepared 60 ovitraps with six different colors (red, orange, yellow, green, blue, and black), which were placed in 10 houses. Each house was installed with six ovitraps with a distance of 25 cm between colors. These ovitraps functioned as traps to collect mosquito eggs, which were then counted and analyzed.

The data collected in this study consisted of primary and secondary data. Primary data came from direct field observations, while secondary data were obtained from literature and previous research. Data processing was carried out through the stages of editing, coding, entry, and tabulation. Then, the data were presented in descriptive and analytical form using tables and narratives. Data analysis involved two types of approaches: descriptive analysis to describe the observational data and inferential analysis for statistical tests. Normality tests were performed using Shapiro-Wilk and ANOVA tests were used to determine whether ovitrap color had a significant effect on the number of mosquito eggs captured.

RESULT

The Mokoau Community Health Center (Puskesmas) is located in the southwest of Kendari City, and the entire area is located on the mainland of Sulawesi Island. The area of the Mokoau Community Health Center (Puskesmas) is 21.17 km². The area varies by sub-district, with Mokoau Sub-district being the largest, followed by Lalolara, Kambu, and Padaleu Sub-districts.

Mosquito Egg Count Data

The number of *Aedes aegypti* mosquito eggs was calculated using 10 experiments. The results are as follows:

Table 1. Mosquito Egg Count Data

<i>Ovitrap Colour</i>	R 1	R 2	R 3	R 4	R 5	R 6	R 7	R 8	R 9	R 10	Total
Yellow	65	52	72	32	18	16	26	16	21	20	338
Red	34	37	30	20	6	15	6	10	16	16	190
Black	36	28	42	28	22	20	11	26	18	20	251
Green	26	26	18	10	10	15	11	15	9	14	154
Orange	23	18	11	8	14	13	8	13	11	16	135
Blue	32	28	20	11	9	11	10	17	15	14	167

Table 1. Above Shows the distribution of *Aedes Aegypti* mosquitos eggs captured in ovitraps of various colours during 10 repetition (R1-R10). Each column from R1 to R10 represents the observation results for each repetition. The ovitrap colors tested included yellow, red, black, green, orange, and blue, with the total number of eggs captured in each color calculated for all repetitions. These data illustrate the variation in the number of mosquito eggs captured in each repetition based on the ovitrap color used, providing important information for further analysis of the effectiveness of each color in attracting mosquitoes to lay eggs.

Distribution Results of the Number and Average of Mosquito Eggs

The test results show the distribution of the number and average number of *Aedes aegypti* mosquito eggs caught on the Ovitrap, which can be seen in Table 2.

Table 2. Number and Average of *Aedes Aegypti* Mosquito Eggs Caught on Ovitrap Colors

No	Ovitrap Colour	Aedes Aegypti Mosquito Eggs		Average	Standart Deviation	Max-Min
		Total	%			
1.	Yellow	338	27,37	33,80	21,254	72 – 16
2.	Red	190	15,38	19,00	11,175	37 – 6
3.	Black	251	20,32	25,10	9,024	42 – 11
4.	Green	154	12,47	15,40	6,257	26 – 9
5.	Orange	135	10,93	13,50	4,601	23 – 8
6.	Blue	167	13,52	16,70	7,832	32 – 9
Total		1235	100	123,5		

Based on the results of Table 2, after 10 repetitions of the experiment, a total of 1235 eggs were trapped. The most *Aedes aegypti* mosquito eggs were found in the yellow Ovitrap (27,37%), with an average of 33,80 eggs captured. Then the least number of *Aedes aegypti* mosquito eggs was in the orange Ovitrap (10,93%) with an average of 13,50 eggs captured. The following is a diagram of the results of the percentage distribution of the number and average of *Aedes Aegypti* mosquito eggs trapped in the color of the Ovitrap which can be seen in Figure 1.

Normality Test Results

The normality test is a crucial step in statistical analysis to determine whether the data obtained are normally distributed. The normal distribution is a basic assumption that must be met when conducting various parametric statistical tests, such as the t-test or ANOVA. The basis for decision-making in the normality test is as follows:



1. If the significance value (Sig.) is greater than 0.05, the research data is normally distributed.
2. Conversely, if the significance value (Sig.) is less than 0.05, then the research data is not normally distributed.

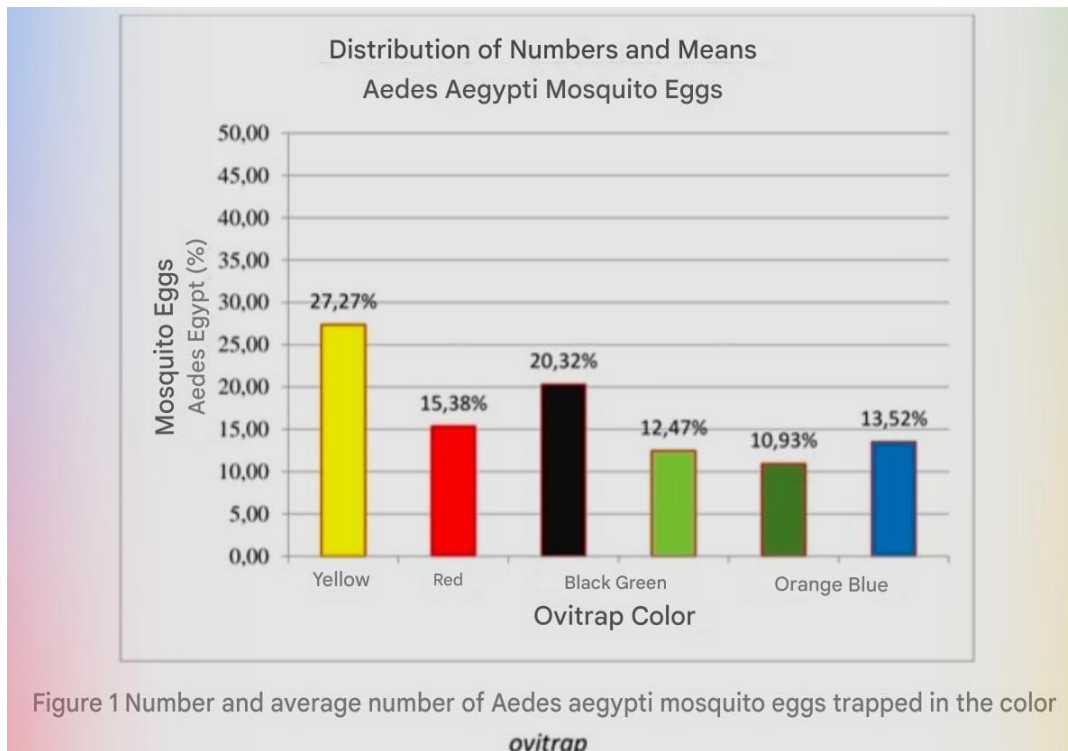


Table 3. Normality Test Result

Tests of Normality				
Total Eggs	Shapiro-Wilk			
	Statistic	Statistic	df	Sig.
	.249	.881	6	.275

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the SPSS output in Table 3 above, it is known that the significance vae of Asymp.Sig (2-tailed) is 0.275 or (> 0.05). Therefore, in accordance with the decision-making basis for the Kolmogorov-Smirnov normality test above, it can be concluded that the data in this study are normally distributed.

Results of the Difference in the Average Number of Mosquito Eggs Captured in All Observations Based on Ovitrap Color

The results of the average difference in mosquitoes caught in all observations based on Ovitrap color can be seen in Table 4.

Table 4. Average difference in mosquito eggs caught in observations based on Ovitrap

Ovitrap Colour (I)	Ovitrap Colour (II)	Difference Average (I-II)	Standart Error	p-value	95% Confidence Interval
Yellow	Red	14,800	5,098	0,005	4,58 - 25,02
	Black	8,700	5,098	0,094	-1,52 - 18,92
	Green	18,400	5,098	0,001	8,18 - 28,62
	Orange	20,300	5,098	0,000	10,08 - 30,52
	Blue	17,100	5,098	0,001	6,88 - 27,32
Red	Yellow	-14,800	5,098	0,005	-25,02 - (-4,58)
	Black	-6,100	5,098	0,237	-16,32 - 4,12
	Green	3,600	5,098	0,483	-6,62 - 13,82
	Orange	5,500	5,098	0,285	-4,72 - 15,72
	Blue	2,300	5,098	0,654	-7,92 - 12,52
Black	Yellow	-8,700	5,098	0,094	-18,92 - 1,52
	Red	6,100	5,098	0,237	-4,12 - 16,32
	Green	9,700	5,098	0,062	-,52 - 19,92
	Orange	11,600	5,098	0,027	1,38 - 21,82
	Blue	8,400	5,098	0,105	-1,82 - 18,62
Green	Yellow	-18,400	5,098	0,001	-28,62 - (-8,18)
	Red	-3,600	5,098	0,483	-13,82 - 6,62
	Black	-9,700	5,098	0,062	-19,92 - 0,52
	Orange	1,900	5,098	0,711	-8,32 - 12,12
	Blue	-1,300	5,098	0,800	-11,52 - 8,92
Orange	Yellow	-20,300	5,098	0,000	-30,52 - (-10,08)
	Red	-5,500	5,098	0,285	-15,72 - 4,72
	Black	-11,600	5,098	0,027	-21,82 - (-1,38)
	Green	-1,900	5,098	0,711	-12,12 - 8,32
	Blue	-3,200	5,098	0,533	-13,42 - 7,02
Blue	Yellow	-17,100	5,098	0,001	-27,32 - (-6,88)
	Red	-2,300	5,098	0,654	-12,52 - 7,92
	Black	-8,400	5,098	0,105	-18,62 - 1,82
	Green	1,300	5,098	0,800	-8,92 - 11,52
	Orange	3,200	5,098	0,533	-7,02 - 13,42

Based on the results in Table 4, the yellow Ovitrap color had a significance value of $p < 0,05$, indicating a difference between the Ovitrap colors. Then, the red, black, green, orange, and blue Ovitrap colors had a p-value of $> 0,05$, indicating no difference between them.



Figure 2 Aedes Aegypti Mosquito Eggs

DISCUSSION

This study aimed to determine the preferred ovitrap color for *Aedes aegypti* mosquitoes to lay eggs in the Mokoau Community Health Center (Puskesmas) area. *Aedes aegypti* mosquitoes are the primary vectors of dengue fever (DHF), chikungunya, and Zika and have specific egg-laying preferences.

Based on Table 2, it can be seen that the yellow color is the most attractive for mosquitoes to lay eggs, with a total of 338 eggs (27,37% of the total) and an average of 33,80 eggs per repetition. The relatively high standard deviation (21,254) indicates significant variation, possibly due to the influence of environmental factors. In contrast, the orange color has the fewest number of eggs, namely 135 eggs (10.93%), with an average of 13,50 eggs and a low standard deviation (4,601), indicating greater consistency in egg numbers.

Figure 1 confirms that yellow attracts mosquitoes, with 27,27% of eggs found in yellow ovitraps. This is nearly double the rate of orange (10,93%) and green (12,47%), indicating the strong visual attraction of yellow for mosquitoes to lay eggs. Conversely, orange was the least effective color, with the lowest percentage.

Statistical analysis based on Table 4 shows a significant difference between the yellow ovitrap and the other colors, with a p-value $< ,05$, especially when compared to red, green, orange, and blue.

This study's finding, which shows a predominance of egg deposition in yellow ovitraps, is in line with the observations of Stephen et al., who reported that yellow ovitraps produced the highest percentage of *Aedes aegypti* egg hatching compared with other colors. These results indicate that the selection of ovitrap color plays an important role in the effectiveness of mosquito control, with yellow and black being the most attractive colors, whereas orange is less effective than the other colors. The fact that *Aedes aegypti* mosquitoes still lay eggs in ovitraps of all colors, including yellow, as reported by Darmawati et al. (2021), further supports that color modification can be applied as a

strategy to optimize ovitrap performance in the field. In addition to color modification, the use of attractants such as brown sugar solution and baker's yeast can also increase the effectiveness of Ovitrap. Research by Made Agus Nurjana & Ade Kurniawan (2016) shows that attractants that produce CO₂ and ethanol through fermentation can attract more mosquitoes to lay eggs, helping in controlling mosquito populations. Monitoring mosquito density indicators such as the Container Index (CI) and House Index (HI) also shows that mosquito populations can decrease over time with proper Ovitrap use. The success of Ovitrap implementation also depends on community participation and understanding of how to use and maintain Ovitrap. Public education, as well as coordination with health workers and mosquito larvae control cadres, is crucial to ensure the sustainability of this method in controlling mosquito population. The findings of this study indicate that yellow ovitraps act as the most effective visual attractants because they capture the highest number of *Aedes aegypti* eggs and differ significantly from other colors, whereas orange ovitraps show the lowest effectiveness; therefore, yellow can be recommended as the primary ovitrap color in vector control and ovitrap-based surveillance strategies in the Mokoau Community Health Center working area.

CONCLUSION

Based on the research results, the following conclusions can be drawn:

1. *Aedes aegypti* mosquitoes showed a preference for laying eggs on ovitraps of various colors, although not all colors were equally attractive. The study found that *Aedes aegypti* mosquitoes preferred to lay their eggs on yellow ovitraps, which proved to be the most attractive, resulting in the highest number of eggs captured. Other colors, such as black, red, blue, green, and orange, also served as egg-laying sites, but in smaller numbers than yellow ovitraps.
2. The yellow color demonstrated the highest effectiveness in significantly increasing the number of catches compared to other colors. Conversely, the orange color was found to have the lowest effectiveness.

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