


The influence of ylang-ylang flower extract administration (*Cananga Odorata*) as an *Aedes Aegypti* Mosquito Instar III

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received Mar 5, 2024 Revised Mar 7, 2024 Accepted Mar 28, 2024</p>	<p>The dengue virus is spread by the <i>Aedes aegypti</i> mosquito. In Indonesia, dengue hemorrhagic fever (DHF) still has a relatively high morbidity and fatality rate. Therefore, initiatives are required to reduce the incidence by controlling mosquito populations, using natural larvicides as one method. Ylang-ylang flower (<i>Cananga odorata</i>) is among the vegetation that may be used as larvicides because it contains flavonoids, saponins, tannins, linalool, and eugenol. This study aims to investigate the impact of administering ylang-ylang flower extract (<i>Cananga odorata</i>) as larvae of <i>Aedes aegypti</i> mosquito instar III. This work used a post-test only control group experiment conducted in a laboratory experimental at the Entomology Laboratory of the Institute of Tropical Disease (ITD) Airlangga University. There were six research groups used in this study, namely negative control, the control using ylang-ylang flower extract concentration with 0,1%; 0,75%; 1,5%; 2,25%, and 3%. The data analysis using larval samples were obtained from the Institute of Tropical Disease (ITD) Airlangga University. According to the analysis, a level of 3% the highest average mortality or death of larvae was 100%, and the lowest average death of larvae at a concentration of 0,1% was 3,75%. The Kruskal-Wallis test findings revealed substantial variations ($p < 0.05$) in each group, and the Mann Whitney U post hoc test revealed a substantial variations in concentrations of 0,1% with 0,75%; 1,5%; 2,25%; 3% and concentrations between 0,75% to 1,5%, 2,25%, and 3%. Considering the findings of the study, it can be determined that the ylang-ylang's flower extract (<i>Cananga odorata</i>) has an influence as a natural larvicide of <i>Aedes aegypti</i> mosquitoes instar III.</p>
<p>Keywords:</p> <p>Aedes Aegypti Larvicide Ylang-Ylang (<i>Cananga Odorata</i>)</p>	

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INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is defined as a form of disease acute which has clinical symptoms of bleeding, causing shock and even death (Fagbami & Onoja, 2018; Harapan et al., 2019; Leowattana & Leowattana, 2021). The dominant vector of dengue fever that occurs in the region of Indonesia is the *Aedes aegypti* mosquito, except in areas at altitudes reaching 1 km above

sea level (Adnyana & Surya, 2023; Kurnia & Suryawan, 2019; Weerasinghe & Medagama, 2019). However, until now, the vaccine for dengue fever has not yet been innovated and causes the handling of this problem still focus on vector control (Pramadani et al., 2020). Various prevention programs to control dengue fever have been carried out, but the number of cases continues to increase every year (Arfan et al., 2022; Lestari et al., 2019). Thus, it can be said that dengue fever has quite high morbidity and mortality rates in Indonesia (Ciptono et al., 2021).

According to data from the World Health Organization (WHO), the incidence of dengue fever infections reaches around 50 - 100 million a year. In 2019, around 40% of the world's population, by 2.5 billion people, had homes in areas at high risk of transmission of dengue fever infection (CDC, 2020). According to WHO data for 2020, the Asian region leads all other tropical and subtropical regions in dengue cases. In 2018, there were 280,552 cases found throughout Southeast Asia. The East Java Provincial Health Service reported that 1,220 dengue fever patients were found in East Java, with 21 mortalities, most aged between 5 and 14 years in 2022. Surabaya has contributed to the number of dengue fever cases in 2022 amounting to 178 cases, with the highest peak in February during the transition period (Sulistiawati & Bilqis Inayatillah, 2023).

Chemical control, biological agents, environmental management, and PSN eradication can all be utilized to combat dengue, especially *Aedes aegypti*. Chemical control using synthetic pesticides that eliminate adult mosquito vectors and mosquito larvae/larvae is a common control method used today. Temephos (*Abate*) is a form of insecticide used to control mosquito larvae that transmit dengue fever (Indonesian Ministry of Health, 2020). According to the World Health Organization (WHO), chemical larvicides are the best choice when vector and disease control present a high risk at certain times and in places where disease may occur. The use of chemical larvicides and other larvicides also has disadvantages. In addition, repeated exposure to chemicals can cause water exposed to pesticide residues, especially drinking water, to become dangerous as it has been contaminated (United States Environmental Protection Agency, 2001).

Indonesia stands out among nations for its rich array of plant species, many of which offer diverse benefits. One notable example is the ylang-ylang flower (*Cananga odorata*), recognized for its potential as a natural pesticide. Saponins work by remodeling cell membranes and disrupting metabolism in larvae and resulting in death of larvae (Ishak et al., 2019). Flavonoids processes their way into larval system passes through respiratory tissue, which causes disruption of energy metabolism and results in the larvae being unable to breathe again. Linalool and geraniol are recognized to stimulate motor nerves and increase sensory nerve activity, resulting in paralysis and seizures in larvae (Rahmayanti et al., 2016). The results showed that citronella extract was effective in killing 50% of the population of test larvae with LC50 values at a concentration of 36.48% and the time needed to kill 50% of the population of test larvae was 10,450 hours (Makkiah et al., 2019). The results of other research show that flower extract can be a larvicide (Berliani et al., 2021). Apart from that, neem leaves are also effective (Nur I et al., 2019). This research is different from previous research, this research aims to analyze it more deeply regarding the influence of administering ylang-ylang flower extract as larvicide for *Aedes aegypti* mosquitoes instar III.

RESEARCH METHOD

This analysis used a laboratory experimental experiment (Sugiyono, 2020; Widarsa et al., 2022) conducted at the Institute of Entomology Laboratory Tropical Disease Airlangga University Surabaya. Research employed true experimental design with post-test only control group design. Selected populations were from *Aedes aegypti* mosquito instar III larvae aged 5-7 days obtained at the Entomology Laboratory of the Institute of Tropical Disease Airlangga University Surabaya. Total samples were analyzed through 20 test larvae by per-experimental group. In this study, 6 (six) groups were used (5 treatments + 1 negative control) and there were as many as four repetitions. For each treatment and repetition, 20 finished larvae were required accumulation of

larvae *Aedes aegypti* and was used on analysis 20 individuals x 6 groups x 4 repetitions = 480 larvae. Sampling of *Aedes* potential to be used as a control group and treatment group sample. This observation was started in July 2023. Ylang ylang flower extract (*Cananga odorata*) had been produced using the maceration method then was divided into 5 (five) concentrations according to research, namely concentrations of 0,1%; 0,75%; 1,5%; 2,25%, and 3% (Nurdianti, 2016). The data obtained were analyzed using SPSS software. Analysis of *Kolmogorov-Smirnov* applied in the normality test because the sample size was more than 50, and the *Lavene* test was used in the homogeneity of variance test. The statistical test applied in this study was *one-way ANOVA*. If the results did not qualify within the parameters, then the statistical test was *Kruskal Wallis*.

RESULTS AND DISCUSSIONS

The actual test used concentration levels that have been determined through preliminary tests. There were 6 treatment groups with 20 larvae in each group in this stage. The concentration levels used were negative control, 0,5%; 1,5%; 3%; 5%; and 10%.

Table 1 Preliminary test of the influence of administering ylang ylang flower extract (*Cananga odorata*) on the death of *Aedes aegypti* Instar III mosquito larvae

Rate Extract Flower Memories (%)	Amount Larvae Tested	Mortality
Control negative	20	0
0.5%	20	11
1.5%	20	19
3%	20	20
5%	20	20
10%	20	20

The results of the following preliminary tests show that as many as 11 larvae died when administering 0,5% concentration, 19 larvae died at 1,5% concentration, and 20 larvae died at concentrations of 3%, 5%, and 10%.

Probit Analysis Test Result

LC50 and LC95 probit analysis tests were carried out to determine the dose concentration levels applied in the preliminary test. The following are the results of the probit analysis test:

Table 2. LC50 and LC95 probit analysis test results

Probability	95% Confidence Limits for Dose		
	Estimate	Lower Bound	Upper Bound
0.50	0.097	0.599	0.144
0.95	1.309	1.025	1.934

The results of the probit analysis test show that the accumulated LC50 is 0,097%, the lowest dose is 0,559%, and the highest is 0,144%. Meanwhile, the LC95 value is 1,309%, the lowest dose is 1,025%, and the highest is 1,934%.

Actual Test Results

In the actual test of 6 groups, each group containing 20 *Aedes aegypti* mosquito instar III larvae with 4 replications. This group was divided according to Different levels that are negative control, including 0,1%; 0,75%; 1,5%; 2,25%; and 3%. Before the actual test was carried out, all *Aedes aegypti* mosquito instar III larvae were fasted 1 day and put it in a glass filled with extract according to the specified concentration. After 24 hours, the glass filled with extract was observed. The following graph shows the average number of larval deaths.

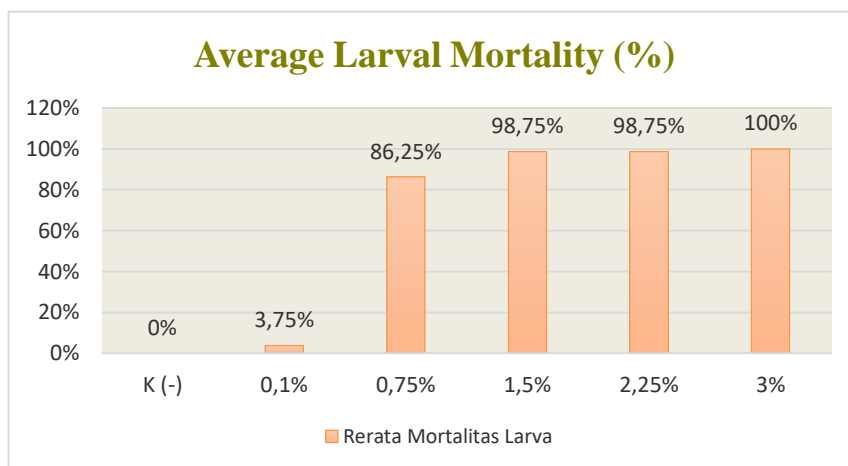


Figure 1. Average death of *Aedes aegypti* mosquito instar III larvae in replications 1 to 4

The percentage of instar III *Aedes aegypti* larvae during replication 1 to 4 administered ylang ylang (*Cananga odorata*) flower extract had a different average for each group as shown in Figure 1. In the negative control, there were no dead larvae so the average death was 0%. At a concentration of 0,1%, the average larval death is 3,75%. At a concentration of 0,75%, the average larval death is 86,25%. At concentrations of 1,5% and 2,25, there was a similar average larval death by 98,76%. At a concentration of 3%, all larvae died so that the larval death is 100%.

Statistical Analysis Results

The aim of this experiment was to determine the concentration of ylang ylang flower extract (*Cananga odorata*), which had the most influence in *Aedes aegypti* instar III mosquito larvicide. This is necessary to calculate larval death at each concentration of ylang ylang (*Cananga odorata*) flower extract used. Several statistical tests were carried out to find out this analysis.

Results Test Normality Death of *Aedes aegypti* Larvae

Two classifications of normality analysis are available in the form of analysis *Kolmogorov-Smirnov* if the sample is > 50 as well analysis *Shapiro-Wilk* if the sample is < 50. In this observation, the *Shapiro -Wilk* test was used because there were < 50 treatment groups. If $p > 0.05$, it is concluded that the data is considered normally distributed.

Table 3 Shapiro-wilk normality test results

Rate	Shapiro-Wilk	
	Mortality Average	Sig .
K(-)	0%	.
0,1%	3,75%	0.272
0,75%	86,25%	0.272
1,5%	98,75%	0.001
2,25%	98,75%	0 . 0 01
3%	100%	.

The following Shapiro-Wilk test results identified a significance value in the 0,1% and 0,75% concentration groups because of P (0.272). Whereas in the negative control, 1,5%; 2,25%; and 3% concentration groups, the data were not normally distributed ($p < 0.05$). Therefore, it is necessary to continue non-parametric analysis, namely Kruskal-Wallis because the data does not meet parametric requirements.

Results Test of Kruskal-Wallis Death in *Aedes aegypti* Larvae

To compare the mean larval death in the experimental groups, the *Kruskal-Wallis* test was used because the data from the study were not qualified parametric test indicators. The number of groups is more than 2 and the test was carried out once or *post-test* only. Analysis results by *Kruskal-Wallis* is presented in Table 4 . Data is stated to be significant if $P < 0,05$.

Table 4. Kruskal-wallis test results

Rate	Average Mortality
K (-)	0%
0,1%	3,75%
0,75%	86,25%
1,5%	98,75%
2,25%	98,75%
3%	100%
Kruskal Wallis	Asymp Sig. 0.001

The *Kruskal-Wallis* test above show that, there is a difference in the average death of instar III *Aedes aegypti* larvae per year based on the concentration of ylang-ylang flower extract (*Cananga odorata*) group. So that it is able to determine levels how much different is in significance for each group. Then, analysis is required for *post-hoc Mann-Whitney U*.

Results Test of Post-Hoc Mann Whitney U

Analysis of *Post-hoc Mann Whitney U* was used to determine which parts had significant differences. This test was carried out because in the previous test, namely the *Kruskal-Wallis test*, $P < 0.05$ was achieved or there was an imbalance in the average death of *Aedes aegypti* mosquito instar III larvae in each group.

Table 5 Post-Hoc Mann Whitney U test results

Concentration	K (-)	0,1%	0,75%	1,5%	2,25%	3%
K (-)	-	0.131	0.013	0.011	0.011	0.008
0.1%		-	0.019	0.017	0.017	0.013
0.75%			-	0.017	0.017	0.013
1.5%				-	1,000	0.317
2.25%					-	0.317
3%						-

Information:



: Significantly different ($P < 0,05$)



: Not significantly different ($P > 0,05$)

Mann Whitney U post-hoc technique observations in Table 5 concluded that were significantly different ($P < 0.05$) when concentration groups 0.75%, 1.5%, 2.25%, 3%. At concentrations between 0.1% and 0.75%, 1.5%, 2.25%, 3%, $P < 0.05$ was obtained. As well as concentrations between 0.75% and 1.5%, 2.25% and 3%, $P < 0.05$ was also obtained.

Discussion

Description of Actual Test Results

The results of the analyses carried out in this experiment identified that there were differences in larval death rates based on the amount of concentration of ylang ylang extract applied. The highest larval death rate reached 100% when 3% ylang-ylang flower extract was administered, while the lowest larval death rate reached 3,75% when 0,1% ylang-ylang flower

extract was applied. Meanwhile, at concentrations of 1,5% and 2,25%, there was a similar average of 98,75%. This identifies that the concentration of ylang ylang flower extract and larval death are directly proportional because more metabolite substances, such as flavonoids, saponins, polyphenols, linalool, and geraniol enter the larval body. The results show that the higher the level of ylang-ylang flower applied to the larvae, the higher the level of larval death as the larvae are no longer able to neutralize secondary metabolites that enter their bodies (Ariani, 2015).

Based on WHO provisions, mosquito residue due to the use of insecticides on a surface is identified efficient if possible destroys $\geq 70\%$ of mosquitoes. This statement is in line with the results of the research above that administering a concentration of 3% ylang ylang flowers to mosquito larvae caused mosquito death to increase to 100%. Based on research conducted by Septya Lailly Rachmah (2017), it was stated that the death of *Aedes aegypti* mosquito larvae caused by the active ingredients in ylang ylang flowers, namely essential oils by linalool content (11,28%) to main ingredient, geraniol (3,89%). Linalool and geraniol can increase the sensitivity of the larva's sensory nerves and cause motor nerve stimulation in the form of convulsive and paralytic effects on larvae. Based on the results of phytochemical analysis of ethanol extract of ylang-ylang flowers applied by Aisyah et al (2014).

Based on experiments researched by Novi, using ethanol extract of cassava leaves, saponin, flavonoid, and tannin compounds were obtained. This research used levels of 0,5%; 1%; 1,5%; 2,5%; 3%, and 3,5% *Aedes aegypti* mosquito larvicide. It was found that the average death at a concentration of 0,5% was 15,2%. At a concentration of 3,5% it reached an average death of 100%. These results prove the higher levels of secondary metabolites consumed by larvae, the higher it is accumulation of dead larvae.

Statistical Analysis Results

Based on obtaining statistical analysis by applying *Kruskal-Wallis* analysis that $P=0,001$ which means $P<0,05$. From these results, it is stated that ylang ylang flowers (*Cananga odorata*) are efficient in *Aedes aegypti* mosquito instar III larvicide.

According to previous observations by Al Mushof & Syamsi (2021) carried out in Bandung using ylang ylang flower extract as a larvicide *Aedes aegypti* with levels of 0,02%; 0,04%; and 0,06%, the average death rate was 20%, 60%, and 100%.

In a similar study, administering ylang ylang flower extract and bandotan leaves as larvicide for the *Aedes aegypti* mosquito by Indarti found that $p<0,05$, with concentrations of 1g/l, 2g/l, 3g/l, and 4g/l with the highest death at 4g /l, namely 22 out of 25 larvae died (Amilah, 2012).

Differences in each research result were caused by several factors, such as the solvent and the extract preparation method used. This experiment applied the maceration method using the cold principle for extraction because it utilized simple tools and processes. In addition, the maceration method can also prevent the growth of bacteria and fungi in the extract. This method used 96% ethanol solvent, which has a high enough polarity level so that it can optimally attract metabolite compounds found in plants, such as flavonoids, saponins, and polyphenols (Sogandi & Gunarto, 2020).

Moreover, in the research conducted by Fikri et al. (2020), it explained that beside being caused by the concentration of ylang-ylang flower extract, the death of mosquito larvae was also influenced by the time of exposure to the ylang-ylang flower extract. In his research, the results obtained were that the level of effectiveness in killing half of the mosquito larvae was at a concentration of 80% with observations for 72 hours.

Post Hoc Mann Whitney U Test Results

In addition to using statistical analysis through analysis *Kruskal-Wallis*, observation also applied analysis *Post Hoc Mann Whitney U*. This analysis was conducted because the results of the *Kruskal-Wallis* test stated that H_1 was accepted. Acquisition *Post Hoc test* identified that there were significant differences in the groups between levels of 0.1% and 0,75%; 1,5%; 2,25%; and 3%, which

means that there was an influence on the administration of ylang-ylang flower extract for use as a larvicide and in the groups between 0,75% with 1,5%; 2,25%; and 3%. As a result, it can be interpreted that the best level can be used as a larvicide for the *Aedes aegypti* mosquito are 1,5%; 2,25%; and 3% in accordance with the Commission (2012). This states that utilization larvicides are considered effective in causing Larval death is 90-100%.

According to research by Naufal et al. (2021) who compared ylang ylang flower extract and long eggplant fruit as *Culex* mosquito larvicide, they found that the most effective concentration was 20%, and the lowest concentration was 3%. Meanwhile, according to research by Rahmina & Agoes (2014), which used ylang ylang bark extract via analysis *post hoc* Mann Whitney U found that a concentration of 0,20% was efficient applied for *Aedes aegypti* larvicide.

CONCLUSION

Administering levels of 0,5%; 0,75%; 1,5%; 2,25%; and 3% ylang ylang flower extract (*Cananga odorata*) has an influence as a larvicide for the *Aedes aegypti* mosquito instar III. Further observation is required through Use only one active ingredient on ylang ylang flower extract (*Cananga odorata*) as larvicide *Aedes aegypti*. For further analysis research, different concentrations of active substances were applied to analyze how to remove the dark green color caused by the maceration process of making ylang ylang flower extract (*Cananga odorata*) so that it does not produce bias. The limitation of this research is that it is limited to one extract only. Future research can carry out research by adding other extracts.

References

- Adnyana, I. M. D. M., & Surya, A. (2023). Strategy to control and eradicate dengue hemorrhagic fever vectors in Bali. *International Journal of Public Health Science*, 12(1). <https://doi.org/10.11591/ijphs.v12i1.22201>
- Aisyah, Y., Rasdiansyah, R., & Muhaimin, M. (2014). Pengaruh Pemanasan terhadap Aktivitas Antioksidan pada Beberapa Jenis Sayuran. *Jurnal Teknologi Dan Industri Pertanian Indonesia*, 6(2). <https://doi.org/10.17969/jtipi.v6i2.2063>
- Al Mushof, M., & Syamsi, A. B. (2021). Respon UMKM Produk Makanan Terhadap Implementasi Undang-Undang Nomor 33 Tahun 2014 Tentang Jaminan Produk Halal Di Kabupaten Pamekasan. *Kaffa : Jurnal Fakultas Keislaman*, 2(2), 1-19.
- Amilah, S. (2012). Penggunaan Berbagai Media Tanam Terhadap Perkembangan dan Pertumbuhan Tanaman Brokoli dan Baby Kailan. *Wahana*, 59(2).
- Arfan, I., Rizky, A., & Hernawan, A. D. (2022). Factors associated with dengue fever prevention practices in endemic area. *International Journal of Public Health Science*, 11(4). <https://doi.org/10.11591/ijphs.v11i4.21784>
- Ariani, N. A. & S. (2015). Pengaruh Faktor Demografi Terhadap Financial Literacy Mahasiswa Angkatan 2012. *Jurnal Pendidikan Akuntansi (JPAK)*, 3(2), 1-11.
- Berliani, J. R., Salsabila, Y. Z., Anjaini, R. F., & Sasongko, H. (2021). Efektivitas Larvasida Formula Granul Mengandung Ekstrak Bunga Melati (Jasminum sambac) dan Biji Pepaya (*Carica papaya* L.) Terhadap Mortalitas Larva *Aedes aegypti*. *JPSCR: Journal of Pharmaceutical Science and Clinical Research*, 6(1). <https://doi.org/10.20961/jpscr.v6i1.30620>
- Ciptono, F. A., Martini, Yuliawati, S., & Saraswati, L. D. (2021). Gambaran Demam Berdarah Dengue Kota Semarang Tahun 2014 - 2019. *Jurnal Ilmiah Mahasiswa*, 11(1), 1-5.
- Fagbami, A. H., & Onoja, A. B. (2018). Dengue haemorrhagic fever: An emerging disease in Nigeria, West Africa. In *Journal of Infection and Public Health* (Vol. 11, Issue 6). <https://doi.org/10.1016/j.jiph.2018.04.014>
- Fikri, Z., Ernawati, F., & Jiwintarum, Y. (2020). Formulasi Sediaan Spray Ekstrak Etanol 96% Buah Terung Ungu Panjang (*Solanum Melongena* L.) Dan Bunga Kenanga (*Cananga Adorata*) Terhadap Kematian Nyamuk *Aedes* Sp. *Jurnal Analis Medika Biosains (JAMBS)*, 7(1), 56. <https://doi.org/10.32807/jambs.v7i1.177>
- Harapan, H., Michie, A., Mudatsir, M., Sasmono, R. T., & Imrie, A. (2019). Epidemiology of dengue hemorrhagic fever in Indonesia: Analysis of five decades data from the National Disease Surveillance.

- BMC Research Notes, 12(1). <https://doi.org/10.1186/s13104-019-4379-9>
- Kementerian Kesehatan RI. (2020). *Modul pengendalian demam berdarah dengue*. 19-23.
- Komisi, P. (2012). Metode Standar Pengujian Efikasi Pestisida. Jakarta: Departemen Pertanian.
- Kurnia, B., & Suryawan, I. W. B. (2019). The association between obesity and severity of dengue hemorrhagic fever in children at Wangaya general hospital. *Open Access Macedonian Journal of Medical Sciences*, 7(15). <https://doi.org/10.3889/oamjms.2019.660>
- Leowattana, W., & Leowattana, T. (2021). Dengue hemorrhagic fever and the liver. *World Journal of Hepatology*, 13(12). <https://doi.org/10.4254/wjh.v13.i12.1968>
- Lestari, T. P., Sholikhah, S., & Qowi, N. H. (2019). Factors Influencing the Incidence of Dengue Haemorrhagic Fever. *Jurnal Ners*, 14(3 Special Issue). <https://doi.org/10.20473/jn.v14i3.17153>
- Makkiah, M., Salaki, C. L., & Assa, B. (2019). Efektivitas Ekstrak Serai Wangi (*Cymbopogon nardus* L.) sebagai Larvasida Nyamuk *Aedes aegypti*. *JURNAL BIOS LOGOS*, 10(1). <https://doi.org/10.35799/jbl.10.1.2020.27977>
- Naufal, Siswi, & Ida. (2021). Hubungan Postur Kerja , Durasi Mengemudi Dengan Keluhan Nyeri. *Jurnal Kesehatan Masyarakat (e-Journal)*, 9(1), 65-71.
- Nur I, E., . W., & . R. (2019). EKSTRAK DAUN MIMBA (*Azadirachta Indica*) SEBAGAI LARVASIDA NYAMUK *Culex* sp. *GEMA LINGKUNGAN KESEHATAN*, 17(2). <https://doi.org/10.36568/kesling.v17i2.1057>
- Nurdianti, L. (2016). Formulasi Dan Evaluasi Gel Ibuprofen Dengan Menggunakan. *Jurnal Kesehatan Bakti Tunas Husada*, 14(March).
- Pramadani, A. T., Hadi, U. K., & Satrija, F. (2020). Habitat *Aedes aegypti* dan *Aedes albopictus* sebagai Vektor Potensial Demam Berdarah Dengue di Kecamatan Ranomeeto Barat, Provinsi Sulawesi Tenggara. *ASPIRATOR - Journal of Vector-Borne Disease Studies*, 12(2), 123-136. <https://doi.org/10.22435/asp.v12i2.3269>
- Rahmayanti, R., Putri, S., & Fajarna, F. (2016). Uji POTENSI KULIT BAWANG BOMBAY (*Allium cepa*) SEBAGAI LARVASIDA TERHADAP KEMATIAN LARVA NYAMUK *Aedes aegypti*. *Jurnal Edukasi Dan Sains Biologi*, 5(1), 77794.
- Rahmina, L. Y., & Agoes, S. (2014). Influence of Auditor Independence, Audit Tenure, and Audit Fee on Audit Quality of Members of Capital Market Accountant Forum in Indonesia. *Procedia - Social and Behavioral Sciences*, 164, 324-331. <https://doi.org/10.1016/j.sbspro.2014.11.083>
- Septya Lailly Rachmah, Ocky Dwi Suprobowati, S. (2017). EFEKTIVITAS MAT BUNGA KENANGA (*Cananga odorata*) SEBAGAI ANTI NYAMUK ELEKTRIK TERHADAP NYAMUK *Aedes aegypti*. 6(2), 501-507.
- Sogandi, S., & Gunarto, F. (2020). Efek Larvasida Fraksi Etil Asetat Daun Bangun-bangun (*Plectranthus amboinicus*) terhadap Mortalitas Larva *Aedes aegypti*. *ASPIRATOR - Journal of Vector-Borne Disease Studies*, 12(1), 27-36. <https://doi.org/10.22435/asp.v12i1.1288>
- Sugiyono. (2020). *Metode Penelitian Kualitatif*. Bandung : Alfabeta.
- Sulistiawati, & Bilqis Inayatillah. (2023). Enhancing Knowledge on Prevention of Dengue Hemorrhagic Fever (DHF) through Focus Group Discussion (FGD) and Training of Trainers (TOT) Approaches during the Pandemic Period at Dupak Health Center, Surabaya. *Indian Journal of Public Health Research & Development*, 14(2), 334-340. <https://doi.org/10.37506/ijphrd.v14i2.19127>
- United States Environmental Protection Agency. (2001). Temephos Facts. *Angewandte Chemie International Edition*, 6(11), 951-952., 2-5.
- Weerasinghe, W. S., & Medagama, A. (2019). Dengue hemorrhagic fever presenting as encephalitis: A case report. *Journal of Medical Case Reports*, 13(1). <https://doi.org/10.1186/s13256-019-2201-x>
- Widarsa, K. T., Astuti, P. A. S., & Kurniasari, N. M. D. (2022). Metode Sampling Penelitian Kedokteran dan Kesehatan. In *Metode Sampling Penelitian Kedokteran dan Kesehatan*. <https://doi.org/10.53638/bp.9786239968908>