International Journal of Health, Economics, and Social Sciences (IJHESS)
Vol. 8, No. 2, April 2026, pp. 1737~1743
DOI: 10.56338/ijhess.v8i2.10983
Website: https://jurnal.unismuhpalu.ac.id/index.php/IJHESS

Effectiveness of Papaya Leaf Squeeze (Carica Papaya L.) as a biolarvicide against the larval mortality of mosquito larvae of Tribus Anophelini (Anopheles sp) and Tribus culicini (Aedes sp)

Putri Nurul Afni Kau[1], Herlina Jusuf[2], Tri Septian Maksum[3]
[1,2,3]Jurusan Kesehatan Masyarakat, Fakultas Olahraga dan Kesehatan Universitas Negeri Gorontalo

Corresponding Author: putrinurulafnikau1505@gmail.com

Article Info

Article history:

Received 12 Feb, 2026
Revised 29 Mar, 2026
Accepted 20 Apr, 2026

Keywords:

Papaya Leaves, Biolarviccide, Mortality, Anopheles sp, Aedes sp

ABSTRACT

Mosquito-borne diseases are still a public health problem. Mosquitoes of the Anophelini tribe (Anopheles sp) play a role in the transmission of malaria, while the Culicini tribe (Aedes sp) transmits dengue hemorrhagic fever (DHF). One of the safest larval control efforts is the use of biolarviccides, such as papaya plants (Carica papaya L.) which are more friendly to humans and the environment. The purpose of the study was to determine the effectiveness of papaya leaf juice as a biolarvicide against the mortality of Anopheles sp and Aedes sp mosquito larvae. Pseudo-experimental research type, Non-equivalent control group design. Samples of 400 larvae, consisting of 200 larvae of Anopheles sp and 200 larvae of Aedes sp instar III. The larvae were given a concentration of 10%, 20%, and 30% papaya leaves with 3 repetitions, observed for 24 hours. Data analysis was conducted using the One-Way ANOVA test and the Independent Sample t-test. The results of the study were the highest at a concentration of 30% of 90%, the lowest at a concentration of 10% of 40%. The mortality of Aedes sp larvae is highest at a concentration of 30% at 95%, lowest at a concentration of 10% at 50%.

In conclusion, there was no difference in the effectiveness of papaya leaf juice as a biolarvicide on the mortality of Anopheles sp and Aedes sp mosquito larvae (p-value = 0.930). The public is advised to use papaya leaf juice biolarvicide, as an alternative to mosquito larval control that is more environmentally friendly.

INTRODUCTION

Indonesia is between 6° North Latitude to 11° South Latitude and 95° East Longitude to 141° East Longitude. This astronomical position causes Indonesia to have a tropical climate (Nimah & Hidayati, 2020). The tropical climate in Indonesia is very supportive of the growth of animals and plants, as well as being a suitable environment for the development of various diseases, especially vector-borne diseases. Vectors are organisms that do not directly cause disease, but play a role in transmitting pathogens from one host to another (Arfah et al., 2024).

Diseases transmitted by mosquito vectors are still a serious health problem in the community. Among the different types of vectors, mosquitoes of the tribe *Anophelini* (*Anopheles sp*), and mosquito tribe *Culicini* (*Aedes sp*) is the most commonly found and has an important role in the transmission of diseases such as malaria and dengue hemorrhagic fever (DHF) (Anggreini et al., 2025).

This mosquito-borne disease is still a public health problem in Indonesia, both in urban and rural areas, one of which is malaria (Bestari et al., 2020). Malaria is one of the infectious diseases that is still an important health problem, both at the global and national levels (Alayda et al., 2025).

According to a report by the WHO In 2023, there are an estimated 263 million cases of malaria with 597,000 deaths worldwide. This figure shows an increase of around 11 million cases in 2023 compared to 2022 (WHO, 2024). According to Ministry of Health of the Republic of Indonesia (2025), Malaria cases in Indonesia until November 2025 were recorded at 617,925 cases with the number of deaths reaching 95 people. Based on data on malaria cases from 2021 to 2025 obtained from the Gorontalo Provincial Health Office, malaria cases in the period from January to October 2025 were 1,596 cases.

Another disease transmitted through mosquitoes is dengue hemorrhagic fever. Dengue is one of the diseases that is of serious concern in various countries, especially in tropical and subtropical regions. The disease

is caused by the dengue virus transmitted by mosquitoes *Aedes aegypti* and *Aedes albopictus* (Permatasari, 2024).

Based on WHO data, in the period from January to July 2025, more than 4 million cases were reported with more than 3,000 deaths in 97 countries (WHO, 2025). Meanwhile, dengue cases in Indonesia until October 2025 were recorded at around 131,393 cases with a total of 544 deaths (Ministry of Health of the Republic of Indonesia, 2025). Data on dengue cases obtained from the Gorontalo Provincial Health Office in 2024 showed that the highest number of cases reached 2,434 people who were confirmed positive for dengue with 24 deaths. As for the January-September 2025 period, 547 people were recorded suffering from dengue.

The high cases of malaria and dengue fever in Gorontalo Province make vector control a very important step to take. Vector control is an effort to reduce the risk of disease transmission through reducing vector breeding habitats, reducing vector density, limiting contact between vectors and humans, and breaking the chain of transmission (Handiny et al., 2020).

Efforts made by the government to reduce the incidence of disease include through chemical control with the use of synthetic larvicide, namely sprinkling abate powder on water reservoirs (Maulana et al., 2022). The chemical larvicide that is widely used is abate, which has a negative impact so that it can cause poisoning in humans, livestock, environmental pollution, and cause resistance to other insects (Nurhayani et al., 2021). This condition encourages the need for innovation in finding larvicide alternatives that are safer, more environmentally friendly, affordable, and easily obtained by the community (Tunggadewi et al., 2025).

Biolarvicides or larvicides made from natural materials derived from plants are generally toxic to mosquito larvae or larvae, but do not cause a negative impact on the surrounding environment or public health (Tamba et al., 2023). One of the plants that has the potential to be used as a biolarvicide or natural larvicide is the papaya plant (*Carica papaya L.)*.

Papaya plants are one of the tropical plants that are easy to grow in tropical climates such as Indonesia. However, the public in general does not know that one part of this plant, namely papaya leaves, has the potential as a biolarvicide, because so far the plant has been planted more to meet the needs of vegetables or fruits in households (Noviani et al., 2020). Papaya leaves contain active ingredients such as enzymes *Papain*, *Saponin*, *flavonoids*, *alkaloids*, and *Tannins* which has the potential to be used as a biolarvicide to kill mosquito larvae (Dhenge et al., 2021).

Based on the results of the study Effectiveness of Papaya Leaf Extract Kill Test (*Carica papaya L.*) Against Mosquito Larvae *Anopheles aconitus donits* done by (Ningsi et al., 2016), using instar III/IV larvae *Anopheles Aconitus* a total of 25 heads. It showed the highest larval mortality rate at a concentration of 1000 ppm, namely with a percentage of 56% at the 24-hour observation time and at the 36-hour observation time the percentage of larval mortality was 96%. Research results Dhenge et al., (2021), about papaya leaf extract (*Carica papaya L.*) as a larvicide for mosquitoes *Aedes aegypti* by using papaya leaf extract treatment shows that papaya leaf extract is effective in killing larvae *Aedes* Aegypti at a concentration of 25% had the highest larval mortality rate, which was 78% (19.5 heads).

Research Objectives

The purpose of this study is to determine the effectiveness of papaya leaf juice (*Carica Papaya L.)* as a biolarvicide against mosquito larval mortality *Anopheles sp* and *Aedes sp*.

RESEARCH METHODS

The manufacture of squeezes and testing the effectiveness of biolarvicides of papaya leaf juice (*Carica papaya L.*) were carried out at the Public Health Laboratory, Gorontalo State University. This research will be conducted in January 2026. This type of research is a quasi-experiment using *a Non equivalent control* group design. In this study, 6 treatments and 1 control were carried out with 3 repetitions on each treatment and observation time for 1 x 24 hours. The statistical test in this study uses *the One-Way ANOVA* test and *the Independent Sample t-test*.

RESULTS

The effectiveness of papaya leaf juice (*Carica papaya L.*) as a biolarvicide against the larval mortality of *Anopheles sp* and *Aedes sp mosquitoes*

Table 1. Larval Mortality *Anopheles sp* and *Aedes sp* Using Papaya Leaf Juice (*Carica papaya L.)*

Types of Mosquito Larvae	Concentration (%)	Number of Larvae tail	Number of Larval Mortality			Mortality		Larval Mortality Species
			PI	PII	PIII	Red	Percentage	
Anopheles sp	0	20	0	0	0	0	0	Controls
	10	20	8	10	7	8	40	Resist
	20	20	10	12	15	12	60	Resist

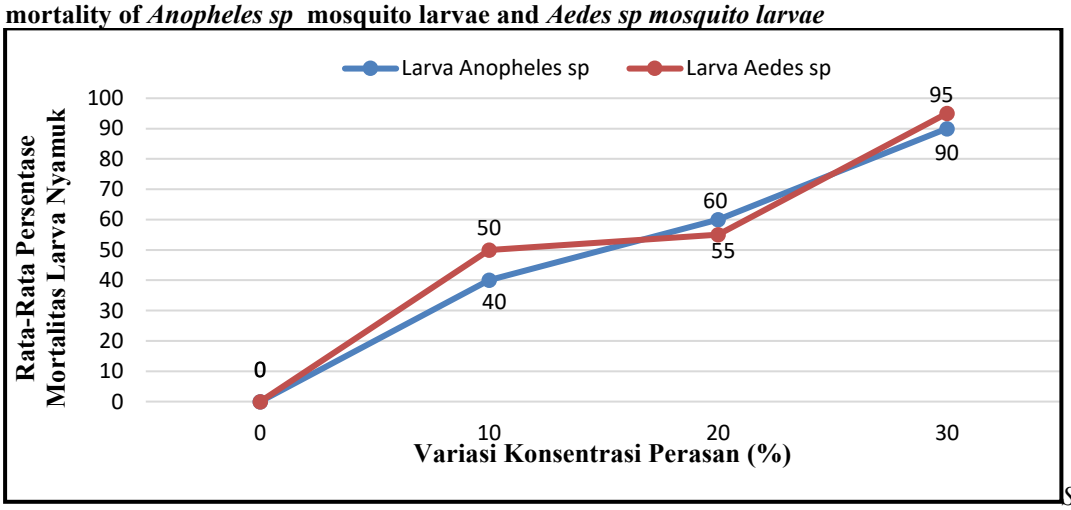
Types of Mosquito Larvae	Concentration (%)	Number of Larvae tail	Number of Larval Mortality			Mortality		Larval Mortality Species
			PI	PII	PIII	Red	Percentage	
	30	20	18	19	18	18	90	Tolerant
Aedes sp	0	20	0	0	0	0	0	Controls
	10	20	11	8	10	10	50	Resist
	20	20	9	11	11	11	55	Resist
	30	20	19	15	19	19	95	Tolerant

Description : PI = First Repetition
PII = Second Repetition
PIII = Third Repetition
Source: Primary Data, 2026

Based on table 1, papaya leaf (*Carica papaya L*) with concentrations of 10%, 20%, and 30% shows that a concentration of 30% is the most effective as a biolarvicide against the larval mortality of *Anopheles sp* mosquitoes with an average larval mortality of 18 (90%) or in the tolerant category and the least number of larval mortality at a concentration of 10% as many as 8 larvae (40%) or in the resistant category.

Mortality of Aedes sp *mosquito larvae* using papaya leaf juice as a biolarvicide with concentrations of 10%, 20%, and 30% where the most effective as a biolarvicide is a concentration of 30% with a total of 18 larval mortality (90%) included in the category of tolerant larval species and the lowest mortality rate is at a concentration of 10% with mosquito larval mortality of 10 (50%) which is included in resistant species.

Differences in the Effectiveness of Papaya Leaf Squeeze (*Carica papaya L.*) as a biolarvicide against the mortality of *Anopheles sp* mosquito larvae and *Aedes sp mosquito larvae*



Source : Primary Data, 2026

Image 1. Mosquito larval mortality graph *Anopheles sp* and *Aedes sp*

Based on figure 1 shows larval mortality *Anopheles sp mosquito* and *Aedes sp* increases along with the increase in the concentration of papaya leaf juice given. Where the higher the concentration, the higher the number of larval deaths.

Analysis of the effectiveness of papaya leaf spraying *(Carica papaya L.)* as a biolarvicide against the larval mortality of *the mosquito Anopheles sp*

Table 2. *One-Way ANOVA Test*

Variable	*p-value*
Concentrations of 10%, 20%, and 30% of papaya leaves (*Carica papaya L.*Düssel	0,001

Source : Primary Data, 2026

Based on table 2, it shows that the results of the statistical test of papaya leaves (*Carica papaya L.*) use *One-Way ANOVA*, obtained a value *p-value* = 0.001 < 0.05 which means there is a difference between concentration groups using papaya leaf juice (*Carica papaya L.*) against mosquito larval mortality *Anopheles sp*. This shows that the concentration of the spray is effective on mosquito larval mortality *Anopheles sp.*

The LSD (*Least Significant Difference) test,* sometimes referred to as the *Smallest Real Difference* (BNT) test, is used in *the post Hoc* test (advanced test) to determine different variations in concentration.

Table 3. Post *Hoc Test*

Concentration Variations	*p-value*
10% concentration with 20% concentration	0,030
20% concentration with 30% concentration	0,005
30% concentration with 10% concentration	0,000

Source: Primary Data, 2026

Based on table 3 of the LSD *(Least Significant Difference)* test results, it shows a difference in concentration variation in all treatment groups, namely at a concentration of 10% with a concentration of 20% with *a p-value* = 0.030 < 0.05. Then between the concentration of 20% with a concentration of 30% (*p-value* = 0.005 < 0.05), and the concentration of 30% with a concentration of 10% obtained a *p-value* = 0.000 < 0.05.

Analysis of the effectiveness of papaya leaf spraying *(Carica papaya L.)* as a biolarvicide against the larval mortality of *Aedes sp mosquitoes*

Table 4. Test *One Way ANOVA*

Variable	*p-value*
Concentrations of 10%, 20%, and 30% of papaya leaves (*Carica papaya L.*Düssel	0,002

Source : Primary Data, 2026

Based on table 4, it shows that the results of the statistical test of papaya leaf juice (*Carica papaya L.*) use *One Way ANOVA*, obtained *p-value* 0.002 < 0.05 which means that there is a difference in the variation in the concentration of papaya leaf juice (*Carica papaya L.*) as a biolarvicide against mosquito larval mortality *Aedes sp*.

Table 5. Post *Hoc Test*

Concentration Variations	*p-value*
20% concentration with 30% concentration	0,002
30% concentration with 10% concentration	0,001

Source : Primary Data, 2026

Based on table 5 there is a difference between the concentration of 20% and the concentration of 30% obtained with the value of *p-value* 0.002 < 0.05. At a concentration of 30% with a concentration of 10%, there is also a difference in the variation in concentration obtained in the value *p-value* = 0.001 < 0.05.

Analysis of differences in the effectiveness of papaya leaf *juice (Carica papaya L.)* as a biolarvicide against the mortality of *Anopheles sp* mosquito larvae and *Aedes sp mosquito larvae*

Table 6. *Test Independent Samples t-test*

Variable	*p-value*
Differences in mortality of *Anopheles sp* and *Aedes sp mosquito larvae*	0,930

Source : Primary Data, 2026

Based on table 6, it shows that the results of the statistical test of papaya leaf juice (*Carica papaya L.*) against mosquito larval mortality *Anopheles sp* and mosquito larvae *Aedes sp* by using Test *Independent Sample t-test*, obtained a value *p-value* 0.930 > 0.05 which means there is no significant difference in the effectiveness of papaya leaf juice (*Carica papaya L.*) as a biolarvicide against mosquito larval mortality *Anopheles sp* and mosquito larvae *Aedes sp.*

DISCUSSION

Effectiveness of Papaya Leaf Squeeze (*Carica papaya L.*) as a biolarvicide against the larval mortality of *the mosquito Anopheles sp*

Based on the results of statistical tests using the *One-Way ANOVA*, obtained a value *p-value* = 0.001 < 0.05 which means that each concentration of the papaya leaf squeeze (*Carica papaya L.*) effective as a biolarvicide against mosquito larval mortality *Anopheles sp*. According to (WHO, 2005) A larvicide concentration is said to be effective if it can kill between 10% - 95% of the larvae tested.

In the control group (0%) no mosquito larval mortality was found *Anopheles sp* after observation for 1x24 hours because it only contains *aquades*. *Aquades* is distilled or distilled water, it can also be called pure water because it contains almost no minerals (Widi et al., 2020). Mortality rate of mosquito larvae *Anopheles sp* on papaya leaf juice at concentrations of 10%, 20%, and 30%, respectively 40%, 60%, and 90%.

The results indicate that the higher the concentration, the higher the number of larval deaths. According to (Sampe & Watuguly, 2016), low concentrations have low toxic levels so that they cause low larval mortality. On the other hand, the higher the concentration, the higher the toxic level, causing the larval mortality to be higher. Based on the results of research conducted by (Ningsi et al., 2016) shows that the mortality of mosquito larvae *Anopheles aconitus* increasing along with increasing the concentration of papaya leaf extract with a 24-hour observation time.

Larval mortality is categorized according to standard guidelines that classify mortality rates into three categories, namely > mortality of 98% categorized as susceptible species, 80-98% mortality categorized as tolerant species, and 80% < mortality included in the category of resistant species (Maksum & Irwan, 2024). The results of the study show that the mortality of mosquito larvae *Anopheles sp* At concentrations of 10% and 20% are 40% and 60% which means mosquito larvae fall into the category of resistant species.

At a concentration of 30% of mosquito larval mortality *Anopheles sp* is 90% or in the tolerant category. It is said to be a tolerant species which means that mosquito larvae *Anopheles sp* can still defend itself from the active compounds present in the juice (Abdullah et al., 2025). Active chemical compounds found in papaya leaves play a role in mosquito larval mortality *Anopheles sp* namely such as flavonoids, alkaloids, saponins, and tannins.

Effectiveness of Papaya Leaf Squeeze (*Carica papaya L.*) as a biolarvicide against the larval mortality of *Aedes sp mosquitoes*

Statistical test results using *One Way To Change* Shows value *p value* = 0.002 < 0.05 which means that each concentration of papaya leaf juice (*Carica papaya L.*) effective as a biolarvicide against mosquito larval mortality *Aedes sp*. As in mosquito larvae *Anopheles sp,* The results of the study after 24 hours did not find any mosquito larvae that died in the control group (0%), because *aquades* does not have a larvicide effect that causes death in test larvae (Amalia, 2016). Papaya leaves (*Carica papaya L.*) as an effective biolarvicide against mosquito larval mortality *Aedes sp*.

The results of the study showed that the mortality of larvae *Aedes sp* at the concentration of 10%, 20% and 30% papaya leaves respectively, namely 50%, 55% and 95% This is in line with what is recommended by (WHO, 2005) that a larvicide concentration is said to be effective if it can kill between 10% - 95% of test larvae. The results of the study also showed an increase in larval mortality at each concentration level. So it can be said that the higher the concentration given, the higher the larval mortality (Fajriansyah & Sartika, 2022).

At a concentration of 10% and 20%, the larval mortality is 50% and 55%, which means that the larvae are in the category of resistant species. Mosquito larval mortality at a concentration of 30%, which is 95%, is included in the category of tolerant species because it is caused by the adaptability of larvae, the activity of detoxifying enzymes, and the nature of the juice of papaya leaves which is a natural biolarvicide with relatively mild toxicity. This is also due to the biological variability of individual larvae *Aedes sp*, such as different tolerance levels to active compounds (Fahtori et al., 2025). Chemical compounds found in papaya leaves are flavonoids, tannins, saponins, and alkaloids that function as natural larvicides and insecticides, so they can kill larvae *Aedes sp* (Maulana et al., 2022).

Differences in the effectiveness of papaya leaf spraying (*Carica papaya L.*) as a biolarvicide against the mortality of *Anopheles sp* mosquito larvae and *Aedes sp mosquito larvae*

Based on the results of the statistical test using *the Independent sample t-test,* a *p-value* = 0.930 > 0.05 was obtained, which means that there was no significant difference between the effectiveness of papaya leaf juice on the mortality of *Anopheles sp mosquito larvae and* Aedes sp *mosquito larvae*. Based on the results of the study, it can be found that the highest effectiveness of papaya leaf biolarvicide is found in the mortality of *Aedes sp mosquito* larvae using a concentration of 30% with the death of 95% of mosquito larvae. Meanwhile, the lowest level of effectiveness of papaya leaves as a biolarvicide is found in the mosquito larvae *of Anopheles sp* with a concentration of 10%, resulting in the death of 40% of mosquito larvae.

The absence of a difference in effectiveness between the two mosquito larvae was caused by the difference in mortality that occurred between the treatment groups tended to relatively small although it increases with increased concentration. In addition, it can be caused by The type of chemical compounds contained in the papaya leaves. Deaths that occur in test larvae can be caused by secondary metabolite compounds contained in papaya leaves (Sudarwati & Fernanda, 2019).

Based on phytochemical tests that have been carried out from several studies, it is found that most plants and fruits that have the potential to become biolarvicides contain secondary metabolite compounds such as flavonoids, saponins, tannins, and alkaloids (Utami & Porusia, 2023). The content of flavonoid compounds can affect the metabolic process of larvae by damaging the permeability of the cell wall, and inhibiting the work of

enzymes. Saponin compounds are glycoside compounds that are toxic and have a bitter taste (Khalish et al., 2025).

Tannin compounds can bind to protease enzymes which cause the performance of these enzymes to be inhibited so that the metabolic process of cells can be disrupted and the larvae will be deficient in nutrients (Ramayanti & Febriani, 2016). Alkaloid compounds can cause discoloration in the larvae's body to become more transparent and the larvae's body movements to slow down with the presence of touch stimuli with a position that always bends the body (Bisyaroh, 2020). The presence of these compounds indicates that papaya leaves are effective as a biolarvicide.

CONCLUSION

1. Based on the results of the study, it can be concluded that the Papaya leaf squeeze (*Carica papaya L.*) with concentrations of 10%, 20%, and 30% effective as biolarvicides against the larval mortality of *Anopheles sp* mosquitoes with *a p-value* = 0.001. There are different concentration variations namely 10% and 20% concentrations with *p-value* = 0.030. Concentration variation of 20% and 30% (*p-value* = 0.005), and concentration of 30% and 10% (*p-value* = 0.000).
2. Papaya leaves (*Carica papaya L.*) with concentrations of 10%, 20%, and 30% effective as biolarvicides against the larval mortality of *Aedes sp mosquitoes (p-value* = 0.002). There are different concentration variations namely 20% and 30% concentrations (*p-value* = 0.002), as well as concentration concentrations of 30% and 10% (*p-value* = 0.001).
3. There was no difference in the effectiveness of papaya leaf juice (*Carica papaya L.*) as a biolarvicide between the mortality of *Anopheles sp mosquito larvae and the mortality of* Aedes sp *mosquito larvae* with *a p-value* = 0.930.

SUGGESTIONS

The public is advised to use natural plant-based larvicides, such as papaya leaf juice, as an alternative to mosquito larval control that is more environmentally friendly accompanied by mosquito nest eradication (PSN) to be more effective. For future researchers, it is recommended to test with higher concentrations, longer exposure times, and test the phytochemical content of papaya leaves to find out the active compounds in them.

REFERENCES

Abdullah, M. R., Kadir, L., & Nurfadillah, A. R. (2025). Test of the Effectiveness of Soursop Leaves and Soursop Seeds (Annona Muricata Linn) as Vegetable Larvicides Against Mortality of Anopheles sp. Mosquito Larvae. Collaborative Journal of Science, 8(4), 1758–1768. https://doi.org/10.56338/jks.v8i4.7112

Alayda, N., Aidha, Z., & History, A. (2025). Analysis of the Implementation of the Malaria Control Program at the Gambir Baru Health Center. Journal of Preventive Promotion, 8(3), 419–433. http://journal.unpacti.ac.id/index.php/JPP

Amalia, R. (2016). The Killing Power of Noni Leaf Juice (Morinda citrifolia) on the Death of Aedes Aegypti Larvae. In Semarang State University. Semarang State University.

Anggreini, Y. S., Agustarika, B., & Fabanyo, R. A. (2025). Community Empowerment through Mosquito Vector Control Education as an Effort to Prevent Dengue Disease and Malaria in the Community in Klamana Village. Journal of Community Service Creativity (PKM), 8(10), 4806–4819. https://doi.org/10.33024/jkpm.v8i10.22157

Arfah, A. M., Indasah, I., & Nurwijayanti, N. (2024). Education on Mosquito Vector Control as Disease Carriers in Students of SMAN 26 Central Maluku. Journal of Indonesian Innovation Community Service, 2(1), 163–168. https://doi.org/10.54082/jpmii.342

Bestari, R., Priawan F, Rosyidah D, & Cahyo F. (2020). Test of the Effectiveness of Betel Leaf Extract (Piper Betle L.) against Mortality of Anopheles Aconitus Larvae. Medika Respati : Scientific Journal of Health, 15.

Bisyaroh, N. (2020). Toxicity Test of Moringa Seed Extract (Moringa Oleifera) against Aedes Aegypti Mosquito Larvae. Journal of Pharmaceutical Tinctures, 1(2), 34–44. https://doi.org/10.35316/tinctura.v1i2.987

Dhenge, N. F., Feed, P. D., & Lidia, K. (2021). Larviccide Effectiveness Test of Papaya Leaf Extract (Carica papaya) on Larval Mortality of Dengue Hemorrhagic Fever Mosquito Aedes aegypti. Cendana Medical Journal, 21(1), 156–162.

Fahtori, F., Solikah, M. P., Anggraeni3, R., Study, P., & Applied, S. (2025). Comparison of the Effectiveness of Papaya Leaf Infestation with Temephos 1% as a Larvicide of Aedes Aegypti Mosquitoes That Cause Dengue. Indonesian Journal of Health Research Innovation (Ijhri), Vol 02 No(03), 113–123. https://journal.ymci.my.id/index.php/ijhri/index

Fajriansyah, F., & Sartika, I. (2022). Effect of Papaya Leaf Extract (Carica papaya linn) on Aedes aegypti Larvasida. Sago Journal of Nutrition and Health, 3(2), 157. https://doi.org/10.30867/gikes.v3i2.926

Handiny, F., Rahma, G., & Rizyana, N. (2020). Vector Control (N. Pangesti (ed.)). Ahlimedia Press.

Ministry of Health of the Republic of Indonesia. (2025a). Dengue Cases Reach 131 Thousand, 544 People Died. CNN Indonesia.

Ministry of Health of the Republic of Indonesia. (2025b). Malaria Cases in Indonesia. Ministry of Health.
Khalish, V. Al, Harminarti, N., & Katar, Y. (2025). Test the Potential of Malu's Putri Leaf Extract (Mimosa pudica Linn) Growing in Padang as a Vegetable Larvicide against Aedes aegypti Mosquito Larval Mortality. Andalas Health Journal, 9(2), 195–202. https://doi.org/10.25077/jka.v9i2.1250
Maksum, T. S., & Irwan, I. (2024). The Efficacy of Cymbopogon nardus (Citronella) Leaf Extract Biolarvicide on the Mortality of Third Instar Larvae of Malaria Vector. 7, 1110–1117. https://doi.org/10.26655/JMCHEMSCI.2024.9.1
Maulana, M., Hidayah, N., Nugrah, D., & Kusuma, I. K. (2022). Test the Effectiveness of Ethanol Extract of Papaya Leaves (Carica papaya Linn) as a Biolarvicide of Ae.aegypti. An-Nadaa: Journal of Public Health, 9(1), 14–21. https://ojs.uniska-bjm.ac.id/index.php/ANN/article/view/6060
Nimah, L., & Hidayati, L. (2020). Strengthening PHBS Plus in an effort to prevent tropical diseases and Covid-19 in Tambakwedi, Surabaya, East Java. Journal of Community Service, 16(2), 145–154.
Ningsi, E., Yuniar, N., & Fachlevy, A. (2016). Effectiveness of Killing Power Test of Papaya Leaf Extract (Carica papaya L.) Against Anopheles aconitus donits Mosquito Larvae in Efforts to Prevent Malaria in the Rice Field Area of Lalonggombu Village, Andoolo District, South Konawe Regency. Scientific Journal of Public Health Students Unsyiah, 1(3), 1–10.
Noviani, Prambudi, D. A., & Mulyadi, F. (2020). The expert system for diagnosing diseases in papaya plants uses a web-based backward chaining method. Poltanesa Bulletin, 21(2), 50–51.
Nurhayani, N., Sari, D. N., Bestari, R. S., & Risanti, E. D. (2021). Test the Effectiveness of Tobacco Leaf Extract (Nicotiana tabacum L.) Against Mortality of Anopheles aconitus Larvae. Biomedicine, 13(1), 68–75. https://doi.org/10.23917/biomedika.v13i1.11272
Permatasari, D. (2024). Dengue Fever Risk Analysis on the Environment: Reviewing Impacts and Management Strategies. Al Ihsan Health Journal, 1(1), 1–6.
Ramayanti, I., & Febriani, R. (2016). Larvicide Effectiveness Test of Papaya Leaf Extract (Carica papaya Linn) against Aedes aegypti Larvae. Medicine, 6(2), 79–88. https://doi.org/10.32502/SM.V6I2.1383
Sampe, V., & Watuguly, T. (2016). Effectiveness of Pangi Seed Extract (Pangium edule Reinw) on Mortality of Anopheles Mosquito Larvae. 2(2), 152–159.
Sudarwati, T. P., & Fernanda, H. (2019). Application of the Utilization of Papaya Leaves (Carica papaya) as a Biolarvicide for Aedes aegypti Larvae (N. Hariyati (ed.)). Granite. www.penerbitgraniti.com
Tamba, I. G., Sudarmaja, I. M., Swastika, I. K., & Diarthini, N. L. (2023). Effectiveness of using papaya seed powder (Carica papaya L) as a larvicide of Aedes aegypti mosquito larvae. Digest of Medical Science, 14(1), 425–428. https://doi.org/10.15562/ism.v14i1.1703
Tunggadewi, A., Zulkarya, L., Nafi'ah, L., Handayani, Y., Wildayanti, Pratiwi, Y., Firmansyah, G., Pratitis, M., & Permatasari, N. I. (2025). Socialization on Dengue Prevention with the Utilization of Papaya Seeds as Larvicides to Overcome Mosquito Development at SMK DutaKarya. The Stage of Kindness: Journal of Social Service, 2(3), 33–37. https://doi.org/10.62951/panggungkebaikan.v2i3.1953
Utami, A. W., & Porusia, M. (2023). Literature Review of the Effect of Plant Insecticides and Synthetic Insecticides on the Larval Mortality of Aedes Aegypti Mosquito Larvae. Journal of Public Health, 11(2), 168–189. https://doi.org/10.14710/jkm.v11i2.37721
WHO. (2005). Guidelines For Laboratory and Field Testing of Mosquito Larvicides. In World Health Organization.
WHO. (2024). World Malaria Report 2024. World Health Organization.
WHO. (2025). Dengue. World Health Organization.
Widi, U., Mardawati, E., & Putri, S. H. (2020). Testing the Antioxidant Activity of Red Dragon Fruit Peel (Hylocereus polyrhizus) as a Peel Off Gel Mask. Journal of Agricultural Industry, 2(1), 95–102.