JBIO : journal of biosciences
(the journal of bioscences)
Vol. 10. No. 1. Maret 2024

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

JBIO: jurnal biosains (the journal of biosciences)
http://jurnal.unimed.ac.id/2012/index.php/biosains
email : jbiosains@unimed.ac.id
Universitas Negeri Medan

POTENTIAL ANALYSIS OF THE BIOLARVACIDAL PLANT ON *AEDES AEGYPTI* FROM THE COMMUNITY YARD OF GUNUNGPUYUH SUB-DISTRICT, SUKABUMI CITY

Hilda Munadiah[1], Muhammad Nur Azzura Saraesa [1], Siti Patmawati[1], Siti Nurrachmatia Azizah[1], Zidan Rachmat Pratama[1] Billyardi Ramdhan[1], Jujun Ratnasari[7]*

[1]Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Sukabumi, Jl. R. Syamsudin SH. No.50 Sukabumi City, Indonesia
* Corresponding author : jujun.ratnasari@ummi.ac.id

Received : Agust 2023
Revised :February 2024
Accepted :March 2024

First Publish Online : March, 30, 2024

Keywords : Larvasides, Biolarvasides, Gunungpuyuh, Aedes aegypti, LC50

ABSTRACT

Dengue hemorrhagic fever (DHF) is an infectious disease caused by the dengue virus and transmitted through the bite of the *Aedes sp*. mosquito. This disease is one of the main problems in Indonesia. Sukabumi is one of the cities in West Java that has the highest case di DHF. Chemical larvicides were used to control the *Aedes aegypti* mosquito. But its cause resistance in mosquito larva, so the seek for alternatives larvicides from natural and environmentally friendly are sought. Many studies had carried out on alternatives larvicides derived from natural product (biolarvicides). Natural larvicides have one advantage, that they do not cause resistance in mosquitoes. Several studies on biolarvicides are summarized to obtain information on several plants planted by the community in Gunungpuyuh District, Sukabumi City, which have the potential as biolarvicides. Of the 343 species of plants planted by the community, seven species of plants have high effectiveness with an LC (Median Lethal Concentration) LC50 value of <750 ppm. Lemongrass, cucumber, soursop, and kaffir lime were plants that potencial as biolarvicides compared to the others with LC50 values of 1.553 ppm, 189.261 ppm, 279.882 ppm, and 603 ppm. This plant is easy to cultivate and can be used as a biolarvicides by the community.
.

Introduction

Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the Dengue virus and transmitted through the bite of the *Aedes sp*. mosquito. According to WHO (2014) dengue hemorrhagic fever was first reported in Southeast Asia in 1954, namely in the Philippines, then spread to various countries. Indonesia is a Dengue hyperendemic country where the four serotypes of the dengue virus spread across 34 provinces. The Indonesian Ministry of Health noted that in 2022, the cumulative on dengue cases in Indonesia up to the 22nd week has reported 45,387 cases. While the number of deaths from dengue reached 432 cases. (Ministry of Health, 2022).

In the City of Sukabumi, there was a rapid increase in DHF cases, and has an endemic area with an incidence rate (IR) or

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

morbidity rate reaching 113/100,000 population, far above the limit of 49/100,000 population. Based on DHF IR, an area can be categorized as high risk if IR > 55 per 100,000 population. Based on data obtained from the Sukabumi City Health Office, it was recorded that until February 2022 the number of DHF cases had reached 264 cases. This number even exceeds the cumulative cases that occurred in 2021, namely 160 cases. This shows that there is a significant spread of DHF in early 2022 and there have even been 4 (four) deaths. One of the areas with the highest number of DHF cases is Karamat Village, Gunungpuyuh District. From the data, it is necessary to have the more intensive treatment and prevention in controlling Dengue Hemorrhagic Fever (DHF). The condition of the tropical area entering the rainy season will support the development of dengue fever vectors. Other factors such as mobility, population density, behavior, society, and unhealthy environmental conditions will make the spread of Dengue Hemorrhagic Fever more widespread and become a breeding ground for mosquitoes (Ministry of Health RI, 2022).

Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the dengue virus with clinical manifestations of fever, muscle aches, and joint pain accompanied by leukopenia, rash, lymphadenopathy, and thrombocytopenia. Dengue fever is caused by the dengue virus which is spread by the *Aedes aegypti* mosquito. Apart from carrying the dengue virus, *Aedes aegypti* is also a carrier of yellow fever and chikungunya viruses. Eradication of *Aedes aegypti* mosquitoes is very difficult because they can adapt to the environment which makes them very resilient, even after disturbances due to natural phenomena or human intervention. On the other hand, the use of synthetic insecticides is very effective in killing mosquito larvae. However, its continuous use can cause negative impacts such as environmental pollution, and insects becoming resistant, resurgent, or tolerant to pesticides (Muzayyanaturrodiyah, 2019). Besides the eradication of the mosquito, an effort to form a healthy community and support the implementation of clean and healthy living behavior (PHBS) is one of the ways to prevent Dengue Hemorrhagic Fever (DHF).

The use of these synthetic insecticides to eradicate mosquitoes in the last 40 years has increased either in quality and quantity. It is because these synthetic insecticides are easier to use, more effective, and more profitable from an economic standpoint. As a result of excessive and uncontrolled use, it has caused unexpected effects, such as resistance to the Aedes aegypti L. Approximately 20,000 people die per year due to pesticide poisoning, but it also causes fatal effects, such as cancer, disability, and infertility. Other negative impacts include the death of natural enemies of mosquitoes, the death of beneficial organisms, disruption of the quality and balance of the environment due to residues, and the emergence of resistance in target animals (vectors) (Moehammadi, 2005).

Indonesia is a developing country that has a lot of natural resources. A lot of research and development of natural larvicides or larvicides derived from plants. It is because the use of abate in the long term can cause resistance to mosquito larvae. In addition, natural larvicides are environmentally friendly because they are easy to decompose in nature. Some plants have a class of secondary metabolic compounds that can have an effect as larvicides, including alkaloids, saponins, tannins, and phenolic compounds. Some plants that can be use as biolarvicides in larvae mosquitoes are Bandotan (*Ageratum conyzoides*), Cucumber (*Cucumis sativus*), Kaffir lime (*Citrus hystrix*), Sambiloto

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

(*Andographis paniculata*), Soursop (*Annona muricata*), Lemongrass (*Cymbopogon nardus*), and Ciplukan (*Physalis angulata*). Therefore we are interested in analyzing the potential of larvicidal plants from the community yards of the Gunungpuyuh sub-district, Sukabumi City. This study aims to reveal the potential of larvicidal plants to *Aedes aegypti* larvae from the community yards of the Gunungpuyuh sub-district, Sukabumi City

Materials and Methods

Data on medicinal plants in the Gunungpuyuh sub-district were obtained directly from field survey results. The plants cultivated by the community around their homes were identified. The plant's metabolites and their benefits were study through a literature study. Based on the literature study, it was study which plants from the plants grown by the Gunungpuyuh community could be use as biolarvicides.

Based on literatures studies effectiveness of plant compounds killed larvae can be seen from the lethal concentration of the compound LC_{50}. LC_{50} means the concentration of a compound that can kill 50% of the total population of testing animals.

Results and Discussion

The data obtained in the field showed that there were 343 species of plants planted by the Gunungpuyuh community. Based on literature studies, all types of these plants have active compounds. Several active compounds from these plants have been study for their effects on mosquito larvae. The effects of the compound on mosquito larvae were consider effective if the compound at concentration can kill 50% (LC_{50}) of the total population. LC_{50} is express in ppm (parts per million) or mg/L concentrations. Natural compounds can be categorized as active as biolarvicides if their LC_{50} is less than 750 ppm (Komalamisra et al., 2005).

From the 343 plant species were identified in the gunungpuyuh community, seven species had several active compounds against *Aedes aegypti* mosquito larvae (table 1). Based on table 1, it seen that the LC_{50} concentration of the compounds possessed by the seven species of plants is still more than 100 ppm, based on the categories put forward by Komalamisra et al. (2005), compounds in these plants are classiffy as active compounds as biolarvicides on *Aedes aegypti*. Cucumber has the lowest IC_{50} among the six plant species, so it said that the compounds in cucumber are more active as biolarvicides than other plants. Cucumber fruit contains saponins, alkaloids, and flavonoids (Syamsul et al., 2014; Nurhidayat et al., 2018; Rahmayanti et al., 2021). Flavonoids, saponins, and tannins are disliked by insects. As is the case with research on the effects of mango leaf extract containing flavonoids, saponins, and tannins, at a concentration of 60% it was effective in inhibiting *Aedes aegypti* larvae within 24 hours, and effectively inhibiting *Culex* sp larvae within 24 hours (Suhaillah et al., 2019).

The mechanism of flavonoids in killing mosquito larvae is by interfering with the nerve and respiratory systems of the larvae, so that the larvae cannot breathe. The mechanism of saponins in killing larvae is by inhibiting the action of the cholinesterase enzyme in the digestive system of the larvae (Cania et al, 2013). In addition, saponins can bind to proteins and lipids in the cell membrane resulting in damage to the membrane structure. Membrane damage causes an imbalance in cell homeostasis and affects cell lysis (Ahdiah et al, 2015). The tannin mechanism in killing larvae is by reducing the activity of the digestive enzyme protease and amylase (Ahdiah et al., 2015).

JBIO : journal of biosciences
(the journal of bioscences)
Vol. 10. No. 1. Maret 2024

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

Saponins and alkaloids found in marigold leaves (*Tagetes erecta*) also have the same effect on Aedes aegypti mosquito larvae (Marini et al., 2018; Pramudya et al., 2020). Flavonoids are also present in noni leaves (*Moringa citrifolia*) which can kill Aedes aegypti larvae with an LC_{50} of 7.96 ppm with an exposure time of 24 hours (Ati et al., 2022).

Table 1. Plant metabolites that active as biolarvacides in *Aedes aegypti*

Spesies	Local name	Part of plant use	Compound	LC_{50} (ppm)	LC_{90}(ppm)	Ref
Ageratum conyzoides L	Bandotan	leaves	Saponins, flavonoids, polyphenols, and essential oils	2528.7	2528.47	
Cucumis sativus L.	Mentimun	fruit	phenolics, flavonoids and terpenoids	189.261	-	Nurhidayat et al., (2018)
Citrus hystrix	Jeruk purut	leaves	Essential oil, flavonoids, saponins and terpenes	279.882	4000	Ansori et al., (2018)
Andographis paniculata	Sambiloto	leaves	flavonoids, alkaloids and essential oil	1373.6	-	Imanta et al., (2017)
Annona muricata L	Sirsak	seed	Acetogenin, palmitic acid, tannins, phytates and cyanide	603	1641	Ni Putu (2022)
Cymbopogon nardus L	Serai	leaves	Essential oils (citronella, citronellol, and geraniol)	1.553	-	Novitarani et al., (2021)
Physalis angulata L	Ciplukan	leaves	Alkaloids, flavonoids, saponins, tannins, steroids and terpenoids	3303	-	Rindahayeni (2019)

The lime leaves (*Citrus hystrix*) which contain limonoids can kill *Aedes aegypti* larvae at LC_{50}190.55 ppm (Risti et al., 2014). Limonoids are essential oils in oranges that can eliminate the coordination system of mosquito larvae (Lestari et al., 2016; Musiam et al., 2018; Ansori, 2018). Lime leaf extract can also kill Aedes aegypti larvae by 76.7% (Mangampa et al., 2017). Limonoids are included in the terpenoid group, as are the terpenoids found in bitter leaf (*Andrographis paniculata*) which affect the digestive system of *Aedes aegypti* larvae (Imanta et al., 2017). Terpenoids can inhibit feeding on the larvae so that the larvae starve and die. Like the research by Lestari et al. (2016), flavonoids, terpenoids (limonoids, citronellal, linalool, citronellol, citronella acetate, caryophyllene geraniol), and saponins in kaffir lime leaves can kill *Aedes aegypti* larvae with LC_{50} 279.882 ppm.

The content of terpenoids (linalool, eugenol, and 1,8-cineol), flavonoids, alkaloids, essential oils, and tannins in the leaves of *Ocimum sanctum* and *Ocimum basilicum* are also able to kill *Aedes aegypti* mosquito larvae (Firmansyah et al., 2019; Cristella et al., 2020). These compounds cause damage to the intestinal epithelium of *Aedes aegypti* larvae so that the larvae starve and die. Likewise, acetogenin compounds such as annonin, annonacin, Bulatasin, Bulatasinon, squaamosin asimisin, and annonastatisn in soursop leaf extract (*Annona muricata*) can kill larvae up to 96.66% (Kolo et al., 2018). Likewise, terpenoids in celery leaves (Avium graveolens) are able to kill *Aedes Aegypti* larvae (Kartika et al., 2020).

In general, the active compounds contained in plants cultivated by the Gunungpuyuh community can kill *Aedes aegypti* larvae.

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

These plants can be used as biolarvicides. These active compounds can inhibit growth, affect the nervous system, inhibit the reproductive development of insects, inhibit breathing, damage the digestive system so that they can cause death (Kolo et al., 2018). The active compound will increasingly affect the death of the larvae as the concentration of the compound used increases and the length of time the compound is exposed to the larvae.

Conclusions

Several plants planted by the Gunungpuyuh community in Sukabumi City can be developed and utilized as biolarvicides.

Acknowledgment

Thank you to The Kedai reka program from Direktorat Jendral Pendidikan Tinggi for fund support and Dinas Kesehatan Kota Sukabumi as Mitra in research and community service.

References

Ahdiyah, I. (2015). *Pengaruh ekstrak daun mengkokan (Nothopanax scutellarium) sebagai larvasida nyamuk Culex sp* (Doctoral dissertation, Institut Teknologi Sepuluh Nopember).

Ansori, A. N. M., Adrianto, H., & Hamidah, H. (2018). *Efektivitas biolarvasida ekstrak fraksi polar daun Citrus hystrix dan Citrus aurantifolia terhadap Culex quinquefasciatus*. Jurnal Vektor Penyakit, 12(1), 33-38.

Ati, V. M., Meye, E. D., Refli, R., Dima, A. O., Amalo, D., & Jebatu, U. L. (2022). *Moringa leaf (Moringa oleifera L) flavonoids utilization in suppressing growth of Aedes aegypti larvae*. Jurnal Ilmiah Berkala Sains dan Terapan Kimia, *16*(1), 64-74.

Cania, E., & Setyanimgrum, E. (2013). *Uji efektivitas larvasida ekstrak daun legundi (Vitex trifolia) terhadap larva Aedes aegypti*. Jurnal Majority, *2*(4)

Christella, A. C., Makimian, R., & Dewi, R. (2020). *The effect of basil (Ocimum basilicum) leaves extract as biolarvacide against Aedes aegypti larvae.* Damianus Journal of Medicine, *19*(1), 24-29.

Firmansyah, N. E., Aulung, A., Wibowo, H., & Subahar, R. (2019). *Activity of Ocimum sanctum leaf extract against Aedes aegypti larvae: midgut histopathological alteration*. ASPIRATOR-Journal of Vector-borne Disease Studies, *11*(1), 13-18.

Moehammadi, N. (2005). *Potensi biolarvasida ekstrak herba ageratum conyzoides linn. dan daun Saccopetalum horsfieldii Benn. terhadap larva nyamuk Aedes aegypti* L. Berkala Penelitian Hayati Journal Of Biological Researches, *11*(1), 1-4.

Muzayyanaturrodiyah S, E. L. Y. N. (2019). *Efektivitas ekstrak daun beluntas (Pluchea indica (L.) Less.) sebagai anti nyamuk elektrik terhadap nyamuk Aedes aegypti* (Doctoral dissertation, Poltekkes Kemenkes Surabaya).

Nurhidayat, I. A., & Sukiya, S. (2018). *Uji efektivitas ekstrak buah mentimun (Cucumis sativus L.) terhadap mortalitas larva Anopheles aconitus*. Kingdom (The Journal of Biological Studies), *7*(2), 101-109.

Imanta, E., & Hidajati, N. (2017). *Uji biolarvasida nyamuk Aedes aegypty dari hasil isolasi ekstrak metanol tanaman sambiloto (Andrographis paniculata*). UNESA Journal of Chemistry, *6*(1), 36-41.

Kartikasari, D., & Suryaningrat, D. (2020). *Uji stabilitas dan keamanan granul ekstrak batang seledri (Avium graveolens) sebagai biolarvasida Aedes aegypti*. Jurnal Ilmiah As-Syifaa, *12*(1), 16-21.

Kolo, S. M. (2018). *Efektivitas biolarvasida ekstrak daun sirsak dan serai wangi terhadap larva nyamuk Aedes aegypti*. Jurnal Saintek Lahan Kering, *1*(1), 11-13.

Komalamisra, N., Trongtokit, Y., Rongsriyam, Y., & Apiwathnasorn, C. (2005).

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40339

Screening for larvicidal activity in some Thai plants against four mosquito vector species. Southeast Asian Journal of Tropical Medicine and Public Health, *36*(6), 1412.

Kusdiantini, M. (2017). *Aktivitas biolarvasida serai dapur (Cymbopogon citrates) pada larva nyamuk Aedes aegypti* (Doctoral dissertation, Universitas Pendidikan Indonesia).

Lestari, T. (2016). Pemanfaatan jeruk purut (*Citrus Hystrix*) sebagai biolarvasida. *Jurnal Kebidanan dan Kesehatan Tradisional*, *1*(2).

Mangampa, Y., Nisa, M., Fahimah, N., Rannu, S. L., Anugrawan, M., & Doa, F. R. (2017). *Efek biolarvasida nyamuk aedes aegypti dari granul ekstrak daun jeruk nipis (Citrus aurantifolia)*. Jurnal Ilmiah Manuntung, *3*(2), 116-121.

Marini, M., Mahdalena, V., & Ni'mah, T. (2018). *Potensi ekstrak daun marigold (Tagetes erecta L.) sebagai Larvasida terhadap Larva Aedes aegypti di Laboratorium*. Jurnal Vektor Penyakit, *12*(2), 109-114.

Musiam, S., Armianti, M., & Putra, A. M. P. (2018). *Uji biolarvasida ekstrak metanol daun jeruk nipis (Citrus aurantifolia) terhadap Larva Nyamuk Aedes aegypti L*. Jurnal Ilmiah Ibnu Sina, *3*(1), 55-63.

Ni Putu Maitri Vidya, C. R. (2022). *Efek larvasida ekstrak metanol daun sirsak (Annona muricata L.) terhadap mortalitas larva nyamuk Culex sp. Instar III* (Doctoral dissertation, Universitas Mataram).

Novitarani, N. A., & Hermiyanti, P. (2021). *The effectiveness of mixed leaves from pandan leaves (Pandanus amaryllifolius) and lemongrass stems (Cymbopogon nardus Linn. Rendle) as biolarvacides against Aedes aegypti larva*. Plant Cell Biotechnology and Molecular Biology, 1-6.

Pramudya, M., Rosmanida, R., Zuraidassanaaz, N. I., Savira, N. I. I., Sakinatussajidah, E., & Putri, I. P. (2020). *Crude methanol extract of brotowali leaves (Tinospora crispa) as biolarvacide against dengue vector Aedes aegypti*.

Rahmayanti, R., Putri, S. K., & Wahab, I. (2021). *Uji efektifitas perasan kulit mentimun (Cucumis sativus L) sebagai larvasida terhadap larva nyamuk Culex sp*. Jurnal Biology Education, *9*(2), 141-148.

Rindahayeni, R., & Hayati, I. (2019). *Uji efektifitas ekstrak daun ciplukan (Physalis angulata L.) terhadap larva nyamuk Aedes aegypti L*. Jurnal Ilmiah Pharmacy, *6*(1), 94-104.

Risti, R. V. R., Puspawati, P. U. S., Rahmatullah, S. W., & Efansyah Noor, E. N. (2014). *Efektivitas ekstrak daun jeruk nipis (Citrus aurantifolia) sebagai biolarvasida larva Aedes aegypti* (Doctoral dissertation, AAK Borneo Lestari).

Rochmat, A., Bahiyah, Z., & Adiati, F. (2017). *Pengembangan biolarvasida jentik nyamuk Aedes aegypti berbahan aktif ekstrak beluntas* (*Pluchea indica* Less.). Reaktor Chemical Engineering Journal, *16*(3), 103-108.

Suhaillah, L., & Solikhah, S. (2019). *Efektifitas konsentrasi larutan daun mangga (Mangifera indica L.) sebagai daya hambat pertumbuhan larva Aedes aegypti dan Culex sp*. Jurnal Sains, *9*(17).

Syamsul, E. S., & Purwanto, E. N. (2014). *Uji aktivitas perasan buah mentimun (Cucumis sativus L) sebagai biolarvasida terhadap larva nyamuk Aedes aegypti* L. Jurnal kimia mulawarman, *11*(2).