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# *LARVICIDAL ACTIVITY OF TURMERIC (Curcuma domestica) EXTRACT AGAINST Aedes aegypti* L.

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***Abstract***

*Indonesia occupies the top position as the country with the highest dengue cases in ASEAN. A variety of prevention dengue can be done which can be used chemicals. Chemical insecticides indeed provide effective results and optimal, but many negative impacts both on the environment and living organisms. The many negative effects of chemical insecticides led to new research in the vector control safer, simpler, and environmentally sound. Control using biological insecticides (vegetable) is one of them. One of the plants that can be used as larvicides are turmeric (Curcuma domestica). Tumeric contains bioactive compounds such as essential oils, alkaloids, flavonoids, saponins potential as an alternative killer mosquito larvae. Researchers create 6 concentration turmeric extract (0g / L; 0.25 g / L, 0.5 g / L; 1g / L; 2g / L; 4g / L) of each concentration included 25 larval Aedes aegypti L. The data obtained were performed Shapiro-Wilk normality test and then test the hypothesis by Kruskal Walis and probit test. Results obtained $LC_{50}$ value is 2.084g/L or 0.208% (w/v). The results showed that tumeric extract (Curcuma domestica) is effective to kill the larvae Aedes aegypti L.*

***Keywords***: *Turmeric Extract; Dengue; Aedes aegypti L. larvae*

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## INTRODUCTION

Dengue fever (DBD) is a disease found in most tropical and subtropical regions. DBD is caused by mosquito-borne infections (Rau *et al*., 2019) with four dengue virus serotypes (DEN 1, 2, 3, 4) (Harapan *et al*., 2019). WHO designates Indonesia as one of the hyperendemic countries. 32 out of 33 province in Indonesia (355 cities from 444 cities) affected by DBD, with the number of cases as many as 380 cases of DBD and 1-2 people die every day (Mustafa & Basri, 2019).

DBD disease is caused by dengue virus spread by the *Aedes aegypti* L. mosquito. *Aedes aegypti* L. is also a carrier of yellow fever and chikungunya virus (Rochmat *et al*., 2016). The eradication of *Aedes aegypti* L. mosquitoes is inefficient because they have the adaptability to the environment, so mosquitoes do not have a major impact on disturbances due to human intervention or natural phenomena. The use of insecticides to control larvae is usually by using abate (*temephos*) that is proven to cause poisoning in humans such as dizziness, nausea, and nervous disorders if the dose given is very high, and if used for a long time eating negatively impacts resistance in DBD vectors (Isaac *et al*., 2019). By looking at the negative impact that occurs if using synthetic insecticide out of plant insecticides, because insecticidal compounds from plants easily decompose in the environment, do not leave residues in the air, water, or soil, and have a better level of safety. Plants that can be used as a natural insecticide making material have the content of any namely tannins, saponins, alkaloids, flavonoids, and sterols (Suling et al., 2020).

Turmeric rhizomes (*Curcuma domestica*) contain essential oils one of which is turmerone. Turmeron is a type of seskuiterpen that has a ketone ring (Chang *et al*., 2007). Sesquiterpene is a major element in essential oils in turmeric. Essential oils contain tumeron consisting of ar-tumeron, α-tumeron, and β-tumeron, these three compounds have similar chemical structure, physical properties, and molecular weight (Kao *et al*., 2007). The properties of insect repellent and turmeric antifeed are associated with the appearance of turmerons (Lee et al., 2001), kurkuminod (Chowdhury *et al*., 2000), terpenoid, α-terpeniod, and γ-terpenoid (Cheng *et al*., 2009). Flavonoids were reported as strong inhibitors of acetylcholinesterase (AchE) from mosquito larvae indicating it to be the presumable site of larvicidal action, the same results were observed for oleic. Flavonoid can also inhibit feed and act as a growth regulator (Perumalsamy *et al*, 2015).

Alkaloids have an influence in the central nervous system of the insects, acting on the receptors of several neurotransmitters, provoking uncontrolled muscular movements, paralysis, seizures, and death. They can also affect the sodium channels of the nerve cell membrane, preventing the transmission of nerve impulses (Rattan, 2010). Studies with synthetic analog alkaloids have revealed to have a greater degree of inhibition of AchE (Borrero *et al*., 2018; Carreno *et al*., 2014). Based on the background above, we want to research Larvicidal Activity Of Turmeric (*Curcuma domestica*) Extract Against *Aedes aegypti* L.

## MATERIALS AND METHODS

This research is an experimental study with a control group design using five different concentrations of tumeric extract; each treatment was performed three replications and each replication used 25 larvae. The samples tested in this study were turmeric simplicia powder taken from the Center for Research and Development of Plants Medicine and Traditional Medicine Tawangmangu, Central Java. Turmeric simplicia iswas then macerated using by 70% ethanol with a ratio of 10 parts of Simplicia with 75 parts of the solvent at room temperature for 5 days protected by the light, while repeatedly stirred. The liquid of maceration iswas tightened using a rotary evaporator to get viscous extract. Before the extract obtained is tested to larva *Aedes aegypti* L., the extract is carried out phytochemical screening, including the test of the presence of tannins or polyphenols, flavonoid test, saponin test, and alkaloid test (Habibi, 2018; Nasution *et al.,* 2020). Test activity as a turmeric extract violin against 450 healthy instars III larvae by looking at its active movement. Testing of larvae's activity against *Aedes aegypti* L. larvae was conducted at the Indonesian Center for Vector Research and Development and Reservoir of Salatiga Disease. The treatment consists of 6 concentrations of turmeric extract ; 0 g/L; 2,5 g/L; 5 g/L; 10 g/L; 20 g/L; and 40 g/L in the glass. Each concentration treatment was given 25 *Aedes aegypti* L. larvae, convered with gauze and stored in a room at a temperature of 25$^{o}$C-30$^{o}$C. Observations were made after 24 hours by counting the number of dead larvae.

The data obtained were performed Shapiro-Wilk normality test and then test the hypothesis by Kruskal Walis and probit test, to find out LC50 of turmeric extract.

## RESULTS AND DISCUSSION

The purpose of this study is to find out the activity of turmeric extract against the larvae of *Aedes aegypti* L. Turmeric used in the study was obtained from a farmer in

Karang Pandan with criteria as shown in table 1.

Table 1. Secondary Data of Turmeric (*Curcuma domestica*)

| Criteria | Information |
|---|---|
| Age | 9 months |
| Height | 700 cm |
| Planting Time | December 2012 |
| Harvest Time | August 2013 |
| Water Content | 11% |

Turmeric samples obtained from farmers were carried out in the determination of crops and continued with the manufacture of Simplicia.

Harvest age determines the composition of active components contained in raw materials, for example, old fruit has a different composition to the young fruit (Yasni, 2012). The maturity level is raw fruit, half-cooked fruit, and ripe fruit obtained the same type of secondary metabolite compounds but different levels, where the ripe fruit will have higher levels of secondary metabolites (Sirait et al., 2014). Table 1 uses turmeric rhizomes age 9 months, where the age of the rhizomes include old age and ready to harvest and the age of these rhizomes following the research Purwakusumah et al., (2016) Temulawak rhizomes with the age of 9 months have higher levels of major bioactive metabolites than the age of rhizomes 7 and 8.

Simplicia obtained is extracted and evaporated until it obtains viscous extract, the viscous extract obtained is calculated percent yield so that it is obtained data as listed in table 2. The percent of yield was used to know weight percentage of the extract compared to the weight of Simplicia.

Table 2. Results of Turmeric Ethanol Extract Rendemen

| Dry Weight simplisia (g) | Dry exposition weight (g) | Rendemen (%) |
|---|---|---|
| 250 | 63 | 25,2 |

Turmeric ethanol extract was first carried out phytochemical screening to find out type of secondary metabolites in the sample. Based on the phytochemical screening of turmeric extract all secondary metabolite were positively found in the compounds tested. The type and results

of phytochemical screening for turmeric are shown in Table 2 below.

Table 3. Data Test Qualitative Screening Turmeric

| No | Qualitative Screening | Test Results |
|---|---|---|
| 1 | Alkaloid | test (+) |
| 2 | Saponin | test (+) |
| 3 | Flavonoid | test (+) |
| 4 | Tannin and Polyphenol | test (+) |
| 5 | Terpenoid | test (+) |
| 6 | Fenolate | test (+) |

The results of phytochemical screening of sample extracts in this study are 70% turmeric ethanol extract (*Curcuma domestica*) positively containing flavonoids, alkaloids, saponins, terpenoids, phenolic, and tannins that acts as larvacide

The results of the test of larvae against larvae of *Aedes aegypti* L. are shown in table 4 as below. To see the percentage of larval death after being added in variations in the concentration of turmeric extract (*Curcuma domestica*) after 24 hours of observation is shown in table 5 below.

Tabel 4. Larvae Test data on larvae of *Aedes aegypti* L.

| Observation Time (Minutes) | Crude Concentration of Turmeric Extract (*Curcuma domestica*) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 g/L | | | 2,5 g/L | | | 5 g/L | | | 10 g/L | | | 20 g/L | | | 40 g/L | | |
| | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 |
| **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 6 | 5 | 6 | 3 |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 4 | 6 | 8 | 8 | 6 | 9 | 9 |
| **15** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 9 | 6 | 10 | 12 | 10 | 10 | 19 | 14 |
| **30** | 0 | 0 | 0 | 12 | 8 | 5 | 9 | 9 | 13 | 20 | 20 | 16 | 13 | 17 | 18 | 13 | 20 | 20 |
| **60** | 0 | 0 | 0 | 25 | 13 | 9 | 16 | 16 | 15 | 21 | 22 | 20 | 20 | 22 | 25 | 19 | 24 | 25 |
| **120** | 0 | 0 | 0 | 25 | 19 | 24 | 21 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| **1440** | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

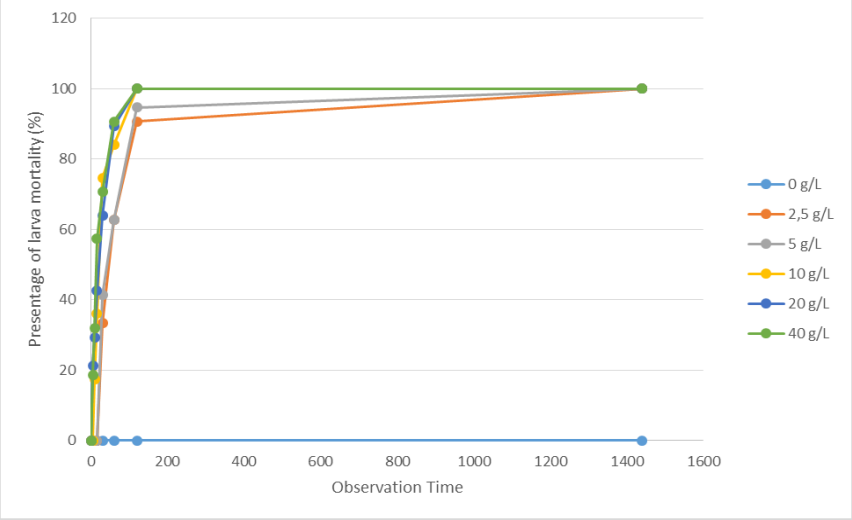
Description : R1 : Replication One
R2 : Replication Two
R3 : Replication Three

Table 4 for the smallest consetration variation of 2.5 g/L indicates that all larvae will show death after 24 hours of observation, and for 40 g/L concentrations indicate larval death at 2-hour observation.

Table 5. Presentase of larval death in various concentrations of turmeric extract (*Curcuma domestica*) for 24 Hours

| Observation time (Minutes) | Percentage of larval death in various concentrations of turmeric extract (*Curcuma domestica*) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 g/L | | 2,5 g/L | | 5 g/L | | 10 g/L | | 20 g/L | | 40 g/L | |
| | Total | % | Total | % | Total | % | Total | % | Total | % | Total | % |
| **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 21 | 14 | 19 |
| **10** | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 17 | 22 | 29 | 24 | 32 |
| **15** | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 36 | 32 | 43 | 43 | 57 |
| **30** | 0 | 0 | 25 | 33 | 31 | 41 | 56 | 75 | 48 | 64 | 53 | 71 |
| **60** | 0 | 0 | 47 | 63 | 47 | 63 | 63 | 84 | 67 | 89 | 68 | 91 |
| **120** | 0 | 0 | 68 | 91 | 71 | 95 | 75 | 100 | 75 | 100 | 75 | 100 |
| **1440** | 0 | 0 | 75 | 100 | 75 | 100 | 75 | 100 | 75 | 100 | 75 | 100 |

From table 5 shows all variations in concentrations imposed on larvae over 24 hours showing all larvae experience death except the control group (0 g/L). Below is a graph of the mortality percentage of larva for variation of treatment observed every minute interval of observation.




Picture 1. Graph of the mortality percentage of larva for variation of treatment observed every minute interval of observation

The LC50 value obtained from this study was 2,084 g/L (0.2%), in the sense that the concentration of added turmeric extract is 2,084 g/L (0.2%) able to kill 50% of the larvae of the *Aedes aegypti* L mosquito. According to the WHO, Larvasida is declared effective if it can kill larvae ≥ 10% of the total test larvae. Where the number of larvae that die after treatment of concentration (2,5 g/L, 5 g/L, 10 g/L, 20 g/L, and 40 g/L), larvae show death above 10% within 24 hours.

The death of larvae by turmeric extract is thought to be related to the secondary

metabolite content of 70% turmeric ethanol extract (*Curcuma domestica*) (Kaban, 2019). The results of phytochemical extraction screening in this study are 70% turmeric ethanol extract (*Curcuma domestica*) positively containing flavonoids, alkaloids, saponins, terpenoids, phenolic, and tannins. The content of flavonoids enters the body system of larvae through the respiratory system, which will have an impact on respiratory, the larvae cannot breathe normally and will have an impact on the death of larvae (Cania & Setyaningrum, 2013; Pulungan, 2017; Nasution *et al.,* 2020).

The alkaloid content of turmeric will have an impact on indigestion. Alkaloids can degrade cell membranes to get inside and damage cells (Cania & Setyaningrum, 2013). Tannins work as an estrogen substance that can shrink tissue and shut down protein structures in the skin and mucosa resulting in the death of larvae (Yanie et al., 2013).

Saponin on turmeric works by lowering the voltage on the surface of the mucosal membrane of the digestive mucosa of the larva so that the walls of the digestive structure are corrosive and eventually damaged (Irwan et al., 2007). Terpenoids have antifeedant properties, resulting in larvae dying, terpenoid compounds that have larvacide activity are monoterpenes (Kishore et al., 2014).

## CONCLUSION

Ethanol extract of 70% turmeric (*Curcuma domestica*) positively contains flavonoids, alkaloids, saponins, terpenoids, phenolates, and tannins, with a value of LC50 obtained from this study is 2,084 g / L or 0.208% (w/v). The results showed that tumeric extract (*Curcuma domestica*) is effective to kill the larvae *Aedes aegypti* L.

## REFERENCES

Borrero Landazabal MA, Carreno Otero AL, Kouznetsov VV, Duque Luna JE, Mendez-Sanchez SC, Landazabal MAB, Oterob ALC, Lunac JED. (2018). Alterations of mitochondrial electron transport chain and oxidative stress induced by alkaloid-like α-aminonitriles on Aedes aegypti larvae. Pestic Biochem Physiol. 144:64-70.

Cania B, & Setyaningrum E. (2013). Uji Efektifitas Larvasida Ekstrak Daun Legundi (Vitex trifolia) Terhadap Mortalitas Larva Aedes Aegypti. Fak Kedokt Univ Lampung. 2(4).

Carreno Otero AL, Vargas Mendez LY, Duque L. JE, Kouznetsov VV. (2014). Design, synthesis, acetylcholinesterase inhibition and larvicidal activity of girgensohnine analogs on Aedes aegypti, vector of dengue fever. Eur J Med Chem. 78:392-400.

Cheng SS, Chua MT, Chang EH, Huang CG, Chen WJ and Chang ST. (2009). Variations in insecticidal activity and chemical compositions of leaf essential oils from Cryptomeria japonica at different ages. Bioresource Technology. 100: 465–470.

Habibi, Ahmad Ikhwan, R. Arizal Firmansyah, Siti Mukhlishoh Setyawati. (2018). Skrining Fitokimia Ekstrak n-Heksan Korteks Batang Salam (Syzygium polyanthum). Indonesian Journal of Chemical Science. 7(1), 1-4.

Harapan, H, Michie A, Mudatsir M, Sasmono RT, Imrie A. (2019). Epidemiology of Dengue Hemorrhagic Fever in Indonesia: Analysis of Five Decades Data From the National Disease Surveillance. BMC Research Notes.12(350):1-6. https://doi.org/10.1186/s13104-019-4379-9.

Irwan, Azidi, Noer Komari, Rusdiana. (2007). Uji Aktivitas Ekstrak Saponin Fraksi N-Butanol Dari Kulit Batang Kemiri (Aleurites moluccana WILLD) Pada Larva Nyamuk Aedes aegypti. Jurnal Sains dan Terapan Kimia. 1(2): 93-101

Kaban, K. (2019). EKSTRAK RIMPANG KUNYIT (Curcuma longa Linn) MENURUNKAN PENYAKIT PERLEMAKAN HATI NON-ALKOHOLIK. BIOLINK (Jurnal Biologi Lingkungan Industri Kesehatan), 5(2), 123-130.

Nasution, J., Suharyanto, A., & Dasopang, E. S. (2020). Study Ethnobotany of Minyak Karo. Budapest International Research in Exact Sciences (BirEx) Journal, 2(1), 96-100.

Nasution, J., Riyanto, R., & Chandra, R. H. (2020). Kajian etnobotani Zingiberaceae sebagai bahan pengobatan tradisional Etnis Batak Toba Di Sumatera Utara. Media Konservasi, 25(1), 98-102.

Rattan RS. (2010). Mechanism of action of insecticidal secondary metabolites of plant origin. Crop Protection. 29(9):913-920.

Kao L, Chen CR and Chang CMJ. (2007). Supercritical $CO_2$ extraction of turmerones from turmeric and high-pressure phase equilibrium of $CO_2$ + turmerones. Journal of Supercritical Fluids. 43: 276–282.

Rau, M. J., Arifuddin, A., Afrianti, S., & ., Pitriani. (2019). The Analysis of Environmental Risk and the Use of Repellent on Dengue Hemorrhagic Fever in Kamonji Public Health Center. Journal of Current Medical Research and Opinion, 2(05), 144-147. https://doi.org/10.15520/jcmro.v2i05.156

Kishore N, Mishra BB, Tiwari VK, Tripathi V, Lall N. (2014). Natural products as leads to potential mosquitocides. Phytochem Rev.;13(3):587-627. doi:10.1007/s11101-013-9316-2

Lee, HS, Shin WK, Song C, Cho KY and Ahn YJ. (2001). Insecticidal activities of ar-turmerone identified Curcuma longa L. rhizome against Nilaparvata lugens (Homoptera: Delphacidae) and Plutella xyostella (Lepidoptera: Yponomeutidae). Journal of Asia–Pacific Entomology; 4: 181–185.

Perumalsamy H, Jang MJ, Kim J-R, Kadarkarai M, Ahn Y-J. (2015). Larvicidal activity and possible mode of action of four flavonoids and two fatty acids identified in Millettia pinnata seed toward three mosquito species. Parasit Vectors. 8(1):237-250.

Pulungan, A. S. S. (2017). Aktivitas antijamur ekstrak etanol daun kunyit (Curcuma longa Linn.) terhadap jamur Candida albicans. BIOLINK (Jurnal Biologi Lingkungan Industri Kesehatan), 3(2), 124-128.

Purwakusumah, Edy Djauhari, Lusi Royani, Mohamad Rafi. (2016). Evaluasi Aktivitas vAntioksidan dan Perubahan Metabolit Sekunder Mayor Temulawak (Curcuma xanthorriza) Pada Umur Rimpang Yang berbeda. Jurnal Jamu Indonesia. 1(1):10-17

Rochmat, Agus, Zahrotul Bahiyah, dan Mitha Fuji Adiati. (2016). Pengembangan Biolarvasida Jentik Nyamuk Aedes Aegypti L. Berbahan Aktif Ekstrak Beluntas (Pluchea indica Less.). Reaktor. 16(3):103-108.

Mustafa, A, & Basri. (2019). Perbandingan Daya bunuh Daun Pala (Myristica fragrans) dan Daun Sirih (Piper betle L) Sebagai Larvasida Alami Terhadap Larva Aedes aegypti Instar III di Kota Ternate. PROMOTIF: Jurnal Kesehatan Masyarakat. 9(1):1-8

Sirait, E.U, Khotimah , S. & Turnip, M. (2014). Ekstrak buah Laban (Vitex pubescens Vahl) sebagai Penghambat Pertumbuhan Salmonella thypi dan Staphylococcus aureus. Jurnal Protobiont. Universitas Tanjungpura. 3(3) : 40-45.

Suling, Lucy, Indria Agustina, Fatmaria. (2020). Uji Daya Bunuh Ekstrak Etanol 70% Kelakai (Stenochlaena palustris (Burm. F.) Bedd) Terhadap Larwa Instar III Aedes aegypti. Herb-

Medicine Journal. 3(1): 6-11. DOI: 10.30595/hmj.v3i1.6375

Yanie Elvi, Shinta Elystia, Anggi Kalvin, Muhammad Irfhan. (2013). Pembuatan Pestisida Organik Menggunakan Metode Ekstraksi dari Sampah Daun Pepaya dan Umbi Bawang Putih. Tek Lingkung.10(1): 46-59.

Yasni, S. (2012). Teknologi Pengolahan dan Pemanfaatan Produk Ekstraktif Rempah. Bogor. IPB Press