Biota
Biologi dan Pendidikan Biologi

http://biota.ac.id/index.php/jb
DOI: https://doi.org/10.20414/jb.v13i1.234

Research Article

Biolarvicide of *Culex quinquefasciatus*

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Abstract

Biolarvicide is the larvicide derived from plants and relatively safe. The objective of this study was to determine the effect of pletekan leaf powder (*Ruellia tuberosa*), mimosa (*Mimosa pudica*), papaya (*Carica papaya*), and guava (*Psidium guajava*) on *Culex quiquefasciatus* larval mortality. The method was an experimental with a completely randomized design consisted of 5 treatments (0 gr, 0,25 gr, 0,5 gr, 0,75 gr, and 1 gr) and 5 repetitions for each plant. The data were analyzed by analysis of variance. Based on the results, leaf powder used in the study, namely guava leaves powder (1 gr), mimosa (1 gr), leaves of pletekan (1 gr), and leaves of papaya (1 gr) showed a very significant effect ($P < 0{,}05$) on *Culex quiquefasciatus* larval mortality. It can be concluded that the pletekan, mimosa, papaya, and guava had the potential as biolarvicide of *Culex quinquefasciatus*.

Keywords: Biolarvicide, Guava, Mimosa, Papaya, Pletekan.

1. Introduction

Larvicide is a pesticide slaying larvae (insects in development) (Antonio-Nkondjio, Sandjo, Awono-Ambene, & Wondji, 2018). Eradication of larvae using larvicide is one of the best methods to control insects in the ecosystems. Unfortunately, synthetic larvicide is often used by society (Marcombe et al., 2018; Xiao & Wu, 2019). The use of synthetic larvicide can cause insect resistance, environmental pollution, and pestiferous organisms, include humans (Perumalsamy, 2009). Consequently, biolarvicide should be used for diminishing the effects. Biolarvicide is the larvicide from the plant. It is felicitous to be developed due to its potential for controlling the vector of the disease. Its exertion is relatively safe and profitable (Braks, Giglio, Tomassone, Sprong, & Leslie, 2019; Wood & Goulson, 2017). The secondary metabolites in plants, such as flavonoids, terpenoids, and alkaloids have no impact to the environment, and others (Isah, 2019; Li et al., 2019; Yang et al., 2018). Based on the references, many plants that have not been optimized yet functionally (Bedini et al., 2018; Dougoud, Toepfer, Bateman, & Jenner, 2019; Hung et al., 2019; Pilaquinga et al., 2019; Ragavendran et al., 2019; Sharma, Kumar, & Tripathi, 2017).

Terpenoid and alkaloid of *Nothopanax scutellarium* have a role as biolarvicide of *Aedes aegypti* (Bilal, Akram, & Ali-Hassan, 2012; Bilal, Sahar, & Din, 2017; Mohankumar, Shivanna, & Achuttan, 2016). Extract of *Nicotiana tabacum* illustrated that flavonoid as biolarvicide of *Aedes aegypti* (Fernandes et al., 2018; Krzyzaniak et al., 2017;

Perumalsamy, Jang, Kim, Kadarkarai, & Ahn, 2015; Yousefbeyk et al., 2018). Moreover, the essential oil, terpenoid, alkaloid, flavonoid, and saponin, of *Lansium domesticum,* can slay the larvae of *Aedes aegypti* (Ali, Ravikumar, & Beula, 2012; Ali, Ravikumar, & Beula, 2013; Bagavan, Rahuman, Kamaraj, & Geetha, 2008; Ma, et al., 2019). Sidik (2015), revealed that alkaloid, saponin, and flavonoid as the toxic of larvae. Be in accordance, plants from Indonesia contain a lot of secondary metabolites which is effective to remove the insect's larvae (El-Akhal, Guemmouh, Ez Zoubi, & El Ouali Lalami, 2015; Ghosh, 2013; Rawani, Ray, Ghosh, Sakar, & Chandra, 2017; Subramaniam, Kovendan, Mahesh Kumar, Murugan, & Walton, 2012). However, the researches do not exhibit yet its function as biolarvicide of *Culex quinquefasciatus*.

C. quinquefasciatus is a vector filariasis (elephantiasis) disease. Filariasis is caused by 2 main species of filarial worms, namely *Wuchereria bancrofti* and *Brugia malayi* (Das, 2009; Famakinde, 2018; Gordon, Jones, & McManus, 2018; Kron, Walker, Hernandez, Torres, & Libranda-Ramirez, 2000; Simonsen, Malecela, Michael, & Mackenzie, 2008). Its activities from 6 pm to 6 am so disturbing humans. The development of this mosquito is very fast. Banyuasin Health Department (2016), said that Banyuasin is one of the areas in South Sumatera which has the highest chronic case of filariasis. The high number of filariasis in Banyuasin, South Sumatera, caused by the high number of *Culex quinquefasciatus*. Hence, biolarvicide is very needed to control the development of mosquito by using plants which often found in the environment, especially in Palembang, South Sumatra, and unknown yet another usefulness, such as *Ruellia tuberosa*, *Mimosa pudica*, *Carica papaya*, and *Psidium guajava*.

Ruellia tuberosa contains secondary metabolites, like flavonoid, steroid, triterpenoid, and alkaloid (Balamurugan, Nishanthini, & Mohan, 2014; Khachitpongpanit, Singhatong, Sastraruji, & Jaikang, 2016; Lin, Huang, Cheng, Sheu, & Chen, 2006). Aquadest extract of the leaves has flavonoid, alkaloid, polyphenol, tannin, quinone, monoterpenoid, and sesquiterpenoid. *Mimosa pudica* has alkaloid, flavonoid, terpenoid, sterol, tannin, and saponin. The compounds had found in the leaves, stem, and root (Muhammad, Hussain, Jantan, & Bukhari, 2016; Vimala & Gricilda Shoba, 2014). *Carica papaya* also contains an alkaloid, carpain, cerivastatin, violaxanthin, papain, flavonoid, polyphenol, and saponin (Sai, Thapa, Devkota, & Joshi, 2019). Likewise, *Psidium guajava* has secondary metabolites, such as flavonoid, tannin, phenol, and essential oil. Based on the references, the compounds are suggested to play a role as biolarvicide of *C. quinquefasciatus*. Nevertheless, the function of these plants is still not widely known by society. Therefore, this research needs to be done by using pletekan, mimosa, papaya, dan guava. The objective of this study was to find out the effect of pletekan, mimosa, papaya, dan guava.

2. Materials and Method

The research was carried out in the natural science laboratory, UIN Raden Fatah Palembang. Larvae of *Culex quinquefasciatus* obtained was identified morphologically by using Cutwa et al., (2008). The method was an experimental with a completely randomized design consisted of Pletekan leaves powder (control (0 gr), P1 (0,25 gr), P2 (0,5 gr), P3 (0,75 gr), dan P4 (1 gr)) for 5 repetitions. Mimosa powder (control (0 gr), P1 (0,25 gr), P2 (0,5 gr), P3 (0,75 gr), dan P4 (1 gr)) for 5 repetitions. Papaya leaves powder (control (0 gr), P1 (0,25 gr), P2 (0,5 gr), P3 (0,75 gr), dan P4 (1 gr)) for 5 repetitions. Guava leaves powder (control (0 gr), P1 (0,25 gr), P2 (0,5 gr), P3 (0,75 gr), dan P4 (1 gr)) for 5 repetitions. The plants used were derived from locations with an average ambient temperature of 29^{o}C and humidity of 87,5%. The leaves used are leaves that are not too young and not too old. For the mimosa, all of its parts were used in this study. Dried samples were blended into powder, approximately 20 gr for each sample. Then, plant powder was experimented with larvae.

As many as 20 Larva identified was prepared into 100 ml water volume. Plant powder was given to test the potential of larvicide. Then, larval mortality was observed after 4 hours. The characteristics of dead larvae are immobile, smaller than normal size, stiff, and pale in color when compared to controls (Farnesi et al., 2012). Data observed were analyzed by using ANOVA.

3. Results and Discussion

3.1. Results

The results showed that the mortality of larvae. It showed the discrepancy in the percentage of *C. quinquefasciatus'* larval mortality. The percentage of *C. quinquefasciatus'* larval mortality in each treatment can be seen in Figure 1.

Figure 1 represented that the enhancement in larval mortality of *C. quinquefasciatus*. This improvement revealed that the powder used in this study (guava, mimosa, pletekan, and papaya) had an impact on mortality. Based on these improvements and changes, analysis of variance was carried out. Analysis of variance pointed out that the powder of plants has very significant leverage ($P < 0,05$) to the larval mortality of *C. quinquefasciatus*. It meant that the powder used in this study could be used as biolarvicide of *C. quinquefasciatus*.

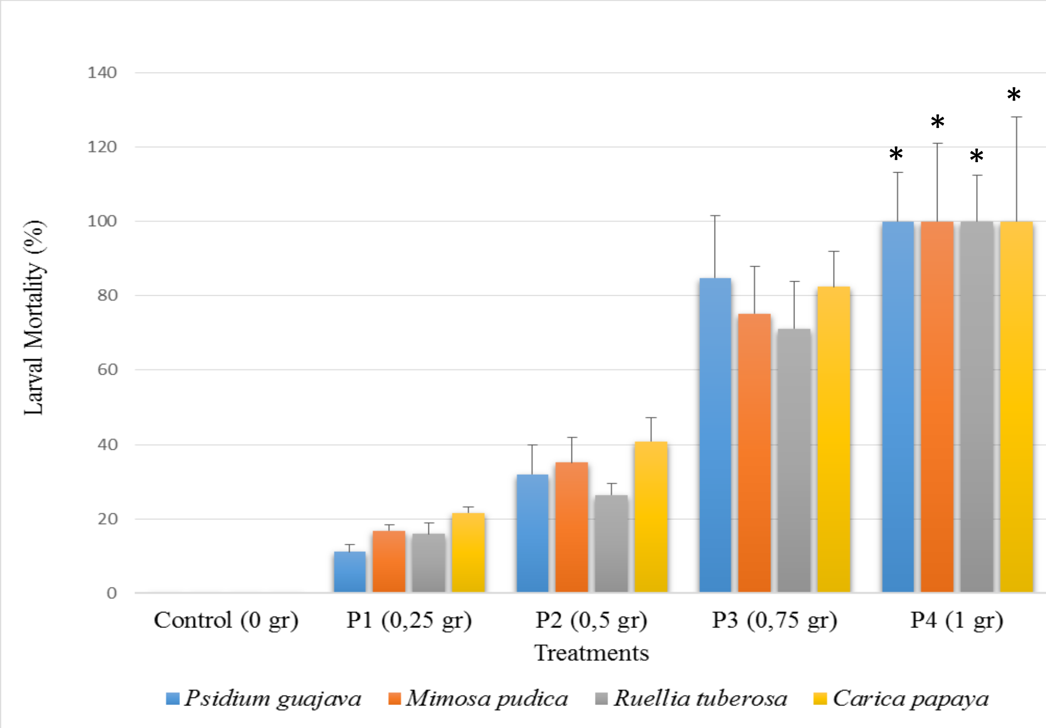

Figure 1. Percentage of *Culex quinquefasciatus'* larval mortality (*: significantly different to the other treatments)

3.2. Discussion

Leaves powder used in the study, specifically guava, mimosa, pletekan, and papaya, denoted a very significant clout on larval mortality of *Culex quinquefasciatus*. This leverage could be seen in the P3. However, the percentage at P4 revealed that all larva had died. Larval mortality is caused by the secondary metabolites found in plant powder, such as flavonoid, saponin, tannin, and alkaloid (Altemimi, Lakhssassi, Baharlouei, Watson, & Lightfoot, 2017). Based on observations after 4 hours, it was seen that the larva was immobile, smaller than normal size, stiff, and pale in color when compared to controls. This situation indicated that the larva had died. It was suggested to be caused by secondary metabolites in plants powder that was used in this study, such as flavonoids, saponins, tannins, and alkaloids. The compounds from the plant's powder used to bind to water and its contacts to larvae.

Flavonoid acts as an inhibitor of the respiratory system of *Culex quinquefasciatus* larvae. It interrupts the siphon membrane. It goes into the larval body through the siphon and devastates the siphon membrane by interfering with the phospholipid-binding so that the membrane ruptures (Fantin et al., 2019) . The breakage can obstruct absorption the oxygen. Besides, flavonoid inhibits the enzyme of ATPase which causes insufficient energy so that the larvae undergo the paralysis of the respiratory organs (Semwal, Combrinck, & Viljoen, 2016; Thapa, 2019). Consequently, the larva will difficult to adopt oxygen and death. This mechanism was expected to cause the larva to turn pale.

Besides flavonoids, there are several active compounds contained in the powder used in this study, such as saponin and tannin.

Saponin has a role as the digestive toxic for the larva (Da Silva et al., 2012; Zeng, Wu, Zhao, Yun, & Peng, 2018). Water-soluble saponin enters the body of the larva through the mouth and comes into the digestive tract (foregut, midgut, and hindgut). However, in the midgut, it only has a peritrophic membrane that protects the cells from the friction of particles (Hussain et al., 2019; Jampilek, Kos, & Kralova, 2019). Saponin wrecks this membrane. Saponin has strong quality as the surfactant. Surfactant is the molecules that can dissolve with lipid and water (Aggrey, Asiedu, Adenutsi, & Anumah, 2019; Marrelli, Conforti, Araniti, & Statti, 2016). Mechanism of saponin as the toxic can penetrate the peritrophic membrane and binding to lipids until the epithelium of midgut breakage. This causes the absorption of nutrients hampered and the larvae will lack nutrients (Lu et al., 2018; Miguel-Aliaga, Jasper, & Lemaitre, 2018). As well as saponin, tannin also had a role as the digestive toxic for the larvae.

Tannin is the polyphenol that can form complex compounds with proteins (Adamczyk, Simon, Kitunen, Adamczyk, & Smolander, 2017; Okuda & Ito, 2011). Formation of tannin and protein due to hydrogen bonds. The mechanism of action of tannin as the poison occurs in the midgut which is an organ that absorbs nutrients and secretes digestive enzymes (Cirkovic Velickovic & Stanic-Vucinic, 2018; Wang, Perumalsamy, Wang, & Ahn, 2019). The digestive enzymes, that is protease enzyme, are inhibited by tannin so that the role of the protease enzyme in catalyzing proteins into amino acids as the nutrient intake needed for growth is disrupted. Protein deposition by tannin causes the protease enzyme cannot break down the protein so that the work of the enzyme is inhibited. This retardation can disrupt metabolism and larvae will lack nutrients. If this process occurs continuously, it will cause larval mortality marked by the larvae was smaller than normal size.

Alkaloid has the mechanism to degrade the exoskeleton by dissolving the chitin layer. It is a waxy material as a source of carbon and nitrogen for the growth of larvae after molting**.** The disruption of exoskeleton causes the molting process agitated (Dong et al., 2007; Liang, Li, Gu, Qin, & Ji, 2015; Wilson, Tseng, Potter, Davidowitz, & Hildebrand, 2018). It perhaps caused the larvae to become stiff. This mechanism still needs further research.

Conclusion

Based on this study, it can be concluded that the pletekan (*Ruellia tuberosa*), Mimosa (*Mimosa pudica*), papaya (*Carica papaya*), and guava (*Psidium guajava*) had the potential as biolarvicide of *Culex quinquefasciatus*.

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