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Belimbing Wuluh (*Averrhoa bilimbi* Linn.) Leaf Powder as the Natural Repellent Against Meat Fly (*Genus Sarcopaga*)

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Abstract

Efforts are often made to control meat flies with chemical insecticides, but they harm humans, the environment, and other organisms. We use belimbing wuluh leaf as a natural repellent in controlling meat flies. The purpose of this study is to determine the effect of belimbing wuluh leaf powder as a natural repellent and the number of effective doses against meat fly. Using 15 samples at each dose of 1 gr, 2 gr, 3 gr, 4 gr, 5 gr, negative control without powder, positive control with Top Killer powder, performed four repetitions every 10 minutes of observation for 60 minutes. Kolmograv-Smirnov normality test, P-value 0.200> 0.05 means that the data for each group is normally distributed. Variant test, P-value 0.066> 0.05, so there was a group that had homogeneous data variants, an ANOVA test resulted in a Sign value of 0.001. There is an effect of the belimbing wuluh leaf powder dose as the repellent of meat flies. The 5-gram dose is the most effective as a natural repellent of meat flies. (*Genus Sarcopaga*)

Introduction

Vector-borne diseases are one of the public health problems in Indonesia, one of which is fly vector-borne diseases. Flies are one of the vectors of disease intermediaries whose populations are found around the community. Flies are major public and domestic health pests that spoil food, cause irritation, and are vectors of many infectious disease pathogens of medical and veterinary importance (Baana et al., 2018).

Flies are a type of Arthropoda belonging to the Order Diptera. Several species of flies have the most role in public health problems, namely as vectors of disease transmission. As a cosmopolitan pest, flies will cause a disturbance, irritation, spoil food, and are vectors for many pathogenic organisms that attack humans and livestock (Kumar et al., 2012). As a mechanical vector, flies transfer pathogens through their hairy body parts, eating way, and regurgitation of their feces (Baana et al., 2018). Flies usually eat and reproduce in feces, animal waste, carrion, and other decaying organic matter. They live in close contact with various microorganisms including human pathogens, which may attach to the fly's body surface. The continuous movement of flies between breeding sites and human habitation can lead to the transmission of pathogens to humans and animals (Khamesipour et al., 2018). Flies transmit more than 100 human and non-human diseases including bacterial infections such as salmonellosis, anthrax, shigellosis, typhoid fever, tuberculosis, cholera, diarrhea, and protozoan infections such as amoebic dysentery. In addition, it is also responsible for transmitting the pathogens that cause trachoma and conjunctiva, both of which are estimated to cause approximately 6 million cases of childhood blindness each year worldwide. There are also indications that flies have the potential to be carriers of avian influenza viruses that threaten humans (Baana et al., 2018; Wanaratana et al., 2011; Wanaratana et al., 2013).

Several types of flies that have received

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attention in the health sector are house fly, meat fly, green fly, and fruit fly. Disease agents that can be transmitted mechanically are intestinal bacteria, intestinal worm eggs, and intestinal protozoa (Ryani et al., 2017). In this study, researchers chose meat fly, because of some harm caused, especially for human health, like transmitting various diseases such as typhoid, dysentery, cholera, diarrhea, and can also cause myiasis (fly infestations in humans body tissues) (Mathison & Pritt, 2014). It transmits worm eggs such as pinworms, roundworms, hookworms, and tapeworms. The fly also transmits viral infections, rickettsial infections, and in some cases, life-threatening *Escherichia coli* (Baana et al., 2018). In addition, there is a report that the stomach contains worm eggs of *Ascaris lumbricoides* and *Trichuris trichiura* that can transmit helminthiasis (Sucipto, 2011).

A meat fly is a fly that includes ectoparasites found in meat and animal carcasses and is one type of fly that can transmit disease. This fly belongs to the *Genus Sarcophaga* which means that it eats meat. The fly is very detrimental to the community because it causes accelerated spoilage, an unpleasant odor, causing the presence of the maggot on the media that is infested, poor appearance, and unpleasant odors on media such as meat. The fly is detrimental to the community because they cause accelerated decay (Dewi et al., 2017).

The body of the meat fly is gray with a chessboard-like pattern on the abdomen and three dark stripes on the dorsal thorax. In its life cycle, it is vivifar and releases live larvae in its breeding sites. Like meat, carrion, feces, and rotting vegetables. The life cycle of this fly lasts 2-4 days. Meat fly is generally found in open markets, stalls, meat, garbage, and dirt (Sucipto, 2011). A market is a place that supports the survival of flies, including meat fly, because there are various kinds of sales such as necessities, meat, fish, chicken, fruits, and vegetables. So the market has the potential for the presence of excessive flies (Ryani et al., 2017).

Control of flies has been carried out both chemically and non-chemically. Non-chemical control for adult flies by repelling and trapping flies such as fly adhesive, lamp traps that can kill flies with electricity. Chemical control is carried out by larvicides, surface spraying, room spraying, baiting, and fly repellants (Sucipto, 2011). Long-term application and extensive use of synthetic insecticides have resulted in the accumulation of residues in food, milk, water, soil and caused adverse health effects for humans and ecosystems (Mossa et al., 2018). Insecticide residues contained in the food chain can harm humans, causing poisoning and even death. In addition, various studies have shown that pesticides/insecticides can have long-term effects, namely causing cancer, male and female reproductive health problems, neurological disorders, and damaging the immune system (Mossa et al., 2018). The insect control, including meat fly (*Genus Sarcophaga*) by chemical insecticides, to control parasitic organisms whose mobility is high like flies can cause problems. The problems are the effects of pesticides that are detrimental to health and the environment, the risk of developing insect resistance, and bioaccumulation through the food chain, emphasizing the need to find environmentally friendly alternatives (Baana et al., 2018).

To reduce synthetic insecticides usage, it is necessary to develop biological control by utilizing plants that exist in nature. One that can be as a vector insect repellent, especially meat fly, safe for the environment and society. Plant extracts have long been proposed as attractive alternatives to synthetic insecticides for pest management because they are environmentally friendly, economical, usually target-specific, and biodegradable (Sisay et al., 2019).

Belimbing wuluh (*Averrhoa bilimbi Linn.*) is a plant that is often used for medicine and its fruit as an ingredient for cooking. As a medicinal plant, *A. bilimbi* is used in diabetes mellitus and hypertension treatment. Also as an antimicrobial agent (Alhassan & Ahmed, 2016). Several previous studies stated that the plant contains bioactive compounds. According to Suluvoy, the bioactive compounds contained in the belimbing wuluh fruit are flavonoids, tannins, alkaloids, phenols, and saponins (Suluvoy & Berlin, 2017). Ahmed et al, in the phytochemical test in his research, found the leaf extract contains alkaloids, flavonoids, saponins, terpenoids, triterpenes, and phenolics (Ahmed et al., 2018). The compounds that function as

insecticidal and larvicidal activities are saponins and terpenoids (Rohmah et al., 2020). Almost all parts of belimbing wuluh, including leaf, can and is often used. The leaf is used in medicines as antimicrobial, antioxidant, anticancer, wound healing, antidiabetic, antihypertensive, and toxicity (Alhassan & Ahmed, 2016)

Saponins are stomach poisons that can inhibit the feeding activity of larvae (Wahyuni et al., 2018). Flavonoids, as respiratory and contact poisons, are absorbed and enter the body cavity, which will inhibit metabolic processes (Wahyuni et al., 2019). The same thing, according to Wahyuni, is that the content of flavonoids can enter through the mouth and respiratory tract (spiracles) can cause nervous disorders so that the body withers and causes death (Wahyuni & Yulianto, 2018).

Several studies have been conducted on belimbing wuluh in general. Mostly for medicine, but some also for insect control. Research conducted on "Larvicidal Activity and Histopathological Effect of *Averrhoa bilimbi* Fruit Extract on *Aedes aegypti* from Surabaya, Indonesia" found that the extract of the fruit was effective to kill *A. aegypti* larvae with the most effective concentration of 2000 mg/kg. L with larval mortality 100% of the total test larvae with LC50 value is 1061.275 ppm, and LC90 value is 1461.255 ppm (Rohmah et al., 2020).

In this study, researchers used belimbing wuluh leaf powder to repel meat fly, which in some previous studies used the leaf as medicines and vegetable insecticides. Therefore, researchers tried to use belimbing wuluh leaf as vegetable repellents on flies, especially meat fly. It is reinforced by the opinion of Alhassan et al, stating belimbing wuluh leaf can be used as medicine (Alhassan & Ahmed, 2016). Besides, it can also be used as an ingredient to keep insects away (antifeedant) from food sources (Suluvoy & Berlin, 2017), (Rohmah et al., 2020). Based on the information above, researchers are interested in researching "The Effect of Belimbing Wuluh Leaf Powder (*Averrhoa bilimbi Linn.*) As a Natural Repellent Against Meat Flies (*Genus Sarcophaga*)". This study aims to determine the effect of belimbing wuluh leaf powder as a natural repellent against meat fly and to determine the most effective amount of belimbing wuluh leaf powder as a natural repellent against meat flies.

Method

The research was conducted at the Pekanbaru Health Polytechnic Research Laboratory in June-August 2019. The test insects in this study were meat flies obtained from catching at Rumbai Market, Pekanbaru. The belimbing wuluh leaves used in this test were obtained at Tampan Permai Panam Housing, Pekanbaru. This study examines the effectiveness of belimbing wuluh leaf powder as a vegetable repellent on meat fly without ignoring the factors that affect their lives. Namely temperature, humidity, as well as available food. The research design used a Completely Randomized Design Method (CRD) with five dosage levels. Namely 1 gram, 2 grams, 3 grams, 4 grams, 5 grams, negative control without using the leaf powder, and positive control using chemical insecticides (top killer powder) which was repeated four times.

Preparation of test animals is done by inviting meat flies to come by placing pieces of dead fish meat and rotting chicken meat in fly traps. Furthermore, meat flies that have been trapped are kept for one day and then selected flies for test animals that are healthy and actively moving/flying. The test sample for each number of doses (weight), positive control, and negative control consisted of 15 flies with four repetitions so that the total sample amounted to 360 meat flies.

Image 1. Meat fly (Sarcophaga)

The stages of making belimbing wuluh leaf powder are as follows the leaves are collected approximately 500 grams, washed with water, then cut into small pieces. Furthermore, they were dried at room temperature. After they dry, they are mashed using a blender so that they become powder. The cage for testing consisted of 2 kinds of boxes, the first box measuring W: 50 x W: 50 x H: 50 cm as a large cage and the second box measuring W: 25 x W: 25 x H: 25 cm as a small cage. For large cages and small cages, the surroundings are covered with mosquito netting. However, when doing the test, each side of the small box is covered with plastic. But in the middle of one side is made a circle that is not covered with plastic for the air ventilation so the meat flies can breathe. In some corners of the small cages, there were holes as the passages for flies to the large cage during testing.

Image 2. Test Cage

The test was carried out by inserting 15 meat flies into each small cage that had been filled with various doses of belimbing wuluh leaf powder, as well as for negative control and positive control, and was carried out four times. Belimbing wuluh was put in a large cage. Then observed the behavior of meat flies during the study, every 10 minutes for 60 minutes of observation, and counted the number of meat flies that came out of the small cage to the large. The same thing in the second, third, and fourth repetitions. Data analysis using statistical tests of variance analysis with RAL followed by the One Way ANOVA test.

Result and Discussion

Based on the results of research, flies that come out of small cages into large cages with various doses given, namely 1 gram, 2 grams, 3 grams, 4 grams, 5 grams, Top Killer positive control, and 0 grams negative control (without belimbing wuluh leaf powder). The calculation and observation of the number of meat flies that came out of the small cage to the large cage were observed at 10-minute intervals for 60 minutes with four repetitions. In the negative control (without powder), no flies were seen leaving the small cage to the large at each repetition. However, the positive control showed a significant change. Within a not too long time, the flies panicked and flew irregularly. The flies tried to find holes in the corners of the cage walls. And soon, the meat flies came out of the small cage into the large. In this positive control, all flies went out to the large cage on each repetition.

In the amount of 1 gram and 2 grams of the leaf powder, the meat fly behavior and condition began to appear to be affected by the content of bioactive compounds. Some flies tried to fly away from the powder. It can be seen from the average number of flies leaving the small cage to the large, respectively, as much as 18.% and 26.6% for 60 minutes of observation. At a dose of 3 grams of belimbing wuluh leaf powder, the behavior and condition of the meat fly was a lot of restlessness flying here and there trying to find a way to get out of the small cage into the large. It can be seen from the average number of flies that came out of the small cage to the large on 56.6% treatment for 60 minutes of observation. Furthermore, in the amount of 4 grams and 5 grams of the leaf powder, the behavior of meat flies is more aggressive, flying here and there, even hitting the box walls and getting more aggressive to avoid the leaf powder because it contains more bioactive compounds. It can be seen from the average number of meat flies that leave the small cage to the large of 93.3% and 98.3% for 60 minutes of observation.

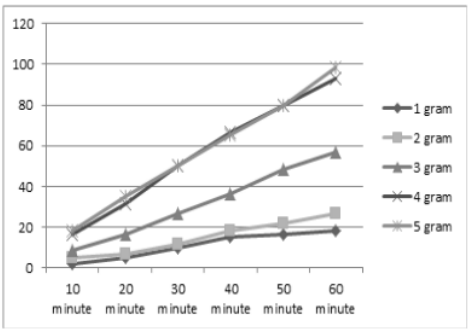

Image 3. Percentage of Meat Fly Coming Out from The Small Cage to The Large in Each Treatment (Primary Data, 2019)

In Image 3 above, the difference in the belimbing wuluh leaf powder amount has a different effect on meat fly. The number of meat flies coming out of the small cage into the large increased along with the increase of doses given to each treatment. It means, the higher the doses, the higher the content of bioactive compounds contained in belimbing wuluh leaf powder, and the number of flies coming out from the small cage to the large. It showed the potential of belimbing wuluh leaf powder as a natural repellent against meat flies.

From the results of the Kolmograv-Smirnov Normality Test Statistical Test, it was obtained a P-value of 0.200 from 5 treatment groups, which means large (>) 0.05. It means that the distribution of data from each group is normally distributed. The results of the Variance test obtained a P-value of 0.066 is large (>) of 0.05, so some groups have homogeneous data variants. Based on the results of the second statistical test above, the results obtained to meet the requirements for the ANOVA test because the data distribution is normally distributed and the data variance is homogeneous. In the One-way ANOVA test, a Sign value of 0.001 was obtained. There is an effect of the amount (weight) of belimbing wuluh leaf powder (*Averrhoa bilimbi*) against meat fly (*Genus Sarcophaga*).

From the observations' results, the number of meat fly coming out of the small cage to the large cage increased along with the number of treatment doses. Based on Image 3, there was an increase in the number of flies that ran along with the increasing number of belimbing wuluh leaf powder. It is caused by the higher doses of belimbing wuluh leaf powder. The more toxic compounds inhaled by the respiratory system of meat fly in the form of respiratory poisons will be accumulatively faster, more effective, and ultimately drives the meat fly away.

From the results of this study, the level of toxicity gave the effect of repulsion of belimbing wuluh leaf powder increased with increasing concentration. In addition, the length of time exposed to belimbing wuluh leaf powder will also increase the toxicity of insecticides (repellents) from belimbing wuluh leaf. Because the more it absorbs toxic compounds, it will affect the body's metabolism and cause the meat flies to stay away. Time exposed to insecticides will also increase the toxicity. Because the more it absorbs toxic compounds, it will affect the body's metabolism and cause meat flies to stay away. It is aligned with research (Wahyuni & Yulianto, 2018), on plant-based insecticides of basil leaf extract against the death of *A. aegypti* mosquitoes. The more *A. aegypti* mosquitoes absorb the compounds contained in the toxic basil leaf extract, the more mosquitoes die. In addition, the longer exposure to basil leaf extract compounds will increase the level of toxicity. Because the more it absorbs toxic compounds, it will affect the body's metabolism and cause *A. aegypti* mosquito mortality. Likewise, Kosini's research on the *Gnidia kaussiana* extracts effect (*Thymeleaceae*) on *Callosobruchus maculatus (Coleoptera Chrysomelidae)* absorbs more toxic compounds. It will slow down development, cause the death of larvae, and melanization of the cuticle. It results in disruption of the endocrine system that controls growth and development. Larval molting is caused by several secondary metabolites such as terpenoids, alkaloids, and flavonoids (Kosini & Nukenine, 2017).

From the results of observations of meat fly after giving belimbing wuluh leaf powder, with different doses, in the amount of 1 and 2 grams, it appears that the behavior of meat fly moves away from the leaf powder looking for gaps to get out of the small box into the big box. In the amount of 4 and 5 grams, the meat fly was more aggressive in flying and even hit the box wall. From various books and journals

about belimbing wuluh, the effectiveness of the belimbing wuluh plant is strengthened by its moderate sticky sap containing a source of active compounds with various biological activities, namely flavonoid compounds, saponins, and tannins. As explained by Sina, et al that the presence of phenols, flavonoids, and tannins in plants is most likely responsible for the observed free radical scavenging effects. Flavonoids and tannins are phenolic compounds. Plant phenolics are the main compound that acts as primary antioxidants or free radical binders (Sina et al., 2016). These chemical compounds are toxic to insects, vectors and are not liked by insects. From this information, belimbing wuluh leaf contains bioactive compounds, namely flavonoids, saponins, and tannins, that can affect meat fly. They are toxic so that one of them can act as meat fly repellent.

Flavonoids are one of the largest groups of phenolic compounds that can modulate the expression and activity of several enzymes in signaling and cell metabolism (Santos Felix et al., 2018). Flavonoid compounds have specific characteristics such as planar and aromatic rings (Fernandes et al., 2019). Flavonoids play a vital role in plant protection against plant-eating insects and herbivores (Acheuk & Doumandji-Mitiche, 2013). The content of flavonoids as bioactive compounds contained in belimbing wuluh leaves can enter through the mouth and the respiratory tract and spiracles found on the skin surface. It can cause nervous disorders so that the flies move very aggressively, flying here and there until they hit the wall of the box.

This study is in line with the research of Gautam et al. (2013), on *Anopheles* and *A. aegypti* larvae after administration of *Vitex negundo* plant extract containing flavonoids. It showed integument disintegration with loss of the chitin layer and abnormal stretching of the larval body. It is due to the neurotoxic effect of the *Vitex negundo* plant extract containing flavonoids. Wahyuni explained that the flavonoid as a bioactive compound in basil leaf extract contains alcohol that enters through the mouth and the respiratory tract and through spiracles found on the skin surface which can cause nervous disorders so that the mosquito wings wither, stiffen, and are unable to fly anymore (Wahyuni & Yulianto, 2018).

The flavonoids in belimbing wuluh leaf also interfere with the respiratory system, so meat fly finds it difficult to breathe and try to find their way from the experimental cage. Wahyuni's research, regarding garlic extract (*Allium sativum*) as a vegetable larvicide in the control of green fly (*Calliphoridae*) explained that flavonoids are respiratory poisons and contact poisons. Which, if it is absorbed and entered the body cavity of the fly in excess will cause dizziness and even cause death (Wahyuni et al., 2019). Utami, and Cahyati, in their research on the potential of frangipani leaf extract as an insecticide against *A. aegypti* mosquito, explained that flavonoids function as respiratory poisons or respiratory inhibitors. Flavonoids will enter along with the air (O2) through the respiratory system and will inhibit the respiratory system in the body of the *A. aegypti* mosquito (Utami & Cahyati, 2017). According to Yi, *Rotenone* is known as a respiratory chain inhibitor, preventing the transport of electrons from NADH to CoQ. *Azadirachtin* has behavioral regulation properties as an antifeedant and deterrent for many insects, and also interferes with insect growth, although it acts slowly (Yi et al., 2012). Wahyuni's research on bintaro leaf extract (*Carbera manghas*) as a larvicide in the control of *A. aegypti* mosquitoes explained that the larvae that died looked stiff, causing the loss of the chitin layer and abnormal stretching of the larva's body, which entered through the mouth and respiratory tract/spiracles so that *A. aegypti* larvae have difficulty breathing this is due to the presence of flavonoids (Wahyuni et al., 2018).

In addition, the cause of meat fly trying to stay away from belimbing wuluh leaf powder is due to the presence of saponin compound present in it. The compound has a bitter taste. It is not liked by insects, especially meat fly so that they stay away from the powder. So the saponins contained in belimbing wuluh leaf powder have insect repellent activity so that meat flies try to get out of the experimental cage.

Saponins are a class of triterpenoid compounds that can be used as insecticides. According to Kosini and Nukeinine, alkaloid compounds in fresh fruit will taste bitter on the tongue. It also toxic secondary metabolites that can block ion channels, inhibit enzymes,

or interfere with nerve transmission, loss of coordination, and death (Kosini & Nukenine, 2017). Saponin is found in plants. Both fruit and leaves. When is eaten by insects, could reduce the activity of digestive enzymes and food absorption so that saponins act as stomach poisons (Aditama & Yosep, 2019). In his research, Rohmah explained that the larvicidal compound contained in A. bilimbi fruit extracts is saponin. Saponin has potential as a larvicide and works as gastric poison in Ae. aegypti by lowering the surface tension of the mucous membranes in the digestive tract, making them more susceptible to damage. Damage mainly occurs in the middle of the larval intestine because various functions occur in this place, such as digestion, absorption of nutrients, ion transport, and osmoregulation (Rohmah et al., 2020; Chaieb, 2017; Chaieb & Protection, 2017). Saponin compounds as insecticides are to change the eating behavior of insects by inhibiting (uptake) food in the digestive tract. Saponin can also inhibit the growth of the larval stage by interfering with the larval molting stage (Chaieb, 2017).

Likewise, the tannin compounds contained in belimbing wuluh leaf can cause hyper dose and have a bitter taste so that meat fly is not strong enough to approach the powder so that meat flies try to escape from small cages to large cages. In Wahyuni's research, it was explained that tannins interfere with the digestive system of larvae in the absorption of food ingredients (Wahyuni et al., 2018). Tannins and pellitorine mainly affect the epithelium of the midgut and gastric septum and malpighian tubules in larvae of *C. pipiens* and *A. aegypti* (Kim & Ahn, 2017).

Based on the results of the analysis above, meat fly that inhaled belimbing wuluh leaf powder will mean that there are differences in the number that fly out from small cage to large cage due to differences in the number of doses of belimbing wuluh leaf. In other words, there is an effect of the amount of belimbing wuluh leaf powder on the rejection of meat flies. The effect of insecticides on insects is very dependent on the form, the way it enters the insect's body, the type of substance contained, the concentration dose, and the length of exposure (Sucipto, 2011). In the results of this study, it can be seen in Image 3, that giving belimbing wuluh leaf powder for 60 minutes in a dose of 5 grams can repel 15 meat flies, and the average number of flies that run at that amount within 60 minutes of observation is 98, 3% meat flies. This amount is the largest and fastest in repelling meat fly when compared to other doses. Thus, it is known that the higher the amount of belimbing wuluh leaf powder, the stronger the effect as a vegetable repellent so that it can apply to meat fly. The higher the amount of belimbing wuluh leaf powder given, the higher the effectiveness of the insecticide against meat fly.

Based on the research, the most effective dose is 5 grams. In this dose, almost all flies go away, which is 98.3% in 4 repetitions. Positive control treatment (Top Killer) was carried out to compare the quality of the amount of belimbing wuluh leaf powder whether or not it was the same as the positive control sold in the market. The negative control treatment was carried out to compare its effectiveness with belimbing wuluh leaf powder. The results obtained were no meat fly left after 60 minutes of observation. Overall, we can conclude that the active substances contained in the belimbing wuluh leaf powder (*Averrhoa bilimbi*) can repel meat fly (*Sarcophaga*). Since the more active substance molecules from the belimbing wuluh leaf powder exposed to meat fly, the greater the effect. Therefore, belimbing wuluh leaves have the potential as an alternative insecticide, namely vegetable repellent, because the source is easy to obtain and does not cause residues in nature. Several previous studies support this opinion on the need to use vegetable insecticides as alternative insecticides.

According to Chang's 2014 research, the use of inappropriate doses of insecticides will make insects easy to adapt by carrying out a series of "metabolite detoxification" processes or the removal of residual toxins (chemical insecticides) very quickly. In addition, the use of inappropriate doses will also make the insects adaptable to increase the survival rate of "survival" with sublethal doses called incentivization. Both will affect the synchronization power of the insect's immune system and ultimately be passed on to the next generation. Therefore, it is necessary to develop alternative insecticides, larvacides,

and repellents that are safer and more effective. In this regard, Chang explained that natural insecticides are needed to suppress the dangers of insecticides that cause resistance and will slow down the process of genetic adaptation in vectors. In addition to the occurrence of resistance, it turns out that there are still other problems, namely the toxic effects of insecticides that occur not only on insects, humans but also on the environment and even the balance of the ecosystem (Chang et al., 2014). Similarly, Hikal et al in their research explained that plant-based insecticides only affect target insects, do not destroy beneficial natural enemies, and provide residue-free food and a safe environment. Therefore, Hikal et al recommend the use of plant-based insecticides as an integrated insect management program that can highly reduce the use of synthetic insecticide (Hikal et al., 2017). Based on this, natural repellents are necessary for vector control because they are more environmentally friendly, effective, and low-cost with wide availability in nature, as stated in the research conducted by Rohmah et al. (Rohmah et al., 2020).

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Conclusion

From the One-way ANOVA test, the Sign value was 0.001, there was an effect of the amount (weight) of belimbing wuluh leaf powder (*Averrhoa bilimbi*) on the rejection of meat flies (*Genus Sarcophaga*). The total dose of 5 grams is the most influential as a natural repellent for meat fly. Belimbing wuluh leaf powder has the potential to be used by the community as a natural repellent from environmentally friendly plants, especially in controlling meat fly. This natural repellent is relatively easy to make with simple materials and technology and leaves no residue in the environment, so it is relatively safer than chemical insecticides.

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