The Effectiveness of Attractants on the Amount of Mosquito Aedes Sp. Trapped on Ovitrap

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Keywords: mosquito aedes sp., attractant, ovitrap.

Abstract: Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus and can be transmitted through the vector mosquitoes Aedes aegypti and Aedes albopictus. The addition of attractants to ovitrap can be used as a prevention of diseases caused by mosquitoes Aedes sp. The purpose of this study was to determine the effectiveness of various types of attractants against the number of Aedes sp. trapped on the ovitrap. This type of research is a quasi-experiment with Anova statistical test. The sample used was 300 mosquitoes Aedes sp. The research was conducted with three repetitions of treatment and three observations with a 24-hour timeframe for each observation. The attractants used in this study were plantain peel extract, brown sugar fermentation, straw soaked water and plain water as a control. The results showed that the highest number of mosquitoes trapped in the attractants of plantain peel extract, brown sugar fermentation, and straw soaked water was four, nine, and 21, respectively. Statistically, it can be concluded that the straw soaked water attractant is the most effective attractant (p-value = 0.001) because it caused more mosquitoes to be trapped in each repetition in the ovitrap. This can be a safer alternative attractant for the environment and human health to control the mosquito Aedes.sp vector.

1 INTRODUCTION

Tropical countries, such as Indonesia, are very suitable as a breeding ground for vectors that have a considerable number and types. Therefore, vector-borne diseases such as bacterial, viral, parasitic, and microbial infections can work well because both the agent and the vector reproduce. Mosquitoes are a vector that can cause health problems in the world. In Indonesia, the mosquito population is quite large, so that it can cause several serious diseases which should receive special attention from the government (Soegijanto, 2004). During the rainy season, the mosquito population will increase due to the large number of places inundated by water so that it can act as a place for breeding of mosquitoes (Soegijanto, 2006; Kurniati Alfi, 2013).

Dengue Fever (DHF) is transmitted by Aedes aegypti and Aedes albopictus mosquitoes (Sinaga, 2018). The Aedes aegypti mosquito lives in urban habitats and breeds mostly in homes and human-made containers (WHO, 2018). During the night, the Aedes aegypti mosquito has the habit of resting indoors or sometimes outdoors, which is close to its breeding ground. It can also be a dark and humid place (Sinaga, 2019).

Based on the health profile of North Sumatra in 2016, there were 8,715 cases with 4626 male cases and 4265 female cases. In 2016 the number of dengue cases reported was 1,784 cases with 11 deaths (IR / Morbidity = 80.0 per 100,000 population (Dinas Kesehatan Sumatera Utara, 2016). Meanwhile, based on the health profile of the city of Medan in 2016, Medan Johor was the highest area for cases of dengue hemorrhagic fever. The number of dengue hemorrhagic fever sufferers was 158 cases, with 81 male cases and 77 female cases with one death (Puskesmas Medan Johor, 2018).

Eradicating the life cycle of mosquitoes is a necessary treatment because the dangers posed by mosquitoes are very life-threatening. Eliminating adult mosquitoes and their larvae, eradicating mosquito nests and preventing contact with mosquitoes is one way that can be done for prevention. The use of mosquito repellents such as

Hartono, ., Samosir, F., Hulu, V., Simanullang, A., Dameria, ., Hutasoit, T. and Mendrofa, I.
The Effectiveness of Attractants on the Amount of Mosquito Aedes Sp. Trapped on Ovitrap.
DOI: 10.5220/0010292301810187
In *Proceedings of the International Conference on Health Informatics, Medical, Biological Engineering, and Pharmaceutical (HIMBEP 2020)*, pages 181-187
ISBN: 978-989-758-500-5

mosquito coils, sprays, lotions and electrics are ways to avoid direct contact with mosquitoes. Mosquito repellent is effective enough to ward off mosquitoes that will approach the human body. However, mosquito repellent itself contains toxins that are harmful to human health.

Mosquito egg trapping (ovitrap) is a method that can reduce mosquito populations without the use of insecticides. This method was first developed by Fay and Eliason in 1966 and then used by the Central for Diseases Control and Prevention (CDC) in Aedes aegypti surveillance (Polson et al., 2002). Standard ovitrap uses a plastic cup (350 ml) with a height of 91 mm and a diameter of 75 mm, painted on the outside black to make it dark, then filled with water three-quarters of the way and given a layer of paper (Widyastuti, 2005).

The addition of attractants to the use of ovitrap works to attract female mosquitoes to lay their eggs in the ovitrap. Due to the attractants' appealing smell to the mosquitoes, it is hoped it increases the number of mosquitoes trapped (Ningsih, 2016). An attractant is something that attracts insects (mosquitoes) both chemically and visually (physically). The attractants from chemicals can be ammonia, CO2, lactic acid, octanol, and fatty acids. These substances or compounds come from organic materials or are the result of the metabolic processes of living things. Attractants can be used to influence behavior, monitor, or reduce mosquito populations directly, without causing injury to other animals and humans, and leaving no residue on food or foodstuffs (Wijayanti and Widyanto, 2015).

In Armis' study, plantain peel extract showed effectiveness against the number of mosquitoes trapped in the ovitrap (Armis, Susilawati and Adzriful, 2016). Furthermore, Bangun's study showed brown sugar attractants were more effective than other attractants (Bangun, 2017). On the other hand, Dwinata's research convinced that straw soaked water was more effective than other attractants (Dwinata et al., 2015).

The purpose of this study was to determine the effectiveness of various types of attractants on the number of DHF mosquitoes trapped in ovitrap and to reduce the dengue mosquito population with natural control without using insecticides. The attractants used in this study were plantain peel extract attractants, brown sugar fermentation and straw soaked water. Thus, they were environmentally friendly and did not cause health problems in the community.

2 METHOD

This research was in the form of a quasi-experiment. The research design used in this study was a completely randomized design (CRD) with three times of treatment repetitions. This research was conducted in the Entomology Laboratory of BTKL PP Kelas I Medan. The study was done from June to August 2020. The object in this study was the Aedes sp. mosquito. The population number was taken based on the research needs, which were 300 adult mosquitoes.

To get adult mosquitoes, we looked for larvae and bred the mosquitoes as follows:

1. DHF mosquito larvae were sought in mosquito breeding places such as water reservoirs and banana tree midribs. Mosquito larvae were then put into a rearing container and given a particular food.
2. We observed the maintenance container. After the larvae turned into pupae, the pupae were counted and transferred to another container and put in a cage measuring 100 x 100 x 100 cm until the pupae turned into adult mosquitoes.

To make the ovitrap, we cut three bottles in half. The bottom parts of the bottle were then filled with plantain peel extract, fermented brown sugar and straw soaked water as attractants. Next, the tops of the bottles were inserted into the bottom. When reinserting it, we tried to wrap the bottle as tightly as possible so that the CO2 released only came out through the middle hole (Figure 1 and 2).

Figure 1: How the bottle gets cut and formed

Figure 2: Final ovitrap made by researcher

There were four types of attractants made in the study. Firstly, the plantain peel extract. It was made at the Phytochemical Pharmacy Laboratory of Universitas Sumatera Utara in the following ways:

1. Washed plantain skin to remove the sap and drained while aerating, then cut into small pieces
2. In the drying cupboard, a 40-watt incandescent lamp was installed, the container in the drying cabinet was covered with parchment paper and then filled with cleaned and cut plantain peel.
3. Drying was carried out to produce dry simplicia, which was indicated by the ease with which the simplicia was easily broken.
4. The dried simplicia was then mashed until it became a powder. Simplicia was made in the form of powder to expand the surface of the simplicial. So, the contact between the solvent and the simplicia was maximized
5. Furthermore, the extraction used ethanol p.a solvent and was carried out by maceration, protected from direct sunlight and at room temperature.
6. The extract obtained was then filtered with filter paper and a Buchner funnel using a vacuum erlenmeyer. The filtrate obtained was evaporated with a rotary vacuum evaporator and put into an incubator until a thick extract was obtained and then stored in a freezer.

Secondly, the brown sugar fermentation. It was made in the following ways:

1. Provided 200 ml of water and then added brown sugar.
2. Let stand for 2 hours in a closed container to produce maximum water.
3. Then put in a mosquito trap or ovitrap.

Thirdly, the straw soaked water. It was made through these steps:

1. Dried the straw and cut into small pieces.
2. Put the straw chunks in a bucket containing 1 liter of water, then covered with transparent plastic and let stand for seven days.

Fourthly, the plain water. We took a container and collected water from the water tap.

The next step was delivering the experiment as follows:

1. Mosquito traps with four types of attractants are placed in the mosquito cage of 100 x 100 x 100 cm in size.
2. Then, researchers put 100 adult mosquitoes in the cage.
3. We counted and recorded the number of mosquitoes trapped in each mosquito trap for three days with three observations.
4. Next, the cage was emptied. We put 100 adult mosquitoes into the cage. Then, we did the same thing until the third time.

Data analysis was used to determine the effectiveness test of various types of attractants on the number of dengue mosquitoes trapped in the ovitrap. First, it tested for normality. If the data showed abnormal or sig < 0.05, then proceed with Kruskal Wallis. If the data showed sig > 0.05 then using the Anova test to determine the difference in the number of mosquitoes trapped (Hulu and Sinaga, 2019).

3 RESULTS AND DISCUSSION

Table 1 shows that the plantain peel extract attractant (0.200 > 0.05), brown sugar fermentation attractant (0.138 > 0.05), straw soaked water attractant (0.200 > 0.05), and ordinary water attractant as a comparison or control (0.200 > 0.05) were normally distributed. Therefore the researchers conducted the Anova test. Then, table 2 describes the average number of mosquitoes trapped on the ovitrap. Each replication was carried out for three days. The total average amount of trapped mosquitoes from the three replications of plantain peel extract attractant was 2.00, and the minimum and maximum limits of trapped mosquitoes were 0 and 4. In the brown sugar fermentation attractant, the average total mosquito trapped of the three replications = 6.00 and the minimum and maximum limits of trapped mosquitoes, namely 3 and 9. In the straw soaked water attractant, the average total of trapped mosquitoes from the three replications = 17.78 and the minimum and maximum limits of trapped

mosquitoes are 14 and 21. In ordinary water attractants as a comparison or control, the average total trapped mosquitoes from the three replications = 1.67 and the minimum and maximum limits of trapped mosquitoes are 0 and 3.

Table 1: The data normality test.

No	Variables	Statistic of Kolmogorov-Smirnov[a]	p-Value of Kolmogorov-Smirnov[a]	Conclusion	n
1	Plantain peel extract	0,167	0,830	p-Value > 0,05, assumption of normality is received, at the level of significance 5 %	100
2	Brown sugar fermentation	0,242	0,453	p-Value > 0,05, assumption of normality is received, at the level of significance 5 %	
3	Straw soaked water	0,202	0,278	p-Value > 0,05, assumption of normality is received, at the level of significance 5 %	
4	Plain water	0,192	0,364	p-Value > 0,05, assumption of normality is received, at the level of significance 5 %	

Table 2: The description of the number of mosquitoes Aedes sp. trapped in ovitrap at the BTKL Kelas I Entomology Laboratory, Medan.

Variable		Mean	Std. Deviation	Minimum	Maximum
Plantain Peel Extract	test 1	2,33	0,577	2	3
	test 2	1,67	1,155	1	3
	test 3	2,00	2,000	0	4
	Total average	2,00	1,225	0	4
Brown sugar fermentation	test 1	5,67	1,155	5	7
	test 2	4,00	1,000	3	5
	test 3	8,33	0,577	8	9
	Total average	6,00	2,062	3	9
Straw Soaked Water	test 1	14,67	0,577	14	15
	test 2	18,67	1,155	18	20
	test 3	20,00	1,000	19	21
	Total average	17,78	2,539	14	21
Ordinary Water	test 1	1,67	1,155	1	3
	test 2	1,67	1,528	0	3
	test 3	1,67	0,577	1	2
	Total average	1,67	1,000	0	3

Based on table 3 below, by using the Anova test, the p-value of plantain peel extract, fermentation of brown sugar, and straw soaked water showed that the straw soaked water attractant was more effective than other attractants. This is because the p-value of straw soaked water = 0.001, which means that the p-value of straw soaked water = 0.001 < 0.05 and the p-value of straw soaked water is smaller than the other attractants.

Table 3: The effectiveness of various types of attractants on the number of mosquitoes Aedes sp. trapped in the ovitrap in the BTKL Kelas I Entomology laboratory, Medan

No	Variable	Homogeneity	p-Value
1	Plantain Peel Extract	0,372	0,842
2	Brown sugar fermentation	0,471	0,004
3	Straw soaked water	0,471	0,001
4	Plain Water	0,286	1,000

3.1 The Difference in Effectiveness of Plantain Peel Extract against Plain Water as Aedes Sp. Attractant

Based on the results of statistical tests using the ANOVA test, it was obtained p-value = 0.842 (p value> 0.05) with an average of 5.67, so Ho was accepted, and Ha was rejected. It could be concluded that there was no effect of plantain peel extract against Aedes sp. trapped on the ovitrap in the Entomology laboratory BTKL PP Kelas I Medan. However, when compared with ordinary water extractants, plantain peel extract was more effective because the p-value of plantain peel extract was smaller, namely 0.842 < 1,000.

This study is not in line with Armis' research, which shows that the p-value = 0.000 (p-value <0.05), meaning that plantain peel extract is effective against the Aedes sp. mosquito trapped in the ovitrap (Armis, Susilawati, and Adzriful, 2016). The plantain peel extract contains flavonoids and saponins. Flavonoids are plant defense compounds that can inhibit the digestive tract of insects and are also toxic. Saponins can inhibit the work of the enzyme which results in a decrease in the work of the digestive organs and the use of protein for insects, thus paralyzing the Aedes sp. mosquitoes trapped on the ovitrap (Armis, Susilawati and Adzriful, 2016). However, this research is in line with Agustiani describing that there is no effect of plantain peel extract against Aedes sp. mosquitoes trapped on the ovitrap with p-value = 0.516 (p-value > 0.05) (Agustiani, 2016). Plantain

peel extract contains flavonoids, saponins, ethanol and CO2. Ethanol and CO2 attract mosquitoes. CO2 is a way for mosquitoes to find their prey so that mosquitoes are attracted to come to the ovitrap. Flavonoids are plant defense compounds that can inhibit the digestive tract of insects and are also toxic. Meanwhile, Saponins can inhibit the work of the enzyme which results in a decrease in the work of the digestive organs and the use of protein for insects, thus paralyzing the Aedes sp. mosquito trapped on the ovitrap (Armis, Susilawati and Adzriful, 2016).

3.2 The Difference in Effectiveness of Brown Sugar Fermentation against Plain Water as Aedes sp. Attractant

Based on the results of statistical tests using the ANOVA test, it was obtained p-value = 0.004 (p-value <0.05) with an average of 15.67, so Ho was rejected and Ha was accepted. It could be concluded that there was the effectiveness of brown sugar fermentation against the Aedes sp. trapped on the ovitrap in the Entomology laboratory BTKL PP Kelas I Medan. Research on the conversion of brown sugar to alcohol utilizing fermentation, namely sugar, which is very popular with almost all living things as an energy source (Wijayanti and Widyanto, 2015). Brown sugar fermentation which produces bioethanol and CO2, where these compounds can attract mosquitoes compared to mosquito traps without CO2, where carbon dioxide (CO2) is one way for mosquitoes to find their prey, so mosquitoes are attracted to bite humans because humans exhale CO2 (Kurniati Alfi, 2013). The CO2 produced from the fermentation of brown sugar is expected to trick mosquitoes to get closer to the ovitrap (Fadlilah Isna, Aris Santjaka, 2016).

The results of this study are in line with Verawaty's research which proved that fermentation of brown sugar and yeast solution is useful as an attractant against Aedes sp. with p-value = 0.005. It means that there is the effectiveness of brown sugar fermentation on the number of mosquitoes Aedes sp. trapped on the ovitrap (Verawaty, 2017). Besides, the results of this study are also in line with Bangun's research which shows that brown sugar fermentation is more effective than red chili extract in catching Aedes sp. Mosquitoes. The effectiveness of brown sugar fermentation in catching mosquitoes was 26 while the red chili extract caught 13 mosquitoes (Dzahara, 2018).

According to the assumptions of researchers, the conversion of brown sugar to alcohol by fermentation is very popular with almost all living things as an energy source. The fermentation of brown sugar produces bioethanol and CO2, where these compounds are able to attract mosquitoes compared to mosquito traps without CO2. carbon dioxide (CO2) is one way for mosquitoes to find their prey. That's the reason mosquitoes are attracted to biting humans because humans exhale CO2. The CO2 produced from the fermentation of brown sugar is expected to trick mosquitoes to get closer to the ovitrap.

3.3 The Difference in the Effectiveness of Straw Soaked Water against Plain Water as Aedes sp. Attractant

Based on the results of statistical tests using the ANOVA test, it was obtained p-value = 0.001 (p-value <α) with an average of 17.78 trapped mosquitoes, so Ho was rejected. Ha was accepted so that it can be concluded that there is the effectiveness of straw soaked water on the number of mosquitoes Aedes sp. trapped on the ovitrap at the BTKL Entomology Laboratory in Medan. The results of this study are in line with Dwinata's research showing there is an effectiveness of straw soaked water on the number of trapped Aedes sp mosquitoes, with a p-value of 0.000 (p-value <α). It means that the straw soaked water can attract Aedes aegypti mosquitoes (Dwinata et al., 2015). The results of this study are also in accordance with Salim and Satoto (2015) which shows that there is the effectiveness of straw soaked water on the number of Aedes sp. trapped on the ovitrap with p-value = 0.029 (p-value < α) which having an average of 3.476 Aedes sp. trapped (Salim and Satoto, 2015).

The research on straw-soaked water for seven days has the potential to attract mosquitoes because the straw soaked water undergoes a metabolic process that produces substances in the form of ammonia and CO2. The Aedes sp mosquito has sensilla on the antennae and palpus so that it recognizes the host through body odor, CO2, heat, and body moisture (Bobby Fahmi Muldan Pahlevi, 2017). That is why the straw soaked water is preferred by mosquitoes to land and get trapped in the straw soaked water ovitrap. According to Sitti, the straw soaked water contains ammonia and CO2, which creates a distinctive odor that functions as an attractant for mosquitoes (Aulia and Djamahar, 2014). This distinctive odor is captured by mosquito antennae containing several olfactory bipolar nerves known as ORNs (Olfactory Receptor Neurons). ORNs are at the end of the dendrites and axons whose function was to detect chemicals such as the distinctive odor of straw soaked water. Then, the odor will bind to OBPs

(Odorant Binding Proteins) which work apart from dissolving odor molecules as well as acting in the selection of olfactory information (Mardiyah, 2016).

According to the researchers' assumption, the 7-day straw immersion water has the potential to attract mosquitoes because the straw soaked water undergoes a metabolic process that produces substances in the form of ammonia and CO2. Aedes sp. has sensilla on the antennae and palpus so that it recognizes the host through body odor, CO2, heat, and body moisture. This causes the straw soaked water to be preferred by mosquitoes to perch and eventually become trapped in the straw soaked water ovitrap.

4 CONCLUSIONS

The results of this study indicate that the straw soaked water is more effective than the plantain peel extract, brown sugar fermentation, and plain water (p-value = 0.001). The number of mosquitoes trapped in the ovitrap in the straw soaked water on the first repetition was 15, the second repetition was 20 and the third repetition was 21. Temperature and humidity affect the growth and length of life of mosquitoes. This research was conducted by ignoring the two factors that influence the lives of these mosquitoes. Also, the time provided for observing the treatment process is only 24 hours. These two conditions could be the limitations of the study. Thus, they should be taken into consideration for further research.

The results of this study are expected to be an alternative for vector control of the Aedes.sp mosquito as a safe attractant for the environment and human health. The results of this study are also expected to be used by other researchers by using straw soaked water attractants but with different concentrations to determine the most effective concentration level as a natural attractant.

ACKNOWLEDGMENTS

We would like to thank the Universitas Prima Indonesia, Badan Teknik Lingkungan dan Pengendalian Penyakit Kelas I Medan and the phytochemical laboratory of Universitas Sumatera Utara for their support.

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