Effectiveness of Cinnamon Bark (Cinnamomum burmannii) Extract in the Production of Aromatic Wax as a Repellent for Haouse Flies (Musca domestica) in Preventing Incidents Diarrhea in Kendari City

Siti Rabbani Karimuna*[1], Winda Nirmala[2], Syefira Salsabila[3], Yasnani Yasnani[4], Asnia Zainuddin[5]

[1,2,3,4,5] Public Health Department, Halu Oleo University, Kendari, Southeast Sulawesi, Indonesia
Rabbanikarimuna@gmail.com[1], Windanirmala2802@gmail.com[2], Syefira.salsabila@uho.ac.id[3], yasnani@uho.ac.id[4], asnia.zainuddin@uho.ac.id[5]

Abstract. Plant-based insecticides are single active ingredients derived from plants that can be used to control house flies (*Musca domestica*). One of the plants that can be used as a Plant-based insecticide is cinnamon bark (*Cinnamomum burmannii*) extract. House flies (*Musca domestica*) are a vector of various diseases related to the digestive system, such as diarrhea. This study aimed to determine the effectiveness of cinnamon bark (*Cinnamomum burmannii*) extract in producing aromatic candles as a repellent against house flies (*Musca domestica*) in preventing diarrhea in Kendari City. The research method used was a pure experiment with a Post Test Only Control Group Design research design. The research began by applying cinnamon bark extract to aromatic candles with five different concentrations, namely 10%, 20%, 30%, 40% and 50%. The number of dead flies observed after 6 and 12 hours of treatment was recorded for each concentration. The results were data analysis processed using the probit test to obtain the LC50 value and the ANOVA test to test the differences between treatment groups. Based on the probit test, the LC50 value was 2.522. The ANOVA test obtained a p-value of 0.406, indicating no significant difference in dead flies between the treatment groups.

Keywords: Cinnamon bark, House flies, Aromatic candles, Effectiveness

1. Introduction

Botanical insecticides are single or multiple active ingredients derived from plants that can be used to control plant-disturbing organisms. Botanical insecticides function as repellents, attractants, antifertility (sterile), killers, and others [15]. One of the uses of vegetable insecticides is to control house flies, which are known to cause diarrhea [2]. Diarrhea is one of the endemic diseases which is still a health problem in the world. Diarrheal disease is known to have the potential to cause Extraordinary Events (KLB) and is still a contributor to mortality in Indonesia, especially in toddlers [9].

J. Jumakil et al. (eds.), *Proceedings of the 1st Halu Oleo International Conference on Public Health (HOICPH 2023)*, Advances in Health Sciences Research 77,
https://doi.org/10.2991/978-94-6463-427-3_15

The World Health Organization (WHO) publishes that diarrhea is still the number one cause of death for children under five worldwide. In 2015, diarrhea caused around 688 million people to get sick, and 499,000 deaths worldwide occurred in children under five years of age, around 14%3, while in 2017, WHO stated that nearly 1.7 billion cases of diarrhea occurred under five with 525.000 Deaths in children under five each year [16] The results of Basic Health Research (Riskesdas) in 2018 the prevalence of diarrhea in Indonesia in toddlers was 12.3%, in 2019 it was 40% or as many as 1,591,994 cases, in 2020 it was 28.8% or 1,140,503 cases, then experienced decreased to 879,596 cases in 20217. In 2021, the coverage of services for diarrhea sufferers in toddlers was 23.8% of the target set [7]. The 2018 Southeast Sulawesi Provincial Health Office reported that the coverage of diarrhea services in toddlers was 31.6% or as many as 14,496 cases; in 2019, it was 27.06% or as many as 14,619 cases. In 2020, it was 18.97% or as many as 8,284 cases, which will decrease by 13.7% in 2021 [7].

Diarrhea is caused by bacterial infections such as campylobacter, clostridium difficile, escherichia coli, salmonella, and shigella due to several factors such as nutrition, socio-economic, environment and contaminated food and drink [5]. Food and drink contaminated with bacteria is caused by garbage which is a breeding ground for flies due to the humid, smelly and dirty conditions, which has a negative impact in the form of high fly density [1]. The high number of flies density in an area or in fly breeding places, one of which is landfills or SPAL stagnant water, can affect the cause of diarrhea due to contamination of food and drinks by bacteria carried by vectors/insects, namely flies [6]

The control of house flies for the community in general only uses air freshener in the form of a spray, hangs water in plastic bags and uses sticky traps, but this is considered to be significantly less effective at driving away flies [3]. While using chemical insecticides is known to cause resistance, resurgence, emergence of secondary pests, environmental contamination, residual effects on agricultural and livestock products and even poisoning in humans. To overcome the negative effects of using chemical insecticides, it is necessary to use vegetable insecticides in the form of bioinsecticides because they are selective and have a short persistence so there is no fear of leaving residues and are environmentally friendly [11].

Botanical insecticides can be found in cinnamon plants. Cinnamon, with another name, *Cinnamomum burmannii,* is one of the plants in which the bark, branches, leaves, and branches can be used as a spice and is one of Indonesia's export commodities [10]. Cinnamon leaves contain flavonoids, alkaloids, saponins, phenolic hydroquinones, and tannins [12]. Likewise, cinnamon bark can produce essential oils. People generally use cinnamon bark only as a spice or an additional cake ingredient. The most significant content of cinnamon is essential oil, which contains the main compounds cinnamaldehyde (60.72%), eugenol (17.62%), and coumarin (13.39%). The content of the active compound eugenol in cinnamon essential oil can function as an antioxidant and antimicrobial [3]. Essential oils are compounds generally in liquid form and are obtained from plant parts such as roots, bark, stems, leaves, seeds, and flowers by steam distillation. Essential oil is also one of the chemical constituents of cinnamon, and it has antibacterial properties [12].

2. Methods

This research is a type of quantitative research using pure experimental methods. The research design was a post-test-only control group design, which does not use a pretest on the sample before treatment. Sampling was carried out by means of purposive sampling, namely the method of selecting subjects based on certain characteristics or characteristics related to the characteristics of the population. Data were obtained from the experimental results in the form of the number of house flies (*Musca domestica*) that died after being treated with aromatic wax from cinnamon bark extract (*Cinnamomum burmannii*) at various concentrations with a predetermined exposure time of 1 hour and calculated after 12 hours. The independent variables in this study were temperature, humidity and observation time of aromatic candles of cinnamon bark extract with concentrations of 10%, 20%, 30%, 40% and 50% for *Musca domestica* flies. The dependent variable in this study was the effectiveness of cinnamon extract against the *Musca domestica* house fly at the time of the study.

3. Results and Discussion

3.1 Results

Table 1. Results of Temperature and Humidity Measurements Before and After Treatment

Group	Temperature (°C)		Humidity (%)	
	Early	End	Early	End
Control	26	29	64	78
10%	26	29	64	78
20%	26	29	64	78
30%	26	29	64	78
40%	26	29	64	78
50%	26	29	64	78

Source: Primary data, 2023

Table 1 shows that the initial temperature of the room in the control group and the concentration group is the same, namely 26°C, and the final temperature in the control group and the concentration group is the same, namely 29°C. The initial humidity of the room in the control group and concentration group is known to have the same value, namely 64% and 78%, and the final humidity in the control group and concentration group is known to have the same value, namely 78%.

Table 2. Percentage of house fly mortality in the first hour (60th minute) of observation using cinnamon bark extract of various concentrations as an experimental group

Aromatic wax concentration (%)	Observation time	The number of test flies for each treatment (tail)	Number of dead flies (tails)	% Death
Control	60 minutes	15	0	0
10	60 minutes	15	1	7
20	60 minutes	15	1	7
30	60 minutes	15	2	13
40	60 minutes	15	3	20
50	60 minutes	15	2	13

Source: Primary data, 2023

Based on Table 2 the results of observations of the effectiveness test of cinnamon extract aromatic candles against house flies in the control group were 0 or no dead test flies were found. At a concentration of 10%, there were 1 fly (7%) that died, at a concentration of 20% there were 1 fly (7%), at a concentration of 30% there were 2 flies (13%), at a concentration of 40% there were 3 flies (20%) and at a concentration of 50% there were 2 flies that died (13%) in the first 1 hour of observation.

Table 3. Percentage of Housefly Mortality at the 12th Hour of Observation Using Cinnamon Bark Extract of Various Concentrations as an Experimental Group

Aromatic wax concentration (%)	Observation time	The number of test flies for each treatment (tail)	Number of dead flies (tails)	% Death
Control	12 hours	15	0	0
10	12 hours	15	6	40
20	12 hours	15	8	53
30	12 hours	15	9	60
40	12 hours	15	11	73
50	12 hours	15	14	93

Source: Primary data, 2023

Based on Table 3, the results of observations on the effectiveness of cinnamon extract aromatic candles against house flies in the control group were 0 or no dead test flies were found. At a concentration of 10%, 6 flies (40%) died, at a concentration of 20% there were 8 individuals (53%), at a concentration of 30% there were 9 individuals (60%), at a concentration of 40% there were 11 individuals (73%) and at a concentration of 50%, 14 flies (93%) died during the 12th hour of observation.

Table 4. Results of Different Tests Between Various Treatment Groups on Mortality of Musca domestica Housefly and Kruskall-Walls

	Number of Dead Flies
Chi-Square	4.000
df	4
Asymp. Sig.	0.406

Source: Primary data, 2023

Based on Table 4, it shows that the value of p> 0.05 (p = 0.406), so it can be concluded that there is no significant difference in the number of flies that died between the groups being compared. In addition to using Kruskall-Wallis analysis, this study also used probit analysis to determine the value of Lethal Contrentation 50 (LC50) on the arimatic wax of cinnamon bark extract *Cinnamomum burmannii* against the Musca domestica house fly.

Table 5. LC50 Value of *Cinnamomum burmannii*

LC50	**Cinnamon Concentration**	***Lower Bound***	***Upper Bound***
LC50	2,522	1,528	3,443

Source: Primary data, 2023

Based on the probit test results on the death rate of the test flies, the LC50 value was obtained at a concentration of 2.522. This means that at a concentration of 2.522, cinnamon could kill 50% of the *Musca domestica* house fly, with a lower limit of 1.528 and an upper limit of 3.443 at a 95% confidence level.

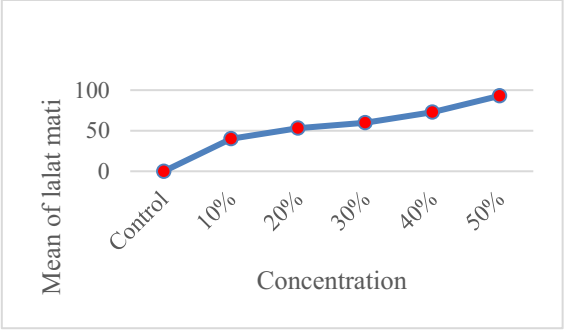

Fig. 1. Mortality Curve of the *Musca domestica* house fly

In the curve above, it can be seen that the greater the concentration of cinnamon, the greater the mortality of the Musca domestica house fly. Increasing the concentration of cinnamon causes an increase in the death of the Musca domestica house fly, this proves that the death of house flies is caused by the toxic properties of cinnamon.

3.2 Discussion

1. Temperature and Humidity Measurement

Based on Table 1, the initial room temperature for all treatments was 26°C and the final temperature was 29°C. This temperature is the ideal temperature for the life of the Musca domestica house fly. For this reason, temperature is a factor that does not affect the death of the Musca domestica house fly. The optimum temperature for house fly species to be fully active is between 20 - 40°C, while at 15 - 20ºC the fly activity begins to decrease [14]. The initial humidity for all treatments was 54%, while the final humidity was 54%. 78%. This humidity includes the ideal humidity for the life of the Musca domestica house fly. For this reason, humidity is a factor that does not affect the death of the Musca domestica house fly. The optimal humidity for house fly species to be fully active is between 45% - 90% [4].

2. Number of deaths of Musca domestica house flies after 24 hours of treatment

Based on Table 3, observations were made of the Musca domestica house fly in the experimental group, namely at concentrations of 10%, 20%, 30%, 40% and 50% the flies were seen starting to move actively away from the test medium which previously the flies were moving quite calmly in the group control. After treatment within 24 hours of observation, it was found that there were dead flies with stiff bodies.

3. Test of Differences Between Various Treatment Groups on Mortality of Musca domestica Housefly with Kruskall-Walls

Kruskall-Wallis analysis was used to determine whether there was a significant difference in the death of the Musca domestica house fly at each concentration. The results of the Kruskall-Wallis analysis show that the value is $p > 0.05$. This indicates that in this study, there was no significant difference in the number of dead flies between the groups being compared.

4. LC50 Value of Cinnamomum burmannii

As shown in Table 5, the concentration of the cinnamon extract obtained the LC50 value at a concentration of 2.522, meaning that at a concentration of 2.522, the aromatic wax of *Cinnamomum burmanni*i extract can kill 50% of the Musca domestica house fly with a lower limit of 1.528 and an upper limit of 3.443 in 95% confidence level, it can be concluded that the LC50 value is at a concentration of 2.522.

The death of the test flies during the administration of the aromatic candles of cinnamon bark extract was thought to be due to the substances contained in the cinnamon. The results of research conducted by Safratilofa (2016) showed the presence of saponins, tannins, phenolic compounds, flavonoids, alkaloids, steroids and glycosides. In addition, cinnamon contains Cinnamaldehide, Cinnamylacetate, Eugenol, Tannins, Essential oils, Flavonoids, Saponins [13]. The insecticidal potency of *Cinnamomum burmanni* cinnamon extract is thought to

be due to the active substances it contains, such as eugenol, saponins, tannins and flavonoids [8].

Research Limitations

Attempts have been made to carry out this research in accordance with existing guidelines, but it still has limitations related to the research process, namely when collecting Musca domestica house flies, which require more time and effort to obtain the targeted number of test flies and the collection process. house flies are constrained by climate change.

4. Conclusion

Based on research data on the effectiveness of cinnamon bark extract (*Cinnamomum burmannii*) as an aromatic candle to repel insects against house flies (*Musca domestica*), it can be concluded that aromatic candles from cinnamon bark extract (*Cinnamomum burmannii*) are effective as aromatic candles to repel insects against Musca domestica house flies. there was no significant difference in the mortality of the Musca domestica house fly that died in the various treatment groups of aromatic wax of cinnamon bark extract (*Cinnamomum burmannii*) and there was an LC50 of aromatic wax of cinnamon bark extract of 2.522. *Cinnamomum burmannii* cinnamon bark extract is effective as a vegetable insecticide, so further research is needed regarding its direct application to the field.

References

1. Ahyanti M. A., Prayudhy, Y., & Sarip, U. “The Effectiveness of Several Plants in Controlling the House Fly (*Musca domestica*).” Journal of Health Sciences, 15(4), 398-402. (2022).
2. Daswito, R., Folentia, R., & F, M. Y. “Effectiveness of Green Betel Leaf Extract (Piper Betle) as a Botanical Insecticide against Housefly (Musca domestica) Mortality. Moluccan Health Polytechnic Journal, 10(2). (2019).
3. Djarot, P., Rahmadini, A., & Utami, N. F. “Antibacterial Test of Connected Leaf Extract (*Gynura procumbens (Lour.) Merr*.) and Tapak Liman (*Elephantopus Scaber L*) Leaf Against Salmonella Thypi.” Ecology: Scientific Journal of Basic and Environmental Sciences, 19(1), 1-11. (2019).
4. Fitri, Anisa & Dyah Mahendrasari Sukendra. “The Effectiveness of Organic Bait Variations on Eco Friendly Fly Traps as an Effort to Reduce Fly Populations.” Higeia Journal of Public Health Research and Development. 4(2), 448-459. (2020).
5. Handayani, S., Najib, A. & Wati, N. P. “Antioxidant Activity Test of Daruju Leaf Extract (*Acanthus ilicifolius L*.) Using the 1,1-diphenyyl-2-picrylhidrazil (DPPH) Free Radical Squeezing Method.” Indonesian Phytopharmaca Journal, 5(2), 299– 308. (2018).
6. Ismawati, Lestari, H., & Jafriati. “The Relationship between Flies Density, Settlement Distance and Garbage Disposal Facilities with Diarrhea in Settlements Around the Kendari City Uptd Slaughterhouse (Rph) in Anggoeya Village, Poasia District, 2015.” Thesis, Faculty of Public Health, Haluoleo University, 1-9. (2015).
7. Republic of Indonesia Ministry of Health. “Indonesia Health Profile 2021.” Jakarta: RISKESDAS. (2022).

8. Maulina, Y., As rinawaty & Kasman. "The Potential of Cinnamon Extract as a Natural Larvicidal Against Aedes Aegypti Larvae in the Soil Bumbu Research and Development Center Laboratory." Diploma thesis, Kalimantan Islamic University MAB. (2020).
9. Nugraha P., Elvi J. & Rika Y.P. "Factors Associated with the Incidence of Diarrhea in Toddlers in the Kapuas Kanan Hulu Village, Sintang District." Journal of Public Health, 1(1), 33-38. (2022).
10. Nurhayati, S., & Sukesi, T. W. "Insecticidal Effects of Ethanol Extract of White Guava Leaves (*Psidium Guajava L*) on Housefly Larvae (*Musca domestica L*)." Indonesian Journal of Environmental Health 17(2), 59- 62. (2018).
11. Refki, S., & Santori. "Development of Botanical Insecticides from Stalks of Pepper (*Piper Nigrum L*.) To Reduce the Use of Chemical Insecticides." Journal of Agriculture and Animal Science, 2(2). (2022).
12. Safitri, L. "Antibiotic Effectiveness Test of Cinnamon Leaf Extract (*Cinnamomum burmannii*) Against the Growth of Salmonella Typhi In Vitro." Thesis. Muhammadiyah University of North Sumatra Medan. (2018).
13. Safratilofa. "Test of Inhibitory Power of Cinnamon Leaf Extract (*Cinnamomum burmanii*) Against Aeromonas Hydrophila Bacteria." Batanghari Jambi University Scientific Journal. 16(1), 98-103. (2016).
14. Septiana W. "The Effect of Using Bay Leaf, Betel Leaf, and Lemongrass Extracts as Natural Tofu Preservatives on Organoleptic Properties." Thesis, University of Lampung. (2018).
15. Alfianto, N., & Hartoko, I. V. "Potential of Betel Leaf (*Piper betle, L*) in Making Environmentally Friendly Botanical Insecticides." National Seminar on Biology and Science Education II, 400-406. (2017).
16. Utami, Tantri, Rabiah, Maryam & Yulta Sometimes. "Factors Influencing the Incidence of Diarrhea in Toddlers in the Working Area of the Birobuli Health Center, Palu City." An Idea Health Journal. Vol. 2(1), 35-40. (2022).