Effect Of Papaya Leaf Extract (*Carica Papaya L*) As A Bioinsecticide To Remove Cage Flies (*Stomoxys calcitrans*)

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ABSTRACT

This research investigates the effectiveness of papaya leaf extract (Carica papaya L.) as a bioinsecticide against stable flies (Stomoxys calcitrans) and aims to identify the most effective concentration and solvent for killing these pests. Conducted using a Completely Randomized Design (CRD), the study utilized papaya leaf extracts obtained through maceration at concentrations of 10%, 15%, and 20%, with 96% ethanol and aquades as solvents. Phytochemical analysis confirmed the presence of beneficial compounds such as alkaloids, flavonoids, and saponins. The one-way ANOVA results revealed a significant impact of the ethanol-based extract on fly mortality, with a p-value of 0.00, while aquades showed no significant effect (p = 0.065). Notably, a 20% concentration of the ethanol extract achieved 100% mortality of stable flies within 50 minutes, indicating that papaya leaf extract is a cost-effective and environmentally friendly bioinsecticide, particularly when using ethanol as a solvent.

KEYWORDS: Papaya leaves; Bioinsecticides; Cage Flies; Exterminator

INTRODUCTION

Flies are vectors of diseases, meaning they transmit and spread various infectious diseases. They carry pathogens from household waste, trash, and other sources of filth through their bodies and transfer them from contaminated materials to uncontaminated ones, which can include food, drinks, or drinking water for both people and animals (Putri et al., 2017).

Efforts to control fly populations and reduce the risk of disease transmission can be achieved through chemical, biological, physical methods, or by improving environmental sanitation. Generally, fly control is commonly done using insecticides. Insecticides are substances that biologically target and kill insects. They can be natural or plant-based insecticides, as well as synthetic ones. However, the use of synthetic insecticides can lead to environmental pollution and pose health risks to humans and animals. Natural or plant-based insecticides are derived from plants and contain active compounds that can be toxic (Nurhayati & Sukesi, 2018).

Indonesia has many plants that can serve as sources of herbal pesticides. Papaya is one such plant that can be used as a pesticide for crops. Papaya leaves contain compounds that are toxic to insects, particularly saponins, alkaloids, carpain, papain, and flavonoids (Setiawan & Oka, 2015). Papaya leaves are easily found and cultivated by the community. Many previous studies have used papaya extracts as natural pesticides, especially using papaya flower extracts with a concentration of 75% as the most effective biopesticide against flies (Iskandar et al., 2019).

The study by (Herawati & Timur, 2022) specifically used 100% papaya leaf extract to kill stable flies (*Stomoxys spp.).* The use of 30% papaya leaf extract as a mosquito repellent was found to be effective in repelling Aedes aegypti mosquitoes by up to 90% (Nur Fadilah et al., 2017) Additionally, research by (Dias et al., 2019) demonstrated that papaya seed extract and jasmine extract at a concentration of 25% were capable of killing Aedes aegypti larvae within 60 minutes. The objective of this research is to determine the effectiveness of papaya leaf extract as a bioinsecticide against stable flies.

RESEARCH METHOD

Research Design

The type of research design used is a Completely Randomized Design (CRD). This research experiment used papaya leaf extract (*Carica papaya L.*) using the maceration method consisting of three concentrations, including 10%, 15%, 20% (Taha & Inang, 2018) and variations of 96% ethanol solution and aquades. This research design measures the effect of treatment on the experimental group by comparing the group with the control group. In this study, 8 treatment groups were used consisting of 6 treatment groups and 2 control groups (negative controls) with 3 replications.

Research Procedures

Making Papaya Leaf Extract, namely by the preparation of papaya leaf extract (*Carica papaya L.*) was carried out at the Laboratory. Papaya leaves were first cleaned with water then dried for 2 days and blended into powder, after which the papaya leaf powder was extracted using 96% ethanol for 3 days. The extract liquid was concentrated using a Vacuum Rotary Evaporator to obtain a concentrated extract (Dhenge et al., 2021). Polar compounds can attract more active compounds such as alkaloids, flavonoids, saponins and other polar compounds in papaya leaves.

Next, a phytochemical screening test was carried out to determine the active compounds alkaloids, flavonoids, terpenoids, saponins and tannins.

This study will use 3 concentrations, namely 10%, 15%, and 20% with a control concentration of 0%. After the three concentrations are obtained, they will then be diluted using 96% ethanol solvent and distilled water, then put into each 100 ml sprayer bottle (spray tool) that has been provided.

In the Research Stage, namely: Prepare 8 test containers in the form of 20 cm^3 tubes. Stable flies obtained from cow pens at the Menggah Village farm, Sukoharjo Regency which are put into jars with holes for ventilation. Each container that has been provided contains 10 stable flies that are taken randomly. So the total number of mosquitoes in this study is 80 stable flies. Extract papaya leaf extract (*Carica papaya L.*) with a predetermined concentration. When it will be used, prepare 8 sprayer bottles for each concentration and negative control using either ethanol solvent or aquades solvent. Spray into each test container. Spraying is carried out on the walls of the test container with 10 sprays each. Each formula tested is E0 (formula without papaya leaf extract with ethanol solvent) and A0 (formula without papaya leaf extract with aquades solvent). then Test container containing extract with formula E1 (10% papaya leaf extract formula with ethanol solvent), E2 (15% papaya leaf extract formula with ethanol solvent), E3 (20% papaya leaf extract formula with ethanol solvent), A1 (10% papaya leaf extract formula with aquades solvent), A2 (10% papaya leaf extract formula with aquades solvent) and A3 10% papaya leaf extract formula with aquades solvent). Observe the flies in the test container every 10 minutes for 60 minutes. Count and record the number of dead stable flies. The death of stable flies can be observed physically with signs including: flies do not move at all even though they have received stimulation in the form of touch or gusts of wind and the cage body has shown stiffness.

Data Analysis

The data obtained were analyzed by normality and homogeneity tests followed by one-way ANOVA test. The ANOVA test was intended to see the relationship/influence of papaya leaf extract (*Carica papaya L.*) on the death of stable flies (*Stomoxys calcitrans*), then continued with the Tukey Post Hoc test using the IBM SPSS application and a Confidence Level of $\alpha = 0.05$ to see and find out the eight most effective treatment groups in killing stable flies (*Stomoxys calcitrans*).

RESULT AND DISCUSSION

Based on the research findings, papaya leaf extract (*Carica papaya L.*) has the potential to be used as a natural bioinsecticide at certain concentrations to replace synthetic insecticides, which can be harmful to the environment and cause chemical resistance in stable flies. The bioinsecticidal effects of papaya leaf extract (*Carica papaya L.*) are due to its phytochemical compounds that are toxic to stable flies (*Stomoxys calcitrans*). These compounds include alkaloids, flavonoids, saponins, tannins, and terpenoids.

Alkaloids are compounds present in papaya leaves that act as contact toxins to flies. They work by degrading cell membranes, causing damage to the cells, and acting as neurotoxins within the fly's body. Alkaloids disrupt the fly's nervous system by inhibiting the enzyme acetylcholinesterase, which leads to the accumulation of acetylcholine and disrupts the nerve-to-muscle impulse transmission. This results in muscle spasms and paralysis, ultimately leading to the fly's death (Ramayanti & Febriani, 2016).

Flavonoids are toxic compounds that affect the respiratory system of flies (fumigants). They enter the siphon organs of the fly, causing damage that impairs respiratory function. Flavonoids can lead to nerve damage in the respiratory system, which can result in the death of the fly (Ramayanti & Febriani, 2016).

Saponins act as contact toxins by damaging the cuticular membrane of the fly. This damage allows other toxic compounds to enter the fly's body and disrupts the cuticle's balance, causing fluid loss and dehydration (Aseptianova et al., 2017)

Tannins are toxic compounds that interfere with the digestive system of flies. They act as digestive toxins by binding to proteins and reducing the activity of digestive enzymes. This impairs the fly's ability to digest and absorb nutrients, leading to stunted growth and nutritional disturbances (Yuliasih & Widawati, 2017). According to (Ramayanti &

Febriani, 2016), tannins bind to digestive enzymes such as protease, preventing the breakdown of dietary proteins and their absorption.

Terpenoids are toxic compounds that damage the cuticular layer of the fly's skin. They bind to lipids and proteins in the cell membrane of insects and can cause cell lysis. Terpenoids are capable of penetrating the insect's cuticle, leading to the insect's death (Palgunadi et al., 2020).

Table 1. Shapiro Wilk Normality Test

Tests of Normality							
	Concentration	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Death	A0	.	6	.	.	6	.
	A1	.407	6	.002	.640	6	.001
	A2	.293	6	.117	.822	6	.091
	A3	.315	6	.064	.781	6	.039
	E0	.392	6	.004	.701	6	.006
	E1	.226	6	.200*	.842	6	.135
	E2	.258	6	.200*	.950	6	.741
	E3	.190	6	.200*	.934	6	.614

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 2. Test Homogeneity Test

Solvent		Levene Statistic	df1	df2	Sig.
Aquades Solvent					
Death	Based on Mean	40.250	3	20	.000
	Based on Median	20.741	3	20	.000
	Based on Median and with adjusted df	20.741	3	14.211	.000
	Based on trimmed mean	38.986	3	20	.000
Ethanol Solvent					
Death	Based on Mean	2.045	3	20	.140
	Based on Median	1.383	3	20	.277
	Based on Median and with adjusted df	1.383	3	14.584	.287
	Based on trimmed mean	2.024	3	20	.143

Table 3. One Way Anova Test

Stable Fly Death with Aquades Solvent

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.333	3	3.111	2.828	.065
Within Groups	22.000	20	1.100		
Total	31.333	23			

Stable Fly Mortality with Ethanol Solvent

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	280.250	7	40.036	13.382	.000
Within Groups	119.667	40	2.992		
Total	399.917	47			

The data obtained were analyzed using IBM SPSS Statistics 27 and Microsoft Excel. Before conducting the One-Way ANOVA test, normality and homogeneity tests were performed. For the Shapiro-Wilk normality test: for aquades solvent: 0% concentration (A0) had a significance value of 0.00; 10% concentration (A1) had a significance value of 0.01; 15% concentration (A2) had a significance value of 0.091; 20% concentration (A3) had a significance value of 0.039. For ethanol solvent: 0% concentration (E0) had a significance value of 0.06; 10% concentration (E1) had a significance value of 0.135; 15% concentration (E2) had a significance value of 0.741; 20% concentration (E3) had a significance value of 0.614. If the significance value is less than 0.05, the data is considered not normally distributed. If the significance value is greater than 0.05, the data is considered normally distributed. Based on the IBM SPSS output, data for both aquades and ethanol solvents for A0, A1, A2, A3, and E0 are not normally distributed, while formulations E1, E2, and E3 are normally distributed.

For the Homogeneity test (testing for equal variances), the IBM SPSS output for the Test of Homogeneity of Variance showed a significance value of 0.00 for aquades solvent and 0.140 for ethanol solvent. Since the significance value for ethanol is 0.140 (greater than 0.05), it can be concluded that the variance for ethanol solvent is the same or homogeneous. However, the variance for aquades solvent is different or not homogeneous. Therefore, the homogeneity assumption for the One-Way ANOVA test is met for ethanol solvent.

Based on the data in Table 3, there is a significant difference between the concentrations of papaya leaf extract (*Carica papaya L.*) with ethanol solvent regarding the average mortality of stable flies (*Stomoxys calcitrans*). This is evident from the significance value $p = 0.00$ ($p < 0.05$), leading to the acceptance of the alternative hypothesis (Ha). It can be concluded that there is an effect of papaya leaf extract (*Carica papaya L.*) with ethanol solvent on the mortality of stable flies (*Stomoxys calcitrans*). In contrast, for aquades solvent, the significance value was $p = 0.065$ ($p > 0.05$), leading to the acceptance of the null hypothesis (Ho) and the rejection of the alternative hypothesis (Ha). Thus, it can be concluded that there is no effect of papaya leaf extract (*Carica papaya L.*) with aquades solvent on the mortality of stable flies (*Stomoxys calcitrans*).

This finding is consistent with the research conducted by (Kardinan, 2007) titled "Repellent Activity of Rosemary Plant Extract (*Rosmarinus officinalis*) Against Flies (*Musca domestica*)." The study showed a significant repellent effect, with concentrations ranging from 2.5% to 20% showing effectiveness between 12.7% and 42.6%.

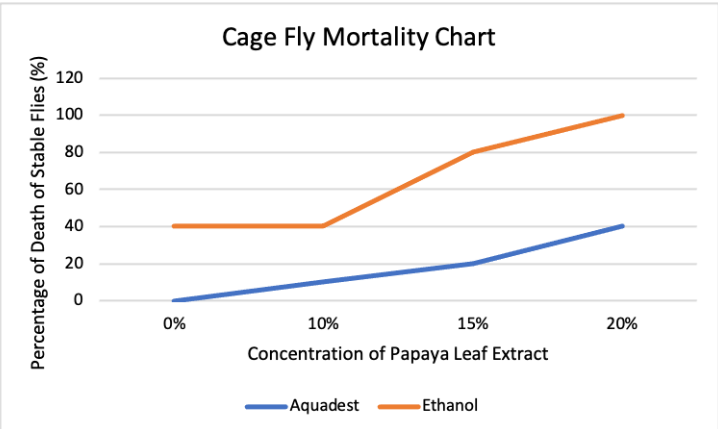

Figure 1. Cage Fly Mortality Chart

Based on Figure 1, it shows that the percentage of mortality from papaya leaf extract (*Carica papaya L.*) is directly proportional to the dosage, meaning that higher concentrations of papaya leaf extract result in a higher percentage of mortality in stable flies (Stomoxys calcitrans). It is observed that ethanol solvent is more effective in killing stable flies compared to aquades solvent. This is consistent with the dose-response relationship theory, which is illustrated by curve (A) for certain essential nutrients and curve (B) for chemicals. According to curve (B), as the dosage increases, the response also increases, both in terms of the proportion of the population reacting and the severity of the response . Additionally, further toxic effects will occur with increasing doses. Furthermore, a sudden application of bioinsecticides, particularly at high concentrations, can cause stress in the test animals, resulting in a significant number of deaths within 24 hours (Pramana & Samino, 2014).

CONCLUSION

A 20% concentration of papaya leaf extract (*Carica papaya L.*) with ethanol solvent is effective in killing stable flies (*Stomoxys calcitrans*), with a 100% mortality rate achieved within 50 minutes. This indicates that papaya leaf extract can serve as an economical and environmentally friendly natural bioinsecticide. Furthermore, papaya leaf extract (*Carica papaya L.*) using ethanol solvent is more effective as a bioinsecticide for killing stable flies (*Stomoxys calcitrans*) compared to using aquades.

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