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Potential of Beluntas Leaf Extract *(Pluchea indica L)* as a basic ingredient for Making Liquid Anti-Mosquito Repellent

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Abstract: The herbaceous Belugas leaves (Pluchea indica L.) belong to the Asteraceae family and are commonly utilized as food and hedges. They typically grow wild. Alkaloids, saponins, flavonoids, tannins, triterpenes, and steroids are among the substances found in belugas leaves that may have insecticidal properties. The purpose of this study is to use the leaf extract of Beluntas (Pluchea indica L.) as a foundational component for liquid mosquito repellant. In order to produce a thick extract of beluntas leaves, this study used an extraction process that involved evaporating 96% ethanol solvent. Several concentrations of the thick extract were diluted, including 15%, 25%, 35%, 45%, and 55%. The collected data, which was mosquito mortality, was subjected to a One-Way Anova test with a significance level of p = 0.000 <0.05, and then the Duncan test. The findings demonstrated that the number of mosquitoes that perished varied depending on the concentration fluctuations of beluntas leaf extract, with the highest concentration of beluntas leaf extract killing mosquitoes at a rate of 55% and a mosquito mortality percentage of 98.4%.

Keywords: Anti-mosquito; Beluntas leaf (Pluchea indica L); Concentration; Extract

Introduction

The plant beluntas (Pluchea indica L.) can withstand dry s oil surfaces with hard, rocky soil conditions and thrive in tropical climes (Hikmawanti et al., 2024). Beluntas plants are also frequently used as fresh food and as yard fence plants (Yi Xin et al., 2021). This plant belongs to the Asteraceae tribe, which goes by numerous names as it extends throughout Indonesia (Pratama et al., 2021).

The traditional community uses beluntas leaves as a diaphoretic, an appetite enhancer (stomacic), an antipyretic, and a refresher. Beluntas plants are used in medicine to ward against illness. Dengue fever is one of them. The Aedes aegypti mosquito is the source of dengue illness. Mosquito bite prevention is essential since, in addition to dengue fever, mosquitoes can transmit diseases like malaria, chikungunya, elephantiasis, and acute inflammation of the neurological system (Priya et al., 2023). In addition to vector control, maintaining a clean lifestyle, and the 3M movement (drain, cover, and bury), mosquito netting and mosquito repellent oles burn or electric can be used to prevent mosquito bites. Nonetheless, synthetic insecticide-type active components are present in mosquito repellents that are readily available in the community (Bharathithasan et al., 2024). Insecticide use in the attempt to eradicate mosquitoes can have detrimental effects, including resistance, revival, health issues, and different environmental effects (Onen et al., 2023).

Using natural medications, such as those derived from plants, is one option. Because they readily break down in nature and do not pose serious residual dangers, plant insecticides are seen to be safer than other pesticides because they do not harm live organisms or the environment. Certain plants, such as lavender, vetiver, lemongrass, geranium, and basil, contain active chemicals of the monoterpene group, including geraniol and citronellol, which have been shown to have

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insecticidal effects on mosquitoes (Sousa et al., 2022). The terpenoid and alkaloid categories contain additional active ingredients used in mosquito repellent products (Gajger & Dar, 2021). In soft-bodied animals, the material may cause stomach poisoning and contact poisoning.

Beluntas (Pluche indica L.) is a plant that has the potential to be employed as an all-natural insecticide. Polyphenols, alkaloids, flavonoids, tannins, saponins, steroids, and triterpenoids are among the bioactive components found in beluntas. The substance is poisonous to insects and may be used as a natural insecticide. It also functions as a contact and stomach toxin, impairing digestion (Nwaji et al., 2022).

The use of mosquito repellents has become one of the most effective ways to prevent disease transmission and the discomfort associated with mosquito bites (da Silva & Ricci-Júnior, 2020). In the community, anti-mosquito insecticides circulating on the market are widely used. Broadly speaking, mosquito repellent can be in the form of spreads, sprays, burns, or electric liquids. Electric liquid mosquito repellent is considered to have the highest level of safety compared to spray and burn mosquito repellent (Wahyono & MW, 2016).

Electric liquid mosquito repellent is easier to use and does not leave waste after use like in mosquito repellent (Dahniar, 2011). Electric mosquito repellent has several advantages over other methods. Among them are practical, do not leave ash, and do not cause a pungent smell of smoke (Utami & Cahyati, 2017).

Based on the problems that have been described a solution is given, it is important to employ plants in ways that don't have adverse effects, which is why this paperaims to use beluntas plant (Pluchea indica L.) leaf extract as a foundational component for liquid mosquito repellant.

Method

The method used in this research is experimental research, specifically actions aimed at using the leaf extract of the Beluntas plant *(Pluchea indica L.) as* a fundamental component for liquid mosquito repellant, is the type of research that is being used. The data collected in this study is data obtained from the number of mosquitoes that died at each concentration of beluntas leaf extract (Pluchea indica L). The data collected is recorded in the form of a table. The parameter measured was the number of mosquitoes that died after being given liquid mosquito repellent from beluntas leaf extract. To find out the percentage of mosquito mortality after treatment is calculated in the following way:

$$\text{Percentage of Deaths} = \frac{Average\ number\ of\ deaths}{Total\ number\ of\ mosquitoes} \times 100\% \quad (1)$$

The observation data was analyzed using one-way variance analysis (ANOVA) and further tests using the Duncan test using the SPSS program. The following tools are utilized in this research: jars (maserai containers), sieves, stirring rods, measuring pipettes, funnels, erlenmeyer, measuring cups, blenders, evaporators, digital balances, beakers, measuring flasks, and three mosquito cages. Beluntas leaves, 96% ethanol, distilled water, filter paper, paper cups made of cotton, gauze, rubber bands, and plastic cups, and label paper were the materials employed in this investigation.

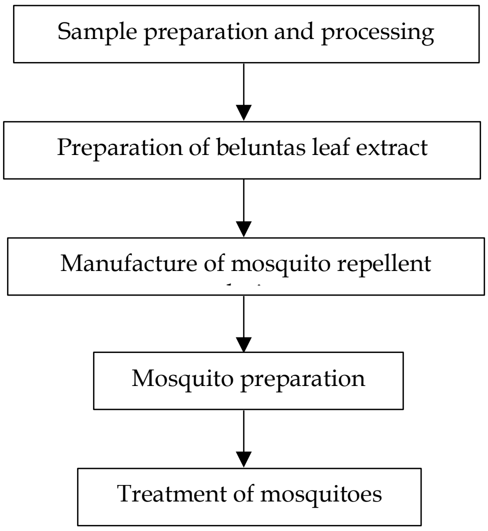

Figure 1. Research Flow

1. Making the extract from beluntas leaves

The maceration procedure is used in the process of creating extracts. The belugas leaves were washed, chopped, and dried before being blended and sieved till smooth. Weighing 300 grams of dried beluntas leaf powder is the first step in making beluntas leaf extract. A maceration container containing the material was filled with 1500 mL of 96% ethanol. After that, wrap aluminum foil over the maceration container and soak it for three times as long as seventy-two hours. Following that, filter paper was used to filter the filtrate, and a rotary evaporator was used to evaporate the solvent. thick extract of basil leaves was thus prepared. Next, use distilled water to dilute the thick extract into several concentrations: 15%, 25%, 35%, 45%, and 55%.

2. Testing for mosquitoes

Using a basic aspirator, mosquitoes were removed from the breeding zone and put into paper cups. Eighteen paper cups are needed for this study; each cup holds twenty-five mosquitoes. There were 450 mosquitoes in all that were studied. The prepared electric mosquito repellent must be used first, followed by the test animals' preparation. Next, use mosquitoes that have not been treated with electric mosquito repellent as a control group and repeat the test three times. The mosquitoes within the paper cup were then transferred. After that, the anti-mosquito is placed inside the cage and left for an hour. Using an aspirator, transfer the mosquitoes that have fainted into the paper cup and keep it for a full day. Next, tally how many mosquitoes perish throughout a 24-hour period. The number of mosquitoes that perished in the trial after receiving insect repellent made of beluntas leaf extract at varying dosages was the study's assessed parameter.

Result and Discussion

Beluntas (Pluchea indica L.) leaves were extracted for this investigation utilizing the maceration process. In order to conduct the study, beluntas leaf extract was tested at concentrations of 15%, 25%, 35%, 45%, and 55%. Each concentration was tested three times, and a positive control was a liquid electric mosquito repellent solution that is available under the HIT brand. Table 1 displays the findings of the study's 24-hour observations of mosquito mortality. The table illustrates this, as different concentrations of beluntas leaf extract have varying lethal effects on mosquitoes that perish up to a predefined concentration level:

Table 1. Mosquito Mortality During a 24-hour Observation of Beluntas Leaf (Pluchea Indica L.) with Electric Exposure

Treatment	Concentration	Mosquitoes	Dead Mosquitoes			Average	Percentage
			Replication 1	Replication 2	Replication 3		
1	15%	25	20	21	20	20.3	81.2%
2	25%	25	22	21	21	21.3	85.2%
3	35%	25	23	23	22	22.6	90.4%
4	45%	25	24	24	24	24	96%
5	55%	25	25	25	24	24.6	98.4%
6	Control Sample	25	25	25	25	25	100%

The data shown in Table 1 indicates that, following a 24-hour treatment, the test mosquitoes in each group exhibited varying percentages of mortality in relation to the increased concentration of extract. As the table illustrates, the percentage of mosquitoes that die at 15% concentration is equivalent to 81.2% dead mosquitoes, at 25% it is equivalent to 85.2% dead mosquitoes, at 35% it is equivalent to 90.4% dead mosquitoes, at 45% it is equivalent to 96% dead mosquitoes, and at 55% it is equivalent to 98.4% dead mosquitoes. There were 25 mosquito fatalities in the control sample group, meaning that the electric liquid mosquito repellent using beluntas leaf extract had a 100% success rate in preventing mosquito bites. The average mosquito mortality in the treatment group rose as the concentration of beluntas leaf extract in each of the five treatment groups increased. This is due to the fact that an extract's active components increase with extract concentration. This supports assertion in that an increase in concentration will have an increasing insecticidal effect since more mosquitoes will die the higher the concentration employed and the longer the observation period.

Analysis of variance was used to conduct testing after it was determined how the concentrations differed. To find out if adding beluntas leaf extract (Pluchea indica L.) with different concentration variations affects the number of mosquito deaths, analysis of variance in the form of a one-way anova test is utilized. Table 2 displays the findings of the one-way anova test analysis of the quantity of killed mosquitoes.

Table 2. Results of analysis of variance of the number of dead mosquitoes on the addition of beluntas leaf extract (Pluchea indica L)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	53.333	5	10.667	48.000	.000
Within Groups	2.667	12	.222		
Total	56.000	17			

Table 3. Duncan test results of beluntas leaf extract (Pluchea indica L)

group	N	Subset for alpha = 0.05			
		1	2	3	4
Concentration 15%	3	20.33			
Concentration 25%	3		21.33		
Concentration 35%	3			22.67	
Concentration 45%	3				24
Concentration55%	3				24.67
Sig.		1	1	1	0.145

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 3.000.

Beluntas leaf extract (Pluchea indica L.) was added, and the number of mosquito deaths varied depending on the concentration, according to the analysis of variance data, which revealed a p value of 0.000 < 0.05. An further test, the Duncan test, might be used to identify which of the five concentration groups had significant differences and to ascertain the concentration that killed mosquitoes the most effectively. Table 3 displays the Duncan's test results.

The findings of the Duncan test, based on the data in Table 3, indicate that there is a real or significant difference in the number of mosquitoes that die when beluntas (Pluchea indica L) leaf extract concentrations of 15%, 25%, and 35% are applied. It is evident that the 55% concentration is the most effective concentration, even if the concentrations of 45% and 55% did not differ. This indicates that the two concentrations can kill mosquitoes nearly equally. Thus, it is evident that the percentage of mosquito kills increases with the amount of beluntas leaf extract applied.

Plant extracts are used as a source of vegetable insecticides because plants have a defense mechanism (Sangkota et al., 2022). The concentration of the extract is one of the variables influencing how secondary metabolites enter the mosquito's body. The mosquito's body will absorb the secondary metabolites due to the extract's higher concentration. On the other hand, fewer secondary metabolites enter the mosquito's body at lower extract concentrations. Vegetable pesticides have the ability to kill because of the poisonous compounds they contain (Hassaan & El Nemr, 2020). In soft-bodied animals, these compounds can function as gastrointestinal, respiratory, and contact poisons. Alkaloid, flavonoid, saponin, tannin, terpenoid, and steroid chemicals make up the secondary metabolite content of beluntas leaf extract (Wijaya et al., 2019). To have a varied effect on mosquitoes, the concentration of the extract determines how much component content is present.

Alkaloids serve as plant promoters, insect defenders, and hormone regulators in plants. The alkaloid content of plant compounds has the potential to be poisonous to insects by attaching to acetylcholine receptors in the nervous system, causing chaos in the nervous system and ultimately leading to death (Bhardwaj et al., 2021). The biggest naturally occurring class of phenolic chemicals present in all vascular plants, aside from alkaloids, are flavonoid compounds (Bhambhani et al., 2021).

Flavonoid compounds have antimicrobial, antiviral, antifungal, and anti-insect properties (Zhang et al., 2024). Flavonoids act as neurotoxins that create weariness in the neurological system by entering the insect body through the respiratory system as spiracles (Lunz & Stappen, 2021). Flavonoids are compounds that can inhibit the digestive tract of insects and are also toxic. Flavonoids function as respiratory inhibitors or as respiratory toxins. Flavonoids work by entering the body of insects through the respiratory system which then causes wilting of nerves and damage to the spirals so that the insects have difficulty breathing and eventually die (Lubis et al., 2018).

Saponins include hormonal components and are both extremely poisonous to insects and antimicrobial. Additionally, saponins function as stomach poisons, inhibiting the action of cholinesterase enzymes in mosquitoes and reducing the activity of digestive enzymes and food absorption (Yata et al., 2022). Saponins work as insecticides for adult mosquitoes by interacting with cholesterol, causing interference in the synthesis of ecdysteroids, which are important for insect growth and development (Djeghader et al., 2018). In addition, saponins have toxic effects on insects, such as anti-feeding properties, disruption of the molting process, growth regulation, and death (Nuryady et al., 2024).

Tannins are present in nearly every part of the plant, including the roots, fruit, bark, and leaves. Tannins cause insects to weaken by suppressing their development rate, ability to consume feed, and ability to survive. Tannins inhibit insects from digesting food by binding the proteins that the digestive system needs for growth, which disrupts the process of protein absorption in the digestive system (Perkovich & Ward, 2020). Tannins are a type of polyphenol that will inhibit the entry of food substances needed by insects so that the nutritional needs of insects are not met, eventually there are metabolic and physiological disorders of the cell which will cause cell damage (Ramayanti et al., 2017).

Triterpenoids are repulsive because they have a strong smell that insects dislike, which makes them less effective as food sources for insects. This substance functions as an insect-killing gastrointestinal toxin. Because of the presence of these compounds, plants may act inadvertently as natural pesticides that impede or even eradicate mosquito growth. Insects are harmed by substances known as steroids. Steroid chemicals found in plants, such phytoecdison, which can prevent insects from molting, have a protective role (Dembitsky, 2020).

The amount of active ingredients in each beluntas leaf extract varies, which results in variations in the amount of active substances that each mosquito is exposed to when the electricity is turned on, according to study observations. Because of this, the reduced concentration undoubtedly results in a drop in the active ingredients it contains, and the effectiveness is correspondingly decreased.

Conclusion

Beluntas leaves (Pluchea indica L.) can be utilized as a natural insecticide to kill mosquitoes by using electric devices in each treatment, according to the research findings. In this investigation, the beluntas leaf extract concentration that killed the greatest number of mosquitoes was 55%, reaching 98.4%.

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Author Contributions

Sitti Rahmawati: Concept and design, analysis and interpretation, writing and drafting of the manuscript, securing funding, obtaining funding, technical or material support, critical supervision, final approval, and overall responsibility. Winarsih: Data collection, data analysis and interpretation, and drafting of the manuscript. Tri Santoso, Suherman, Dewi Satris Ahmar and Magfirah: Critical revision of the manuscript, technical or material support, supervision, and final approval

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Conflicts of Interest

No conflict of ineterest.

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