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The Effectiveness Test Of Aromatherapy Candles Made From Ciplukan (*Physalis Angulata* L.*)* Leaf Extract Against *Aedes Aegypti* Mosquitoes

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ABSTRACT

Dengue Hemorrhagic Fever (DHF) remains a major public health problem in Indonesia, with increasing incidence rates reported annually. The continuous use of synthetic insecticides for mosquito control may lead to environmental pollution and insecticide resistance, creating a need for safer and environmentally friendly alternatives. One potential alternative is the use of plant-based insecticides derived from ciplukan (Physalis angulata L.*) leaves, which contain bioactive secondary metabolites with insecticidal properties. This study aimed to determine the effectiveness and stability of aromatherapy candles containing Physalis angulata* L. *leaf extract against Aedes aegypti mosquitoes. A quasi-experimental design was used with four groups: candles containing Physalis angulata* L. *leaf extract at doses of 200 mg, 300 mg, and 400 mg, and a negative control. Mosquito mortality was observed for 120 minutes immediately after candle preparation and after three days of storage. The results showed that the 400 mg dose produced the highest mortality rate, reaching 60% in the immediate test and 80% after three days of storage. Lower mortality rates were observed at the 200 mg and 300 mg doses. These findings indicate that higher extract concentrations increase mosquito mortality and that the candle formulation remains stable after storage. In conclusion, aromatherapy candles containing Physalis angulata* L. *leaf extract are effective against Aedes aegypti mosquitoes, with the 400 mg dose showing the greatest effectiveness and stability.*

Keywords*: Aromatherapy Candle, Aedes aegypti, Bioinsecticide, Dengue Fever, Physalis angulata* L.

Introduction

Dengue fever is a mosquito-borne viral disease caused by the dengue virus and remains a major public health problem worldwide. The disease is primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes, with *Aedes aegypti* recognized as the principal vector due to its close association with human settlements and its high vector competence. According to the World Health Organization (WHO), dengue cases have increased dramatically over recent decades, with more than 7.6 million reported cases globally in 2024, highlighting the continuing threat posed by dengue transmission worldwide (WHO, 2024).

In Indonesia, dengue remains endemic and continues to impose a substantial public health burden. According to the Indonesian Ministry of Health, 53,131 dengue cases and 404 deaths were reported in March 2024, increasing to 60,296 cases and 455 deaths within the following weeks. In Riau Province, dengue cases remain relatively high, with Pekanbaru City reporting one of the highest case numbers in the region (Kementerian Kesehatan Republik Indonesia, 2024; Sari & Muharima, 2024).

Vector control remains one of the most effective approaches for preventing dengue transmission. Although dengue vaccines are currently available in several countries, vector management remains an essential component of dengue prevention programs. The WHO recommends Integrated Vector Management (IVM), including source reduction, environmental management, and mosquito population control, as a primary strategy for reducing dengue transmission (World Health Organization, 2023).

Chemical insecticides are widely used to control mosquito populations; however, their prolonged and intensive use has contributed to the emergence of insecticide resistance in Aedes mosquitoes. Insecticide resistance has become a major challenge in dengue vector control programs worldwide and may reduce the effectiveness of conventional mosquito control strategies (Liu, 2015; Moyes *et al*., 2017). Insecticide resistance has become a growing concern in many dengue-endemic countries and may reduce the effectiveness of conventional vector control programs. Consequently, the development of alternative and environmentally sustainable mosquito control agents has become increasingly important.

Plant-based insecticides have attracted considerable attention as environmentally friendly alternatives to synthetic insecticides. Botanical insecticides are generally biodegradable, environmentally friendly, and less harmful to non-target organisms compared with conventional synthetic insecticides (Benelli *et al*., 2017; Pavela *et al*., 2019). Botanical insecticides are generally biodegradable, exhibit lower toxicity toward non-target organisms, and contain diverse bioactive compounds that may reduce the risk of resistance development. Several reviews have reported that plant-derived compounds, including alkaloids, flavonoids, tannins, terpenoids, and essential oils, possess larvicidal, adulticidal, and repellent activities against *Aedes aegypti* mosquitoes (Benelli, 2018; Silverio *et al*., 2020).

Physalis angulata L. (ciplukan) is a medicinal plant widely distributed in tropical regions and known to contain various secondary metabolites, including alkaloids, flavonoids, saponins, tannins, steroids, and terpenoids. These compounds have been associated with insecticidal and larvicidal activities. Previous studies

demonstrated that ciplukan leaf extract exhibits larvicidal effects against *Aedes aegypti* larvae, suggesting its potential application in mosquito control programs (Mulyani *et al*., 2024; Paramitha & Zazaroh, 2022).

Although the insecticidal potential of *Physalis angulata* L has been reported, studies evaluating its application in aromatherapy candle formulations against adult *Aedes aegypti* mosquitoes remain limited. Furthermore, information regarding the stability of such formulations after storage is still scarce. Therefore, this study aimed to evaluate the effectiveness and short-term stability of aromatherapy candles containing *Physalis angulata* L. leaf extract against *Aedes aegypti* mosquitoes. The findings are expected to contribute to the development of environmentally friendly mosquito control products based on natural plant extracts.

Methodology

This study employed a quasi-experimental design using a static group comparison approach. The design was used to compare the effectiveness of aromatherapy candles containing different doses of *Physalis angulata* L. leaf extract against *Aedes aegypti* mosquitoes by comparing treatment groups with a control group.

The independent variable in this study was the dose of *Physalis angulata* L. leaf extract incorporated into the aromatherapy candles, namely 200 mg, 300 mg, and 400 mg. The dependent variable was the mortality of *Aedes aegypti* mosquitoes after exposure to the aromatherapy candles for 120 minutes. This study aimed to evaluate the effect of different extract doses on mosquito mortality.

The research sample consisted of adult *Aedes aegypti* mosquitoes. Four experimental groups were used, including three treatment groups and one negative control group. Each group consisted of 10 mosquitoes. Mosquitoes were randomly assigned to each group using a simple random sampling technique.

Primary data were obtained through direct observation of mosquito mortality after exposure to aromatherapy candles. Secondary data were obtained from scientific journals, books, and other relevant references related to *Physalis angulata* L. and mosquito control.

The materials used in this study were *Physalis angulata* L. leaves, 70% ethanol, distilled water, filter paper, paraffin wax, and *Aedes aegypti* mosquitoes. The equipment used included a blender, analytical balance (Ohaus), glass beaker (Iwaki), rotary vacuum evaporator (Eyela), sieve, stainless-steel bowl, candle mold, wick, and dropper.

The study was conducted at the Parasitology Laboratory of Akademi Kesehatan John Paul II Pekanbaru. Data analyzed in this study included the number and percentage of mosquito mortality in each treatment group. Data were analyzed descriptively by calculating mortality percentages and comparing the mortality rates among treatment and control groups. The results were then presented in tabular form and described narratively.

Research Hypothesis

H_0: Aromatherapy candles containing *Physalis angulata* L. leaf extract are not effective in causing the mortality of *Aedes aegypti* mosquitoes.

H_1: Aromatherapy candles containing *Physalis angulata* L. leaf extract are effective in causing the mortality of *Aedes aegypti* mosquitoes.

Result and Discussion

The study involved four test groups: candles with a 200 mg dose, candles with a 300 mg dose, candles with a 400 mg dose, and a negative control group. Each test group used 10 *Aedes aegypti* mosquitoes. The effectiveness of the aromatherapy candles was tested in two trials: immediately and after storage for 3 days. The candles, formulated with various doses, were lit in a closed container containing 10 *Aedes aegypti* mosquitoes, and mortality was observed for 120 minutes. The results are shown in the following table:

Table 1. Mortality of *Aedes aegypti* mosquitoes after exposure to immediate prepared to aromatherapy candles

Group	Number of *Aedes aegypti* mosquito deaths	Percentage
200 mg dose	3	30 %
300 mg dose	4	40 %
400 mg dose	6	60 %
Negative control	1	10 %

Table 1 shows the number of *Aedes aegypti* mosquito deaths observed after 120 minutes with immediate candle treatment. At a dose of 200 mg, 3 (30%) mosquitoes died; at a dose of 300 mg, 4 (40%) mosquitoes died; at a dose of 400 mg, 6 (60%) mosquitoes died; and in the negative control, 1 mosquito died. The same testing was also conducted after storing the candles for 3 days. The test results are shown in the following table:

Table 2. Mortality of *Aedes aegypti* mosquitoes after exposure to aromatherapy candles stored for 3 days

Group	Number of dead *Aedes aegypti* mosquitoes	Percentage
200 mg dose	2	20 %
300 mg dose	3	30 %
400 mg dose	8	80 %
Negative control	0	0 %

Table 2 shows the number of *Aedes aegypti* mosquito deaths observed after 120 minutes with candle treatment stored for 3 days. At a dose of 200 mg, 2 (20%) mosquitoes died; at a dose of 300 mg, 3 (30%) mosquitoes died; and at a dose of 400 mg, 8 (80%) mosquitoes died. In the negative control, no mosquitoes died.

When compared with the results obtained immediately after candle preparation (Table 1), the 400 mg dose consistently produced the highest mosquito mortality, causing 60% mortality in the immediate test and 80% mortality after three days of storage. In contrast, lower mortality rates were observed at doses of 200 mg and 300 mg in both observation periods.

The findings demonstrate that aromatherapy candles containing *Physalis angulata* L. leaf extract possess insecticidal activity against *Aedes aegypti* mosquitoes. The highest mortality was consistently observed at the 400 mg dose in both the immediate and three-day storage tests, indicating that the effectiveness of the formulation was maintained during the storage period.

The increase in mosquito mortality with increasing extract concentration suggests a dose-dependent effect. Similar findings were reported by Rindahayeni and Hayati (2019), who observed that higher concentrations of *Physalis angulata* L. extract resulted in increased mortality of *Aedes aegypti* larvae. These findings indicate that the insecticidal activity of ciplukan leaf extract is influenced by the concentration of bioactive compounds present in the formulation.

According to Mulyani *et al*. (2024), the insecticidal activity of *Physalis angulata* L. leaf extract may be attributed to the presence of secondary metabolites such as tannins, saponins, and flavonoids. Tannins can interfere with digestive enzyme activity and disrupt cell membrane integrity, leading to impaired physiological functions. Saponins are known to damage the insect cuticle and increase membrane permeability, resulting in excessive fluid loss. Flavonoids may act as respiratory toxins by disrupting respiratory processes and damaging the spiracles, ultimately leading to mosquito mortality (Umami & Ahsanunnisa, 2015).

The sustained mosquito mortality observed after three days of storage suggests that the active compounds in the candle formulation remained relatively stable under the storage conditions used in this study. Proper storage conditions may contribute to maintaining the biological activity of plant-derived compounds over time.

Mosquito vector control remains an essential component of dengue prevention programs, despite the availability of dengue vaccines such as Dengvaxia in several countries. Chemical insecticides are still widely used through fogging and other vector control measures; however, their prolonged and intensive use may contribute to the development of insecticide resistance in *Aedes aegypti* populations (Ghiffari, Fatimi, & Anwar, 2013).

Natural insecticides derived from plants have attracted increasing attention because they are biodegradable, environmentally friendly, and generally safer for non-target organisms. Previous studies have highlighted the potential of plant-derived products as sustainable alternatives for mosquito control and arbovirus prevention programs (Achee *et al*., 2019; Pavela *et al*., 2019). The results of the present study indicate that aromatherapy candles containing *Physalis angulata* L. leaf extract have the potential to be developed as an alternative natural insecticide for controlling *Aedes aegypti* mosquitoes, the primary vector of dengue fever.

Conclusion

The study demonstrated that aromatherapy candles containing *Physalis angulata* L. leaf extract exhibited insecticidal activity against *Aedes aegypti* mosquitoes, with the highest mortality observed at the 400 mg dose. The results also suggest that the formulation retained its insecticidal activity after three days of

storage, indicating acceptable short-term stability under the storage conditions used in this study.

Declaration of Competing Interest

I declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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