

Formulation of Aromatherapy Candle Preparation from Coffee with Potential as a Mosquito Repellent

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A B S T R A C T

Background: Coffee is one of the plants that contain antioxidant compounds including polyphenols, flavonoids, proanthocyanidin coumarin, chlorogenic acid, trigonelline and tocopherol. Compounds that have a direct repellent effect are flavonoids. This study aims to determine the effectiveness of aromatherapy candle preparations that have the potential as mosquito repellent. **Objective:** This study aims to determine whether aromatherapy candles from coffee can have the potential as mosquito repellent. **Method:** This type of quantitative experimental research uses the maceration method using 96% ethanol then formulated into 4 variations with concentrations: Formulation 0 (does not contain coffee extract), Formulation 1 (contains 10% coffee extract), Formulation 2 (contains 15% coffee extract) and Formulation 3 (contains 20% coffee extract). Physical evaluations carried out include organoleptic tests, melting time tests, burning time tests, mosquito effectiveness tests and hedonic tests. **Results:** The results of the study showed that Formulation 3 was the most optimal formula because it met all the physical evaluation parameters and effectiveness tests, it could kill 5 mosquitoes, and most respondents even liked the aroma, color and shape. **Conclusion:** This study shows that aromatherapy candles have the potential to be a natural mosquito repellent that is effective and safe to use.

INTRODUCTION

According to the World Health Organization (WHO), Indonesia ranks as the country with the highest number of dengue fever (DHF) cases in Southeast Asia. The breeding sites of *Aedes aegypti* mosquitoes—including eggs, larvae, and pupae—are typically found in stagnant water collected in various containers. Mosquito transmission can be controlled by preventing or disrupting its vector, namely mosquito larvae (Sari et al., 2024). Climate change can influence patterns of infectious diseases and increase the risk of transmission. Research has shown a positive correlation between rainfall and dengue fever cases of 8.4%, indicating that rainfall contributes approximately 84% to the incidence of dengue, while the remaining 16% is affected by factors such as temperature and humidity (Arivandy, 2024).

Mosquitoes generally nest in damp, cool, and dark environments (Aseptianova & Nurina, 2017). Their rapid reproduction leads to the spread of numerous mosquito-borne diseases. Transmission occurs when mosquitoes bite and suck blood. Therefore, community efforts to control mosquito populations are crucial. One common method is the use of mosquito repellents containing insecticides (Macellia et al., 2022).

The development of coffee (*Coffea* sp.) production in Indonesia has shown significant growth. Coffee production reached 676.5 thousand tons in 2007 and increased to approximately 691.16 thousand tons in 2013, marking a 2.17% increase over this period (Indrasari et al., 2024). Community empowerment in certain villages through outreach programs to enhance food security provides knowledge, skills, resources, and access that enable people to independently manage, produce, and secure food sources (Agustina et al., 2024).

Coffee plants contain various antioxidant compounds, including polyphenols, flavonoids, proanthocyanidins, coumarin, chlorogenic acid, trigonelline, and tocopherols. Among these, flavonoids exhibit a direct repellent effect. Flavonoids act as respiratory toxins that weaken the nervous system, disrupt respiratory functions, and manipulate odors, preventing mosquitoes from approaching human skin. Meanwhile, saponins and polyphenols function as stomach poisons that reduce digestive enzyme activity and food absorption, giving them larvicidal or insecticidal properties. Tannins also interfere with the

respiratory and nervous systems, producing effects similar to those of saponins and polyphenols (Alimin, 2022).

A practical mosquito repellent dosage form is a candle preparation, as it does not come into direct contact with the skin, thereby reducing the risk of allergic reactions. Repellent candles can also serve as lighting and decorative elements to enhance the appearance of a room (Ida et al., 2020). Traditionally, candles were used solely as a source of light during power outages. However, today candles are also used as room decorations and air fresheners, with aromatherapy candles being particularly popular (Melviani, 2021).

Aromatherapy is a form of alternative therapy that was first introduced through the use of essential oils. One example of an aromatherapy product is the aromatherapy candle (Lusiana, 2023). Aromatherapy involves the use of essential oils extracted from natural plants to promote health and well-being (Kurniasih et al., 2024). Aromatherapy candles can function as room fresheners, mind relaxants, and insect repellents. They can be made from commonly available natural ingredients and have the potential to replace conventional candles (Harahap et al., 2022). Moreover, the use of aromatherapy candles has minimal side effects since they do not contain harmful chemicals (Sihombing, 2022).

A study by Amalia (2023) reported that coffee bean husk extract exhibits natural larvicidal activity against mosquito larvae. The bioactive chemical compounds in coffee husks can act as agents that kill mosquito larvae, with eco-enzyme coffee husk larvicides showing effective activity at a 20% concentration and 78% molarity. Previous studies have revealed that coffee beans contain numerous beneficial compounds for human health—such as alkaloids, caffeine, flavonoids, tannins, and saponins—which, while advantageous for humans when consumed in appropriate amounts, are harmful to insects such as mosquitoes. Generally, coffee beans are processed mainly as brewed beverages or food additives (Kurniawan, 2018). Based on these findings, this research focuses on utilizing coffee bean extract to formulate aromatherapy candles with natural mosquito-repellent potential.

METHODOLOGY

The research conducted was quantitative with an experimental laboratory method, carried out at the Pharmacy Laboratory of Politeknik Baubau and the Integrated Chemistry Laboratory of Politeknik Bina Husada Kendari.

The instruments used in this study included a Bunsen burner, stirring rod, porcelain dish, measuring cylinder, wooden tongs, beaker glass, horn spoon, stopwatch, thermometer, and aromatherapy candle molds. The materials used were coffee, 96% alcohol, stearic acid, liquid paraffin, *cera alba*, and candle wicks.

The working procedures consisted of simplicia preparation, extract preparation (at the Integrated Chemistry Laboratory, Politeknik Bina Husada Kendari), formulation of aromatherapy candle preparations, and physical evaluation of the preparations (at the Pharmacy Laboratory, Politeknik Baubau).

The physical evaluation of the aromatherapy candles included five tests: organoleptic test, melting point test, mosquito repellency effectiveness test, burning time test, and hedonic test.

RESULTS & DISCUSSION

Research Results

Organoleptic Test Results

In this study, the organoleptic test was conducted to observe the physical characteristics of the aromatherapy candle preparations, including shape, color, and aroma. The results of the preparations produced can be seen in Table 1.

Table 1. Results of the Organoleptic Test

Formulasi	Shape	Warna	Aroma
Formulasi 0	Solid	White	Chandle
Formulasi I	Solid	Light Brown	Coffee
Formulasi II	Solid	Mocha	Coffee
Formulasi III	Solid	Dark Brown	Coffee

Source: Primary Data (2025)

Melting Point Test Results

In this study, the melting point test was conducted to determine the temperature at which the candle begins to melt. The melting point is defined as the temperature at which the solid and liquid phases of a substance coexist in equilibrium at a given pressure.

Table 2. Melting Point Test Results

Formulasi	Initial Melting Point (°C)	Final Melting Point (°C)	Melting Point Range (°C)
Formulasi 0	36,6 °C	42,6 °C	6 °C
Formulasi I	35,4 °C	41,6 °C	6,2 °C
Formulasi II	33,3 °C	40,5 °C	7,2 °C
Formulasi III	32,9 °C	37,8 °C	4,9 °C

Source: Primary Data (2025)

Mosquito Repellency Effectiveness Test Results

The effectiveness test was carried out in cages containing several mosquitoes in each cage. A total of four cages were used, and this test was conducted to determine the effectiveness of each formula against mosquitoes.

Table 3. Mosquito Repellency Effectiveness Test Results

Formulasi	Repellency Effect	Mortality	Burning Time
Formulasi 0	Stationary	-	30 Minutes
Formulasi I	Restless	-	30 Minutes
Formulasi II	Restless	3 Mosquitoes	30 Minutes
Formulasi III	Restless	5 Mosquitoes	30 Minutes

Source: Primary Data (2025)

Hedonic Test Results

This test was conducted by distributing questionnaires to 20 panelists. The questionnaire contained questions regarding the overall assessment of the aromatherapy candle preparations, using a four-point scale: dislike, slightly like, like, and strongly like.

Table 4. Hedonic Test Results on Candle Aroma

Formulasi	Dislike	Slightly Like	Like	Strongly Like
Formulasi 0	9	3	5	3
Formulasi I	-	4	11	5
Formulasi II	-	-	12	8
Formulasi III	-	-	4	16

Source: Primary Data (2025)

Table 5. Hedonic Test Results on Candle Color

Formulasi	Dislike	Slightly Like	Like	Strongly Like
Formulasi 0	-	4	11	3
Formulasi I	-	4	14	2
Formulasi II	-	-	10	10
Formulasi III	-	-	8	12

Source: Primary Data (2025)

Table 6. Hedonic Test Results on Candle Shape

Formulasi	Dislike	Slightly Like	Like	Strongly Like
Formulasi 0	-	-	14	6
Formulasi I	-	-	11	9
Formulasi II	-	-	11	9
Formulasi III	-	-	10	10

Source: Primary Data (2025)

DISCUSSION

In Table 1, the results of the organoleptic test of aromatherapy candle formulations are presented. Formulation 0 (without coffee extract), Formulation I (containing 10% coffee extract), Formulation II (containing 15% coffee extract), and Formulation III (containing 20% coffee extract) were all in solid form. For aroma, Formulation 0 exhibited the characteristic smell of plain candle, whereas Formulations I, II, and III produced the characteristic aromatic smell of coffee. In terms of appearance, Formulation 0 was white due to the absence of coffee extract, Formulation I was light brown with 10% coffee extract, Formulation II was mocha with 15% coffee extract, and Formulation III was dark brown with 20% coffee extract. These variations in color were due to the different concentrations of coffee extract used in the aromatherapy candle preparations.

In Table 2, the melting point test results of the aromatherapy candles are shown. The lowest melting point was observed in Formulation III with 20% coffee extract, at an average of 37.8 °C, while the highest melting point was found in Formulation 0 with 0% coffee extract, at an average of 42.6 °C.

Formulation I (10% coffee extract) had a melting point of 41.6 °C, and Formulation II (15% coffee extract) had 40.5 °C. The highest melting point recorded was 42.6 °C in the formulation without extract. According to Kurniasih (2024), the melting point ranges between 42–60 °C in accordance with the Indonesian National Standard (SNI). Among the four formulations, only Formulation 0 (without coffee extract) met the SNI standard. Rahmawati (2024) reported that the higher the concentration of essential oils in a candle, the lower the melting point, due to the volatile nature of essential oils.

In Table 3, the effectiveness of the mosquito repellent activity of the aromatherapy candles is presented. Formulation 0 (0% coffee extract) showed no effectiveness against mosquitoes, while Formulations II and III were effective. Formulation II (15% coffee extract) killed 3 mosquitoes, and Formulation III (20% coffee extract) killed 5 mosquitoes. Meanwhile, Formulation I (10% coffee extract) caused the mosquitoes to become restless and uncomfortable with the aroma released from the candle, but did not cause mortality. Thus, Formulation 0 produced no effect on the test organisms, whereas Formulations I, II, and III caused restlessness, with Formulations II and III additionally causing mortality. In this test, both negative and positive controls were performed. The negative control was used to confirm that the solvent itself did not cause mosquito mortality, while the positive control was used to verify mortality in the test organisms.

In Table 4, the burning time test results are shown. The longest burning time was observed in Formulation III with 20% coffee extract, lasting 309 minutes, while the shortest burning time was observed in Formulation 0 with 0% coffee extract, lasting 240 minutes. From the results of Formulations 0, I, II, and III, it can be seen that the higher the concentration of coffee extract, the longer the burning time of the aromatherapy candles. This was associated with the evaporation of essential oils during combustion.

In Table 5, the hedonic test results based on aroma preference among 20 respondents are presented. The highest preference at scale 4 (strongly like) was found in Formulation III, with 16 respondents. At scale 3 (like), the highest was Formulation II with 12 respondents. At scale 2 (slightly like), the highest was Formulation I with 4 respondents. At scale 1 (dislike), the highest was Formulation 0 with 9 respondents. These results indicate that the most preferred aroma was that of Formulation III containing 20% coffee extract.

In Table 6, the hedonic test results based on color preference are shown. At scale 4 (strongly like), the highest was Formulation III with 12 respondents. At scale 3 (like), the highest was Formulation I with 14 respondents. At scale 2 (slightly like), the highest was shared between Formulations 0 and I with 4 respondents each. At scale 1 (dislike), none of the respondents selected any of the formulations. These findings indicate that the most preferred color was that of Formulation I with 10% coffee extract.

In Table 7, the hedonic test results based on shape preference are shown. At scale 4 (strongly like), the highest was Formulation III with 10 respondents. At scale 3 (like), the highest was Formulation 0 with 14 respondents. At scales 2 (slightly like) and 1 (dislike), none of the respondents selected any of the formulations. These results suggest that the most preferred shape was that of Formulation 0.

CONCLUSION

Conclusion

Based on the results of this study, coffee extract-based aromatherapy candles show potential as mosquito repellents. The formulated *Kaongke-ongkea* coffee seed extract can be utilized in aromatherapy candles due to its strong distinctive coffee aroma, which was preferred by most panelists. Formulation III, containing 20% coffee extract, was the most optimal formulation, fulfilling all physical evaluation parameters except for the melting point test. Conversely, Formulation 0 did not meet the physical evaluation parameters. The addition of 15% coffee extract to the candles demonstrated mosquito mortality, with three mosquitoes killed within 30 minutes of burning, while the addition of 20% extract resulted in the death of five mosquitoes. Therefore, it can be concluded that coffee extract has potential as a mosquito repellent, although its mortality rate remains relatively low.

Suggestions

It is recommended for future researchers to conduct further testing of aromatherapy candles as potential antidepressants, as well as to explore the modification of dosage forms from aromatherapy candles to aerosol formulations using coffee extract as a mosquito repellent for product development.

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REFERENCES

