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# Effectiveness of Natural Mosquito Repellent Made from Clove Flower Stems (*Syzygium aromaticum* L. Merr. & L.M. Perry) and Community Perceptions of Its Utilization

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***Abstrak***

*Tangkai bunga cengkeh (Syzygium aromaticum L. Merr. & L.M. Perry) merupakan limbah pertanian yang mengandung senyawa eugenol, berpotensi sebagai bahan aktif alami dalam produk anti nyamuk. Penelitian ini bertujuan untuk mendeskripsikan proses formulasi anti nyamuk bakar berbahan tangkai bunga cengkeh, mengevaluasi efektivitas waktu pembakaran, serta menganalisis persepsi masyarakat terhadap penggunaannya. Metode yang digunakan adalah deskriptif kuantitatif. Produk diformulasikan dari campuran serbuk tangkai bunga cengkeh, perekat (joss powder), dan air dengan perbandingan 20 g : 6 g : 40 mL, dicetak dalam bentuk spiral, dan dijemur selama 2–3 hari. Produk yang dihasilkan memiliki warna cokelat tua, aroma khas cengkeh, tekstur halus, panjang spiral 65 cm, diameter 11 cm, dan berat rata-rata 21 gram, menyerupai bentuk anti nyamuk sintetis. Rata-rata waktu pembakaran mencapai 9,3 jam. Persepsi masyarakat terhadap produk ini tergolong positif, terutama dalam aspek aroma, warna, dan efektivitas dalam mengusir nyamuk. Temuan ini menunjukkan bahwa tangkai bunga cengkeh berpotensi sebagai bahan baku alternatif yang efektif, ramah lingkungan, dan dapat diterima oleh masyarakat dalam pengembangan produk anti nyamuk alami.*

***Kata kunci:*** *Tangkai bunga cengkeh, anti nyamuk bakar, persepsi masyarakat*

**Abstract**

Clove flower stalks (*Syzygium aromaticum* L. Merr. & Perry) are agricultural waste containing eugenol compounds, which have the potential to be natural active ingredients in mosquito repellent products. This study aims to describe the formulation process of mosquito repellent made from clove flower stalks, evaluate the effectiveness of burning time, and analyze public perception of its use. The method used is descriptive quantitative. The product is formulated from a mixture of clove flower stalk powder, adhesive (joss powder), and water with a ratio of 20 g: 6 g: 40 mL, molded in a spiral shape, and dried for 2-3 days. The resulting product has a dark brown color, a distinctive clove aroma, a smooth texture, a spiral length of 65 cm, a diameter of 11 cm, and an average weight of 21 grams, resembling the shape of synthetic mosquito repellent. The average burning time reaches 9.3 hours. Public perception of this product is relatively positive, especially in terms of aroma, color, and effectiveness in repelling mosquitoes. These findings indicate that clove flower stalks have the potential to be an alternative raw material that is effective, environmentally friendly, and acceptable to the community in the development of natural mosquito repellent products.

**Keywords:** Clove flower stalks, mosquito coils, public perception

## INTRODUCTION

Indonesia is one of the countries with the highest biodiversity in the world, including in terms of the wealth of plants that have ecological and economic value. Clove is one of the important natural resources for Indonesia in the fields of health and economy, where Indonesia is both an exporting country and the origin of the clove plant. North Maluku is one of the producers of this spice (Suparman et al., 2020). Harnani (2010) states that clove essential oil from various regions in Indonesia such as Maluku, Sumatra, Sulawesi, and Java contains eugenol compounds in varying concentrations, where eugenol is the main

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

component contributing to the biological activity of cloves, including as a plant insecticide. Suwaiya and Lestari (2020) states that repellents such as eugenol affect the specific olfactory behavior of species in mosquitoes, including *Aedes aegypti*. The research of Taher (2015) shows that the eugenol content in the stems of clove flowers of Afo Ternate, Gorontalo, and Tuni Buru Selatan varieties are 86%, 89%, and 89%, respectively. Based on this potential, the utilization of clove flower stem waste as a raw material for mosquito repellent incense becomes a strategic solution to reduce waste while providing a more environmentally friendly alternative to mosquito repellents.

Burning mosquito coils are generally spiral-shaped and work through combustion that produces smoke to repel mosquitoes. This product is commonly used in the control of disease vectors such as dengue fever and malaria. The mechanism of action of burning mosquito repellent in producing smoke to repel mosquitoes is effective in controlling disease vectors such as dengue fever and malaria. The use of burning mosquito repellent in disease vector control is widespread. However, most burning anti-mosquito products available on the market contain synthetic active ingredients such as DEET, propoxur, and dichlorvos (DDVP). Repeated exposure to these compounds has been linked to various adverse health effects in humans, including skin irritation, nervous system disorders, and damage to vital organs (Idris et al., 2025). Another study showed that sub-chronic exposure to smoke from burning mosquito repellent could cause histopathological changes in vital organs such as the liver, kidneys, lungs, and brain in animal models (Kurawa, 2018). In addition, research by Abubakar and Hassan (2007) shows that exposure to smoke from burning mosquito repellents over a certain period can cause histopathological changes to vital organs, such as the liver and lungs, indicating potential systemic toxicity due to the chemical compounds produced during combustion. These findings highlight the need for the development of safer and more environmentally friendly mosquito repellents. Therefore, safe, effective, and easily accessible natural alternatives are needed by the community. Natural insecticides have several advantages, including being easily biodegradable in the environment, being more human-friendly, and reducing the risk of water and soil contamination. Burning clove flower stalks produces a distinctive aroma and has potential as a mosquito repellent. This herbal-based product presents a potential solution to replace synthetic mosquito repellents.

In addition to the effectiveness of the product in repelling mosquitoes, the level of community acceptance is also an important factor in the success of utilizing products made from natural ingredients. The public's perception of clove-stem based mosquito repellent will greatly determine the extent to which this product can be widely accepted. Perception, according to Akbar (2015), is the result of the sensory process followed by the interpretation of the stimuli received, in this case encompassing the aroma, shape, and effectiveness of the product. Therefore, this study not only examines the burning duration of the product as an indicator of effectiveness, but also assesses the community's perception of the use of burning mosquito repellents as a social approach in the development of agricultural waste-based innovations.

## METHOD

This research uses a quantitative descriptive method to describe the process of making burning mosquito repellent based on clove flower stalks, measure the burning duration as an indicator of product effectiveness, and evaluate the community's perception of its use. The research was conducted in Dufa-Dufa Village, North Ternate District, in March-April 2024. Data were collected through literature studies, field observations of the production process and burning tests, as well as the distribution of questionnaires to assess community responses to the produced product. Data analysis includes an analysis of the time (duration) required to

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

burn the product completely and an analysis of community perceptions regarding burning mosquito repellent made from clove flower stalks.
The tools used in this research include a traditional mortar to grind the clove flower stems, a container to mix the ingredients, a manual spiral mold to shape the mosquito repellent incense, and a place or base to dry the product. Additionally, a scale is used to weigh the materials, measuring cups and droppers to measure liquids, rulers and threads to measure the length of the mosquito repellent coils, and matches to burn the product. To ensure the fineness of the materials, a sieve or mesh of 30 mesh size is used. The material used in the production of the mosquito repellent incense is dried clove flower stems.

**The Process of Making Mosquito Repellent Sticks**
The production of burning mosquito repellent begins with preparing dried clove stems and Joss powder as a binder. The clove stems are crushed using a traditional pestle, then sieved to obtain fine flour. After that, 20 grams of the finely ground clove stem flour, 6 grams of binder flour (Joss powder), and 40 mL of water are measured and mixed in a container until homogeneous. The resulting dough is then poured into a manually shaped spiral mold.

**Drying Stage**
After the mosquito-repellent incense mixture is shaped into a spiral form, the product undergoes a drying process. Drying is done by exposing the product to direct sunlight for 2–3 days. During this process, the product is placed on a clean, flat surface that is protected from dust and rainwater to ensure optimal drying results. The purpose of drying is to reduce the moisture content in the product, resulting in a solid mosquito-repellent incense that is not easily broken and ready for burning tests. Products that are completely dry are marked by a hard texture and even color. After the product is dry, a burning test is conducted. The burning test is carried out by igniting the mosquito-repellent incense and measuring the burning time using a timer. Additionally, community responses regarding the effectiveness of the mosquito-repellent incense are measured using a questionnaire. The number of respondents using the product is 40 people taken from family members who utilize burning mosquito repellent during the testing.

**Data Analysis Techniques**

1. **Burn Time Analysis:**
   The burning time data is analyzed descriptively to calculate the average time required to burn the product completely. The average burning time is calculated using the following formula:

$$\text{Average Burn Time} = \frac{\sum_{i=1}^{n} ti}{n} \text{ ……..(1)}$$

   Note:
   - $t_i$ = i-th combustion time (in hours)
   - n = number of trial tests

2. **Analysis of Public Perception:**
   The data obtained from the respondents' questionnaires were analyzed quantitatively to calculate the percentage of answers for each question category. The percentage for each category is calculated using the following formula:

$$\text{Percentage} = \left(\frac{\text{Number of category responses}}{\text{total respondents}}\right) \text{x100\% …… (2)}$$

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

Note:

- Category Answer Count = the number of respondents who chose a certain category
- Total Respondents = the total number of respondents who answered the questionnaire

## RESULTS AND DISCUSSION

### 1. Physical Characteristics of Mosquito Repellent Candles

The formulation of mosquito coils made from clove flower stalks produces a product with optimal physical characteristics that resemble synthetic mosquito repellents available on the market. The resulting product is spiral-shaped with a length of 65 cm, a diameter of 11 cm, and an average weight of 21 grams. The dark brown color produced is very similar to commercial products, while the distinctive clove aroma adds a natural value without the need for additional artificial fragrances. The fine powder texture and neat molding indicate that the ratio of 20 grams of clove flower stalk powder, 6 grams of adhesive, and 40 mL of water is the most suitable formulation to produce an effective, stable, and easy-to-use product for consumers.

### 2. Testing the Burn Time of Mosquito Repellent Incense Made from Clove Flower Stems

After the clove flower stem-based mosquito repellent product is dried, a burning test is conducted three times to measure the burning duration until the product is completely burned, using a timer device. The burning time test is carried out to determine the efficiency of the product as a mosquito repellent that can be used for a relatively long time, thereby providing more comfort to its users. The results of the production of the mosquito repellent with physical characteristics approaching commercial products (solid shape, not easily broken) produce varying weights, ranging from 18-21 grams per stick. This weight variation is influenced by the homogeneity of the material mixture and the precision during the manual molding process. The results of the burning test of the clove flower stem mosquito repellent based on weight and burning duration are presented in Table 1.

**Table 1. Anti-Mosquito Burning Test of Clove Flower Stalks Based on Weight and Duration of Burning**

| Repetition | Weight (g) | Time/hour |
|---|---|---|
| 1 | 19 g | 8 hour |
| 2 | 20 g | 8 hour |
| 3 | 21 g | 12 hour |
| **average** | **20,3 g** | 9,3 hour |

### 3. Public Perception of Clove Flower Stem Mosquito Repellent Products

The research results show that all respondents (100%) agree that clove flower stalk waste can be utilized as raw material for incense mosquito repellent, reflecting full support for the functional use of agricultural waste. The majority of respondents (93.33%) also expressed agreement that this utilization should continue as an environmentally friendly alternative solution for mosquito control. Most respondents assessed that this product is effective for use indoors, particularly in preventing mosquito bites. Additionally, all respondents (100%) stated that clove flower stalk-based mosquito repellent is suitable to be used as a functional product.

The results of this study show that the utilization of clove flower stalk waste as raw material for mosquito repellent incense not only receives full support from the community, but is also considered an innovative and environmentally friendly solution. The community is

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

increasingly aware of the importance of using natural materials in everyday products to reduce negative impacts on the environment. With proven product effectiveness and high acceptance levels, this product has great potential to be further developed and widely accepted in the market as a safe and efficient alternative for mosquito control. Complete data regarding public responses to this product can be seen in Figure 1.

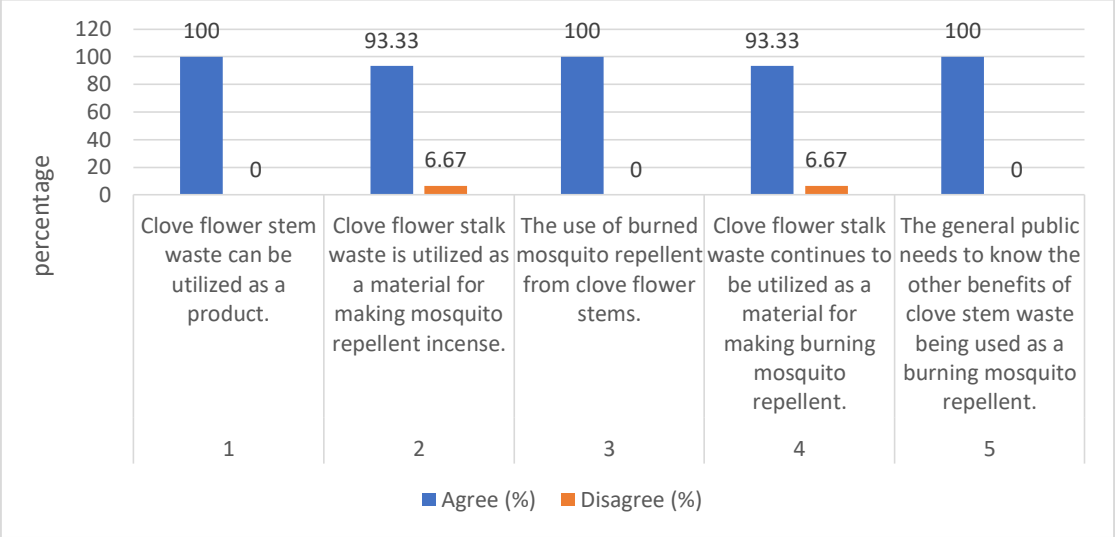


**Figure 1. Community Perception in Utilizing Clove Flower Mosquito Repellent**

In addition, the level of public preference for clove flower stalk-based mosquito repellent products is very high, especially in terms of aroma, with 60% of respondents liking it very much and 40% liking it. In terms of texture, 33.33% of respondents liked it very much and 66.67% liked it, while in terms of color, 40% of respondents liked it and 60% liked it very much. The public also showed a high level of satisfaction with the effectiveness of this product in preventing mosquito bites, with 40% of respondents liking it very much and 53.33% liking it. On the other hand, synthetic mosquito repellent products received less favorable responses, with the majority of respondents indicating they liked it less or disliked it very much, reaching 40%.

Public support for clove stem-based mosquito repellent products shows that awareness of the importance of more environmentally friendly alternatives is increasing. The aroma of this product, favored by the majority of respondents, indicates that natural ingredients like clove can provide a more pleasant sensation compared to synthetic products that often have a sharp or unpleasant odor. Additionally, the well-received texture of the product also shows that the physical quality of this product can compete with other commercial products. The effectiveness in preventing mosquito bites, which also received positive feedback, demonstrates the great potential of this product to become a leading choice in the market. Most respondents who are less fond of or very dislike synthetic products indicate a distrust of the chemicals used in those products, which pose risks to health and the environment. This serves as evidence that the public is increasingly opting for more natural and safer products. Therefore, the use of clove flower stalk waste as a raw material for burning mosquito repellents has a great opportunity to be widely accepted and can be developed as a more environmentally friendly and beneficial product.

The level of public preference for clove flower stem-based mosquito repellent products is presented in Figure 2.

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

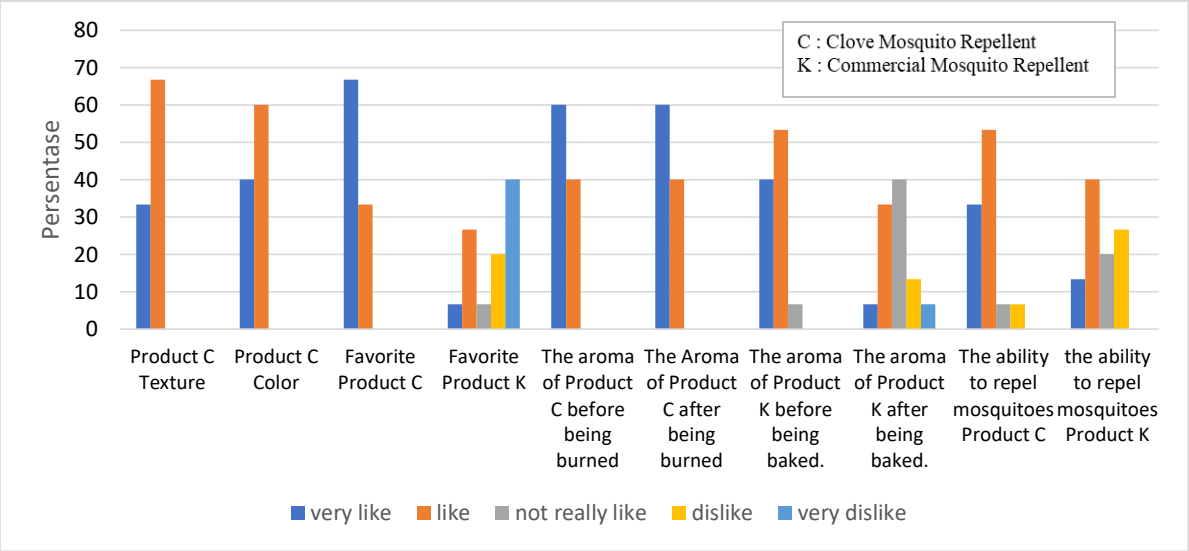


**Figure 2. The Level of Public Preference for Mosquito Repellent Products Made from Clove Flower Stems**

## Physical Characteristics of Clove Flower Stalk-Based Mosquito Repellent

The physical characteristics of products such as aroma, texture, and color play an important role in determining the level of public acceptance of natural-based mosquito repellent products. The research results show that the majority of respondents like the physical characteristics of the product, especially the unique aroma from the clove flower stalk, which is considered not pungent and provides comfort during use. This is in line with the findings of Aliah et al (2016), which state that the eugenol compound in cloves contributes to the distinctive aroma while also serving as an active ingredient for repelling insects.

In addition to the aroma, the texture of the hard product and its unobtrusive natural color become a unique attraction that enhances the aesthetic value of the product. This assessment is supported by research conducted by Zulaikha et al (2019), which states that positive perception of the texture and color of natural mosquito repellent products correlates with the comfort and trust of the community in the safety of the raw materials. Thus, the physical characteristics of mosquito-repellent products made from clove flower stems not only serve as indicators of product quality but also as factors that strengthen market acceptance of innovations based on agricultural waste.

## Burning Time and Effectiveness of Clove Flower Stem Mosquito Repellent Incense

Research shows that clove flower stalks-based burning mosquito repellent products have an effective and consistent burn time, providing more comfort for users. Compared to synthetic products that burn quickly, this product is more efficient and durable. These findings support previous research indicating that clove oil is effective as an active ingredient repellent against *Aedes aegypti* (Budiman et al, 2023)(Luker et al., 2023). The use of clove flower stalks as raw material is not only efficient in burn duration but also effective in preventing mosquito bites, with the majority of respondents giving positive perceptions. Laboratory test results show that a 10% v/v clove oil lotion emulsion provides complete protection against mosquito bites for over an hour (Luker et al., 2023).

Its effectiveness is also reinforced by the content of eugenol compounds that are repellent and insecticidal, which can kill 100% of mosquitoes within <60 minutes at a concentration of 4% (Budiman et al, 2023), and reduce mosquito landing rates by over 90% (Zulaikha et al., 2019). A lotion formulation with a concentration of 5% provides protection

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

for up to 6 hours (Juniyanti et al., 2021), while statistical tests show significant repellent effects at certain concentrations (Oktari et al., 2022). Tests on clove flower extract as an insecticide show an $LC_{50}$ value of 3.434% and an $LC_{90}$ value of 22.070%, confirming the biological potential of cloves in controlling mosquito populations (Getas et al., 2021). These findings confirm that clove stem-based mosquito repellent products are effective and environmentally friendly, and are well accepted by the community.

Recent research shows that clove flower stem-based mosquito repellent is effective as a natural insecticide to control mosquito populations. A study conducted by Ayal et al (2021) proved that the smoke produced from burning clove stems can effectively eliminate mosquitoes, which is believed to be due to the content of essential oils, flavonoids, alkaloids, and saponins that can damage the membranes of larvae and inhibit the endocrine system of mosquitoes. In addition, another study by Getas et al (2021) found that clove flower extract applied with a spray method at various concentrations can significantly increase the mortality of *Aedes aegypti* mosquitoes, where the higher the concentration of the extract used, the higher the observed mosquito death rate within the observation period of up to 24 hours. The same results were obtained by Hasanuddin et al (2023) which showed that the composition of 500 grams of clove flower extract was the most effective, with an average mosquito mortality reaching 3.66% within 2-4 hours, although its effectiveness was still below that of the positive control such as chemical insecticides.

Overall, the results of the research support the use of clove flower stalks as a natural anti-mosquito material, both through combustion mechanisms and spray extracts, with effectiveness increasing along with the concentration of the active ingredients used. The active compound content in cloves plays a crucial role in reducing mosquito activity and increasing mortality, making it an eco-friendly alternative for disease vector control.

**Public Perception of Clove Flower Stem-Based Mosquito Repellent Products**

The public shows a high interest in mosquito repellent products made from clove flower stems, particularly due to the awareness of the importance of more environmentally friendly alternatives. The majority of respondents (93.33%) expressed agreement that the use of clove flower stem waste as a raw material for mosquito repellent should continue as an alternative solution for environmentally friendly mosquito control. This is in line with findings from research by Permatasari and Afida (2023), which shows that consumers have a positive perception of the quality of mosquito repellent products, with significant differences related to the effectiveness of products in preventing mosquito bites. In addition, the community also assesses that the product is effective for use indoors. For example, research by Zulaikha et al (2019) revealed that clove leaf extract has significant mosquito repellent properties, which supports the effectiveness of mosquito repellent products made from clove flower stems.

The community also shows a high acceptance of the use of mosquito-repellent products made from clove flower stalks. This is reflected in the 100% of respondents stating that this product is suitable for use as a functional product. This acceptance is supported by research findings by Zulaikha et al (2019), which found that clove leaf extract is effective in combating *Aedes aegypti* mosquitoes. Thus, mosquito-repellent products made from clove flower stalks are not only effective in preventing mosquito bites but are also well accepted by the community as a safe and environmentally friendly alternative.

**The Level of Public Preference for Clove Stem Based Mosquito Repellent Products**

The results of this study show that mosquito repellent products made from clove flower stems have a very high level of preference among the community, especially in terms of aroma, texture, color, and effectiveness in preventing mosquito bites. Users of this product also reported a decrease in mosquito bites and an increase in comfort while engaging in

E-ISSN: 2829-0844
Vol 8 No (1) April 2025

activities indoors, thus reinforcing the finding that clove flower stems are effective as a natural solution for mosquito control in everyday environments. This finding is in line with research by Zulaikha et al (2019), which proves that clove leaf extract is effective as a repellent against *Aedes aegypti* mosquitoes. Additionally, the study by Kurawa (2018) also shows that aromatherapy biobriquettes made from clove and lemongrass can repel mosquitoes by up to 90%, with a preference level reaching 80%. The combination of natural ingredients such as cloves and lemongrass has proven to not only enhance the effectiveness of mosquito repellent but also strengthen community acceptance of the product (Suwaiya & Lestari, 2020).

The formulation of air freshener liquid made from clove leaf extract with a concentration of 4.5% yielded the best results in effectiveness tests and consumer preference levels, indicating that the proper adjustment of extract concentration can enhance the performance and appeal of the product in the community (Sudin, 2022). In addition, clove leaf extract is effective as a repellent against house flies (*Musca domestica*) using the spray method, demonstrating the broad potential of cloves as an active ingredient in insect repellent products (Aliah et al., 2016). In line with these findings, Yusmitaria et al (2020) in her study on aromatherapy candles made from clove leaf and lemongrass extracts, showed that the product is not only effective in repelling mosquitoes but is also favored by the community. Therefore, utilizing clove flower stem waste as a raw material for burnable mosquito repellent products can be an innovative and environmentally friendly solution that has high added value and the potential to be widely accepted by the community.

## CONCLUSION

Clove flower stalks (*Syzygium aromaticum* L. Merr. & Perry) have the potential as an alternative raw material for natural burning mosquito repellent products. The resulting product has a spiral shape, dark brown color, and distinct clove aroma, with an average burning time of 9.3 hours. Evaluation of public perception shows a positive response, especially towards the aroma, color, and effectiveness of the product in repelling mosquitoes. With eugenol compound content that can disrupt mosquito sensory receptors, this product has proven to be effective and well-accepted by the community, making it an environmentally friendly choice with potential for further development.

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