

# Development, Evaluation and Comparison of Herbal Eco-Friendly Mosquito Repellent Cakes

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**Abstract:** *This research study aimed to develop and evaluate eco-friendly mosquito repellent cakes using herbal ingredients. Formulations included varying concentrations of essential oils—catnip, patchouli, lemon, eucalyptus, and clove—and leaf pastes from plants like Moringa olifera, citronella, and marigold. Binders used in the formulations included neem and wood powders, as well as liquid binders like glycerin and starch solutions. The prepared cakes were assessed through a series of tests, including mosquito repellent efficacy, smoke emission, residual smoke, irritation, field trials, volatile compound analysis, and protection time. Comparisons with commercial products (Allout, Mortein, and Good Knight papers) showed that patchouli-based cakes provided the longest protection time, while catnip had shorter protection yet outperformed other herbal formulations. Though Good Knight papers killed mosquitoes quickly, they lacked prolonged protection and emitted potentially harmful smoke. Allout and Mortein also exhibited strong repellent properties but were synthetic and more costly compared to the herbal cakes.*

**Index Terms—** *Catnip, Citronella, Eco-friendly mosquito repellent cakes, Moringa olifera and Patchouli.*

## INTRODUCTION

Mosquitoes, members of the family *Culicidae*, encompass approximately 3,600 species of small flies. Derived from the Spanish word for "little fly," mosquitoes are characterized by their segmented bodies, a pair of wings, long legs, and specialized piercing-sucking mouthparts. While all mosquitoes feed on nectar, only females of specific species have adapted to consume blood, which enables them to act as vectors for disease. Mosquitoes are responsible for transmitting numerous serious diseases, including malaria, dengue, Zika virus, chikungunya, yellow fever, and Japanese encephalitis. These diseases pose major health threats worldwide, especially in tropical and subtropical regions, where the impact on human

and animal health is severe. Given the significant role mosquitoes play in disease transmission, the use of mosquito repellents has become essential in reducing the risk of bites and associated diseases. Repellents work by masking the scents that attract mosquitoes or by using substances that repel them directly. Available in forms such as lotions, sprays, candles, and wearable devices, repellents create a barrier between the user and mosquitoes, thereby lowering the chances of bites. Due to rising environmental and health concerns, there is an increasing demand for eco-friendly and safe mosquito repellent products. Natural alternatives often made from essential oils, plant extracts, and herbs like citronella and eucalyptus, have gained popularity as effective yet gentle options. These formulations are especially appealing to individuals seeking reduced chemical exposure, particularly when used for children, pregnant women, and people with sensitive skin. The eco-friendly approach ensures not only personal safety but also environmental protection, aligning with the global shift toward sustainable and health-conscious choices. The market now offers a wide array of mosquito repellents, both chemical-based and natural, to meet varying consumer needs. Eco-friendly options are increasingly preferred, providing effective mosquito protection while minimizing ecological impact and health risks.

## MATERIALS

Citronella leaf:



Fig-3.1: Citronella grass

Scientific Name: *Cymbopogon nardus*

Biological Source: Citronella leaf is derived from the grass species *Cymbopogon nardus*.

Family: Citronella belongs to the Poaceae family, which is the grass family.

Chemical Constituents: The main chemical constituents of citronella leaf are citronellal, geraniol, and citronellol, which contribute to its distinct fragrance and insect-repellent properties.

Uses:

- Keeps mosquitoes away naturally.
- Adds a refreshing scent to candles, soaps, and lotions.
- Provides a calming aroma in aromatherapy.
- Enhances the flavor of certain dishes.
- Acts as a natural bug deterrent in the garden.

Clove oil:



Fig-3.2: Clove oil

Scientific Name: *Syzygium aromaticum*

Biological Source: Clove oil is derived from the buds of the clove tree, scientifically known as *Syzygium aromaticum*.

Family: Clove belongs to the Myrtaceae family.

Chemical Constituents: The main chemical constituent of clove oil is eugenol, which gives it its distinct aroma and therapeutic properties. Other constituents include eugenyl acetate, beta-caryophyllene, and methyl salicylate.

Uses:

- Relieves toothaches and oral discomfort naturally.
- Have antimicrobial properties for oral hygiene.
- Provides a soothing and relaxing aroma in aromatherapy.
- Used in traditional medicine for digestive issues.
- Acts as a topical analgesic for pain relief.

Eucalyptus oil:



Fig-3.3: Eucalyptus oil

Scientific Name: *Eucalyptus globulus*

Biological Source: It comes from the leaves of the *Eucalyptus globulus* tree.

Family: It belongs to the Myrtaceae family.

Chemical Constituents: The main chemical constituents of eucalyptus oil are eucalyptol (also known as cineole), alpha-pinene, and limonene.

Uses:

- Eucalyptus oil can help relieve congestion and promote easier breathing.
- It is often used as a natural insect repellent.
- Eucalyptus oil can provide a cooling and soothing effect when applied topically.
- It is used in aromatherapy to promote relaxation and reduce stress.
- Eucalyptus oil can be added to cleaning products for its refreshing scent and antimicrobial properties.

Catnip oil:



Fig-3.4: Catnip oil

Scientific Name: *Nepeta cataria*

Biological Source: It comes from the leaves and stems of the *Nepeta cataria* plant, also known as catnip or catmint.

Family: It belongs to the Lamiaceae family, which is the mint family.

**Chemical Constituents:** The main chemical constituents of catnip oil include nepetalactone, nepetalic acid, and various terpenes.

**Uses:**

- Catnip oil is often used in aromatherapy to promote relaxation and reduce stress.
- It can be used as a natural insect repellent.
- Catnip oil is sometimes used in skincare products for its soothing properties.
- It is also used in herbal remedies to help with digestive issues.
- Some people use catnip oil to help relieve headaches or migraines.

**Patchouli oil:**



Fig-3.5: Patchouli oil

**Scientific Name:** Pogostemoncablin

**Biological Source:** Patchouli oil is derived from the leaves of the Pogostemon cablin plant.

**Family:** It belongs to the Lamiaceae family, which includes other aromatic plants like mint and lavender.

**Chemical Constituents:** The main chemical constituents of patchouli oil include patchoulol, alpha-bulnesene, and pogostone.

**Uses:**

- Patchouli oil is often used in perfumes and fragrances for its earthy and musky scent.
- It can be used in skincare products to help with acne, dry skin, and inflammation.
- Patchouli oil is sometimes used in aromatherapy to promote relaxation and relieve stress.
- It can be added to hair products to help with dandruff and oily scalp.
- Some people use patchouli oil as a natural insect repellent.

**Lemon oil:**



Fig-3.6: Lemon oil

**Scientific Name:** Citrus limon

**Biological Source:** Lemon oil is extracted from the peels of the Citrus limon fruit.

**Family:** It belongs to the Rutaceae family, which includes other citrus fruits like oranges and grapefruits.

**Chemical Constituents:** The main chemical constituents of lemon oil include limonene, beta-pinene, and gamma-terpinene.

**Uses:**

- Lemon oil is commonly used in cleaning products for its fresh and citrusy scent.
- It can be added to skincare products to help brighten and clarify the skin.
- Lemon oil is often used in aromatherapy to uplift mood and promote a sense of energy.
- It can be used as a natural air freshener to eliminate odors.
- Some people use lemon oil for its potential digestive and detoxifying properties.

**Moringa olifera:**



Fig-3.7: Leaves of *Moringa olifera*

*Moringa olifera*, commonly known as drumstick tree or horseradish tree, is a plant species

**Family:** Moringaceae.

**Biological source:** *Moringa olifera* is native to the Indian subcontinent and is known for its nutritious leaves, seeds, and pods.

**Chemical constituents:** *Moringa olifera* include vitamins, minerals, antioxidants, and bioactive compounds such as flavonoids and phenolic acids.

Uses:

- Moringa olifera leaves can be used in cooking and salads for their nutritional value.
- The seeds of Moringa olifera are often used to produce oil for cooking and skincare products.
- Moringa olifera is sometimes used as a natural supplement for its potential health benefits.
- The roots and bark of Moringa olifera are used in traditional medicine for various purposes.
- Moringa olifera is sometimes used as a natural water purifier due to its antimicrobial properties.

Mari Gold:



Fig-3.8: Leaves of *Tagetes erecta*

Scientific Name: *Tagetes erecta*

Biological Source: Marigold is a flowering plant native to Mexico and Central America.

Family: It belongs to the Asteraceae family, which includes other daisy-like flowers.

Chemical Constituents: Marigold flowers contain various compounds such as flavonoids, carotenoids, and essential oils.

Uses:

- Marigold flowers are often used in gardens as decorative plants for their vibrant colors.
- Marigold extracts are sometimes used in skincare products for their soothing properties.
- Some people use marigold as a natural remedy for skin irritations and minor wounds.
- Marigold petals can be used to make herbal teas or infusions with a pleasant aroma.
- Marigold is sometimes used in traditional medicine for its potential anti-inflammatory properties.

Neem Powder:



Fig-3.9: Powder of *Azadirachta indica*

Scientific Name: *Azadirachta indica*

Biological Source: Neem powder is derived from the neem tree, which is native to the Indian subcontinent.

Family: It belongs to the Meliaceae family, which includes other plants like mahogany.

Chemical Constituents: Neem powder contains various compounds such as nimbin, nimbidin, and azadirachtin

Uses:

- Neem powder can be used as a natural remedy for acne and skin blemishes.
- It is often used in hair care to promote a healthy scalp and reduce dandruff.
- Neem powder is sometimes used in oral hygiene products for its antimicrobial properties.
- It can be used as a natural insect repellent for plants and pets.
- Neem powder is also used in traditional medicine for its potential health benefits.

Wood Powder:



Fig-3.10: Wood powder

Wood powder is a fine, dry substance that is derived from various types of wood.

Glycerin:

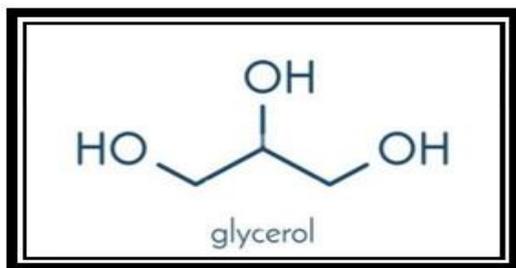


Fig-3.11: Chemical structure of Glycerol

Glycerin is also known as glycerol.

Biological Source: Glycerin can be derived from plant or animal fats through a process called hydrolysis.

Physical Properties:

- Glycerin is a clear, colourless liquid
- It has a thick and syrupy consistency.
- Glycerin is odourless.
- It has a sweet taste.
- The boiling point of glycerin is around 290 degrees Celsius.
- It is soluble in water and miscible with many organic solvents.

Chemical Properties:

- Glycerin is a trihydric alcohol, meaning it has three hydroxyl groups (-OH) in its molecular structure.
- It is hygroscopic, which means it can absorb moisture from the air.
- Glycerin is non-toxic and safe for human consumption.
- It is stable under normal conditions and does not easily react with other substances

Starch:

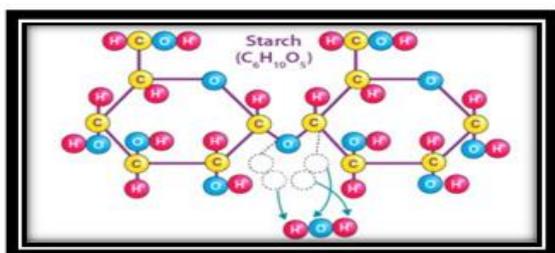


Fig-3.12: Chemical Structure of Starch

Sources:

Starch is primarily derived from plants, such as corn, wheat, potatoes, and rice.

These plants store starch in their roots, tubers, seeds, and grains.

Properties of starch:

- White, odourless, and tasteless powder.
- Consists of two types of glucose polymers: amylose and amylopectin.
- Amylose is a linear polymer, while amylopectin is highly branched.
- Insoluble in cold water.
- Can form a gel when heated with water.

Uses:

- Thickening agent in sauces, soups, and gravies.
- Stabiliser in food products like ice cream and salad dressings.
- Texturizer in baked goods, giving them a desirable texture.
- Binding agent in processed meats and vegetarian alternatives.
- Used in the paper industry to improve paper strength.

Formulation of Mosquito Repellent Cakes



Fig-3.13: Ingredients used in the formulation of mosquito repellent cakes

Table-3.1: Ingredients used in formulation of Mosquito repellent cakes

S.NO	INGREDIENTS	Formulations				
		F1	F2	F3	F4	F5
1	Eucalyptus oil(ml)	3ml	-	-	-	-
2	Clove oil(ml)	-	3ml	-	-	-
3	Lemon oil(ml)	-	-	3ml	-	-
4	Catnipoil(ml)	-	-	-	3ml	-
5	Patchoulioil(ml)	-	-	-	-	3ml
6	Wood Powder (g)	5g	5g	5g	5g	5g
7	Neem Powder (g)	5g	5g	5g	5g	5g
8	Glycerin(ml)	4ml	4ml	4ml	4ml	4ml
9	Starch solution (ml)	5ml	5ml	5ml	5ml	5ml

Table-3.3: Formulation table for mosquito repellent cakes with Leaf paste

S.NO	INGREDIENTS	Formulations		
		F6	F7	F8
1.	<i>Moringaolifera</i>	4gm	-	-
2.	Citronella	-	4gm	-
3.	Marigold	-	-	4gm
4.	Wood Powder (gm)	5gm	5gm	5gm
5.	Neem Powder (gm)	5gm	5gm	5gm
6.	Glycerin(ml)	4ml	4ml	4ml
7.	Starch solution(ml)	5ml	5ml	5ml

METHODOLOGY

Preparation of Mosquito Repellent Cakes with Leaf Paste: Natural ingredients, including citronella, *Moringa oleifera*, marigold leaves, neem powder, wood dust, glycerin, and starch, were collected. The leaves were washed, chopped, and blended into a smooth paste. This paste was mixed with neem powder and wood dust in controlled proportions. Glycerin and starch solution were gradually added to achieve a dough-like consistency, followed by thorough hand kneading to ensure even distribution. The mixture was shaped into round cakes or patties and air-dried for one to two days. Finally, the dried cakes were stored in airtight containers to preserve their effectiveness.

Preparation of Mosquito Repellent Cakes with Essential Oils: Essential oils, including clove, eucalyptus, catnip, patchouli, and lemon, were collected along with powdered neem, wood dust, glycerin, and starch solution. The dry ingredients (neem powder and wood dust) were combined in desired proportions and stirred for even distribution. Essential oils were gradually added to the dry mixture while stirring continuously. Glycerin and starch solution were then incorporated until a dough-like consistency was achieved. The mixture was kneaded thoroughly by hand for uniformity. Small portions were shaped into round cakes or patties and air-dried for one to two days. Finally, the dried cakes were stored in airtight containers to maintain effectiveness.



Fig-3.14: Different formulations of mosquito repellent cakes -F1 to F8 (Essential oils & Leaves paste)

Evaluation Parameters for Mosquito Repellent cakes:

1. Evaluation of Moisture content:  
To assess the moisture content of the mosquito repellent cakes, samples were prepared as per the formulation. Each cake was weighed to obtain its wet weight, then dried under sunlight to remove moisture. After drying, the cakes were weighed again to determine their dry weight. The difference between the wet and dry weights indicated the moisture content of the cakes.

2. Smoke Efficacy Testing:  
To assess the smoke efficacy of the mosquito repellent cakes, each cake was weighed to establish its initial mass. The cakes were then ignited under controlled conditions to ensure consistent burning. After burning for a predetermined duration, the cakes were extinguished and allowed to cool to room temperature. The remaining residue was weighed, and the mass consumed during burning was calculated by subtracting the residue mass from the initial mass. This

value represented the amount of repellent used. Finally, the mass consumed was divided by the burning duration to determine the smoke emission rate, expressed in grams per minute (g/min).



Fig-3.15: Smoke Efficacy testing

### 3. Residual Smoke Efficacy Testing:

To assess the residual smoke efficacy of the mosquito repellent cakes, a visual examination was conducted to check for structural integrity and any defects. Each cake was ignited and allowed to burn completely, ensuring thorough combustion for accurate evaluation of smoke generation and fragrance dispersal. A timer was used to record how long the fragrance lingered in the testing environment after burning. Observations were made regarding changes in fragrance intensity, longevity, and overall effectiveness. After burning, the residue was visually inspected and weighed using a precision scale. Additionally, the testing area was evaluated for the presence of smoke and any associated characteristics such as odor and visibility.



Fig-3.16: Residual smoke efficacy testing

### 4. Protection Time Assessment:

To assess the protection time of the mosquito repellent cakes, testing was conducted in a controlled indoor environment with minimal air circulation to reduce external variables. The cakes were ignited to activate

their repellent properties, and a timer was started simultaneously while observing insect activity. The duration for which the repellent effectively deterred insects was systematically recorded to provide quantitative data on its efficacy.

### 5. Dermal Irritation Assessment:

To evaluate dermal irritation from the mosquito repellent cakes, a small amount of the formulation was applied to the skin of human volunteers. Skin reactions were systematically assessed at specified intervals of 24, 48, and 72 hours post-application. Observations were made for any signs of allergic reactions, including rash, inflammation, or itching, throughout the monitoring period.

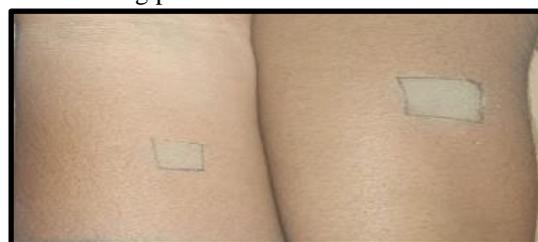


Fig.3.17: Dermal irritation

### 6. Odor Evaluation:

To assess the odor of the mosquito repellent cakes, a well-ventilated area free from other odors was prepared for accurate evaluation. Each cake was ignited, allowed to burn for a few seconds, and then the flame was gently blown out, ensuring the cakes smoldered to release smoke and aroma without an active flame. The smoke was allowed to disperse, and the aroma was fully developed. Each cake's emitted aroma was then individually assessed, noting distinctive characteristics. Descriptive names were assigned to categorize the scents, such as citrusy, aromatic, earthy, floral, or woody.

### 7. Field Trials:

In our study, field trials were conducted to evaluate the performance and user satisfaction of the mosquito repellent cakes in real-world conditions. Participants willing to use the cakes were recruited and provided with detailed usage instructions. They were encouraged to incorporate the repellent cakes into their daily routines based on their usual habits and preferences. Throughout the trial period, systematic feedback was collected from participants regarding their experiences. A comprehensive questionnaire was developed to capture their perceptions and feedback on the mosquito repellent cakes.

Mosquito Repellent Questionnaire

Participant Information:

1. Name(optional):
2. Age:
3. Gender:
4. Location(City/Country):
5. Have you used mosquito repellent products before?(Yes/No)
6. How often do you encounter mosquito problems in your area? (Rarely/Sometimes/Often/Always)

Mosquito Repellent cake experience:

7. How long you have been using the mosquito repellent cakes?
8. Which scent(s) of the mosquito repellent cakes did you try?  Citronella  Eucalyptus  Clove oil  Lemonoil  Catnip oil  Patchouli oil  *Moringa olifera*  Mari gold
9. Did you find the scent(s) pleasant? (Yes/No)
10. What is the burning ability of mosquito repellent cakes?  Even  Uneven

11. Did you observe any changes in fragrance intensity over time during burning? (Yes/No)
12. How would you describe the aroma of the burning mosquito repellent cakes?  Citrusy  Aromatic  Earthy  Woody
13. How effective did you find the mosquito repellent cakes in repelling mosquitoes? (Choose one)  Very effective  Somewhat effective  Not very effective  Not effective at all

14. How long did the mosquito repellent cakes provide protection against mosquitoes? (Approximate duration)
15. Did you experience any skin irritation or allergic reactions after using the mosquito repellent cakes? (Yes/No)

- If yes, please describe: \_\_\_\_\_

Testing Area and Environment:

16. Where did you primarily use the mosquito

repellent cakes?

- Indoors
- Outdoors
- Camping
- Others (Please specify)

17. How would you describe the ventilation and odour in the area where you used the mosquito repellent cakes? (Choose one)  Well ventilated with no other odours  Moderately ventilated with slight odours  Poorly ventilated with strong odours

Overall Satisfaction and Recommendation:

18. On scale of 1 to5, how satisfied are you with the mosquito repellent cakes overall? (1 being dissatisfied, 5 being satisfied)
19. Would you recommend the mosquito repellent cakes to others? (Yes/No)

- If no, please specify reason(s)for not recommending:

Additional Comments:

20. Is there anything else you would like to share about your experience with the mosquito repellent cakes?



Fig3.18: Field trails

Comparison Studies with Marketed Formulations:

In our comparative study, prominent commercial mosquito repellent products, including All Out,

Mortein, and Good Knight papers, were selected to facilitate a comprehensive comparison with our developed mosquito repellent cakes. A controlled testing area was established in a closed room with minimal air circulation to eliminate odors and other repellents that could interfere with the results. Each product, including the commercial options and our cakes, was strategically placed in different corners of the room to ensure equal distribution and exposure to mosquito activity. After allowing sufficient time for the products to take effect, we monitored their effectiveness in repelling mosquitoes, assessing the efficacy and duration of protection, any adverse reactions, emitted odors, and overall safety.



Fig3.19: Comparison of prepared herbal mosquito repellent cakes with commercial products

## RESULTS

### 1. Evaluation of Moisture content

Table4.1: Wet and Dry weights of prepared mosquito repellent cakes (F1-F4)

S.No	Eucalyptus oil(F1)		Clove oil (F2)		Lemon oil (F3)		Catnip oil(F4)	
	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)
1.	6.0	3.3	6.9	4.0	6.9	3.8	6.1	3.5
2.	5.4	3.7	7.1	3.6	6.8	3.7	6.2	3.4
3.	5.7	3.4	7.0	3.8	7.0	3.9	6.5	3.5
4.	5.5	3.5	7.1	3.7	7.2	3.8	6.7	3.6

Table4.2: Wet and Dry weights of prepared mosquito repellent cakes (F5-F8)

S.No	Patchouli oil(F5)		<i>Moringa olifera</i> Leaf paste(F6)		Citronella leaf Paste(F7)		Mari Gold leaf Paste(F8)	
	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)	Wet weight (g)	Dry weight (g)
1.	6.0	4.3	6.6	2.6	6.1	3.1	6.3	2.8
2.	6.8	4.6	7.1	2.2	6.4	3.4	6.2	2.7
3.	6.4	4.0	6.3	2.4	6.5	3.2	6.5	2.8
4.	6.2	4.3	6.2	2.4	6.5	3.5	6.5	3.0

### 1. Smoke efficacy testing:

Table4.3: Results of Efficacy testing

Formulation	Smoke emission Rate (g/min)	Duration of fragrance (min)	Consistency of burn
F1	0.27	9	Even
F2	0.348	4	Uneven
F3	0.365	19	Even
F4	0.335	10	Uneven
F5	0.413	15	Even
F6	0.299	9	Uneven
F7	0.304	10	Even
F8	0.27	4	Uneven

### 2. Residual smoke efficacy testing:

Table4.4:Results of residual efficacy testing

Formulation	Residual fragrance duration(min)	Residue Amount(g)
F1	15	0.6

F2	10	0.12
F3	25	0.15
F4	20	0.15
F5	30	0.17
F6	20	0.11
F7	20	0.06
F8	8	0.1

3. Protection time Assessment:

Table4.5: Results of protection time assessment test

Formulation	Testing area	Duration of assessment (Min)	Protection time (hrs)
F1	Wash basin	15min	3hrs
F2	Hall	20 min	2 hrs
F3	Near dustbin	25 min	3 hrs
F4	Corridor	15 min	4 hrs
F5	Kitchen room	15 min	6 hrs
F6	Office room	20 min	1.5 hrs
F7	Pharmaceutics cabin	20 min	1 hr
F8	Principal cabin	20 min	2 hrs

4. Dermal Irritation:

Table4.6: Results of Dermal irritation test

Formulation	Type of skin Irritation
F1	No irritation
F2	No irritation
F3	No irritation
F4	Mild irritation
F5	No irritation
F6	Mild irritation
F7	No irritation
F8	No irritation

5. Odour Evaluation:

Table4.7: Results of odour evaluation test

Formulation	Substance	Descriptive Term
F1	Eucalyptus oil	Camphoraceous
F2	Clove oil	Spicy
F3	Lemon oil	Citrusy
F4	Catnip oil	Earthy
F5	Patchouli oil	Earthy
F6	<i>Moringa olifera</i>	Slightly nutty
F7	Citronella	Citrusy
F8	Marigold	Aromatic

6. Field trails:

Table4.8: Results of field trails

Participants	Location	Protection time	Burning ability	Overall Satisfaction
G1	Indoor	3hrs	Even	4.1 out of 5
G2	Indoor	2 hrs	Uneven	3.9 out of 5
G3	Indoor	3 hrs	Even	4.0 out of 5
G4	Indoor	4 hrs	Uneven	4.5 out of 5
G5	Indoor	6 hrs	Even	4.8 out of 5
G6	Indoor	1.5 hrs	Uneven	3.5 out of 5

G7	Indoor	1 hr	Even	4 out of 5
G8	Indoor	2 hrs	Uneven	3.8 out of 5

8. Comparison of mosquito repellents with marketed formulations:

Table4.9: Results of comparative studies

Criteria	Formulation (Catnip oil)	Formulation (Patchouli oil)	Marketed Formulation 1 (all out)	Marketed Formulation 2 (Mortein)	Marketed Formulation 3 (Good night Papers)
Effectiveness	medium	high	medium	low	high
Duration of protection	4 hrs	6 hrs	24hrs	8hrs	10-15min
Fragrance	Earthy		Strong odour		
Ease of use	<ul style="list-style-type: none"> <li>Requires Ignition</li> <li>Emits smoke and odour</li> </ul>		Simple insertion of pre-filled bottles into plug-in devices	<ul style="list-style-type: none"> <li>Requires Ignition</li> <li>Emits smoke and odour</li> </ul>	
Safety	DEET free, Eco friendly, and Safe for environment		Should be cautious for children and pets		
Price	Rs. 8/ cake	Rs. 12/cake	Rs. 80/ Refill	Rs. 05/coil	Rs. 1/paper
Availability	Should be ordered from stores		Easily Available in the market		
Overall user satisfaction	Good	Best repellent	Best repellents from synthetic origin		
	repellent Activity from natural origin	activity from Natural origin			

DISCUSSION

The effectiveness of herbal mosquito repellents has been studied in recent years, and the results have been encouraging. In this present research work, an attempt was made to prepare herbal eco-friendly mosquito repellent cakes using various plants and essential oils.

We selected plants such as *Moringa olifera*, Citronella, Mari gold and Essential oils like Patchouli oil, Clove oil, Lemon oil, Catnip oil and Eucalyptus oil to prepare mosquito repellent cakes. Supporting excipients like Neem and wood powder as solid and starch and glycerine solutions were taken as liquid binders which aids in the cake formation. Different concentrations of leaves paste and essential oils were tested for mosquito repellent activity. The prepared cakes were evaluated for various parameters like moisture content, efficacy testing, residual efficacy testing, protection time assessment, dermal irritation, odour evaluation and field trials. The cakes were also compared with commercial repellents like Allout, Mortein and Good knight papers to access the potential of herbal mosquito repellent cakes.

In our research, we focused on evaluating the effectiveness of different formulations, specifically comparing catnip and patchouli. Through irritation tests, field trials, and smoke emission tests, we found

that patchouli had a longer protection time and a strong smell, making it a promising ingredient for mosquito repellent cakes. Catnip, on the other hand, had a slightly shorter protection time compared to patchouli but still outperformed the other formulations we tested. Based on these findings, it can be concluded that both catnip and patchouli have potential as natural mosquito repellents. Patchouli stands out for its longer protection time and strong smell, while catnip offers a viable alternative with decent effectiveness. Incorporating these ingredients into personalized mosquito repellent cakes could provide an attractive option for individuals seeking natural and effective protection against mosquitoes.

CONCLUSION

This study demonstrates that blends of essential oils can effectively repel mosquitoes, offering a promising alternative to traditional synthetic repellents like DEET and di-methyl phthalate. The use of chemicals for mosquito control may show significant environmental and health risks, making natural products a more eco-friendly solution.

Various plants, including *Moringa oleifera*, citronella, marigold, and essential oils such as patchouli, clove, lemon, catnip, and eucalyptus, were tested for their repellent properties. The results indicated that herbal

mosquito repellent cakes made from catnip and patchouli oil, with neem and wood powder as binders, exhibited the highest repellent activity.

These essential oils have the potential to be developed into commercial products, such as essence sticks and cakes. Additionally, homemade herbal repellents are safer than commercial options and can be easily prepared at home without significant investment, making them a practical choice for mosquito control.

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