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SENSORY ASSESSMENT OF ECO-FRIENDLY MOSQUITO REPELLENT INCENSE STICKS PREPARED FROM MARIGOLD FLOWERS AND HERBS

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ABSTRACT

The present investigation entitled “Assessment of eco-friendly mosquito repellent incense sticks prepared from marigold flowers and herbs” was conducted at the Horticulture Research Laboratory, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Bastar (C.G.) during the year 2025–26. The investigated that Mosquito-borne illnesses like malaria, dengue and chikungunya pose serious health risks and synthetic insect repellents containing hazardous chemicals like DEET and synthetic pyrethroids can cause respiratory issues, allergies and environmental contamination. Making ecologically friendly incense sticks out of natural botanical herbs and plant materials such as marigold flower petals, neem, basil, lemongrass and camphor is a safe, non-toxic, biodegradable and sustainable alternative to synthetic chemical repellents. The effectiveness and sensory-based mosquito-repelling capabilities of several herbal formulations were evaluated in this study. Among all the treatment combinations T₇ [Neem Powder (50%) + Jigat Powder (14%) + Camphor Powder (36%)] exhibited the best overall incense stick qualities. On the other hand, formulation T₁₀ showed considerably lower burning efficiency, increased irritation and decreased overall sensory acceptability.

Key words: Herbal Incense Sticks, Mosquito Repellency, Neem, Camphor, Vector Control, Natural Formulations.

Introduction

The current study is titled “Assessment of eco-friendly mosquito repellent incense sticks prepared from marigold flowers and herbs” Mosquito-borne diseases are still a major global public health problem, particularly in tropical and subtropical regions. Diseases like dengue, chikungunya and malaria infection cause millions of illnesses and a significant number of fatalities each year. The number of mosquito vectors has grown due to inadequate sanitation, poor waste management, fast urbanization and climate change all of which have expedited the spread of disease. Children and pregnant women are still among the populations most vulnerable to these vector-borne diseases. Chemical repellents including DEET, allethrin, prallethrin, picaridin and IR3535 are commonly used for personal protection against

mosquito bites. Despite their efficacy, prolonged exposure to these substances has been associated with adverse health effects such as skin irritation, respiratory disorders, allergic reactions and environmental pollution. As people awareness of these problems has increased so has the demand for safe, biodegradable and ecologically friendly alternatives derived from natural plant resources. Herbs and flowers have long been utilized in traditional medical systems due to their therapeutic, antimicrobial and insect-repelling properties. Herbs such as neem (*Azadirachta indica*), lemongrass (*Cymbopogon citratus*), tulsi (*Ocimum sanctum*), marigold (*Tagetes* spp.) and camphor (*cinnamomum camphora*) have bioactive compounds that repel insects without endangering people or the environment. These plant resources may be combined to incense sticks using natural binders like jigat

powder (*Litsea glutinosa*) and cow dung powder to produce sustainable mosquito-repelling products. Neem is regarded as one of the most effective natural insect repellents because it includes azadirachtin and other physiologically active compounds. Similarly, marigold flowers contain essential oils and secondary metabolites that help deter insects.

Material and Methods

Geographical Condition

The study was carried out at the Horticulture Research Laboratory, Krantikari Debridhur College of Horticulture and Research Station, Jagdalpur, Chhattisgarh during the year 2025–2026. The geographical coordinates of study area are Latitude : 19°12'00"N and Longitude: 81°56'00"E. Bastar district is situated in the southern region of Chhattisgarh, India. It extends geographically from 17°46'2" to 20°34'2" North latitude and 80°15'2" to 82°25'2" East longitude

Fresh marigold flowers and herbal products came from nearby local sources and the college research farm. The ingredients used to create mosquito-repelling eco-friendly incense sticks were selected for their insect-repelling properties and compatibility with herbal compositions.

Raw Material Selection & Powder Preparation

Neem (*Azadirachta indica*): Because of its well-known insecticidal and mosquito-repelling qualities leaf powder was used as the primary active ingredient.



Plate 1: Rolling combination treatment dough on bamboo sticks.

Marigold (*Tagetes patula*): It was combined to flower petal powder which has a beautiful floral aroma and naturally existing volatile compounds that deter insects.

Lemongrass (*Cymbopogon citratus*): Leaf powder was utilized as a natural supply of essential oils, particularly citral, which enhances the efficacy of insect repellent and provides a rejuvenating aroma.

Basil (*Ocimum sanctum*): basil leaf powder has antimicrobial, insect-repelling, and aromatic properties, it improved the formulation's overall quality.

Camphor (*Cinnamomum camphora*): The inclusion of camphor powder enhanced the incense sticks scent and repelling properties while promoting even burning.

Jigat (*Litsea glutinosa*): Powder served as a natural binding agent providing the required mechanical strength and consistency to the incense sticks.

Cow dung powder: the stick's biodegradability, burning characteristics and integrity were improved by using cow dung powder as an eco-friendly combustible binder.



Plate 2: Raw materials in powdered form.

Table 1: Raw material and their special properties to make mosquito repellent incense sticks.

S. No.	Plant parts	Properties
1	Neem (<i>Azadirachta indica</i>)	Anti-helminthic, antifungal, antidiabetic, antibacterial, antiviral, insecticidal, antimicrobial
2	Jigat (<i>Litsea glutinosa</i>)	Natural binding agent
3	Basil (<i>Oscimum sanctum</i>)	Antiviral, antifungal, antibacterial
4	Lemongrass (<i>Cymbopogan citratus</i>)	Natural insect repellents
5	Camphor (<i>Cinnamomum camphora</i>)	Insect repellent, Cooling, antioxidant
6	Marigold (<i>Tagetes patula</i>)	Antioxidant, mosquito repellent
7	Cowdung	Binding agent, disinfectant

Methodology:**1. Collection of herbs and marigold flowers:**

Herbs such as lemongrass, basil, neem, camphor and cowdung, together with fresh marigold flowers, were collected by hand from the floriculture area beside Jagdalpur and KVK Jagdalpur.

2. Grading of herbs and marigold flowers: Only marigold flower petals, neem leaves, basil leaves, lemongrass leaves, camphor, jigat powder and cowdung were used to produce mosquito-repelling incense sticks. Thus using scissors or by hand flower petals and the leftover herbs were taken from each crop's blooms and classified according to the quantity of leaves.**3. Sun drying of herbs and marigold flowers:**

To ensure sufficient sun drying for around seven to ten days the collected material was spread out in thin layers and turned often.

**Plate 3:** Main product after drying.**Table 2:** Treatment details of plant parts as powder form.

Treatment	Treatment Details
T ₁	Neem Powder (80%) + Jigat Powder (20 %)
T ₂	Neem Powder (75%) + Jigat Powder (19 %)+ Marigold Powder(6%)
T ₃	Neem Powder (70%) + Jigat Powder (18%) + Lemongrass Powder (12%)
T ₄	Neem Powder (65%) + Jigat Powder (17%) + Lemongrass Powder (18%)
T ₅	Neem Powder (60%) + Jigat Powder (16%)+ Basil Powder (24%)
T ₆	Neem Powder (55%) + Jigat Powder (15%) + Basil Powder (30%)
T ₇	Neem Powder (50%) + Jigat Powder (14%) + Camphor Powder (36%)
T ₈	Neem Powder (45%) + Jigat Powder (13%) + Camphor Powder (42%)
T ₉	Neem Powder (40%) + Jigat Powder (12%) + Cow Dung Powder (28%) + Marigold Powder (20%)
T ₁₀	Neem Powder (35%) + Jigat Powder (11%) + Cow Dung Powder (36%) + Marigold Powder (18%)

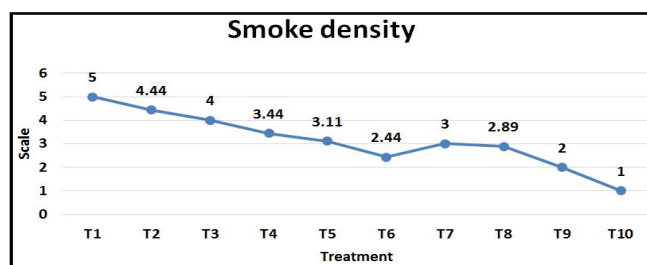
4. Grinding herbs and marigold flowers into a powder: All of the dried herbs and petals were coarsely powdered using a grinder.**5. Preparation of formulations according to treatment:** The treatment described how to make the right combination of flowers and herbs. Following the conversion of percentage-based treatment levels into measurable values, the corresponding weights were computed and represented in grams (g) for practical observation.**6. Preparation of the powder mixture into dough:** Warm water was gradually added to each treatment until the dough-like consistency was achieved to create the mosquito-repelling incense dough.**7. Rolling the mosquito-repellent incense dough onto sticks:** An equal amount of dough was used to roll each incense stick. Each incense**Fig. 1:** Effect of smoke density of mosquito repellent incense sticks.

Table 3: Sensory parameter based on reading of mosquito repellent incense sticks.

Treatment	SD	AI	PI	FA	UB
T ₁	5.00	3.222	7.33	4.000	63.333
T ₂	4.44	2.332	5.44	4.333	63.333
T ₃	4.00	3.110	4.22	6.000	60.000
T ₄	3.44	3.221	4.11	6.000	70.000
T ₅	3.11	3.557	2.55	7.000	73.333
T ₆	2.44	4.778	2.33	7.000	70.000
T ₇	3.00	6.779	0.11	8.667	90.000
T ₈	2.89	5.221	0.33	8.000	86.667
T ₉	2.00	2.000	3.33	5.667	70.000
T ₁₀	1.00	3.111	2.67	5.000	70.000
C.D.	0.235	0.295	0.29	0.542	6.263
SE(m)	0.079	0.099	0.099	0.183	2.108
SE(d)	0.112	0.140	0.14	0.258	2.981
C.V.	4.379	4.599	5.305	5.128	5.095

SA: Smoke density; AI: Aroma intensity;
PI: Presence of irritation; FA: Fragrance acceptability;
UB: Uniformity of burning

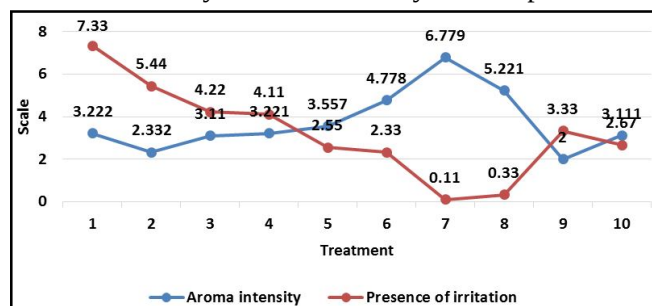
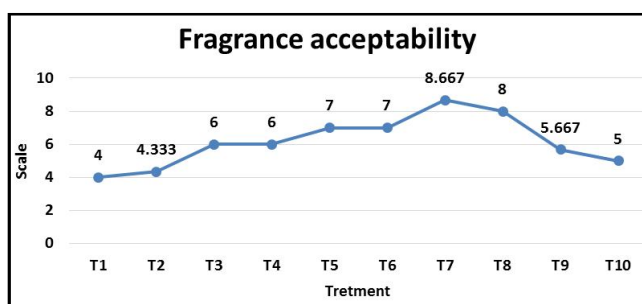
stick was individually rolled on a plain circular hardwood stick. After rolling the incense sticks until they were uniformly thick, they were placed on a tray plate and allowed to dry.

8. Drying of mosquito repellent incense sticks:

The hand-rolled, mosquito-repelling incense sticks from each treatment were dried in a hot air oven at 40 to 50 degrees Celsius for 60 to 80 minutes.

Observation Parameter

A trained sensory panel assessed the produced herbal mosquito repellent incense sticks sensory quality under controlled testing settings. Following the incense sticks' ignition, sensory characteristics such as smoke density, aroma intensity, presence of irritation, fragrance acceptability and uniformity of burning were evaluated. A five-point descriptive intensity scale (1 being extremely low and 5 being very high) was used to assess smoke density. Fragrance acceptability was measured on a nine-point hedonic scale that ranged from "dislike extremely" to "like extremely." Aroma intensity and the presence of

**Fig. 2:** Effect of aroma intensity and presence of irritation of mosquito repellent incense sticks.**Fig. 3:** Effect of fragrance acceptability of mosquito repellent incense sticks.

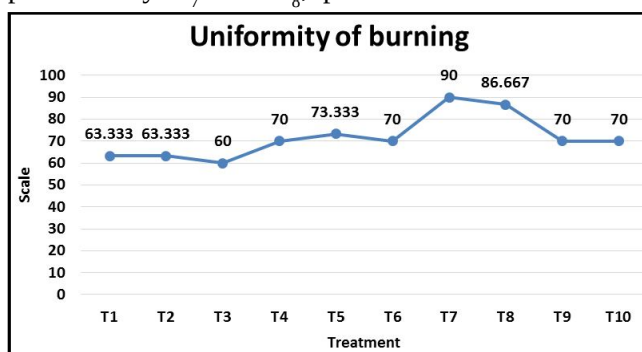
irritation were evaluated using the relevant hedonic rating scales. A numerical quality score method (60 = bad, 70 = fair, 80 = good, and 90 = excellent) was used to evaluate burning uniformity.

Result and Discussion

The sensory response of the herbal mosquito repellent incense sticks differed noticeably among the formulated treatments. The formulation T₇ (50% neem powder + 14% jigat powder + 36% camphor powder) achieved the best overall sensory performance. It exhibited the strongest aroma, the highest consumer preference for fragrance, the most uniform burning behavior and the least irritation during burning, indicating excellent product quality and user acceptability.

Among the remaining treatments, T₈ (45% neem powder + 13% jigat powder + 42% camphor powder) also demonstrated superior sensory characteristics. This formulation produced a pleasant and intense aroma, high fragrance acceptance, consistent burning performance and very low irritation, making it the second most preferred treatment for indoor use.

In contrast, T₁ generated the densest smoke but was associated with the highest irritation level reducing its overall sensory acceptability. The weakest aroma was observed in T₉, whereas T₁₀ produced the least smoke during combustion. These findings indicate that formulations containing a higher proportion of camphor particularly T₇ and T₈, provided a better sensory

**Fig. 4:** Effect of uniformity of burning of mosquito repellent incense sticks.

experience than the other treatments. Overall T₇ emerged as the most suitable formulation while T₈ ranked second because of its favorable balance of aroma, burning quality, fragrance acceptability and user comfort. The similar finding was examined by Gutierrez-osuna *et al.*, (2001) in correlation of sensory analysis with electronic nose data for swine odour remediation assessment. And Shriram *et al.*, (2023) in formulation and evaluation of mosquito repellent stick.

Conclusion

The current study showed that the herbal mosquito repellent incense stick compositions clearly differed from one another according to the sensory evaluation. With the most appealing scent, the greatest fragrance acceptance, consistent burning behaviour and the least amount of discomfort during application T₇ outperformed all other treatments in terms of overall sensory performance. T₈ is another potential formulation with strong consumer appeal, as evidenced by its superb sensory qualities and second-place ranking. Despite producing thick smoke, T₁ was less suitable overall due to its greater level of discomfort. According to the results, camphor-containing formulations—specifically, T₇ and T₈—offer better sensory quality and increased user comfort. Consequently, T₇ is the best formulation for creating an environmentally safe herbal mosquito repellent incense stick, whereas T₈ is a similar substitute for real-world uses.

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