DEVELOPMENT AND ASSESSMENT OF CONES INFUSED WITH HERBAL MOSQUITO REPELLENT FORMULA

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Abstract:

The formulation and evaluation of herbal mosquito repellent cones represent a promising approach to address the growing concerns associated with chemical-based mosquito control methods. This study focuses on developing cones infused with natural plant extracts known for their insect-repelling properties. The research aims to provide an eco-friendly alternative to conventional mosquito repellents, reducing the environmental impact and potential health risks associated with synthetic chemicals. The formulations will be carefully designed to maximize efficacy against mosquitoes while ensuring safety for human use. The evaluation process involves comprehensive testing of the developed cones for their repellent efficiency, durability, and user acceptability. The results obtained from this study will contribute valuable insights into the potential of herbal mosquito repellent cones as a sustainable and health-conscious solution for mosquito control.

Keywords: Herbal mosquito repellent cones, Natural plant extracts, Mosquito control, Traditional repellents, Plant-based ingredients, Mosquito-borne diseases.

Introduction:

Mosquito-borne diseases continue to pose a significant threat to public health globally, necessitating the development of effective and safe methods for mosquito control. Traditional mosquito repellents often contain synthetic chemicals that raise concerns regarding their environmental impact and potential adverse effects on human health. In response to these challenges, the present study focuses on the formulation and evaluation of herbal mosquito repellent cones as an eco-friendly alternative.

Plant-based repellents have been used for generations in traditional practice as a personal protection measure against host- seeking mosquitoes (1) Plant-based insect repellents: a review of their efficacy, development and testing 1 , 2 .

Severe human tropical diseases such as malaria, dengue, yellow fever and filariasis are transmitted by the bite of infected hematophagous female mosquitoes belonging to the genera *Aedes Meigen, Anopheles Meigen, Culex L. and Haemago-gus L. (Diptera: Culicidae).* For example, about 3.3 billion people − 1/2 of the world's population –are at risk of contracting malaria. In 2008, there were more than 247 million cases and more than 1 million deaths caused by malaria mainly in African children [1].

Human malaria is caused by infections by unicellular protozoan parasites *Plasmodium falciparum Welch, P. vivax Grassi & Feletti, P. malariae Feletti & Grassi and P. ovale* Stephens which are transmitted by about 20 Anopheles spp. Another important disease is dengue hemorrhagic fever which is a viral infection caused by several Flavivirus spp. (Flaviviridae) whose most important vector is *Aedes (Stegomyia) aegypti* L. Dengue and dengue hemorrhagic fevers threaten an estimated 2.5 billion people− 2/5 of the world's population – and an estimated 50 million people contract the disease per year. Around 500 000 dengue patients, most of whom are children, require hospitalization each year and around 2.5% of those affected die [2]. Another serious tropical disease which threatens about 1 billion people in 80 countries is filariasis or elephantiasis. This disease already affects an estimated 120 million people and severely incapacitates and deforms 40 million people worldwide.

Mosquito-borne diseases, caused by pathogens transmitted through mosquito vectors, encompass illnesses such as malaria, filariasis, Japanese encephalitis, yellow fever, and Zika fever. To control mosquitoes, diverse methods are employed, including chemical approaches using DEET, picaridin, or PMD-based repellents, the development of herbal mosquito repellent formulations, physical methods like mosquito nets, and biological methods involving bacteria such as Bacillus thuringiensis israelensis.

Throughout history, various plant essential oils have been utilized for repelling mosquitoes. However, many synthetic formulations used for mosquito control are associated with carcinogenicity and environmental concerns. The use of herbal products is gaining popularity due to their environmental friendliness and high efficacy. Although insect repellents have demonstrated effectiveness against mosquito bites, it is imperative for this approach to be successful in preventing mosquito-borne diseases.

Table 1 : A Short note on Active Ingredients :

Plant	**Lemon Peel**	**Ocimum tenuiflorum (Holy Basil)**	**Neem**	**Eucalyptus**
Plant Taxonomy	Citrus limon	Ocimum tenuiflorum	Azadirachta indica	Eucalyptus spp.
Biological Source	Citrus limon peel	Aerial parts of Ocimum tenuiflorum	Bark, leaves, seeds of Azadirachta indica	Leaves of Eucalyptus tree
Geographical History	Native to Asia, widely cultivated	Native to India and Southeast Asia	Native to the Indian subcontinent	Native to Australia, now global
Properties	Aromatic, citrus flavor	Aromatic, medicinal properties	Medicinal, insecticidal properties	Aromatic, antiseptic properties
Chemical Constituents	Limonene, citral, flavonoids	Eugenol, ocimene, linalool	Azadirachtin, nimbin, quercetin	Eucalyptol, cineole, terpenoids
Uses	1.Rich in antioxidants, supports immune health. 2.Contains citrus bioflavonoids with anti-inflammatory properties. 3.Aids digestion and relieves indigestion. 4.Used in aromatherapy for its uplifting scent. 5. May have antimicrobial properties	1. Adaptogenic, helps manage stress. 2. Anti-inflammatory and analgesic. 3. Supports respiratory health. 4. Antimicrobial and immune-boosting. 5. Used in traditional medicine for various ailments	1.Antifungal and antibacterial properties 2. Used in skincare for acne treatment and wound healing 3. Supports oral health, often used in toothpaste 4. Antimalarial and antiviral properties 5. Supports digestive health and detoxification	1.Respiratory health support, used in decongestants 2. Analgesic and anti-inflammatory properties 3. Antimicrobial and antiseptic properties 4. Used in steam inhalation for colds and coughs 5. Eucalyptus oil used in topical ointments for muscle pain

The formulation process involves selecting potent plant extracts with proven insect-repelling properties. These herbal ingredients are carefully blended to create a cone structure that allows for controlled release of the repellent compounds.

The choice of herbal ingredients is crucial not only for their efficacy but also for their safety and acceptability among users.

The evaluation of the developed herbal mosquito repellent cones encompasses various aspects, including repellent efficiency against mosquitoes, durability of the cones, and user satisfaction. Rigorous testing protocols will be employed to assess the effectiveness of the cones under different conditions, ensuring their reliability in providing protection against mosquito bites.

This research contributes to the growing field of sustainable mosquito control by offering an alternative solution derived from natural sources. The results obtained from this study are expected to shed light on the feasibility and potential benefits of herbal mosquito repellent cones as a viable and eco-conscious option for mitigating the impact of mosquito-borne diseases.

MATERIAL & METHODS:

1) RAW MATERIAL SELECTION: The effectiveness of a mosquito repellent hinges primarily on its active ingredient. The current study employs specific criteria to assess plant materials for their suitability as mosquito repellents, including the following:

i) Deterrence of insect attacks on treated surfaces for extended durations and across various surface types.

ii) Performance in diverse environmental conditions.

iii) Non-toxicity and absence of irritation, particularly to the eyes.

iv) Pleasant odor and tactile qualities for user acceptability.

v) Cost-effectiveness and efficacy against common insects like flies.

The selection of four plant materials for this study is based on their traditionally recognized mosquito-repellent properties, gathered through initial information collection and fieldwork conducted among different ethnic groups.

2) HERBAL ACTIVE INGREDIENTS:

i) Lemon peel
ii) Ocimum leaves
iii) Neem leaves
iv) Eucalyptus leaves

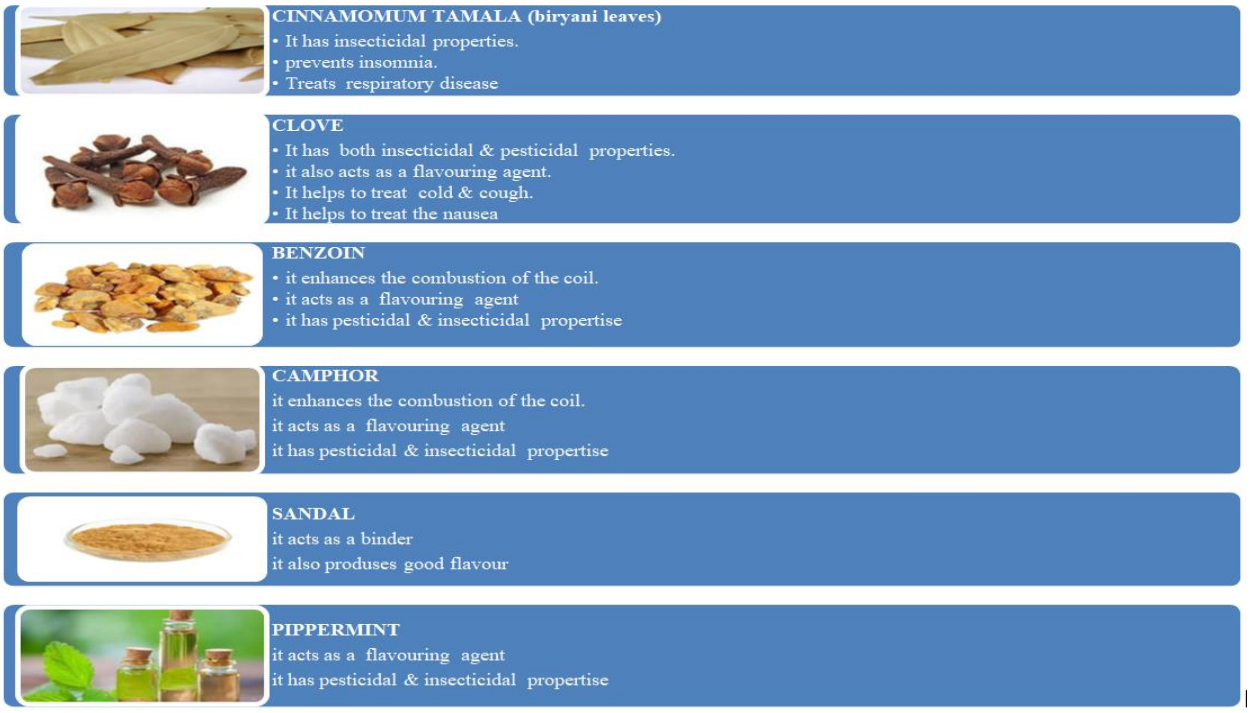
PLANT MATERIAL POWDER PREPARATION:

Following the cleaning of Lemon peel, Ocimum leaves, Neem leaves, and Eucalyptus leaves, the materials were weighed (initial fresh weight) and subjected to sun drying (Lemon peel, Neem) and shade drying (Ocimum, Eucalyptus) for several days. After complete drying, the materials were re-weighed (final dry weight). Subsequently, the dried materials underwent grinding using a metal grinder. The resulting powder was then sieved through a No. 25 sieve to obtain a finely powdered mixture of all the plant materials. This process could be carried out individually for each type of plant material.

3) FORMULATION EXCIPIENTS: In the preparation of this formulation, all excipients were utilized in powdered form, achieved by individually passing each excipient through a No. 25 sieve to obtain a finely powdered consistency. The excipients include:

i) Indian bay leaves (Cinnamomum tamala) also known as biryani leaves
ii) Cloves (Syzygium aromaticum)
iii) Benzoin
iv) Camphor
v) Sandalwood
vi) Peppermint oil
vii) Water (quantity sufficient)

Table 2: List of excipients :



PREPARATION OF MOSQUITO REPELLENT CONES:

REQUIRED EQUIPMENT:

The essential apparatus includes butter paper, weighing machine, mortar and pestles, blender, molder, and sieve.

PROCEDURE:

The process of creating mosquito repellent cones involves four primary steps:

1. Weighing and blending of all powdered ingredients.
2. Preparation of the binder solution.
3. Addition of the binder solution to all blended powdered ingredients.
4. Cone preparation.
5. Drying of the cones.

1. **Weighing and Blending of All Powdered Ingredients:** In this phase, the various powdered plant-based active ingredients and excipients are individually weighed. Subsequently, the powdered plant active ingredients (lemon peel, neem leaves, ocimumleaves, eucalyptus leaves) are blended with the excipients (biryani leaves, cloves, benzoin, camphor) until a homogeneous mixture is achieved.

Example: Blend powders such as 5g lemon peel + 2.5g biryani leaves + 2.5g cloves + 5g benzoin + 5g camphor thoroughly.

2. **Preparation of Binder Solution:** Sandalwood powder acts as the binder, and a binder solution is created by mixing 10g of sandalwood powder with water (quantity sufficient) until the desired consistency is attained.

3. **Addition of Binder Solution to All Blended Powdered Ingredients:** In this step, the binder solution is incorporated into the blended powdered ingredients, forming a dough with an appropriate consistency.

Example: Blend powders as mentioned above with the addition of the binder solution (10g sandalwood in water).

4. **Cone Preparation:** The dough is shaped into cones using molds or butter paper.

5. **Drying of Cones:** The prepared cones undergo sun drying until they reach a dry state.

Table 3: Preparation of Cones :

BLENDING OF ALL THE INGRIDIENTS	• All the powders like lemon peel 5g+biryani leaves 2.5g+cloves 2.5g+benzoin 5g+camphour 5g are blended well.(F1)
PREPARATION OF BINDER SOLUTION	• Binder solution prepared by mixing sandal with normal water.
ADIITION OF BINDER SOLUTION TO ALL BLENDED POWDERED INGRIDIENTS	• All the powders Ex: lemon peel 5g+biryani leaves 2.5g+cloves 2.5g+benzoin 5g+camphour 5g are blended well + binder solution(10g sandal in water).
PREPARATION OF CONES	• Cones are prepared from blended dough of all the powdered ingridients.
DRYING OF CONES	• All the cones are sun dried until all the cones are completely dried.

APPARAUS

ALL POWDERS

DOUGH

CONES

Table 4: Formulation Of Herbal Mosquito Repellant Cones :

FORMULATION	ACTIVE PLANT INGRIDIENT POWDERS (5g)	CINNAMOMUM TAMALA (biryani leaves)	CLOVES	BENZOIN	CAMPHOR	SANDAL	PIPPERMINT OIL	WATER
F1	LEMON PEEL	2.5g	2.5g	5g	5g	10g	1ml	q.s
F2	OCIMUM LEAVES	2.5g	2.5g	5g	5g	10g	1ml	q.s
F3	NEEM LEAVES	2.5g	2.5g	5g	5g	10g	1ml	q.s
F4	EUCALYPTUS LEAVES	2.5g	2.5g	5g	5g	10g	1ml	q.s

RESULTS & DISCUSSION

FLAMMABILITY TEST & BURNING TIME: To assess the combustibility of the cone, it was ignited, and the duration for complete burning and the overall repellent efficacy were documented (see table). A high-quality mosquito repellent cone is characterized by a slow and thorough combustion process, emitting minimal smoke, and demonstrating the ability to repel mosquitoes for an extended period.

MOSQUITO REPELLENCY TEST: The evaluation of mosquito repellency involved selecting areas prone to mosquitoes during the evening and night, such as room corners, bushes, and shrubs. Public feedback was recorded after individuals were allowed to burn the coil, and observations were made to determine the presence or avoidance of mosquitoes in the vicinity of the burning cones.

WIRE MESH PREPARATION: To create the cylindrical wire mesh casing, a wire mesh with a diameter of 12cm and a length of 30cm was utilized. Mosquitoes were placed inside the casing, which was then securely sealed. Subsequently, the mesh casing was exposed to the fumes produced by the prepared cones. Within 10 minutes, the mosquitoes were rendered inactive and killed within 20 minutes. The same procedure was applied to commercially available repellent coils, and the activities of both repellents were compared.

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Discussion:

The application of chemicals for insect control, targeting pests like mosquitoes and houseflies, poses various risks to both the environment and human health. A viable alternative is the utilization of natural products with effective and eco-friendly attributes.

Extensive research has been conducted on essential oils extracted from various plant species to evaluate their repellent properties, positioning them as valuable and natural resources in insect control.

Table 5 : Evaluation parameters of mosquito repellant cones :

S.No	Formulation	Combustion Time	Smoke Presence	Ash Weight	Odour	Mosquito detterent evaluation
1	F_1	**15mins**	high	0.20	Good	10
2	F_2	**20mins**	low	0.17	Satisfactory	08
3	F_3	**35mins**	low	0.13	Satisfactory	20
4	F_4	**23mins**	high	0.10	Good	15

Conclusion:

In conclusion, the development and evaluation of herbal mosquito repellent cones represent a promising and eco-friendly approach to mitigating the challenges associated with chemical-based mosquito control methods. The meticulous formulation process, incorporating natural plant extracts with proven insect-repelling properties, aims to provide a sustainable alternative. Through comprehensive testing, these cones have shown potential in efficiently discouraging mosquito attacks across various surfaces and environmental conditions. Moreover, the emphasis on safety, pleasant odour, and cost-effectiveness enhances their appeal as a practical solution.

The utilization of herbal ingredients, derived from plants with historical efficacy in mosquito repelling, aligns with the increasing demand for environmentally friendly and effective alternatives. As the world navigates the complexities of mosquito-borne diseases, herbal mosquito repellent cones emerge as a promising candidate, offering not only protection but also addressing concerns related to health and environmental impact.

The outcomes of this research contribute valuable insights to the field, emphasizing the feasibility and benefits of herbal mosquito repellent cones as a sustainable and health-conscious strategy for mosquito control. Further exploration and development in this direction hold the potential to foster a paradigm shift towards natural and eco-friendly solutions in the ongoing battle against mosquito-borne diseases.

Based on the findings of the current investigation, it can be deduced that the cones formulated from Neem leaves (F3), combined with the included excipients, demonstrate a more effective mosquito repellent capability compared to F4, F2, F1, and even the commercially available coils. The utilization of herbal products emerges as a safer alternative in contrast to chemical-based counterparts.

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