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NATURAL MOSQUITO REPELLENT STICKS: A REVIEW

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ABSTRACT

Mosquito-borne diseases remain a significant public health concern worldwide. The emergence of insecticide resistance and the adverse effects of synthetic repellents have led to a growing interest in natural alternatives. This review explores the efficacy of mosquito repellent sticks made from neem, marigold, lantanas, Calotropis gigantea, and tulsi. Each plant possesses unique phytochemical compounds with reported mosquito repellent properties. Understanding their effectiveness and potential mechanisms of action can aid in the development of safer and eco-friendly mosquito control strategies. Natural repellents usually contain plant extracts such as citronella, lemongrass, neem oil, and other plant extracts that are known to repel insects Although these substances have proven effective against mosquitoes in the laboratory, but vary in effectiveness under real conditions. Some studies report comparable efficacy of synthetic mosquito repellents, while others highlight limitations, especially in areas with high mosquito populations or during periods of peak activity Safety considerations are of utmost importance when using natural resistance bars. While generally considered harmless, prolonged exposure to smoke from burning wood, especially in poorly ventilated areas, can pose a respiratory hazard to the Skin associated with the wood or its components direct communication can cause sensitive people to become irritated or irritated. Thus, the use of appropriate management guidelines including proper ventilation and avoidance of direct skin-to-skin contact is essential to minimize potential health risks

Keywords: Natural Mosquito Repellent, Repellent Sticks, Neem (Azadirachta Indica), Marigold (Tagetes Spp.), Lantanas (Lantana Spp.), Calotropis Gigantea, Tulsi (Ocimum Sanctum), Phytochemicals, Insect Repellent, Mosquito-Borne Diseases, Eco-Friendly, Plant Extracts, Vector Control, Larvicidal Activity, Essential Oils.

I. INTRODUCTION

Mosquitoes are vectors for various diseases, including malaria, dengue fever, Zika virus, and West Nile virus, posing a significant threat to global public health. Traditional methods of mosquito control often involve the use of synthetic repellents and insecticides. However, concerns over the environmental impact and health risks associated with these chemicals have prompted a search for natural alternatives. Plants have long been utilized for their insect-repelling properties, with several species showing promise as mosquito repellents. In recent years, the use of mosquito repellent sticks made from botanical extracts has gained popularity due to their convenience and perceived safety. This review focuses on five plant species—neem (Azadirachta indica), marigold (Tagetes spp.), lantanas (Lantana spp.), Calotropis gigantea, and tulsi (Ocimum sanctum)—and evaluates their efficacy as mosquito repellents when incorporated into stick formulations.

Combining the actions:

Neem, marigold, lantanas, Calotropis gigantea, and tulsi as mosquito repellents can potentially create a synergistic effect, enhancing the overall efficacy of the repellent formulation. Here's how the combined actions of these plants may work:

- Broad Spectrum Repellent Action: Each plant species contains a unique combination of phytochemical compounds that act as natural insect repellents. By combining these plants, the repellent formulation can target a broader spectrum of mosquito species and effectively repel a wider range of mosquito vectors.
- Enhanced Duration of Protection: Different plant extracts may exhibit varying rates of evaporation and persistence on the skin or surrounding environment. By combining multiple plant extracts, the repellent formulation may achieve a longer duration of protection against mosquito bites, providing extended relief for users.
- Complementary Mechanisms of Action: Each plant species may target mosquitoes through different mechanisms, such as interference with mosquito olfactory receptors, disruption of mosquito feeding behavior, or interference with mosquito development stages. Combining these plants can exploit

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complementary mechanisms of action, making the repellent formulation more effective at repelling mosquitoes at various life stages.

- Reduced Risk of Resistance Development: Mosquitoes can develop resistance to specific chemical compounds over time, rendering conventional insecticides and repellents less effective. By using a combination of plant extracts with diverse chemical profiles, the likelihood of mosquitoes developing resistance to all active ingredients simultaneously is reduced, prolonging the efficacy of the repellent formulation.
- Eco-friendly and Sustainable Solution: Utilizing natural plant extracts as mosquito repellents is environmentally friendly and sustainable compared to synthetic chemicals. By harnessing the repellent properties of multiple plant species, the formulation can offer a greener alternative for mosquito control without harming non-target organisms or disrupting ecosystems.
- Cultural and Traditional Significance: Some of these plants, such as tulsi, hold cultural and traditional significance in various communities. Incorporating these culturally important plants into the repellent formulation may enhance user acceptance and promote the adoption of natural mosquito control practices rooted in local traditions.
- Potential for Customization and Optimization: The relative proportions of each plant extract can be adjusted to optimize the repellent formulation's efficacy, sensory attributes (such as fragrance), and user acceptability. Research and development efforts can focus on refining the formulation to maximize its mosquito-repellent properties while ensuring safety and user comfort.

1. **Neem (Azadirachta indica):**

Fig: Neem (Azadirachta indica)

Neem, also known as Indian lilac, is renowned for its diverse medicinal properties. The active constituents of neem, particularly azadirachtin, nimbin, and nimbidin, exhibit potent insecticidal and repellent effects against a wide range of pests, including mosquitoes. Neem-based repellent sticks have shown promising results in repelling mosquitoes and reducing mosquito bites. Moreover, neem extracts have been found to disrupt mosquito development stages, offering additional control measures against mosquito populations.

2. **Marigold (Tagetes spp.):**

Fig: Marigold (Tagetes spp.)

Marigolds are ornamental plants prized for their vibrant flowers and distinct fragrance. The essential oils extracted from marigold flowers contain compounds such as limonene, α-terpinene, and β-caryophyllene, which possess mosquito repellent properties. Incorporating marigold extracts into mosquito repellent sticks

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has been shown to effectively deter mosquitoes, thereby reducing the risk of mosquito-borne diseases. Additionally, marigold extracts exhibit larvicidal activity, targeting mosquito larvae and interrupting their life cycle.

3. Lantanas (Lantana spp.):

Fig: Lantanas (Lantana spp.)

Lantanas are flowering plants native to tropical regions, valued for their colorful blooms and aromatic foliage. The essential oils derived from lantana leaves contain various terpenoids and phenolic compounds with insect-repelling characteristics. Mosquito repellent sticks formulated with lantana extracts have demonstrated efficacy in repelling mosquitoes, making them a viable option for personal protection against mosquito bites. Furthermore, lantana extracts exhibit larvicidal activity, contributing to mosquito control efforts in breeding sites.

4. Calotropis gigantea:

Fig: Calotropis gigantea

Calotropis gigantea, commonly known as crown flower or giant milkweed, is a perennial shrub found in tropical regions. The latex and extracts of Calotropis gigantea contain cardenolides and alkaloids with insecticidal properties. Studies have shown that Calotropis gigantea extracts possess mosquito repellent activity, making them suitable for incorporation into mosquito repellent sticks. Additionally, the toxic effects of Calotropis gigantea extracts on mosquito larvae offer potential for larval control in mosquito breeding habitats.

5. Tulsi (Ocimum sanctum):

Fig: Tulsi (Ocimum sanctum)

Tulsi, also known as holy basil, holds significant cultural and medicinal importance in many parts of the world. The essential oils extracted from tulsi leaves contain compounds such as eugenol, cineole, and camphor, which exhibit mosquito repellent properties. Mosquito repellent sticks formulated with tulsi extracts have demonstrated efficacy in repelling mosquitoes and reducing mosquito bites. Moreover, tulsi extracts possess larvicidal activity, providing an additional mechanism for mosquito control.

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Plant profile:

1. Neem (Azadirachta indica):

- Description: Neem, also known as Indian lilac, is a fast-growing evergreen tree native to the Indian subcontinent.
- Botanical Features: Neem trees can reach heights of up to 15-20 meters, with dense foliage and small, fragrant white flowers.
- Active Constituents: Neem contains several bioactive compounds, including azadirachtin, nimbin, and nimbidin, which exhibit insecticidal and repellent properties.
- Traditional Uses: Neem has been used in traditional medicine for centuries to treat various ailments due to its antifungal, antibacterial, and antiviral properties.
- Pest Control: Neem extracts are widely utilized in agriculture as natural pesticides and insect repellents.
- Additional Uses: Neem leaves, seeds, and oil are used in the production of soaps, shampoos, cosmetics, and pharmaceuticals.

2. Marigold (Tagetes spp.):

- Description: Marigolds are herbaceous annual or perennial plants known for their vibrant flowers and distinctive fragrance.
- Botanical Features: Marigold plants typically grow up to 30-90 cm in height, with dense foliage and flowers ranging in color from yellow to orange and red.
- Active Constituents: Marigold flowers contain essential oils rich in compounds such as limonene, α-terpinene, and β-caryophyllene, which possess insect-repelling properties.
- Traditional Uses: Marigolds have been used in traditional medicine to treat various skin conditions, inflammation, and digestive issues.
- Pest Control: Marigold extracts are used as natural insecticides and repellents in agriculture and gardening to control pests such as aphids, nematodes, and mosquitoes.
- Additional Uses: Marigold flowers are often used in floral arrangements, culinary dishes, and natural dyes.

3. Lantanas (Lantana spp.):

- Description: Lantanas are flowering plants native to tropical regions, belonging to the Verbena family (Verbenaceae).
- Botanical Features: Lantana plants vary in size from small shrubs to sprawling bushes, with clusters of small, brightly colored flowers.
- Active Constituents: Lantana leaves contain essential oils rich in terpenoids and phenolic compounds with insect-repelling properties.
- Traditional Uses: Lantanas have been used in traditional medicine to treat various ailments, including fever, respiratory problems, and skin conditions.
- Pest Control: Lantana extracts are utilized as natural insecticides and repellents in agriculture and landscaping to deter pests such as mosquitoes, flies, and ants.
- Ecological Impact: Some species of lantanas are considered invasive in certain regions, displacing native plant species and altering ecosystems.

4. Calotropis gigantea:

- Description: Calotropis gigantea, also known as crown flower or giant milkweed, is a perennial shrub native to tropical regions of Asia and Africa.
- Botanical Features: Calotropis gigantea plants can grow up to 3-4 meters in height, with large, waxy leaves and clusters of star-shaped flowers.
- Active Constituents: Calotropis gigantea contains latex and extracts rich in cardenolides and alkaloids, which exhibit insecticidal properties.
- Traditional Uses: Calotropis gigantea has been used in traditional medicine to treat various ailments, including fever, inflammation, and respiratory conditions.
- Pest Control: Calotropis gigantea extracts are utilized as natural insecticides and repellents in agriculture and pest control to combat pests such as mosquitoes, caterpillars, and agricultural pests.

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- Toxicity: Despite its medicinal properties, Calotropis gigantea is toxic to humans and animals if ingested, and precautions should be taken when handling the plant.

5. Tulsi (Ocimum sanctum):

- Description: Tulsi, also known as holy basil, is a sacred herb in Hinduism and is revered for its medicinal and spiritual significance.
- Botanical Features: Tulsi plants are aromatic perennial herbs that can grow up to 60-90 cm in height, with small, fragrant leaves and purple or white flowers.
- Active Constituents: Tulsi leaves contain essential oils rich in compounds such as eugenol, cineole, and camphor, which possess insect-repelling properties.
- Traditional Uses: Tulsi has been used in traditional medicine for thousands of years to treat various ailments, promote longevity, and enhance spiritual well-being.
- Pest Control: Tulsi extracts are utilized as natural insecticides and repellents in agriculture, gardening, and pest control to deter pests such as mosquitoes, flies, and ants.
- Cultural Significance: Tulsi is considered a sacred plant in Hinduism and is often grown in homes and temples for its spiritual benefits and medicinal properties.

Formulating mosquito repellent sticks:

Using neem, marigold, lantanas, Calotropis gigantea, and tulsi involves a step-by-step procedure.

1. Ingredient Preparation:

- Collect fresh or dried plant materials of neem leaves, marigold flowers, lantana leaves, Calotropis gigantea leaves or latex, and tulsi leaves.
- Clean the plant materials thoroughly to remove any dirt or debris.
- Dry the plant materials completely to reduce moisture content and enhance the extraction process.

2. Extraction of Active Compounds:

- Choose an appropriate extraction method based on the desired compounds to be extracted. Common methods include solvent extraction, steam distillation, or cold-pressing.
- Extract the active compounds from each plant material separately to preserve their individual properties.
- Filter the extracted solutions to remove any impurities or solid particles.

3. Formulation Development:

- Determine the proportions of each plant extract to be used in the formulation based on their repellent properties and compatibility.
- Select a suitable base material for the repellent sticks, such as beeswax, coconut oil, shea butter, or a combination of these ingredients.
- Melt the base material using a double boiler or low heat until it becomes liquid and homogeneous.
- Gradually add the plant extracts to the melted base material while stirring continuously to ensure uniform distribution.

4. Addition of Optional Ingredients:

- Consider adding additional ingredients to enhance the stability, consistency, or fragrance of the repellent sticks.
- Optional ingredients may include stabilizers (e.g., vitamin E oil), emollients (e.g., jojoba oil), fragrances (e.g., essential oils), or skin-soothing agents (e.g., aloe vera gel).
- Incorporate these optional ingredients into the melted mixture and stir until thoroughly combined.

5. Pouring and Molding:

- Prepare suitable molds or containers for pouring the repellent stick mixture.
- Pour the melted mixture into the molds or containers while it is still in a liquid state.
- Fill the molds or containers to the desired level, ensuring that there are no air bubbles or gaps in the mixture.
- Allow the mixture to cool and solidify at room temperature or in a refrigerator until the repellent sticks harden and take shape.

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6. Quality Control and Testing:

- Conduct quality control tests to assess the stability, safety, and efficacy of the formulated repellent sticks.
- Test the repellent sticks for consistency, texture, odor, and overall product appearance.
- Evaluate the repellent sticks for their effectiveness in repelling mosquitoes using laboratory assays or field trials.
- Perform safety assessments to ensure that the formulation is non-toxic, non-irritating, and safe for use on human skin.

7. Packaging and Labeling:

- Package the repellent sticks in suitable containers or packaging materials that protect them from light, heat, and moisture.
- Label the repellent sticks with clear instructions for use, including application guidelines, precautions, and storage recommendations.
- Include a list of ingredients, expiration date, and any relevant safety information on the packaging labels.
- Consider using eco-friendly or recyclable packaging materials to minimize environmental impact.

8. Distribution and Marketing:

- Develop a distribution strategy to make the repellent sticks available to consumers through retail outlets, online platforms, or community distribution channels.
- Implement marketing and promotional activities to raise awareness about the benefits of the natural mosquito repellent sticks and differentiate them from synthetic alternatives.
- Provide educational materials and resources to inform consumers about the plant-based ingredients, their repellent properties, and the importance of mosquito bite prevention.
- Seek feedback from users and stakeholders to continually improve the formulation, packaging, and marketing of the repellent sticks based on real-world experiences and preferences.

Repellent Efficacy:

- Measure the effectiveness of the repellent sticks in repelling mosquitoes under controlled laboratory conditions and in field trials.
- Conduct tests to determine the duration of protection provided by the sticks and their efficacy in reducing mosquito landings and bites.

Safety:

- Assess the safety of the repellent sticks for human use by conducting skin irritation tests, sensitization tests, and other relevant safety assessments.
- Evaluate potential toxicity of the ingredients and the formulated product through appropriate toxicity testing.

Stability:

- Determine the stability of the repellent sticks under various storage conditions, including temperature, humidity, and light exposure.
- Monitor changes in physical appearance, texture, fragrance, and efficacy over time to ensure product stability.

Skin Compatibility:

- Evaluate the skin compatibility of the repellent sticks by conducting patch tests or other dermatological assessments.
- Assess skin irritation, allergic reactions, and other adverse effects associated with prolonged use of the product.

Consistency and Texture:

- Assess the consistency, texture, and uniformity of the repellent sticks to ensure ease of application and user satisfaction.
- Evaluate factors such as hardness, smoothness, and spreadability of the sticks.

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Fragrance:

- Evaluate the fragrance of the repellent sticks to ensure that it is pleasant and not overwhelming.
- Consider using natural fragrances from essential oils or botanical extracts that complement the overall sensory experience.

Longevity:

- Assess the longevity of the repellent sticks by determining how long they remain effective after application.
- Conduct studies to determine the residual activity of the sticks on skin or clothing over time.

Environmental Impact:

- Consider the environmental impact of the repellent sticks, including the biodegradability of ingredients and packaging materials.
- Evaluate the eco-friendliness of the formulation and its potential impact on non-target organisms and ecosystems.

User Acceptance:

- Gather feedback from users through surveys, interviews, or product reviews to assess overall satisfaction and user experience.
- Consider factors such as ease of application, comfort, and convenience of use.

Cost-effectiveness:

- Evaluate the cost-effectiveness of the repellent sticks compared to other mosquito control methods, taking into account factors such as efficacy, durability, and affordability.

II. CONCLUSION

Natural mosquito repellent sticks derived from neem, marigold, lantanas, Calotropis gigantea, and tulsi offer promising alternatives to synthetic repellents. These botanical extracts contain phytochemical compounds that effectively repel mosquitoes and inhibit their development, thereby reducing the risk of mosquito-borne diseases. Incorporating these plant extracts into repellent stick formulations provides a convenient and eco-friendly method of personal protection against mosquitoes. Further research is warranted to optimize formulations, assess long-term efficacy, and evaluate their suitability for large-scale mosquito control programs. Embracing natural mosquito repellents not only promotes sustainable pest management practices but also minimizes environmental and health risks associated with synthetic chemicals

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