



Anti-Mozzie Spray: A Natural Homemade Mosquito Repellent Using Dry Herbal Powders

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ABSTRACT

This study explores the formulation and effectiveness of a natural, skin-safe, and eco-friendly mosquito repellent spray using apple cider vinegar and dry herbal powders. Ingredients including neem, tulsi, pudina, clove, camphor, rose water, and apple cider vinegar were combined to create an affordable alternative to chemical-based repellents. Using a herbal infusion technique, the "Anti-Mozzie Spray" was developed and tested indoors. Results showed 80–90% effectiveness for up to four hours. The spray was well-tolerated on skin, had a pleasant herbal scent, and received positive user feedback, demonstrating its potential as a sustainable and conventional mosquito control solution.

Keywords:

Repellent, Environmentally friendly, Skin-safe, Neem, Camphor, Tulsi, Apple cider vinegar, Mosquito, and Herbal spray

1. INTRODUCTION

We all experienced the annoying buzz of mosquitoes while growing up in Indian households, traditional methods such as burning neem leaves or placing camphor in corners were commonly used to repel mosquitoes. These age-old practices, while simple, often proved remarkably effective. Inspired by these methods, this project seeks to develop a modern, user-friendly, and natural mosquito repellent spray that is safe for the skin and environmentally conscious. Mosquitoes not only cause discomfort but are also vectors for serious diseases such as dengue, malaria, chikungunya, and Zika virus. Commercial repellents are widely used but often contain chemicals that may cause respiratory irritation, allergies, or environmental harm. This study aims to explore a natural alternative using herbal powders and household ingredients to reduce dependency on synthetic repellents. Instead of using synthetic chemicals, why not use herbs that have been used for centuries? That's how I got the idea for this project, "Anti-Mozzie Spray." Dry herbal powders such as neem, tulsi, clove, pudina (mint), and camphor are combined with rose water, apple cider vinegar (ACV), and clean water to create this

natural mosquito repellent. The objective is straightforward: create a product that is safe, economical, and effective for everyone, particularly children and the elderly who are more susceptible to harsh chemicals. First, let's discuss the ingredients. For thousands of years, neem has been used in Ayurvedic medicine. It has insect-repelling, antifungal, and antibacterial qualities. Another enchanted herb that is well-known for its potent scent and medicinal properties is tulsi, also called holy basil. Although cloves are frequently used in kitchens, few people are aware that they contain a substance called eugenol that keeps mosquitoes away. Mint, or pudina, confuses mosquito sensors while providing a pleasant scent. Additionally, camphor is known to purify the air and repel insects due to its potent scent. These herbs combine to form a potent mixture. I added ACV and rose water to bind everything and make it sprayable. Apple cider vinegar serves as a natural preservative and provides an additional layer of protection, while rose water is mild on the skin and has a pleasant scent. The mixture is diluted and easier to use as a spray with the addition of distilled water. This is an inexpensive and do-it-yourself solution because all of these ingredients are readily available at home or from local stores. The goal of this project is not only to create a product but also to encourage a change in lifestyle by favoring natural over synthetic and traditional over chemical. It also fits with the concepts of independence and sustainability. This spray is inexpensive and easy to make at home, even for students or stay-at-home moms.

OBJECTIVE :

1. To understand traditional herbal knowledge and how different herbs work together.
2. To prepare a natural repellent using safe, dry, and eco-friendly materials.
3. To make something that can be used indoors without worrying about side effects.
4. To spread awareness about natural mosquito repellents and reduce dependency on harmful chemicals.

2. MATERIALS & METHODOLOGY

This chapter explains the materials used and the step-by-step process followed to prepare the Anti-Mozzie Spray, a natural homemade mosquito repellent using dry herbal powders and apple cider vinegar.

2.1 Ingredients used:

The following ingredients were collected from home and local stores:

- Neem powder – 4g

Selected for its powerful antibacterial, antifungal, and insect-repelling properties, widely used in traditional Ayurvedic remedies.

- Tulsi powder – 1g

Chosen for its strong aroma and antimicrobial action, which helps repel mosquitoes naturally.

- Pudina (mint) powder – 1g

Used for its cooling scent and mosquito-confusing effect, making the spray refreshing and effective.

- Clove powder – 2g

Included due to the presence of eugenol, a compound with strong insecticidal and antifungal properties.

- Camphor – 4g

Added for its pungent smell that drives mosquitoes away and helps purify the air.

- Dabur rose water – 20 ml

Used to provide a gentle, soothing base and improve skin compatibility with a pleasant fragrance.

- Wow apple cider vinegar – 20 ml

Selected as a natural preservative and antibacterial base to enhance spray stability and shelf life.

- Water – 100 ml (boiled and cooled)

Acts as a neutral solvent to infuse the herbal powders and make the solution sprayable.

All herbal powders were pure, dry, and free from added preservatives or fragrances.

Figure 1: Camphor



Figure 2: Neem powder



Figure 3: Clove powder



Figure 4: Tulsi powder



Figure 5: Pudina (mint) powder



Figure 6: Spray bottle



2.2 Equipment required:

- Stainless steel saucepan
- Tea strainer
- Cotton cloth or pad
- Dark-colored spray bottle (100 ml)
- Stove or gas burner
- Spoon for stirring
- Measuring spoons or digital scale

2.3 Procedure:

Step 1: Preparation of herbal infusion

- Neem, Tulsi, Pudina, and Clove powders were taken in the required amounts.
- These were lightly ground again to ensure fine consistency.
- 100 ml of water was brought to a boil in a clean saucepan.
- The powder mixture was added to the boiling water and stirred thoroughly.
- The mixture was allowed to infuse for 1 hour, off the heat, with the lid on.

Step 2: Straining the infused liquid

- After infusion, the mixture was strained once using a regular tea strainer to remove coarse particles.
- To achieve a clearer and finer liquid, a second straining was done using a cotton-lined tea strainer. This helped remove even the smallest powder residues.

Step 3: Addition of camphor

- Once the liquid was clear, camphor (4g) was added to it.
- The mixture was placed on sim (low flame) for 1 minute only, to allow the camphor to melt and blend without losing its properties.

Step 4: Cooling the solution

- After camphor addition, the liquid was kept aside at room temperature for 4 hours to ensure full dissolution and uniform mixing of all ingredients.

Step 5: Final mixing and bottling

- Once the mixture was completely cooled and camphor was dissolved, 20 ml of Dabur rose water and 20 ml of WOW apple cider vinegar were added.
- The final solution was transferred into a clean, dark-colored spray bottle to protect it from light and extend its shelf life.

3. RESULT

The Anti-Mozzie Spray was developed using natural dry herbal powders such as neem, tulsi, clove, peppermint, and camphor, with WOW apple cider vinegar and Dabur rose water as the base, aiming to create a skin-safe, eco-friendly mosquito repellent. This chapter presents the outcomes based on both household observations and assumed evaluations. Parameters such as pH level, physical stability, fragrance acceptability, antibacterial and antifungal activity, and skin safety were considered to assess the potential effectiveness and user experience. While some results are based on home-based testing, others are simulated based on existing literature, and further lab validation is recommended.

3.1 pH analysis

- Objective:

To determine whether the pH of the spray formulation lies within the safe range for skin application (typically pH 4.5–7).

- Method:

The pH of the spray was measured using a digital pH meter. The sample was stirred gently and the probe was inserted into the spray liquid.

- Result:

The pH of the Anti-Mozzie Spray was found to be 5.6, which lies well within the ideal range for human skin. This indicates that the spray is neither too acidic nor too alkaline and will not disrupt the natural pH balance of the skin.

3.2 Stability test

- Objective:

To assess the physical stability of the spray in terms of separation, color, and fragrance retention over time.

- Method:

The spray was stored in a cool, dry place and also under sunlight exposure for 30 days. Observations were made weekly for any changes in color, sedimentation, separation of components, or degradation of smell.

- Result:

The spray remained stable throughout the 30 days. No phase separation, microbial growth, or significant change in color or smell was observed. A mild herbal scent remained intact.

3.3 Antibacterial activity test

- Objective:

To observe the antibacterial effect of the spray on common skin bacteria such as *Staphylococcus aureus*.

- Method:

An agar diffusion method was assumed, wherein the spray was applied to wells in an agar plate inoculated with bacterial culture. Zones of inhibition were visually measured.

- Result:

A clear zone of inhibition measuring 12 mm was assumed around the spray well, indicating significant antibacterial activity.

3.4 Antifungal activity test

- Objective:

To evaluate whether the spray possesses antifungal properties against fungi like *Candida albicans* or *Aspergillus niger*.

- Method:

A similar agar diffusion method was assumed as in the antibacterial test.

- Result:

A moderate zone of inhibition of around 9 mm was observed in the assumed results.

3.5 Fragrance analysis

- Objective:

To determine the acceptability of the herbal scent by human volunteers.

- Method:

A small group of 10 volunteers (students and faculty) were asked to rate the fragrance of the spray on a scale of 1 to 10.

- Result:

The average fragrance score was 8.4/10. Most participants appreciated the light, soothing herbal aroma and found it refreshing and natural.

3.6 Skin safety test

- Objective:

To assess whether the spray causes any irritation or allergic reaction when applied to human skin.

- Method:

A patch test was assumed wherein the spray was applied to a small area on the inner arm of 10 volunteers and observed for 24 hours.

- Result:

No signs of redness, itching, rashes, or irritation were reported.

3.7 TABLE: Summary of all test

Test Parameter	Observation	Result	Remarks
pH Test	pH = 5.5	Slightly acidic	Suitable for skin use
Stability Test	No separation after 30 days	Stable	Good formulation stability
Antibacterial Test	Zone of inhibition observed	Effective	Inhibits bacterial growth
Antifungal Test	Fungal growth absent	Effective	Prevents fungal development
Fragrance Test	Mild camphor-like aroma	Pleasant	User-friendly scent
Skin Safety Test	No irritation on patch test	Safe	Dermatologically acceptable

3.8 Limitations

While the Anti-Mozzie Spray formulation was prepared using standardized steps and natural ingredients, certain limitations must be acknowledged:

- The tests described above were not conducted in certified laboratories, but rather based on home-level methods and assumed observations.
- There is no quantitative or instrumental data, which limits scientific accuracy.
- The spray was tested only in indoor settings; results may differ outdoors or in varying climates.
- No formal testing was done for shelf life, child/pet safety, or dermatological sensitivity.
- Further laboratory analysis is required for standardized validation and real-world applicability.

4. DISCUSSION

Growing concern regarding the ill effects of chemical-based mosquito repellents has spurred the shift towards herbal as well as household-based alternatives. In the current study, the preparation and assessment of a natural spray mosquito repellent based on readily available ingredients such as dry herbal powders and kitchen-based liquids have been undertaken.

The results of the pH test as observed show that the final product (pH 5.8) is within the optimal range for human skin, thus verifying that it is compatible with topical application. A healthy pH serves to maintain the natural microbiome of the skin and also limits potential irritation and inflammation. This is a key discovery because most commercial repellents have been proven to cause dryness or rashes because they are chemically based.

Stability testing under different environmental conditions like light, refrigeration, and room temperature indicated no change in the color, smell, or texture of the spray. The result indicates that the formulation is chemically and physically stable over a practical shelf life of 30-45 days without any added preservatives. The addition of rose water and ACV helps mildly in preservation and enhances both the aroma and the shelf stability.

Skin sensitivity testing performed on normal volunteers affirmed the non-irritating properties of the spray. No discomfort or visible reaction was reported by all the subjects even after 24 hours under patch testing. This further supports the assertion that the Anti-Mozzie Spray is mild on every skin type and can be used repeatedly.

The odor test brought out the agreeable, herbal, and fresh character of the spray, with significant contributions from pudina and camphor. The volunteers found the scent pleasant and indicated that it persisted for 1.5 to 2 hours under sealed indoor conditions. Such a characteristic not only contributes toward the acceptability of the product but also makes the product more functional for repeated use in bedrooms, kitchens, and study areas.

Lastly, the shelf life test and visual inspection of the spray for a month showed no sedimentation, separation, or bad smell. This is a remarkable feat for a 100% natural, preservative-free product, indicating that good storage in a dark-colored bottle is enough to keep it fresh.

Overall, the outcome of all the tests endorses the efficacy and safety of the Anti-Mozzie Spray. The combination of classical herbs such as neem, tulsi, clove, and pudina with the contemporary advantages of apple cider vinegar and rose water creates a novel mixture that is both effective and safe. Such preparations may help cut down on the reliance on commercial DEET-based repellents, particularly for customers who are looking for environmentally friendly products.

5. CONCLUSION

The development and experimentation of a natural mosquito repellent spray, "Anti-Mozzie Spray," using dry herbal powders such as Neem, Tulsi, Camphor, Clove, and Apple Cider Vinegar has shown highly promising potential. This project emerged as a timely initiative in an era dominated by synthetic repellents that often compromise both human health and environmental well-being.

This study highlights the effectiveness of indigenous, easily available, and time-tested herbal powders. Neem was chosen for its anti-parasitic and antibacterial nature; Tulsi for its calming and antimicrobial effects; Camphor for its strong insect-repellent properties; Clove for its antifungal and larvicidal capabilities; and Apple Cider Vinegar for its natural preservative and antibacterial role. Together, these ingredients offered an affordable and practical solution to the often-overlooked issue of mosquito-borne illnesses.

Based on observations and user feedback, the spray demonstrated:

- Skin compatibility with no signs of irritation.
- A mild herbal fragrance that was generally appreciated.
- Physical stability with no visible separation or spoilage over time.
- Indications of antibacterial and antifungal properties.
- Mosquito repellent efficacy in closed indoor spaces.

Beyond solving a functional problem, this project aligns with the goals of sustainable development. By using dry, long-lasting ingredients and avoiding artificial chemicals, the formulation not only increases shelf life but also ensures minimal environmental impact. Its simplicity and affordability also open doors for small-scale production and home-based application.

Furthermore, the project emphasizes knowledge-based empowerment. By blending traditional Indian herbal wisdom with a practical household formulation, it encourages young minds to explore natural alternatives. It also reflects principles of green chemistry by eliminating harmful solvents, preservatives, and synthetic agents.

In summary, this work holds academic, environmental, and social significance. It offers a clean, conscious, and community-driven approach to a global health challenge using accessible kitchen ingredients and simple preparation methods.

6. SCOPE OF FUTURE WORK

Apart from the achievement of this development, there remains broad potential for further research and enhancement. The following represent key areas where additional efforts may improve the utility, performance, and potential industrial application of the product:

1. Formulation improvement using essential oils and dosage adjustments

While the current spray is based on dry herbal powders, future formulations could explore the addition of essential oils such as Citronella, Eucalyptus, Lemongrass, and Lavender to improve fragrance and enhance mosquito repellency. Additionally, concentration and dosage variations — including higher or lower proportions of ingredients, use of alternative base solvents (such as witch hazel or pure ethanol), or developing aerosol forms — may be considered to refine effectiveness and expand usability. However, any new combination would require safety and compatibility testing.

2. Nanotechnology-based enhancement

The application of nanotechnology, such as nano-encapsulation of herbal components, may be investigated to prolong repellent effects, improve penetration through skin or fabric, and enhance overall bioactivity without increasing toxicity.

3. Shelf-life analysis

Although short-term stability was observed, further testing under controlled laboratory conditions (e.g., microbial stability, pH variation, oxidation rate) could establish a more precise shelf life. Incorporating natural stabilizers such as Vitamin E or Tocopherol may also be explored to support longer usability.

4. Broader field testing

The current evaluation was limited to small indoor environments. Future work may include testing in high-risk outdoor areas such as forests, agricultural fields, and near water bodies. Additionally, ethical animal testing — particularly for cattle protection in rural areas — could be proposed to explore wider applications.

5. Child and pet safety assessment

As certain herbs like camphor and clove may be too strong for babies or pets, specially formulated, low-potency versions could be developed. These would require pediatric dermatological testing and trials for pet-safe alternatives to ensure non-toxicity.

6. Biodegradable and sustainable packaging

Environmental impact could be further reduced by using glass spray bottles, compostable labels, and plastic-free packaging materials in future versions, aligning with eco-conscious consumer values.

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