



Formulation and evaluation of natural mosquito repellent hoop cones

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Abstract

Mosquitoes are found all over the world and are responsible for spreading diseases like malaria, dengue, and yellow fever. Controlling mosquito populations and protecting oneself from mosquito bites are crucial in preventing the spread of these infectious diseases. Mosquitoes carry a wide range of illnesses, so it's important to use mosquito-repelling solutions. There is also a growing market for "natural" DEET-free repellents. These repellents come in various forms such as spray, lotion, and wearable items and they contain active ingredients like picaridin, IR 3535, and essential oils such as eucalyptus and lemongrass. These repellents work by reducing the likelihood that mosquitoes will be attracted to human scent. According to the Environmental Protection Agency (EPA), natural oil painting-based insect repellents can be safely used by adults and children older than two months when used as directed.

Keywords: Mosquito attractants, Standardized procedures, Repellent efficacy, laboratory testing, spatial repellency, contact repellency, and techniques review ,limonene oil, camphor, activated charcoal, turmeric.

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Introduction

Oranges, belonging to the Rutaceae family, are citrus fruits that are packed with dietary fiber and vitamin C, along with other essential nutrients. Their round or oval-shaped form is covered with tough, orange or yellow-orange skin, and the juicy, sweet or sour segmented interior varies with the specific variety [1]. While there are numerous treatments for malaria and other mosquito-borne diseases, preventing illness altogether is always the preferred approach. This has led to the creation of "mosquito repellent," which works by making surfaces uncomfortable for mosquitoes. These repellents, whether in the form of chemicals, medicinal herbs, or essential oils, have been shown to have various pharmacological effects, including deterring insects and mosquitoes. Natural medicines are more widely accepted due to their perceived safety and fewer adverse effects compared to synthetic ones [2-12].

To reduce mosquito populations, chemical insect repellents are commonly used to eliminate adult mosquitoes, prevent them from biting people, or eradicate mosquito larvae at their breeding grounds. As mosquito-borne illnesses pose serious health risks and are becoming harder to control due to increasing mosquito reproduction and chemical tolerance, synthetic pesticides and repellents have been extensively employed to combat them [13].



Fig 1. Mosquitoes involvement in the spread of several diseases

The following are the various mosquito species and the illness they can cause:

1. Aedes mosquito

This mosquito is responsible for diseases like Dengue fever, West Nile fever, yellow fever, and Zika virus. The bodies and legs of these mosquitoes are easily recognized

by their characteristic black and white patterns.

2. The albopictus mosquito

This Often known as the Asian tiger mosquito, this species is responsible for the spread of several viral illnesses, such as dengue, Zika, and yellow fever. Furthermore, it carries a number of filarial nematodes, including *Dirofilaria immitis*. Tropical and subtropical regions, particularly those in Southeast Asia, are typically home to this type of mosquito. 3. Infections like malaria are associated with the marsh mosquito, or *Anopheles* mosquito.

Types of repellent mosquitoes

These are numerous natural and synthetic repellents that can be used to ward off mosquitoes.

1. Synthetic

The most potent repellent is a synthetic chemical called DEET. It is essentially a poison that masks the body's organic odour and emissions of carbon monoxide.

A comparison of synthetic repellents revealed that IR3535 (3-[Nbutyl-N-acetyl] amino propionic acid, ethyl ester) lasted longer than "natural" repellents and was just as efficient at keeping mosquitoes away as DEET. DEET exposure raised the risk of mood fluctuations, insomnia, and cognitive impairment. Icaridin also known as picaridin. Is produced by DEET (N, N diethyl-m-toluamide)

The benefits of using synthetic repellents

Repellents with "Natural" active components are less effective than synthetic ones containing DEET or Picaridin. The natural repellent solutions were most effective for the first 30 to 60 minutes and required reapplication to be useful over several hours, while all the synthetics provided almost 100% [3 -4] Repellency for the first two hours. Synthetic repellents have drawbacks such as causing rashes, edema, eye discomfort, and worse issues though they are uncommon and can include brain swelling.



Fig 2. Plants that having the ability to repel mosquito

2. Natural Way

Physical method : Regularly changing the water in the fowl shower: purging the ancient tires, buckets, plastic covers etc of stagnant water at least once a week, such as pools, rain barrels, showers and well springs wearing full sleeved clothing to secure yourself is moreover exceptionally imperative, particularly at first light and night fall. Settle your Entry way or window screens to keep mosquito's out. In comparison to coils and other possibly perilous repellents, mosquito nets are accepted to give way better security against mosquitos. If you rest beneath mosquito netting you may be confident that you are ensured from creepy crawlies [14,15,16].

Chemical Constituents

Table: 1 Chemical Constituent

S.No	INGREDIENTS	QUANTITY	ROLE
1.	Neem leaves powder	5gm	Insecticide, mosquito repellency
2.	Orange peel powder	2gm	Insecticide
3.	Camphor	2gm	Air purifier
4.	Lemon eucalyptus oil	1ml	Natural mosquito repellency
5.	Sandlewood oil	1ml	Flavouring agent
6.	Cow dung powder	2gm	Bio fuel
7.	Activated charcoal	10gm	Combustion
8.	Gum acacia	2gm	Binding agent

Materials and Methodology

1. Azadirachta indica or neem

Azadirachta indica, or neem, is a plant with strong anti-insect feeding qualities. When consumed in extremely little amounts by moth larvae, it effectively impedes their transformation. In addition to azadirachtin, other chemicals that are considered major liminoids that are effective against insects and pests include salanim, gedunin, azadinone, nimbin, nimbidine, nimbicidine, and nimitinolare. By altering the life cycle of insects, Azadirachta indica's active ingredients prevent their growth. Fresh neem leaves were taken from Ashokrao Mane College of Pharmacy's herbal garden in Peth Vadgaon. They were then washed with tap water and allowed to dry in the sun for four days in a row.



Fig 3: Neem plant an essential oil

2. Orange peel powder

Because orange peel powder contains bioactive ingredients such terpenes and flavonoids, it has larvicidal effects on mosquito larvae. These components disrupt the mosquito life cycle by acting on their larvae, making orange peel powder a crucial element in mosquito management efforts, particularly for removing breeding areas.



Fig 4: Dried Orange peel powder

3. Camphor

The original form of camphor is an oily, white resin derived from the *Cinnamomum camphora* tree. Additionally commonly accessible in the market are its crystals. It is a proven mosquito and ant repellent that has been used for generations.



Fig 5 :Original Camphor

4. Cow Dung Powder

In many rural areas where cattle are regularly grown, cow dung powder is commonly accessible. In addition, it is less expensive than traditional repellents for mosquitoes. Cow dung powder is a practical option for controlling mosquitoes because of its availability and affordability, especially in places with low resource.

5. Sandal wood oil

Odors have the power to favorably affect emotions and mood. When used as mosquito repellents, medicinal fragrances found in perfumes can evoke feelings of relaxation, comfort, or invigoration. This could improve outdoor experiences and reduce the stress or anxiety associated with areas where mosquitoes are common [18, 19].

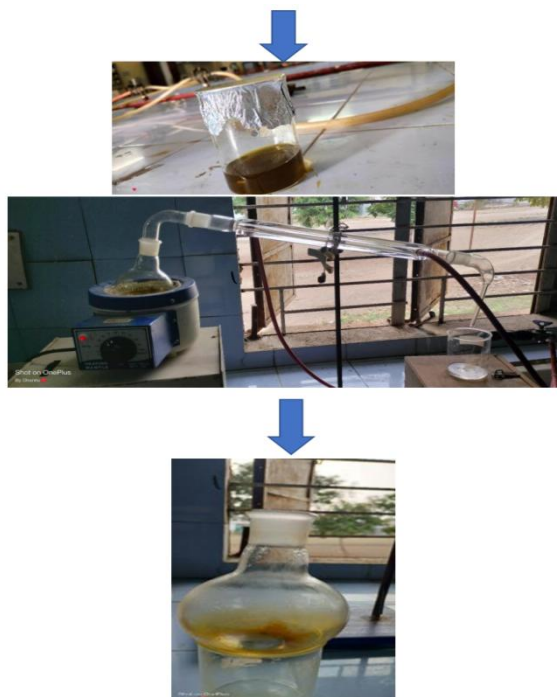


Fig 6: Method of Obtaining Additional Essential oils

Procedure

1. All the powders were weighed according to the formula and properly mixed in a mortar pestle.
2. Powder the shed dried herbal material. The orange peel, neem leaves, cow dung were shed dried and powdered by using domestic grinder and mixed to the above powder mixture.
3. It is combined with finel ground camphor powder.
4. Acacia and charcoal were mixed into water.

5. The powder combination is added to the hot liquid.
6. The mixture was cooled completely and made into a thick paste.
7. Then the mixture was moulded into the shape of cones.
8. Gradually add an adequate amount of sandal wood oil to form a batter, shaping it into cone-like structures.
9. Sun-dry the formed dhoop until they are completely rigid and thoroughly dry.
10. Subsequently, carry out an assessment of the final product [20, 21].



Fig 7: Making of mosquito repelling incense



Fig 8: Natural Mosquito Dhoop Cones

Evaluation Tests

1. Cage Test

This test entails putting a mosquito in a cage and then setting a nearby dhoop on fire. To find out if the dhoop repels the mosquito, you can watch how it behaves. It is a sign that the Dhoop is working if the mosquito stays away from the vicinity.

2. Mosquito Landing Test

This test counts how many mosquitoes land on an individual exposed skin when they are near the Dhoop. One way to conduct this test is to have someone sit in a room with Dhoop burning and count how many mosquitoes land on their skin in a predetermined amount of time, like five minutes.

3. Fume Test

This test determines the presence of particular compounds by identifying the color and smell of the fumes generated when a product burns.

4. Toxicity Test

To make sure the prepared Dhoop is safe to use, a toxicity test is conducted. All of the ingredients utilized in the formulation, including charcoal, camphor, turmeric, and limonene oil, were non-toxic.

5. Irritability test

This test is used to determine whether the prepared Dhoop irritates the skin in any way [22].

Table 2: Evaluation Parameters of Herbal Mosquito Repellent Dhoop.

S.No	PARAMETERS	HERBAL DHOOP CONE
1.	Burning time	10 min
2.	Odour	Satisfactory
3.	Irritation	No irritation
4.	Smoke visibility	High
5.	Ash weight (g)	0.867 gm
6.	Mosquito repellent activity	8 min
7.	Colour	black

6. Burning on Users

To do the test, simply collect mosquitoes from both daytime and nighttime locations. They looked at mosquito repellent operations for a while before recording the public's reaction. We observed and documented any adverse reactions to the prepared incense sticks, such as soreness, coughing, or crying.

7. Organoleptic Test

By examining the composition, this test evaluated the repellent candles' texture, color, and scent.

8. Mosquito Killing Time

This test is done to see how fast or slow you can kill a mosquito [24, 25].

Result

It was discovered that exposure to the dhoop created using the previously described procedure inhibited the majority of mosquito growth on plates with various aeromicroflora. The toxicity test for the prepared dhoop was 0.90%, while the traditional preparation's toxicity test was 0.99%. The test we took and its outcome were listed in the table no. 02 containing the test and we had their result. Every formulated cone was tested in a laboratory in a standard usual room environment in a confined area with a greater population of mosquitoes, by lightening and contrasting with the same size aromatic herbal cone and flammability rate, burning efficiency with respect to burning time and over all efficient repellent operation.



Fig :9 Natural mosquito repellent cone

Discussion

To keep mosquitoes away, an old-fashioned, natural solution is to prepare mosquito repellent dhoop out of orange peels. The mixture is rolled up and placed in the sun to dry into little dhoop cones. Once the dhoop cones have dried, you may light them and place them in an area to keep mosquitoes away. This natural repellent works rather well at keeping

mosquitoes away, while it may not be as efficient as chemical-based repellents. The goal of the current study is to create a herbal-based mosquito-repellent dhoop cone by utilizing neem powder and eucalyptus oil as fillers in combination with cow dung. Supporting excipients are also included in the mixture. In this instance, the herbal powder's ability to deter mosquitoes is evaluated.

Summary

To make the dhoop, the orange peels are dried and then ground into a fine powder. This powder is combined with other natural insect repellents like camphor and activated charcoal powder. The mixture is then formed into a paste and shaped into the shape of tiny cones or sticks that can be smoked like regular incense. When smoked, the dhoop releases a pleasant smoke that keeps insects like mosquitoes away. Mosquito repellent made from orange peels is an organic and natural replacement for repellents with chemical basis.

Conclusion

The study on repelling mosquitoes that was previously analyzed indicates that natural repellents are more effective than synthetic ones. Natural repellents may need to be reapplied more regularly to provide complete protection because they can evaporate completely. It's also imperative that you use the dhoop in an area with enough ventilation and that you follow all the safety precautions when lighting and operating it. In general, creating an insect repellent dhoop could be a risk-free and effective way to keep mosquitoes away, but it's important to take caution and evaluate the product's performance and safety thoroughly. The herbal-based mosquito repellent Dhoop cone exhibits outstanding effectiveness against mosquitoes while posing no negative side effects. The dhoop cone was inexpensive, safe to use, and environmentally beneficial. All age groups can utilize it and find it easy portable. Herbal dhoop cone is highly suggested for the formulation of mosquito repellent dhoop cone since it gives out a nice smell and deters mosquitoes.

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Conflict of Interest

No Conflict of interest

Informed Consent and Ethical Statement

Not Applicable.

References

1. Preparation of Mosquito Repellent Dhoop from Orange Peel 2) Sahu B., Dutta S., Mishra S. P., Khute S., Kumar L., Gupta A. S., Dewangan K.: A brief review on dhoop and its properties, *Journal of Preventive Medicine and Holistic Health* 2021, 7(1), 3-9.

2. Trivedi A., Rai P. and Jitendra Kumar: Formulation of low smoke herbal mosquito repellent sticks by using different essential oils, *The Pharma Innovation Journal* 2018, 7(4) 173-175.
3. Ruchi S. Shivhare, Manish A. Kamble, Mahapatra D. K., Ingole A. R., Baheti J. R., Bisen A.: Development of mosquito repellent gel formulations from various natural volatile oils: comparative study with the marketed formulation odomos®, *Journal of Drug Delivery & Therapeutics* 2018, 8(6), 106-110.
4. Ponkiya N., Desai S., Mistry J., Patel S., Ingalhalli R.: Development of economical mosquito repellent using marigold plant, *International Journal for Research Trends and Innovation* 2018, 3(11), 47-54.
5. Mendhekar S. Y., Bodke N. N., Thorat P. B., Jadhav S.L., Gaikwad D.D.: Formulation and evaluation of polyherbal mosquito repellent creams (ointment type) with extra skin nourishing impact, *World Journal of Pharmacy and Pharmaceutical Sciences* 2017, 6(12), 1731-1742.
6. Rwang P. G., Effoim O. E., Mercy K. P., Etokakpan A. M.: Effects of *Psidium guajava* (guava) extracts on immature stage of mosquito, *International Journal of Complementary & Alternative Medicine* 2016, 4(5), 1-5.
7. Ranasinghe M. S. N., Arambewela L., Samarasinghe S.: Development of herbal mosquito repellent formulations, *IJPSR* 2016, 7(9), 3643-3648.
8. Lad N., Palekar S.: Preparation and evaluation of Herbal Dhooop for cleansing the air, *International Journal of Herbal Medicine* 2016, 4(6), 98-103.
9. Gupta P., Vasudeva N.: Marigold: A Potential Ornamental Plant Drug, *Hamdard Medicus* 2012, 55(1), 45-59.
10. Kamaraj C., Bagavan A., Elango G., Zahir A. A., Rajakumar G., Marimuthu S., Santhoshkumar T., Rahuman A. A.: Larvicidal activity of medicinal plant extracts against *Anopheles subpictus* & *Culex tritaeniorhynchus*, *The Indian Journal of Medical Research* 2011, 134(1), 101-106.
11. Bagavan A., Rahuman A. A.: Evaluation of larvicidal activity of medicinal plant extracts against three mosquito vectors, *Asian Pacific Journal of Tropical Medicine* 2011, 29-34.
12. Elissa AH, Nicole FA, Laurence J and John R. "Olfaction: Mosquito receptor for humansweat odorant". *Nature*. 2004;427(6971): 212-213.
13. Medicated mosquito nets mooted to fight malaria: The Hindu, Online edition of India's National Newspaper, 2006.
14. <http://www.mosquito netting. com / mosquito control.html>.
15. Enayati AA, Hemingway J and Garner P. Electronic mosquito repellents for preventing mosquito bites and malaria infection, *Cochrane Database Syst Rev*. 2007; 18: 34-42
16. Biswas, A., Pal, S. (2011). Mosquito larvicidal activity of some essential oils and their major constituents. *Journal of Environmental Science and Health, Part A*, 46(1):1-8.
17. Chand, S., Kaushik, R. K. (2012). Efficacy of mosquito repellent formulations containing essential oils of *Ocimum sanctum* and *Cymbopogo*
18. Kadam, V. S., Jadhav, S. K. (2012). Mosquito larvicidal activity of some essential oils and their major constituents. *Journal of Environmental Science and Health, Part A*, 47(1):1-8.
19. Yelmate AA, Thonte SS. Ethnobotanical Survey of Plants on Hattibet (Deverjan) District Latur Maharashtra. *Journal of Pharmacognosy and Photochemistry*. 2018; 7(3):1345-1348.
20. Yelmate AA, Satpute KL, Design, 2024. Development and Evaluation of Polyherbal Soap against Bacterial Skin Infections. *Journal of University Of Shanghai for Science and Technology* 25(12) 41-51.
21. Yelmate A.A. and Dr. Thonte s.s, Phytochemical Screening by FTIR Spectroscopic Analysis of Some Indian Medicinal Plants, *European Journal of Molecular & Clinical Medicine*, 2020; 7(11): 4362-4371.
22. Caraballo AJ. Mosquito repellent action of Neemos. *J Am Mosq Control Assoc*. 2000; 16:45-46.
23. Chaiyakunapruk N., Kongkaew C., Sakunrag I., Tawatsin. Effectiveness of citronella preparations in preventing mosquito Bites: systematic review of controlled laboratory experimental studies. *Tropical Med Int Health* 2011; 16: 802810.
24. Curtis CF, lines JD, Ijumba J, Callaghan A, Hill N, Karimzad MA. (1987). The relative efficacy of repellents against Mosquito vectors of disease. *Medical veterinary entomology* 16: 109-119.