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Formulation and Evaluation of Mosquito Repellent Candle

¹Riya A. Bharate, ²Vaibhav S. Nikam, ³Tauhid B. Mulani

Associate Professor, Dept. of Pharmaceutics, Vidya Niketan College of Pharmacy, Lakhewadi (Indapur), Pune ²Student, Vidya Niketan College of Pharmacy, Lakhewadi (Indapur), Pune ³Student, Vidya Niketan College of Pharmacy, Lakhewadi (Indapur), Pune

Abstract: Modern and conventional herbal therapy for illness prevention primarily derives from herbal plants, which contain a variety of biologically active substances that are beneficial for enhancing one's quality of life. as an environmentally responsible substitute for chemical repellents. Combining a suitable wax base for maximum burning, the candle contains a blend of natural essential oils, such as lemon, lavender, and rosemary, that are known for their ability to repel insects. The number of illnesses brought on by mosquitoes is increasing day by day. Yellow fever, dengue, zika virus, filariasis, malaria, and chicken-gunya are among the illnesses that are frequently brought on by mosquitoes. The created candle was tested at room temperature in the lab. The created candle is assessed for Organoleptic Character colour, Fragrance, texture, testing for irritability, flammable Test. humans health and insects can benefit from the use of herbal mosquito repellent candles. To ensure safety for indoor usage while optimising efficacy, the formulation process required figuring out the perfect concentrations for each essential oil. Through field testing in controlled circumstances, the duration and efficacy of mosquito deterrent were measured in order to assess the candles' repellent ability. The assessment also included physical attributes including stability, scent throw, and burn time. The outcomes demonstrated that the polyherbal composition considerably decreased mosquito attraction; an ideal mix demonstrated *improved efficacy*

Keywords: Herbal; Mosquito; repellent; candle

I. INTRODUCTION

Mosquitoes are perhaps the most alarming insect-sucking blood that afflicts humans. Anophelesspecies of flies, The genera Culex and Aedes are vectors for multiple disease diseases such as Dengue, fever, malaria, yellow fever etc. The mosquitoes insert their saliva into the host 's blood and induces an immune response by binding the IgG and IgE antibodies to the antigens. The reactions cause pain, scratching, redness and often it transforms into the bumps. It's the mosquito's saliva that also creates a severe irritation, scratching rash. Mosquito bites can also cause severe skin irritation via the human interaction with the mosquito via an allergic response to the saliva. ^[1]

Polyherbal formulation plays a crucial function in treating multiple medical disorders. Numerous polyherbal formulas are used in ethanomedic science as well as in the world's conventional medicines system. The important logical method of this polyherbal mixture serves as the foundation of clinicians in the field of science. ^[2]

Polyherbal formulas were systematic attempts to use experimental techniques to show the efficacy of herbal extracts. There is actually a revived interest in conventional drugs, from both an academic and an industrial standpoint. Gradually, concerted attempts against mosquito-borne diseases have been made to keep up with medical understanding of herbal medicines. In ancient, polyherbal formulation has substantial attempts to avoid mosquito-borne diseases. [3] Natural repellents-Most repellents are available today that can quickly ward off the mosquitoes but are not ideal for the safety as they contain a toxic chemical called DEET. A chemical repellent that can make you unattractive in mosquitoes' eyes is perfect to use. Candles containing citronella oil that are repellent to mosquitoes are commonly marketed in the United States. ^[4]

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Fig no.1: Mosquito^[5]

Mosquito-Borne Diseases:

Malaria: Plasmodium parasites, which cause malaria, are spread via female Anopheles mosquito bites. ^[6] Malaria is still a major problem worldwide; in 2022, there were roughly 249 million cases, which resulted in nearly 619,000 fatalities. Children under five and pregnant women are more vulnerable. Severe anemia can result from malaria.

Dengue: The mosquitoes Aedes aegypti and Aedes albopictus are the culprits behind dengue. Dengue fever is widespread, especially in portions of Africa and the Americas. About 4.1 million suspected dengue cases were reported in the Americas in 2023, with 2,049 fatalities and 6,710 severe cases. With more than 2.9 million suspected cases, Brazil had the most. There was a major dengue outbreak in Africa, with 688 fatalities and 146,878 probable cases. Hospitalization and even death are possible outcomes of severe dengue, especially in youngsters and people with weakened immune systems.^[6]

Chikungunya: The Aedes aegypti and Aedes albopictus mosquitoes are the cause of chikungunya. Chikungunya cases have significantly increased across the Americas as of 2023; in the first few months alone, nearly 214,000 cases were documented. Particularly hard hit is Paraguay, which has 138,730 cases, the most in its history. Bolivia has had high levels of dengue and chikungunya transmission, while other nations such as Uruguay and Argentina have also recorded local transmission for the first time. Severe joint pain and a sudden onset of fever are hallmarks of chikungunya. Usually lasting a few days, this joint pain can sometimes linger for weeks, months, or even years ^[7]

Life cycle of Mosquitoes:

There are four unique phases in a mosquito's life cycle: egg, larva, pupa, and adult.

Egg: On or close to water surfaces, female mosquitoes deposit their eggs. Both single and clustered eggs can be deposited. The time it takes for the eggs to hatch which depends on the environment can range from a few days to many weeks.^[8] Larva: The larvae, also referred to as "wigglers," reside in the water after hatching. Known as "in stars," they go through four stages of growth. Larvae consume aquatic organic materials, such as bacteria and algae. They use a siphon at the water's surface to breathe air.

Pupa: Mosquitoes transition from the larval to the pupal stage, which is referred known as "tumblers" because to their aquatic mobility. The mosquito transforms into its adult form during this non-feeding stage. Depending on the species and the climate, the pupal stage might last anywhere from a few days to a week.

Adult: After emerging from the pupal case, the adult mosquito lays on the water's surface to dry its body and wings before taking off. Depending on their species and the habitat, adult mosquitoes can live anywhere from a few weeks to many months. In order to grow their eggs, female mosquitoes look for blood meals, but males typically consume nectar and other plant fluids. Under ideal circumstances, the entire life cycle from egg to adult can be completed in as little as 8-10 days, but environmental considerations may cause it to take longer.

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Fig. 2 : Life cycle of Mosquito^[9]

Mechanism of Action of Mosquito Repellence:

Mosquito repellents usually operate by either utilizing a scent that mosquitoes naturally shun and find unpleasant or by disguising the scent of humans. ^[10] The olfactory receptors (ORs) and gustatory receptors (GRs) of mosquitoes are the targets of mosquito repellents. Repellants work by interfering with these receptors, which makes it harder for mosquitoes to locate and attack people. Mosquitoes locate their hosts by using their olfactory apparatus to detect carbon dioxide [CO2] and other human scents. Heat sensors are used by mosquitoes to identify body heat released by warm-blooded hosts. In order to prevent landing and biting, repellents that function as contact irritants. ^[11]



Fig No. 3- Mode of action of Mosquito Repellence^[12]

Polyherbal Mosquito Repellent Candle:

A polyherbal mosquito repellent candle is a kind of candle made with natural substances to keep insects away. Usually, plant-based natural herbs and their essential oils which are known to have mosquito-repelling qualities are used to make

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it. Natural waxes like soy, beeswax, or palm wax are also frequently used in these candles. This has gained popularity as an environmentally friendly substitute for chemical repellents. Although chemical-based solutions are frequently used to control mosquitoes, they are hazardous to humans due to their synthetic components. The market is seeing an increase in demand for the creation of herbal-based insect repellents as a result of these toxicity issues. ^[13]

Advantages of herbal mosquito repellent candles:

- Herbal mosquito repellent candles are lighter in weight, height hence is easy to use, handle anywhere and transport.
- They contain essential oils used for repellent properties which impart a pleasant fragrance over strong scent.
- They contain natural ingredients and natural essential oils hence they are safe and less likely to cause irritation to skin or allergic reactions.
- They are Eco-friendly as they are biodegradable.
- Herbal mosquito repellents are generally less toxic to non target organism.

Need of Study:

The study of herbal mosquito repellent candles is essential due to the growing concerns over the health and environmental risks associated with chemical-based repellents. Many conventional mosquito repellents contain synthetic compounds like DEET, which may cause skin irritation, respiratory issues, and long-term health effects with frequent use. In contrast, herbal alternatives made from natural plant extracts such as citronella, lemongrass, eucalyptus, and neem offer a safer, eco-friendly solution. Research into the effectiveness, safety, and longevity of herbal mosquito repellent candles can help develop sustainable and non-toxic options for mosquito control, especially important in regions prone to mosquito-borne diseases like malaria and dengue. Such studies also support the promotion of traditional knowledge and the use of renewable resources.

Aim & Objective

Aim:

The aim of developing a herbal mosquito repellent candle is to create a natural, safe, and ecofriendly alternative to chemical-based repellents for effectively repelling mosquitoes and reducing the risk of mosquito-borne diseases.

Objectives:

- To formulate a mosquito repellent candle using herbal ingredients such as citronella, neem, lemongrass, or eucalyptus oils.
- To evaluate the effectiveness of the herbal candle in repelling mosquitoes in indoor and outdoor environments.
- To ensure the safety and non-toxicity of the candle for human use and the environment.
- To promote the use of renewable, biodegradable, and locally available natural resources
- To offer a cost-effective and sustainable mosquito control solution, especially for rural and tropical areas.

PLAN OF WORK:

Review of Literature Selection of suitable drug and excipients Preparation of herbal extracts Pre-formulation study Phytochemical analysis for the prepared extracts Development of herbal formulation for the prepared extract Evaluation of the developed formulation

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II. MATERIALS AND EQUIPMENT

Beeswax

Synonym: Yellow wax, Cera alba

Biological source: Honeycomb of the honey bee, Apis mellifera Linn and other species of Apis Family: Apidae. **Chemical constituents**: Ester of fatty acids and long – chain alcohols



Fig. 4. Beeswax

Neem

Synonym: Nimba, Margosa.

Biological source: Neem is fresh or dry leaves and seed oil of Azadirachta Indica.

Family: Meliaceae.

Chemical Constituents: Azadirachtin, Nimbin, Nimbidin, Nimbidol, Gednin, Sodium Nimbinate





Uses

Neem leaves extract can be used as an insecticide or mosquito repellent in herbal mosquito repellent candles. In which Active Ingredient is Azadirachtin.It has been demonstrated to prevent the reproduction of aquatic larvae like mosquitoes and plant-feeding larvae as well as their larval, pupal, and adult moults. Neem is among the safest ways to prevent mosquitoes from biting your body. Neem's efficacy lasts for around three hours and can repel 70% of mosquitoes. [14] Neem is helpful in the treatment of a variety of skin disorders, wounds, and infections due to its inherent antibacterial and antifungal qualities. Also helpful in Antipyretic. ^[15]

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Camphor

Synonym: Camphora, Gum camphor Biological source: wood of the camphor Laurel tree (Cinnamomum camphora). Family: Lauraceae

Chemical

Constituent: 1% essential oil (cineol, pinene,thymol, menthol), wood contain around 3%.



Fig 6. Camphor

Uses

camphor for itchiness, pain, and cough. Insect bites, acne, and numerous other ailments are also treated with it. A powerful sense of smell is possessed by mosquitoes. They use the scent of carbon dioxide emissions from human bodies to locate them. Thus, while burning camphor in a space, the mosquitoes are repelled from it by its potent scent, which also disorients them with their own odour. Your house will release them from their hiding places as soon as they scent it.

Tulsi

Synonym: Ocimum sanctum, Ocimum tomentosum Common Name: Holy Basil, Sacred Basil. Biological source: It consist of fresh and dried leaves of Ocimum Species like Oscimum sanctum L. And Ocimum basilicum L. Family: Lamiaceae

Chemical

Composition: Volatile Oil (linolol, eugenol, ocimemene, citral, thymol), vitamins and mineral, other compound.



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Fig 7. Tulsi oil **DOI: 10.48175/568**





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Uses

All sections of the plant, including the stem, leaves, seeds, roots, and flowers, are medicinal. Numerous ailments, including sore throats, kidney stones, eye conditions, respiratory issues, coughs, and stress, are treated with it. It is also used by people as a mosquito repellent. It can assist in calming, repairing, And revitalizing the skin.^[16] Help to prevent hairfall, minimize the gray hair, help in thickness.^[17]

Clove powder

Synonym: caryophyllum, Laung Biological Source: The dried, unopened flower of clove tree. Family: Myrtaceae

Chemical

Composition: Eugenol acetate, Beta caryophyllene and alpha humulene



Fig 8. Clove powder Uses:

Antimicrobial properties: Cloves have antibacterial and antifungal properties, making them useful for treating infections.

III. EXPERIMENTAL WORK AND METHODOLOGY

Measure out a Beeswax piece and weigh it precisely.

Make tiny slices in the beeswax and use a heating mantle to melt it in a beaker.

After the ingredients have melted sufficiently, begin combining the camphor, clove powder, neem powder, and tulsi oil in a beaker, stirring continuously.

After adding each item, whisk for a full fifteen minutes.

Pour the mixture into the size mould above.

The mould allowed to cool to room temperature.

After three to five hours, take the candle out of the mould

Sr No.	Ingredient Name	Quantity	Uses
1.	Beeswax	50gm	Insect repellent
2.	Camphor	2gm	Burning, Room Freshener.
3.	Tulsi oil	2ml	Anti-inflammatory, Antioxidant
4.	Neem powder	4gm	Insecticide
5.	Clove powder	4gm	Insecticide

Table 1: Formulation of poly Herbal Mosquito Repellent Candle

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Fig 9. Herbal Mosquito Repellant Candle

IV. RESULT AND DISCUSSION

Result:

Organoleptic test: This test was done visualising the formulation to evaluate the texture, colour and Fragrance. Colour: The colour of formulation was found to be green. **Fragrance**: Fragrance of formulation was found to be satisfied. **Texture**: Formulation texture was found uniform ^{[18].}

Irritancy test: It found that prepared mosquito repellent candle did not cause any irritation to skin by burning candles ^[19]. **Burning time**: Burning time visualized using 3 candles named as C1, C2, C3 respectively their burning time is calculated using watch.^[20]

Candle no.	Burning time	Application time	Efficiency
C1	35	8PM- 9PM	Good
C2	38	8PM- 9PM	Good
C3	36	8PM- 9PM	Good

Table 2. Burning time and efficiency of candle

Flammable test:

The prepared candle was tested for flammability to explore mosquito repelling habits, and burned Quality with respect to burning time and subsequently its Spotting process effectiveness flammability test for candle was conducted to verify its apparent flammability in the laboratory [21].

DISCUSSION

On basis of evaluation test studies and observations, it's found that the candle was done successfully using various try outs. Formulated candle was tested in laboratory room temperature. By burning a herbal mosquito repellent candle, with adequate number of mosquitoes, the burning efficiency and time, flammability rate and mosquito repellent activity of candle was assessed. This test shows effectiveness because of natural ingredients and essential oils present in candle such as Neem, Marigold, Lemongrass, Clove, Rosemary and Lavender oil which are known for their mosquito repellent

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activity. These herbal ingredients and oils were incorporated into melted wax. The mixture was poured into suitable mold. Candle was observed for its safety, efficacy and irritancy.

V. CONCLUSION

The prepared herbal mosquito repellent candle is made using natural herbal ingredient, it does not cause any irritation to skin or any allergic reaction. The herbal mosquito repellent candle is very easy to use and handle as it is light in weight. Herbal mosquito repellent candle is beneficial for repelling mosquitoes and human health also. It concludes that used herbs and essential oils was very safe and effective to use as mosquito repellents. Outcomes Effective Mosquito Repellent:

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