



FORMULATION AND EVALUATION OF HERBAL MOSQUITO REPELLENT CANDLES

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ABSTRACT:-

Herbal plants possess a variety of biologically active compounds beneficial for human health and are the foundation of both modern and traditional herbal medicine aimed at disease prevention. Researchers have investigated various plants known for their life-supporting properties and their potential applications. The goal of this study was to create a candle infused with essential oils from lemongrass, neem, cinnamon, marigold, jasmine, and rose to repel mosquitoes. The candle underwent tests to assess its flammability, burn duration, and effectiveness in repelling mosquitoes. This could be due to the various active components found in the oils. The results indicated that the produced polyherbal candle was more potent, cost-effective, and non-toxic compared to the chemical-based mosquito repellents available on the market, considering factors like effectiveness and scent consistency.

INTRODUCTION:-

The most prevalent insect that feeds on human blood is the mosquito¹. They are tiny insects that are members of the Culicidae family². Mosquito species belonging to the Anopheles, Culex, and Aedes genera are vectors for pathogens that cause a variety of ailments, including dengue, malaria, and yellow fever³. Furthermore, the Zika virus, chikungunya, Japanese encephalitis, Rift Valley sickness, West Nile virus, and lymphatic filariasis are all spread by mosquitoes. In tropical and subtropical areas across the world, mosquito-borne illnesses pose a serious threat to public health, and managing them is getting harder. Given the rising prevalence of diseases spread by mosquitoes, effective mosquito control is essential. By consuming blood from an infected person or animal, mosquitoes can acquire a virus or parasite that causes sickness. Although the virus grows inside the mosquito, it does not injure the insect. The virus is then spread to other people by the mosquito when it bites them. Over 700 million people are infected by mosquitoes each year, which leads to over one million fatalities globally². One efficient way to stop these illnesses is to use repellents for mosquitoes. Any material that is applied to the skin, clothing, or other surfaces to prevent mosquitoes from landing or climbing on them is known as a mosquito repellent. Even if conventional chemical repellents work well, their possible negative effects on the environment and human health frequently cause worry. The creation and assessment of a herbal mosquito repellent candle are the main objectives of this project. A pleasant and easy way to keep mosquitoes away is using candles. We want to make a formulation that is safe and non-toxic by using natural herbal substances and essential oils that are known to have mosquito-repelling qualities, like neem, clove, orange peel, lemongrass, marigold, rosemary, and lavender. More than 2.5 billion people, or more than 40% of the world's population, are currently at danger of contracting dengue fever, which is spread by the Aedes aegypti mosquito and causes over 100 million infections annually, thousands of deaths, and other illnesses.

Mosquito-Borne Diseases

Malaria

Plasmodium parasites, which cause malaria, are spread via female Anopheles mosquito bites⁴. 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. If left untreated, malaria can cause cerebral malaria, severe anemia, and even death.

Dengue

The mosquitoes *Aedes aegypti* and *Aedes albopictus* are the culprits behind dengue. Dengue fever is very common, especially in portions of Africa and the Americas. About 4.1 million suspected cases of dengue were recorded throughout the Americas in 2023, with 2,049 fatalities and 6,710 severe cases. With more than 2.9 million suspected infections, Brazil had the most instances. 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.

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.

Yellow Fever

The main way that the yellow fever virus is spread to humans is by the bite of an infected *Aedes* or *Haematosis* mosquito. As of 2023, there are either endemic areas or endemic cases of yellow fever in 13 Central and South American countries and 34 African countries. A study based on data from African sources claims that in 2013, yellow fever killed between 29000 and 60000 people and caused between 84000 and 160000 severe cases. Factors like urbanization, increasing travel, and climate change all have an impact on these diseases and help mosquito vectors spread. Enhancing healthcare infrastructure to efficiently treat epidemics, encouraging preventative measures including the use of mosquito nets and insect repellents, and increasing surveillance are all part of the efforts to control and prevent these diseases. Mosquito species and diseases caused by them:

- **Aedes Mosquitoes:**

Aedes Albopictus and *Aedes Aegypti* are the species.

Conditions: Zika virus, dengue fever, chikungunya, and yellow fever

- **Anopheles mosquitoes:** *Anopheles Gambiae* and *Anopheles Funestus* species

Diseases: malaria

- **Culex Mosquitoes:** *Culex Pipiens* and *Culex Quinquefasciatus* are the species. Lymphatic filariasis, Japanese encephalitis, St. Louis encephalitis, and West Nile virus are among the illnesses.

- **Different Species of *Mansonia* Mosquitoes** Lymphatic filariasis is one of the diseases.

Life Cycle of Mosquito

The life cycle of a mosquito consists of four stages: the egg, larva, pupa, and adult.⁵

Egg

Egg close to water's surface, female mosquitoes deposits their eggs. Either group egg lying is possible. Depending on the surroundings, it may take a few days or several weeks for the eggs to hatch because they need water.

Larva

Larva also Known as “wrigglers” after they hatch, the larvae are aquatic organisms. They experience four growth phases, or “instars.” Bacteria and algae are among the organic elements that larvae eat from the water. Through a syphon at the water's surface, they breathe air.

Pupa

Following the larval stage, mosquitos transition into the pupal stage, which they refer to as “tumblers” due to their tendency to move in the water. The mosquito changes into its adult form during this phase, which is devoid of eating. Depending on the species and 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 its wings and body on the water's surface before taking off. Depending on the species and the habitat, adult mosquitoes normally have a lifespan of a few weeks to a few months. While male mosquitoes often feed on nectar and other plant liquids, female mosquitoes prefer blood meals in order to grow their eggs.

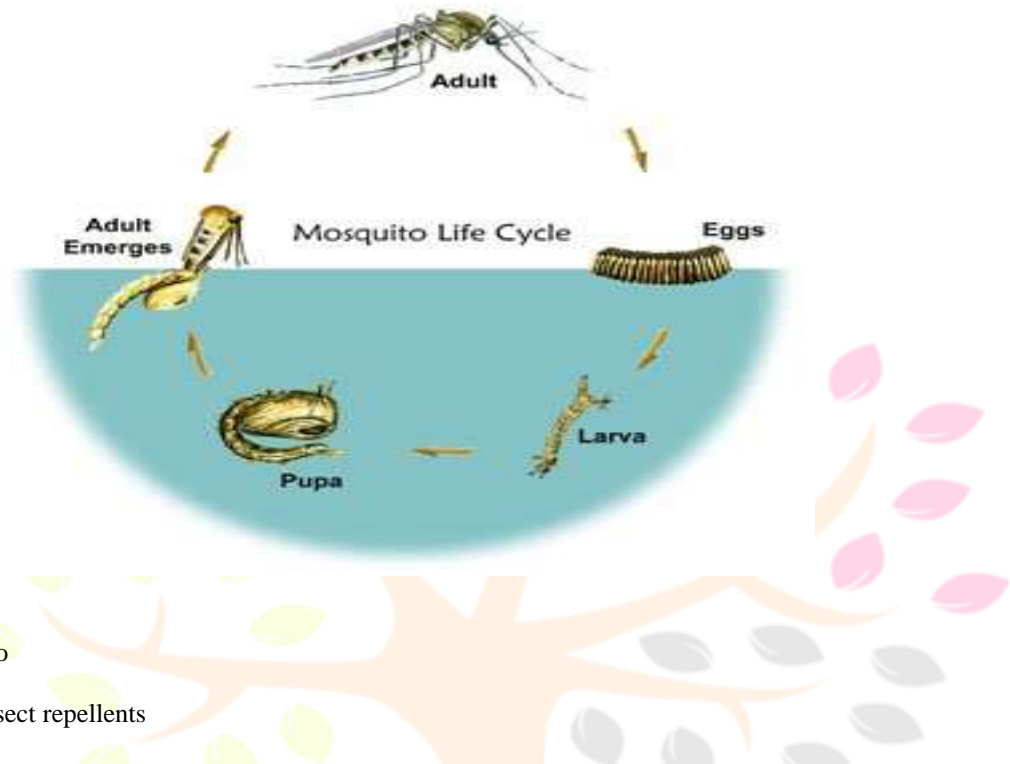


Fig. Life Cycle of Mosquito

Mechanism of action by insect repellents

According to Acree et al.(1968), *Aedes aegypti* is attracted to lactic acid which is a component of human sweat. Studies done by others on the behaviour of mosquitoes indicated that lactic acid was only slightly attractive alone. This therefore proves its synergistic effect with carbon dioxide and other unidentified components of human odour that may be essential. Compounds such as steroids, phenols, carboxylic acids, indoles that exude from animals attracts mosquitoes. Physiological sensory studies on insect gives the impression that mosquito repellent reduce biting rate by interfering with host-enticing signals and change a sensual information to a repulsive one due to activation of many sensory receptors leading to confusion of the mosquito. The mosquito as a result is not able to detect host attractants such as carbon dioxide, lactic acid, ammonia and other compounds hence protecting the host.

Name of Herbs

- 1) Neem oil
- 2) Lemongrass oil
- 3) Marigold oil
- 4) Bees wax
- 5) Cinnamon oil
- 6) Rose oil
- 7) Jasmine oil

1) NEEM

- SYNONYM- *Azadirachta indica*
- BIOLOGICAL SOURCE- *Azadirachta indica*.
- FAMILY- Meliaceae (Mahogany family)

- USES- Anti-Inflammatory-analgesic, Antibacterial.



Neem is a medium- to large-sized evergreen tree with a straight trunk and dark brown to grey bark. It can reach a height of roughly 40 meters while simultaneously expanding in breadth or diameter by several centimetres. Rainfall must typically be between 500 and 1150 mm each year. Neem can tolerate drought, however it finds it hard to survive in waterlogged and poorly draining soils⁷. Its vividly coloured, dark green, pinnate leaves with nine to fifteen serrated leaflets, each measuring seven centimetres. Small, white, sweet-smelling, and arranged in clusters, the blooms make great nectar sources for Ffr bees. . Green drupes with smooth, elliptic seeds and pulp covering them are the fruits. The fruit turns golden yellow as it ripens. In June through August, most frequently⁶. Around the world, research has been conducted on the pesticidal qualities of six species in the Meliaceae family. However, new research on phytochemical insecticides based on extracts of *Azadirachta indica* (neem) shows the greatest promise. Even though there was almost any international recognition of neem in the 1920s, Indian experts were the first to investigate its benefits. It wasn't until 1959 that a German entomologist discovered that neem trees in Sudan were resistant to migratory locust attacks.

2) LEMONGRASS

BIOLOGICAL NAME: *Cymbopogon citratus*

FAMILY: poaceae



Uses: Lemongrass, also called *Cymbopogon citratus*, includes musk odours that draw mosquitoes, such carbon dioxide and lactic acid, as well as citronella oil. To put it another way, a repellent that contains citronella oil actually prevents mosquitoes from detecting certain scents. Citronella, a well-known insect repellent, is found in lemongrass. By covering up the smells that mosquitoes are drawn to, including lactic acid and carbon dioxide, it makes it more difficult for them to find people. Natural Alternative: Lemongrass-based repellents are a safer choice for kids and those with sensitive skin than chemical repellents that contain DEET because they are a natural alternative. Nice Fragrance Lemongrass is a good substitute for synthetic repellents because of its fresh, citrusy scent. Lemongrass works well, but because its natural oils might evaporate more quickly than synthetic repellents, it might need to be reapplied more regularly.

3) MARIGOLD :-

SYNONYM- Genda

BIOLOGICAL SOURCE –Calendula Officinialis

FAMILY-Daisy



In order to create mosquito candles, coils, and incense sticks, the researchers aim to employ portions of the marigold plant (*Tagetes erecta*). It repels mosquitoes without harming the environment because it doesn't contain any of the dangerous chemicals found in some commercial treatments.

4) 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.



Uses

Encaustic painting, candles, polish, lubricants, waterproofing agents, and lost wax casting. A cheap, naturally occurring biological polymer, beeswax is composed of several low-cost, non-toxic components. It is also frequently used in the production of controlled-release pharmaceutical formulations. It is an organic insecticide that is also found in mosquito-repelling candles. Beeswax is one naturally occurring material that is highly crystalline.

5) CINNAMON OIL

Synonyms: Ceylon cinnamon oil, Cassia oil, *Cinnamomi aetheroleum*

Botanical Source:

- *Cinnamomum verum* (syn. *C. zeylanicum*) – true/Ceylon cinnamon
- *Cinnamomum cassia* – Chinese cassia

Plant Family: Lauraceae



Part Used: Bark and leaves (for essential oil extraction)

Uses

- Food flavoring and fragrance (GRAS status by FDA)
- Aromatherapy (stimulating, warming)
- Topical use in diluted form for pain and infections
- Natural preservative and antimicrobial in cosmetics and products

6) JASMINE OIL



Botanical Names:

- *Jasminum grandiflorum* (Common Jasmine or Spanish Jasmine)
- *Jasminum sambac* (Arabian Jasmine)

Family: Oleaceae

Uses:

- Aromatherapy: Diffused or used in inhalation blends
- Topical: Diluted in a carrier oil for massage or skin care
- Perfumery: Heart to base note in natural perfumery
- Cosmetic Formulations: Creams, lotions, and hair products

Formulation Table

Sr. No.	Ingredient name	Quantity	Use
1	Neem oil	8ml	Insecticide
2	Lemongrass oil	1ml	Repellancy
3	Marigold oil	1ml	Repellancy
4	Bees wax	250gm	Emits brightest most warm tone flame
5	Cinnamon oil	1ml	Insect repellent
6	Rose oil 1ml		Fragrance agent
7	Jasmine oil	1ml	Repellancy



Procedure

1. Use of bees wax as a candle base.
2. Then cutting bees wax into smaller pieces forming uniform pieces for even melting.
3. we use weighing machine for adequately weighing bees wax.
4. Weighted Bees wax transfer into china dish.
5. Melt bees wax by using simple water bath instrument.
6. After melting incorporation of different oils have done.
7. After this wick has been place in moulds.
8. Then transferring into different moulds.
9. Different shapes mould were used such as measuring cylinder, tea cup, plastic water glass etc.
10. After prepared oils and Bees wax mixture filled in different moulds.
11. Kept in refrigerator.
12. After refrigerator per candle was removed.
13. Hence formulations of herbal mosquito repellent candle done.



Evaluation Test

1. Uniformity of mass:

Each group's ten candles were chosen at random and weighed by hand. Ten. Weight of The individual group was noted. Load average Calculated, and had personal weight Compared with average weight⁸.

2. Organoleptic test of distress candles:

This test was conceived Evaluate texture, color and smell.⁹

3. Melting points of represented candles: was determined by the melting point Maximum temperature Candle condition. For this, in small amounts Candles were placed in a capillary tube and drowned in disruptive. The temperature was determined 50 ° C. The temperature was increased by a change Viewed and temperature noted in the state.¹⁰

4. Flame tests of represented candles:

Wick was illuminated to appreciate behavior, Stability of color, residue and flame.

5. Burning rate of candles (BR):

The candle's starting mass (M1) and the time of light (T1) were recorded for this test. Once candle Time (T2) and mass prevents (M2) from burning Noted once again.

Burning time was T2 -In T1 hours and mass burnt M2 – M1 Gram. The burning rate was done done according to follow Formula $(\frac{M2-M1}{T2-T1})$ in village per hour.¹¹



Research Through Innovation

CONCLUSION

- Herbal mosquito repellent candles offer a promising and effective solution to the persistent problem of mosquitoes and the diseases they carry.
- Their natural ingredients, non-toxic nature, and pleasant fragrances make them an attractive alternative to conventional chemical repellents.
- They not only serve the functional purpose of repelling mosquitoes but also create a comfortable, aromatic environment in any setting.
- As consumer demand for eco-friendly and health-conscious products continues to rise, the popularity and market growth of herbal mosquito repellent candles are likely to increase.
- By continuing to innovate and refine the formulations, these candles can become a staple in households, gardens, and outdoor spaces, providing an effective and safe method of mosquito control while promoting a sustainable lifestyle.

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