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Formulation And Evaluation of Herbal Mosquito Repellent Candle.

1. Piya Mehta, 2. Prima Patel, 3. Manav Upadhyay, 4. Aayushi Berawala, 5. Tanmay Shah, 6. Dr. Nidhi Chauhan

1. B. Pharm, 2. B. Pharm, 3. B. Pharm, 4. B. Pharm, 5. M. Pharm, 6. PhD

1. Laxminarayan Dev College of Pharmacy
2. Laxminarayan Dev College of Pharmacy
3. Laxminarayan Dev College of Pharmacy
4. Laxminarayan Dev College of Pharmacy
5. Laxminarayan Dev College of Pharmacy

6. Professor and HOD in the Department of Pharmacognosy at Laxminarayan Dev College of Pharmacy

Abstract: Herbal plants contain various biologically active compounds that are useful for life enhancement, and they are the
The main origins of modern and conventional herbal medicine for disease prevention. The nature of different kinds of life-supporting voters of plants that have been studied by scientists for their applications. The purpose of the research was to devise a herbal mosquito repellent candle that would include Lemon oil, cloves, cinnamon, lavender oil, marigold, neem, and rose water. The candle was tested for flammability, burning time, and repellency against mosquitoes. It may be attributed to the presence of the Different active constituents of the oils. The test showed that the manufactured poly herbal candle had become more effective, Cheaper, and non-poisonous than the candle repellents currently available on the market based on chemicals in fighting mosquitoes.

Keywords - Mosquito repellent candle, mosquitoes.

INTRODUCTION

Mosquito-borne disease is a major human health problem in all tropical and subtropical countries. The diseases transmitted include malaria, filariasis, yellow fever, Japanese encephalitis, and dengue fever. Culex Quique fasciatus, the potential vector of lymphatic filariasis, is the most widely distributed tropical disease, with around 120 million people infected worldwide and 44 million people having common chronic manifestations (Bernhardt et al., 2003). Controls of such serious diseases are becoming increasingly difficult because of the high rate of reproduction and development of resistance to insecticides in mosquitoes (Sukumar et al., 1991). Synthetic pesticides have been extensively used for mosquito control by either killing adult mosquitoes that bite human beings or by killing mosquito larvae at the breeding sites of vectors.

However, its deleterious impact on the non-target population and the development of resistance prompted the search for alternative, simple, and sustainable methods of Mosquito control. The need for the development of effective insecticides should be taken into consideration due to toxicity problems, together with the increased incidence of insect resistance. In most of the world, synthetic chemical larvicides continue to be applied for controlling mosquitoes, but many of these chemicals are toxic to human, animal, and plant life, and resistance can be problematic in regulating the control. Therefore, researchers are currently exploiting natural substances to be used as insecticides for controlling larval mosquitoes. These formulations are safe, eco-friendly, cheap,

easy to use, and have maximum repellence against mosquitoes. Hence, an effort was made to prepare an herbal-based mosquito repellent.

LIFE CYCLE OF MOSQUITO

THE LIFE CYCLE OF MOSQUITOES CONSISTS OF FOUR DISTINCT STAGES:

- **Egg -** Female mosquitoes lay their eggs on or near water surfaces. Eggs can be laid singly or in clusters. The eggs require water to hatch, a process that can take anywhere from a few days to several weeks, depending on the environmental conditions.
- **Larva -** Once hatched, the larvae, commonly known as "wigglers," live in the water. They undergo four growth stages known as instars. Larvae feed on organic matter in the water, including algae and microorganisms. They breathe air through a siphon at the surface of the water.
- **Pupa -** After the larval stage, mosquitoes enter the pupal stage, also called "tumblers" because of their movement in the water. This is a non-feeding stage where the mosquito transforms into its adult form. The pupal stage lasts from a few days to a week, depending on temperature and species.
- **Adult -** The adult mosquito emerges from the pupal case and rests on the water's surface to dry its wings and body before flying away. Adult mosquitoes typically live for a few weeks to a few months, depending on species and environmental conditions. Female mosquitoes seek blood meals for egg development, while males generally feed on nectar and other plant juices.

The entire life cycle, from egg to adult, can take as little as 8-10 days under optimal conditions, but may take longer depending on environmental factors.

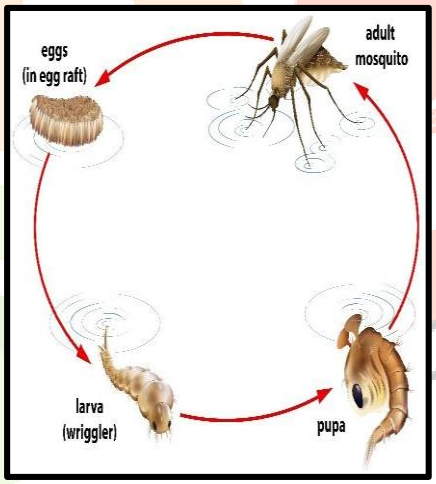

FIG.1 LIFE CYCLE OF MOSQUITO

HISTORY OF REPELLENT

Traditionally, in many parts of the world, some plants were used as repellents against insects to prevent biting. These were used as plant oils, cow dung, or tars, and many more. Even though many studies have been made on artificial (synthetic) repellents, fewer strides have been made in the area of natural (plant) repellents. Citronella oil was the first among four others that were recorded in history to be used as an insecticide and, at times, for the treatment of hair to prevent head lice before the Second World War. The three others, dimethyl phthalate, Indolone, and Rutgers 612, were discovered, patented, and made available respectively in 1929, 1937, and 1939. During World War II, combined formulation of the later three components in the ratio 6-2-2: dimethyl phthalate, Indolone and Rutgers 612 respectively was quickly prepared for the military yet it could not produce the expected protection of the military personnel across the globe Synthetic insect repellent made of, N-diethyl-m-toluamide (DEET) was for military use only and its first product was introduced for civilian use in 1956 DEET currently remains the gold standard for mosquito repellent irrespective of the reported toxic side effects, which include skin rashes and itches, encephalopathy in children, serious allergic response, low blood pressure and reduce heart rate, it has been generally regarded as safe.

MOSQUITO REPELLENT MODE OF ACTION

It has been observed in many cases that actions that can be categorized as repellence may be the product of any number of physiological or metabolic happenings. The repellence in mosquitoes triggered by DEET is believed to be due to the blockage of lactic acid receptors and the elimination of upwind flight, which results in the host being "lost" by an insect. Research has also been provided. Further proof of the function of lactic acid in host searches: Examining the biology of mosquitoes after a meal of blood. Host-seeking activity at Aedes aegypti ceases after a meal of blood, the susceptibility of receptive neurons to lactic acid decreases, and this decrease coincides with the termination of host-seeking behavior. Upon oviposition, the immunity to lactic acid returns to normal.

MECHANISM OF ACTION OF MOSQUITO REPELLANT CANDLE

Herbal mosquito repellent candles work by emitting scents that mask human odors, disrupt mosquito olfactory receptors, and create an unpleasant environment, thereby deterring them from biting.

- Masking Human Odors:
  Mosquitoes are attracted to the scent of carbon dioxide, lactic acid, and other compounds emitted by humans. Herbal repellent candles, when burned, release scents that can mask or interfere with these natural attractants, making humans less detectable to mosquitoes.
- Disrupting Olfactory Receptors: Mosquitoes use their antennae to detect odors, and these antennae contain receptors that allow them to identify potential hosts. Herbal repellents, particularly those containing essential oils like citronella or lemongrass, can disrupt these receptors, making it difficult for mosquitoes to find and bite humans.
- Creating an Unpleasant Environment:
  Some herbs and essential oils used in mosquito repellent candles have a natural repellent effect on mosquitoes. The strong, often unpleasant scent emitted by these candles can deter mosquitoes from entering or remaining in an area

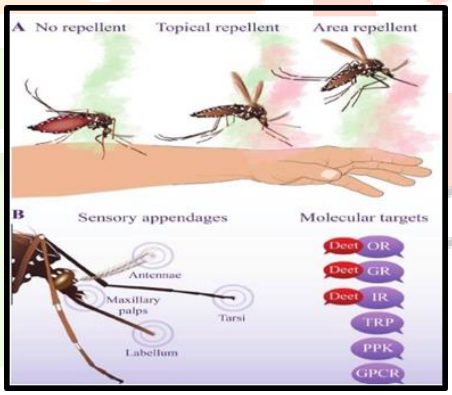

FIG.2 MODE OF ACTION

DRUG PROFILE
NEEM

FIG.3 NEEM TREE

SYNONYM- Azadirachta indica, Margosa, Azadirachta
BIOLOGICAL SOURCE- Azadirachta indica.
FAMILY- Meliaceae (Mahogany family)
USES- Anti-Inflammatory, Analgesic, Antibacterial.

MARIGOLD

FIG.4 MARIGOLD

SYNONYM- Genda
BIOLOGICAL SOURCE - Calendula Officinalis
FAMILY- Daisy
USES- Chemical that contains a particular smell that many insects find unappetizing. The smell is caused by a chemical known as "a-Terthienyl". This lends a natural insecticidal property to marigolds. Other toxic compounds present in the ingredients include alkaloids, papain, terpenes, and cyanogenic glycosides, which are detrimental to human health. It also contains pyrethrin, a natural compound effective as a mosquito killer. Marigold is said to deter some common insect pests, as well as nematodes. Marigolds are often planted in companion planting with tomatoes, chilies, and potatoes. Due to antibacterial thiophenes exuded by the roots, marigolds should not be planted near any legume crop. Thiophenes repel aphids, white flies, maggots, and many other pests. Simultaneous steam distillation extractions (SSDE) volatiles isolated from the flower of the erect species are believed to have higher insecticidal activity. Flower contains pyrethrum, an ingredient found in many insect repellents.

BEESWAX

FIG.5 BEESWAX

SYNONYM- Paraffin wax, turpentine
BIOLOGICAL SOURCE- Honeybees A. mellifera
FAMILY- Apidae
USES- Beeswax is a natural biological polymer containing a mixture of several non-toxic and cheap substances (esters of fatty acids, alcohols, acids, etc.). The number of reported individual components that have been contained in beeswax exceeds 300, which are from various species of honeybees. Depending on the honeybee species and the geographical zone, the concentrations of individual components and substance classes may have only small differences. In addition, from the viewpoint of chemistry, it is a stable and water-repellent substance.
Beeswax is a highly crystalline natural product that is used in pharmaceuticals, cosmetics, food, and other industries. It is also frequently used in the preparation of controlled-release drug preparations. It is a natural pesticide, and it is also used in mosquito repellent candles.

LAVENDER OIL

FIG.6 LAVENDER OIL

SYNONYM: Sweet oil, oleum olive
BIOLOGICAL SOURCE- Levendula Latifolia
FAMILY-Mint
USES- Crushed lavender flowers produce a fragrance and oil that can repel mosquitoes. An animal study from 2002, Trusted Source on hairless mice, found lavender oil to be effective at repelling adult mosquitoes. Lavender has analgesic, antifungal, and antiseptic qualities. This means that in addition to preventing mosquito bites, it can calm and soothe the skin.

ROSE WATER

FIG.7 ROSE WATER

SYNONYM – Gulab
FAMILY- Rosaceae
BIOLOGICAL SOURCE- They are woody perennial flowering plants of the genus Rosa.
USES-antibacterial

LEMON OIL

FIG.8 LEMON OIL

SYNONYM- Citrus oil, peel oil
BIOLOGICAL SOURCE- peel of citrus fruit through cold pressing
FAMILY-rutacea
USES: Fragrance, repellent activity

CLOVE

FIG.9 CLOVE

SYNONYM- Clove flower, Clove buds, Lavang
BIOLOGICAL SOURCE- Dried flower buds of Eugenia caryophyllus
FAMILY- Myrtaceae
USES- Cloves, which are aromatic flower buds of a tree in the Myrtaceae family, have been traditionally used as a mosquito repellent due to their strong scent and natural compounds that mosquitoes find repulsive.

The main reason for their effectiveness is the presence of a natural compound called eugenol, which is known to have insecticidal properties. This compound, when released into the air around your home or outdoor areas, deters mosquitoes by irritating their senses, making them avoid the area.

CINNAMON

FIG.10 CINNAMON

SYNONYM- Chinese cinnamon, Dalchini
BIOLOGICAL SOURCE- Consists of dried bark freed from the outer cork and the shoots growing on the cut stumps of Cinnamomum aromaticum
FAMILY- Lauraceae
USES - Cinnamon is known to repel mosquitoes because of its strong scent and the presence of compounds like cinnamaldehyde. These compounds interfere with mosquitoes' sensory reception, making it difficult for them to locate their targets. Cinnamon oil can also act as a natural insecticide, killing mosquito larvae and deterring adult mosquitoes from the area.

FORMULATION OF CANDLE

TABLE.1 FORMULATION OF CANDLE

SR. NO.	INGREDIENT NAME	CANDLE 1 QTY	CANDLE 2 QTY	CANDLE 3 QTY	USE
1.	NEEM EXTRACT	8 ml	8 ml	8 ml	INSECTICIDE
2.	BEESWAX	182 gm	182gm	182gm	IT EMITS THE BRIGHTEST MOST WARM-TONED FLAME (INSECT REPELLENT)
3.	MARIGOLD EXTRACT	2 ml	-	-	MOSQUITO REPELLENT
4.	LAVENDER OIL	-	2 ml	-	MOSQUITO REPELLENT
5.	LEMON OIL	-	-	2 ml	MOSQUITO REPELLENT FRAGRANCE
6.	CLOVE	-	2 ml	-	MOSQUITO REPELLENT
7.	CINNAMON	-	-	2 ml	MOSQUITO REPELLENT
8.	ROSE WATER	2 ml	-	-	FRAGRANCE

PROCEDURE

1. Take beeswax and weigh the beeswax accurately.
2. Cut the beeswax into small pieces and melt the beeswax in a beaker with the help of a heating mantle.
3. After properly melting, start combining the neem extract & marigold extract in a beaker. After adding the extract, start stirring it with the stirrer.
4. Then add the rose water in the given quantity for the fragrance.
5. Then add lavender oil and peppermint oil as per the given quantity and stir them properly.
6. Then add a clove to candle 1, cinnamon to candle 2, and a clove + cinnamon mixture to candle 3 according to the given quantity.
7. After adding all the ingredients, keep stirring for up to 15 minutes.
8. Pour the above mixture into a suitable-sized container.
9. Allow the Mold to be cooled at room temperature.
10. After ½ hour, remove the candle from the Mold.

EVALUATION PARAMETERS

1. **Fragrance and appearance-** This test was done by visualizing the formulation to evaluate the texture, color, and Fragrance.
2. **Weights of the candles-** The weights of formulation-1 and formulation-2 candles were measured by placing them on an analytical balance. Their respective weights were noted
3. **Flammable test-** The prepared candle was tested for flammability to explore mosquito-repelling habits and burned Quality concerning burning time and, subsequently, its Spotting process effectiveness. An inflammability test for the candle was conducted to verify its apparent combustibility in the laboratory. Thus, the time taken to light the candle and its causal symptoms, such as pain and coughing, were documented and registered
4. **Irritancy-** Irritancy factors include teary eyes and an irritating cough. These were evaluated to know the

tendency of candle emissions to cause eye and respiratory irritation. Three different formulated candles were lit to evaluate the above factors.

5. **Emissions**- Emission factors include soot production and fragrance emissions. The soot and strength of the fragrance produced by the candles while burning were evaluated by lighting the candles of formulations 1, 2, and 3.
6. **Burning rate of candle**: For this test, the initial mass of the candle (M1) and the time of lighting (T1) were noted. Once the candle stopped burning, the time (T2) and mass (M2) were once again noted. The time of burning was T2–T1 in hours, and the mass burnt was M2–M1 in grams. The burning rate was calculated according to the following formula $M2-M1$ / $T2-T1$ in grams per hour.
7. **Mosquito repellent activity test:** Test conducted using a small net. 10 mosquitoes are collected in a net and checked for their activity for 5 minutes. Out of 10 mosquitoes, 4 mosquitoes and 2 repels. The dying percentage of candles for mosquitoes is 40 %, and the repelling percentage is 20 %

EVALUATION RECORDS IN TABULAR FORM

TABLE.2: EVALUATION PARAMETER RECORDS

SR NO.	PARAMETER	CLOVE CANDLE	CINNAMON CANDLE	MARIGOLD CANDLE	MIX
1	FRAGRANCE	MILD SOOT WAS PRODUCED BUT HAS A STRONG ODOUR	MILD SOOT WAS PRODUCED BUT HAS PLEASANT ODOUR	MILD SOOT WAS PRODUCED BUT HAS A PLEASANT ODOUR	MILD SOOT WAS PRODUCED BUT HAS A STRONG ODOUR
2	WEIGHTS OF THE CANDLE	200 Gm	200 Gm	200 Gm	200 Gm
3	FLAMMABLE TEST	GOOD	GOOD	GOOD	GOOD
4	IRRITANCY	NO TEARY EYES AND COUGH	NO TEARY EYES AND COUGH	NO TEARY EYES AND COUGH	NO TEARY EYES AND COUGH
5	EMISSIONS				
6	BURNING RATE OF THE CANDLE	30 MINS	33 MINS	29 MINS	35 MINS

DISCUSSION

Based on evaluation test studies and observations, it's found that the candle was done successfully using various tryouts. A formulated candle was tested in the laboratory at room temperature.

By burning an herbal mosquito repellent candle, with an adequate number of mosquitoes, the burning efficiency and time, flammability rate, and mosquito repellent activity of the candle were assessed.

This test shows the effectiveness of natural ingredients and essential oils present in candles such as Neem, Marigold, Garlic, Clove, Cinnamon, Peppermint oil, and Lavender oil, which are known for their mosquito-repellent activity. These herbal ingredients and oils were incorporated into melted wax. The mixture was poured into a suitable mold. A candle was observed for its safety, efficacy, and irritancy.

CONCLUSION AND OUTCOME

CONCLUSION

The prepared herbal mosquito repellent candle is made using natural herbal ingredients; it does not cause any irritation to the skin or any allergic reaction. The herbal mosquito repellent candle is very easy to use and handle as it is lightweight. Herbal mosquito repellent candles are beneficial for repelling mosquitoes and improving human health. It concludes that herbs and essential oils are very safe and effective to use as mosquito repellents.

OUTCOME

1. Effective Mosquito Repellent: The herbal candle proved to be effective in repelling mosquitoes, providing a safer alternative to chemical repellents.
2. Non-Toxic and Safe: The use of natural ingredients ensures that the candle is non-toxic and safe for humans and pets, making it suitable for both indoor and outdoor use.
3. Eco-Friendly: The project reinforced the viability of creating environmentally friendly products that do not harm the ecosystem.
4. Aromatic Benefits: The inclusion of essential oils not only enhances the mosquito-repellent properties but also provides a pleasant fragrance and potential therapeutic benefits.
5. Practical Application: The candles are easy to prepare and can be used in homes.

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