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The Herbal Barrier: - Formulation and Evaluation of Lemongrass Based Herbal Mosquito Repellant Cream.

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ABSTRACT

Mosquito-borne diseases continue to pose a significant public health challenge worldwide, increasing the demand for safe, effective, and environmentally friendly mosquito repellents. The present study aimed to formulate and evaluate a herbal mosquito repellent cream containing extracts of lemongrass (Cymbopogon citratus), neem (Azadirachta indica), tulsi (Ocimum sanctum), and clove (Syzygium aromaticum), which are well known for their insect-repellent and antimicrobial properties. The herbal extracts were incorporated into a cream base using the emulsification method to obtain a stable topical formulation. The prepared cream was evaluated for its organoleptic characteristics, pH, homogeneity, spreadability, viscosity, washability, irritancy, stability, and mosquito repellent activity. The formulation exhibited acceptable physicochemical properties, good stability, and was non-irritant to the skin. The mosquito repellent evaluation demonstrated satisfactory protection against mosquito bites for a considerable duration, indicating the synergistic effect of the selected herbal ingredients. The findings suggest that the developed herbal mosquito repellent cream is a promising natural alternative to synthetic chemical repellents, offering effective protection with improved safety and better skin compatibility. Further studies involving large-scale stability testing and clinical evaluation are recommended to establish its long-term efficacy and commercial potential.

Keywords: Herbal mosquito repellent cream, Lemongrass, Neem, Tulsi, Clove, Herbal formulation, Topical cream, Natural insect repellent.

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INTRODUCTION

Plants produce many chemicals to protect themselves from insects that feed on them. These chemicals help plants defend against insects and pests that can damage them. Many of these compounds are also effective in repelling mosquitoes and other biting insects. Because of this, plant-based repellents are often preferred over synthetic chemical repellents.

Plant chemicals can be classified into groups such as alkaloids, terpenoids, phenolics, proteinase inhibitors, and growth regulators. Plant-based mosquito repellents contain these compounds, which work in different ways. Some compounds repel insects, some prevent them from feeding, while others can harm insects or stop their growth and development [5]. Plants naturally produce these chemicals as a defense mechanism against insects.

When plant leaves are damaged, they release smells known as volatile compounds. These odors help protect plants from insects. Mosquitoes dislike many of these plant odors. Mosquitoes and other insects use smell receptors on their antennae and mouthparts to locate food, hosts, and dangers in their environment. Certain plant chemicals can block or confuse these receptors, making it difficult for mosquitoes to find humans. This action is similar to synthetic repellents such as DEET, which also interfere with the mosquito's sense of smell.[6]

Researchers have discovered that some plant compounds affect the same mosquito smell receptors targeted by DEET. [6,7] For example, citronellal and linalool are highly effective in repelling mosquitoes.[8] Many plant vapours are also toxic to insects when inhaled, which further increases their effectiveness as mosquito repellents.

People prefer plant-based repellents because they are natural, environmentally friendly, pleasant-smelling, and generally have fewer harmful side effects. These repellents help prevent mosquito bites and reduce dependence on synthetic chemicals.[9]

Humans have used plants to repel mosquitoes for thousands of years. Long ago, people discovered that certain plants could naturally repel insects because of their strong odors and special chemical compounds. [10] One traditional method was hanging crushed plants inside homes to keep mosquitoes away. This practice is still followed in some parts of the world where people have limited access to modern mosquito control products.[11,12,13,14]

Another traditional method involved burning plants or dried leaves to produce smoke that mosquitoes dislike. Before the development of commercial mosquito repellents, this was a common practice. Over time, people also began extracting oils and preparing mixtures from plants to apply on the skin or clothing to prevent mosquito bites. The use of plant oils as mosquito

repellents has been documented by Greek, Roman, and Indian scholars, showing that natural mosquito control methods have been used for centuries.[15]

Today, plant-based repellents are widely used in tropical and rural areas because they are affordable, easily available, and considered safer than chemical repellents.[17] In many poor communities, natural repellents are often the only available method of protection against mosquitoes and the diseases they spread.[18] Many people prefer plant-based repellents because they are natural, environmentally friendly, pleasant-smelling, and generally safe for humans and the environment.

The search for effective plant-based mosquito repellents often depends on traditional knowledge from local communities. Researchers visit villages and speak with people who are familiar with medicinal and insect-repellent plants. They collect information about how the plants are used, where they are found, and how effective they are against mosquitoes. This approach helps scientists identify useful plants more efficiently than testing every plant species individually.[19]

Another method used by scientists is laboratory screening, where many plants are tested for mosquito-repellent properties. Researchers identify chemical compounds in plants that can repel mosquitoes. Although this process requires significant time, money, and effort, it has led to the discovery of several effective natural repellents. One important example is PMD, a plant-based mosquito repellent discovered from plant sources. PMD is now widely used in mosquito repellent products because it is effective and considered safer than many synthetic chemical repellents.[20,21,22,23]

Harmful effects of chemicals by mosquito repellent [25]:

Chemicals	Problem Associated
Deet	Neurological issues, Scarring in adults
Picardin	Inhalation toxicity, Eye Irritation
Scourge	Liver and Thyroid Problems
Anvil	Boost tumor growth in Cancer
Malation	Acute and Chronic Neurological Problems
IR3535	Toxicity on oral, dermal, inhalational exposure
Para-Methane-Diol	Eye and face irritation
Metofluthrin	Neurotoxicity
Permthrin	Irritation to (Nose, lungs, throat), Headache, Fatigue, Excessive Salivation, Dizziness.

Mosquitoes are responsible for spreading serious diseases like malaria, dengue, chikungunya, lymphatic filariasis, and zika, all of which can have dangerous effects on human health.

Key Mosquito-Borne Diseases

Malaria: Malaria is a potentially fatal disease caused by the plasmodium parasite, primarily transmitted through the bite of infected female Anopheles mosquitoes.

Symptoms typically appear 10–15 days after exposure and include fever, headache, chills, and nausea. Severe malaria can lead to life-threatening complications such as cerebral malaria, anemia, and kidney failure.

Diagnostic methods include blood smear, rapid tests, and PCR. High-risk groups include children under five, pregnant women, travelers, and people with weakened immunity. Early treatment helps prevent serious illness.

Dengue: Caused by the dengue virus, this disease is spread by Aedes aegypti and Aedes albopictus mosquitoes. While many infections are mild, severe dengue can cause dangerously high fever, severe headaches, rashes, and even death. Symptoms begin 4–10 days after infection.

Chikungunya: This viral disease is also spread by Aedes mosquitoes. Symptoms include fever, joint pain, and rash. There is no specific medication, but vaccines for at-risk populations are available.

Lymphatic Filariasis: Known as elephantiasis, this disease is caused by filarial roundworms and transmitted by Anopheles, Culex, and Aedes mosquitoes. It can cause swelling, disability, and social stigma. Prevention includes mass drug administration.

Zika Virus: Transmitted mostly by Aedes mosquitoes, Zika can cause birth defects such as microcephaly if contracted during pregnancy. Other symptoms may include fever, rash, joint pain, and conjunctivitis. [24]

Prevention and Control Strategies

1. Use mosquito repellents: EPA-approved mosquito repellents should be used on exposed skin and clothing.
2. Wear long-sleeved clothing: Protective clothing reduces the chance of bites, especially during peak mosquito hours like dawn and dusk.
3. Eliminate stagnant water: Mosquitoes breed in standing water, so remove water from flower pots, gutters, birdbaths, and containers.
4. Install screens and use nets: Window and door screens, as well as bed nets, prevent mosquitoes from entering homes and protect sleeping children.
5. Community and environmental control: Community involvement and public education are essential for eliminating breeding sites and reducing overall transmission.

6. Medical interventions: Early diagnosis and treatment of illness, as well as mass drug administration for diseases like lymphatic filariasis, help reduce the impact of mosquito-borne diseases.

How the Herbal Cream Works?

1. Lemongrass, neem, tulsi, and clove oil are all known for their ability to repel insects, especially mosquitoes.
2. The cream is made by extracting the active parts (usually the oils) from these herbs, which are then mixed carefully into a smooth, skin-friendly base.
3. When applied to the skin, this cream creates a subtle barrier filled with natural scents and compounds that mosquitoes find unpleasant or confusing. This means mosquitoes are much less likely to land on you or bite you.

Safety and Benefits

1. The herbal cream is gentle—tests showed that it didn't cause irritation, redness, or discomfort in users, making it safe for regular use, even for people with sensitive skin. It has a pleasant, natural aroma thanks to the combination of essential oils.
2. The protection it offers is strong: studies found that the best formulations can provide up to 90% protection against mosquitoes, which is very close to the level of protection offered by leading chemical repellents like DEET.

Why Choose Herbal ?

1. This kind of herbal mosquito repellent is much safer for both people and the environment than many chemical-based repellents. There's no worry about toxic ingredients, and it's biodegradable.
2. Herbal creams offer a sustainable, natural approach to staying safe from
3. mosquitoes, letting you enjoy the outdoors with peace of mind.

Plan of work

- Literature Survey – Different research papers and articles were studied to understand the use of herbal ingredients in mosquito repellent creams and their effectiveness.
- Selection of Drug & Excipients – Suitable herbal ingredients and other materials required for cream preparation were selected based on their properties and compatibility.
- Extraction of Plants – The selected plants were processed and extracted using appropriate methods to obtain the active constituents used in the formulation.
- Formulation & Evaluation of Cream – The herbal cream was prepared and evaluated for parameters such as appearance, pH, Spreadability, stability, and mosquito repellent activity.

- Data Compilation & Report Writing – All observations and results obtained during the study were collected, analyzed, and arranged systematically for preparation of the final report.

Sr No.	Activity	Time Period (Days)
1	Literature Survey	15 days
2	Selection of Drug & Excipients	15 days
3	Extraction of Plants	10 days
4	Formulation & Evaluation of cream	45 days
5	Data Compilation & Repot Writing	15 days

Objective of Herbal Mosquito Repellent Cream

- To develop a mosquito repellent cream using natural ingredients such as lemongrass, neem, tulsi, and clove.
- To explore the potential of herbal extracts as safer alternatives to synthetic chemical repellents.
- To evaluate the effectiveness of the formulated cream in repelling mosquitoes.
- To study the contribution of each plant-based ingredient in enhancing repellent activity.
- To assess the physical and chemical properties of the cream, including texture, spreadability, stability, and pH, for suitable skin application.
- To compare the prepared herbal formulation with commercially available mosquito repellent products in terms of safety and performance.
- To promote the use of eco-friendly, cost-effective, and skin-friendly solutions for mosquito protection.

Drug Profile

Lemongrass *(Cymbopogon citratus)*:-

Lemongrass, also known as Cymbopogon citratus, is a tall, perennial grass that can grow up to 6 feet in height and around 4 feet wide. It is widely recognized for its pleasant, lemon-like aroma and is commonly found in tropical and subtropical regions, especially in Southeast Asia. This plant grows in dense clusters, with long, slender leaves that are about 1.3 to 2.5 cm wide and can reach up to 3 feet in length. Its leaves are green and linear, tapering at the tips, with a fragrant aroma that's richer than actual citrus and hints of mint and camphor. The plant produces small flowers at the tips of its leaves in long inflorescences, adding to its visual appeal and usefulness.

Uses and Benefits

Lemongrass is not just a culinary herb but also holds medicinal and aromatic significance. It is used in cooking to add a bright, citrus flavour to dishes and soups, especially in Southeast Asian

cuisines. The plant is also valued for its essential oil, which is used for its anti-inflammatory, antimicrobial, and mood-boosting properties. It acts as a natural insect repellent, especially against mosquitoes, and is used in aromatherapy and household cleaners.

Traditional and Medicinal Uses

In various traditional medicines, lemongrass has been used for its calming effects, to aid digestion, and to help treat urinary tract issues. It is believed to have anti-inflammatory, antispasmodic, and antibacterial properties that may help protect against infections and reduce fever.

Cultivation

Lemongrass is cultivated in many tropical countries, including India, Sri Lanka, Thailand, Vietnam, and the Pacific Islands. It thrives in warm, moist climates and is often grown as a perennial crop, with the oil extracted from its leaves and flowering tops.Overall, lemongrass is a versatile, fragrant herb with a rich history of culinary, medicinal, and aromatic uses, making it a valuable plant both locally and globally.

Bioactive Components:-

The main chemical constituent of lemongrass useful as an insect repellent is citral, which is a mixture of geranial (α-citral) and neral (β-citral), and geraniol. Other compounds like limonene and citronellal also contribute to the repellent action. Even minor components like eucalyptol play a role in the overall efficacy.

Lemongrass is a wonderfully versatile plant that's beloved around the world for many reasons. In the kitchen, its long, slender leaves with a sharp edge add a fresh, citrusy flavour to soups, curries, and teas, bringing a bright and fragrant twist to these dishes. Beyond cooking, lemongrass is treasured for its essential oil, which is commonly used in perfumes, soaps, and cosmetics because of its clean, pleasant aroma.[30]

But lemongrass isn’t just about its scent or taste—it also has some impressive health benefits. Its oil has natural antibacterial, antifungal, and anti-inflammatory properties, making it valuable for soothing minor infections and reducing inflammation.[29]

Figure 1: Lemongrass Plant [1]

Kingdom: Plantae

Division: Magnoliophytes

Class: Liliopsida

Family: Poaceae

Genus: Cymbopogon

Species: Cymbopogon citratus

2.Neem *(Azadirachta indica):-*

Neem, also known as the neem tree or Indian lilac, is a remarkable plant with a wide range of health benefits. It has natural antibacterial, antifungal, antiviral, anti-inflammatory, and antioxidant properties, making it effective in fighting various infections and soothing inflammation. Traditionally, neem has been used to treat skin disorders, heal wounds, reduce fever, and address dental problems like toothaches.

Neem oil and leaf extracts are commonly used to make herbal remedies, cosmetics, and natural insect repellents. Thanks to its powerful healing qualities, neem is often called a "green treasure" and has been prized in traditional medicine for centuries. Its gentle but effective nature makes it a popular choice for promoting healthy skin and protecting against harmful microbes.[29]

Bioactive Components:-

Neem is a remarkable plant rich in diverse phytochemicals. Its fruits, seeds, leaves, stems, and bark all contain valuable compounds such as limonoids. The seed oil, which is yellow, bitter, and has a distinct garlic-like smell, is composed of glycerides, polyphenols, nimbolide, triterpenes, and beta-sitosterol, with about 2% limonoid content. Neem leaves are packed with beneficial nutrients

like quercetin, catechins, carotenes, and vitamin C, making them an important source of natural antioxidants.

Azadirachtin is one of the most important chemical compounds found in neem, known for its powerful mosquito-repelling properties. Extracted mainly from neem seeds, it is considered one of the most effective natural substances for combating insects. Along with azadirachtin, other limonoids—belonging to the triterpene class—also play a significant role in enhancing neem's insect-repellent activity.[30]

Meliantriol :- Potent feeding inhibitor that stops insect from eating.

Salannin :- Potent feeding inhibitor.

Nimbin and nimbidin :- It has antiviral activity and also have pesticidal effect.[29]

Figure 2: Neem Plant [2]

Kingdom: Plantae

Division: Magnoliophyta (Angiosperms)

Class: Magnoliopsida (Dicotyledons)

Order: Sapindales

Family: Meliaceae

Genus: Azadirachta

Species: Azadirachta indica A. Juss

Tulsi *(Ocimum tenuiflorum):-*

Ocimum tenuiflorum, commonly known as holy basil or tulsi, is an aromatic perennial herb from the Lamiaceae family. It holds a special place in traditional Ayurvedic medicine and is widely used in various herbal preparations. Tulsi contains several bioactive compounds such as eugenol, carvacrol, flavonoids, caryophyllenes, camphor, cinnamyl acetate, and eugenol-methyl-ether, which give it its unique fragrance and therapeutic properties. It is valued for its antimicrobial, anti-

inflammatory, antioxidant, and immunity-boosting effects, making it one of the most revered medicinal plants in India.[29]

Bioactive Components:-

The main active compound in tulsi is eugenol, which plays a key role in its mosquito-repelling properties. Another important component, methyl eugenol, makes up about 20 percent of the plant's volatile oil. Linalool and carvacrol also contribute significantly to tulsi's overall insect-repellent and insecticidal effects. In addition, sesquiterpene hydrocarbons such as caryophyllene are present and further enhance these protective properties.[30]

Beyond its insect-repelling ability, tulsi contains a variety of bioactive compounds like flavonoids, phenolic acids, and tannins that offer antioxidant, anti-inflammatory, and antimicrobial benefits. These compounds help neutralize free radicals, support immune function, and promote general health, making tulsi not only a natural insect repellent but also a powerful medicinal herb.[29]

Figure 3:Tulsi Plant [3]

Kingdom: Plantae

Division: Angiospermae (Magnoliophyta)

Class: Dicotyledonae (Magnoliopsida)

Order: Lamiales

Family: Lamiaceae (Labiatae)

Genus: Ocimun

Species: Ocimum sanctum.

Clove *(Syzygium aromaticum)*

Cloves contain approximately 14 to 21 percent of volatile oil, with eugenol being the major active compound, accounting for nearly 70 to 90 percent. Other important constituents include acetyl

eugenol, gallotannic acid, alpha- and beta-caryophyllenes, methyl furfural, gum, resin, and fiber. Clove oil is recognized as one of the most effective natural mosquito repellents because of its high eugenol content. The compound emits a sharp, peppery, and woody smell that mosquitoes find irritating and unpleasant. This strong aroma disrupts the sensory receptors on their antennae, preventing them from detecting human cues such as carbon dioxide, body heat, perspiration, and odour, and thereby keeping them away from humans.

Beyond its insect-repelling property, cloves also possess several medicinal qualities. The bioactive compounds in clove oil exhibit strong antimicrobial, antifungal, antioxidant, and analgesic activities. Eugenol, in particular, is known for its ability to inhibit bacterial growth, reduce inflammation, and relieve dental pain. The antioxidant components help neutralize harmful free radicals, supporting overall health and enhancing tissue protection. These combined effects make clove not only a powerful mosquito repellent but also a versatile medicinal spice widely valued in both traditional and modern medicine.[29]

When eugenol is combined with synergistic compounds, its mosquito-repelling power increases significantly, and it can also lead to higher mosquito larval mortality. Beta-caryophyllene, which is present in high concentrations in clove oil, further enhances its overall repellent and insecticidal activity. Another important component, eugenyl acetate, also plays a key role in strengthening the repellent properties of clove oil. Together, these bioactive compounds make clove oil a highly effective natural alternative for Mosquito control.

Figure 4: Clove Buds [4]

Kingdom: Plantae

Division: Angiospermae (Magnoliophyta)

Class: Dicotyledonae (Magnoliopsida)

Order: Myrtales

Family: Myrtaceae

Genus: Syzygium

Species: Syzygium aromaticum

Experimental work

1. **Literature Review** – Various books, journals, and research articles were referred to for understanding herbal mosquito repellents and their applications.
2. **Selection of Ingredients** – Suitable herbal ingredients and other required materials were chosen for the preparation of the cream formulation.
3. **Extraction of Plant Materials** – Selected plant materials were extracted using appropriate methods to obtain the active components.
4. **Preparation of Cream Base** – The cream base was prepared by properly mixing the oil phase and water phase ingredients.
5. **Formulation of Mosquito Repellent Cream** – The herbal extracts were added into the cream base to prepare the mosquito repellent cream.
6. **Evaluation of Cream** – The prepared cream was checked for parameters such as appearance, pH, spreadability, consistency, and stability.
7. **Mosquito Repellency Test** – The mosquito repellent activity of the formulated cream was tested under suitable conditions.
8. **Data Recording and Analysis**
9. **Result and Discussion**
10. **Conclusion**

Excipient Profile

Excipient Profile of Natural Ingredients Used in Mosquito Repellent Cream:-

Stearic Acid

Category: Emulsifying agent and thickening agent

Appearance: White waxy solid

Function in Cream: Helps in forming stable cream, improves consistency and texture

Solubility: Insoluble in water, soluble in alcohol and oils

Uses: Used in creams, lotions, ointments, and cosmetics

Storage: Store in a cool and dry place

Beeswax

Category: Natural wax and stiffening agent

Appearance: Yellowish solid with pleasant odour

Function in Cream: Provides thickness, stability, and smooth texture to the cream

Solubility: Insoluble in water, soluble in oils and organic solvents

Uses: Used in ointments, creams, lip balms, and cosmetics

Storage: Store in tightly closed container away from heat

Liquid Paraffin

Category: Emollient and moisturizing agent

Appearance: Clear, colourless oily liquid

Function in Cream: Keeps skin soft and prevents dryness

Solubility: Insoluble in water

Uses: Used in creams, lotions, ointments, and skincare products

Storage: Store in well-closed container at room temperature

Glycerine

Category: Humectant and moisturizer

Appearance: Clear, colorless, viscous liquid

Function in Cream: Retains moisture and keeps skin hydrated

Solubility: Miscible with water and alcohol

Uses: Used in creams, lotions, syrups, and cosmetic products

Storage: Store in airtight container in cool place

Rose Water

Category: Perfuming and soothing agent

Appearance: Clear liquid with pleasant rose fragrance

Function in Cream: Provides fragrance and cooling effect to skin

Solubility: Miscible with water

Uses: Used in creams, cosmetics, skin toners, and herbal preparations

Storage: Store in cool and dry place away from sunlight

Formulation of Herbal Mosquito Repellent Cream[25]

Ingredients	Quantity	Role of Ingredient
A. Oil phase		
Lemongrass Oil	3ml	Mosquito Repellent
Neem Oil	1.5ml	Mosquito Repellent
Clove Oil	3ml	Mosquito Repellent
Tulsi Oil	2 ml	Mosquito Repellent
Stearic Acid	7 ml	Emulsifier and oil base
Beeswax	5 gm	Stabilizing agent, Emollient
Liquid Paraffin	4ml	Lubricating Agent, Emollient
B. Water Phase		
Glycerine	4 ml	Humectant
Water	Q.S	Vehicle
C. Organoleptic Ingredients		
Perfumes (Rose Water)	Q.S	Fragrances

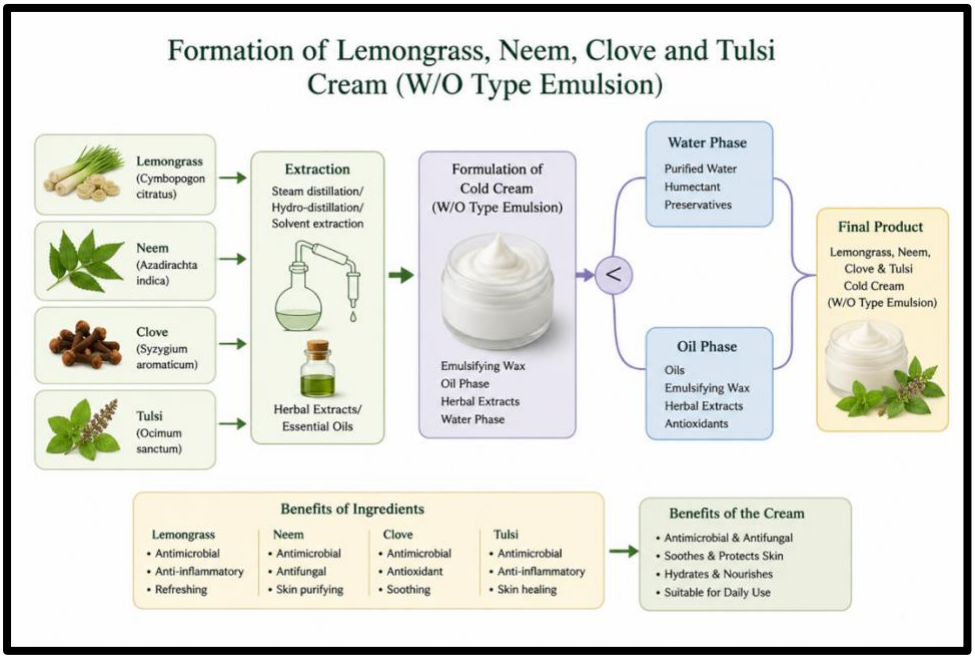

Figure 5: AI-generated representation of herbal cream formulation process.

MATERIALS AND METHOD

Collection of plant material[24,30] :-

Lemongrass

We cut the plants so that about 10 to 20 cm of the stem is left above the ground. The first time we pick the plants is, after six to nine months of putting them in the ground. We do this when the weather is dry. Then we separate the leaves from the stems of the plants. We leave the leaves. Stems to dry at room temperature. After the leaves and stems of the plants are completely dry we cut the plants into pieces.

Neem

Fresh neem leaves were collected carefully. These leaves were then cleaned well to get rid of dust and impurities. The leaves were spread out. Left at room temperature which was around 25 to 27°c for about 2 weeks. This was done so that the leaves could dry out completely. Once the leaves were fully dry they were turned into a powder using a mixer grinder. The powdered neem leaves were then sifted through a sieve, number 60 to get a fine and even powder. The fine neem leaf powder was then stored in a container that was airtight. This was done to keep the powder safe, from moisture and contamination. The neem leaf powder was stored properly.

Tulsi

The crop was picked when the plants were blooming because that's when the essential oil is at its best. Harvesting at this time helps get an amount and high-quality oil. The harvesting was done on days because dry weather keeps the plant material fresh. The plant material stays good in weather.

After picking the plant materials were spread out in a spot. They weren't left in sunlight because much heat can make the essential oils less good. The plant materials were left to dry in the shade for 7 days. This helped get rid of most of the moisture. When the plant material was dry it was ground into a powder. A grinder was used for this. The coarse powder form makes it easy to use the material for things, like extraction. The plant material was then used for extraction. The plant material was used for extraction after this step.

Clove

Clove buds can be picked from the tree every year when the tree's old enough which is usually around six years old and this can go on for a very long time even up to seventy nine years. The best time to pick clove buds is when they are still growing and the colour starts to change from green to a bit pink or red. This is a time to pick them because it means the cloves will be good quality. After we pick the clove buds we have to separate them from the sticks they are attached to. This is important so that the cloves can dry properly and be quality. The clove buds are dried in the sun for days. While they are drying they lose a lot of water seventy percent of what they weighed before. As they get drier the colour of the clove buds changes to a brown colour with a little bit of red and this means they are ready to be stored or used.

Extraction

Extraction of Lemongrass, neem, Tulsi and Clove by Clevenger apparatus [30]:-

- A certain amount of plant stuff was taken to get the extracts.

Plant	Quantity
Lemongrass	30 g
Neem	50 g
Tulsi	50 g
Clove	50 g

- These plant materials were put in a flask. Then the right amount of water was added to each one.

Plant	Quantity
Lemongrass	300 ml
Neem	250 ml
Tulsi	300 ml
Clove	250 ml

The flask was connected to a Clevenger device. This device helps get oils from plant materials using steam

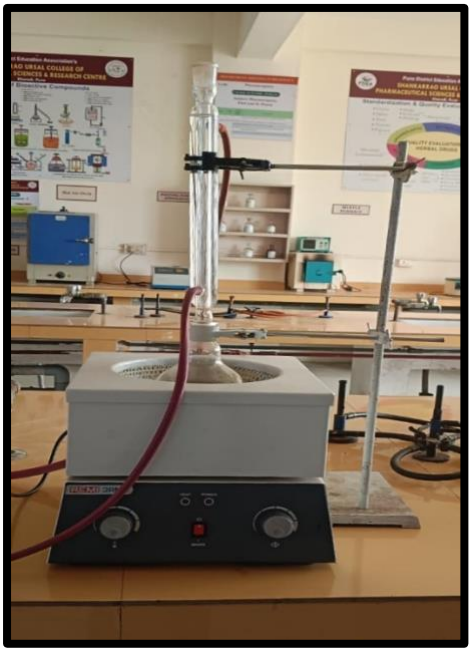

Figure 6: Hydrodistillation

- The flask was connected to a Clevenger device. This device helps get oils from plant materials using steam.
- Cold water flowed through the condenser so that the vapors could cool down and turn into liquid.
- The mixture was heated with a heater. The temperature was controlled carefully so that the water and essential oil vapors came out smoothly.
- These vapors went through the condenser where they cooled down and turned into liquid. This liquid was collected in a tube. The essential oil separated from the water in the tube.
- The extra water automatically went back into the flask. This allowed the extraction to continue without stopping.
- The heating was done for 8 hours. This made sure all the essential oils were extracted from the plant materials like Lemongrass, Neem, Tulsi and Clove.
- The apparatus was allowed to cool down after it was all done. The water that was collected was carefully removed from the tube. This left behind the extracted oil from Lemongrass, Neem, Tulsi and Clove.
- The extracted essential oil was purified more using a machine.
- The essential oil was then put in a box to cool down. This helped remove all the moisture from the oil.
- After it cooled down the extracted essential oil, from Lemongrass, Neem, Tulsi and Clove was weighed correctly. The weight was recorded.

Figure 7: Heating Mantle

Preparation of Herbal Mosquito Repellent Cream:

Procedure for Preparation of Herbal Mosquito Repellent Cream

Firstly, beeswax (2.8 g), stearic acid, liquid paraffin, and other oil-soluble ingredients were accurately weighed and transferred into a china dish. The mixture was heated on a water bath at about 70°C until all the ingredients melted completely and formed a uniform oil phase.

Simultaneously, borax was dissolved in the aqueous phase containing glycerine and rose water. This water phase was also heated separately to the same temperature of 70°C to maintain uniformity between both phases.

After complete melting of the oil phase, neem extract (0.5 g) along with volatile oils such as lemongrass oil, clove oil, and tulsi oil were incorporated carefully into the oil phase with continuous stirring. These ingredients were added at controlled temperature to preserve their natural active constituents and aroma.

Subsequently, the hot aqueous phase was added slowly into the oil phase with constant stirring. Continuous stirring was maintained until a smooth and homogeneous cream was formed. Proper mixing helped in obtaining a stable emulsion with uniform consistency.

Finally, the prepared cream was stirred continuously during cooling until the temperature reached approximately 30°C. The finished herbal mosquito repellent cream was then transferred into a clean, dry, and properly labeled airtight container for further evaluation and storage.[30]

Evaluation Test

Organoleptic Evaluations

The physical properties and all formulated cream were evaluated by its color, odor, and texture. The results are tabulated below:

Colour : White

Odour: Characteristic odor

Texture: Hard

Figure 8: Formulation

Irritancy Test

Irritation Test Procedure: -

A small amount of the prepared herbal mosquito repellent cream was applied gently on a small portion of the skin. The area was kept under observation for about 24 hours to check for any skin reaction. During this period, the skin was examined for redness, itching, swelling, burning sensation, or any kind of irritation. The observations were noted carefully at regular intervals. No signs of irritation or allergic reaction were observed, which showed that the formulated cream was safe and suitable for topical application.

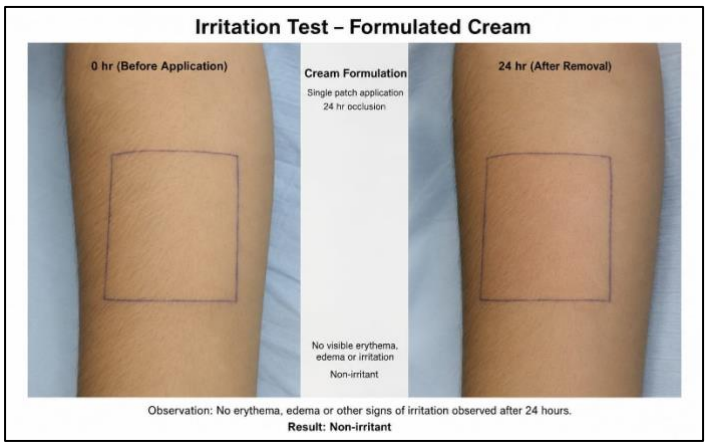

Figure 9: Irritation Test

Observation: No Irritation

Homogeneity

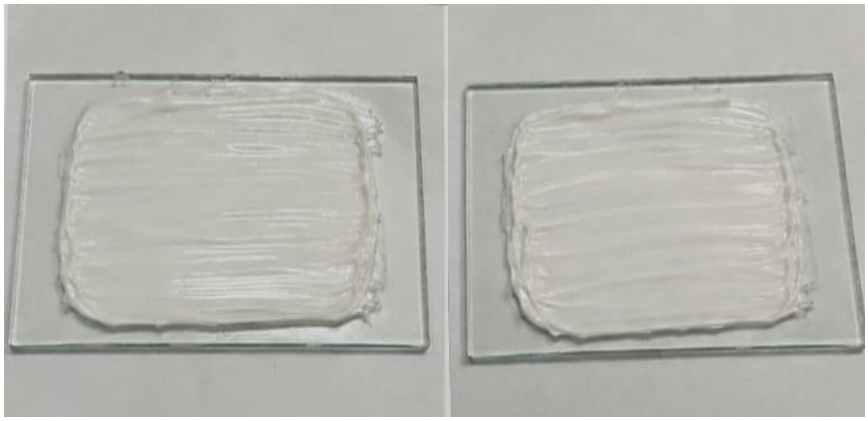

Figure 10: Homogeneity testing

Homogeneity of formulated herbal cream was evaluated by visual appearance and touch. The visual appearance and touch were good.

pH Determination

Figure 11: pH determination

The pH of the formulated herbal cream was found to be 5.8

Spreadability

The prepared herbal cream formulation was tested for spreadability and the area covered by the fixed amount of cream was found to be 9.62mm^2**.**

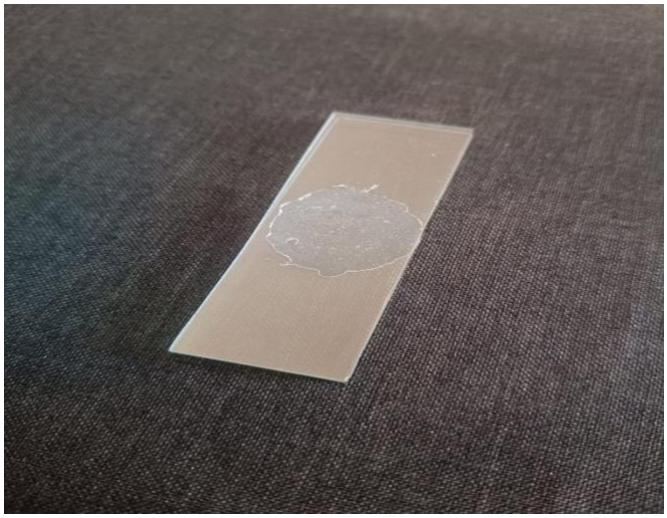

Figure 8: Spreadability testing

RESULTS AND DISCUSSION

Sr.No	Evaluation Test	Result
1.	Spredability	9.62mm^2
2.	Washability	Good with water better with detergent
3.	Ph Determination	5.8
4.	Ease of Application	Easy
5.	Irritability	No Irritation

We have looked at the Prepared Formulation. Checked all its Properties. The Prepared Formulation has been found to be, within the limit.

- Herbal Ingredients have made it possible to create formulations that do not have bad effects. These Herbal Ingredients give the formulations the properties they need.
- The Preparation is a cream. It does not have any side effects. This is why people want to buy products**.**
- The costs of the Prepared Formulation are lower compared to formulations. This makes the Prepared Formulation a better choice because it is cheaper.

CONCLUSION

Mosquitoes are really bad for health because they suck blood and spread diseases like Malaria, Dengue Fever, chikungunya and Yellow Fever. These diseases are very serious. Mosquitoes are like carriers of these diseases.

Plant-based mosquito repellents are a choice because they are natural and do not harm humans or the environment. They are also biodegradable. Using repellents can reduce the bad effects of chemical repellents that are not natural.

Neem is a plant that has a compound called azadirachtin. This compound is a natural insect killer. It helps to keep mosquitoes away. In this study a cream was made using neem extract and oils from Lemongrass, Tulsi and Clove. People like products because they are safe and work well.

The cream was tested for how it spreads how stable it is, its pH level and if it irritates the skin. The cream looked good felt smooth and was easy to apply. When it was tested for irritancy there was no redness, itching or skin irritation. This means the cream is safe to put on the skin. The study showed that neem leaves and the oils of lemongrass, tulsi and clove are good at keeping mosquitoes. They can be used as an alternative to chemical mosquito repellents. Mosquito repellents made from things, like neem leaves and these oils are a good choice.

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