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FORMULATION AND EVALUATION OF HERBAL MOSQUITO REPELLENT CREAM

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ABSTRACT

The increasing prevalence of mosquito-borne diseases such as malaria, dengue fever, and chikungunya has led to a growing demand for effective mosquito repellents. Conventional repellents like DEET and other synthetic chemicals, while effective, often come with potential side effects such as skin irritation, allergic reactions, and environmental concerns. As a safer and more sustainable alternative, this project explores the formulation of a ***herbal mosquito repellent cream*** *using* ***natural plant-based ingredients*** *known for their insect-repellent properties.The primary aim of this study was to develop a* ***topical cream*** *that effectively repels mosquitoes while remaining safe for human skin, particularly for children and those with sensitive skin. The cream was formulated using* ***neem oil (Azadirachta indica)***, ***citronella oil (Cymbopogon nardus)***,***tulsi oil (Holy Basil Oil)***, ***Clove oil (Eugenia aromaticum)****and, combined in a natural cream base consisting of* ***beeswax, coconut oil .*** *This project suggest that the herbal mosquito repellent cream provides a* ***natural, safe, eco-friendly****, and* ***cost-effective*** *alternative to chemical repellents. Furthermore, the product has potential for commercial development, particularly in rural and tropical regions where mosquito-borne illnesses are most prevalent.*

This project not only promotes the use of herbal resources but also contributes to the ongoing search for sustainable and health-conscious alternatives to synthetic personal care products.

KEYWORDS: *Herbal Repellent, Mosquito Repellent, Cream, Essential Oils, Natural Ingredients, Eco-Friendly, Skin-Friendly, Traditional Medicine, Ayurvedic Formulation, Cream Stability.*

1. INTRODUCTION

Mosquitoes are small insects, but they can cause big health problems. They spread serious diseases like **malaria**, **dengue**, **chikungunya**, and **Zika virus**, which can make people very sick or even lead to death. In many countries, especially warm ones, mosquito bites are a common problem, especially during the rainy season. [2]

To avoid getting bitten by mosquitoes, people often use **chemical repellents** such as creams, sprays, and coils. One common chemical used is called **DEET**. While these products work well, they can also cause problems like: [2]

- Skin rashes or irritation
- Allergies
- Breathing difficulties (especially in children)
- Harm to the environment

Because of these problems, many people are now interested in using **natural, plant-based repellents**. Some plants contain oils that naturally keep mosquitoes away. These oils are called **essential oils**, and they can be used to make creams that are: [4]

- Safer for the skin
- Better for the environment
- Made from easily available ingredients

In this project, we made a **herbal mosquito repellent cream** using natural oils from: [1]

- **Citronella** (keeps mosquitoes away with its strong smell)
- **Lemongrass** (contains citronellal, a natural repellent)
- **Neem** (used in traditional medicine to kill or repel insects)
- **Eucalyptus** (has a cooling smell and helps drive away insects)
- **Clove** (acting as a natural insect repellent.)
- **Tulsi (**using its strong aroma and active compounds to deter mosquitoes)

These oils were mixed into a cream base made from **beeswax, glycerin**, and **water**, to make a smooth and skin-friendly product.

'In short, this project is about using **nature's power** to create a **safe, effective, and eco-friendly mosquito repellent cream**. With the increasing problems caused by chemical repellents, **herbal products offer a better and safer solution**. By making and testing this cream, we hope to prove that **natural ingredients can protect us** just as well as synthetic ones—without harming our skin or the environment.'

➢ **Environmental Impact of Chemical Repellents** [3] [2]

Chemical mosquito repellents are not just harmful to our health, but they can also **damage the environment** in these ways:

1) Water Pollution

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When people wash off chemical repellents from their skin, the chemicals can end up in **water** sources like rivers or lakes. This can:

- Harm **fish** and other water animals.
- Pollute the water, affecting the **ecosystem** and everything living in it.

2) Harm to Wildlife

The chemicals in repellents can also affect **other animals**, like:

- **Birds** that drink contaminated water or eat poisoned insects.
- **Insects** like **bees** and **butterflies**, which are important for **pollination** (helping plants grow).

These animals are very important for the environment, and using chemical repellents can harm them and upset the balance of nature.

➢ **Why Herbal Repellents?** [1] [4]

Herbal or **natural mosquito repellents** made from plant-based ingredients have become a popular solution to the problems caused by chemical products. Here's why herbal repellents are needed:

1) **Fewer Health Risks**:
Natural ingredients such as **essential oils** from plants like **citronella, neem, eucalyptus**, **lemongrass, clove and tulsi** are known to effectively repel mosquitoes without the harmful side effects associated with chemicals. These natural oils are:
   - **Safe for the skin**, even for sensitive skin
   - **Non-toxic** when applied in small amounts
   - Suitable for all age groups, including **children and the elderly**

2) **Eco-Friendly and Biodegradable**:
Herbal repellents are made from natural, plant-based oils, which are biodegradable and **safe for the environment**. Unlike chemicals, these products won't harm the:
   - **Water** systems
   - **Soil** and plant life
   - **Animals** and aquatic creatures

   This makes herbal repellents an environmentally friendly choice.

3) **Effectiveness of Herbal Ingredients**: [5]
Many essential oils from plants have **insect-repelling properties**. Some of the most effective oils for repelling mosquitoes include:
   - **Citronella oil**: Known for its strong mosquito-repelling scent.
   - **Neem oil**: Has both insect-repellent and medicinal properties.
   - **Lemongrass oil**: Contains citronellal, a powerful mosquito deterrent.
   - **Eucalyptus oil**: Known for its fresh scent and mosquito-repelling properties.

➢ **Cultural and Traditional Use** [7]

For hundreds of years, people in many countries have used **plants** to keep away mosquitoes and other insects. Long ago, there were no chemical sprays or creams. So, people used natural Herbal Plants.

These plants helped to **stop mosquito bites** and also helped with **itching and swelling** from insect bites.

Even today, many people still use these natural methods because they are **safe, cheap, and easy to find**.

Now, as more people want to live **naturally and avoid harmful chemicals**, herbal mosquito repellents are becoming popular again. They help us use **old traditional ideas** in a **safe and modern way**.



Fig.1

2. STATEMENT OF THE PROBLEM:

Mosquito-borne diseases such as malaria, dengue, chikungunya, and Zika virus continue to pose serious health threats, especially in tropical and subtropical regions. Synthetic mosquito repellents like DEET and other chemical-based formulations, although effective, often cause skin irritation, allergic reactions, and long-term environmental harm due to their toxicity and non-biodegradable nature. [9]

There is a growing need for safe, natural, and eco-friendly alternatives that can offer comparable protection without the adverse effects associated with synthetic products. Herbal ingredients such as neem, citronella, eucalyptus, tulsi, and lemongrass have been traditionally known for their mosquito-repelling properties, yet their use in commercially viable and stable cream formulations remains limited. [7] [4]

This project aims to address this gap by developing a topical herbal mosquito repellent cream that is both effective and safe for human use, while being environmentally sustainable.

3. HYPOTHESIS

A cream formulated with selected herbal ingredients such as neem, citronella, eucalyptus, tulsi, and lemongrass will exhibit effective mosquito repellent activity, comparable to synthetic repellents, while being safe, skin-friendly, and environmentally sustainable.

4. AIM

To develop a natural and effective mosquito repellent cream using herbal ingredients that are safe for human skin and environmentally friendly.

Objectives

1. To select herbal ingredients with proven mosquito repellent properties (e.g., neem, citronella, eucalyptus, tulsi, lemongrass).
2. To prepare a skin-friendly cream base suitable for topical application.
3. To incorporate herbal extracts or oils into the base in effective concentrations.

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4. To evaluate the repellent activity of the formulated cream against mosquitoes.
5. To assess the physical properties, stability, and skin compatibility of the cream.
6. To compare the herbal formulation's efficacy with a commercial repellent product.

5. NEED FOR HERBAL REPELLENTS

➢ **Growing Concerns About Chemical Repellents**

In today's world, **mosquito-borne diseases** like **malaria, dengue, chikungunya**, and **Zika virus** continue to affect millions of people every year, particularly in tropical and subtropical regions. While there are effective **chemical mosquito repellents** available in the market, they come with several **disadvantages**: [8] [7]

1) **Side Effects on Health**:
   Many **chemical repellents** contain ingredients like **DEET**, which is very effective but can cause:[11]
   - **Skin irritation** or **rashes**
   - **Eye irritation** if it comes in contact with eyes
   - **Allergic reactions** in some people
   - **Headaches**, dizziness, or even nausea if inhaled
2) **Not Safe for All Groups**:
   Chemicals such as DEET are not recommended for:
   - **Infants** or **young children** (under 2 years)
   - **Pregnant women**
   - People with **sensitive skin** or allergies
3) **Environmental Concerns**:
   Chemical repellents often end up in the environment. When washed off or thrown away, they can: [6]
   - Pollute **water** sources
   - Harm **wildlife**, especially aquatic creatures
   - Damage plant life and ecosystems

   This creates a need for **eco-friendly alternatives** that won't harm the environment.

➢ **The Growing Demand for Natural Products** [10] [6]

- As awareness of the side effects of synthetic chemicals rises, more people are turning to **natural alternatives** for their everyday needs.
- The **natural products market** is growing fast, and more people prefer herbal products for **healthcare**, **beauty**, and even **household products**.

6. INGREDIENTS USED IN CREAM AND THEIR ROLES [12] [11] [13] [5]

Ingredient	Role / Function
Citronella Oil	A natural oil with a strong smell that keeps mosquitoes away. It is one of the most common herbal mosquito repellents.
Neem Oil	Has insect-repelling and antibacterial properties. It also helps to soothe the skin.
Lemongrass Oil	Contains citronellal, which is known to repel mosquitoes. It also gives a fresh scent.
Clove oil	acting as a natural insect repellent
Tulsi oil	using its strong aroma and active compounds to deter mosquitoes
Beeswax	Helps to thicken the cream and gives it a smooth texture. Also helps form a protective layer on the skin.
Stearic Acid	A natural fatty acid that helps to blend oil and water in the cream. It also gives the cream a firm structure.
Glycerin	A moisturizer that keeps the skin soft and prevents dryness.
Coconut Oil / Almond Oil	Used as a base oil to mix all ingredients and help spread the cream smoothly on the skin.
Distilled Water	Used to form the cream base and make it smooth and easy to apply.
Preservative (Optional, Natural)	To keep the cream fresh and stop it from spoiling over time (like Vitamin E or natural preservatives).

All the ingredients used are:

- Natural
- Safe for the skin
- Eco-friendly
- Effective in keeping mosquitoes away

These ingredients work together to create a gentle, non-toxic, and effective mosquito repellent cream.

7. HERBS USED IN MOSQUITO REPELLENT CREAM : [5] [6] [17]

I . Neem Oil



Fig.2 **NEEM**

A. Common Name: Neem
B. Biological Name : Azadirachta indica
C. Family: Meliaceae
D. Mode of Action (MOA):

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Neem exhibits multiple modes of action, especially due to its primary active compound **azadirachtin**. Here's how it works:

1. **Insecticidal Action**:
   - Disrupts insect hormone systems, especially **ecdysone** (molting hormone).
   - Acts as an **antifeedant**, **repellent**, and **growth regulator**.
   - Inhibits oviposition (egg-laying) and development of larvae and pupae.
2. **Antimicrobial & Antifungal Action**:
   - Inhibits growth of certain **bacteria**, **fungi**, and **viruses**.
   - Interferes with microbial cell membranes and metabolism.
3. **Medicinal Effects** (in humans):
   - **Anti-inflammatory**, **antioxidant**, **antipyretic**, **analgesic**, **antidiabetic**, **antimalarial**, **hepatoprotective**, and **immunomodulatory** actions.

E. Major Chemical Constituents:

1. **Azadirachtin** – Primary bioactive compound (insecticidal)
2. **Nimbin** – Antibacterial and antifungal
3. **Nimbidin** – Anti-inflammatory and antipyretic
4. **Salannin** – Antifeedant
5. **Quercetin** – Antioxidant, antibacterial

II. Lemon Grass Oils

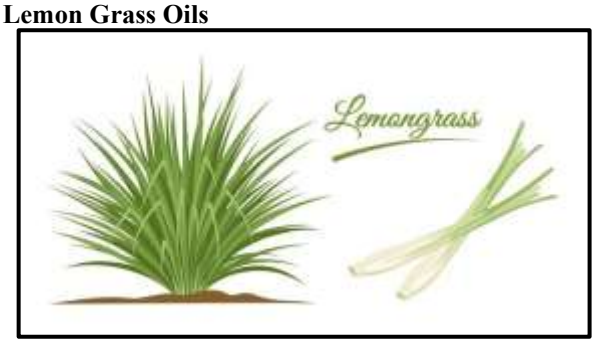


Fig.3 **Lemon Grass**

A. Common Name: Lemongrass Oil
B. Biological Name : Cymbopogon citratus or Cymbopogon flexuosus
C. Family: Poaceae (Grass family)
D. Mode of Action (MOA):

Lemongrass oil contains several bioactive compounds that give it a range of therapeutic and practical benefits:

1. **Antimicrobial & Antifungal Action**:
   - The main active compound in lemongrass oil, **citral**, has been shown to have strong antimicrobial properties against bacteria, fungi, and yeast.
   - Effective against **pathogens** like *E. coli*, *Salmonella*, and *Candida*.
2. **Anti-inflammatory Action**:
   - Used for reducing inflammation and soothing sore muscles, as well as for conditions like arthritis.
3. **Insecticidal & Repellent**:
   - Known to repel insects like mosquitoes, fleas, and ticks due to its strong aroma. Lemongrass oil is often used in **natural insect repellents**.

E. Major Chemical Constituents:

1. **Citral** (Geranial & Neral) – The primary active compound (strong antimicrobial, antifungal, and anti-inflammatory properties)
2. **Limonene** – Antioxidant and antimicrobial
3. **Caryophyllene** – Anti-inflammatory, analgesic
4. **Terpinolene** – Antioxidant, antimicrobial

F. Uses: Aromatherapy, Massage Oil, Insect Repellent.

III. Clove Oil



Fig.4 **Clove Oil**

A. Common Name: Clove
B. Biological Name : Syzygium aromaticum
C. Family: Myrtaceae
D. Mode of Action (MOA):

Clove contains bioactive compounds that exhibit several actions:

1. **Antimicrobial Action**:
   - **Eugenol**, the primary compound in clove, has powerful **antibacterial**, **antifungal**, and **antiviral** properties.
   - Effective against oral bacteria, and commonly used in **dental care** (e.g., clove oil).
2. **Analgesic & Anti-inflammatory**:
   - **Eugenol** also has pain-relieving (analgesic) and anti-inflammatory effects, often used in topical applications for toothaches and sore muscles.
3. **Antioxidant**:
   - Clove's compounds can neutralize free radicals, helping reduce oxidative stress in the body.
4. **Digestive Aid**:
   - Traditionally used as a **carminative** to help with indigestion, bloating, and nausea.
5. **Insect Repellent**:
   - Applied in various natural repellent products or diffused to repel mosquitoes.
6. **Insecticidal**:
   - Used in natural insect repellents due to its strong aroma and bioactive properties.

E. Major Chemical Constituents:

1. **Eugenol** – The primary bioactive compound (antimicrobial, analgesic)
2. **Acetyleugenol** – Aromatic compound with antimicrobial properties
3. **β-caryophyllene** – Anti-inflammatory and antioxidant
4. **Tannins** – Antioxidant and antimicrobial
5. **Flavonoids** – Antioxidant properties

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6. **Methyl eugenol** – Antimicrobial and insecticidal properties

IV. Citronella Oil



Fig.5 **Citronella Oil**

A. Common Name: Citronella Oil

B. Biological Name : There are two main species from which citronella oil is extracted:
1. **Cymbopogon nardus** *(Ceylon citronella)*
2. **Cymbopogon winterianus** *(Java citronella)*

C. Family: Poaceae (Grass family)

D. Mode of Action (MOA): Citronella oil acts mainly through its strong aromatic and chemical properties:
1. **Insect Repellent**:
   - **Primary Mode of Action**: Its volatile compounds interfere with the insect's olfactory receptors, masking the scent of carbon dioxide and body odor that attract insects.
   - Effective against **mosquitoes**, **ticks**, **lice**, and **fleas**.
   - Works by **repelling**, not killing, insects.
2. **Antimicrobial Action**:
   - Exhibits **bactericidal** and **fungicidal** activity due to its phenolic and aldehyde compounds.
3. **Anti-inflammatory & Antioxidant**:
   - Helps reduce swelling and oxidative stress in topical applications..
4. **Calming/Aromatherapy Effects**:
   - Provides a mild **sedative** effect and is often used to relieve stress and uplift mood.

E. Major Chemical Constituents:
1. **Citronellal** – Primary insect repellent compound
2. **Citronellol** – Antimicrobial, anti-inflammatory
3. **Geraniol** – Antibacterial, antifungal, fragrance component
4. **Limonene** – Antioxidant and cleansing agent
5. **Camphene** – Antimicrobial and aromatic properties

F. Common Uses: Insect Repellent, Aromatherapy, Personal Care

V. Tulsi Oil



Fig.6 **Tulsi Oil**

A. Common Name: Tulsi (also known as Holy Basil)

B. Biological Name: Ocimum sanctum (also referred to as *Ocimum tenuiflorum*)

C. Family: Lamiaceae (Mint family)

D. Mode of Action (MOA): Tulsi exhibits mosquito-repellent properties through the following mechanisms:
- **Olfactory masking**: The **essential oils** in Tulsi (especially **eugenol**, **methyl eugenol**, and **linalool**) interfere with the mosquito's ability to detect host odors.
- **Repellent barrier**: The **volatile compounds** form a vapor cloud that acts as a **protective barrier**, preventing mosquitoes from landing on the skin.
- **Insecticidal properties**: Some components of Tulsi oil show **mild toxic effects on mosquito larvae** and may have a **knockdown effect** on adult mosquitoes in higher concentrations.

E. Uses of Tulsi in Herbal Mosquito Repellents:

Natural Mosquito Repellent
Tulsi essential oil is used in creams, sprays, and incense sticks to **repel mosquitoes naturally** without harmful chemicals like DEET.
- **Larvicidal Properties**
  Tulsi extracts can be used in water bodies to **kill mosquito larvae**, helping in mosquito population control..
- **Safe for Skin**
  Tulsi-based repellents are generally **non-irritating** and suitable for use on sensitive skin or children when properly formulated.

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8. FORMULATION TABLE FOR 50GM CREAM :- [3] [8] [9]

Ingredients	Quantity	Role Of Ingredient
. OIL PHASE		
Neem oil	0.45ml	Mosquito Repellent
Clove Oil	0.9ml	Mosquito Repellent
Lemon Grass Oil	0.9ml	Mosquito Repellent
Citronella Oil	0.6ml	Mosquito Repellent
Basil (Tulsi Oil)	0.6ml	Mosquito Repellent
Camphor Oil	0.45 ml	Mosquito Repellent
Cetyl alcohol	1.5 gm	Stiffening Agent , Thickener
Stearic Acid	2.1gm	Emulsifier and oil base
Beeswax	1.5gm	Stabilizing agent, Emollient
Liquid Paraffin	1.2ml	LubricatingAgents, Emollients
B . Water Phase		
Glycerin	1.2 ml	
Propylene Glycol	1.2 ml	Humectant
Methyl Paraben	0.18 gm	Humectant , Plasticizer
Water	Q.S	Vehicle
C.Organoleptic Ingredients		
Coconut Oil	Q.S	Antioxidant
Aloe Gel	1.5 gm	Moisturizing Agent
Colours (BEET Juice)	Q.S	Coloring Agents
Perfumes (Rose Essence)	Q.S	Fragrances

Formulation Table For 15gm Cream

9. METHODOLOGY [11] [17] [18]

1. Materials Used

- Citronella oil
- Neem oil
- Lemongrass oil
- Clove oil
- Tulsi oil
- Aloe Gel
- Beeswax
- Coconut oil or Almond oil
- Glycerin
- Stearic acid
- Distilled water
- Natural preservative (e.g., Vitamin E)

2. Equipment Used

- Beaker
- Stirring rod or magnetic stirrer
- Water bath or heater
- measuring cylinder
- pH meter or pH paper
- Container for storing cream

3. Procedure to Prepare the Herbal Cream

Step 1: Prepare the Oil Phase

- Take **beeswax**, **stearic acid**, and **coconut oil/almond oil** in a beaker.
- Heat the mixture in a **water bath** (indirect heat) until everything melts and mixes well.
- Add the **essential oils** (citronella, neem, lemongrass, clove, tulsi) to this melted oil mixture.

Step 2: Prepare the Aqueous Phase

- In another beaker, warm **distilled water** and **glycerin**.
- Stir well to mix.

Step 3: Mixing Both Phases

- Slowly pour the **warm water phase** into the **oil phase** while stirring continuously.
- Keep stirring until the mixture becomes **thick and creamy**.

Step 4: Add Preservative

- Once the cream cools slightly, add a **natural preservative** (like vitamin E oil).

Step 5: Store the Cream

- Transfer the cream into a clean, airtight **container**.
- Label it and store it in a cool, dry place.



Fig.7 Formulation Process

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10. TESTING & OBSERVATIONS

After making the herbal mosquito repellent cream, we tested it to see how well it works and how good it is for the skin. Below are the tests we did and what we observed:

1. Physical Appearance

- **Test**: We checked the color, smell, and texture of the cream.
- **Observation**:
  - Color: Light yellow or off-white
  - Texture: Smooth and creamy
  - Smell: Pleasant herbal smell (due to essential oils)
  - No lumps or separation of oil and water [4]

2. PH Test

- **Test**: We used pH paper or a pH meter to check the cream's pH.
- **Observation**:
  - pH value was between **5.5 and 6.5**, which is safe for skin.
  - The cream is **non-irritating** and suitable for all skin types.

3. Spreadability Test

- **Test**: A small amount of cream was placed between two glass slides and lightly pressed. We then measured how far it spread.
- **Observation**:
  - The cream spread **easily and evenly**.
  - It had good coverage and did not feel sticky.

4. Stability Test

- **Test**: The cream was stored in a closed container for **2–4 weeks** at room temperature to see if it changed over time.
- **Observation**:
  - No change in color, smell, or texture.
  - No separation of oil and water.
  - The cream remained **stable and fresh**.

5. Mosquito Repellency Test

- **Test**: A volunteer applied the cream on one arm and kept it in a mosquito cage (arm-in-cage method). We counted how many mosquitoes landed or bit the skin.
- **Observation**:
  - Very **few or no mosquitoes** landed on the arm with the cream.
  - The effect lasted for **2–3 hours** or more.
  - The cream showed **good mosquito repellent activity**.

Summary of Observations

Test Name	Result
Appearance	Smooth, creamy, pleasant smell
pH	Skin-friendly (around 6)
Spreadability	Easy and even
Stability	No changes over 2–4 weeks
Mosquito Repellency	Effective for 2–3 hours

11. CONCLUSION

In this project, we successfully made a **herbal mosquito repellent cream** using natural ingredients like **citronella oil, neem oil, eucalyptus oil**,**Clove oil, Tulsi oil and lemongrass oil**. These ingredients are known for their **mosquito-repelling** properties and are **safe for the skin**. [19] [14]

We tested the cream for its:

- **Appearance** – it was smooth and pleasant-smelling.
- **pH level** – safe for human skin.
- **Spreadability** – easy to apply and non-sticky.
- **Stability** – stayed fresh and unchanged over time.
- **Effectiveness** – it kept mosquitoes away for a few hours after application.

The results showed that the cream is **effective**, **safe**, **eco-friendly**, and a good alternative to **chemical repellents**. Since chemical repellents can cause health problems and harm the environment, herbal creams like this one are a **better and safer choice**.

This project also shows how **traditional herbal knowledge** can be used in modern times to solve common problems like mosquito bites—**naturally and safely**.



12. FUTURE SCOPE

This project has shown that a **herbal mosquito repellent cream** can be a **safe, natural, and effective** alternative to chemical repellents. There are many ways this idea can grow and improve in the future. [5] [10]

1. Industrial or Commercial Production

- The cream can be produced on a **large scale** in factories.
- With proper packaging and branding, it can be sold in **shops, pharmacies, or online** as a safe, herbal product.
- It could also be used in **schools, hospitals**, or **rural areas** where chemical repellents may not be safe or affordable.

2. Improved Formula

- More research can be done to find the **best combination of herbal oils** for longer protection.
- **Advanced natural ingredients** like aloe vera or turmeric can be added to make the cream **soothing**, **anti-itch**, or **anti-inflammatory**. [7]

3. Other Product Forms

- Besides cream, the repellent can be made into:
  - **Spray** (for easy use on clothes or in rooms)
  - **Roll-on** (for quick skin application)
  - **Lotion** (for daily use)
  - **Mosquito repellent patches** (for children and babies)

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This would give **people more options** based on their needs.

4. Longer Protection Time

- Right now, herbal creams may work for 2–3 hours.
- Future studies can focus on increasing the protection time to **6–8 hours** using natural fixatives or binders.

5. Clinical and Safety Testing

- The cream can be tested on **more people** of different age groups, including **children**, **elderly**, and those with **sensitive skin**.
- Tests can check for **any allergic reactions**, **skin sensitivity**, and **long-term safety**.[17]

6. Eco-Friendly and Sustainable Packaging

- Use of **biodegradable tubes**, **recycled containers**, or **paper-based packaging** can make the product even more **environment-friendly**.
- Labels can include **information about the herbs** to promote awareness of **natural remedies**.

7. Support Local Farmers and Herbal Industry

- The herbs used in the cream can be **grown locally** to support **small farmers and herbal growers**.
- This can also help **promote Ayurvedic and traditional medicine** in a modern way.

8. Awareness and Education

- Awareness programs can be started to **teach people** about the benefits of using **herbal repellents** instead of chemical ones.
- This can especially help people in **villages** and **tropical areas** where mosquito problems are high.

There is a lot of potential for herbal mosquito repellent products in the future. With more research, support, and public interest, herbal repellents can become a safe, affordable, and eco-friendly solution to fight mosquito-borne diseases. This not only improves public health but also supports a greener and healthier world. [18] [19]

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