

# Development and Evaluation of an Herbal Mosquito Repellent Cream Enriched with Skin Moisturizing Agents

Ankita<sup>1</sup>, As Kumar Mandal<sup>1</sup>, S. Tejashwar Rao<sup>1</sup>, Dr. Gyanesh Kumar Sahu<sup>2</sup>, Dr. Chanchal Deep Kaur<sup>1</sup>

<sup>1</sup>Rungta institute of pharmaceutical sciences, Bhilai

<sup>2</sup>Rungta institute of pharmaceutical science and research, Bhilai

## Abstract:

Mosquitoes are the vector of serious diseases such as malaria, dengue, chikungunya, filariasis and the zika virus. Despite of many efforts to control mosquito number, these diseases continue to be major global issue. Therefore, use of mosquito repellent cream is one of the most effective way to prevent from the mosquito bites and illness caused by them. The conventional mosquito repellent contains synthetic chemicals such as DEET. Although they work well, but its long-term use can cause skin irritation and allergic reactions. Because of safety issues, more interest has shifted toward plant-based mosquito repellents, which are safer, eco-friendly, and biodegradable. This research focuses on the formulation and evaluation of a herbal mosquito repellent cream. This cream not only protects against mosquitoes but also offers moisturising benefits for the skin. Herbal ingredients and essential oils have natural mosquito-repelling properties. In this study, a formulation was prepared using lemongrass oil, neem oil, and thyme oil as active mosquito repellent ingredients. Lemongrass oil has active components like geranial, neral, citronella and geraniol that repel insect. Neem oil contains azadirachtin and nimbin has strong repellent effect. Thyme oil has monoterpenes, which disrupt the mosquito's ability to detect humans. Three formulations were formulated and various tests were performed to evaluate its safety and effectiveness of the formulation. The formulated cream has a smooth texture and the PH of all formulations was between 7.2 and 7.3, close to neutral and safe for topical application. Spreadability test revealed that the cream spreads easily on the skin, ensuring even application. The formulated cream was stable and didn't cause any skin irritation. In conclusion, this study successfully developed a safe, stable and effective herbal mosquito repellent cream that offers both mosquito repellent and skin moisturisation.

## **Keywords:**

Herbal mosquito repellent cream, lemongrass, thyme, neem, aloe vera

## **1. Introduction:**

Mosquitoes such as Aedes, Anopheles and Culex are hazardous vectors of human disease, which can cause malaria, dengue, fever, chikungunya, yellow fever, Zika virus and filariasis. According to WHO, millions of deaths are reported due to mosquito-borne illness in tropical and sub-tropical region. (1) Regardless of substantial efforts in recent years to control mosquito-borne disease, malaria itself produces 250 million cases per year and many deaths under five years (WHO,2010). So, preventing mosquitoes could be better than curing mosquito-borne disease. Hence, to avoid mosquito bites, the application of mosquito repellent to exposed skin is an effective protective measure. (2)

A mosquito repellent is a substance that is applied to skin, cloth or other exposed surfaces which deters the mosquito landing on that surface. It is synthesised in such a manner that it makes surface unpleasant and unattractive to mosquitoes so to reduce mosquito contact. Many synthetic mosquito repellents are available in market containing N, N-diethyl- meta-toluamide (DEET) have been used for decades. But long- term use of DEET can cause skin irritation, allergic reactions, neurotoxicity etc. So, for the concern of public safety toward the use of products of plant origin and essential oils, which are a more environmentally friendly and safer alternative. (3)

Many plant extracts show protective properties against mosquitoes and are highly effective in keeping mosquitoes away. Neem extract and Cymbopogon are the most popular natural repellents in the world. Additionally, some essential oils, such as thyme oil, also has mosquito repellent property. Herbal cream was formulated for various purposes such as mosquito repellent and skin care, which is a semi-solid emulsion.

The main objective of this project is to formulate mosquito repellent cream with moisturizing property which should have both repellent nature as well as give soothing benefits to skin. Mosquito repellent property is got by plant extract such as lemongrass, neem, thyme, etc. and moisturizing property by incorporating aloe vera and coconut oil, which have effective soothing effects. (4)

## **2. Material and method:**

### **2.1. Selection of herbal ingredients:**

#### **A. *Cymbopogon citratus*:**

It is one of the most familiar species of the genus *Cymbopogon* from the family Poaceae (Graminae). *Cymbopogon*, also known as lemongrass, barbed wire grass, silky heads, oily heads, citronella grass or fever grass. The leaves contain lemon-fragrance essential oil, which is responsible for many activities. (5)

The plant shows therapeutic benefits, including antibacterial, antifungal, anti-inflammatory, antimalarial and anti-rheumatic effects. However, traditional usage and anecdotal evidence suggest that lemongrass may help deter mosquitoes and reduce the incidence of insect bites. The lemongrass shows repellent activity because of the presence of some active component of its essential oil such as geranial, neral, geraniol, citronellol, citronella and elemol. (6)

FIG.1 LEMONGRASS



### B. *Azadirachta indica*:

It is commonly known as neem, margosa, nimtree or Indian lilac. Neem fruit, seeds, leaves, stems and barks contain diverse phytochemicals. Azadirachtin is the most well-known triterpenoid in neem oil and nimbin is another triterpenoid responsible for many activities. (7) Neem tree is well known traditional medicine shows activities such as antimicrobial, insecticidal and anti-inflammatory activities. Neem is chosen because of the presence of higher content of azadirachtin which have mosquito repellent property. (1)



FIG.2 NEEM

### C. *Thymus vulgaris*:

*Thymus vulgaris* (common thyme) is a flowering plant in the mint family laminaceae. The essential oil of thyme contains monoterpenes such as carvacrol, p-cymene, linalool, alpha-terpinene and thymol which have repellency activities against mosquito. *Thymus vulgaris* work by emitting substance that interfere with olfactory receptors of mosquito making it difficult to detect human scent cues. (8)



FIG.3 THYME

#### D. Aloe- vera:

Aloe-vera belong to Asphodelaceae family. It is used in many products because it possesses moisturizing property. It helps in improving ability of skin to hydrate itself and also remove dead cells. It carries this out by producing collagen and elastin fibres making skin more elastic and soften the skin by its cohesive action on superficial flaking epidermal cells. (9)

### 2.2. Extraction of essential oil:

#### A. Extraction of neem oil:

Neem seeds were used for the extraction of neem oil. Before extraction, neem seeds were washed to remove dirt and dried at 50 °C until their moisture content reached a constant. Then the neem seeds are ground to get powder. The neem seeds were extracted using n-hexane and ethanol for 3 hours with a ratio of neem seed powder to solvent volume of 1:5. After that, the sample was centrifuged to separate the solid fraction from the solution. The filtrate was heated and evaporated to get solvent-free oil. The oil is stored in an amber glass container to prevent oxidative degradation. (10)

#### B. Extraction of lemongrass oil:

Leaves of *Cymbopogon citratus* were dried and after that ground. The ground leaves were placed in a porous thimble for oil extraction using the Soxhlet extraction method with n-hexane solvent. The extract was filtered out and stored at room temperature. (11)

#### C. Extraction of thyme oil:

The thyme leaves are collected and dried it to grounded it into powdered form. 50 g of thyme leaf powder is mixed with 750 ml of distilled water for hydrodistillation extraction of thyme oil. The extracted oil is then stored in a dark vial. (12)

### 2.3. Preparation of cream formulation:

#### Properties of ingredients used in formulation:

| S.no. | Ingredients     | Properties                       |
|-------|-----------------|----------------------------------|
| 1.    | Lemongrass oil  | Mosquito repellent essential oil |
| 2.    | Neem oil        | Mosquito repellent               |
| 3.    | Thyme oil       | Mosquito repellent essential oil |
| 4.    | Aloe-vera       | Moisturiser and skin smoothers   |
| 5.    | Borax           | Emulsifying agent, stabiliser    |
| 6.    | Liquid paraffin | Emollient, occlusive agent       |
| 7.    | Glycerine       | Humectant                        |
| 8.    | Beeswax         | Thickening agent, emulsifier     |

|     |             |                        |
|-----|-------------|------------------------|
| 9.  | Rose water  | Fragrance, consistency |
| 10. | Coconut oil | Moisturiser, Emollient |



**Quantity of ingredients used in formulation**

| S.NO | INGREDIENTS     | Formulation (F1) | 1 Formulation 2(F2) | Formulation 3(F3) |
|------|-----------------|------------------|---------------------|-------------------|
| 1.   | Lemongrass oil  | 0.5 ml           | 1 ml                | 0.5 ml            |
| 2.   | Neem oil        | 0.5 ml           | 0.5 ml              | 0.5 ml            |
| 3.   | Thyme oil       | 0.5 ml           | 0.5 ml              | 1 ml              |
| 4.   | Aloe-vera       | 1 ml             | 1 ml                | 1 ml              |
| 5.   | Borax           | 0.2 gm           | 0.2 gm              | 0.5 gm            |
| 6.   | Liquid paraffin | 12 ml            | 12 ml               | 12 ml             |
| 7.   | Glycerine       | 2 ml             | 4 ml                | 2 ml              |
| 8.   | Beeswax         | 3.8 gm           | 3.8 gm              | 3.8 gm            |
| 9.   | Rose water      | 2.5 ml           | 2.5 ml              | 2.5 ml            |
| 10.  | Coconut oil     | 2 ml             | 2 ml                | 2 ml              |

## Formulation procedure:

Accurately weigh all ingredients

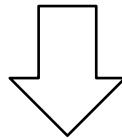


Preparation of oil phase  
(Beeswax, liquid paraffin, coconut oil)

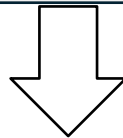


Heat the oil phase to about 70-75°C until completely melt

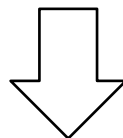
Preparation of aqueous phase in another beaker



Before emulsification process add all plant extracts (Neem oil, thyme oil and lemongrass oil)



Emulsification process  
(Add aqueous phase slowly into oil phase by continuous stirring)



Add aloe-vera gel and then cool the formulation and transfer into suitable container



Final product

**Evaluation:**

The Evaluation test of the herbal mosquito repellent cream is performed to determine its physical properties, stability and efficacy of cream. The evaluation parameters of herbal mosquito repellent cream include organoleptic evaluation, spreadability, pH, skin irritation, repellency and melting point of cream.<sup>13</sup>

**1. Organoleptic evaluation:**

Organoleptic parameters include odour, colour and texture of cream. It determines the appearance of the product.<sup>14</sup>

- Colour: The colour of the formulated herbal mosquito repellent cream is a slight peach.
- Odour: Mild herbal scent due to the presence of essential oils of neem, thyme and lemongrass.
- Texture: The texture of the formulated product is smooth and non-greasy.

**2. pH determination:**

The pH of the formulation was determined by a digital pH meter to estimate its compatibility with the skin.<sup>15</sup>



Fig. PH determination

| Formulation | F1  | F2  | F3  |
|-------------|-----|-----|-----|
| pH          | 7.3 | 7.3 | 7.2 |

### 3. Stability testing:

Stability testing of formulation is performed to ensure that the essential oil used in formulation are remain effective, safe and consistent throughout their shelf-life.<sup>16</sup>

| S.no | Week                 | F1     | F2     | F3     |
|------|----------------------|--------|--------|--------|
| 1    | 1 <sup>st</sup> week | stable | stable | stable |
| 2    | 2 <sup>nd</sup> week | stable | stable | stable |
| 3    | 3 <sup>rd</sup> week | stable | stable | stable |

### 4. Melting point:

It ensures the products stability, quality and proper release of active ingredients at skin temperature.

| Formulation   | F1    | F2    | F3    |
|---------------|-------|-------|-------|
| Melting point | 33 °C | 34 °C | 32 °C |

### 5. Spreadability:



**Fig. Spreadability test**

| Formulation   | F1     | F2     | F3     |
|---------------|--------|--------|--------|
| Spreadability | 6.7 cm | 6.9 cm | 6.7 cm |

## 6. Skin irritation:

Skin irritation test is performed to determine any adverse reactions of the product on human skin.

| Formulation     | F1            | F2            | F3            |
|-----------------|---------------|---------------|---------------|
| Skin irritation | No irritation | No irritation | No irritation |

## Discussion and result:

The present study was conducted to determine the mosquito- repellent activities of essential oil used in formulation including lemongrass oil, thyme oil and neem oil in order to formulate safe and effective herbal mosquito repellent cream.

The formulated cream showed effective repellency. The formulated cream was also evaluated for the parameter like organoleptic, spreadability, pH, melting point, stability and skin irritation to ensure product stability, safety, efficacy and consumer acceptance.

The appearance of the cream was good having smooth texture and easily spreadable to about 6.3 cm. PH of the formulation was found to be 7.3 which is near to the required PH and its melting point was 33 °C. The cream showed no irritation and redness, so it is safe for topical application. So, the formulated herbal mosquito repellent cream was safe, effective and free from any hazardous chemicals.

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