

## FABRICATION OF A NATURAL HERBAL MOSQUITO REPELLENT GEL

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### ARTICLE INFO

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### ABSTRACT

Medicinal plants contain various biologically active compounds that are useful for the improvement of a disease life and treatment and are the main source of synthetic and traditional herbal medicine. The presence of various lives sustaining constituents in plant made scientists investigate these plants for their uses. The objective of the work was to formulate a mosquito repellent gel containing natural ingredients which have their own advantages and benefits the formulation was made. Because in the market many chemical based formulations are present which having many side effects, so I make the formulation based on herbal ingredients which have no side effect of any age group of people. A volunteer's arms and legs rubbed with 1 ml solution of gel was exposed to 30 blood-seeking mosquitoes, and the number of mosquitoes that aligned orbiting the arm and legs were recorded in each minute for 5-minutes. And the analysis was carried out as a triplicate and mosquito repellent activities were found to be outdoor and indoor field trials on mosquito repellent gel active ingredients, which were conducted in three days from 7 am to 11 am by application on volunteers legs and arms. 100% mosquito repellency up to 4-hours was observed for the gel for outdoor and indoor field trials.

**Keywords:** Herbal gel, mosquito repellent gel, formulation of gel, method for gel, natural ingredient for gel, Mosquito repellent.

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### INTRODUCTION:

Mosquitoes are the vectors responsible for spreading different types of fatal human diseases such as malaria, Japanese encephalitis, dengue, filariasis, and yellow fever. It has been reported that mosquitoes are the vectors which alone are responsible for transmission of diseases to 700 million people and cause over 1 million deaths annually across the globe. These vectors have been considered as a major obstacle to socioeconomic development of developing countries particularly in the tropical region [1-3]. The mosquitoes eject their saliva into the blood of the host that creates an immune response due to the binding of the antibodies IgG and IgE to the antigens. The reactions result in irritations, itching, redness and sometime it develops into the bumps. It is the saliva of the mosquito that often causes an irritating rash that is a serious nuisance. In addition, mosquito bites can cause severe skin irritation through an allergic reaction to the mosquito's saliva by human mosquito contact. Mosquitoes bear set of sensors that have the capability to track their prey's presence, these include:

**A. Chemical sensors:** Experiments have shown that mosquitoes appear to sense the lactic acid, carbon dioxide, and propen-3-ol up to many yards away. Those compounds are released by humans and animals on breathing or suddenness. On breathing or perspiration, humans and the animals release these compounds. This is the reason that a person who sweats more becomes the

target of the species and the one who sweats less don't get as many bites.

**B. Heat Sensors:** The mosquitoes also have the ability to detect heat and hence can target the warm-blooded animals very fast once they get close enough.

**C. Visual Sensors:** It's been recorded that the mosquitoes are the intelligent insects as they can easily detect you by looking at your clothing if it contrasts with the background. You are easily detected by them as anything that moves is alive and hence full of blood [4].



Figure 1: Formulated Mosquito Repellent Gel

As we know, most of the mosquito repellent products and devices available in the market are recorded to have harmful effects on humans. So, the purpose of this paper is to develop effective mosquito repellent based on plants to prepare an herbal mosquito repellent gel which may also having no harmful effects on humans.

## MATERIALS AND METHODS:

### Preparations of the Plant Extracts:

For neem extract, 966.67 g. were soaked in hexane solvent, 1,960 ml, and overnight at room temperature with occasional shaking. The hexane extract was filtered and the filtrate was concentrated by rotary evaporator at around 45°C. For the second extraction the same procedure was performed using squeezed Neem seeds. Lastly, the total extract was weighed and stored in the refrigerator at 4°C until the experiment was used [5].

The plant selection was based on their availability as raw materials, scientific evidence and folkloric use as repellents for the mosquitoes.

### Preparations of the Essential Oils:

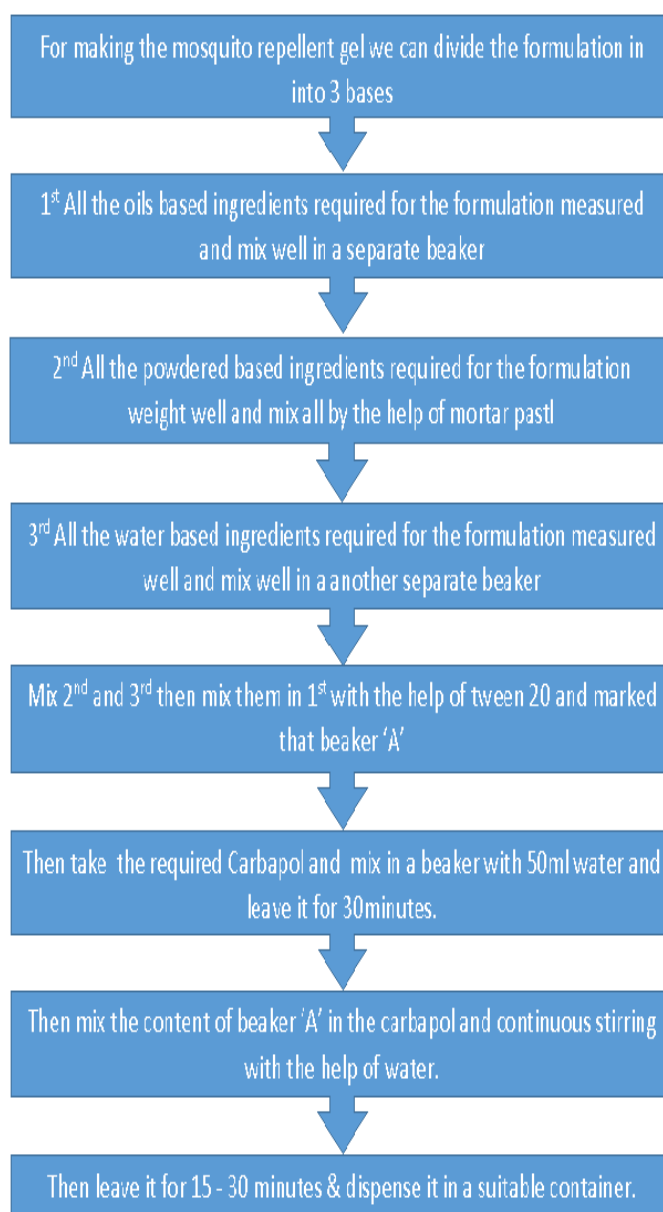
Essential oils of Citronella essential oil, Eucalyptus essential oil and Clove bud oil were purchased from Citro Essential Oils (Pvt.) Ltd, Sri Lanka [6-8].

Hydro-distillation process was separately performed for Tulsi essential oil, 718.90 g; Turmeric essential oil, 700.00 g. Water was added to the weighed quantity of plant material in a round bottom flask which was placed on a heating mantle, and the flask was connected with the Clevenger-arm apparatus. Flow of water was allowed to run in the condenser. While boiling, the volatile oils were carried along with the steam into the graduated distillate receiving the tube and excess water returned to the flask. A layer of the solvent, mixture of dichloromethane and diethyl ether (1:1 ratio), was added to the distillation arm. The essential oils dissolved in the organic solvent mixture which was in the graduated distillate receiving arm. Heating was continued for about 5 hours and assemblies were allowed to cool. At last independent array of aqueous layers and organic layer, then the organic layer was allowed to dry over anhydrous sodium sulphate and aqueous layer was extracted twice with dichloromethane. Finally, the combined solvents were evaporated and essential oil was obtained. Essential oil was weighed and stored in refrigerator at 4°C until it was used for the experiment [6-9].

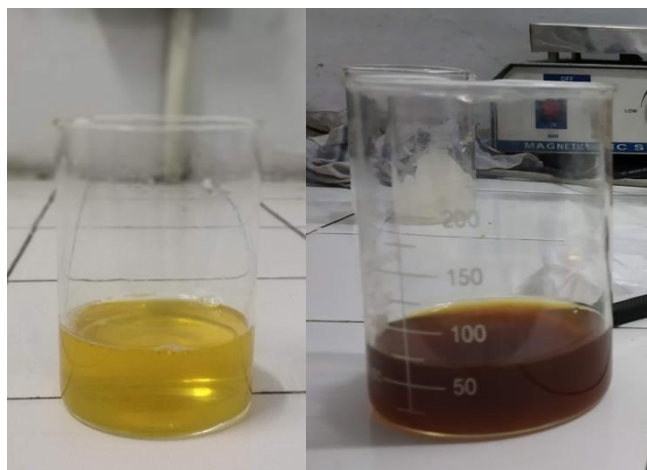
**Table 1: The constituents used in the mosquito repellent gel**

Constituents	Quantity in Gel for 400ml
Citronella essential oil	10.00 ml
Eucalyptus essential oil	10.00 ml
Tulsi essential oil	3.00 ml
Clove bud essential oil	7.00 ml
Clove bud oil	6.00 ml

Turmeric essential oil	4.00 ml
Neem extract	12.00 ml
Hexane	6.00 ml
Ethanol	5.00 ml
Carbapol	5.00 g
Propylene glycol	20.00 ml
Methyl paraban	0.50 g
Tween 20	24.00 ml
Triethanol amine	Few drops
Distilled water	Q.S.



**Figure 2: Method for formulation (Mosquito repellent gel)**



**Figure 3: Base formulation**



**Figure 4: Gel base for formulation**

**Bio-Efficacy Testing of the Mosquito Repellent Gel:**

Bio-efficacy tests of the mosquito repellent gel were done in SRMS CET (Pharmacy). Outdoor and indoor field trials were conducted in three days from 7 am to 11 am by applying the mosquito repellent gel on volunteers' legs and arms. Untreated legs and arms of another volunteer were used as control for this experiment.

**RESULTS & DISCUSSION:**

The percentage yields of the extracts and the essential oils were determined by using the formula,

$$\text{Percentage yield of plant extract or essential oil} = \frac{(W_1)}{(W_2)} \times 100$$

Where,  $W_1$  = the weight of the extract residue obtained after solvent removal

$W_2$  = the weight of peel or pulp taken [10]

**Table 2: Percentage yields of the extracts and the essential oils**

Extracts and Essential Oils	Initial Weight of Plant Material (g)	Weight of Extract or Essential Oil (g)	Percentage Yield (%)
Neem extract	966.67	156.06	16.14
Tulsi essential oil	718.90	7.70	1.07
Turmeric essential oil	700.00	12.39	1.77

**Table 3: Test results of the mosquito repellent gel bio-efficacy**

Time	Day 1				Day 2				Day 3			
	Indoor		Outdoor		Indoor		Outdoor		Indoor		Outdoor	
	Control	Gel	Control	Gel	Control	Gel	Control	Gel	Control	Gel	Control	Gel
7-8am	05	0	03	0	08	0	07	0	02	0	04	0
8-9am	17	0	08	0	12	0	14	0	10	0	09	0
9-10am	16	0	12	0	10	0	18	0	14	0	16	0
10-11am	12	0	10	0	16	0	15	0	15	0	17	0

The numbers of mosquitoes which aligned/left and aligned/bit the volunteers' treated areas of legs within 3 days are monitored in table 3.

According to the indoor and outdoor trials which were carried out for a 4 hour time period each day for 3 days, the mosquito repellent gel has shown 100% mosquito repellency. In the current study, in the preparation of herbal mosquito repellent formulation was using highly volatile essential oils together with herbal extracts. No skin irritations or rashes were observed on the legs and arms of the test volunteers with extracts, essential oils, and the mosquito repellent formulation.

**CONCLUSION:**

The formulation prepared, which have various advantages like easy for use, no irritation, no any kind of side effect for any age group of people, and the preparation of the gel is easy. The herbal products are one of the most preferable now a day, and this herbal mosquito repellent gel's natural ingredients showed their higher mosquito repellent activity when we applied it on the volunteer. The mosquito repellent gel showed their 100% mosquito repellency for outdoor and indoor fields' trials which are carried out for 4 hours for continuously 3 days.

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