

# Formulation of Economically Affordable Herbal Mosquito Repellent Sticks

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**Abstract**—whenever there is a climate change this leads to expand the occurrence of various vector borne diseases like malaria and dengue. Worldwide, Malaria is the one of the most major health related issues. The mostly affected group consists of young children and pregnant women. In 87 nations and territories, nearly half of the world's population dwells in places where malaria transmission is at risk. One of the important methods for limiting the spread of transmissible diseases is mosquito control and personal protection from mosquito bites. The market is currently saturated with chemical-based mosquito repellent products, which are not only more expensive but also more dangerous to the human body. In this paper an effort has been made to develop economically affordable herbal mosquito repellent sticks comprised entirely of herbal ingredients. Since ingredients used were almost herbal hence it has low side effect on inhalation.

**Keywords**— Plant extract, Essential oil, Mosquito repellent activity, Mortality rate, low smoke, public survey.

## I. INTRODUCTION

Malaria is a parasitic life-threatening disease caused by bite of female Anopheles mosquitoes. There are 5 parasite species that cause malaria infection out of these 2 species have greater threat- *P. falciparum* and *P. Vivax*. With the rise in the number of mosquito-borne diseases, controlling of mosquitoes gaining vital importance in human's daily life. To combat rising number of mosquitoes, various solutions like mosquito repellent products are commercially available. Some of them are natural ingredient based while others are synthetic or chemical based products. Chemical based products are widely used to control the mosquitoes, but due to its synthetic components they are still toxic to human body. Due to toxicity issues there is increase in demand of development of herbal based mosquito repellent in the market. Therefore, researchers are actively working with natural ingredients to be used as mosquito larvae insecticides or repellents.

Natural herbal mosquito repellents are non-toxic, effective, eco-friendly, biodegradable cheap and prepared. The natural ingredients were used to make an herbal mosquito repellent sticks; essential oil obtained for eucalyptus leaves, camphor, neem bark/ leaves and acacia gum and gelatin powder used as binding agent. This formulation was evaluated for appearance, efficiency and safety.

## II. MATERIAL & METHODS

### Material

The raw material has been selected based on the traditional knowledge and experience.

#### Herbal products

Cinnamon bark: *Cinnamomum zeylanicum*

Neem bark: *Azadirachta indica*

Neem leaves: *Azadirachta indica*

Eucalyptus oil: *Eucalyptus globulus*

Kapoor: *Cinnamomum camphora*

Acacia gum: *Acacia arabica*

Cinnamon bark, gum acacia, gelatin powder & camphor was purchased from local market.

The saw dust will be used to enhance the combustion process. Neem Bark powder have strong repellent activity of mosquitoes having good binding property. Fumigation of Camphor for making soothing atmosphere. Eucalyptus oil and neem leaves are the most generally used medicinal plants in making of mosquito repellents and has excellent insecticidal property.

### Processing Materials used

1. Sieve
2. Mortal & pestle
3. Paint brush
4. Weighing machines
5. Measuring cylinder

### Methods

#### Essential oils

Eucalyptus essential oil were purchased from the market.

#### Preparation of Neem leaves, Neem Powder & Cinnamon Powder

The fresh Neem Leaves were dried in the shed until it gets completely dry about 3 days. Then dried leaves are transferred to the mortal & pestle and crushed it into fine powder. Then this powder is sieved through the sieve no. 44. The final obtained product is stored for further use.

The dried neem bark are braked down into fine pieces by pestle. Then this fine pieces of bark are converted to fine powder by grinding it into blender. In the same way cinnamon powder also prepared.

#### Preparation of Mosquito repellent sticks

All the required ingredients were taken in a mortar except oil and water and mixed thoroughly. Into this mixture specified amount of essential oil added and blended evenly. At last, water was added as per requirement for binding of sticks. Then, this prepared mixture was filled in the stick mould and kept for drying. The sticks were removed from the mould and placed in the Hot air oven for 30 minutes to get dry. Once the

sticks has dried, store them securely to prevent moisture from being trapped inside and store them for further studies.

TABLE I. Formulation contain essential oil other than main ingredients

Formula	Ingredients	Quantity
A	Eucalyptus oil	13.5 ml
	Camphor	8g
	Cinnamon bark	10g
	Neem bark	10g
	Acacia gum	8.5g
	Water	Q.S
B	Eucalyptus oil	13.5 ml
	Camphor	6.5 g
	Cinnamon bark	8.5 g
	Neem bark	8.5 g
	Neem leaves	5 g
	Acacia gum	8 g
C	Eucalyptus oil	12.5ml
	Camphor	7g
	Cinnamon bark	7.5g
	Neem bark	7.5g
	Neem leaves	5g
	Acacia gum	6.5g
	Saw dust	4g
	Water	Q.s

Assessment of the Product

Flammability test and Burning time

To check the flammability of the sticks, the sticks were burnt. The result are tabulated below.

TABLE II. Flammability test & Burning time

Formula	Burning time(min)	Ash weight(g)	Irritability	Odor	Smoke visibility
A (5g)	20min	1.82g	No	Satisfactory	Low
B (5g)	17min	1.76g	No	Good	Average
C (5g)	22 min	1.64g	No	Good	Average

Mosquito Repellency test

Mosquito repellency test was done in the mosquito abundant regions like home corners, bushes, tea stalls, drainage corners and cafeteria in the evening and night time. After acquiring public permissions to ignite the formulation sticks, their results were noted down and checked if the mosquitoes are getting away after burning the sticks. Additionally, the mosquito repellency was checked by blending various formulations like A, B and C in various required quantity. Mosquitoes are collected in cabinet and repellent activity was checked between 7-10PM. After one hour, experimental area was opened to form a small opening. The mosquitoes that successfully ran away, also counted to determine repellent efficiency of product.

TABLE III. Repellency effect of the formulations in given time

Formula	Application time	Repellent efficiency
A	7-10pm	Density of mosquito is less but effective till 42 min
B	7-10pm	Density of mosquitoes is less and effective till 1.30hrs
c	7-10pm	No mosquitoes were surrounding for minimum 2 Hrs.

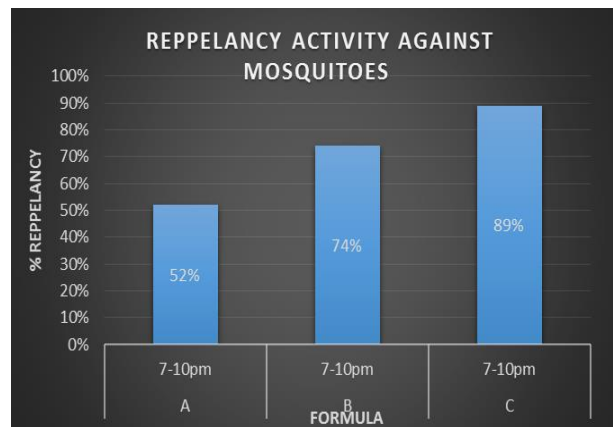


Fig. 1. Primary Observations of Herbal Mosquito sticks (A, B & C) showing repellency activity against Mosquitoes

Public Survey

Public survey was done to study safety and efficacy of the formulation. About 50 volunteers are selected and formulation was distributed amongst all volunteers and feedbacks were collected. The study was conducted for 30 days in the form of questionnaire. The data collected was studied statistically and represented.

TABLE IV. Public survey

Questions	Feedback
Opinion about the safety and quality of the product?	Positive
Is it easy to handle product?	Positive
About efficacy of the product?	Positive
Opinion about texture and design?	Positive
Whether it is economically affordable product or not?	Positive

On the basis of results of public survey it is seen that from more people are in favor of using this product. Handling of product is easy due to its size, shape, Light in weight and non-irritable nature. Natural excipients are used in prepared formulation, hence there are no safety related issues. Also, all Volunteers noted the product is economically affordable due to its herbal contents.

III. CONCLUSION

The developed herbal mosquito repellent provide long lasting protection and is safe for human life, with no side effect and no feedback of environmental ill effect, as an alternative to synthetic chemical repellents. Thus instead of using chemical sources this herbal mosquito repellent having defined quality and which is prepared from well accessible and affordable herbal sources can be used. The formulation of mosquito repellent sticks is strongly advised to use because they have a pleasant odor and potency to repel mosquitoes. The Eucalyptus oil have high degree of repellency as it contains main ingredient eucalyptol, made of 1, 8-Cineole plus tannins (70%). It is used in the formulation gives pleasant odor during ignition. Also Neem leaves has the compounds belonging to a general class of natural products called "limonoids." The limonoids have demonstrated an ability to block insect growth, affecting a range of species that includes some of the most deadly pests of agriculture and human health. "Azadirachtin" has proved to be the leaves main agent

for battling insects. In this formulation, Cinnamon bark shows as a great-smelling, environmentally friendly mosquito repellent activity more effectively than DEET. Other contents like neem bark, saw dust are used for the low smoke ignition of the product. Gum acacia is used as the natural binding agent to prepare mosquito repellent sticks. With this ingredient the formed product shows 89% repellency activity against mosquitoes. The formulation is safe, eco-friendly, cheap, easy to handle and has maximum repellence against mosquitoes.

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