

Formulation and Evaluation of Mosquito Repellent Stick

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ABSTRACT

Most of mosquito-repellent products and devices are made up of synthetic materials presenting market which causes various harmful effects on human beings. The resistance can be developed by the mosquito due to continuous exposure at high doses. Hence, the present research work represents the development and evaluation of mosquito repellent sticks with the help of various herbal products such as starch powder, wood powder, charcoal powder, eucalyptus oil, coconut oil, lavender oil, lemongrass and cinnamon oil, peppermint and citronella, neem oil making them ozone-friendly, financial effective, non-harmful.

Keywords: Mosquito repellent, Stick, Herbal oil, Device, Herbal product.

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INTRODUCTION

Mosquito-repellent products make it unsuitable for mosquitos. Human beings are searching for mosquito repellent products that are safe as well as low toxicity and obtained from herbal plants. There are many plants present in environments containing essential oils, which are found to be safe against mosquito repellents.

Probable Mechanism of Action

The mosquitos possess a number of chemical receptors. Lactic acid and CO₂ are released in the sweat of people which makes it more attractive for female *Anopheles* mosquitoes. The chemical receptors present in mosquitoes are activated by lactic acid in human beings. The mosquito repellent antagonist destroys the lactic acid receptors and hence gives protection from mosquitoes.¹

Diseases Caused Due to Mosquitoes as Vector

- Bacterial, viral and protozoan diseases are found in mosquitoes.
- The quantity of mosquito's increased which is a huge problem in our countries because mosquito causes malaria, yellow fever, malaria, chikungunya, filarial, etc
- Naturally, mosquito repellent is present in the different trees or plants that have properties volatile in nature are called as essential oils.

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harmful effects on human beings. The resistance can be developed by the mosquito due to continuous exposure at high doses.

Market Preparations

DEET, citronella oil, Lcaridin, IR3535. There are various marketed preparation available such as cream, citronella oil, DEET and other products but some of those marketed products increases the demand of herbal content repellent because hazardous content in mosquito repellent such as DEET may cause skin allergy, breathing-related disorders and other health disorders. A large amount of dangerous component content substances present in spray have been categorized among carcinogenic substances. The chemical insect spray can also pollute the environment. Hence, the aim of the given research work to formulate and evaluate mosquito-repellent sticks. The mosquito repellent stick is an ozone-friendly, financially effective, non-harmful and easily available by using locally available plant resources. The stick prepared by forming the layer of oil can reduce the chance of developing resistance by mosquitoes. Hence the purpose of the given research was to formulate the mosquito repellent stick by forming different layers oil at different concentrations.²

Advantages of Mosquito Repellent Stick

The repellent made from natural sources such as oils has the advantages over a synthesis repellent. Hence, the purpose of the given innovative work was to prepare the mosquito repellent

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containing volatile oils. The repellent stick has advantages such as:

- Economically effective, easily formulated and maintained.
- Least mechanical equipment, hard work and skill.
- Fast responses.
- Reducing bad smells in the environment, disease-causing bacteria and viruses.³

Experimental Work and Methodology

The following materials were used:

Charcoal and wood powder

The charcoal powder is obtained from burning organic material such as wood, and bamboo and then treated with oxygen and steam. Wood powder is obtained from the unwanted material of woodworking operations such as chopping, grinding, and milling. It is composed of small chippings of wood. The charcoal and wood powder enhanced the combustion process.

Starch powder

The commercial starch powder obtained from crushing of starch present in food material and then mixing the pulp with water. After that, the paste is washed or removed impurities



Figure 1: (a) Starch powder, (b) Wood powder, (c) Charcoal powder



Figure 2: Eucalyptus oil, coconut oil, lavender oil, lemongrass oil, cinnamon oil, peppermint oil, citronella oil, neem oil

and then dried. The starch powder was used due to its binding properties.

Eucalyptus oil

Eucalyptus oil is obtained from the fresh leaves and top branches of the eucalyptus plant. 20% eucalyptus oil provided more than 94% protection against mosquitoes for 4 hours.

Coconut oil

Coconut oil is obtained from the coconut tree (*Cocos nucifera*) and used as unsaturated fatty acids and emulsifier.

Lavender oil

Lavender oil is obtained from the flowers of *Lavandula angustifolia* belonging to the family of Lamiaceae. Lavender oil is used as an analgesic, antifungal, and antiseptic.

Lemongrass oil

Lemongrass oil is obtained from the *Cymbopogon citratus*. The essential oil used as an aroma therapy.

Cinnamon oil

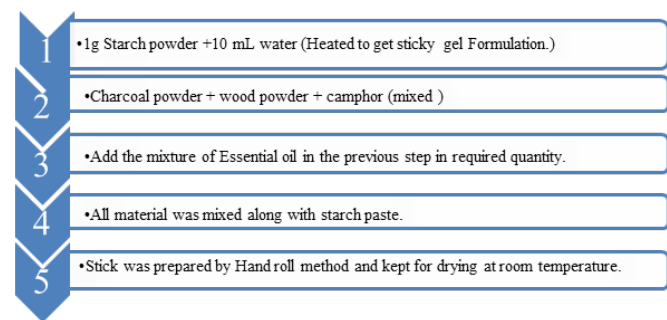
Cinnamaldehyde exhibits the strongest mosquito-repellent activity.

Peppermint oil

Peppermint essential oil is obtained from the flowers and plants of peppermint powder. Effective repellent for 45 minutes.

Citronella oil

Citronellol, citronellal, geraniol, citral and limonene exhibit mosquito-repellent properties.



Flow chart 1:

Table 1: Justification of the material used

S. No.	Ingredients	Justification
1.	Charcoal and wood powder	Enhanced the combustion process
2.	Starch powder	Good binding property
3.	Eucalyptus oil	20% eucalyptus oil provided more than 94% protection against mosquitoes for 4 hours.
4.	Coconut oil	Unsaturated fatty acids and emulsifiers
5.	Lavender oil	Analgesic, Antifungal, and Antiseptic
6.	Lemongrass oil	Geraniol and citral content Lemongrass oil has a strong, earthy, fresh and lemony smell
7.	Cinnamon oil	Cinnamaldehyde exhibits the strongest activity.
8.	Peppermint oil	Effective repellent for 45 minutes
9.	Citronella oil	Citronellol, citronellal, geraniol, citral and limonene exhibit mosquito-repellent properties.
10.	Neem oil	Neem oil shows insecticidal activity due to the azadirachtin chemical compound. 2% concentration of neem oil 56% effective upto four hours.

Neem oil

Neem oil is obtained from the seed oil *Azadirachta indica* due to the presence of α -terpinyl acetate, eucalyptol and δ -cadinene and α -cadinene (Table 1).⁴

Table 2: Formulation Table F1

S. No.	Ingredients	Concentration used	Length of stick in cm
1.	Charcoal powder	2 g	16 cm
2.	Wood powder	2 g	
3.	Citronella oil (10%)	0.4 mL	

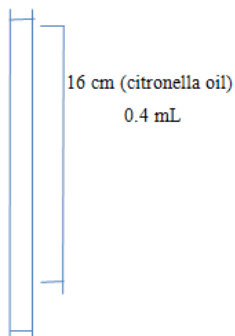


Figure 3: formulation F1:-Mosquito repellent stick base material (Charcoal powder, Wood powder)

Table 3: Formulation table F2

S. No.	Ingredients	Concentration used	Length of stick in (16 cm)
1.	Eucalyptus oil (32%) + Coconut oil (10%)	0.32 + 0.01 mL (1 gm)	4 cm
2.	Lavender oil (64%) + Lemongrass oil (1.0%)	0.64 + 0.01 mL (1 gm)	4 cm
3.	Cinnamon oil (25%) + Peppermint oil (2%)	0.25 + 0.02 mL (1 gm)	4 cm
4.	Citronella oil (10%) + Neem oil (2%)	0.1 + 0.02 mL (1 gm)	4 cm

Table 4: Evaluation of mosquito repellent activity

S. No.	Area	Report was given by the observer	Remark
1	Laboratory corners	No irritation mosquito removed from room	Mosquito are repelled
2	Collage premises	Smoke does not cause irritation to mosquito-escaped	Mosquito are repelled
3	Home	No irritation mosquito escaped	Mosquito are repelled

Table 5: Sensory evaluation of mosquito repellent activity

S. No.	Formulation	Burning time (minutes)	Ash content (gm)	Odor	Smoke visibility	Suffocation	Irritability
1.	F1	15	1.3	Satisfactory	high	No	No
2.	F2	20	1.4	Good	Average	No	No
3.	F3	35	1.2	Good	Low	No	No

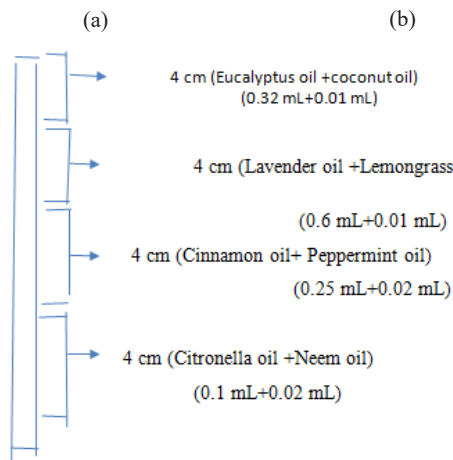
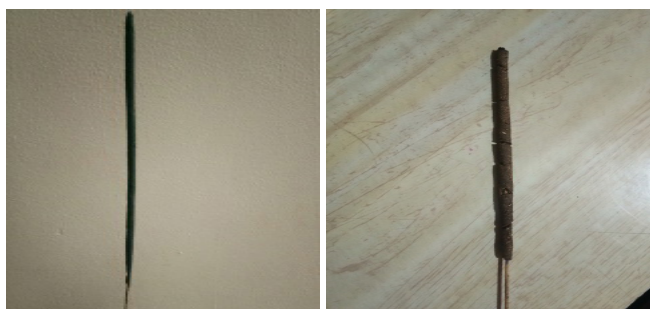


Figure 4: (a): Formulation F2:-Mosquito repellent stick base material (Charcoal powder) (b): Formulation F2:-Mosquito repellent stick base material (Wood powder)

MATERIAL AND METHODS

Procedure for the Preparation of Mosquito Repellent Stick

Firstly, we have add 1 g starch powder in 10 mL of water and heat continuously to form the sticky gel formulation, after that add charcoal powder, wood powder and camphor and mix properly, next in powder add essential oil in a given quantity after all the ingredients mixed properly and then prepared mosquito repellents stick by hand roll method and dry at room temperature (Figures 1 and 2, Flowchart 1).^{5,6}

Formulation F1

Formulation F1 was prepared by using charcoal powder and wood powder. First, 2 g of charcoal powder and wood powder in 10% of citronella oil (0.4 mL) and after that 16 cm of mosquito repellent stick by hand roll method (Table 2 and Figure 3).

Formulation F2 (Wood powder as base) and Formulation F3 (Charcoal powder as a base)

Formulation F2 was prepared by wood powder as a base and Formulation F3 was prepared by using charcoal powder as a

base. After that both the base powder mixed the eucalyptus oil (32%) and coconut oil (10%) make 1st layer, next mix the lavender oil (64%) and lemon grass oil (1.0%) make the 2nd layer. Then mix the cinnamon oil (25%) and peppermint oil (2%) to prepare the 3rd layer. Then mix the citronella oil (10%) and neem oil (2%). And lastly prepare the 16 cm of mosquito repellent stick by hand roll method.

First, added 2 g of charcoal powder and wood powder in 10% of citronella oil (0.4 mL) and after that prepare 16 cm of mosquito repellents stick by hand roll method (Table 3 and Figure 4).⁷

Evaluation Parameter

Evaluation of mosquito repellent activity

For evaluating mosquito repellent activity the formulated mosquito repellent stick were checked for its flammability, burning efficiency with respect to burning time and comparatively its effective repellent activity.

The flammability test of this stick was evaluated to check its consistent combustibility. After that, the time taken to burn the stick, the smoke produced and its harmful effects such as infuriation, struggle of breath, and running of nose and eye were observed and recorded.⁸

The sticks were burnt in selected mosquito-prone areas in the evening and day period of laboratory corners college premises, and home (Table 4).

Sensory evaluation

Evaluation parameter of mosquito repellent stick was carried out by group of five people for using 6 point Hedonic scale for each attribute as per BIS (1971) (Table 5).

- Dislike fairly,
- Neither like nor dislike,
- Like fairly,
- Like moderately,
- Like very much,
- Like extremely⁹

RESULT AND DISCUSSION

- The ideal requirement of good mosquito repellent is consistent, slow and complete burning producing low smoke and being capable of repelling mosquitoes to a longer time; the death number of mosquitoes directly proportional to the time period of burning time
- The mosquito repellent stick having less weight and more period of burning time is more suitable.¹⁰
- The mosquito repellent sticks have less amount of moisture content leads to fast burning and results in low ash content.
- In the present work, a mosquito repellent stick was prepared from charcoal powder and oils in different layers and formulation F3 was significantly effective and possesses the above-mentioned requirements.^{11,12}

CONCLUSION

A complete literature survey was find out previous preparation of mosquito repellent sticks. The essential oil have mosquito

repellent activity such as eucalyptus oil, citronella oil, neem oil, lavender and coconut oil, lemongrass and peppermint oil, cinnamon oil, etc was selected and prepared stick by using a binder. The sticks are subjected for evaluation and the result was very satisfactory.¹³ The feedback of results was also satisfactory when given to 6 panels of people. The stick was also tasted for allergic symptoms and the result was obtained that no such allergic symptoms like coughing, sneezing, or constricted in breathing were reported. Hence the outcome are signified by the mosquito repellent activity.^{14,15}

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