

Original article

Formulation of herbal-based low-cost mosquito repellent coils from Neem (*Azadirachta indica*) and Makhioti (*Flemingia strobilifera*) leaves

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Abstract: Mosquitoes are the most disturbing blood sucking insects affecting human beings. Several mosquito species belonging to the genera *Anopheles*, *Culex* and *Aedes* are vectors of pathogens for various diseases such as dengue, malaria, yellow fever, Japanese encephalitis and several other infections. Mosquitoes also transmit diseases, to more than 700 million and over one million deaths are reported annually across the globe. Therefore, the control of mosquitoes is an important public health concern around the world, despite the technological developments in the healthcare sector, Mosquitoes- borne diseases pose serious challenges. Repellence as one of the strategies has been in practice for a long time in the management of mosquito borne diseases, most of the mosquito repellent products and device available in the market are reported to have harmful effects human beings. They can cause respiratory problems, headache, skin infections etc. Mosquito repellent coil which are available in the market give harmful effects on our health. It is also not good for our environment. So, in his study we had selected Neem (*Azadirachta indica*) and Makhioti (*Flemingia strobilifera*) plant leaves to prepare herbal mosquito repellent coils and evaluate their flammability as well as mosquito repellence activity. The leaves of these two plants have been used traditionally to repel insect as well as mosquitoes. Neem oil is used to kill harmful insects. In this study we had found that these herbally prepared mosquito repellent coils gave better results than the chemical mosquito repellent coils. These herbal coils are also eco-friendly as well as not injurious to our health. Results showed that herbally prepared coils possess better mosquito repellent activity than the market available chemical mosquito repellent coils.

Keywords: Mosquito repellent; *Azadirachta indica*; *Flemingia strobilifera*; Herbal; Leaves

1. Introduction

Controlling mosquitoes is of utmost importance in the present-day scenario with rising number of mosquitos borne diseases [Fardin, 1998]. The mosquitoes take a lead role in carrier of parasites like protozoa, virus, fungus, etc. They can cause some serious diseases like Dengue, Hepatitis-B, etc. which may cause death [Kartz et al., 2008]. The alarming increase in the prevalence of mosquitoes is mainly due to deforestation,

industrial agriculture and stagnant water. Therefore, special products such as mosquito repellents are necessary to control mosquitoes.

Insect repellents are an alternative to using pesticides. Insecticides kill mosquitoes, ticks, cockroaches etc. They are mainly available in spray forms [KIM et al., 2005]. An individual can be protected from insect bites by using these insect repellents which are available in the market. To get rid of mosquitoes, we use mosquito coil, (Good Night/All Out), Agarbatti etc., which are easily available in the market. But these chemically prepared insect repellents which are found in the form of coil, liquid have negative effect on human health. So, there is a need of less harmful, cheap and ecofriendly insect repellent to solve this problem. Usually, insect repellents simply discourage insects and send them flying or crawling away [Mandavgan et al., 2005]. Almost anything can kill instantly at high doses, but being classified as a pesticide means death even at lower doses. Some old studies suggested that the ingestion of large doses of thiamine could be effective as an oral insect repellent against mosquito bites [Mulla et al., 2001]. However, there is now convincing evidence that thiamine has no effect on mosquito bites. Some claim that plants like wormwood or sage, lemon balm, lemon grass, lemon thyme and the mosquito plant (Pelargonium) will act against mosquitoes [Nakahara et al., 2013]. Some insect repellents are available in the form of spray or lotion that has to be applied onto the skin for the prevention of mosquito bite [Nerio et al., 2010 & Olivo et al., 2008]. Natural mosquito repellents were preferred over chemical mosquito repellents due to their advantages. The insect repellents are used from the ancient period. Different types of plant oils were used to kill insects [Patel et al., 2012 & Phal et al., 2012]. In 1937 dimethyl phthalate was discovered and later several other compounds have been formulated. But these chemical repellents have many side effects on human health as well as to the environment [Ranasinghe et al., 2016]. So, natural insect or mosquito repellents can be a good alternative way to combat with insects. Citronella oil is the most widely used mosquito repellent [Rani et al., 2013]. It has fewer toxic effects. Efforts have been made to find new active substances derived from natural plants to replace synthetic pyrethroids. So, in this study we had selected Neem and Makhioti plant to prepare herbal mosquito repellent coils from their leaves and evaluate their mosquito repellent activity. Their flammability, irritability as well as burning time were also determined. These plants have been used traditionally to control mosquitoes and insects.

2. Materials and Method

2.1 Collection of samples: Leaves of Neem and Makhioti plant were collected from Rongdoi village of Charigaon, Bahona, Jorhat, Assam. Collected leaf samples were identified and confirmed following the standard literature studies.



Fig1: *Azadirachta indica* (Neem)



Fig 2: *Flemingia strobilifera* (Makhioti)



Fig 3: Drying of Leaves (Neem and Makhioti)

2.2. Plant profile:

a) **Local Name:** Neem

Scientific Name: *Azadirachta indica*

Family: *Meliaceae*

Description: These are fast growing evergreen trees, generally 15-10m tall. Leaves are 20-40cm in length. Flowers are small, perfumed, about 1cm in diameter.

Traditional use: Leaves of this plant are used as an insect repellent, anti-bacterial, anti-fungal, antioxidant, anti-viral and also used in ayurvedic medicine for various skin disorders and diabetes.

b) **Local Name:** Makhioti

Scientific name: *Flemingia strobilifera*

Family: *Fabaceae*

Description: These are perennial flowering much branched plants having about 30-300cm height. Leaves are 8-15cm long. Bears white pea-shaped flowers having creamy petals.

Traditional use: Makhioti plant leaves are used as insect repellents. Roots are used in epilepsy, hysteria, and to induce sleep, pounded roots are given in fever

2.3 Preparation of herbal coils: After collection, leaves were washed properly, shade dried for 7-days and crushed into powder mixer grinder. Powdered leaf samples were kept in air tight containers.

To prepare herbal mosquito repellent coils, plant leaf powder was mixed with coconut fibre, extract of wood, candle and Maida flour. 4gm of each neem and makhiatu leaves extract, 2gm of wood extract, 1gm of coconut fibre, 4gm of melted candle and 30ml maida were mixed well and added hot water to these materials. After mixing properly, the mixture of leaf powder with other substances kept under sun for drying. After drying, coils were kept in air tight containers for further use [Rani et al.,2013].



Fig 4: Dried leaves of Neem and Makhioti



Fig 5: Grounded leaf powder



Fig 6: Preparation leaf paste



Fig 7: Preparation of herbal coils from Neem and Makhioti leaves



Fig 8: Dried herbal coils



Fig 9: Burning of herbal coil

2.4 Evaluation of Neem and Makhioti leaf coils

The efficacy of prepared Neem and Makhioti leaf coils were evaluated on three parameters such as flammability, burning time and mosquito repellence test [Das et al., 2000].

(a) Flammability test and burning time:

To observe the flammability of the prepared coils, the coils were burnt using candles (Fig. 9). The quantity of ash, irritation produced by the coils and the time taken to burn completely were recorded. Ash weights and their burning time of the prepared coils have been documented (Table 1) [Yang et al., 2005]. Residual percentage were determined based on ash weight and dry weight. The percentage residual is determined by:

$$\text{Residual (\%)} = \text{Ash weight/ dry weight} \times 100$$

(b) Mosquito repellency test:

Mosquito repellency test was done simply by selecting the mosquito-prone areas in the evening and night period such as bushes, shrubs, laboratory corners of Zoology department and canteen of Bhaona College [Govindarajan,

2005]. The public remarks were noted down after allowing them to burn the coils and checking if the mosquitoes are present or escaping away from the burning coils (Table 2).

3. Results:

Table1: Parameters to check the flammability of the prepared herbal coils

Name of the sample	Dry weight (gm)	Ash Weight (gm)	Time taken to burn (min)	Residual (%)	Irritation	Remarks
Neem coil	20.15	3.23	60	16.02	No irritation	Fully burnt
Makhloti coil	18.45	2.76	65	14.95	No irritation	Fully burnt

Table 2: Mosquito repellency test of herbal coil prepared from Neem leaf powder

Sl No	Areas	Reports given by people	Remarks
1	Zoology Department premises	Mosquitoes moved outside	Mosquito repelled
2	Class room corners	Mosquitoes moved outside	Mosquito repelled
3	Bahona college Canteen	Mosquitoes escaped	Mosquito repelled
4	Laboratory corners	Mosquitoes moved outside	Mosquito repelled

Table 3: Mosquito repellency test of herbal coil prepared from Makhloti leaf powder

Sl No	Areas	Reports given by people	Remarks
1	Zoology Department premises	Mosquitoes escaped	Mosquito repelled
2	Class room corners	Mosquitoes moved outside	Mosquito repelled

3	Bhaona college Canteen	Mosquitoes escaped	Mosquito repelled
4	Laboratory corners	Mosquitoes moved outside	Mosquito repelled

4. Discussion:

Insects are known for their aggravating bites, stings, infectious and disease-spreading properties, so humans have long found ways to control them. We don't need every insect life to kill. Birds, reptiles and mammals obtain food from insects, and many help pollinate plants [Ansari et al., 2000]. But mosquitoes are harmful for human health. They are the vectors of life-threatening diseases and in a country like India mosquito borne diseases are very much common. Specially in Assam, climatic conditions are favorable for their breeding. During rainy season there is a surge in diseases like dengue, malaria and encephalitis. So, it become necessary to control mosquitoes by adapting different techniques. Mosquito repellent coils is one of them but the chemical coils which are sold by shops are harmful for human health and not eco-friendly. The smoke released by chemical coils containing substances like insecticides and prolonged exposure to this smoke can lead to respiratory irritation or health issues for people sensitivities or allergies. So herbal mosquito coils prepared from leaf or seed of plant can be an alternative to these harsh chemical coils as they do not contain any harmful chemicals. In this study, herbal mosquito repellent coils were prepared from leaf powder of Neem and Makhioti and their efficacy was determined. Along with efficacy their flammability, burning time and irritability were also analyzed. It was found from the study that the prepared herbal coils possess mosquito repellent activity and don not cause any irritability to human. As these are chemical free, these can be a replacement of chemical market available mosquito repellent coils.

5. Conclusion

The results of this study clearly demonstrated that Neem and Makhioti leaf coils had potency to repel mosquitoes. It also improves our knowledge in the field of repellency of plant leaves against disease causing mosquitoes. Hence the results may contribute to a reduction in the application chemical mosquito repellent coils. However further studies should be recommended to identify the active compounds and toxicity to develop eco-friendly control of mosquitoes.

Conflict of interest

We have no conflict of interest.

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