

Original Research

Laboratory evaluation and comparative study of herbal mosquito coils against the filarial vector, *Culex quinquefasciatus* (Diptera: Culicidae)

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**ABSTRACT:**

Synthetic insecticides employed for the control of insect pests are toxic to man and livestock acting as pollutants to the environment, killing all beneficial insects thereby causing a disturbance to the ecosystem. The use of natural products such as plant essential oils has assumed significance as an important component of insect pest management because of their financial viability and eco-friendly nature. They hold promise as alternatives to chemical insecticides to reduce pesticide load in the environment. A laboratory experiment was conducted to investigate the efficacy of three essential oils -eucalyptus oil, lemon grass oil and thyme oil for the repellent activity against the filarial vector, *Culex quinquefasciatus*. Among the essential oils, Lemon grass oil showed good repellency property when compared to the other two plant oils. Hence, the results of the investigation would indicate a significant potential for lemon grass oil as a possible source of natural products that could be used as an alternative to synthetic insecticides.

**Keywords:**

Mosquito, *Culex quinquefasciatus*, repellency, Plant essential oil.

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## INTRODUCTION

Mosquitoes are considered as an important insect pests that affect the health and well being of human beings and other animals worldwide. Mosquitoes are cosmopolitan in distribution and have occupied many niches including higher altitudes. Mosquitoes are always considered as a nuisance because they consume blood from living vertebrates, including human beings (Bernhard *et al.*, 2003). In India, annually around 40 million people suffer from mosquito borne diseases. The extensive use of mosquito repellents and insecticides in public health programmes has caused extensive level of environmental pollution and serious health hazards. Many of them are alarmingly toxic to human beings and also other non-target organisms.

Controlling the mosquitoes in an effective manner is often complex and expensive task which requires support from communities and also from different groups such as industry, agriculture, state and local governments (Joseph *et al.*, 2004). The harmful effect of the pesticides on the environment, animals, plants and human beings is an issue of great concern. As far as India is concerned, many of the insecticides and larvicides are commercialized in the form of dust, powder or sprays that contain chemicals such as organochlorine, organophosphates and synthetic pyrethroid. Yet mosquitoes, due to a prolonged use of these insecticides become resistant and thus it becomes a difficult task to eradicate them totally (Prajapati *et al.*, 2005). They also pose a threat to the human population by carrying vector borne diseases and sometimes out break as epidemics. Hence to control the vector mosquitoes, efforts are being taken to look for an alternate solution which will ultimately minimize the use of synthetic insecticides.

The development of eco-friendly insecticides will serve its purpose as a new alternate to substitute the synthetic insecticides essentially cutting down the chemical pollution. The pyrethrum flower extracts

contain active materials that are potential enough to control the mosquito population. (Sutthanont *et al.*, 2010). In recent times, plant products are used as novel chemo therapeutants in pest management in different parts of the world, because of their biodegradable nature. (Hardin and Jackson, 2009). Therefore, the present study was aimed to investigate the mosquito repellent nature of three essential oils: *Eucalyptus tereticornis* (Eucalyptus), *Cymbopogon citratus* (lemon grass) and *Thymus vulgaris* (thyme) against *C. quinquefasciatus*.

## MATERIAL AND METHODS

### Plant Oils:

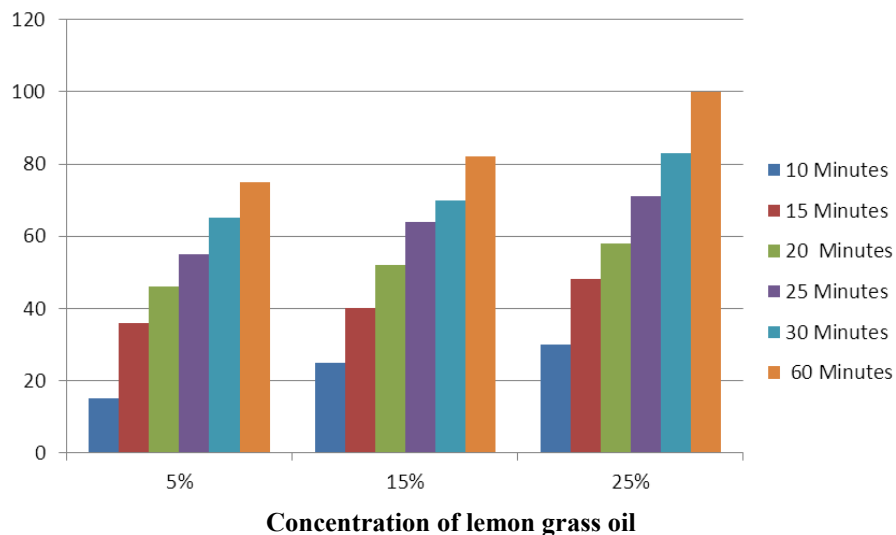
The plant oils were purchased from the Aromatic Oil Stores, Coimbatore, Tamil Nadu and formulated for the experiment. A stock solution at 1000 ppm is prepared by dissolving the essential oils in distilled water using 2 ml of 100% acetone respectively. The serial dilutions of essential oils at the concentration of 5%, 15% and 25% and three replicate of each concentration were made.

### Preparation of herbal mosquito coils:

Mosquito coils were prepared using cow dung, sawdust, neem leaves, flower waste and tulsi leaves. Then the essential oils, *Thymus vulgaris*, Lemon grass, and Eucalyptus oils were sprayed (w/w) on top of the coil by using a hand spray pump in different concentration of 5%, 15% and 25 % separately and they were used for its efficacy against *C. quinquefasciatus* mosquito. The coil was dried in the oven at 70°C for 6 hours was dried for half an hour at room temperature. These coils were then packed in suitable air tight plastic folders and kept for 2 – 3 days for even spread of the essential herbals on the coil.

### Test Organisms

The test organism, *C. quinquefasciatus*, was reared in the laboratory in the Department of Zoology, PSGR Krishnammal College for Women, Coimbatore, Tamil Nadu. Dog biscuits and yeast powder in a ratio of 3:1



**Figure-1** Repellency of lemon grass oil against *C. quinquefasciatus*

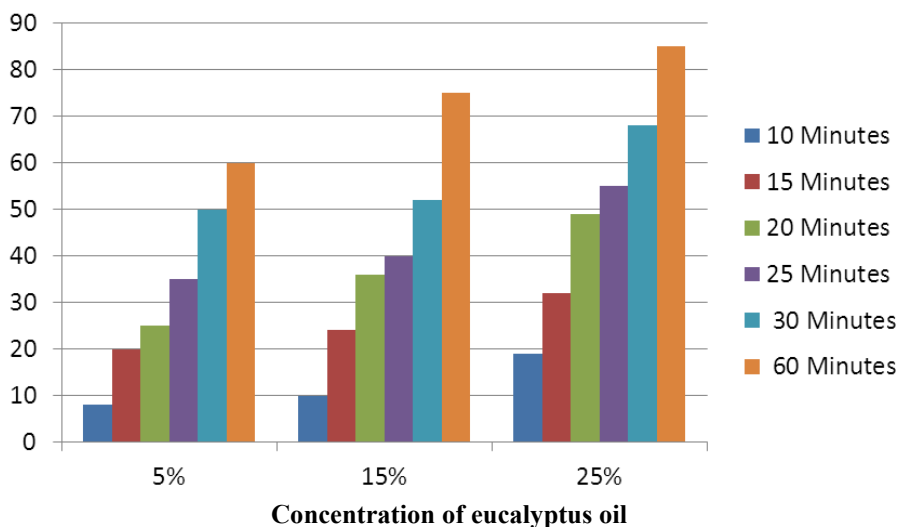
were given as feed for the mosquito larvae. On the other hand, adult mosquitoes were fed with a 10% sucrose solution and a 1 week-old chick. Mosquitoes were kept at relative humidity of 28-30°C, 75 ± 5%, with 14-h light and 10-h dark, photo period (Kitzmiller *et al.*, 1954).

**Bioassays**

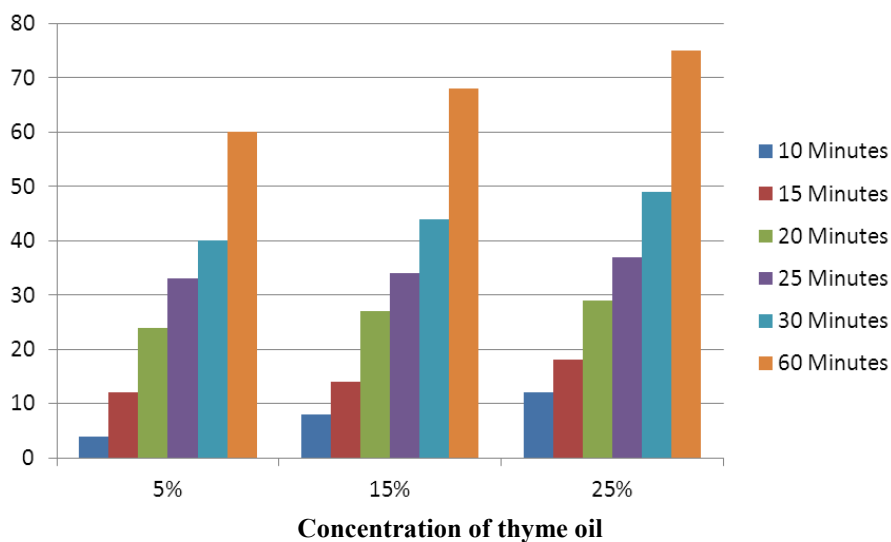
**Repellency Test**

The experiment was conducted in a closed room, with a volume of 92.8 m<sup>3</sup> in the Department of Zoology, PSGR Krishnammal College for Women, Coimbatore, Tamil Nadu. The human volunteers sat at 1 m, 2 m, 4 m, and 8 m from the herbal mosquito coil. The mosquito

coil was put in the middle of one side of the room. For control, 50 female unfed, 5 days old mosquitoes were released in the centre of the room. Then the number of landing mosquitoes on the bare legs of the human volunteers was counted for a period of 2 min. For testing, the mosquito coil was ignited, then counting of the number of landing mosquitoes on the bare legs of the human volunteers began and was recorded at periodic intervals. Three replications were done by changing the positions of the human volunteers, and then repeating the procedure the next day.



**Figure-2** Repellency of eucalyptus oil against *C. quinquefasciatus*



**Figure-3** Repellency of thyme oil against *C. quinquefasciatus*

## RESULTS AND DISCUSSION

The results of repellency test of thyme oil against *C. quinquefasciatus* (Say) after one hour of treatment are presented in Figure-3. The results clearly indicated that the highest repellency was reported at 25% concentration of thyme oil when compared to 5% concentration and 10% concentration. As the concentration of the plant oil formulation increases the total mortality of *C. quinquefasciatus* also gets increased. Figure-2 revealed the efficacy of eucalyptus oil against *C. quinquefasciatus*. The lowest repellency was observed at 5% concentration of eucalyptus oil and the highest repellency was observed at 25% concentration. But the essential oil, eucalyptus oil is more effective than thyme oil. Increase in the concentration of the plant oil formulation was found to increase the total repellency of *Culex quinquefasciatus*. The different concentrations of the lemon grass oil was recorded against *Culex quinquefasciatus* in Figure-1. The percentage of repellency was found to be high in 25 % concentration than 5 % concentration of the plant oil. The results of this study clearly indicated that lemon grass oil had high repellency potential to control the mosquitoes than the other two essential oils.

A number of studies have been focused on lemon grass oil for controlling mosquitoes as a larvicide and a repellent with varied results. Hanifah *et al.*, (2011) demonstrated *C. citratus* extract has more acaricidal activity against *Der-matophagoides farina* and *D. pteronyssinus* than *Azadirachta indica* at 50% concentration. This proves the efficiency of *Cymbopogon citratus* in controlling the insect pests. Oyedele *et al.*, (2002) evaluated the ointment and cream formulations of lemon grass oil in different classes of base and the oil in liquid paraffin solution for mosquito repellency in a topical application. Cilek *et al.*, (2011) studied the efficacy of several commercially formulated essential oils against caged female *Aedes albopictus* and *Culex quinquefasciatus*. Mgbemena (2010) found that the essential oil *O. gratissimum* had a greater larvicidal activity than *C. citratus*. Purwal *et al.*, (2010) tested the activity of *C. citratus* and *Mentha piperita* essential oils in a combination against *Pe-diculus humanus* and found a mean time to death of 60 minutes. Therefore the essential oils can be used as an alternative to synthetic insecticides for vector control programmes.

The essential oils (EO) eucalyptus oil, lemon grass oil, thyme oil were evaluated for repellent activity against the *Culex quinquefasciatus*. Essential oils of

many plants were observed to have mosquito larvicidal property and have received attention as potentially controlling vectors of mosquito borne disease (Zhu *et al.*, 2006). Therefore, the use of lemon grass oils in insect/mosquito control is an alternative pest control method for minimizing the harmful effects of pesticidal compounds on the environment. The present study has identified more plant oils showing larvicidal activity against *Culex* mosquito. The results obtained suggest that the plant oils are promising as larvicides against *Culex* mosquito. The present study also suggests the use of Lemon grass oil as the most effective alternative in controlling mosquitoes.

#### CONCLUSION

The results of the present investigation proved that the all essential oils at higher concentration are effective but lemongrass oil exhibit a significant knock down activity at higher concentration when compared to the other oils. For the commercialization of these herbal mosquito coils, further simulated and actual field trials are required. Hence, Lemongrass essential oil, alone or in combinations with those obtained from other mosquito repellent plant species, could be potentially used for the preparation of mosquito repellent products.

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