

Research Article

Development of Mosquito Repellent Cotton Fabric using *Leucas aspera* and *Ocimum americanum*

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Abstract

The herbal extracts were obtained from *Leucas aspera* and *Ocimum americanum* plants. The fabric was coated with the extract by pad-dry method at room temperature. FTIR analysis was conducted to investigate the functional groups present in the plant extract. Antimicrobial activity test and mosquito repellent test were carried out for both *Leucas aspera* treated and *Ocimum americanum* treated fabrics. The *Leucas aspera* treated fabric showed better antimicrobial and mosquito repellent activity than *Ocimum americanum* treated fabric.

Keywords: Farnesene; *Leucas aspera*; Mosquito repellence; *Ocimum americanum*.

Introduction

Mosquito is one of the deadliest insects found in the world, especially in the tropical countries. It is estimated that there are millions of people in the world suffer from malaria, lymphatic, filariasis, Japanese encephalitis, schistosomiasis, dengue, trypanosomiasis and leishmaniasis [1].

Many plant based products are widely used for control of mosquitoes and protection from mosquito bites because of their insecticidal-repellent properties [2]. The repellent activity of plants to mosquitoes is well known before the introduction of synthetic repellents. They are widely used domestically in the southern regions of India, especially in Tamil Nadu. In these regions, the leaves of *Leucas Aspera* and *Ocimum Americanum* (which is called as 'thumbai' and 'naai thulasi' respectively in Tamil) were burnt to repel mosquitoes from the houses.

With the advent of science and technology, the use of natural products has declined and people started using synthetic products because of its effectiveness, easy usage and long-lasting properties. The synthesis of DEET (n, n diethyl-n-metatoluamide) has been considered the milestone in the field of mosquito repellency. This is the major component in most of the commercially available repellent such as

lotions, cream and aerosols [3-4]. However, this chemical is reported to cause skin rashes to certain people. Serious health and skin problems have been reported, while using chemical repellents and insecticides. Now, the natural products are preferred for healthcare applications as they are less toxic and environmental friendly. The plant products are considerably safer and eco-friendly. Application of such products on textile fabric for its repellent property is more acceptable [5].

In the present work, the herbal solution extracted from *Leucas Aspera* and *Ocimum Americanum* was applied on the fabric using pad-dry method. The antimicrobial and mosquito repellent tests were carried out for the treated and untreated fabrics for comparison.

Materials and methods

Materials

The 100% bleached cotton fabric was sourced from the market and, the *Leucas Aspera* and *Ocimum Americanum* leaves were collected from Salem, Tamilnadu, India.

Method of herbal extraction

The leaves were shade dried to remove the moisture content at room temperature. Then the leaves were ground and sieved to remove the coarse matters. A 10 g of finely sieved powder was

placed in a porous bag and placed in the middle chamber of the Soxhlet apparatus. The extracting solvent (Methanol) of 150 ml was taken in the round bottom flask and heated to its boiling point. The vapour from the solution was made to condense in the condenser with the help of running water. The condensed extract was made to drip into the bag containing leaf powder. When the level of liquid in the chamber rose to the tip of the siphon tube, the liquid content in the chamber was siphoned into the solvent flask. This was considered as one cycle of extraction. This process was continued and each extraction was made to run for 2 h. The extraction of herbal extract from leaf powder using Soxhelt apparatus is as shown in Fig. 1.



Fig. 1. Herbal extraction using Soxhlet apparatus

Preparation of mosquito repellent fabric sample

Six gram of fabric was treated with herbal extract in a liquor ratio of 1:20 by padding and then dried under room temperature. Then the treated fabric was dried at 80-85°C for 5 min in an oven.

Antimicrobial Test (Disc diffusion method)

The apparatus used in this experiment was sterilized using ethanol. Agar medium was prepared using distilled water. The medium and petridish were covered using a cotton plug and they were sterilized. Medium was taken out carefully and then poured into the petridish and was allowed to cool. The bacteria (*E. coli*, *Salmonella typhi*) were taken in the micro pipette and were evenly spread in the petridish. The control, herbal extract treated fabric samples were kept in the petri dish. The plates were

incubated for 24 h. Diameter of inhibition zone (mm) was measured.

Mosquito repellence test

The treated fabric was placed in the standard WHO cone or conical funnel and then the mosquitoes were allowed to sit on the fabric for 3 hours. The efficiency was calculated by observing the number of immobile mosquitoes after treating the fabric. The mosquito repellency setup is shown in Fig. 2.



Fig. 2. Mosquito repellence test setup

The mosquito repelling efficiency was calculated using equation (1).

$$\text{Efficiency of repellency \%} = \frac{\text{number of mosquitoes dead} + \text{number of immobile mosquitoes}}{\text{total number of mosquitoes taken}} \times 100 \quad (1)$$

Results and discussions

FTIR analysis

FTIR spectra of *Leucas Aspera* and *Ocimum Americanum* are shown in Fig. 3 and 4 respectively. The FTIR spectra show the peak absorption at 3301.63, 2921.07, 2854.14, 1729.29, 1606.92, 1406.52 and 3274.42, 2922.38, 2855.79, 1732.04, 1604.57 cm^{-1} for *Leucas Aspera* and *Ocimum Americanum* respectively. In these figures, the main peak is observed at 1606.92 and 1604.5 cm^{-1} for *Leucas Aspera* and *Ocimum Americanum* respectively due to the presence of farnesene, which is responsible for mosquito repellence.

Antimicrobial activity

The zone of inhibition for the herbal extract treated fabrics is given in Fig. 5. The zone of inhibition of herbal extracted treated fabrics is given Table 1. From the Table 1 and Fig. 5, it could be observed that the zone of inhibition of *Leucas Aspera* treated fabric has higher antimicrobial activity than *Ocimum Americanum* treated fabric. The *Leucas Aspera*

treated fabric is showing higher zone of inhibition which may be due to the presence of higher amount of farnesene compound in the *Leucas Aspera*. Farnesene is responsible for

mosquito repellence and its content in *Leucas Aspera* is 26.4% and *Ocimum Americanum* is 14.79% [5-6].

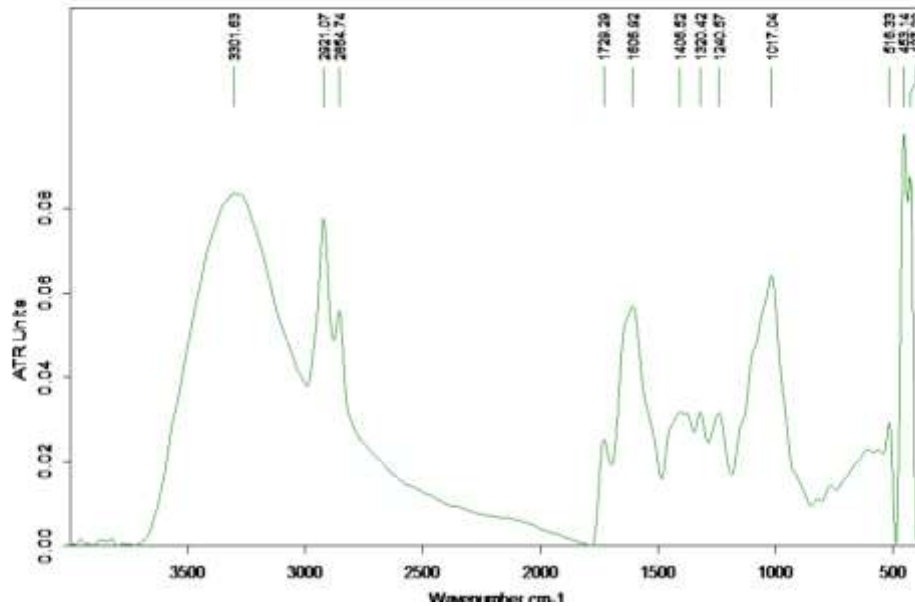


Fig. 3. FTIR spectrum of *Leucas aspera* leaves

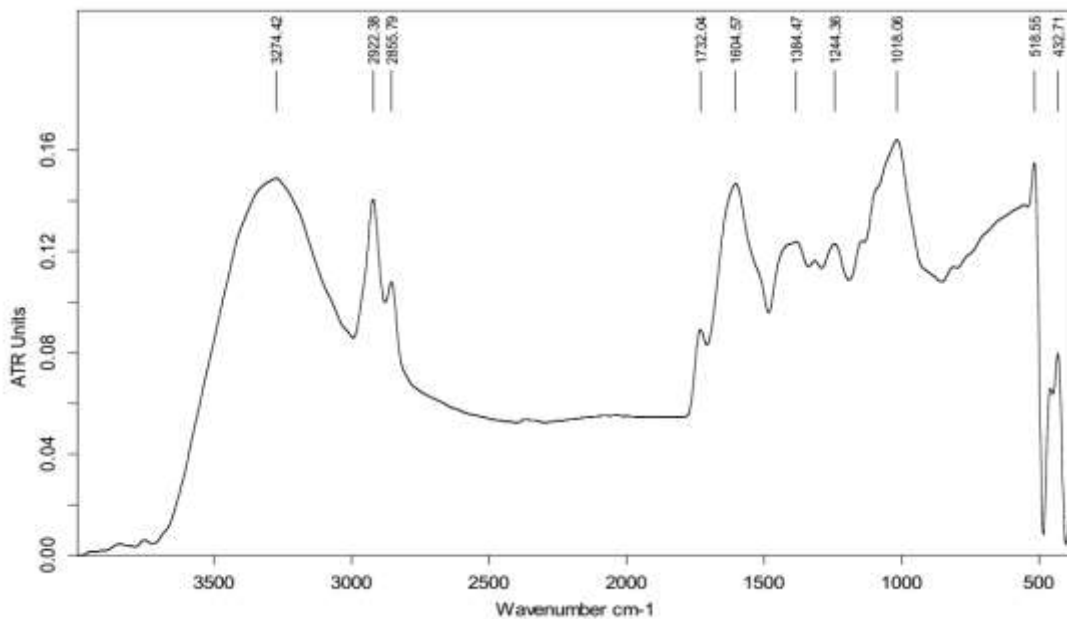


Fig. 4. FTIR spectrum of *Ocimum americanum* leaves



(a) (b)

Fig. 5. Antimicrobial test of (a) *E. coli* and (b) *Salmonella typhi* on *Leucas Aspera* and *Ocimum Americanum* treated fabrics

Table 1. Zone of inhibition of herbal extract treated fabrics

Type of Bacteria	Zone of inhibition (mm)	
	<i>Leucas aspera</i>	<i>Ocimum americanum</i>
<i>E. coli</i>	13	5
<i>salmonella typhi</i>	8	6

Mosquito repellence

The mosquito repellent efficiency of the *Leucas aspera* treated fabric *Ocimum americanum* treated fabric is found to be 68% and 64% respectively. From the result, it could be observed that *Leucas aspera* treated fabric is showing higher repellence than *Ocimum americanum* treated fabric. This may be due to the presence of higher amount of farnesene in the *Leucas aspera*.

Conclusions

Herbal extracts were derived from *Leucas Aspera* and *Ocimum americanum* plants. The fabric samples were treated with *Leucas aspera* and *Ocimum americanum* herbal extract. The FTIR analysis, antibacterial activity and mosquito repellence studies were conducted. The antibacterial activity and the mosquito repellent efficiency are found to be higher in *Leucas aspera* treated fabric compared with *Ocimum americanum* treated fabric. Both the herbals have mosquito repellent efficiency of about 60% and hence they can be used as mosquito repellent.

Conflicts of interest

The authors declare no conflict of interest.

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