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Dyeing of Natural Mosquito repellents finish on fabric

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Abstract

Protective finish has a functionality of giving protection from something in some or the other sense. Mosquito repellent finish is a part of protective finishes which help in protection from mosquitoes which are classified as one of the deadliest pests known to man. Mosquito repellent finishes on textiles are one of the most growing ways to advance the textile field by providing the needed characteristics of protecting against mosquitoes. Thus an endeavour has been made to apply protective finish on cotton fabric by using *Eucalyptus citriodora* (lemon eucalyptus) leaves extract. This natural mosquito repellent finishing agent is very effective, environment friendly, biodegradable as well as inexpensive. A series of experiment were conducted for the development of protective mosquito repellent cotton fabric using lemon eucalyptus leaves extract. The concentration of mosquito repellent extract, concentration of mordant and dyeing time was standardized on the basis of mosquito repellency test. These samples were given after treatment with various concentrations of citric acid for different time and then subjected to test the wash durability and efficacy of mosquito repellency.

Keywords: cotton fabric, lemon eucalyptus leaves, mosquito repellency and wash durability

1. Introduction

The rapid growth in technical textiles and their end-uses has generated many opportunities for the application of innovative finishes. Novel finishes of high added value for apparel fabrics are also greatly appreciated by a more discerning and demanding consumer market. Antimosquito repellent textiles with improved functionality find a variety of applications such as health and hygiene products, specially the garments worn close to the skin and several medical applications, such as infection control and barrier material. Due to rapid urbanization, climate change and other factors, the ill effects of mosquito bite are increasing day by day. Major source of illness and death worldwide is due to diseases spread by insects. Every year about 700 million persons get affected by diseases transmitted by mosquitoes. Wide variety of species are responsible for causing life threatening diseases like Malaria, Chikangunya, Filariasis, Dengue fever, Yellow fever etc. The Zika and ebola virus were spread by mosquitoes, which affect many people in the world. The use of the repellents such as lotions, coils and liquidators are limited in their efficacy due to various reasons. The world where this would lead us would be astonishingly hi-tech and materialistic. To ensure our security and safety from the future hazards, we need to equally development the technology for our protection. This has necessitated the development of mosquito repellent fabrics. A textile fabric with the mosquito protection is one of the revolutionary ways and the much needed feature of driving away the mosquitoes. It protects the humans from the bite of mosquitoes and thereby promising safety from the mosquito borne diseases.

Medicinal plants are the gift of nature to cure limitless number of diseases among human being. The abundance of plants on the earth surface has led to an increasing interest in the investigation of different extracts obtained from the traditional medicinal plants as potential sources of new mosquito repellent agent.

Finishing improves the fabric performance and gives it special functional properties including the final touch. Natural mosquito repellents may be one of the most effective tools for protecting human from vector borne diseases.

Materials and Methods

The investigation was carried out to optimize the process of natural mosquito repellent finishes with leaves of lemon eucalyptus.

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1. Collection of materials

- **Lemon eucalyptus leaves:** Lemon eucalyptus leaves were washed in water, dried in shades at room temperature for one week. Grinded into fine powder form and sieved.
- **Textile material:** Pure white cotton fabric.
- **Chemicals:** Methanol, ferrous sulphate, citric acid for extraction of natural mosquito repellent and mordanting of finished sample, respectively.

2. Optimization of variables for mosquito repellent finishes

- Optimization of concentrations (5, 10 and 15 per cent) of natural mosquito repellent done on optical density basis measured through spectrophotometer.
- Experiments were conducted with concentrations of lemon eucalyptus leaves.
- After optimization, extraction of the lemon eucalyptus leaves was done by using methanol. This extract solution was further diluted in three concentrations i.e.; 45, 50, and 55 per cent and 0.5 per cent concentration ferrous sulphate was diluted in to one finalized extract solution.
- Scoured cotton fabric immersed in different concentrations of natural mosquito repellents. Dyeing

time for cotton samples with extract of lemon eucalyptus leaves were 60, 90 and 120 minutes. Cotton sample were finished by utilizing these parameters.

- **Mordanting of finished (mosquito repellent) Sample:** Tie dyed finished cotton samples were mordanted with 5, 10 and 15 per cent concentrations of citric acid tested for mosquito repellency and wash durability.

Mosquito repellency test: Prepared tie and dyed samples were tested for mosquito repellency in mosquito cage box. Cage test is the quick and cost effective way to determine the mosquito repelling qualities of treated materials. A box of 30×30×30 cm made out of transparent glasses with 25 °C ±2 °C temperature and 60 to 70 per cent humidity was maintained. In the glass box, dyed and unfinished fabrics samples were placed. Release 20 mosquitoes in the box and allow them for 2 minutes. Mosquitoes were deprived of all the nutrition and water for a minimum of 4 hours before exposure. Laboratory tests were performed during daylight hours only and each test was replicated four times. Note down the antimosquito effectiveness by counting the number of mosquitoes which will rest on the unfinished and dyed samples during 2 minutes. Efficiency of mosquito repellency was calculated by using following formula:

$$\text{Efficiency of mosquito replency (\%)} = \frac{\text{No. of escaped specimen} + \text{No. of specimen dead}}{\text{No. of specimen exposed}} \times 100$$

Wash durability test: Tie Dyed finished sample were dipped in 5 per cent mild detergent Ezee solution for 30 minutes. After that samples were washed with plain water, squeezed and dried in shade. Wash durability of dyed samples mordanted with different concentration of citric acid for different time were checked up to 5 to 10 launderings.

3. Effect of finishing (mosquito repellent) Treatment on Physical Properties:

Tie dyed cotton finished sample was evaluated for fabric stiffness, tensile strength, crease recovery and drape coefficient.

Results and Discussion

Results reveal that 10 per cent of lemon eucalyptus leaves showed maximum optical density hence optimized for finishing process. Lemon eucalyptus leaves extract in 55 percent concentration for 90 minutes dyeing time produced excellent mosquito repellency. Dyed cotton samples were mordanted with 10 per cent concentration of citric acid for 90 minutes, revealed good wash durability 5th to 10th laundering. Therefore these finishing conditions were optimized for finishing of cotton fabric. Thus, cotton fabric finished with

lemon eucalyptus leaves protects the human beings from the bite of mosquito and there by promising safety from mosquito borne diseases like malaria, dengue fever and filarasis.

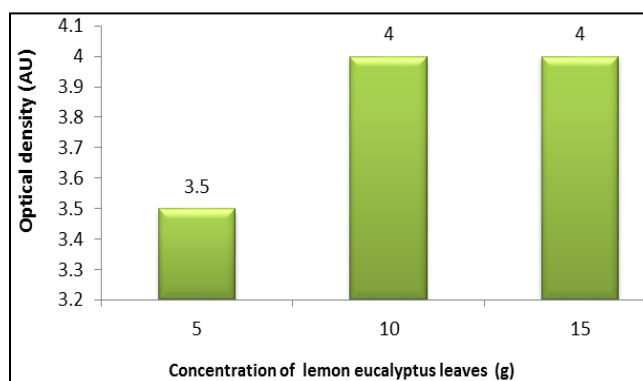


Fig 1: Optical density of lemon eucalyptus leaves extract

Optical density of 5, 10, 15 g lemon eucalyptus leaves powder in 100ml methanol gave the highest value (4.0) therefore, 10g selected as optimum

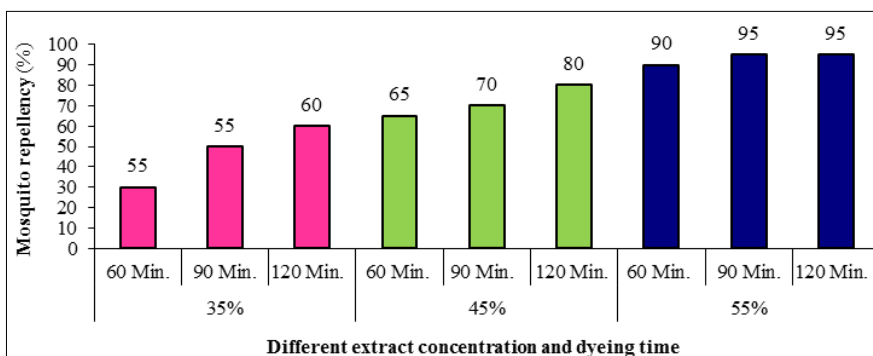


Fig 2: Mosquito repellency of dyed with lemon eucalyptus leaves samples

Table 1: Effect of finishing treatment on cotton fabric properties

	Stiffness	Crease recovery	Drapeability	Tensile strenght
Control (Warp)	3.62	35.8	0.84	29.40
Finished	2.5	47.8	0.05	26.80
Control(Weft)	3.46	33.6	0.86	36.40
Finished	2.94	53.6	0.01	36.608

Lemon eucalyptus leaves extract was taken in 35, 45 and 55% concentration. Data depicts that on increasing concentration from 35-55 per cent mosquito repellency also increases from 55-95%, therefore 55 per cent extract was standardized for dyeing of cotton fabric. Table reveals that fabric become softer and pliable after dyeing with lemon eucalyptus leaves. Crease recovery and drape of tie and dyed cotton fabric also improved. Tensile strength increased in weft direction while slight decrease was observed in warp direction.

Conclusion

Cotton fabric finished with lemon eucalyptus leaves protects the human beings from the bite of mosquito and there by promising safety from mosquito vector diseases and it is eco-friendly, bio-degradable, non toxic, non irritant to the skin and low cost for vector control and can be used with minimum care.

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