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Mosquito repellency finishes in blended denim fabrics

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Abstract

In this study an attempt has been made to approach of developing Mosquito repellency finishes using natural herbs. The three herbal extracts of *R*icinus *communis*, *Senna auriculata* and *Euphorbia herita were* applied on four types of Denim fabrics directly by using pad dry cure method. The Mosquito repellency finishes of the finished fabrics was assessed against bacteria that normally exist like *Anopheles*. To enhance the durability of the finished fabric, wash durability test has been carried out and the results showed good efficiency of finishes even after 30 industrial washes in Denim D fabric when compared to other fabrics.

Key-Words: Denim fabric, Medicinal herbs, Mosquito repellency finishes and Wash durability

Introduction

Mosquito repellent textiles are one of the revolutionary ways to advance the textile field by providing the much-needed features of driving away mosquitoes, especially in the tropical areas. It protects the human beings from the bite of mosquitoes and thereby promising safety from the mosquito-borne diseases, such as malaria, dengue fever (DF), Nile fever, dengue hemorrhagic fever (DHF), chicken gunia and filariasis, are serious public health problems in tropical regions, especially in Africa and Asia. These diseases are transmitted to human beings through mosquito[1].

Most plants contain compounds that they use in preventing attack from phytophagous insects. These chemicals fall in to several categories, including repellents, feeding deterrents, toxins, and growth regulators[2]. "Natural" smelling repellents are preferred because plants are perceived as a safe and trusted means of mosquito bite prevention[3].

Denim has gained much popularity that if you look around, you will surely notice somebody wearing denim in your nearby. Now, more than just complementing a rugged style, the denim has become suitable for any occasion[4].

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The present investigation aims at developing an eco friendly natural Mosquito repellency finish from plant extracts for textile application. Some selective species of plants were identified and screened for their activity and the extracts were applied to four types of blended denim fabric. The efficient herbal extracts were combined to choose the best herbal combination and conditions followed by AATCC 147 methods. The work also aimed at Mosquito repellency finish and to enhance the durability of the finished fabric, wash durability test has been carried out.

Material and methods

The fabric was sourced from the market with respect to the expected quality requirements. The fabric chosen was specified in Table 1 used for the application of Mosquito repellent finish. The leaves of *Ricinus communis (leaves), Senna Auriculata (leaves) and Euphorbia hirta (whole plant)* were used for the antimicrobial finish. The plants and their parts were collected from in and around Coimbatore district, Tamil Nadu, South – east coast of India.

Selection of herbs for Mosquito repellency finish

Pilot study was conducted with 20 selected herbs; from the pilot study three best resulted herbs were selected. Ricinus communis (leaves), Senna auriculata (leaves) and Euphorbia herita (whole plant). The combinations are (1:3:2) and the condition was standardized for the selected best herbs.

Cleaning and powdering of the herbs

The plant parts were washed twice in fresh water to remove other extraneous matter from the plants. These

herbal materials were shadow dried and powdered by using grinding machine

Extraction process

Methanol extraction

Each 6g of the powdered plant material was mixed with 100 ml of methanol in airtight conical flask. After overnight incubation, the supernatant was filtered through What man no.1 filter paper and the filtrate was dried to evaporate the organic solvent at room temperature. The sediment after evaporation was used for finishing the denim fabrics.

Finishing by pad-dry-cure method

The fabric sample was finished with the prepared herbal extracts according to the following recipe. The fabric was immersed for 30 min. After 30 min, the fabric was removed, squeezed and dried at 80 – 85 ºC in the oven for 5 min and cured at 150 ºC for 2 min.

Testing For Insect repellent property

Mosquito Repellency Testing

The mosquito repellency efficiency of the finished fabric was tested using the modified excito chamber method. There have been numerous attempts to accurately measure the behavioral responses of mosquitoes to insecticides using various types of excito-repellency test systems. The test method adopted in the present study for testing the mosquito repellent property is modified excito chamber method.

Testing of Mosquito Repellency

Repellency is known to play an important role in preventing the vector borne diseases by reducing man-vector contact. Synthetic chemicals and insecticides used for control of vectors are causing irreversible damage to the eco-system, as some of them are non-degradable in nature. The photochemical derived from plant resources can act as larvicides, insect growth regulators, repellents and ovipositional attractants, having deterrent activities observed by different researchers.

Mosquito collection

Anopheles mosquitoes were identified based on morphologic keys and they were collected during the evening hours. All mosquitoes were starved of blood and sugar of 4 hours before the tests.

Repellency Behavioral tests

Specially designed two excito repellency test chambers were used to evaluate the efficiency of repellency activity. The wooden outer chamber of excito-repellency testing device (Plate 3.3) measures 34 cm × 32 cm × 32 cm and faces the front panel with the single escape portal. The box is composed of a rear door cover, an inner Plexiglas glass panel with a rubber latex-sealed door, a Plexiglas holding frame, a screened inner chamber, an outer chamber, a front door, and an exit portal slot. Mosquitoes were deprived of all 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. Observations were taken at one-minute interval for 30 minutes. After each test was completed, the number of Escaped specimens and those remaining inside the chamber was recorded separately for each exposure chamber, external holding cage, and paired control chamber. Escaped specimens and those remaining inside the chamber, for the treated samples, were held separately in small holding containers with food and water.

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

Table 1: Specifications of the selected Denim Variants

Nomenculture	Blend	Weave	Weight in Ounces	Colour
A	68%cotton+32% polyester	2/1 RHT	7	Carbon tan
B	68%cotton+32% Poly Lycra	2/1 RHT	7	Carbon tan
C	68% cotton+32% core Spun lycra	2/1 RHT	7	Carbon tan
D	100% cotton	2/1 RHT	7	Carbon tan

Wash durability test

Wash durability by subjecting the sample to washing and testing its mosquito repellency efficiency. The denim fabric was subjected to washing by industrial machines and the antibacterial activity of the washed fabric was assessed by AATCC 147 test method.

Results and Discussion

Effect of Mosquito repellency efficiency of Denim fabric shown in table-2

Samples	Mosquito repellency in %	% loss or gain
A	20	
A sample after 10 washes	16	20
A sample after 20 washes	12	40
A sample after 30 washes	4	80
B	24	
B sample after 10 washes	20	16.6
B sample after 20 washes	15	37.5
B sample after 30 washes	12	50
C	32	
C sample after 10 washes	24	25
C sample after 20 washes	20	37.5
C sample after 30 washes	8	75
D	68	
D sample after 10 washes	60	11.76
D sample after 20 washes	56	17.6
D sample after 30 washes	52	23.5

From the above table it is clearly shows that the mosquito repellency percentage in sample A, B, C and D, in regard of wash durability. Comparison with in the sample A, A1, A2, and A3, A1 (20%) shows more efficiency when compared to other stages of washes.

Within the sample B, mosquito repellency shows good efficiency in B2 (16.6%) when compared to other stages of washes. Within the sample C and sample D, The mosquito repellency in percentage shows good efficiency in C1 (25%) and D1 (11.76%) respectively. When compared to other stages of washes.

Comparison between the sample A, B, C and D. The sample D shows very good efficiency and peak value when compared to other three samples and after all stages of washes and even after 30 industrial washes in Denim D fabric when compared to other fabrics. The repellent finished fabric is wearer to prevent from mosquitoes during evening.

Four variant of Denim fabric were finished with selected medicinal herbs and the mosquito repellency test and wash durability test has been carried out for the four variant and it is concluded that 100% cotton fabric is good and the results showed good efficiency of finishes even after 30 industrial washes in Denim D fabric when compared to other three fabrics. It may be due to other samples are blended with polyester cotton, polyester lycra and polyester core spun lycra but sample D is 100% cotton denim fabric .

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