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Dyeing of Cotton Fabric using Herbs

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Abstract

In this study an attempt has been focus on developing antibacterial finish using natural herbs. The cotton fabric samples were mordanted using natural mordants pomegranate and myrobalon. The mordanted fabrics were dyed with a natural dye Acacia catechu and the fabrics were finished with three herbal extracts of *Tridax procumbens, Plectranthus amboinicus* and *Mentha piperita* by using dip method and pad dry cure method. The Antibacterial finishes of the finished fabrics was assessed against Gram positive and Gram negative bacteria and concluded that the pomegranate mordanted fabric finished with *Tridax procumbens* herb using pad dry cure method gives the excellent result due to herbal imparted in fabric helps to protect the human beings free from skin infections, fungal growth and bad odour.

Keywords: *Acacia catechu;* Cotton*; Mentha piperita; Plectranthus amboinicus; Tridax procumbens*

Introduction

Clothing, food and house are the big three essential needs for human life. Human beings, in their evolutionary process, started to use clothes to cover their bodies. The use of plants and plant products as medicines can be traced as far as the beginning of human civilization. India has about 45,000 plant species and among them, several thousands have been claimed to possess medicinal properties [1]. Various medical plants have been used for years in daily life to treat diseases all over the world [2]. Medicinal plants contain large varieties of chemical substances with important therapeutic properties that can be utilized in the treatment of human diseases. The tribal and rural populations of India largely depend on medicinal plants for their health care [3]. Textiles for medical and hygienic use have become important areas in the textile industry.

Clothing normally used is prone to microbial attack because of higher amount of surface area and presence of moisture [4]. In general, antimicrobial properties can be imparted to textile materials by chemically or physically incorporating functional agents onto fibres or fabrics [5]. There are many natural products which show antibacterial properties, extracts from roots, stem, leaves, flowers and seeds of diverse species of plants exhibit antibacterial properties [6].

In the present work, herbal plant extracts of directly applied onto naturally dyed cotton fabric as antibacterial finishing agents.

Materials and Methods

Materials

Bleached cotton knitted fabric [single jersey, GSM 109] was used as starting material for the study. Acacia catechu is used for dyeing the selected cotton fabric. Medicinal herbs *Tridax procumbens*, *Plectranthus amboinicus* and *Mentha piperita* are used for finishing. Methanol is used for extracting those medicinal herbs.

Methods

Dyeing with *Acacia catechu*: The selected cotton fabric is pre-mordanted with natural mordants pomegranate and myrobolan. The selected acacia catechu dye is dyed for 90 min at 80° to 90°C with material – to- liquor ratio 1:20. Continues stir is required for even dyeing. Then the material is washed and dried.

Extraction process: The collected herbs were shadow dried within a temperature range of 37-40°C. Herbs should not be dried under the sun because it may breakdown the medicinal properties of the herbs. The moisture content of the herb collected was reduced to less than 14% with proper drying since most of the herbs have moisture content of 60-80% and cannot be stored without drying. Proper drying has to be carried out otherwise important compounds may get contaminated. After drying, the grinding was carried out to break down the leaves of the plant in to small units. Extraction refers to separating the desired material by physical or chemical means with the aid of a solvent. Antibacterial active substances were extracted from the plant by methanolic extraction method. The powered plant material was extracted with methanol by adding 20 grams of herbal powder in 100 mL of methanol for 24. Table 1 shows Parts, Techniques and Solvent used for the extraction of Medicinal Herbs [7-9] (Table 1).

Direct application method: The fabric samples were treated with herbal extracts using citric acid as cross-linking agent. Methanolic extracts of *Tridax procumbens*, *Plectranthus amboinicus* and *Mentha piperita* were applied on to the fabric by dip method and pad-dry-cure method. 8% of citric acid is used as a cross-linking agent. For dip method the samples were dipped and dried in room temperature. For pad-dry-cure method the samples were immersed in the methanolic solution for 5 min and it was passed through the padding mangle, running at a speed of 15 m/min with a pressure of 1 kgf/cm^2 to remove excess amount of solution. After padding the samples are air-dried and cured for 3 min at 140°C [10].

Test method: The treated and untreated fabric materials were

HERB	PARTS	SOLVENT
Tridax procumbens	Whole Plant	Methanol
Plectrnthus amboinicus	Whole Plant	Methanol
Mentha piperita	Whole Plant	Methanol

Table 1: Parts, techniques and solvent used for the extraction of medicinal herbs.

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S.No	Fabric Samples	Fabric Samples Abbreviations
1	O	Original Sample
2	DPT	Dip method-Pomegranate mordant-Tridaxprocumbens
3	DPP	Dip method-Pomegranate mordant-Plectranthusamboinicus
4	DPM	Dip method-Pomegranate mordant-Menthapiperita
5	PPT	Pad Dry Cure method-Pomegranate mordant-Tridaxprocumbens
6	PPP	Pad Dry Cure method-Pomegranate mordant-Plectranthusamboinicus
7	PPM	Pad Dry Cure method-Pomegranate mordant-*Mentha piperita*
8	DMT	Dip method-Myrobalan mordant-*Tridax procumbens*
9	DMP	Dip method-Myrobalan mordant-*Plectranthus amboinicus*
10	DMM	Dip method-Myrobalan mordant-*Mentha piperita*
11	PMT	Pad Dry Cure method-Myrobalan mordant-*Tridax procumbens*
12	PMP	Pad Dry Cure method-Myrobalan mordant-*Plectranthus amboinicus*
13	PMM	Pad Dry Cure method-Myrobalan mordant-*Mentha piperita*

Table 2: Nomenclature.

S.No	Fabric samples	Zone of Inhibition	
		Bacteria	
		Staphylococus aureus **(+ ive)**	***Echeriachia coli*** **(- ive)**
1	O	0	0
2	DPT	12 mm	0
3	DPP	10 mm	0
4	DPM	9 mm	0
5	PPT	**19 mm**	**19 mm**
6	PPP	15 mm	11 mm
7	PPM	13 mm	13 mm
8	DMT	16 mm	6 mm
9	DMP	13 mm	0
10	DMM	15 mm	0
11	PMT	12 mm	12 mm
12	PMP	16 mm	0
13	PMM	18 mm	0

Table 3: Antibacterial activity of herbal coated fabric.

qualitatively assessed by Agar Diffusion method [AATCC 147]. The activities were evaluated quantitatively. The samples were inoculated with test organisms. After incubation, a clear area of an interrupted growth underneath and along the side of the test material indicates antibacterial effectiveness of the fabric. The Nomenclature was listed in Table 2.

Result and Discussion

The finished fabrics were assessed for the antibacterial activity by AATCC 147 test method against *Staphylococus aureus* and *Escherichia coli*. It shows that when compared to overall samples, the sample PPT has the zone of inhibition of 19 mm in *Staphylococus aureus* and 19 mm in *Escherichia coli* has good antibacterial activity as shown in Table 3.

Finally, it is concluded that the pomegranate mordanted fabric finished with *Tridax procumbens* herb using pad dry cure method gives the excellent result due to herbal imparted in fabric helps to protect the human beings free from skin infections, fungal growth and bad odour (Table 3).

Conclusion

The antibacterial activity of pomegranate mordanted *Tridax procumbens* treated cotton fabric finished by pad-dry-cure method is found to be higher than that of the fabrics treated with *Plectranthus amboinicus* and *Mentha piperita* separately which was substantiated using AATCC 147 test. *Plectranthus amboinicus* and *Mentha piperita* treated fabric exhibited a better bacterial activity and helps to protect the human beings free from skin infections, fungal growth and bad odour.

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