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Imparting Antimicrobial Finish on Selected Regenerated Cellulosic Fabrics with Herbal Oil Combinations

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Abstract

The functional finishing has becoming the most required need for textile materials. In this study an attempt has been made to impart the antimicrobial source on the Bamboo 100%, Tencel 100% and Bamboo/Tencel 50/50 fabrics. The three herbal oils of thyme oil, cypress oil and Grape fruit oil were screened separately with other oils for many functional properties. Selected these, three herbal oils were mixed with four combinations to ensure the best combination for antimicrobial efficacy. The finished fabrics are evaluated using such test methods (AATCC 147, AATCC100). The investigated result states that (2:1:1) ratio shows the best antimicrobial property in all the three fabrics. Among these fabrics Bamboo/Tencel 50:50 fabric shows the best result.

Keywords: Bamboo fabric; Combination; Functional property; Herbal oil; Antimicrobial

Introduction

The rapid growth in technical textiles and their end-use 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. Antimicrobial textiles with improved functionality find a variety of applications such health and hygiene products, specially the garments worn close to the skin and several medical applications such as infection control and barrier material [1].

Natural antimicrobial substances are not only eco-friendly but also from renewable sources. Bacteria and fungi are microbes that can grow on textiles. Microbial growth, especially bacteria in textile materials can result in the deterioration of fabric properties, development of foul smells, skins irritations and cross infections [2].

The consumers are now increasingly aware of the hygienic life style and there is a necessity and expectations for a wide range of textile products finished with Eco-friendly antimicrobial properties. Eco textiles gain utmost importance as one of the most useful resources that help promote new innovations, in an eco-friendly manner [3].

Many studies have been carried out to extract various natural products for screening antimicrobial activity but attention has not been focused intensively on studying the combination of the products for their antimicrobial activity [4].

Essential oil extracted from several types of plants either by distillation or volatile organic solvents, has been used as a flavoring for year. Antimicrobial activity of plant extracts is frequently due to the essential oil fraction or to sulfur - containing compounds in the aqueous phase. More than 1,340 plants are known to be potential sources of antimicrobial compounds but that few have been studies scientifically [5].

The number of textiles with antimicrobial finishes or which have been antimicrobially modified has increased considerably over recent year. While it was predominantly technical textiles which had antimicrobial finishes in the part, in particular to protect against fungi, textiles worn close to the body are currently increasingly being finished and modified in this way. [6].

Gems grow rapidly by cell division, doubling their population every 20 minutes. The required humidity and an organic medium can initiate for bacterial growth. Antimicrobial finishing of textile fabrics can prevent the growth of various micro organisms. Antimicrobial finishing products are divided into bactericides (causing destruction of bacteria and bacterio-stats (inhibiting bacterial growth). There are three categories of protection against biological attack.

- Protection of the wearer or user of a textile material against microorganisms for aesthetic purposes (suppressing or killing odor-causing bacteria)
- Protection of the textile itself from bio deterioration caused by mold, mildew, and rot- producing fungi.
- Protection of textiles and wearer from insects and other pests [7].
- Herbal garments helps in fighting many common prevalent diseases such as hypertension, heart diseases, asthma, and diabetes and skin disease [8].

A review of antimicrobial finishing of textile has been provided with the consumer increasingly awareness towards the health and hygiene demand for antimicrobial textiles is now increased. The function of antimicrobial finish on the fabric is to protect the wearer from microorganisms affecting on the health. Intense research is going on worldwide with the focus on improvement in protection of textile substrate from microorganisms through an eco-friendly process [9].

It is a cellulosic fibre obtained by regenerating cellulose extracted from the bamboo plant. It is eco-friendly biodegradable having antimicrobial, bacteriostatic, and deodorizing properties. This fibre has high comfort values and can absorb moisture. Bamboo is also very

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sustainable to grow in quick and favorable conditions without the use of pesticides noted [10].

Materials and Methods

The Bamboo 100 %, Tencel 100%, Bamboo/Tencel 50:50 fabrics with the following specification of yarn and fabric. Yarn count: 40s. Fabric type: single jersey fabric. It was scoured, bleached and dyed to attain basic preparatory process.

Herbal oils for combination

Thyme oil, Cypress oil and Grape fruit oil were purchased in Swasthik eucalyptus oil co, Ooty.

Methods

Combinatorial study: Thyme oil, Cypress oil and Grape fruit oil was selected for combinatorial study. These three oils were combined with various ratios such as 1:1:1, 1:1:2, 2:1:1, 1:2:1. The formulated concentrations were then finished individually onto the three fabrics 100% Bamboo, 100% Tencel and 50:50 Bamboo-Tencel. The finished fabrics were then tested for antibacterial activity by AATCC 147 standard method.

Finish application: The fabric was immersed in the oil for 15 min by dip and dry method. The fabric was taken out of bath and squeezed. The fabric was finally dried in ambient air. The efficiency of finished fabric was tested by AATCC- 147.

Antibacterial assessment of fabric samples by AATCC 147: The treated fabric samples (Bamboo 100%, Tencel 100% and 50:50 Bamboo Tencel) were finished with oil mixture which contain Thyme oil, Cypress oil and Grape fruit oil in 4 combinations (1:1:1, 1:1:2, 2:1:1, 1:2:1) and it is cut separately rectangular in shape with 25 X 50 mm (b*l) was taken for the analysis. Sterile nutrient agar was dispensed into Petri dishes. Broth cultures (24 hours) of the test organisms were used as inoculum. Using sterile inoculation loop, the test organisms *Staphylococcus aureus* (ATCC 6538) and *Escherichia coli* (ATCC 8739) were streaked, 5 lines with 4 mm width over the surface of the agar plate. The treated fabric was placed on over the inoculated bacterial species. And the plates were kept for incubation at 37°C for 24 hours. At the end of incubation, zone of inhibition formed around the fabric was measured in millimeter and recorded.

Result and Discussion

Antibacterial activity of the finished fabric – AATCC 147 test method

From the Table 1 it clearly declares that the combinatorial process which supports antibacterial property. In which all the combination has the property to inhibit bacterial growth. Some combinations do not allow microbial growth only beneath the fabric. In which 2:1:1 ratio shows higher value in Bamboo/Tencel 50:50 fabrics compared to other combinations. The Bamboo/Tencel 50:50 which has synergic fabric property hence it shows good antibacterial property when finished with oil combination.

Antibacterial activity assessment by AATCC 100 test method

In combinatorial study the fabric analyzed with AATCC 100 test standard. The result declares that all combinations have some amount of antibacterial activity. Even though 2:1:1 which shows excellent antibacterial property shown in Table 2 and Figure 1 and 2. Both Bamboo and Bamboo/Tencel 50:50 fabrics. Moreover Bamboo/Tencel 50:50 shows the higher value of percentage reduction in bacterial growth.

S. No.	Combination	Fabric samples	Zone of Bacteriostasis (mm)	
			Escherichia coli	*Staphylococcus aureus*
1	1:1:1	100% Bamboo	0	0*
		100% Tencel	0*	0*
		50%:50% Bamboo: Tencel	0*	0*
2	1:1:2	100% Bamboo	0	0
		100% Tencel	0	0
		50%:50% Bamboo: Tencel	0	0
3	2: 1: 1	100% Bamboo	0*	0*
		100% Tencel	0*	0*
		50%:50% Bamboo: Tencel	**38**	**42**
4	1:2:1	100% Bamboo	0	0
		100% Tencel	0	0
		50%:50% Bamboo: Tencel	**0**	**0**
5	100% Bamboo		0	0
6	100% Tencel		0	0
7	50%:50% Bamboo: Tencel		0	0

(*No growth beneath the fabric)

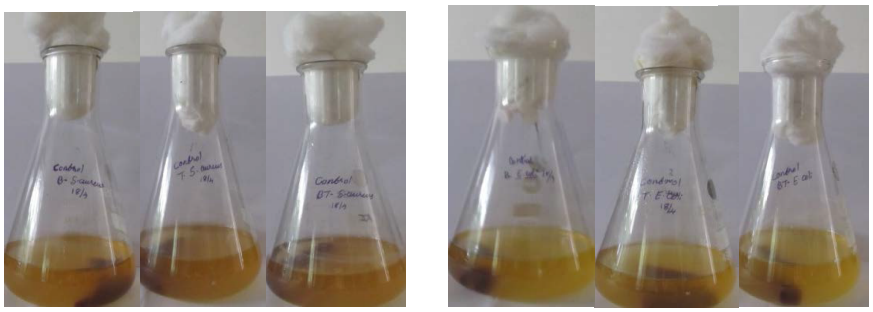
Table 1: Antibacterial activity of the finished fabric - AATCC 147 test method.

S.No	Combination	Fabric	Bacterial count (cfu/ml) after 24 hours	
			Staphylococcus aureus % Reduction	*Escherichia coli* % Reduction
1.	Untreated	100% Bamboo	42	72
		100% Tencel	36	70
		50 :50% Bamboo:Tencel	50	62
2.	1:1:1	100% Bamboo	75	63
		100% Tencel	26	50
		50 :50% Bamboo:Tencel	26	62
3.	1:1:2	100% Bamboo	42	72
		100% Tencel	20	24
		50 :50% Bamboo:Tencel	16	73
4.	2:1:1	100% Bamboo	86	86
		100% Tencel	59	81
		50 :50% Bamboo:Tencel	87	89
5.	1:2:1	100% Bamboo	46	56
		100% Tencel	59	16
		50 :50% Bamboo:Tencel	34	11

Table 2: Antibacterial activity assessment by AATCC 100 test method.

Conclusion

The three herbal oils were taken for combinatorial study. The treated fabrics performance was evaluated using AATCC 147 and 100 test method. The result showed that maximum zone of antibacterial inhibition. Seen in 2:1:1 ratio finished Bamboo/Tencel 50:50 fabrics compared to other fabrics. It declares that use of herbal oil has a source of antibacterial property. However, herbal oil is very eco-friendly and very suitable for textile application.



(a) (b) (c) (a) (b) (c)

S.aureus *Ecoli*

S.aureus (control) (a)Bamboo (b)Tencel *Ecoli* (control) (c)Bamboo/Tencel 50:50
(a) Bamboo (b) Tencel (c) Bamboo/Tencel 50:50

Figure 1: Antibacterial activity assessment by AATCC 100 test method (control).

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