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Antimicrobial Finish on Nonwoven Fabric using Sandalwood Extract

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Abstract: *Health and hygiene are the primary requirements for human beings to live comfortably and work with maximum efficiency. To protect the mankind from pathogens and to avoid cross infection, a special finish like antimicrobial finish has become necessary. As consumers have become more aware of hygiene and potentially harmful effects of microorganisms, the demand for antimicrobial finished clothing is increasing. Antimicrobial textiles help to control the growth of microbes which helps in protecting the wearer from the risk of infection. The application of antimicrobial textile finishes at present is confined to specialty products in the medical, technical, industrial, home furnishing and apparel categories. Hence, there is significant development in investigation of eco-friendly, natural anti-microbial finish from herbs for application on textile substrates. This paper deals with development of herbal medical textiles by applying medicinal herbs on textiles to safeguard the human life. The herbal finished medicated fabrics were tested as per Swiss standards, ISO standards (Indian Standard Organization) and AATCC standards (American Association of Textile Chemists and Colorists). Standard test methods such as Agar Diffusion Test Method as per (SN 19592), and soil Burial Test as per (EN-ISO-17721) a have been carried out.*

Keywords: *Textile, Antimicrobial, Herbs, Medicated, Fabrics.*

1. INTRODUCTION

Textiles have an important role in our daily lives that everyone needs to know something about them. From the time of cave men, dress which was first worn only to protect the body from the vagaries of weather has under gone change as the man himself. Today textiles have been used as adaptive clothing, wearable electronics, medical textiles, industrial garments and smart garments.

In this research work, an attempt has been made to prepare different value added products with medicinal properties using selected natural herbs. Today apparel fabrics are expected to meet all the requirements related to comfort, health-care, handle, easy care properties and performance. There is a need and thrust for eco- friendly herbal textiles to help the society and also to bring up value added garments. The objective of the study is to develop herbal medical textiles by applying medicinal herbs on textiles to safeguard the human life.

2. Materials

The material used to carry out this research work is discussed below

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2.1 Selection of Fabrics

Viscose rayon fabrics were selected for this study. The particulars of fabric used for the study is given in table 2.1.

Table 2.1 Particulars of Yarn and Fabric

S.No	Materials	Particulars
1.	Viscose nonwoven fabric	Spun laced technique, Fabric weight - 40 g/m^2

2.2. Selection of Medicinal Herb

The medicinal plant was identified based on their properties. The plants that has been used for this research work is given in table 2.2.

Table 2.2 Selection of Medicinal Herb

S.No	Common name	Botanical name	Family	Parts used
1.	Sandal	Santalum album	Santalaceae	Wood

2.3 Identification and Collection of Medicinal Herbs

The plants required for this study were collected from the Tamil Nadu Agricultural University (TNAU), Coimbatore that are grown under optimal environmental condition and are fresh, disease free and morphologically identical.

2.4 Preparation and Method of Herbal Extraction

Based on the fabric weight, equal amount of herb is taken. 20 grams of medicinal plant powder per 100 ml of solvent was taken in an air tight conical flask and kept at room temperature for 48 hours. The solvent takes out the active components of the plant. After 48 hours the solvent was allowed to evaporate by keeping the conical flask in open condition for 15 minutes. The residue in the conical flask was filtered to get the extracted solution.

2.5 Finalization of the Herbal Extraction Techniques and Solvents

In extracting the herbal solution two techniques were involved such as "Drying- Powdering - Filtering" and "Grinding - Filtering". Three solvents namely ethanol, methanol and chloroform were used to take out the active components present in the herb. In selecting a suitable solvent and technique for herbal extraction a pilot study was made to see the influence of herbs on solvents, extraction technique and their bacterial effect. Based on the result of pilot study the herbal extracting techniques, solvents used were optimized. Optimization process for the actual herbal extraction is presented in table.2.3

Table 2.3 Finalization of the Herbal Extraction Techniques and Solvents

S.No	Name of the herbs	Techniques used	Solvent used
1.	Sandal-Wood	Drying-Powdering-Filtering	Ethanol

Two different concentrations such as 100% alcohol (alcoholic extract) and 50% alcohol with 50% aqueous (aqueous alcoholic extract) were used. The pilot study result shows that there is no significant difference in the antibacterial effect for "Alcoholic Extract" and "Aqueous Alcoholic Extract". Considering important factors such as cost effectiveness, several component dissolving factor and high yield Aqueous Alcoholic Extract Method was chosen for the study.

2.6 Antibacterial Assessment of Herbal Extract

The antibacterial activity for herbal extract was done using "Well Agar Diffusion Method" against pathogenic organism. Herbal extracts were collected separately and tested for antibacterial activity using above mentioned method against test organisms of gram positive organism (Staphylococcus aureus) and gram negative organism (Escherichia coli).

2.6.1 Cleaning of Glassware

All glass wares cleaned thoroughly for conducting critical experiments.

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2.6.2 Preparation of Media for Antibacterial Assessment

The medium prepared is Muller Hinton Agar. To obtain a solid or gel medium, Agar agar obtained from Seaweeds, Gelidium and Gracilaria were added with distilled water in a conical flask and mixed well without any lump formation. An Agar melts only at 100 degree centigrade and thus remains solid throughout the entire range over which microbes are cultivated, and once melted it stays in the form of liquid until the temperature falls down at 40 degree centigrade. A medium stays in the form of liquid after sterilization if Agar is not added and is called a liquid medium or Broth.

2.6.3 Sterilization of All Apparatus

A simple double jacketed autoclave is used for the study to sterilize media and equipment's. All the apparatus intended to assess the antimicrobial activity of herb is to be sterilized using an autoclave at 121 degree centigrade for 15 minutes at 15 lb pressure. Sterilization is done for complete elimination or killing of microbes.

2.6.4 Inoculation of Herbal Extract

Inoculation was carried out under the laminar air flow chamber. 20ml of prepared medium which is sterilized was poured in each of the sterile Petri- plates and allowed to solidify. 0.1ml bacteria suspension was swapped over the surface of agar medium and wells were created using well cutter. The herbal extract was then added using micro pipette to each of the wells. The plates were then sent for incubation.

2.6.5 Incubation for Growth Media

Most of the pathogenic organisms grow best at 37 degree centigrade. The culture media after inoculation is incubated at 37 degree centigrade in an incubator for 24 hours.

2.6.6 Measuring the Zone of Inhibition

After 24 hours of incubation the incubated plates were examined to interpret the growth over the inoculums. The size of the clear zone was used to evaluate the inhibitory effect of the herbal extract by observing and measuring the diameter of the inhibitory zones and was recorded.

2.6.7 Imparting Herbal Finish to the Selected Textile Material

The herbal extract is finished on viscose fabrics. Three roll padding machine is used to finish viscose nonwoven fabrics for two minutes. After padding, the fabrics were taken, dried and cured.

Composition

Material to liquor ratio	:	1: 10
Herbal extract	:	10 % of fabric weight
Temperature	:	27 degree centigrade
Duration	:	5 minutes

2.6.8 Antimicrobial Assessment for Herbal Finished Medicated Fabrics

The herbal finished medicated fabrics have been tested for antibacterial assessment using Agar Diffusion Test Methods as per Swiss Standard SN 19592. Also Antifungal activity for herbal finished medicated fabrics was assessed using Soil Burial Test as per ISO Standards EN-ISO-17721.

2.6.9 Soil Burial Test (EN-ISO-17721)

The Antifungal assessmentof herbal finished medicated fabric is assessed using Soil Burial Test as per ISO Standards EN-ISO-17721.

3. Results and Discussions

3.1 Antibacterial Assessment of Herbal Extract

The antibacterial assessment of herbal extract was tested against two test organisms of gram-positive bacteria (Staphylococcus aureus) and gram-negative bacteria (Escherichia coli) using "Well Agar Diffusion Method" and is given in table 3.1 and in plate 3.1.

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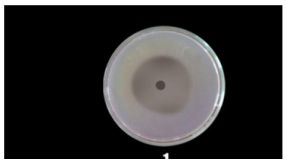
Table 3.1 Antibacterial Assessment of Herbal Extract Using Well Agar Diffusion Method

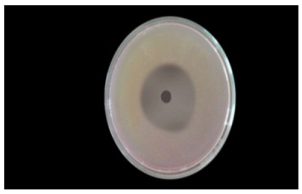
S.no	Herbal Extract Used	Antibacterial Assessment (Zone of Inhibition in (mm)	
		Staphylococcus aureus	Escherichia coli
1.	Sandal-Wood	25	22

The results show a positive approach in both organisms where the gram-positive bacteria (Staphylococcus aureus) shows better result compared to gram-negative bacteria (Escherichia coli).

Plate 3.1 Antibacterial Assessment of Herbal Extract Using Well Agar Diffusion Method



(A) Influence of Staphylococcus aureus on Herbal Extract Using Well Agar Diffusion Method



(B) Influence of Escherichia coli on Herbal Extract Using Well Agar Diffusion Method

From the plate 3.1 (A) it is clear that the influence of Staphylococcus aureus on sandalwood extract shows maximum zone of inhibition than the influence of Escherichia coli.

3.2 Antimicrobial Assessment for Herbal Finished Medicated Fabrics

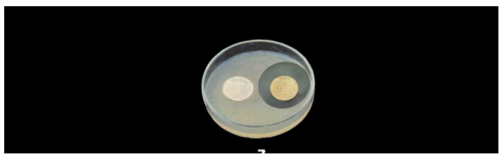
The herbal finished medicated textile is tested for antimicrobial activity as per Standard Test Method. Antibacterial assessment was done using Agar Diffusion Test (SN 195920). The results of antibacterial assessment using Agar Diffusion is shown in table 3.2 and plates in 3.2.

Table 3.2 Antibacterial Assessment of Herbal Finished Medicated Fabrics Using Agar Diffusion Test (SN195920)

S.no	Herbal Finished Medicated Fabrics	Finishing Techniques	Antibacterial Assessment (Zone of Inhibition in mm)	
			Staphylococcus aureus	Escherichia coli
1.	Viscose Nonwoven Control Fabric	-	Nil	Nil
2.	Sandal-Wood Finished Viscose Nonwoven Fabric	Pad-Dry-Cure	24	23

The table 3.2 reveals that antibacterial activity using Agar Diffusion Test shows a positive approach in both the organisms (Staphylococcus aureus and Escherichia coli). Gram positive bacteria (Staphylococcus aureus) shows better result compared to gram negative bacteria (Escherichia coli).

Plate 3.2Antibacterial Assessment of Herbal Finished Medicated Fabrics Using Agar Diffusion Test (SN 195920)



(A) Influence of Staphylococcus aureus on Herbal Finished Medicated Fabrics Using Agar Diffusion Test

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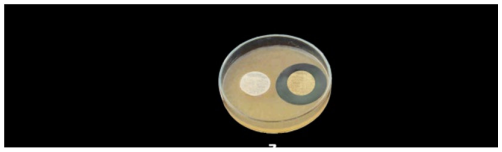

(B) Influence of Escherichia coli on Herbal Finished Medicated Fabrics Using Agar Diffusion Test

From the plate 3.2 (A) it is clear that the influence of Staphylococcus aureus on sandalwood finished viscose nonwoven fabric shows maximum zone of inhibition than the influence of Escherichia coli with respect to Agar Diffusion Test.

3.3 Antifungal Assessment for Herbal Finished Medicated Fabrics Using Soil Burial Test (EN-ISO-17721)

Antifungal assessment of herbal finished medicated fabric using Soil Burial Test as recommended by ISO Standards was evaluated visually by viewing the degree of degradation when compared to the control sample. Table 3.3 and plate 3.3 shows the antifungal assessment of herbal finished medicated fabric using Soil burial test.

Table 3.3 Antifungal Assessment of Herbal Finished Medicated Fabrics Using Soil Burial Test (EN-ISO17721)

S. No	Herbal Finished Medicated Fabrics	Observation		Antifungal Activity
		Staphylococcus aureus	Escherichia coli	
1.	Viscose Nonwoven Control Fabric	Degraded	Degraded	-ve
2.	Sandal finished Viscose Nonwoven Fabric	Not degraded	Not degraded	+ve

+ve indicate the presence of bacterial inhibition
- ve indicate the absence of bacterial inhibition

From the table it is clear that the herbal finished medicated fabrics were not degraded compared to the control samples which are degraded.

Plate 3.3 Antifungal Assessment of Herbal Finished Medicated Fabrics Using Soil Burial Test(EN-ISO17721)

A) Influence of Staphylococcus aureus on Herbal Finished Medicated Fabrics Using Soil Burial Test

B) Influence of Escherichia coli on Herbal Finished Medicated Fabrics Using Soil Burial Test

The plate 3.3 (A & B) shows that the herbal finished medicated fabrics has resistance to degradation whereas the control samples shows sensitivity to degradation.

4. Conclusion

The human body generates sweat during various conditions of activity leading to sensory excitation and thermal excitation. Human sweat provides a suitable shelter for bacterial growth, containing 1.4 million bacteria per gram which increases to 9000 million at 50 % moisture level. As global consumers have become more aware of hygiene and potentially harmful effect of microorganisms, the

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demand for antimicrobial textiles are increasing. Thus these conditions have led to worldwide efforts to develop eco-friendly and biodegradable fabrics. With increasing concerns regarding the effect of textile industry on environment, more and more textile researchers, producers and manufacturers are looking to biodegradable and sustainable fabrics as an effective way of reducing the textile impacts on the environment.

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