

## **Antimicrobial efficacy of herbal microencapsulated organic cotton and bamboo knit fabrics**

**S. JAYAPRIYA\*<sup>1</sup> AND G. BAGYALAKSHMI<sup>2</sup>**

<sup>1</sup>Assistant Professor & Head and <sup>2</sup>Associate Professor

<sup>1</sup>Department of Costume Design and Fashion, Nehru Arts and Science College, Coimbatore (T.N.) India

<sup>2</sup>Department of Textiles and Clothing, Avinashilingam Institute for Home Science and Higher Education for Women University, Coimbatore (T.N.) India

### **ABSTRACT**

Clothing is considered as second skin and has been used for protection since immemorial. However in recent years use of clothing is merely connected to the term called “Health Based Clothing”. At present there is a great potential for Herbal finished Antimicrobial textiles as they are eco-friendly, easily biodegradable and their nature of health hazardless. Plants possess antimicrobial properties and they are used in treating various ailments. Finishing with plant extracts minimizes microbial growth in textiles. Hence both antimicrobial property in Plants and clothing can be pooled to acquire more benefits.

**Key Words :** Antimicrobial, Organic cotton, Bamboo, Knitted fabric

### **INTRODUCTION**

From time immemorial, the herbs have played a vital role in providing lead compounds/ components used for the isolation and synthesis of numerous conventional drugs. A general disappointment with conventional medicines, coupled with the desire for a “natural” life style has resulted in a growing consumption of substitute or balancing therapies with the natural products in common and phytomedicines in particular views Zaheer *et al.* (2011). In recent years, application of ethno botanical information in medicinal plant research has expanded to considerable interest in segments of the scientific community opines Heinrich (2000).

#### **Eco-friendly natural finishes on textiles :**

The studies done by Malik and Parmar (2008) reveals that natural finishes have many advantages such as non-toxic, non-irritant, biodegradable, cost effective and easy availability.

Many natural herbs are available in nature that can be used to extract out antimicrobial chemicals opines Sunny Pannu (2013). Studies disclose that specific species of herbs possess antimicrobial properties highlights Thilagavathi and Rajendrakumar (2004).

### **Effectiveness of antimicrobial textile finishes :**

Antimicrobial finish must act quickly to be effective, because the growth rates of microbes are rapid and it must be safe for the manufacturer to apply and consumer to wear, therefore it is essential to select eco-friendly sources for finishing onto the fabrics. The antimicrobial finish should be of low cost opines (Schindler and Hauser, 2004). The antimicrobial finish must be easy to apply and should be compatible with other finishing agents. The finish should also have no undesirable effects including other fabric properties like wear comfort.

### **Selection of fabric :**

According to Singh *et al.* (2001), "Cotton is the most consumed natural fibre in the world". Cotton is the oldest fibre used for textile purpose highlights (Mishra, 2000). Organic Cotton is grown without using Pesticides and it is also used extensively in medical textiles. Bamboo is being consumed as a raw material for textiles mainly due to its renewability, biodegradability and carbon sequestering abilities opines (Waite, 2009). The studies done by Tusie *et al.* (2015) reveal that the comparative analysis of bamboo fibers bring to a conclusion that bamboo fiber has excellent antimicrobial properties that make it perfect for processing into textile. Therefore organic cotton and bamboo fabrics are selected for the Study.

Considering these facts the investigator has planned to carry out a study to develop antimicrobial finished fabric to test its antimicrobial efficacy.

The objectives of the study are as follows:

- To select suitable herbal sources and optimize the parameters
- To treat knitted organic cotton and bamboo fabric using the herbal combination
- To carry out the qualitative assessment of antimicrobial activity in antibacterial finished organic cotton and bamboo knitted fabrics
- To evaluate the antibacterial performances of microencapsulated fabrics.

## **METHODOLOGY**

### **Solvent extraction of collected herbs :**

The ethanol extract of three different plants (*Punica granatum*, *Moringa concanensis*, *Psidium guajava*) was washed twice in fresh water, air dried and powdered using a mortar and pestle and stored in air tight container. 60 grams of powdered plant materials were combined in different ratios like (1:2:3) added 1000 mL of 80% solvent and kept in a reciprocating shaker for 24 h for continuous agitation at 150 rpm/min for thorough mixing and also complete elucidation of active materials to dissolve in the respective solvent. Then, extract was filtered by using muslin cloth followed by Whatmann no.1 filter paper. Finally, the residues were collected and stored for further experiment.

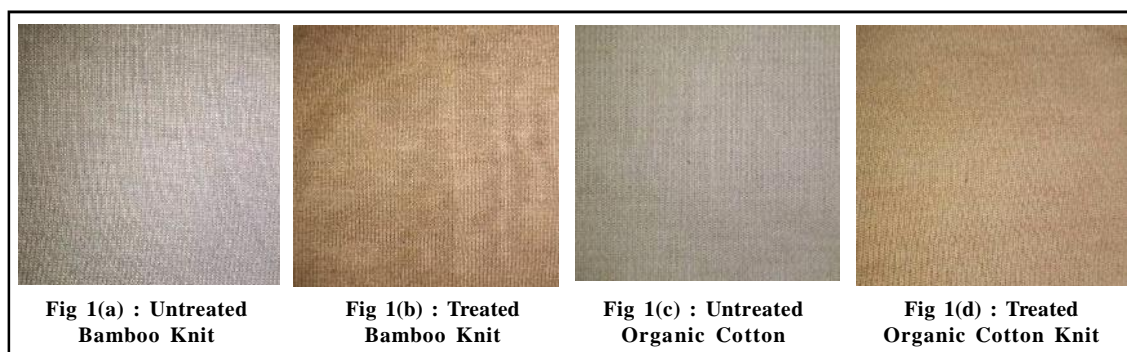
### **Encapsulation of knitted organic cotton and bamboo fabric by ionic gelatin process:**

Microcapsules containing extract were prepared employing sodium alginate. 3% sodium alginate was prepared separately. Then 250 ml of Combination of herbal extract and 100 ml of Tween 20 were added to the polymer solution and mixed thoroughly to form smooth viscous dispersion. This was sprayed into calcium chloride solution by means of a sprayer. The droplets were retained in calcium chloride for 15 minutes. The microcapsules were obtained by decantation and repeated washing with iso propyl alcohol followed by drying at 45° C for 12 hours. These microcapsules

were used for finishing the Organic cotton and Bamboo Knit fabrics.

**Exhaust method :**

According to the following recipe the Organic cotton and Bamboo knit samples were finished incorporating the prepared herbal extract microcapsules. About one liter solution containing 1400 grams of capsules was used to finish two meters of bamboo and cotton fabric. The fabric was immersed in the binder solution (8% citric acid) for 30 minutes under 50° C in an oven. After 30 minutes, the fabric was removed and air dried in shade.



**RESULTS AND DISCUSSION**

**Antibacterial activity by AATCC 147 :**

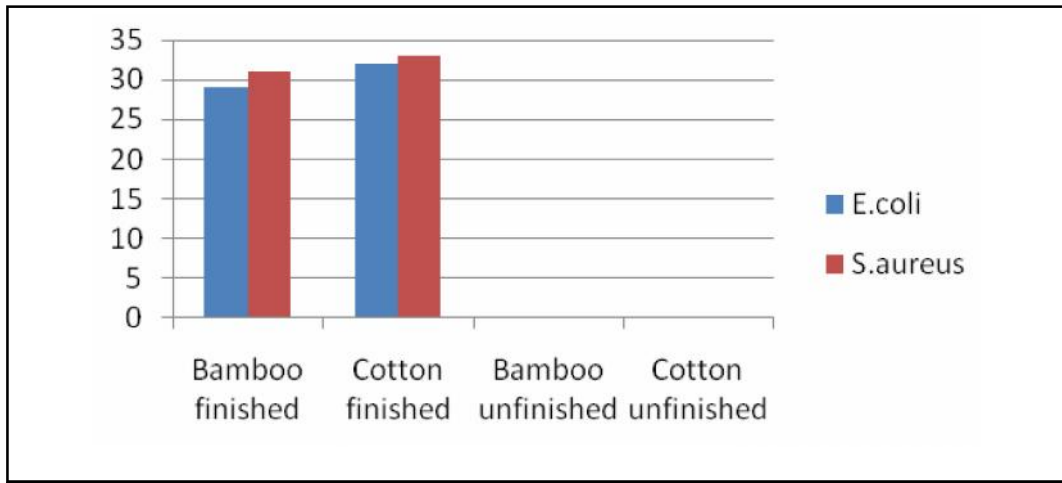
The AATCC Bacteriostasis agar plates were prepared by pouring 15ml of AATCC Bacteriostasis agar media into sterile Petri plates. The plates were allowed to solidify for 10min and the bacterial culture was inoculated as single line followed by the four lines without refilling the inoculation loop. The bamboo and cotton fabric finished and unfinished with extract of different ratios of (*Punica granatum*, *Moringa concanensis*, *Psidium guajava*) of (1:2:3) was cut into 5 x 2.5 cm size with the diameter of 2.5 cm was placed 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 incubation formed around the fabric was measured in millimeter and recorded.

From the above Table 1 and Fig. 2, it is clear that there is significant antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli* in the herbal finished fabric when compared to Unfinished Organic cotton and Bamboo Knit Fabrics.

Sr. No.	Fabric sample	Zone of inhibition (in mm)	
		<i>E. coli</i>	<i>S. aureus</i>
1.	Bamboo finished	29	31
2.	Cotton finished	32	33
3.	Bamboo unfinished	0	0
4.	Cotton unfinished	0	0

**Antifungal activity assessment by AATCC 30 - 2003 Test Method :**

The bamboo and cotton fabric finished and unfinished with extract of different ratios of (*Punica granatum*, *Moringa concanensis*, *Psidium guajava*) of (1:2:3) (sterilized) were placed in intimate



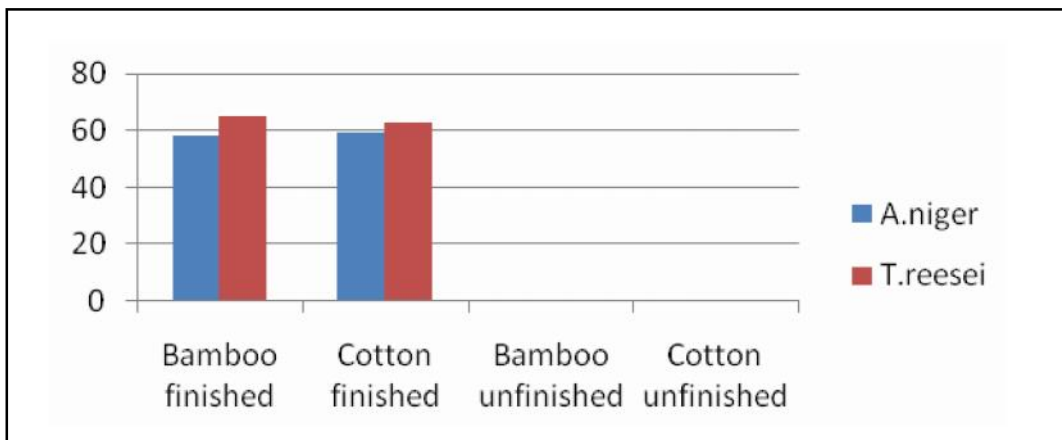
**Fig. 2 : Antibacterial activity by AATCC 147**

contact with Antifungal agar medium, which has been previously swabbed with broth suspension culture of test organisms *Aspergillus niger* (AATCC 6275) and *Trichoderma reesei* (ATCC 28020). After incubation, a clear area of uninterrupted growth underneath and along the side of the test material indicates antifungal effectiveness of the fabric.

From the above Table 2 and Fig. 3, it is evident that there is significant antifungal activity against *Aspergillus niger* and *Trichoderma reesei* in the herbal finished fabric when compared to Unfinished Organic cotton and Bamboo Knit Fabrics.

**Table 2 : Antifungal activity assessment by AATCC 30 - 2003 test method**

Sr. No	Fabric sample	Zone of inhibition (in mm)	
		<i>A. niger</i>	<i>T. reesei</i>
1.	Bamboo finished	58	65
2.	Cotton finished	59	63
3.	Bamboo unfinished	0	0
4.	Cotton unfinished	0	0



**Fig. 3 : Antifungal activity assessment by AATCC 30 - 2003 test method**

**Conclusion :**

Many new horizons are yet to be revealed in textiles and its application. Mere clothing has transformed to Functional textiles in the new arena. Also, research interest is focused on investigating the efficacy of new types of antibacterial that are permanently fixed on the fiber, controlling the multiplication of microorganisms even after many launderings. It is the call for the hour to discover antibacterial possibility of herbal products in fabrics. Therefore, textile finishes with added value, chiefly for medical clothes are significantly long-awaited and there is an increasing demand on global scale.

**REFERENCES**

- Heinrich, M. (2000). Ethnobotany and its role in drug development. *Phytotherapy Res.*, **14** : 479–488.
- Malik, T. and Parmar, S. (2008). Special finishes to garment an overview, [www.fibre2fashion.com](http://www.fibre2fashion.com) (5/04/2008).
- Mishra, S.P. (2000), A text book of fiber science and technology”, New Age International Pvt. Ltd., New Delhi, pp: 78-87.
- Pannu, Sunny (2013). Investigation of natural variants for antimicrobial finishes in innerwear - A Review Paper for Promotion of Natural Hygiene in Innerwear. *Internat. J. Engg. Trends & Technol.*, **4** (5) : pp: 2168,2170.
- Schindler, W.D. and Hauser, P.J. (2004). *Chemical finishing of textiles*. Wood Head publishing, England, pp. 165-172.
- Singh, S., Das, S. and Patil, S. (2001). Improving dye uptake of natural fibers. *The Indian Textile J.*, **CXII** (3) : 9.
- Thilagavathi, G. and Rajendrakumar, K. (2004). Development of ecofriendly antimicrobial finishes using herbs, *Indian J. Fiber & Textile Res.*, **30** : 431-436.
- Tusie, Muhammad Qamar, Amin, Nabeel, Mahmood, Nasir, Ahmad, Israr and Abbas, Mudassar (2015). Antimicrobial studies of knitted fabrics from bamboo, soybean and flax fibers at various blends. *J. Textile Sci. & Engg.*, **5** (3) :1-4.
- Waite, M. (2009). Sustainable textiles: the role of bamboo and a comparison of bamboo textile properties. *J. Textile Apparel Technol. & Management*, **6** :1-22.
- Zaheer, Zahid, Paithankar, Aniruddha P., Deshpande, Sagar D. and Khan, Subur (2011). Optimization of extraction process and phytochemical investigations of *Spathodea campanulata* flowers. *African J. Pharmacy & Pharmacol.*, **5** (20) : 2226-2231.

\*\*\*\*\*

Chena C, Chang W-Y (2007) Antimicrobial activity of cotton fabric pretreated by microwave plasma and dyed with onion skin and onion pulp extractions. *Indian J Fibre Text Res* 32:122-125. Google Scholar. 104.

Rathinamoorthy R, Udayakumar S, Thilagavathi G (2012) Antimicrobial efficacy of Terminalia Chebula fruit extract treated cotton fabric for healthcare applications. *Int J Pharm Sci Nanotechnol* 4:1549-1556. Google Scholar. 122.

The antimicrobial efficacy of the finished fabrics were evaluated by disc diffusion and parallel streak method. Wear study was conducted by converting the finished fabrics into baby cloth diaper and its effect was analyzed.

In the present project Bamboo and Cotton materials are compared on techno-economic basis and knitted materials are developed. End products are tested for the functional and aesthetic properties.

The sonochemical technique appears to be a suitable method for producing organic NPs of soluble compounds, without loss of their intrinsic properties, i.e. the antimicrobial activity of chitosan.

Materials and Methods: The research work has been imparted to analyze the efficacy of antimicrobial Bamboo fabrics are certainly a step up from polyester and conventional cotton, so as long as the brand is transparent about its origins, it can be a safe bet as a more sustainable option. While lyocell bamboo is likely a more sustainable alternative, it's harder to find. For some types of clothing, look for eco-friendly fabrics like organic hemp. In other cases, organic cotton or Tencel will be a better choice from the point of view of the environment, all other things being equal, especially the fabric dyeing process. We should know that the majority of products labelled as "bamboo" are actually