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ASSESSMENT OF ECO-FRIENDLY ANTIBACTERIAL TEXTILES OF HERBAL AND BIO POLYMER TREATED FABRIC

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ABSTRACT

In the present study, an attempt has been made to impart antibacterial finishes to the natural fabrics by using herbal and natural bio polymer. The eco friendly finish has been incorporated into bamboo-cotton woven treated fabric with *terminalia chebula* herbal extract and sericin is extracted from the cocoon degumming water, then both the Extractions was finished by pad-dry and cure method. The herbal extract and biopolymer was evaluated for activity against medically challenging bacteria such as *Staphylococcus aureus* and *Escherichia coli*. The *in-vitro* antibacterial was performed by AATCC 147 for the treated sample. Then the coated sample was analyzed for morphology using FTIR and FESEM test.

KEYWORDS: Bamboo-Cotton fabric, *Terminalia chebula* extract, natural biopolymer, Antibacterial finish.

1. INTRODUCTION

Clothing plays a considerable role in an individual's life at all the ages as it provides a medium of self-expression, a way to conform and a way to suggest wealth and prestige and an outlet for creative energy (Bajwa, 2011). Textiles have such an important bearing on our daily lives that everyone needs to know something about textiles. From earliest times, people have used textiles of various types for covering, warmth, personal adornment and even to display personal wealth. Textiles are still used for these purposes and everybody is ultimate consumers (Thomas, 2006).

Wearing organic clothing is as important as having organic food. Bamboo is one such organic clothing that is gaining in popularity. Bamboo textiles are cloth, yarn and clothing made out of bamboo fibers Naveen (2009). Cotton is abundant and its mechanical properties are well suited for garment production. It is easy to care for and takes well to bleaching (Mudnoor and Laga, 2012).

Cellulase enzymes are used in the scouring, desizing, bleaching, and finishing phases of the textile manufacturing process. The enzymes are used to reduce fabric fuzziness, soften fabric, remove color for special effects and for the removal of neps (Blanchard and Graves, 1995).

Plants are a sustainable source of medicinal products especially in traditional medical practices. Plants contain active substances such as alkaloids, tannins etc., produced during their secondary metabolism which serve as a potential reservoir of medicinal products (Croteau et al 2000). *Terminalia chebula* is an important medicinal plant in Indian traditional medicine and it is most frequently used herb in Ayurveda. The fruit of *terminalia chebula* is consider as the "king of medicines" by Tibetans and second-to- none by ayurvedic apothecaries and also held in high regard by other folk medicinal practitioners.

Biopolymers are polymers that are generated from renewable natural sources, are often biodegradable and non toxic to produce. Biopolymers can be derived from microbial systems, extracted from higher organisms such as plants, or synthesized chemically from basic biological building Harshakharkwal (2017). Sericin is a protein produced by the silkworm, bombyxmori, a holometabolous insect belonging to the lepidoptera order and bombycidae family. The silk thread used in the production of the cocoon, structure that provides the ideal conditions for the occurrence of larval metamorphosis to adults C. Kundu (2008).

2. MATERIALS AND METHODS

Plain weave with 30’s count of bamboo/cotton having the specification with 50:50 blends. Then the grey sample were immersed in boiling water for 20 minutes and dried to remove the starch and impurities. Then the sample was treated with commercial enzyme (cellulase) with 50 ml of 0.1 M phosphate buffer (PH 7.0) level.

2.1 Processing and extraction of natural biopolymer- sericin (Gulrajani *et al.*, 2009)

The cocoons were cleaned in the boiling water and used for the preparation of sericin solution. Cocoons were cut into small pieces for extraction and to about 1 gram were used. Cocoons were mixed in the ratio of 1:40 (sodium carbonate (1.06%) and sodium bi carbonate (0.84%)). The solution was boiled at 100ºC for 1 hour and fibroin was removed by filtration using Whatmann No. 1 filter paper. The extract was precipitated with three volumes of ice-cold ethanol and incubated the solution at 4ºC for overnight. After incubation, the solution was centrifuged at 5000 rpm for 15 minutes. The resultant pellets were collected and dissolved in the distilled water.

2.2 Collection, Processing and extraction of *Terminalia chebula* (Lee, 2017)

The herbal extract selected for the present study was *terminalia chebula* which was collected in and around of Coimbatore. The collected dry fruits were shade dried at room temperature to reduce the moisture content present in the dried fruit of *terminalia chebula.* The dried fruits were then powdered and sieved. For extraction 10gms of dry powder was taken and mixed into 50ml of 80% ethanol. The container was closed and kept overnight. After overnight incubation, the extract was filtered through filter paper and evaporated at room temperature upto 15 ml, inorder to concentrate the extract. This ethanol extract was then finished with bamboo/cotton fabric by pad dry cure method.

2.3 Antibacterial assessment of finished bamboo/cotton fabric 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/ cotton bleached fabrics 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 37ºC for 24 hours. At the end of incubation, zone of incubation formed around the fabric was measured in millimeter and recorded.

2.4 Instrumentation

The surface morphology of treated natural bio polymer and herbal treated samples was observed in FESEM and the chemical composition of the fiber from treated fabrics was studied.

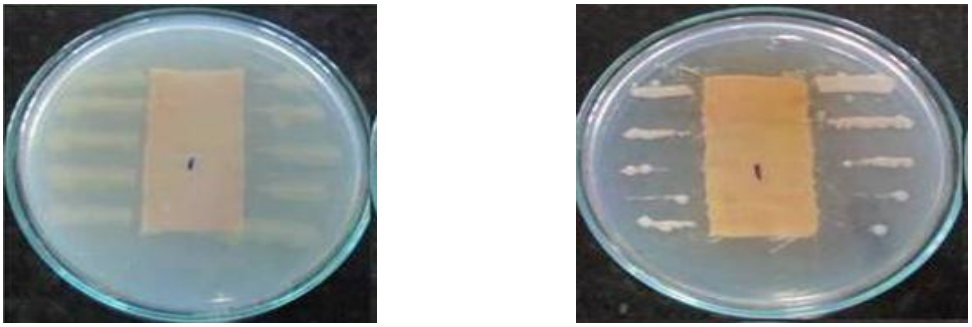
3. RESULTS AND DISCUSSION

3.1 Assessment of Antibacterial activity of finished fabric by AATCC 147

The finished fabric was assessed for the antibacterial activity by AATCC 147 test against *Staphylococcus aureus* and *Escherichia coli* and tabulated in table 1.

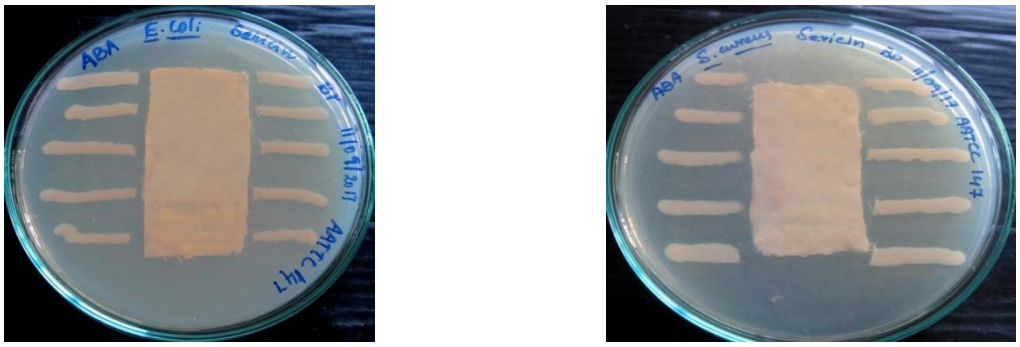
S. no.	Sample	Zone of inhibition (mm)	
		E. coli	***S. aureus***
1	Herbal finished fabric with *Terminalia chebula*	47	43
2	Biopolymer finished fabric with sericin	33	32

Table-1 Shows the activity against *Staphylococcus aureus* and *Escherichia coli.*



E. coli ***S. aureus***

Figure 1: Antibacterial Activity by AATCC 147 for herbal treated sample.



E. coli ***S. aureus***

Figure 2: Antibacterial Activity by AATCC 147 for natural biopolymer treated sample.

The above photograph shows the good zone of inhibition of treated herbal and biopolymer fabrics. The zone of inhibition for the treated sample with ethanolic extract of *Terminalia chebula* shows 43 mm for *Staphylococcus aureus* and 47 mm for *Escherichia coli.* Whereas, for biopolymer treated sample shows 32 mm for *Staphylococcus aureus* and 33 mm for *Escherichia coli* respectively.

3.2 FTIR and FESEM analysis

The FTIR spectra of *Terminalia chebula* herbal finished fabric is shown in figure-3&4 and FESEM picture is given in figure 5 and 4.

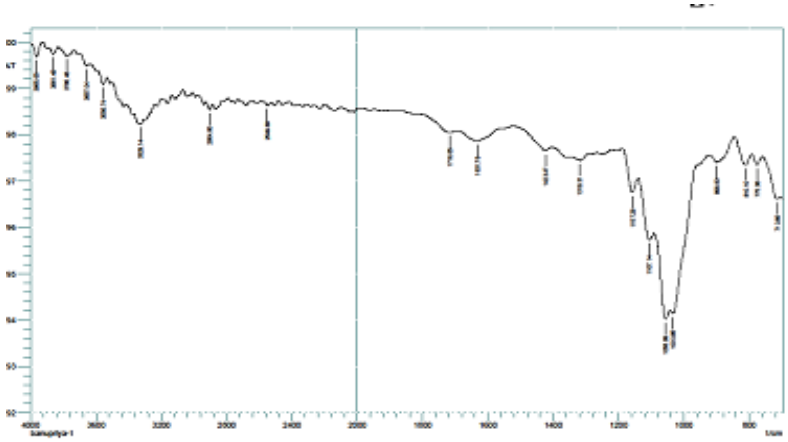


Figure 3: FT-IR analysis of *Terminalia chebula* herbal finished fabric.

The peak of FTIR area within the region of the band at 3331.32, 2922.65 and 1632.96 signifies the existence of functionsl groups such as carbonyl (amide; N-H stretch), organic (alkane; C-H stretch), organic (alkene; C=C stretch), carbonyl (amide; N-H bending), organic (nitro compounds; N-O stretch), carbonyl (acid; C-O streth), organic (alkene,=C-H bending). It is described that the presence of O-H, C-H, C=C 121 and C-O functional groups in the isolated compound from the ethanolic extract of *terminalia chebula* in the presence of phenolic group. These bond forming phenomena are an indication of the removal of hemicellulose, pectin and part of lignin from bamboo and cotton fibers.

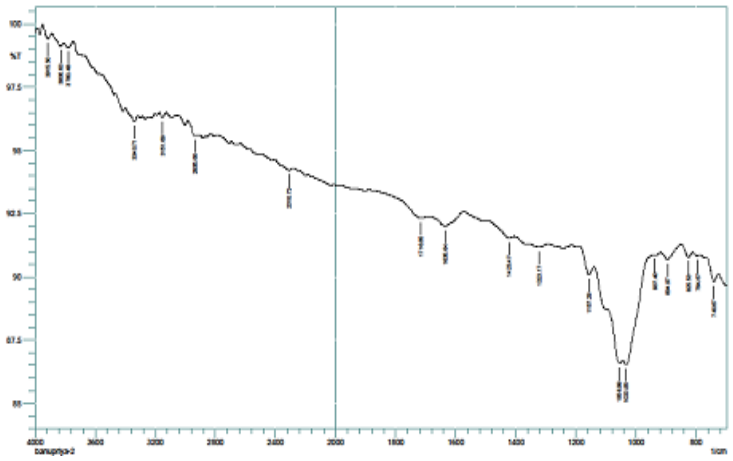


Figure 4: FT-IR analysis of biopolymer finished fabric.

The FTIR analysis of the bamboo/cotton woven fabric was carried out to determine the modifications in the chemical groups upon finishing the bamboo/cotton woven fabric with the natural biopolymer treated sample. This technique provides information about the chemical bonding or molecular structure of materials present in the fabric specimen. The results showed peaks at wavelength of 616.40, 665.82, 1113.64, 1163.19, 1235.75, 1318.16, 1337.44, 1372.43, 1430.23, 1637.88 and 2901.14 cm -1.

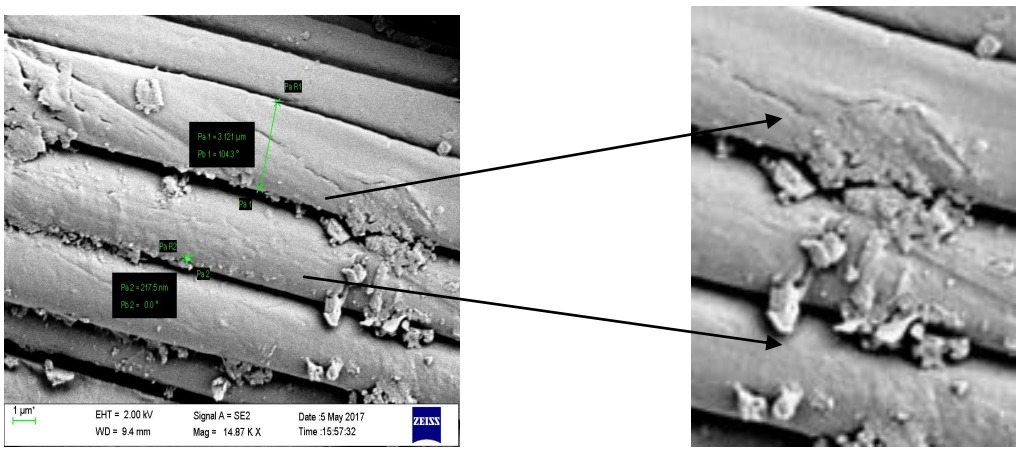


Figure 5: FESEM analysis of *Terminalia chebula* finished fabric.

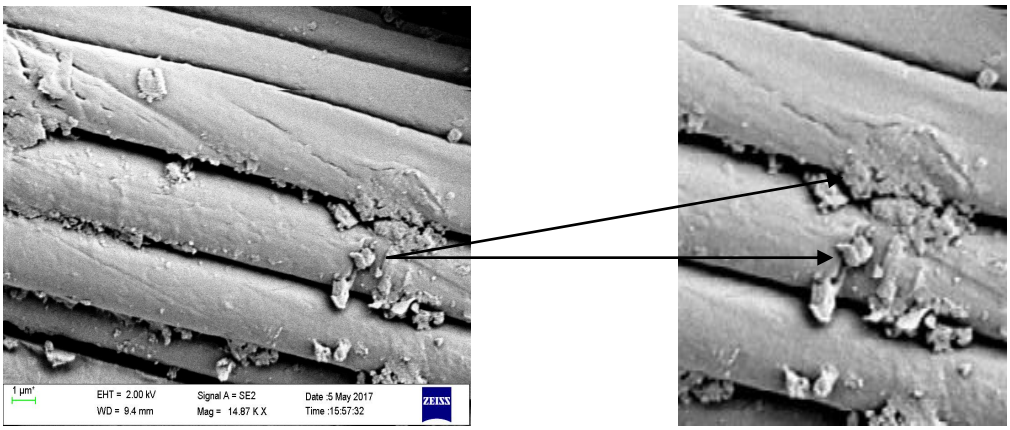


Figure 6: FESEM analysis of natural biopolymer treated fabric.

The above figure-5 gives the presence of *terminalia chebula* coated in the bamboo/cotton woven fabric falls in 1µm and it is firmly attached to the fiber with even distribution. Whereas, in figure-6 gives the presence of sericin biopolymer coated in the bamboo/cotton woven fabric falls in 1µm respectively.

4. CONCLUSION

Thus from the findings, the application of textile material which is to produce durable antibacterial effect using the extract t*erminalia chebula* and natural biopolymer treated

bamboo/cotton woven fabric is more apt. It is also considered as eco-friendly treatment since it uses only herbs and wastage of biopolymer which is treated in textile application. This work can be helpful in the development of low cost eco friendly healthcare products.

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