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A Study on Antibacterial Activity of The Medicinal Herb And Biopolymer Extract for Textile Application

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ABSTRACT

The healthcare and sanitation textiles are gaining more consequence for their eco-friendly and effective nature. Nowadays, there is a new importance on the textile industry with the spirit of new technologies that could add superior properties to the fabrics, there have been noteworthy improvements in technology for ecofriendly antibacterial property that have become crucial to safeguard human beings from harmful microorganisms. The aim of the present work was to asses an eco-friendly finish obtained from herbal and biopolymer extract. The herbal ethanolic extract of *Tinosporacordifolia* and sericin extraction of cocoon from silk worm were used for better antibacterial effect. The extracts were treated onto 30's combed bamboo/cotton woven fabric using a pad-dry-cure method. The antibacterial activity was assessed using Agar Diffusion Method against Gram Positive organism (*Staphylococcus aureus*) and Gram Negative organism (*Escherichia coli*). The *in-vitro* antibacterial analysis was performed for AATCC 147. The samples were imparted with herb and biopolymer showed best results for antibacterial activity against microbes even after 30 washes. The finished sample was analyzed for its morphology using FESEM. Physical parameters like abrasion resistance and tearing strength of controlled and finished bamboo/ cotton fabric were also analyzed.

***KEY WORDS*:** herbal extract, biopolymer extract, antibacterial activity. Wash durability.

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1. INTRODUCTION

Clothes go a long way in satisfying simple or complex emotional needs and can be used consciously or unconsciously to convey subtle or overt messages[1]. Textiles were first developed as a means for carrying food, as mats in shelters and later used as clothing. Nowadays the quality of our lives has greatly improved with the use of green products that are made from natural raw materials. Eco-friendly products are highly beneficial to health as well as environment[2].

Bamboo textile products are having high demand in the market because of their anti bacterial nature, biodegradable properties, high moisture absorption capacity, softness and UV protective capability[3].Cotton is called as "King of fibers" and is composed of highly preferred conventional and versatile natural cellulosic fiber in the array of the world textile economy. It is known for its fascinating feel, comfort and versatility[4].

The reiterate that plain weave has simplest possible pattern and maximum possible frequency of interlacement of yarns and is not easily displaced giving firmness to the fabric thereby resisting slippage of yarns[5]. Clothing being an important need for human life protects us from various infections and other external stimulus factors. Hence, functional textiles with an ideal antimicrobial finish can bring about an effective, durable and compatible multidimensional biotextile. Several studies showed that fabric is more susceptible to microbial attack[6].

Tinosporacardifolia is a large deciduous climbing shrub found throughout India. The ayurvedic name of the plant is Guduchi, Giloy or Amrita. In India, the extract of the plant is used as a remedy for many diseases including diabetes, hepatitis etc., The plant finds a special mention for its use in tribal or folk medicine in different parts of the country. The drug has been subjected to extensive phytochemical, pharmacological and clinical investigations and many interesting findings[7].

Sericin is a protein produced by the silkworm, Bombyxmori, a holometabolous insect belonging to the lepidoptera order and bombycidae family. The recovery of silk sericin from degumming liquor or waste cocoons not only helps to reduce the environmental pollution but also is highly desirable as the recovered sericin has a lot of commercial value finding application[8].

From the findings, ethanolic extract of *Tinosporacordifolia* herbal extract and sericin biopolymer extraction has been reported against microbial infection. Some studies reported *Tinosporacordifolia*can be a potential dietary component which can help in prevention of different disease. Due to unawareness many silk producers and processors are still discarding this valuable sericin as it is in the effluent.

2. MATERIALS AND METHODS

In the present research 30's combed bamboo/cotton woven fabric with 50:50 blends was used. Then the grey sample was immersed in hot water for 20 minutes and dried out to remove the starch and other impurities. Then the sample was treated with commercial enzyme (cellulase) and with 50 ml of 0.1 M phosphate buffer (PH 7.0) level to scour and bleach the fabric.

2.1 Collection, Processing and Extraction of the herb Tinosporacordifolia

The herbal extract selected for the present study was *Tinosporacordifolia*which was collected in and around Coimbatore. The collected fresh leaves were shade dried at room temperature (20^{o}c) to reduce the moisture content present in the leaves of *Tinosporacordifolia*. The dried leaves were then powdered and sieved. For extraction, ten grams of herbal 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 to concentrate the extract. This ethanol extract was then finished with bamboo/cotton fabric by pad dry cure method.

2.2 Extraction of sericin from cocoons

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 around one gram was used. Cocoons were mixed in the ratio of 1:40 with (sodium carbonate (1.06%) and sodium bi carbonate (0.84%)). The solution was boiled at 100 ºC for one 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 the solution was incubated at four degree Celsius for overnight. After incubation, the solution was centrifuged with 5000 revolutions per minute for 15 minutes. The resultant pellets were collected and dissolved in the distilled water. The process is shown in **(Figure-1)**.

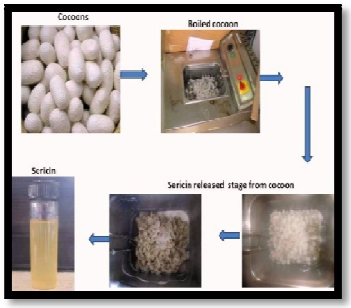


Figure-1: Extraction of sericin from cocoon

2.3 Application of selected herbs by Pad-Dry Cure Method

The extract was finished on the bamboo/cotton fabric using padding mangle. Padded the sample with the three roll padding machine for five minutes. After padding, the samples were dried and cured.

Recipe

Herbal extract - 10% of the fabric weight

Material liquor ratio - 1: 10

Temperature - Room Temperature

Wet pickup - 75% of the fabric weight

Duration - 5 minutes

Procedure

The samples were padded with 10 grams of the selected herbal extract and biopolymer at room temperature for five minutes and dried. Then the finished samples were tested for their Antibacterial activity **(Figure-2).**

Figure-2: Padding mangle

2.4 Evaluation of the fabric finished with Antibacterial Herbal and Biopolymer Extracts (AATCC -147)

The herbal coated fabric and biopolymer were tested as per AATCC (American Association of Textile Chemist and colourist) standards of qualitative methods. The herb and biopolymer coated fabrics were ascertained by qualitative test as recommended by AATCC method standards Agar Diffusion methods (SN19592) using Gram Positive organism (*Staphylococcus aureus*) and Gram Negative organism (*Escherichia coli*). The test dishes were removed from the incubator and were assessed for zone of incubation. This assessment was made by visual examination as well as under the microscope with 40X enlargement. Analysis was made on the basis of presence or absence of bacterial growth which is termed as zone of inhibition after 18-24 hours.

2.6 Characterization using FESEM

The surface topography of the antibacterial finished samples were observed using Fourier transmission scanning electron microscopic (FESEM).

2.6Physical and functional testing of Controlled and finished samples

Abrasion resistance tester

For textile application abrasion resistance is used to find out the ability of a fabric to resist surface wear caused by flat rubbing contact with another material.

Air permeability tester ($cm^3/cm^2/s$)

The air permeability of a fabric is a measure of how well it allows the passage of air through it. Permeability is dependent upon the porosity of the fabric. The porosity is largely determined by the tightness of the fabric weave.

3. RESULTS AND DISCUSSION

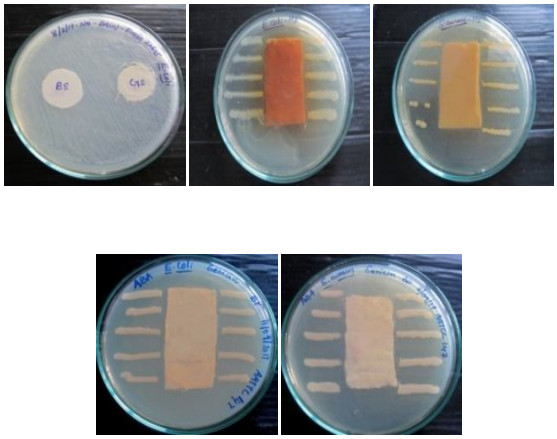
Antibacterial activity of herb and biopolymer extracts

Table-1: Antibacterial activity of herbal extract and biopolymer extraction

Sl. no	Fabric Samples	Zone of inhibition (mm)	
		Escherichia coli	***Staphylococcus aureus***
1	Controlled Sample	0	0
2	*Tinosporacordifolia*herbal extraction	34	32
3	*Sericin* biopolymer extraction	32	33

From the assessment, herbal coated sample and biopolymer sample which showed the zone of inhibition were screened and selected based on the results shown in Table- 1.Among the treated samples, the finished sample with the herb ***Tinosporacordifolia***extract showed inhibition zone of 34 mm and 32 mm against *Escherichia coli* and *Staphylococcus aureus* respectively. Whereas, the sample finished with **sericin** extraction showed an inhibition of 32mm and 33mm against *Escherichia coli* and *Staphylococcus aureus.*

Figure-3



1- Controlled Sample 2 –*Tinosporacordifoli(Escherichia coli)* 3 -*Tinosporacordifolia (Staphylococcus aureus)* 4 -sericin*(Escherichia coli) and* 5 -sericin (*Staphylococcus aureus*).

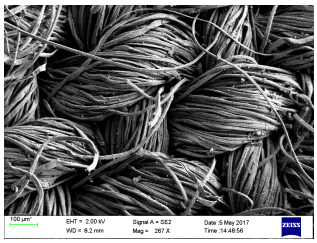
Table-2:Wash durability of Herbal Biopolymer treated fabric samples

Sl.no	Fabric samples	Zone of inhibition (mm)			
		***Tinosporacordifolia*h erbal extraction**		**Sericin biopolymer extraction**	
		E.coli	***S.aureus***	***E.coli***	***S.aureus***
1	Before wash	34	32	32	33
2	After 10 washes	32	30	29	31
3	After 20 washes	28	27	27	28
4	After 30 washes	0*	0	0*	0

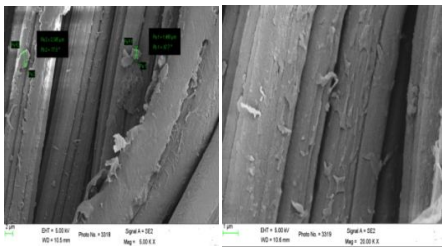
From the above table-2, it was clearly seen that the finished samples with herbal extraction showed antibacterial activity with the zone of inhibition of 34mm and 32mm whereas the sericin biopolymer extraction showed 32mm and 33mm against *Escherichia coli* and *Staphylococcus aureus* respectively. After ten and twenty washes, the washed samples for both herbal and biopolymer extraction samples showed reduction zone of inhibition. Whereas, the samples after thirty washes showed no growth beneath the fabric against *Escherichia coli* for both the samples and no growth against *Staphylococcus aureus*micro organisms.

Characterization of FESEM samples

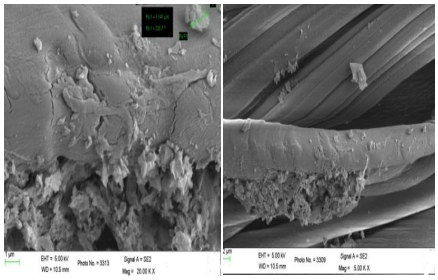
Figure-4 and 5 Characterization of FESEMControlled Sample



***Tinosporacordifolia* herbal coated appearance**



Sericin biopolymer coated appearance



In Figure-4 and 5 shows the Fourier transmission scanning electron microscopic image of Controlled Sample and antibacterial finish on bamboo/cotton woven fabrics with herbal *Tinosporacordifolia*and biopolymer sericin extraction. The Controlled Sample showed no deposition in the inner surface of the fabric. Whereas, the *Tinosporacordifolia*and biopolymer sericin extraction deposition was seen clearly on the inner surface of the fabric.

From the results table-3, there was a slight difference in controlled and finished fabric samples with herbal and biopolymer extraction for before and after abrasion resistance.

Table-3: Abrasion resistance tester

S.No	Abrasion resistance (gms)					
	Controlled sample		Herbal coated sample		Biopolymer coated sample	
	Before	After	Before	After	Before	After
1	0.210	0.205	0.235	0.235	0.230	0.225
2	0.208	0.200	0.240	0.235	0.235	0.230
3	0.210	0.202	0.245	0.240	0.240	0.235
4	0.213	0.205	0.255	0.250	0.245	0.240
5	0.215	0.207	0.240	0.235	0.230	0.225

Air permeability tester ($cm^3/cm^2/s$)

Table-4

Sl.No	Air permeability ($cm^3/cm^2/s$)		
	Controlled Sample	Herbal coated sample	Biopolymer coated sample
1	240	243	242
2	240	233	237
3	235	236	241
4	220	238	240
5	230	236	235

The herbal and biopolymer coated Sample showed an increase in Air permeability when compared with the Controlled sample.

4. CONCLUSION

Thus, from the results obtained, it can be concluded that function of antibacterial finish on bamboo/ cotton fabrics by using herbal and biopolymer extract improved antibacterial properties to a greater extent thus leading to excellent protection. The protein sericin and herbal extracted *Tinosporacordifolia*gives good antibacterial activity and less cost process for the industries applying as finish. The two samples showed good wash durability till 20 washes. As these materials are natural it does not cause allergic reaction, eco sensitiveness and the effluent discarded after the finish has very low pollutants thus the process becomes completely eco friendly.

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