



ISBN	978-81-929866-6-1
Website	icsscet.org
Received	25 – February – 2016
Article ID	ICSSCET024

VOL	02
eMail	icsscet@asdf.res.in
Accepted	10 - March – 2016
eAID	ICSSCET.2016.024

## Effect of Herbal Extraction for Antibacterial Finish for the Development of Knitted Fabrics

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**Abstract:** For eco-friendly antibacterial finish, based on the literature survey ten herbs were selected to finish 100% cotton, 100% bamboo and 50:50 bamboo/cotton single jersey knitted fabrics, for sportswear. The selected herbs were shade dried and ground into fine powder, using methanol, herbal extracts were prepared. Dip dry method has been carried out to finish the selected fabrics with herbal extracts for antibacterial finish. Evaluation of antibacterial finished fabrics were carried out by ENISO 20645 test method, based on the results three herbs namely *Azadirachtra indica* (Neem), *Leucas aspera* (Thumbai), *Acalypha indica* (Kuppaimani) were selected for further study. Microcapsules were developed for the three selected herbs and applied on the selected fabrics using Exhaust method. Microencapsulated antibacterial finished fabrics were assessed by AATCC 100-2004 test method to select best one herb among three. Among all samples, *Azadirachtra indica* (Neem) finished fabrics shows higher percentage of bacterial reduction. Hence, it was selected for further study. Optimization of concentration for *Azadirachtra indica* (Neem) extract at 4%, 6% and 8% has been carried out. Among all the samples, *Azadirachtra indica* (Neem) finished at 6% concentration shows higher percentage of bacterial reduction. Hence, 6% of *Azadirachtra indica* (Neem) was selected for antibacterial finishing.

**Keywords:** 100% cotton, 100% bamboo and 50:50 bamboo/cotton, Antibacterial finish, Herbs, *Azadirachtra indica* (Neem), Microencapsulation, ENISO 20645 test method and AATCC 100-2004 test method.

### Introduction

'Eco-friendly' refers the friendly relationship between humans and their habitats. In other words, humans taking good care of the environment in which they live. Today, in order to protect the environment, the consumers have turned towards eco-friendly clothing. Clothing is generally relied upon as a source of protection factor. In today's world, naturally renewable resources are increasingly being required as a result of human dedication to protect environment. Bamboo fiber is a new regenerated cellulose fiber, created from the bamboo tree. Bamboo does not require any pesticides or chemicals and is also biodegradable [1].

The well-known characteristics of bamboo material is its antibacterial, coolness, pleasant luster, better drape and comfortable soft feel. Regenerated bamboo fibers have high demands in market and are being used in apparels including underwear, T-shirt, sports textiles, socks, towels, bathing suits, sanitary napkins, absorbing pads, bandages and surgical gowns [2].

Cotton is the backbone of the world's textile trade. It is also known as "King of fiber" and "White gold". Due to its unique fiber structure it can absorb water up to 2.7 times of its own weight. Cotton is good in preventing the loss of body heat to allow sweat to pass through it to the outside atmosphere. Cotton is a non- allergic natural fiber that doesn't irritate sensitive skin.

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**Cite this article as:** P C Jeminarani, Dr N Vasugi Raaja. "Effect of Herbal Extraction for Antibacterial Finish for the Development of Knitted Fabrics". *International Conference on Systems, Science, Control, Communication, Engineering and Technology 2016*: 118-121. Print.

Herbs are any plants used for flavoring, food, medicine or perfume. Culinary use typically distinguishes herbs as referring to the leafy green parts of a plant, from a "spice", a product from another part of the plant, including seeds, berries, bark, roots and fruits [3].

Finishing is used to manipulate the appearance, characteristics, performance and hand of a fabric. Antibacterial finishing of textile material aims to protect the users from pathogenic microorganisms and from unpleasant odors generators. Most antibacterial compounds are extracted from plants, being represented by phenolics and polyphenols, terpenoids, essential oils, alkaloids, lectins, polypeptides or polyacetylenes [4].

The consumers are now increasingly aware of the hygienic life style and there is a necessity and expectation of a wide range of textile products finished with antimicrobial properties. Many commercial products are currently available in the market, such products are synthetic based and may not be environment friendly. There are many natural herbal products which shows antimicrobial properties [5].

### Selection of Herbs for Antibacterial Finish

Ten herbs possessing antibacterial property were selected for the preliminary study. Literature study showed that the following herbs namely *Azadirachtra indica* (Neem), *Tridax procumbens* (Mexican daisy), *Achyranthes aspera* (Prickly chaff), *Acalypha indica* (Kuppaimani), *Ocimum sanctum* (Tulsi), *Leucas aspera* (Thumbai), *Aole barbadensis* (Aolevera), *Punica granatum* (Pomegranate rind), *Tagetes stannes* (Yellow bell) and *Bixa orellana* (Annatto seed) having antibacterial activity and hence the above said herbs were selected for the study.

### Extraction of Herbs and Finishing of Fabrics

The selected 10 herbs for antibacterial finish were dried and ground in to fine powder. Using methanol the extraction was prepared. The selected fabrics namely 100% cotton, 100% bamboo and 50:50 bamboo/ cotton were finished using dip dry method.

### Evaluation of Antibacterial Finished Fabrics

Evaluation of 10 antibacterial finished samples each for the selected 10 herbs were carried out qualitatively, according to ENISO 20645 test method. The following microbes *Staphylococcus aureus* and *Escherichia coli* were selected as test organisms for this study. The finished samples were examined for the zone of bacterial inhibition around the fabric samples. The size of the clear zone of bacterial growth inhibition around the finished samples were evaluated which has the inhibitory effect of the herbal extract. The results of antibacterial finished fabrics with selected 10 herbs were given in the table 1.

Table 1 Analysis of herbs for antibacterial activity

S.No.	Herbs	Antibacterial activity zone of bacteriostasis(mm)					
		<i>S.aureus</i>			<i>E.coli</i>		
		C	B	A	C	B	A
1	<i>Azadirachtra indica</i> (Neem)	22	22	22	22	22	22
2	<i>Tridax procumbens</i> (Mexican daisy)	0	0	0	0	0	0
3	<i>Achyranthes aspera</i> (Prickly chaff)	0	0	0	0	0	0
4	<i>Bixa orellana</i> (Annatto seed)	0	0	0	0	0	0
5	<i>Acalypha indica</i> (Kuppaimani)	22	22	22	22	22	22
6	<i>Ocimum sanctum</i> (Tulsi)	0	0	0	0	0	0
7	<i>Leucas aspera</i> (Thumbai)	0	22	22	0	22	22
8	<i>Aole barbadensis</i> (Aolevera)	0	0	0	0	0	0
9	<i>Punica granatum</i> Linn (Pomegranate rind)	0	0	0	0	0	0
10	<i>Tagetes erecta</i> (Marigold)	0	0	0	0	0	0

0\* - Bacterial growth under the test fabric.

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### Selected Three Herbs for Antibacterial Finish

Among all the selected herbs, *Azadirachtra indica* (Neem), *Acalypha indica* (Kuppaimani) and *Leucas aspera* (Thumbai) shows higher rate of bacterial reduction against *S.aureus* and *E.coli*. Hence, these herbs were selected for further study.

### Development of Microcapsules for the Selected Three Herbs for Antibacterial Finish

Microcapsules were developed for the selected herbs namely, *Azadirachtra indica* (Neem), *Acalypha indica* (Kuppaimani) and *Leucas aspera* (Thumbai) extract separately for antibacterial finish.

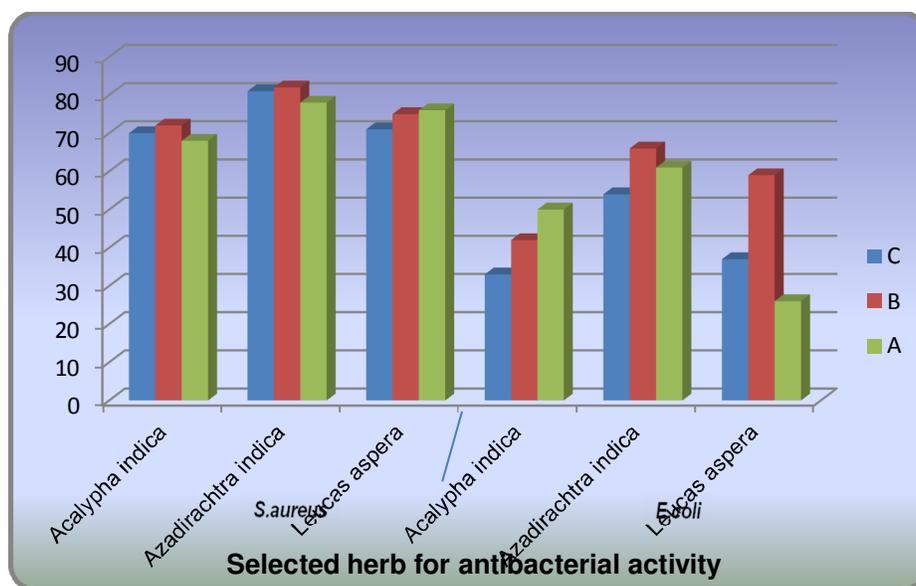
### Application of Microencapsulated Herbs on Knitted Fabrics by Exhaust Method

Exhaust method was selected for the application of microencapsulated herbs on selected fabrics namely 100% cotton, 100% bamboo and 50:50 bamboo/cotton blend.

### Quantitative Assessment of Antibacterial Activity of Microencapsulated Finished Fabrics

Quantitative assessment of antibacterial activity of microencapsulated finished fabrics such as 100% cotton, 100% bamboo and 50:50 bamboo/cotton were carried out by AATCC 100-2004 test method. The following Figure 1, discuss about the bacterial reduction on selected knitted fabrics finished with herbs namely *Acalypha indica* (Kuppaimani), *Azadirachtra indica* (Neem) and *Leucas aspera* (Thumbai).

Figure 1 Assessment of antibacterial activity of microencapsulated finished fabrics



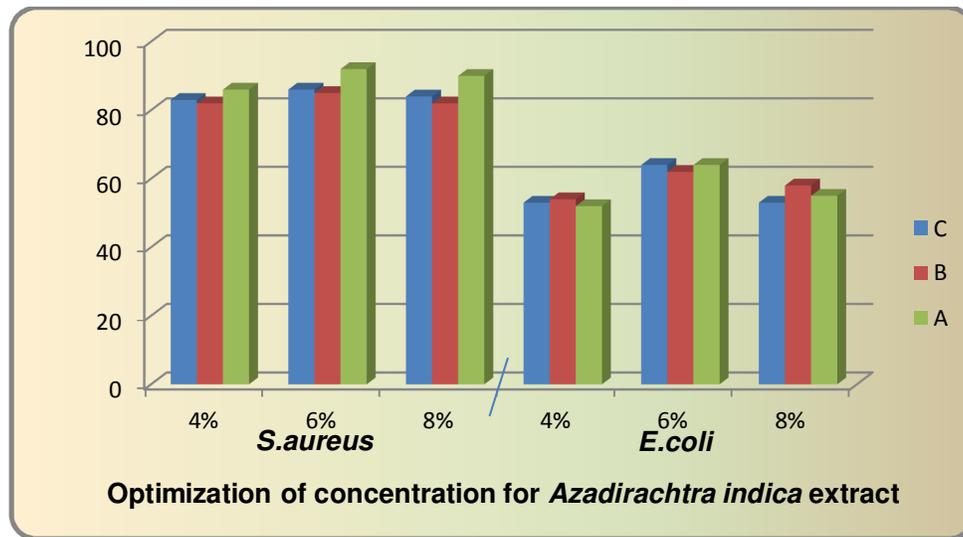
From the result it was concluded that, *Azadirachtra indica* (Neem) finished fabrics namely 100% cotton, 100% bamboo and 50:50 bamboo/cotton shows bacterial reduction of 81%, 82% and 78% against *S.aureus* and 61%, 66%, 54% against *E.coli* respectively. *Acalypha indica* (Kuppaimani) finished fabrics shows bacterial reduction of 70%, 72% and 68% against *S.aureus* and 33%, 42%, 50% against *E.coli* respectively. *Leucas aspera* (Thumbai) finished fabrics shows bacterial reduction of 71%, 75% and 76% against *S.aureus* and 37%, 59% and 26% against *E.coli* respectively. Among three herbs *Azadirachtra indica* (Neem) shows higher percentage of bacterial reduction. Hence, *Azadirachtra indica* (Neem) was selected for further study.

### Optimization of Concentration for Antibacterial Finishing Extract

Optimization of concentration was carried out for the microencapsulated finished fabrics with *Azadirachtra indica* (Neem) at 4%, 6% and 8% concentrations on 100% cotton, 100% bamboo and 50:50 bamboo/Cotton single jersey knitted fabrics.

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Figure 2 Optimization of concentration for antibacterial finishing extract



From the above Figure 2, it was concluded that the selected fabrics namely 100% cotton, 100% bamboo and 50:50 bamboo/cotton finished with 4% *Azadirachtra indica* (Neem) shows bacterial reduction of 83%, 82% and 86% against *S.aureus* and 53%, 54% and 52% against *E.coli* respectively. *Azadirachtra indica* (Neem) finished at 6% concentration shows bacterial reduction of 86%, 82% and 92% against *S.aureus* and 64%, 62% and 58% against *E.coli* respectively. *Azadirachtra indica* (Neem) finished at 8% concentration shows bacterial reduction of 84%, 82% and 90% against *S.aureus* and 53%, 58% and 55% against *E.coli* respectively. Among all the samples, fabrics finished with *Azadirachtra indica* (Neem) at 6% concentration shows higher percentage of bacterial reduction. Hence, 6% of *Azadirachtra indica* (Neem) was selected for this study.

### Conclusion

Ten herbs were selected for antibacterial finish. Methanol was used for the extraction of selected herbs. The developed three single jersey fabrics were finished with herbal plant extracts by dip dry method and analysis of antibacterial property was done qualitatively following ENISO 20645 test methods. Among the ten herbs for antibacterial finish, the three herbs namely *Azadirachtra indica* (Neem), *Acalypha indica* (Kuppaimani) and *Leucas aspera* (Thumbai) shows zone of bacterial inhibition. Hence, these three herbs were selected for antibacterial finish. Microcapsules were developed for the three selected herbs and applied on 100% cotton, 100% bamboo and 50:50 bamboo/cotton fabrics using Exhaust method. Microencapsulated fabrics were assessed by AATCC 100-2004 test method to select best one herb among three. Among all samples *Azadirachtra indica* (Neem) finished fabrics shows higher percentage of bacterial reduction. Hence, *Azadirachtra indica* (Neem) was selected for antibacterial finishing.

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