

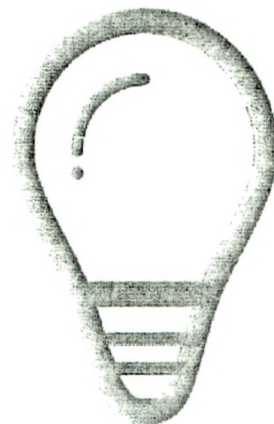
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“RESEARCH HIGHLIGHTS by AVINSAHILINGAM UNIVERSITY”

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Editors

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# ANTIMICROBIAL FINISHING ON COTTON FABRIC WITH *MENTHA SACHALINENSIS* STEM EXTRACT

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## ABSTRACT

A natural antimicrobial finish has been prepared from the *Mentha sachalinensis* (Mint) stem extracts for textile application. To determine suitable solvent for extraction various methods such as ethanol, methanol, and aqueous were used. Similarly to optimize the concentration, time and temperature for the finish of the fabric, pilot study was carried out. The herbal source have been applied to cotton fabric by the method of Ultrasonic Automiser, Padding mangle and Dip and dry. All the treated samples had excellent general appearance and exhibit good physical, mechanical, comfort and absorbency properties. Moderate to fair washing fastness was noted. The surface morphological studies using SEM and FTIR showed the surface coating and active compounds of the extracts respectively. The results of the study proved that the *Mentha sachalinensis* (mint) stem extracts to have good antimicrobial activity suitable for textile finishing.

**Keywords:** anti microbial, *Mentha sachalinensis*, ultrasonic automiser, surface modification.

## Introduction

Textiles have always played a central role in the evolution of human culture. From earliest times, people have used textiles of various types for covering, warmth, personal adornment, and even to display personal wealth, and are still used for these purposes and everyone is an ultimate consumer, (Singh, 2008). Today, the consumers are increasingly aware of the hygienic life style, and there is an expectation for a wide range of textile products with functional

properties (Ramachandran et al 2004). The protective aspects of textiles have provided the ground for innovative developments (Aswini et al., 2010).

Clothing normally used is prone to microbial attack because of higher amount of surface area and presence of moisture (Kavitha et al, 2007). Growth of microbes on textiles during use and storage negatively affects the wearer as well as the textile itself (Zahid Zaheer et al, 2010). Microbes are the tiniest creatures that cannot be seen with the naked eye. They include a variety of microorganism like bacteria, fungi, algae, and viruses. The activity which affects the microbes is known as antimicrobial.

Fabrics treated with antimicrobial finishing prevent the bad odour by preventing the growth of bacteria and fungi which causes the body odour. The finish has excellent potential in various textile uses like inner wears, house hold articles and baby care products. Even though many products have been introduced in the market, still there is very good scope for the textile researchers and manufactures in this field.

The antimicrobial agent works either by the slow release of the active ingredient or by surface contact with the microbes. The general name "antimicrobial finish" is given to all types of finishing agents that kill off fungi and bacteria or inhibit growth and thus have disinfecting properties (Kumar, 2013).

Antimicrobials of plant origin have enormous therapeutic potential. They are effective in the treatment of infectious diseases, while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials. Researchers are increasingly turning their attention to the medicinal plants and it is estimated that, plant materials are present in or have provided the models for 25–50 per cent western drugs.

Various standards have been set by the American Association for Testing Chemicals and Colourist AATCC 100 and AATCC 147 to assess antimicrobial effect. Considering the need and standards put forth for textile products, present study has been carried out with the following objectives to:

- determine the antimicrobial effect of *Mentha sachalinensis* stem
- optimize and evaluate the parameters for antimicrobial finishing
- treat the cotton fabric with selected source and evaluation

## **Materials and Methods**

The cotton fabric was selected for the study. In order to remove size and other natural or finished impurities from the cotton fabric, the fabric was weighed and dipped in 20 liters of water with 70 grams of detergent powder at temperature of 60°C for one hour. After one hour, the fabric was taken out and rinsed thoroughly under running water and dried in shade.

To determine the antimicrobial effect, *Mentha sachalinensis* (Mint) stem was selected for the study. Suitable solvent extraction methods such as ethanol, methanol, and aqueous were used. Similarly to optimize the concentration, time and temperature for the finish of the fabric, pilot study was carried out with 0.5g, 1.0g, 1.5g; 1hr, 3hrs, 5hrs; and 40°C, 50°C, 60°C respectively. Ultrasonic automizer, Padding Mangle and Dip and Dry methods were adopted to finish the cotton fabric with mint extract.

For each of the parameters, the antimicrobial activity was tested and the zone of inhibition was observed. Based on the result of pilot study one gram concentration of the stem extract with material liquor ratio of 1:15 was taken at 50°C and finished for five hours.

The fabric was analyzed subjectively by a panel of judges specializing in Textiles and Clothing. Objective analysis for physical, mechanical, comfort, absorbency and colour fastness properties were also carried out.

To assess the antibacterial and antifungal activities Zone of inhibition around the mint stem extract finished fabric through Parallel Streak method was done. Active compounds present on the fabric were observed by FTIR and SEM analysis. Results were statistically analysed.

## **Findings of the Study**

### **Subjective evaluation**

The sample finished in dip and dry method improved in its general appearance on finishing as reported by 90 per cent of the judges. Further, texture of the Ultrasonic Automiser finished sample exhibited soft texture as expressed by 94 per cent of the judges. Both Ultrasonic Automiser and Dip and Dry methods of finished samples showed even finishing treatment as judged by cent per cent of judges.

### **Objective evaluation**

Thickness of the finished fabric has increased gradually by three to nineteen per cent. Fabric weight increased in the entire sample. Strength of the sample in warp and weft direction increased whereas elongation of the fabric decreased in both warp and weft direction irrespective of the finishing treatment. The abrasion resistance of the fabric has increased in the entire treated sample. Treated sample showed slight and no pilling. Stiffness of the fabric increased in all treated fabric in both warp and weft direction. The crease recovery increased in the fabric after finishing along warp direction and reduced in weft direction. Drapability of the fabric improved in the finished sample. The wettability and absorbency rates of the finished samples increased from 8-32 per cent.

Table 1 Antimicrobial Activity in Treated Fabrics

S.No	Samples	Zone Formation in mm		
		<i>E. coli</i>	<i>S. aureus</i>	<i>C. albicans</i>
1	O	0	0	0
2	UA	10	15	15
3	UA1	8	12	10
4	UA2	7	10	13
5	PM	10	12	15
6	PM1	9	7	10
7	PM2	7	6	13
8	D	12	12	15
9	D1	8	8	10
10	D2	7	5	13

### Antimicrobial assessment

The result of the antimicrobial test was carried out for the untreated and treated fabrics are expressed in Table 1 and 2.

The fabric treated using Ultrasonic Automiser showed 10mm zone of inhibition of against *E.coli* and 15mm for both *S.aureus* and *C.albicans*. After washing of the same fabric, the activity was assessed and the zone formation was observed to be 8mm for *E.coli* and 12mm for *S.aureus* and 10mm for *C.albicans* whereas in second wash 7mm for *E.coli*, 10mm for *S.aureus* and 13mm for *C.albicans* of zone formation was observed.

The fabric treated using padding mangle showed 10 mm zone of inhibition for *E.coli*, 12mm for *S.aureus* and 15mm for *C.albicans*. After first washing, the activity was assessed. and the zone formation was observed as 9mm for *E.coli*, 7mm for *S.aureus* and 10mm for *C.albicans* whereas after second wash 7mm for *E.coli*, 6mm for *S.aureus* and 13mm for *C.albicans* of zone formation was observed.

The fabric treated using dip and dry method showed zone of inhibition of 12mm for *E.coli*, 12mm for *S.aureus* and 15mm for *C.albicans*. After first washing of the same the activity was studied and the zone formation was observed as 8mm for both *E.coli* and *S.aureus* and 10mm for *C.albicans* in first wash where as in second wash 7mm for *E.coli*, 5mm for *S.aureus* and 13mm for *C.albicans* of zone formation was observed (Plate 1 & 2.).

### Antimicrobial Activity in Mint Stem Extract

Mint stem extract is tested with *E.coli*. Standard sample showed 15mm zone of inhibition and the mint stem extract showed 13mm of zone of inhibition.

Plate 1 Zone of Inhibition – E.Coli



Plate 2 Zone of Inhibition – S.aureus

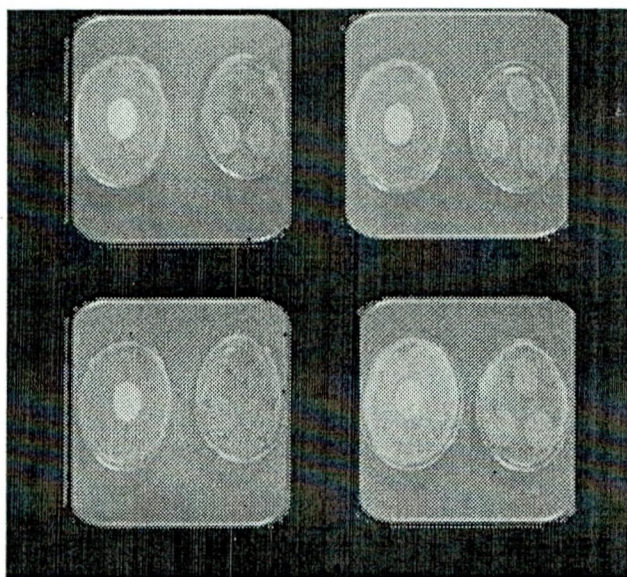


Table 2 Antimicrobial Activity in Mint Stem Extract

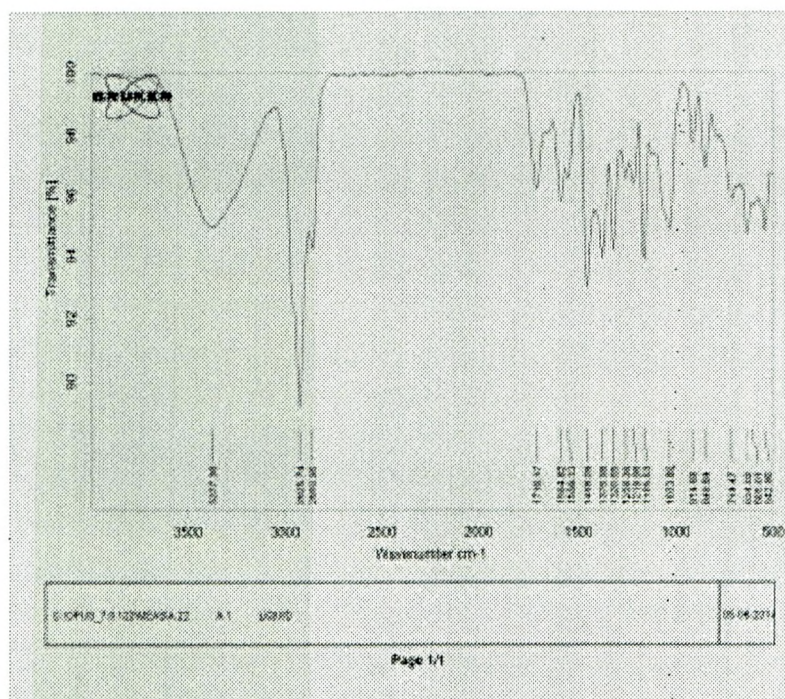
S.No.	Organisms	Standard sample (5 µg/disc)(mm)	Sample (100 µg/disc) Zone of inhibition (mm)
1.	E.Coli	15	13
2.	C.albicans	09	12

Standard sample with *C.albicans* showed 09 mm zone of incubation and mint stem extract showed 12mm zone of incubation (Plate.3).

Plate 3 Zone of Inhibition – *C.albicans*.



Figure 1 FTIR Test



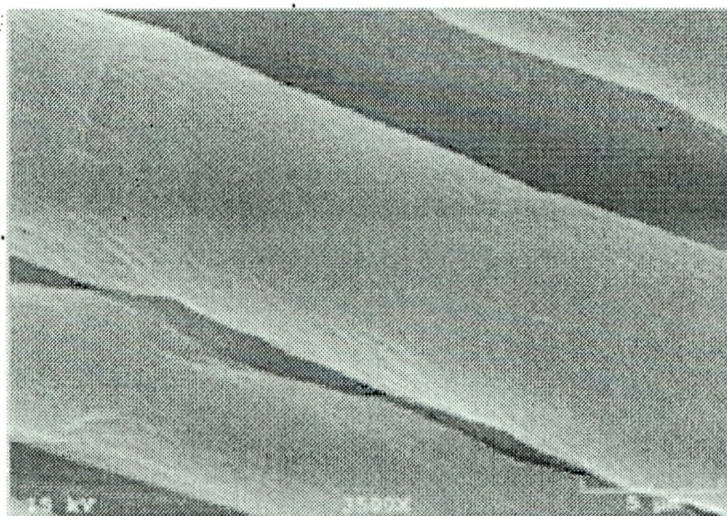
### FTIR Test

The result of FTIR states that the treated fabric with ethanol has the broad peak in the region 2925.74  $\text{cm}^{-1}$  which may be due to O-H stretch and C-H stretch (because sample has been recorded in liquid form in ethanol solvent). Apart the prominent peak was formed at 1458.09  $\text{cm}^{-1}$  and 1165.53  $\text{cm}^{-1}$ . This may be due to the presence of O-H bend and C-O stretch of extract. These bonds reveal the probability of antimicrobial activity. Since the peak levels were higher in ethanol extraction, it was selected for the final study (Figure.1).

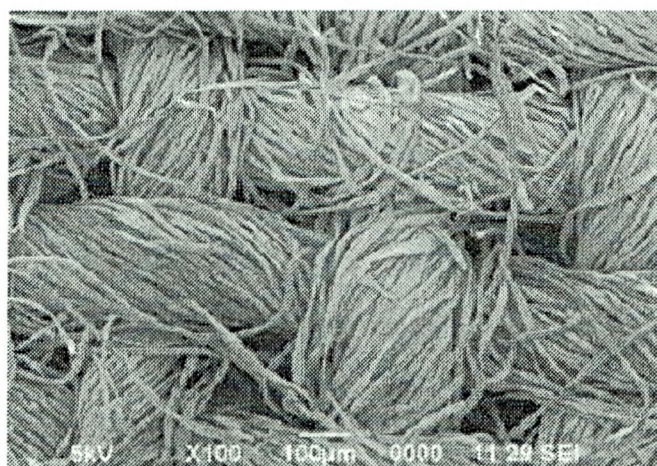
### SEM appearance

The SEM image of the untreated cotton fabric is presented in Plate 4, it can be observed that the surface of the fabric appears to be smooth. The surface

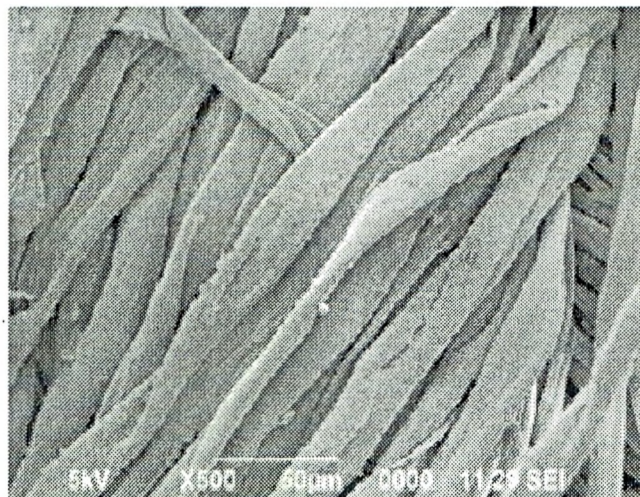
**Plate 4 Untreated cotton fabric**



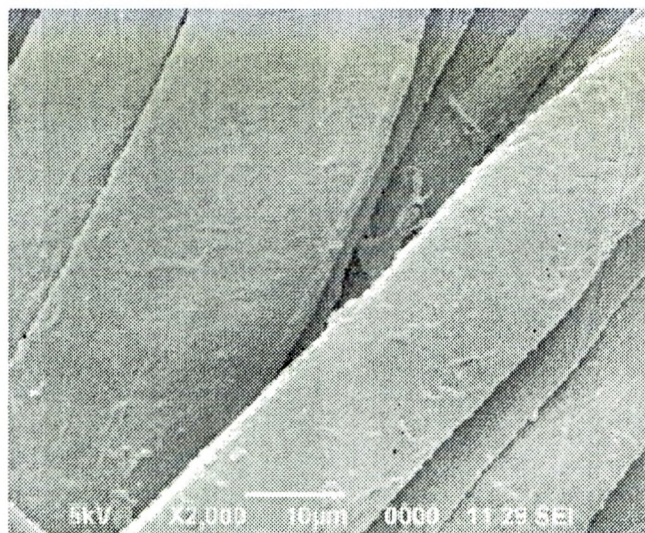
**Plate 5 Treated fabric in 100  $\mu\text{m}$**



**Plate 6 Treated fabric in 50  $\mu\text{m}$**

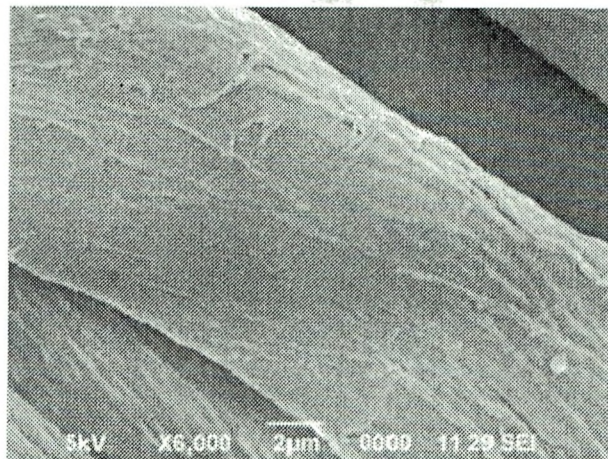


**Plate 7 Treated fabric in 10  $\mu\text{m}$**



appearance of treated cotton fabric is shown in Plates 5, 6, 7 and 8. The microscope views observed at 100  $\mu\text{m}$ , 50  $\mu\text{m}$ , 10  $\mu\text{m}$  and 2  $\mu\text{m}$  are presented in the Plates 5–8. The micrographic images viewed at 10  $\mu\text{m}$  and 2  $\mu\text{m}$  clearly show the adherence and binding of mint stem extract particles on the fiber assembly. When comparing the images shown in Plate 4 and Plate 8, the surface morphological changes due to the mint stem extract finish is noticed in treated fabric. Therefore mint stem extract acts as an effective antimicrobial agent on cotton fabric.

**Plate 8 Treated fabric in 2  $\mu$ m**



## Conclusion

The extract from Mint Stem is suitable for imparting Antimicrobial activity on cotton fabric. The treatment of the fabric with the Mint Stem extract gave a pale green colour with moderate colour fastness property too. Antimicrobial products which undergo minimum wash cycles could be created with fabrics finished with Mint Stem extract.

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