



## Research Article

### STUDY ON ANTIMICROBIAL ACTIVITY OF COTTON, BAMBOO AND SOYABEAN FABRICS WITH HERBAL FINISHING

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#### ABSTRACT

Increasing global research in textiles has created many new applications. The application of innovative finishes to textiles is one such area. Rapid growth in this has generated many opportunities and new end uses. Textiles with improved antimicrobial functionality find variety of applications in health and hygiene products, garments worn close to the skin and in other medical applications for infection control and as barrier material. The present study aims at developing eco-friendly natural antimicrobial finish from plant extracts for textile application. Some selective plants such as *Asteraceae* (Vettukaya Thalai), *Terminalia chebula* (Kadukai), *Coleus aromaticos* (Karpuravalli), *Aloe barbadensis* (Aloe Vera), *Ocimum tenuiflorum* (Tulsi) and *Cymbopogon flexuosus* (Lemon Grass Oil) have good antimicrobial activities. Their extracts are applied to Cotton, Bamboo and Soya bean fabrics. An extensive study is conducted to access the antimicrobial effectiveness of the fabrics finished with the extracts of herbs by employing standard test method (AATCC – 147, 2004). From the results, it is concluded that the three fabrics treated with the said six herbs has remarkable Antimicrobial Activity.

**Keywords:** *Asteraceae* (Vettukaya Thalai), *Terminalia chebula* (Kadukai), *Coleus aromaticos* (Karpuravalli), *Aloe barbadensis* (Aloe Vera), *Ocimum tenuiflorum* (Tulsi), *Cymbopogon flexuosus* (Lemon Grass Oil), Antimicrobial, *S. aureus*, *E. coli*

#### INTRODUCTION

Textiles are rapidly developing into interdisciplinary high tech products. Textiles were considered primarily for economical and functional point of view to some end uses in particular for safety and for health<sup>1</sup>. Surveys indicate that functionality in the apparel product is necessary<sup>2</sup>. Antimicrobial property of fabric is an important parameter for applications such as health and hygiene<sup>3</sup>. To meet the awareness and requirements of consumers textile products based on synthetic antimicrobial agents such as triclosan, organometallics, phenols and quaternary ammonium compounds have been developed and there are also available commercially<sup>4</sup>. Even though synthetic antimicrobial agents are effective they have side effects. Hence, there is a need to develop antimicrobial textiles based on eco friendly agents. Chitosan, a natural biopolymer is of great use in this area of research<sup>5</sup>. India a known biodiversity centre of the world has more than 15,000 to 20,000 plants having medicinal value<sup>6</sup>. Extracts from different parts of these plants exhibit antimicrobial properties<sup>7-12</sup>. Few of them act as bactericides and few act as bacteriostatic<sup>7</sup>. The present study aims to develop an ecofriendly natural antimicrobial finish from extracts of plants for application in textiles. Few selective species of plants were identified. The extracts were applied to Cotton, Bamboo and Soyabean fabrics and tested to assess their antimicrobial effectiveness by standard test methods (AATCC – 147, 2004).

#### Literature Review

Herbs used for the research study along with their medicinal applications



*Asteraceae* (Vettukaya Thalai)\*: Used to heal the cut wound



*Terminalia chebula* (Kadukai)\*: Used for curing fever, cough, asthma, urinary diseases, piles, worms, rheumatism and scorpions sting. It is highly useful in chronic diarrhea, dysentery, flatulence, vomiting, hiccup, colic and enlarged spleen and liver



*Coleus aromaticos* (Karpuravalli)\*: Used to cure cough, cold, sore throats, indigestion, rheumatism etc.



*Ocimum tenuiflorum* (Tulsi)\*: Used to cure cough, cold, sore throats



*Aloe barbadensis* (Aloe Vera)\*: Used for anti-inflammatory treatment

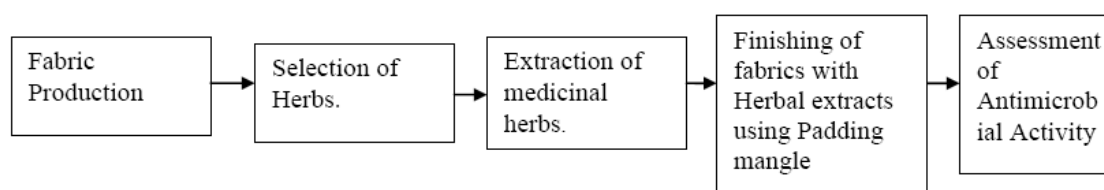


*Cymbopogon flexuosus* (Lemon Grass Oil)\*: Lemon grass oil is used to cure cough, spitting of blood, rheumatism, lumbago, digestive problems, cholera, colic and obstinate vomiting

Lemon grass belongs to Andropogon section called Cymbopogon of the family Gramineae. Lemon grass oil possesses bactericidal and anti-fungal properties, comparable to penicillin in its effectiveness<sup>12</sup>. Male sex hormone agent<sup>8</sup> is present in this oil. It is also reported to have strong activity against two dermatophytes, namely *Trichophyton rubrum* and *Microsporum gypsum*<sup>11</sup>. Pharmacological investigation reveals that it has a depressant

effect on the CNS<sup>2</sup>. It has analgesic and antipyretic properties. The extracted juice of lemon grass is an oral anti tumor drug for the cancer and in combination with cyclodextrin lengthened the survival time<sup>14</sup>. Lemon grass possess high percentage of Vitamin C. Lemon grass oils show activity towards the phyto pathogenic fungi.<sup>10</sup>.

## MATERIALS AND METHODS



### Fabric

The yarn for the fabric is produced using ring spinning system with a blend combination of cotton and bamboo fibre (80/20 ratio), the fabric is produced in loom using the cotton –bamboo yarn as warp and weft. The details are given below

**Table 1. Details of materials used**

Raw material used	Cotton/Bamboo
Blend composition	80/20
Yarn count	2/40' N <sub>e</sub> (Ring spun)
Fabric details	Warp and weft: Cotton – Bamboo yarn Ends/cm: 25. Picks/cm: 21

The fabric samples were scoured with a solution of Sodium hydroxide 2%, Sodium carbonate 1%, Turkey red oil 1%, MLR

ratio 1:30, at the boiling temperature for about 2 hours with a pH 10 -11. After that the fabrics were rinsed thoroughly and air dried at room temperature.

### Herbs

The following natural herbs available in large quantity in Tamil Nadu region of India were selected for this study The names given in parenthesis are local names.

- *Asteraceae* (Vettukaya Thalai),
- *Terminalia chebula* (Kadukai),
- *Coleus aromaticos* (Karpuravalli),
- *Aloe barbadensis* (Aloe Vera),
- *Ocimum tenuiflorum* (Tulsi)
- *Cymbopogon flexuosus* (Lemon Grass Oil)

**Extraction of Medicinal Herbs**

For extraction, 5 grams of dry powder from the herbs were taken separately and mixed into 120ml of 80% Methanol<sup>15</sup>. The container was closed and kept for overnight at room temperature. After overnight incubation, the extract was filtered through filter paper and evaporated to concentrate the extract.

**Finishing of Fabrics with Herbal Extracts**

Methanol extracts of herbs were applied directly on 100% Cotton, Bamboo and Soya fabrics by pad-dry-cure method. The fabrics were padded with herbal extracts for 10min at room temperature with a liquor ratio set at 20:1 with a pressure of 20kgf/cm<sup>2</sup> at a speed of 15 m/min. The padded fabrics were air-dried and then cured at 120.C for 3 min.

**Assessment of Antimicrobial Activity of Finished Fabrics**

Antimicrobial activity of 3 fabrics finished with 6 herbal extracts were evaluated by qualitative (AATCC 147) against *S. aureus*, a Gram-positive organism and *Escherichia coli*, a Gram-negative organism using nutrient agar<sup>15</sup>. The fabric samples cut into rectangular shape with 25 \* 50 mm was taken for the analysis. Sterile bacteriostasis agar was dispensed in to Petri dishes. Broth cultures (24 hours) of the test organisms were used as inoculum. Using sterile inoculation loop, the test organisms (*Escherichia coli* & *Staphylococcus aureus*) were streaked, 5 lines with 4 mm width over the surface of the agar plate. Presterilized samples were placed over the culture inoculated agar surface by using sterile forceps. After placing the samples, all the plates were incubated at 37 °C for 18 to 24 hours. After incubation, the plates were examined for the zone of bacterial inhibition around the

fabric sample. The size of the clear zone was used to evaluate the inhibitory effect of the sample.

**Evaluation**

The inoculated plates were examined for the interruption of growth along the streaks of the inoculums beneath the fabrics and for a clear zone of inhibition beyond the fabric edge. The average width of the zone of inhibition around the test specimen was calculated in mm using Eq.1.

$$\text{Zone of inhibition (MM)} = (T-I)/2$$

Where:

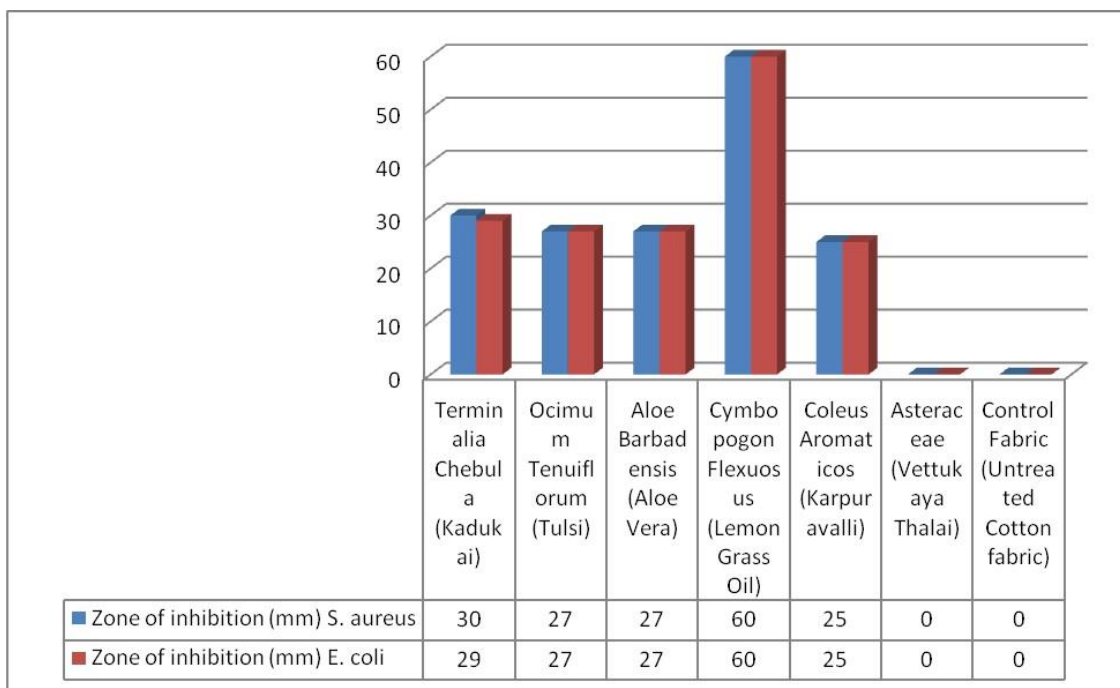
T – width of zone of inhibition, I – width of specimen

**RESULTS AND DISCUSSION**

**The Antimicrobial Activity of Cotton Fabric**

Antimicrobial activity of Cotton fabric treated with *Asteraceae* (Vettukaya Thalai), *Terminalia chebula* (Kadukai), *Coleus aromatics* (Karpuravalli), *Aloe barbadensis* (Aloe Vera), *Ocimum tenuiflorum* (Tulsi) and *Cymbopogon flexuosus* (Lemon Grass Oil) were determined using qualitative methods (AATCC 147) and shown in Figure.1.

The results of agar diffusion method show that except the cotton fabric treated with *Asteraceae* (Vettukaya Thalai), all the other herbal treated cotton fabrics are having very good antimicrobial properties to both gram positive and gram negative micro-organisms. They reveal a zone of inhibition ranging from 25 mm to 60 mm for both gram positive and gram negative bacteria. Figure.1 indicates that there is a bacterial growth in the untreated cotton fabric.



**Figure 1: Antimicrobial activity of Cotton fabric**

**The Antimicrobial Activity of Bamboo Fabric**

From Figure 2 it is observed that except the bamboo fabric treated with *Asteraceae* (Vettukaya Thalai), all the other herbal treated bamboo fabrics are having very good antimicrobial properties to

both gram positive and gram negative micro-organisms. They reveal a zone of inhibition ranging from 25 mm to 45 mm for both gram positive and gram negative bacteria. Figure 2 also indicates that there is a bacterial growth in the untreated bamboo fabric.

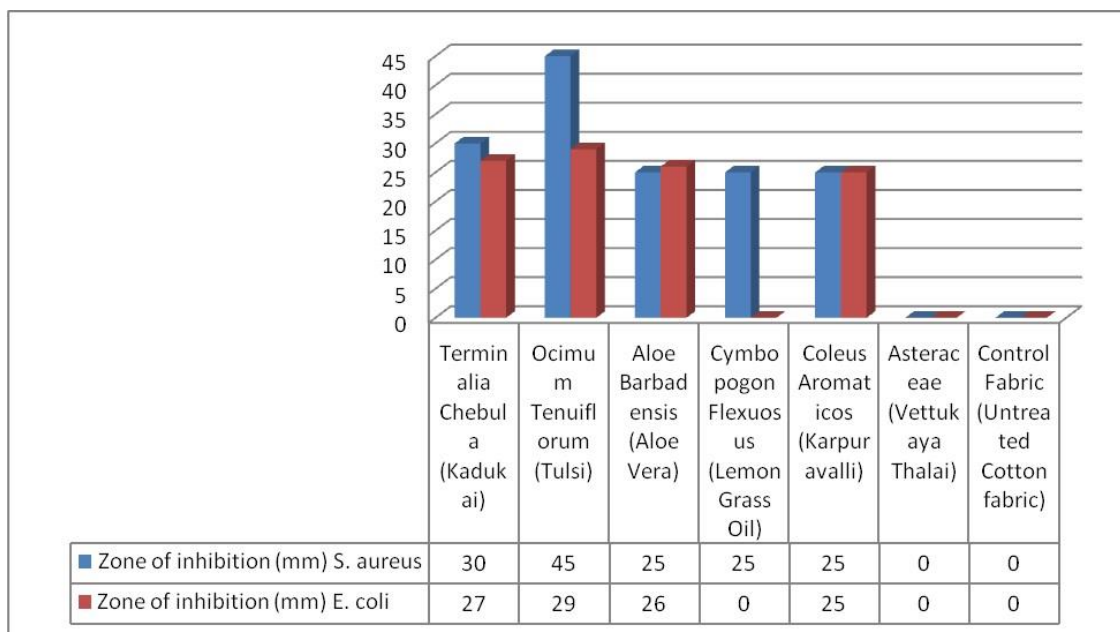


Figure 2: Antimicrobial activity of Bamboo fabric

### The Antimicrobial Activity of Soya fabric

From the Figure.3 it is observed that except the soya fabric treated with *Asteraceae* (Vettukaya Thalai), all the other herbal treated bamboo fabrics are having good antimicrobial properties to both

gram positive and gram negative micro-organisms. They reveal a zone of inhibition ranging from 25 mm to 30 mm for both gram positive and gram negative bacteria. Figure.3 also indicates that there is a bacterial growth in the untreated bamboo fabric.

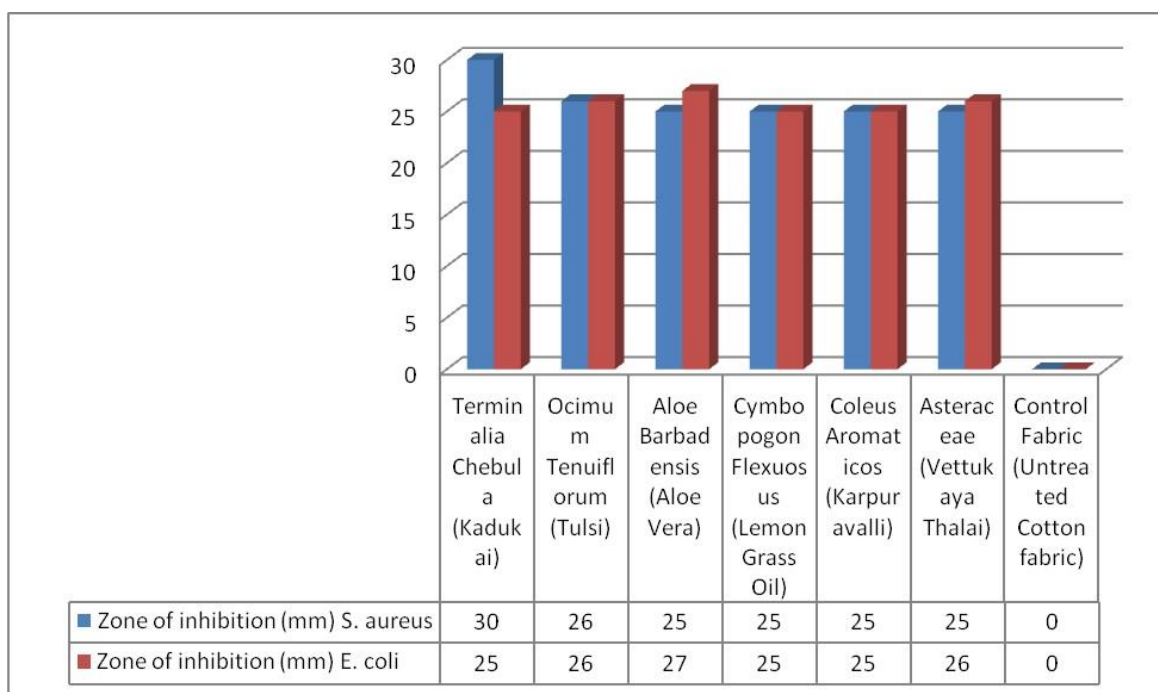


Figure 3: Antimicrobial activity of Soya fabric

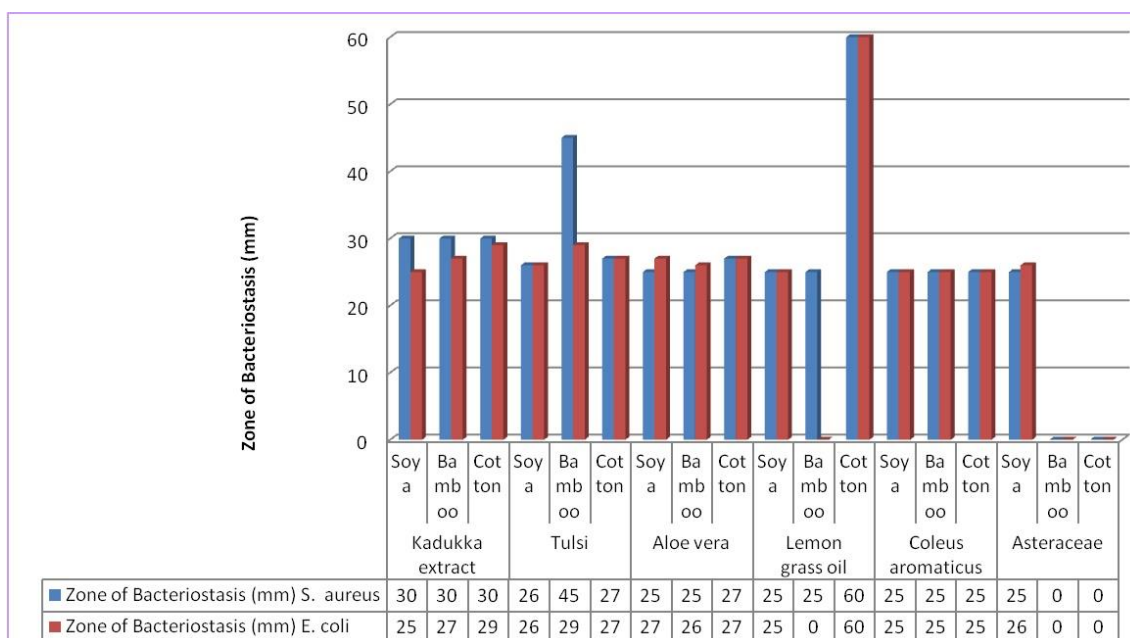


Figure 4: Antimicrobial Activity of Cotton, Bamboo and Soya Fabric

## CONCLUSION

The finishing of Cotton, Bamboo and Soya bean fabrics with six different herbs were found to exhibit appreciable antimicrobial properties. The Asteraceae treated Cotton and Bamboo fabrics have zero efficacy. However it has appreciable efficacy with respect to Soya bean fabric which may be due natural protein origin. The present investigation highlighted that Lemon Grass Oil finished Cotton fabric shows highest efficacy in terms of both gram positive and gram negative bacteria indicating that this technique can be used in the textile industry as antimicrobial finishing of medical textiles for both the gram positive and gram negative bacteria as value added products.

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