

## Development of eco-friendly finish on cotton fabric using herbs

■ SHALINI JUNEJA AND SWATI PATHRIYA

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See end of the paper for authors' affiliations

Correspondence to :

**SHALINI JUNEJA**  
Department of Clothing and  
Textiles, Banasthali Vidyapith,  
BANASTHALI  
(RAJASTHAN) INDIA  
E-mail: shalinijuneja@  
ymail.com

■ **ABSTRACT** : The present subject was done to develop eco-friendly antimicrobial finishes using herbs. It mainly aimed at studying the effect of herbal extracts on cotton fabric. In this study, three herbs viz., neem, tulsi and clove were used for finishing of cotton fabric. Methanolic extracts of neem, tulsi and clove herbs were examined using standard antimicrobial disk diffusion method. Extracts were tested against gram-negative bacteria (*Escherisia coli*). The results related to these herbs showed that the clove and the neem extracts showed good anti bacterial property on cotton fabric. Citric acid treatment was used for post treatment of the herbs treated fabric. Among these, clove extract showed excellent antibacterial property on cotton fabric and tulsi extracts showed minimum antibacterial property.

■ **KEY WORDS** : Eco-friendly, Cotton fabric, Harb

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In the last few decades, with the increase in new antimicrobial fibre technologies and growing awareness about cleaner surroundings and healthy life style, a range of textile products based on synthetic antimicrobial agents such as triclosan, metal and their salts, organometalics, phenol and quaternary ammonium compounds, have been developed and quite a few are also available commercially. Although the synthetic antimicrobial agents are very effective against a range of microbes and give a durable effect on textiles. They are cause of concern due to the associated side effects, action on non-target micro-organisms and water pollution. Hence, there is a great demand for antimicrobial textiles based on eco friendly agents which not only help to reduce the ill effects associated due to microbial growth on textile material but also comply with the statutory requirements imposed by regulating agencies. The inherent properties of the textile fibres provide room for the growth of micro-organisms. Besides, the structure of the substrates and the chemical processes many induce the growth of microbes, humid and warm environment still aggravate the problem. Infestation by microbes cause cross infection by pathogens and development of odour where the fabrics are worn next to skin. In addition, the staining and loss of the performance properties of textile substrates are the result of microbial attack. The use of natural products such as

chitosan and natural dyes for antimicrobial finishing of textile materials has been widely reported. Other natural herbal products, such as *Aloe vera*, tea tree oil, Eucalyptus oil and Tulsi leaf (*Ocimum basilicum*) extracts, can also be used for this purpose. There is a vast source of medicinal plants with active antimicrobial ingredients. Although there are many natural products rich in antimicrobial agents, the study on their use in textiles is well documented. The relatively lower incidence of adverse reactions of herbal products as compared to modern synthetic pharmaceuticals, coupled with their reduced cost, can be exploited as an attractive eco-friendly alternative to synthetic antimicrobial agents for textile applications. Recent developments and plant based bioactive agents have opened up new avenues in this area of research (Joshi *et al.*, 2009). Antimicrobial finishes on fabrics can protect human beings against microbes (Biswas *et al.*, 2007). The application of antimicrobial textile finishes at present is confined to specialty products in the medical, technical, industrial, home furnishing and apparel categories. Though a number of commercial antimicrobial agents have been introduced in the market, their compliance with the regulations imposed by international bodies is still not proven. Recent developments on chitosan (a naturally occurring biopolymer) have open up new avenues in this area of research. The

consumers are now increasingly aware of the hygienic life style and therefore there, is a necessity and expectation for a wide range of textile product finished with antimicrobial properties. The present investigation aims at developing an eco-friendly, naturally antimicrobial finish from herbs like Neem, Tulsi, and clove for textile application. A number of Indian herbs do contain antibacterial, antifungal and antiviral properties. Studies have revealed that some specific species of herbs having antimicrobial activity are suitable for textile application. In this context, selective species of herbs like Neem, Tulsi, and clove were screened for their antimicrobial activities and the extracts were applied to cotton fabrics. Basically with a view to protect the wearer and the textile substrate itself, antimicrobial finish is applied to textile material. The objectives of the study were: to develop an antimicrobial finish to be merged from herbs for textile application and to assess the antimicrobial effectiveness of the herbs.

## ■ RESEARCH METHODS

### Materials used :

#### *Fabric :*

Cotton fabric was selected for the present study and was purchased from Bhilwara district of Rajasthan.

### Natural herbs :

#### *(sources) :*

Neem (*Azadirachta Indica*), Tulsi (*Ocimum sanctum*) and Clove (*Syzygium aromaticum*).

### Nutrient agar medium :

Synthesis nutrient agar was used.

### Microorganism culture used :

One microorganism culture used was assessment of antimicrobial activity of natural herbs extracts.

### Other materials :

Petridishes, parafilms, conical flask, cotton, aluminium foil, glass rod, measuring cylinder and filter paper.

### Determination of preliminary data of the fabric :

#### *Thread count :*

The fabric spread on the table and squares of 1" x 1" size were marked, numbers of thread warp wise and weft wise; within these squares were determined with the help of magnifying glass. Average of five readings were taken and recorded.

### Weight per unit area :

Weight of fabric is described in two ways.

### Weight per unit area :

(Ounes per square yard)

### Weight per unit linear yard :

(Ounes per linear yard)

### Pretreatments of fabrics :

#### *Desizing :*

When a fabric comes from loom, it has various impurities and starch in it. Desizing is a common pretreatment given to all fabrics. It removes the size, present in the fabric to reduce the hydrophobicity of fabrics. The enzymatic desizing was selected for the present study.

#### *Seouring :*

The objective of seouring was to reduce the amount of impurities sufficiently to obtain level and reproducible result in finishing operations. "Caustic soda boil" method was used for seouring

#### Recipe

NaoH	- 3-6% (on the wt of fabric)
Material liquor ratio	- 1:30
Temperature	- 13°C
Time	- 8 hr

The desized fabric was boiled with a caustic soda (5% on the wt fabrics) solution at 130°C for 8 hrs. Then, the material was removed and rinsed in clean water and dried.

#### *Bleaching :*

#### Recipe-

Hydrogen peroxide	- 2-4% (on the wt. of fabric)
Sodium silicate	- 1-5% (on the wt. of fabric)
EDTA	- 1 Pinch
PH	- 10-11
Material liquor ratio	- 100°C
Time	- 2 hr

The bleaching was carried out using the above recipe.

### Procedure :

#### *Preparation of methanolic extracts of herb :*

5 g of dried under shade and ground in 45 ml methanol for 1 and 2 days with intermitted shaking. The plant extracts were filtered through watsman filter paper. The residue was stored at room temperature.

#### *Application of methanolic extracts :*

Methanolic extracts of herbs were applied to cotton fabric by the padding method. The fabric was spread on the Petri dish and then methanolic extract was spread on it. After 5 min, fabric was removed from the Petri dish. The fabric was then dried at 80°C for 15 minutes to remove the moisture.

### Antimicrobial screening :

The methanolic extract of Neem, Tulsi and Clove plants were screened against an *Escherichia coli* (AATCC)

bacterium.

#### Preparation of inoculation :

Stock culture was maintained at a 4°C on slopes of Nutrient agar. Active culture for experiments was prepared by transferring *E.coli* in nutrient broth and that incubated without agitation for 24 hrs at 37°C.

#### Antimicrobial susceptibility test :

Agar diffusion method was used to screen the antimicrobial activity. In this, antimicrobial activity was screened by using synthesis nutrient agar. The agar plates were prepared by pouring 15 ml of molten media into sterilized Petri plates. The plates were solidified for 5 minutes and 10 µl inoculum suspensions were swabbed uniformly and the inoculation was allowed to dry 5 minutes. Then the extract which was kept for 1 and 2 days and the fabric post treated with citric acid at different concentration was placed on medium against the untreated fabric then the plates were covered with parafilm and diffused for 5 minutes. After this, plates were kept at 37°C for 24 hrs in an incubator. At the end of incubation, zones formed around the methanol extract to treated fabrics were measured with transparent ruler in millimeter and inhibition zones were calculated using the following formula :

$$H = (d - D)/2$$

where,

H = Inhibition zone in millimeter

D = Total diameter of specimen and inhibition zone in millimeter

d = Diameter of specimen in millimeter

After that bacterial colonies were counted with colony meter and bacteria reduction was calculated according to modify quinu method :

$$(R\%) = Co - C/Co \times 100$$

where,

R = Rate of reduction

Co = Number of bacterial colonies on the cotton fabrics treated without herbs as control sample.

C = Number of bacterial colonies on the cotton fabric treated with herbs.

## RESEARCH FINDINGS AND DISCUSSION

Cotton fabric was scoured and bleached by conventional impregnation method. Then, application of different herbal extracts of Neem, Tulsi and clove was done.

#### Priliminary data of the fabric :

It was observed that thread count of the fabric was found to be 80×64 *i.e.* warp threads in 1" of the fabric were 80 and weft threads were 64.

#### Assessment of antimicrobial activity of different herbal extracts with respect to zonal area :

It was found the zonal area formed with Neem treated fabric kept for 1 day was 19 mm and it was 23 mm when kept for 2 days for Neem. Treated fabric, when kept for 1 day was 22 mm and for 2 days it was 29 mm for Tulsi. Similarly, the zonal area formed with clove treated fabric, kept for 1 day was 27 mm and it was 34 mm when kept for 2 days. Thus, it can be seen from the data (Table 1), the fabric treated with clove extract had maximum zonal area *i.e.* it showed maximum antimicrobial activity (34 mm). the fabric treated with Neem, formed minimum zonal area (19 mm).

**Table 1 : Animicrobial activity of herbal extracts with respect to zonal area**

Sr. No.	Herbal extracts	Zone in millimeter		Inhibition zone (mm)	
		1 Day	2 Day	1 Day	2 Day
1.	A (Neem)	19	23	4.5	6.5
2.	B (Tulsi)	22	29	6	9.5
3.	C (Clove)	27	34	8.5	12

#### Assessment of antimicrobial activity of different herbal extracts with respect to inhibition zone :

It was found the area of inhibition zone in millimeters formed after application of herbal extracts. It was observed that for Neem treated fabric, area of inhibition zone was formed to be 4.5 mm and 6.5 mm for and 1 and 2 days respectively. For Tulsi treated fabric, inhibition zone area was 6 mm and 9.5 mm for 1 and 2 days, respectively. For clove treated fabric, inhibition zonal area was 8.5 mm and 12 mm for 1 day and 2 days, respectively. Thus, it can be said that clove treated fabric had maximum inhibition zone which was 12mm *i.e.* it showed the maximum antimicrobial property and Neem had lowest inhibition zone which was 4.5mm.

#### Assessment of antimicrobial activity of different herbal extracts with respect to per cent bacterial reduction :

The percentage of bacterial reduction for Neem treated fabric was found to be 39.28 per cent and 48.21 for one day and two days, respectively. For clove treated fabric, bacterial reduction was 57.14 per cent and 71.42 per cent, respectively. Thus, clove treated had maximum bacterial reduction percentage and neem treated fabric had lowest bacterial reduction percentage (Table 2).

#### Assessment of antimicrobial activity of different herbal extracts with respect to zonal area with post treatment :

It was found that clove treated fabric showed maximum antimicrobial activity with citric acid where as Tulsi treated fabric showed minimum antimicrobial activity.

**Table 2 : Antibacterial activity of herbal extracts with respect to per cent bacterial reduction**

Sr. No.	Herbal extracts	Bacteria reduction(%)	
		1 Day	2 day
1.	A (Neem)	39.28	48.21
2.	B (Tulsi)	50	58.9
3.	C (Clove)	57.14	71.42

### Assessment of inhibition zone formed after application of herbal extract along with citric acid :

It was found that antimicrobial activity of herbal extract of Neem with respect to inhibition zone at 70 per cent concentration of citric acid at different M. L.R. came out to be in the range of 8.25-12mm and in Tulsi treated fabric, it was 7.75-10.25mm. For clove treated fabric, when post treatment was applied, inhibition zone formed in the range of 12.75-13.25mm (Table 3).

**Table 3 : Assessment of inhibition zone formed along with citric acid**

Sr. No.	Herbal extracts	Inhibition zone at 70% concentration of citric acid (mm)			
		1:20	1:30	1:40	1:50
1.	A (Neem)	8.25	12.75	12.5	12
2.	B (Tulsi)	7.75	10.5	10	10.25
3.	C (Clove)	12.75	13	12.25	13.25

### Assessment of bacterial reduction percentage formed after application of herbal extracts along with citric acid

It was revealed that for Neem treated fabric, bacterial reduction at 70 per cent concentration of citric acid came out in the range of 91.07-92.85 per cent for Tulsi treated fabrics percentage bacterial reduction came out to be in range of 78.57-82.14 per cent. Thus, Neem treated fabric had maximum bacterial reduction percentage and Tulsi treated fabric had lowest bacterial reduction percentage (Table 4).

**Table 4 : Assessment of bacterial reduction along with citric acid**

Sr. No.	Herbal extracts	Bacteria reduction at different M:L:R of citric acid (70%)			
		1:20	1:30	1:40	1:50
1.	A (Neem)	91.07	100	98.21	92.85
2.	B (Tulsi)	78.57	94.64	91.10	82.14
3.	C (Clove)	83.92	96.42	96.42	87.5

### Comparative analysis of characteristics of inhibition zone and percentage bacterial reduction without post treatment and with post treatment :

The comparatively data analysis between with or without post treatment indicated that the post treatment increased the capacity of fabric to inhibit the bacterium (Table 5).

**Table 5 : Comparative analysis between with or without post treatment**

Sr. No.	Characteristics	Without post treatment			With post treatment		
		Neem	Tulsi	Clove	Neem	Tulsi	Clove
1.	Inhibition zone (mm)	5.5	15.5	10.2	11.3	9.6	12.8
2.	Bacterial reduction(%)	43.7	54.4	64.2	95.5	86.6	91

### Conclusion :

The result of investigation showed that use of herbal extracts have antimicrobial activity to variable extent. Therefore these, methanolic extracts can be successfully used on the textile substrate. However, these herbal extracts have a good antimicrobial property.

### Authors' affiliations:

SWATI PATHRIYA, Department of Clothing and Textiles, Banasthali Vidyapith, BANASTHALI (RAJASTHAN) INDIA

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