Krishnaveni, J Textile Sci Eng 2016, 6:4
DOI: 10.4172/2165-8064.1000267

Journal of Textile Science & Engineering

Research Article Open Access

# Anti-Bacterial Coating of Chrysanthemum Extract on Bamboo Fabric for Healthcare Applications

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## Abstract

Healthcare is a serious business which is not only influenced by practicing medical professionals. Good hygiene is an aid to health, comfort and social interactions. With the increasing threat from new strains of bacteria and viruses growing problems. Textiles being vulnerable to microorganisms attack would cause many cross infections and allergic reactions. The number of bio-functional textiles with an antimicrobial activity has increased considerably over the last few years. The awareness of health and hygiene for consumers has increased the demand for antimicrobial textiles. Antimicrobial finish on fabrics can minimize the transfer of microorganisms onto the wearer by creating a physical barrier. The optimized conditions of chrysanthemum herbal extracts can be applied on the bamboo fabric by padding method with cross linking agent pomegranate. The antibacterial activity is assessed in herbal treated and untreated samples by the standard AATCC 147 qualitative and AATCC 100 quantitative antimicrobial tests against both bacteria .The results showed that the maximum zone of inhibition is found in 2 hr herbal treated fabric with the mordant pomegranate in the material liquor ratio of 1:20 against staphylococcus and *E. coli* bacteria. Good antimicrobial property is achieved in the selected herb against staphylococcus (+ve gram) bacteria and *E. coli* (-ve gram) bacteria and equal zone of inhibition is found against antibiotic.The application of herbal extract on fabrics lasts up to 11 washes in both pad treated fabrics. The present study is an effective method of controlling the spreading of disease through the medicated textiles.

**Keywords:** Chrysanthemum extract; Antimicrobial; Microorganisms; Medical textiles

## Introduction

The Population explosion and the environmental pollution in the recent years forced the researchers to find new health and hygiene related products for the well being of mankind. The nuisance caused by microbes which are minute organisms, but can be most dangerous for creating harm to our lifestyle. Over the past century, much focus has been placed on the sustainability of the earth's environment. This concern, accompanied by a recent boom in the interest of healthy living and consumers are very conscious of textiles that are hygienic [1]. Clothing and textile materials are not only the carriers of micro-organisms such as pathogenic bacteria, odour generating bacteria and mould fungi, but also excellent media for the growth of the microorganisms. 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 may induce the growth of microbes. Humid and warm environment still aggravate the problem. Infestation by microbes cause cross infection by pathogens and development odour where the fabric is worn next to skin [2]. Basically, with a view to protect the wearer and the textile substrate itself antimicrobial finish is applied to textile materials. A wide palette of antimicrobial compounds is now in use but differ in their mode of action. Many commercial antimicrobial agents effective but they are not compatible with skin and the environment. So, the natural herbal products can be used for antimicrobial finishes since there is a tremendous source of medicinal plants with antimicrobial composition to be the effective candidates in bringing out herbal textiles [3,4]. Eco Textiles gain utmost importance as one of the most useful resources that help promote new innovations, in an eco-friendly manner [5,6]. This research work aims at developing a sustainable anti-bacterial coating of chrysanthemum floral extract on bamboo fabric for healthcare applications. An extensive study was conducted to assess the antibacterial effectiveness of the extracts by standard test methods and findings are discussed.

## Materials and Methods

### Selection of material

4 Bamboo fabric with the count of 2 × 40's and plain weave was selected for the study. The fabric was scoured and bleached prior to the application of finish.

### Selection of antimicrobial herb

The chrysanthemum was the plant species chosen for the study. The flowers of chrysanthemum were shadow dried and made into a fine powder.

### Extraction of chrysanthemum solution

15 gms of chrysanthemum powder was mixed with 150 ml of solvent in the conical flask and then the cotton was plugged onto the conical flask. Then it was kept inside the shaker for 24 hours. After 24 hours, the extract was filtered and it was kept in the hot air oven for 3-4 hours for solvent evaporation. The dried extract precipitate was scrapped into the powder form and diluted as per the requirements.

### Method of finish application on fabric

Ethanolic extracts of herb were applied to bamboo fabric by dipping in bath at M:L ratio 1:10 with pomegranate mordant.The

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**Received** August 02, 2016; **Accepted** August 22, 2016; **Published** August 29, 2016

**Citation:** Krishnaveni V (2016) Anti-Bacterial Coating of Chrysanthemum Extract on Bamboo Fabric for Healthcare Applications. J Textile Sci Eng 6: 267. doi: 10.4172/2165-8064.1000267

optimized process conditions were temperature - 38°C, Time – 1 hr, pH – 7 and Concentration – 10%, 30 and 50%. The fabric was then dried at 80°C for 20 minutes to remove the moisture. After coating, the fabric samples were tested for antimicrobial activity as per the standard test methods. Then coated fabric samples were tested for antimicrobial activity as per the standard test methods.

### Assessment of anti-bacterial activity in chrysanthemum extract coated fabric samples

**AATCC-147-1998 (USA): – Qualitative Assessment of antibacterial activity on chrysanthemum extract coated sample by agar diffusion test:** The 50 ml of nutrient agar was prepared and sterilized at 121°C for 15 minutes. Petri plates were autoclaved in hot air oven at121°C for 30 minutes. 20 ml of Nutrient agar was poured into each of these plates and were allowed to solidify.

A series of 8 test tubes containing 4.5 ml of sterile water was taken. 0.5 ml of culture from nutrient broth containing the coated samples was transferred aseptically into the first test tube. Serial dilution was carried out until its reduced dilution was $10^{-8}$.

100 micro liters of $10^{-8}$ diluted culture was taken aseptically and poured onto the Petri plates. This was spreaded by using L rod. The plates were incubated at 37°C for 16-18 hours. Similar procedure was carried out for untreated sample; sample treated different concentrations.

**AATCC-100-1998 (USA): Quantitative Assessment of antibacterial activity on chrysanthemum extract coated sample by broth dilution test:** The 2" × 2" Samples were prepared from the samples chrysanthemum extract coated (untreated, 10%, 30% and 50% treated). 500 ml Elenmeyer conical flasks containing 50 ml of nutrients broth were prepared and sterilized at 121°C for 15 minutes. It was then allowed to cool. The fabric samples were then transferred aseptically into the conical flasks respectively. These were incubated at 37°C for 24 hours in shaker at 121 rpm. After incubation their absorbance were measured at 600 nm.

## Results and Discussion

### AATCC-147-1998 (USA): Qualitative antibacterial assessment of diffusible antibacterial agents ("quick method") – Agar diffusion test

The agar diffusion test results of chrysanthemum extracts for antimicrobial effectiveness against standard test cultures namely *Staphylococcus aureus and Escheirchia Coli bacterial* organisms are given in Table 1 and Figure 1. The zone of bacterial inhibition is indicated by a halo around the specimen. After incubation, the plates were observed for bacterial growth. Then the numbers of colonies were presented and the zone of inhibition was observed for each plate. The plates showed that the 50% extract treated fabric has less number of colonies when compared to other samples.

The samples treated with 50% chrysanthemum extract concentration showed a higher zone of inhibition of about 29 mm and 25 mm when compared to 30% extract treated (21 mm and 19 mm) and untreated samples. From the Table 1, the results indicated that the 50% treated fabric do not support the bacterial growth to larger extent against *Staphylococcus aureus* and *Escheirchia Coli,* where as 30% and 10% chrysanthemum treated sample to a smaller extent when compared to the untreated sample.

### AATCC-100-1998 (USA): Quantitative assessment of antibacterial finishes on textiles-measures the degree of antibacterial activity - Broth dilution test

The reduction rates in the number of colonies found on finished samples at different concentrations are given in Table 2. The test results were clearly indicated that by increasing the solution concentration the reduction rates of bacteria colonies progressively increased. Absorbance value of the sample is directly proportional to the concentration of the cells in the sample. The absorbance values of the 4 samples were compared and the percentage reduction of bacterial effectiveness was calculated. The results showed from the Table 2, that the fabric treated with 50% extract concentration gives low absorbance value (0.27 and 0.33) when compared to 30% concentration (0.38 and 0.41).

This indicates that 50% extract treated fabric do not support the growth of *Staphylococcus aureus* and *Escheirchia coli* compared to others. The chrysanthemum extract treated fabric sample with 50% concentration showed higher bacterial reduction percentage against both the bacterial organisms after finishing treatment.

### Wash durability test

The antimicrobial activities of the finished samples were evaluated for fastness to washing after different wash cycles and the antimicrobial effect percentages are given in Table 3. The durability of antimicrobial effectiveness in 50% extract treated samples in each wash cycles showed better antimicrobial effect compared to 30% and 10% chrysanthemum

| Samples | Zone of inhibition against *Staphylococcus aureus positive bacteria* | Zone of inhibition against *Escheirchia Coli negative bacteria* |
|---|---|---|
| Untreated sample | 0 | 0 |
| Chrysanthemum flower extract treated sample (10%) | 15 | 17 |
| Chrysanthemum flower extract treated sample (30%) | 21 | 19 |
| Chrysanthemum flower extract treated sample (50%) | 29 | 25 |

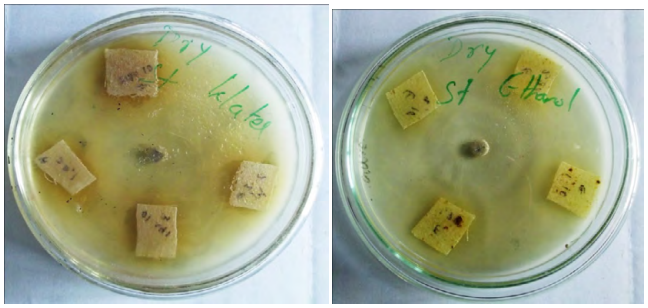
**Table 1:** Qualitative analysis of zone of inhibition of chrysanthemum extracts treated and untreated fabric samples.

| Fabric Samples | Assessment of Antibacterial activity by Absorbance value OD at 600 nm | | | |
|---|---|---|---|---|
| | *Staphylococcus aureus* positive bacteria | | *Escheirchia coli* Negative bacteria | |
| | Absorbance value | % of bacteria Reduction after treatment | Absorbance value | % of bacteria Reduction after treatment |
| Untreated sample | 1.07 | 0 | 1.03 | 0 |
| Chrysanthemum flower extract treated sample (10%) | 0.45 | 51.44 | 0.67 | 34.45 |
| Chrysanthemum flower extract treated sample (30%) | 0.38 | 63.52 | 0.41 | 61.10 |
| Chrysanthemum flower extract treated sample (50%) | 0.27 | 78.50 | 0.33 | 67.96 |

**Table 2:** Quantitative analysis of test results of chrysanthemum extracts treated and untreated samples (Broth dilution test).

| S. No | *Staphylococcus aureus* bacteria | | *Klebsiella bacteria* | |
|---|---|---|---|---|
| | No. of Washes | Zone of inhibition (mm) | No. of Washes | Zone of inhibition (mm) |
| 1 | 1 | 18 | 1 | 17 |
| 2 | 3 | 15 | 3 | 15 |
| 3 | 5 | 13 | 5 | 12 |
| 4 | 10 | 11 | 10 | 9 |
| 5 | 15 | 9 | 15 | 8 |
| 6 | 20 | 7 | 20 | 5 |
| 7 | 25 | 5 | 25 | 3 |

**Table 3:** Durability of antimicrobial effect of treated sample (50% concentration) after 25 washes.



*Staphylococcus Aureus* *Escherichia coli*

**Figure 1:** Zone of inhibition of chrysanthemum extract coated fabric samples.

treated samples. From the Table 3, the test results of antimicrobial effect revealed that the 30% concentration treated samples lasted for 11 washes. It was observed that the activity diminished gradually as the number of wash frequencies increase.

## Conclusion

This research work has given a new idea in finishing of cotton with herbs for antimicrobial activity. The chrysanthemum finishes increases the durability and antibacterial activity of finished fabric to a greater extend. In general, all the chrysanthemum flower extracts treated fabric samples gives better antimicrobial activity against gram positive and negative bacteria. The 50% chrysanthemum flower extracts treated samples exhibited maximum antimicrobial activity in all the tests. The chrysanthemum floral extract coated fabric does not have any bacterial colonies and also control the growth of microorganisms. The finish is cost effective and user friendly because it is natural, easy availability and ecofriendly, it can be repeatedly applied as a renewable finish. It will also lay the foundation for healthcare textiles.

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