

## Research Article

# A STUDY ON THE EFFECT OF COTTON FABRIC FINISHED WITH “AEGLE MARMELOS” HERB

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## ABSTRACT

In the present scenario, environmental consciousness has made people to think about using more eco-friendly products in textile field. Herb extract demonstrating anti-bacterial properties may provide protection on textile applications. The 100% cotton fabric was selected for the study. The objective of the study is to finish the cotton fabric using the herb “Aegle Marmelos (Bael leaves)” and evaluate the anti-bacterial activity against the growth of gram negative and gram positive organisms like *Escherichia coli* (E.coli) and *Staphylococcus Aureus* (S.aureus). Selected herb was extracted using methanol as a solvent and it's made into nanocapsules by high pressure, temperature etc. The nanoencapsulated extract was applied onto the fabric dip-dry method and pad-dry-cure method. It's been then evaluated for anti-bacterial activity; the herb shows good result of activity on pad-dry-cure method than dip-dry method. It may be due to herbs inhibited in the fabric.

**Keywords:** *Aegle Marmelos* herb, antibacterial activity, cotton fabric and Nanoencapsulation method

## INTRODUCTION

The textile and clothing industry is a diverse and heterogeneous industry which covers an important number of activities, from the transformation of fibers to yarns and fabrics, to the production of a wide variety of products. Textiles have such an important bearing on our daily lives that everyone needs to know something about them. Since time immemorial, people have been using textiles of various types, from covering the body for modesty, for warmth, for personal adornment, to display of personal wealth.

Cotton was first cultivated in the old world 7,000 years ago (5th millennium BC), by the inhabitants western Pakistan. For example, at the site of Mehrgarh, early cotton thread has been preserved in copper beads of, says Moulherat et al (2002). Cotton was already being used in weaving, according to Saraf et al (2005). Cotton had its patriotic associations too, for it was spun on the “Charka” by the father of our nation, as denoted by Steven et al (2007).

The word ‘eco’ is short for ecology. Ecology is the study of the interactions between organisms and their environment. Therefore ‘eco’ friendly (or ‘ecology friendly’) is a term to refer goods and services considered to inflict minimal or no harm on the environment quoted by Singer (2007)

*Aegle marmelos* (Bael) is a sacred tree from India, of Rutaceae family, related to citrus. It is a beautiful medium size tree (average is 8.5 m tall), with spines on its branches and very aromatic. Leaves are pale green and trifoliate. Flowers are greenish white, sweetly scented, fruits are yellowish green. It is a good source of vitamin C and protein. There are several medicinal uses of Bael in curing diarrhea, fever, poor absorption, and bleeding, vomiting, nausea with blood, bronchitis, and gingivitis. Decoction of leaves is febrifuge, expectorant, asthmatic complaints. The leaves contain many constituents like alkaloids, aegeline, alkaloid coumarine, and marmine, sterol sitosterol, and essential oils d-limonene. Aegeline has recently attracted the interests of several researches pointed by Ganesh N. Sharma (2011).

Nanoencapsulation is defined as the technology of packaging nanoparticles of solid, liquid or gas, also known as the core or active, within a secondary material, named as the matrix or shell, to form nanocapsules. The core contains the active ingredient (e.g., drugs, perfumes, biocides, vitamins, etc., while the shell isolates and protects the core from the surrounding environment. This protection can be

permanent or temporal, in which case the core is generally released by diffusion or in response to a trigger, such as pH, or enzyme action, thus enabling their controlled and timed delivery to a targeted site.

Nanoencapsulation is the coating of various substances within another material at sizes on the nano scale. This technique is already commonplace within a range of industries but it is accepted that only around 10% of potential applications are being exploited.

In this study the effect of “Aegle Marmelos” on cotton fabric by the application of nanoencapsulation technique is going to be verified for its anti-bacterial activity.

## OBJECTIVES

The objectives of the study includes

- To select the cotton fabric
- To select “Aegle Marmelos” (Bael Leaves) for finishing the cotton fabric.
- To prepare nanocapsules extract of the selected herb.
- To apply the nanocapsule extract of the herb on cotton fabric using dip-dry method and pad-dry-cure method.
- To evaluate the special finish by testing anti-bacterial activity.

## MATERIALS AND METHOD

### Selection of fabric

Based on market survey and consumer survey, two and half meter of 100% cotton fabric was purchased at the cost of Rs.75 from Sri Subramanian Textiles, Coimbatore.

Count of the fabric- 40s

Thickness of the fabric-31mm

### Selection of herb

The Natural herb “*Aegle Marmelos*” (Bael leaves) is selected. It is been collected from in and around areas of Coimbatore.

### Extraction

The fresh leaves are collected in the living areas of Coimbatore were shade dried and it is been grinded into fine powder by using a mixer grinder. The herb extract was produced using methanol as a solvent in soxhlet extraction chamber.

**Recipe**

- Powdered herb - 10gm
- Methanol - 100ml
- Temperature - 40°C
- Duration - 24 hrs

Extraction of herb was carried out by soxhlet apparatus and it's working on steam distillation process. The powdered leaves of 10 gm were added on 100 ml. of methanol, the working temperature was maintained at 40°C and distilled for 24 hours. Once the distillation started the sample start boiling within 5 min and vapour are formed. The vapour is cooled down with the help of condenser. The condensed material was collected on the other side of setup. The collected material is a mixture of herb and methanol. The process is repeated for several cycles for a day, and then the extract was filtered using Whatman No.1 filter paper.

After filtering the herb extract, methanolic solvents were evaporated and the herb extracts were concentrated and stored at 4°C for further studies.

**PROCEDURE OF NANOENCAPSULATION METHOD****Preparation of Nanoencapsules**

The herbal extracts prepared were encapsulated using bovine albumin fraction as the wall material and the nanoparticles (herb) as the core material.

**Procedure**

The herbal extract enclosed bovine serum albumin protein was prepared by coacervation process followed by cross-linking with glutaraldehyde. The herbal extract was incubated with the required protein solution (2% W/V) for an hour at room temperature. The pH of the solution was adjusted to 5.5 by 1M HCL using digital pH meter. Then ethanol was added to the solution in the ratio of 2:1 (V/V). The rate of ethanol addition was carefully controlled at 1 ml per minute. The coacervate so formed was hardened with 25% glutaraldehyde for 2 hours to allow cross-linking of protein. Organic solvents were then removed under reduced pressure by rotary vacuum evaporator and the resulting nanocapsules were collected and stored for further studies.

**DIP METHOD**

The following recipe was used to finish the four selected fabrics by dip method using the extracted herbs.

**Recipe**

- Cotton fabric - 2.5cm ± 0.1cm diameter
- Solvent - the produced nanocapsules
- Time - 20 minutes

For finishing the fabric by dip method, the desized sterile samples was cut with 2.5cm ± 0.1cm diameter. The extracted solvent was added in a beaker. The cotton samples were immersed in the solvent for twenty minutes and then the sample were removed from the solvent and dried in the air without washing. The finished samples were sterilized by UV rays in the laminar air flow chamber to avoid microbial growth on the surface of the fabric. The sterile finished fabric sample was kept in a sterile container.

**PAD-DRY-CURE METHOD****Finishing of selected fabric by pad dry cure method****Recipe**

- Cotton fabric - 1 Meter (100% Cotton)
- Nanocapsules - 2%
- Binder (Citric acid) - 8%
- Temperature - 55°C
- Time - 30 minutes

The basic process was that the nanocapsules were compounded at a particular ratio and padded on the fabric. The nanocapsules were attached to the fabric with binder. By evaporating water during the drying process in a tenter, it allows only the required ingredients to combine with the fabric.

The Compounded solution consisted of 2% of the nanocapsules with binder citric acid 8% and normal textile chemicals were added, such as softener and anti-static electricity agent and kept in a bath. The fabric was dipped into the compounded solution using a roller. The fabric was sent through a mangle to squeeze the dipped chemicals out of the bath at a certain ratio by the pickup rate when the fabric was passed between the rollers. The heat dryer dried the fabric with heat for evaporating water and maintaining its width. The encapsulation worked inside the fabric, filling the spaces between the fibers with an ultra thin film of polymer creating a permanent barrier that was breathable, yet impermeable to both water and wind.

**ANTIBACTERIAL ACTIVITY ASSESSMENT BY AATCC 147 METHOD**

Various test procedure have been used to demonstrate the effectiveness of the antibacterial activity. Some of the tests used are:

- Agar diffusion test
- Challenge test (Quantitative)

Agar diffusion test is a preliminary test to detect the diffusive antimicrobial finish. It is not suitable for non diffusive finishes and textile materials other than fabrics. Objective evaluation of the antimicrobial activity is arrived at by making use of the challenge test where in which the difference between the actual bacterial count of the treated and antimicrobial finishes. The application of the finish is now extended to textiles used for outdoor, healthcare sector, sports and leisure. Novel technologies in antimicrobial finishing are successfully employed in nonwoven sector especially in medical textiles.

**Agar Diffusion Evaluation Method**

Anti bacterial activity of aegle marmelos against staphylococcus aureus (S.aureus), Escherichia coli (E.coli) and Klebsiella pneumonia (K.leb). In order to test the antibacterial efficacy of aegle marmelos against the bacterial isolates Agar diffusion test was done and the results are tabulated as follows.

**Recipe**

- Agar used : Nutrient agar
- Temperature : 37°C
- Time : 24 hours
- Sample size : 1cm in diameter

**Procedure**

Nutrient Agar was prepared. Sterilized in autoclave for 121°C at 15 psi pressure for 20 min. Agar was poured in Petri plates and allowed to solidify; lawn cultures of S.aureus E.coli and K.leb were done using sterile swabs. Treated samples and controlled samples were placed in lawn culture plates and allowed to incubate at 37°C for 24 hours or overnight. After incubation period, zone of inhibition was measured using zone scale and results were tabulated. The following pictures show the inhibition zone levels for directly applied fabric.

**WASH DURABILITY TEST**

The greatest influence was made by washing. During the whole washing cycle, garments were affected by the entire complex of different factors such as a washing solution, abrasion, creasing, heat, various chemicals etc, says Juciene et al (2006). The dip and pad dry nanoencapsulation finished fabrics were analyzed for wash durability by subjecting the samples to washing by industrial machines and testing. The washed fabrics were assessed by AATCC147 method.

## NOMENCLATURE

S.NO	NOMENCLATURE:	S.NO
1	UCF	unfinished cotton fabric
2	DCFAM	dip dry cotton fabric finished with "aegle marmelos"
	CDCFAM	cold dip dry cotton fabric finished with "aegle marmelos"
	HDCFAM	hot dip dry cotton fabric finished with "aegle marmelos"
3	PCFAM	pad dry cotton fabric finished with "aegle marmelos"
	CPCFAM	-cold pad dry cotton fabric finished with "aegle marmelos"
	1DHPCFAM	1 dip pad dry cotton fabric finished with "aegle marmelos"
	2DHPCFAM	2 dip pad dry cotton fabric finished with "aegle marmelos"

## RESULT AND DISCUSSION

The result and discussion pertaining to the study of antibacterial finish on cotton fabric using "*Aegle Marmelos*" leaves was carried out under the following headings.

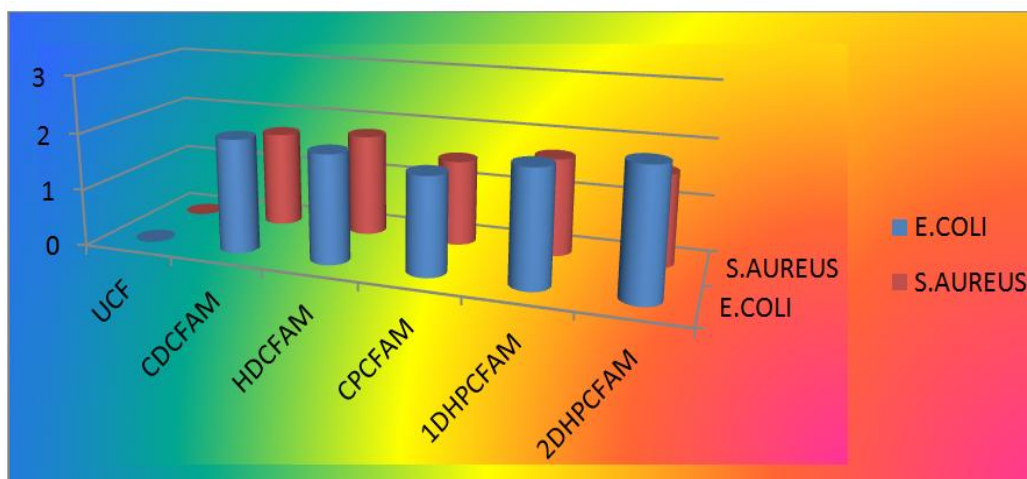
## Anti- Bacterial Assessment By Aatcc 147 Method

The anti-bacterial activity of the UCF, DCFAM and PCFAM nanoencapsulated finished fabrics was tested according to AATCC 147 standard test method.

Table 1: Anti-Bacterial activity [zone of Inhibition (mm)]

S.NO	SAMPLES	ZONE OF INHIBITION(mm)	
		E.COLI	S.AUREUS
1	UCF	NIL	NIL
2	DCFAM	2	1.7
	CDCFAM	1.9	1.8
3	PCFAM	1.7	1.5
	1DHPCFAM	2	1.7
	2DHPCFAM	2.2	1.6

Fig. 1: Anti bacterial Activity.



From the above TABLE-1, FIGURE-1 PLATE 1 and PLATE 2. It shows that UCF sample as no zone of inhibition. From the above 5 samples CDCFAM, HDCFAM, CPCFAM, 1DHPCFAM and 2DHPCFAM the antibacterial Activity against E.coli is better in

2DHPCFAM and the activity against S.aureus is better in HDCFAM because of the inhibition of the nanoencapsulated herb extract applied on the fabric.



**Plate 1** Finished and unfinished samples against *Staphylococcus aureus*.



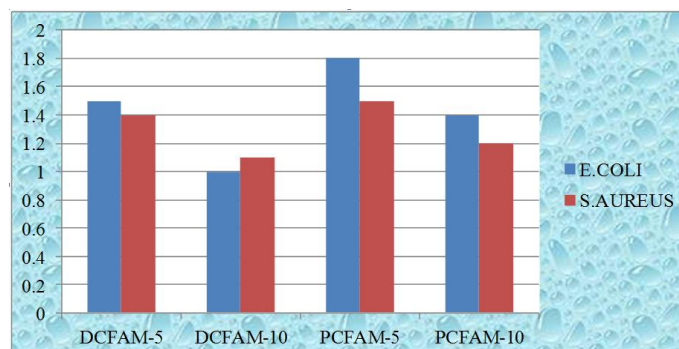
**Plate 2** Finished and unfinished samples against *Escherichia coli*

#### Wash Durability Test

The wash durability test was taken for the sample which has shown high activity against bacteria by both dip dry and pad dry nanoencapsulated fabric based on the ENISO standard method.

**Table 2: wash durability test**

S.NO	SAMPLE	ZONE OF INHIBITION(mm)	
		E.COLI	S.AUREUS
1	DCFAM-5	1.5	1.4
2	DCFAM-10	1	1.1
3	PCFAM-5	1.8	1.5
4	PCFAM-10	1.4	1.2



**Fig. 2: wash durability test.**

From the above FIGURE-2 and TABLE-2 it has found that wash durability of finished fabric are tested after 5 and 10 washes it shows that DCFAM-5 (1.5,1.4);after 10 washes DCFAM-10(1,1.1);whereas PCFAM-5 (1.8,1.5) and PCFAM-10(1.4,1.2) which is better retaining of the finish compared to dip dry fabric

#### CONCLUSION

The above study shows that the natural herbs are gaining more importance nowadays to treat various health issues. Cotton fabric serves as a good absorbent and it is suitable for most of new finishes. The anti-bacterial activity of "Aegle Marmelos" shows good result on pad-dry cure fabric compared to dip method. It may be due to herbs inhibited in the fabric.

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