

Antimicrobial Finish For Cotton Fabric From *Mirabilis Jalapa* Leaf Extract

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Abstract: The present study focused on the preparation of antimicrobial textile from *Mirabilis jalapa* leaf extract. The active components of *Mirabilis jalapa* leaves were extracted using different solvents namely ethanol, ethyl acetate, chloroform, formaldehyde and distilled water. Antimicrobial activity of *Mirabilis jalapa* leaf extracts were determined against the pathogens such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Candida albicans*. Among all the solvents of *Mirabilis jalapa*, the ethanolic leaf extract showed excellent activity against *Staphylococcus aureus* (36mm) and moderately against *Candida albicans* (29mm). The phytochemical compounds such as reducing sugar, Tannins, Phlobatanins, terpenoids saponins, alkaloids, flavonoids and poly phenols were studied. The result obtained for *Mirabilis jalapa* leaf extract treated fabrics proposes that these types of antimicrobial finishes can control the undesirable effects of microbes on textiles which is an important issue in medical and textile field.

Keywords: Herbal extract, *Mirabilis jalapa*, Antimicrobial activity, Antimicrobial textiles.

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I. Introduction

Plant is man's friend in survival, giving him food and fuel and medicine from the days beyond drawn of civilization. Plant continues to be a major source of medicine, as they have throughout human history. For many centuries, medicinal plants have been widely used as remedies for a wide range of diseases including malaria, angina, yaws, gastroenteritis, dental abscesses, headaches, several kinds of fevers and so on. The origin and use of plants to treat various ailments can be traced as far back to ancient manuscripts such as the Bible, Rigvedas and to the history of Herodotus. The plant has been extensively studied for a variety of bioactive principles and screened for different pharmacological activities. Several studies on the leaf extracts of *M.jalapa* have been reported to possess various bioactive properties including antibacterial, antifungal, antiviral^[1], anti-inflammatory^[2], anti-allergic, anti-asthmatic and anti diabetic^[3]

Mirabilis jalapa belongs to the family Nyctaginaceae, plant has been referred with the name as the four o'clock flower plant. It is known as Anthi-Mandhaari in Tamil, Naalumanipoovu in Malayalam. The plant is a tall herbaceous climbing plant with opposite leaves, large showy flowers and prominent tuberous roots. It is planted as ornamental plant throughout the country. In herbal medicine, parts of the plant may be used as a diuretic, purgative, and for vulnerary (wound healing) purposes. The primary objective of the finish was to prepare antimicrobial textile with herbal extract. Antimicrobial textile products have attracted a great interest in recent years. The antimicrobial textile products reduce the transmission of pathogens in the environment and also increase the life of the textile products. In order to scientifically apprise some of the ethno medical uses of the plant, the present study intends to evaluate the antimicrobial properties of *M. jalapa* commonly used in herbal medicine and its application in antimicrobial textiles. The control of undesirable effects of microbes on textiles is becoming an important issue in textile industry.

II. Materials And Methods

2.1. Collection of plant materials^[4]

The *Mirabilis jalapa* leaves were collected from the natural habitat in Gudalur, The Nilgiris, India. The freshly collected healthy leaves were washed under running tap water to eliminate dust and other foreign particles. The shade dried material was grounded into powder and stored in dark.

2.2 Preparation of plant extract^[5]

About one gram of powdered plant materials were dissolved in 10 ml of ethanol, ethyl acetate, chloroform, formaldehyde and water separately. Mixtures were kept in the dark for three days at room temperature. After that the mixtures were filtered through Whatmann no.1 filter paper and kept it for condensation. All the dried extracts were dissolved in DMSO (Dimethyl sulphoxide) and stored it in dry place for further analysis.

2.3. Antimicrobial Susceptibility testing for the leaf extract^[6]

The determination of antimicrobial activity of the *Mirabilis jalapa* leaf extract was performed by using disc diffusion method. Muller Hinton agar was prepared and sterilized. Log phase culture of the test specimens (*Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Candida albicans*) were inoculated over the agar surface. The extracts were diluted in distilled water across a concentration range of 0.1mg/ml – 5.0 mg/ml. Sterile discs were impregnated with 10µl of test dilutions. The dried discs were placed on the inoculated plates. The plates were incubated at 37± 2⁰ C for 24 hours for bacteria and 28±2 °C for 72 hours for fungal activity. Control wells containing neat solvents (negative control) were also run parallel in the same plate.

2.4. Phytochemical Analysis^[7]

Phytochemical analysis of alkaloids, flavonoids, steroid, volatile oil, glycoside, reducing sugar, tannins and saponins was performed.

2.5 Application of *Mirabilis jalapa* leaf extract for antimicrobial finishing on cotton fabrics: Pad dry cure Method^[8]

Mirabilis jalapa leaf extract was applied on destarched 40s count cotton fabric by pad dry cure method. The 40s count, desized 100% cotton fabric was cut to the size of 30x30 cm and immersed in the test solutions. *Mirabilis jalapa* extract (2%) and Alum binder (6%) was used. The sample fabric was immersed in the solution for 5min and then it was passed through a padding mantle, running at a speed of 15/min with a pressure of 1kgf/cm to remove excess solution. 100% wet pic up was maintained for all of the treatments. After padding the fabric was air dried and then cured for 3 mints at 80⁰C.

2.6. Physical characterization of finished fabric^[9]

The following procedures were studied to check the Physical characterization of the finished fabric

2.6.1 Air permeability of finished fabric (ASTM D37-2004)

The treated and untreated fabrics were analyzed for their effectiveness in air permeability at a relative humidity of 65% and temperature of 21°C.

2.6.2 Tensile strength-Grab test of finished fabrics (ASTMD 5034-95-2001)

The breaking strength and elongation of the treated and untreated fabrics were determined by using tensile testing machine.

2.6.3 Tear strength of finished fabrics (ASTM D2261-96)

The tearing strength of treated and untreated fabrics was measured by the tongue procedure using constant rate of extension tensile testing machine.

2.6.4 Wash durability test

The durability of antimicrobial activity of the finished samples was calculated after different wash cycles. The samples were washed with 5% neutral soap solution for 20 minutes and washed with normal water. The washed samples were tested for the retention of antimicrobial activity after 2,4,6,8 and 10 laundering by AATCC -100 test methods.

2.7 Evaluation of antibacterial activity of finished fabric^[10]

Log phase culture of the test organisms *Staphylococcus aureus* (ATCC 6538) and *Escherichia coli* (ATCC 11229) were inoculated on sterile AATCC Bacteriostasis agar. Using sterile 4mm inoculating loop, one loop full of culture was loaded and transferred to the surface of agar plate by making five parallel inoculum streaks approximately 60mm in length and spaced 10mm covering the central area of petridish without refilling the loop. The test fabric specimen was gently pressed transversely, across the five inoculums of streak to ensure intimate contact with agar surface. The plates were incubated at 37°C for 18-24 hours.

The incubated plates were examined for the interruption of growth over the inoculum. The size of the clear zone was used to evaluate the inhibitory effect of the test sample and the average width of the zone along the streak on either side of the test specimen can be calculated by the following formula,

$$W = (T - D) / 2$$

where,

W is the width of clear zone of inhibition in mm.

T is the total diameter of test specimen and clear zone in mm.

D is diameter of the test specimen in mm

2.8 Evaluation of antifungal activity of finished fabric^[10]

Antifungal activities of the finished fabrics were evaluated by qualitative (AATCC100-1999).

2.8.1 Qualitative Test (AATTC Test Method 100-1999)

Microbial suspensions of *Candida albicans* (10231) from a 36 hour old culture in YMB medium (25 µl of 10⁶ cell/ml), were loaded onto 2 × 2 cm cotton fabric. To ensure contact between the yeast cells and the

fabric, a cover cloth was sandwiched over the loaded one. Samples were quenched with 5.0 ml of sodium thiosulfate solution (0.02 N) after 30, 60, 90 and 120 min. Serial dilutions were made using phosphate buffer pH 7, and 100 µl was plated on YMA. Grown colonies were counted after incubation at 37°C for 24 hrs to determine the presence of viable cells. The inhibition rate was calculated as

$$(Ct-T) / Ct \times 100$$

Where,

Ct - No. of grown colonies on control textile,

T - No. of grown colonies on treated textile.

III. Result And Discussion

3.1 Screening of Antimicrobial activity of *Mirabilis jalapa* leaf extract

Solvent extracted samples were screened for antimicrobial activity. Among all the solvents (ethanol, ethyl acetate, chloroform, formaldehyde and water), the ethanolic leaf extract of *Mirabilis jalapa*, showed excellent activity against excellent towards *Staphylococcus aureus* (36mm) and good against *Candida albicans* (29mm)¹¹.

Table 1. Antimicrobial activity of *Mirabilis jalapa* leaf extracts

S.No	Organism	Zone of inhibition in mm				
		Ethanol	Ethylacetate	Chloroform	Formaldehyde	Water
1	<i>Bacillus subtilis</i>	28	-	11	15	19
2	<i>Staphylococcus aureus</i>	36	-	09	12	16
3	<i>Escherichia coli</i>	24	10	20	19	12
4	<i>Pseudomonas aeruginosa</i> ,	27	-	14	-	11
5	<i>Candida albicans</i>	29	-	18	10	-

- No Zone formation

3.2 The Phytochemical analysis of *Mirabilis jalapa* leaf extracts

The *M.jalapa* leaf extract were screened for some secondary metabolites. The following phytochemicals were identified Tannins, Phlobatannins, Saponins, Terpenoids, Alkaloids and Polyphenols^[11,12].

3.3 Evaluation of antimicrobial activity of finished fabric

3.3.1 Antibacterial Test (AATCC test method 147-2007).

The efficacy of ethanolic leaf extract coated cotton fabric was evaluated by Qualitative tests (AATCC test method 147-2007). The cotton fabric finished with ethanolic leaf extract of *Mirabilis jalapa* inhibited the growth of *Staphylococcus aureus* (ATCC 6538) and *Escherichia coli* (ATCC 25922). The result showed that there was no growth under the treated fabric. (Fig 1a, 1b and 1c).

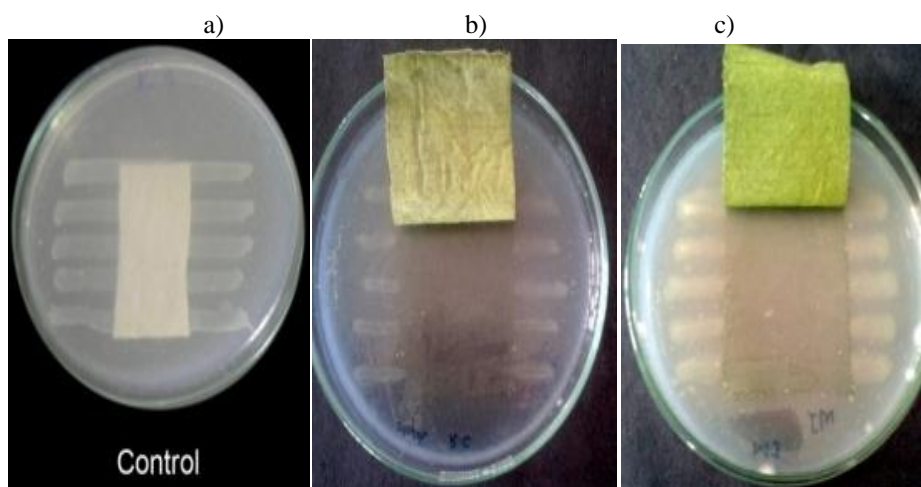


Figure 1. Depicts the result of Antibacterial activity

a) Control fabric

b) *Staphylococcus aureus* (ATCC 6538)

c) *Escherichia coli* (ATCC 25922).

3.3.2 Antifungal Test (AATTC Test Method 100-1999)

The cotton fabric finished with ethanolic leaf extract of *Mirabilis jalapa* inhibited the growth of *C. albicans* (10231), the result showed that growth inhibition was noticed under the treated fabric when compared with untreated fabric (Fig 2d and 2e).

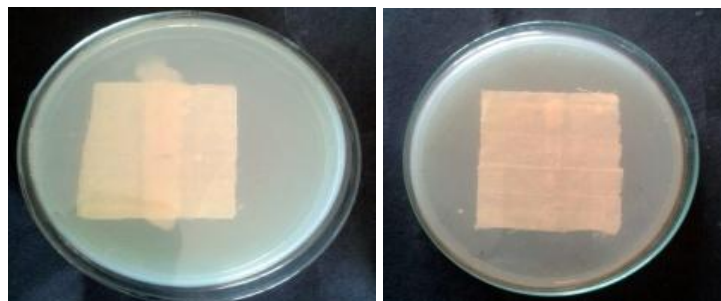


Figure 2.) Depicts the result of Antifungal activity
 d) Untreated fabric e) Treated fabric

3.3.3 Physical characterization of finished cotton fabric

Based upon the results (Table 2) air permeability of the cotton fabric was not much affected after the treatment. Tensile strength value of finished fabric was in acceptable range when compared to control. In treated fabric, the wrap strength reduction occurs from 42.95 Kg to 35.28 and warp elongation was found to be 1.56%. A less tear strength difference was noted in the treated samples both in wrap and weft ways.

Table 2. Physical characterization of finished cotton fabric

S.No	Experiments	Control fabric	Treated fabric
1.	Air permeability	48.3	43.2
Tensile strength			
2.	Wrap strength (kg)	42.95	35.28
	Wrap elongation (%)	13.17	11.61
	Weft strength (kg)	32.86	22.95
	Weft elongation (%)	19.95	17.58
Tear strength			
3.	Wrap strength (gf)	1572.0	1390.0
	Weft strength (gf)	1442.0	1270.0

3.3.4 Wash durability test

The treated fabric sustained 80% of antibacterial activity against the test bacteria until 8 wash cycles and after a slight reduction in the activity of the fabric was noticed.

IV. Conclusion

From the present work it has been concluded that the *Mirabilis jalapa* ethanolic extract have the potent antibacterial activity against the microorganisms. The ethanol is the most suitable solvent for the extraction of biomolecules from *M.jalapa* leaf. The antimicrobial activity of *M. jalapa* attributed to the various phytochemical constituents present in the crude extract. The present study intends to evaluate the antimicrobial properties of *M. jalapa* used in herbal medicine and its application in antimicrobial textiles.

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