IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Characterization Of An Herbal Finished Interlock Fabric

Vishali M[1], Dr. Benitta Christy P[2]

[1]Post Graduate Student, Department of Costume Design and Fashion, PSG College of Arts & Science.

[2]Assistant Professor, Department of Costume Design and Fashion, PSG College of Arts & Science.

ABSTRACT:

Ethno-medicinal plants have been studied in view of the demand for safe, eco-friendly alternatives to the use of synthetic antimicrobials in the textile sector. The development of a bioactive finish using the plant *Leucas aspera* (Thumbai), which is known for its presence of essential secondary metabolites, is the principal focus of the current project.

Aqueous solutions were employed for the extraction of *Leucas aspera* leaves. The components present in these plant extracts were analyzed. In order to allow for ester bond formation between the phenolics in the plant extracts and the cellulose fibers through an environmentally friendly cross-linking reagent like citric acid, the ethanolic extract of the plant was incorporated into the interlock cotton through the use of padding and mangle.

Keywords: *Leucas aspera*; Anti-microbial finish; Herbal textiles; Interlock fabric; Phytochemical screening.

1. INTRODUCTION

As people become increasingly aware of the environment and the hazards of artificial chemical finishing, there is a paradigm shift occurring in the global textile industry towards sustainable practices. Although efficient, traditional antimicrobial finishing often involves the use of artificial compounds such as triclosan or heavy metals such as silver, which may irritate the skin, lead to environmental pollution, and even the development of antibiotic-resistant bacteria. With regard to the production of

functional fabrics, ethno-medicated plants emerge as an effective and environmentally friendly alternative. *Leucas aspera*, commonly known as "Thumbai," is one plant that is especially suitable for the functionalization of textiles among the diverse range of plants from the Indian subcontinent.

The aromatic herb aspera grows across India, specifically in the plains of Tamil Nadu. The plant has for ages received great attention in Siddha and Ayurveda medicine due to its various medicinal properties like treatment of skin diseases, snakebites, and use as antipyretics and anti-inflammatory drugs.

Modern research and advancement in science have proven the efficiency of *L. aspera* because of its complex biochemical structure. Alkaloids, flavonoids, tannins, and saponins are some of the secondary compounds found in the plant used as biological defense against microbe colonization. Scientists are able to provide antimicrobial properties permanently to common materials through these biologically active compounds. This research aims to establish the anti-microbial resistivity against multiple bacterial and fungal strains.

2. MATERIALS AND METHODS

2.1 Raw Materials

The materials used for the development of herbal finished interlock fabric that are given below is sourced completely within Tamil Nadu.

2.1.1 Selection of Herbs:

- The medicinal herb, Thumbai (*Leucas aspera*) was sourced from the landscapes of Tamil Nadu.
- The leaves of the herb were sourced, washed, shadow dried, and powdered through mechanical grinding.

2.1.2 Selection of Textile materials:

100% cotton interlock knitted fabric was used for application of anti-microbial finish. The fabric specification of the interlock fabric is mentioned in Table 1.

S. No	FACTOR	SPECIFICATION
1	GSM	231.2
2	Wales per inch	35
3	Course per inch	40
4	Yarn count	30^s
5	Thickness	0.90 mm

Table 1: Fabric Specification

2.2 Methods

2.2.1 Pre-treatment

2.2.1.1 Scouring

Scouring is a process that eliminates the hydrophobic impurities such as fats, waxes, and pectin from the

grey fabric to increase its absorbency and improve the uniformity of dyeing.

Recipe:

Sample weight: 535 grams

Sodium hydroxide (NaOH): 3%

Sodium carbonate (Na_2CO_3): 1%

Turkey Red Oil: 4ml

Material Liquor Ratio: 1:20

Temperature: 100^o C

Time: 120min

2.2.1.2Bleaching

Bleaching is a process of destroying the natural coloring matter in a fabric and achieving whiteness in a required degree without damaging the cellulose fiber.

Recipe:

Hydrogen peroxide (H_2O_2, 35%): 4.5 g/L

Stabilizer (Sodium silicate): 2-7 g/L

Caustic soda (NaOH): 0.5 g/L

Sodium carbonate: 1.8g/L

Wetting agent: 1g/L

Material Liquor Ratio: 1:20

Temperature: 95^o C

Time: 1-2hrs

2.2.1.3 Citric acid Fixation

Citric acid fixation involves using citric acid as an eco-friendly crosslinking agent to improve the fixation of dyes/ finishes on chemically pretreated fabrics. This method helps in the reducing the washing-off requirements and also imparts anti-crease and easy-care properties.

Recipe:

Citric acid: 20%

Trisodium citrate: 6%

Temperature: 180^o C

Time: 30mins

2.2.2 Extraction

2.2.2.1 Recipe for Extraction

The solvent is extracted with distilled water in a material to liquor ratio of 1:20 using Orbital shaker for 24 hours and filtered with No.1 Whatman Filter paper.

2.3 Qualitative phytochemical analysis

The extracts using distilled water, methanol and ethanol were tested for the presence of bioactivecompounds using the Tube method. The presence of alkaloids(Mayer's test), flavonoids (Alkaline reagent test), saponins (Foam test), proteins (Biuret Test), amino acid (Ninhydrin test), steroids (Salkowski test), carbohydrates (Benedict test), phenol (Ferric chloride test), tannins and glycosides (Keller-Kiliani test) were screened.[4,5,6]

2.2.4 Anti-microbial Susceptibility Testing

The streak method Disk Diffusion test involves media preparation using Mueller Hinton Agar (MHA) for bacterial susceptibility and Sabouraud Dextrose Agar (SDA) for fungal susceptibility. The Four-Direction Swab Streak Plate Inoculation technique is used where the sterile cotton swabs were dipped into the broth cultures of *Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis and Candida albicans*spread evenly over the entire agar surface in five distinctive plates. The plates for bacterial susceptibility were kept inside the incubator for 24hrs and the plates for fungal susceptibility were kept in a room temperature for 24hrs. Then, the zone measurement and interpretation of the results were carried out.[7,8]

2.2.5 Application method

The interlock fabric was finished with distilled water *L. aspera* extract via padding mangle in an MLR of 1:20 using two-dip/ two-nip sequence. The fabric is then dried under room temperature.[9] Citric acid pretreatment promoted covalent fixation through ester linkage between phenolics and cellulose.[1]

3 RESULT AND DISCUSSION

3.1 Phytochemical Analysis of the extract

The qualitative phytochemical screening of aqueous, methanolic and ethanolic extracts from *Leucas aspera* leaf indicated the presence of alkaloids, flavonoids, saponins, protein, amino acids, steroids, carbohydrates, phenols, tannins and glycosides. The aqueous and ethanol extracts showed higher concentration of bio-active compounds. All bio-active compounds except proteins, carbohydrates and glycosides were found in the aqueous and ethanolic extract. The presence of alkaloids, flavonoids, saponins, amino acids, steroids, phenols and tannins indicate the presence of analgesic, UV protective, anti-microbial, anti-fungal and anti-inflammatory properties.

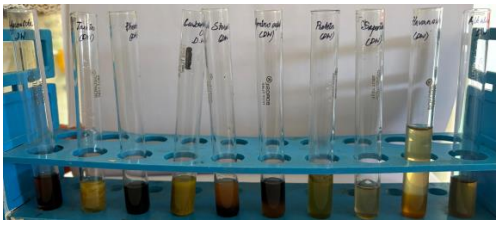


Fig. 1: Phytochemical analysis of Aqueous extract

Test	Phytochemical analysis of *L. aspera* leaf Aqueous extract
Alkaloids	+
Flavonoids	+
Saponins	+
Proteins	-
Amino acid	+
Steroids	+
Carbohydrates	-
Phenols	+
Tannins	+
Glycosides	-

Table 2: Phytochemical analysis of *L. aspera* leaf extract

The results gained from the phytochemical screening are depicted in the pictures from Fig.1 and interpreted in the Table 2.

3.2 Thickness Test

The physical dimension i. e thickness of the developed interlock fabric was calculated using a digital thickness gauge.

S. No	Material	Thickness (in mm)
1	Interlock fabric	0.90

Table 3. Thickness

3.3 Bursting Test

The bursting strength of the 100% cotton interlock fabric was evaluated to determine its mechanical resistance to multi-directional force. The measured values are resulted in the Table 4.

Bursting Strength in Kgs
8.35

Table 4: Bursting Strength

The average bursting strength of the interlock fabric is calculated as 7.96 Kgs in which the loops tucked behind each other in an interlock structure provides higher resistance against the hydraulic diaphragm pressure.

3.4 Air permeability Test

The air permeability of the untreated interlock fabric and the anti-microbial finished interlock fabric was measured to evaluate the impact of the treatment on fabric breathability. The results are summarized in the Table 5.

Sample	Air Permeability		
	R1	R2	R3
Pre-treated	400	160	12
Treated	350	120	8

Table 5: Air permeability

Calculation:

Air permeability and Air resistance of Pre-treated Interlock fabric:

Average rate of air flow = (R1 + R2 + R3) / 3

= 190.67

Air permeability = Average rate of air flow / 5.07 [11]

= 37.61 $cm^3/s/cm^2$

Air resistance = 5.07 / Average rate of air flow

= 0.026 Pa.s/m

Air permeability and Air resistance of Treated Interlock fabric:

Average rate of air flow = (R1 + R2 + R3) / 3

= 159.33

Air permeability = Average rate of air flow / 5.07[11]

= 31.43 $cm^3/s/cm^2$

Air resistance = 5.07 / Average rate of air flow

= 0.032 Pa.s/m

Hence, a reduction of 6.18 $cm^3/s/cm^2$ is attributed to the deposition of *L. aspera* plant extract and the cross-linking agents onto the fabric surface.

3.5 Abrasion Test

The abrasion resistance of the 100% cotton interlock knitted fabric was evaluated using Martindale Abrasion Method. The test was conducted until the sample ruptured. The results are presented in the Table 6.

S.No	Number of Rubs/ Cycle	Initial weight (gms)	Final weight (gms)	Weight loss %
1	85	0.255	0.198	22.35
2	85	0.256	0.195	23.83
3	85	0.254	0.197	22.44
4	85	0.257	0.195	24.12
5	85	0.256	0.194	24.21

Table 6: Abrasion resistance

An average weight loss of 23.39 % was measured after 85 rubs/ cycle and it shows high mechanical durability and offers to provide greater resistance to wear, ensuring that the anti-microbial benefits remain effective over long-term use.

3.6 Anti-microbial Susceptibility test

The anti-microbial efficacy of the untreated and treated (distilled water) interlock fabric was evaluated against the bacterial and fungal strains using the Agar Diffusion Method (Zone of Inhibition). The results are presented in the Table 7.

	Zone of Inhibition			
	S. aureus	**P. aeruginosa**	**B. subtilis**	**C. albicans**
Distilled water treated	26 mm	31 mm	22 mm	21 mm
Control	-	-	-	-

Table 7: Anti-microbial Susceptibility test

The results validate the functional successfulness of the anti-microbial finish applied on the interlock fabric. It is also confirmed that the treated fabric show maximum efficiency of the finish in comparison to the untreated fabric.

SEM Test:

SEM Test for the anti-microbial finished interlock fabric

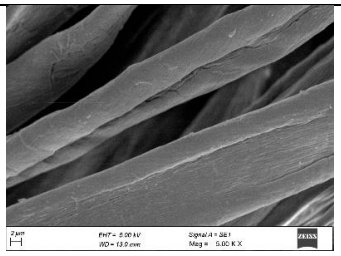
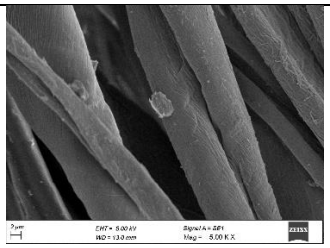
S. No	Size	Pre-treated fabric	Treated fabric
1	2µm		

Table 8: SEM test for anti-microbial finished Interlock fabric

It is evident from SEM images shown in Table 8 that, the fibers are swollen and have flat ridges, few protruding fibrils, concave grooves and rough surface and the presence of *L. aspera* herbal extract is comparatively notable in the structure of fibers' surface in treated fabric.

FTIR Test

FTIR test for *L. aspera*

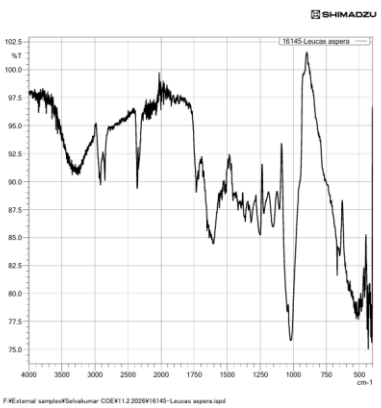


Fig. 4: FTIR for *L.aspera*

The strong absorption in the 3320 cm^{-1} (hydroxyl) and aromatic regions suggest a high concentration of phenolic compounds that are responsible for the medicinal and anti-microbial properties inherent in the *L. aspera.*

4. CONCLUSION

The study proves the potential of *Leucas aspera* as an effective bioresource for making functionalized cotton fabric. The innovation in the preparation of herbal finishing results in a product that is environmentally benign and efficient as an antimicrobial finish. The use of citric acid as a covalent agent in the present study makes the resulting fabric sustainable according to green textile chemistry standard

REFERENCES

1. Venkatraman, P.D.; Sayed, U.; Parte, S.; Korgaonkar, S. Development of Advanced Textile Finishes Using Nano-Emulsions from Herbal Extracts for Organic Cotton Fabrics. Coatings 2021, 11, 939. https://doi.org/10.3390/ coatings11080939

2. Bioactives and Pharmacology of Lamiaceae. (2023). United Kingdom: Apple Academic Press.

3. Rai V, Agarwal M, Agnihotri AK, Khatoon S, Rawat AK, Mehrotra S. Pharmacognostical evaluation of Leucas aspera. Nat Prod Sci 2005; 11:109-14.

4. Yadav, RNS & Agarwala, Munin. (2011). Phytochemical analysis of some medicinal plants. J Phytol. 3.

5. Morsy N. Phytochemical analysis of biologically active constituents of medicinal plants. Main Group Chemistry. 2014;13(1):7-21. doi:10.3233/MGC-130117

6. Scholars, G. (2025). "Phytochemical Investigation And Biological Evaluation Of Some Indian Medicinal Plants". IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS). https://doi.org/10.9790/3008-2002025262

7. Nessiani, R.K., Karmegam, N., Jayakumar, M. (2025). Antibacterial and Antifungal Properties of Green Herbal Compounds for Textile Applications. In: Baskar, C., Ramakrishna, S., Rosa, A.D.L. (eds) Encyclopedia of Green Materials. Springer, Singapore. https://doi.org/10.1007/978-981-97-4618-7_269

8. Jaganathan, Banupriya. (2013). Comparative Study on Antibacterial Finishes by Herbal and Conventional Methods on the Woven Fabrics. Journal of Textile Science & Engineering. 03. 10.4172/2165-8064.1000125.

9. Natarajan, H., Siddhan, P. (2024). Herbal Infusions: Weaving Nature's Pharmacy into Textiles. In: Sundaramoorthy, S., Kubera Sampath Kumar, S., Chavhan, M.V. (eds)
Textile Materials for Good Health and Wellbeing. SDGs and Textiles. Springer, Singapore. https://doi.org/10.1007/978-981-97-6496-9_18

10. Shirazi AM. Studies on Leucas aspera. Indian J Pharm 1947; 9:116-7.

11. TEXTILE TESTING Procedures | PDF | Yarn | Strength Of Materials