APPLICATION OF ANTIMICROBIAL AND UV PROTECTIVE FINISH ON MODAL FABRIC USING CYNODAN DACTYLON.

Yogalakshmi J , Dr.G.Manonmani and S.Gopika

M.Sc., Textiles & Clothing, Department of Home Science, Mother Teresa Women's University Research and Extension Centre, Coimbatore.

Assistant professor, Department of Home Science (Textiles & Clothing), Mother Teresa Women's University Research and Extension Centre, Coimbatore.

Ph.D Research Scholar, Department of Home Science (Textiles & Clothing), Mother Teresa Women's University Research and Extension Centre, Coimbatore.

ABSTRACT

This study explores the application of an antimicrobial and ultraviolet (UV) protective finish on 100% modal woven fabric using Cynodon dactylon (Bermuda grass) extract—a natural herb known for its medicinal properties. The research aims to enhance the functional performance of modal fabric, which is already valued for its softness, breathability, and eco-friendliness. The herb was processed through Soxhlet extraction using ethanol as a solvent, and the extract was applied to the modal fabric using a boiling method. The finished fabric underwent antimicrobial evaluation through the zone of inhibition test against Escherichia coli and Staphylococcus aureus, demonstrating improved antibacterial activity compared to untreated samples. UV protection was assessed using the UPF (Ultraviolet Protection Factor) standard test, which showed significant enhancement in solar protection after treatment. Physical properties such as GSM, tensile strength, and tear strength were evaluated pre- and post-finishing, with results indicating the finish did not compromise fabric integrity. To demonstrate practical applicability, the treated fabric was used to develop a peplum top and a face mask, both of which received favorable subjective evaluation. This study confirms the potential of Cynodon dactylon as a sustainable bio-finish for producing hygienic and protective textile products suitable for daily and specialized use.

Keywords: Cynodon dactylon, modal fabric, antimicrobial finish, UV protection, herbal textiles, Soxhlet extraction.

INTRODUCTION

The modern textile industry is evolving rapidly to meet growing consumer demand for fabrics that are not only comfortable and durable but also functional and sustainable. One of the major innovations in textile finishing is the incorporation of antimicrobial and ultraviolet (UV) protective agents to enhance hygiene, safety, and longevity of garments, especially for sensitive applications such as infant wear, healthcare, and outdoor clothing [1].

Modal, a second-generation regenerated cellulose fiber derived from beechwood, is widely appreciated for its softness, breathability, moisture management, and eco-friendly production process. It offers excellent dye uptake and is less prone to shrinkage and fading compared to conventional cotton [2]. However, like most cellulosic fibers, modal fabrics are susceptible to microbial growth, particularly in humid environments, and offer limited protection against harmful UV rays [3].

To address these limitations, natural herbal extracts are gaining attention as bio-based alternatives to synthetic chemical finishes. Cynodon dactylon (commonly known as Bermuda grass) is a perennial medicinal herb known for its rich phytochemical composition, including flavonoids, alkaloids, and phenolic compounds that exhibit strong antimicrobial, antioxidant, and UV-absorbing properties [4][5].

In this study, an antimicrobial and UV-protective finish is applied to modal fabric using an ethanolic extract of Cynodon dactylon. The treated fabrics are evaluated for physical performance (GSM, tensile, and tear strength), antimicrobial efficacy against E. coli and S. aureus, and UV protection using UPF standards. This project demonstrates the potential for integrating herbal-based functional finishing in sustainable

MATERIALS AND METHODS

2.1 MATERIALS

The fabric used for this study was 100% modal woven fabric sourced from Kothari Fabs, Tiruppur, Tamil Nadu, India. It featured a plain weave construction with a yarn count of 50s and a GSM of 72.9. Cynodon dactylon (Bermuda grass) was collected from cultivated land in Tamil Nadu. The herb is known for its phytochemical richness and has been documented for its antimicrobial and UV protective effects [4][6].

Modal fabric

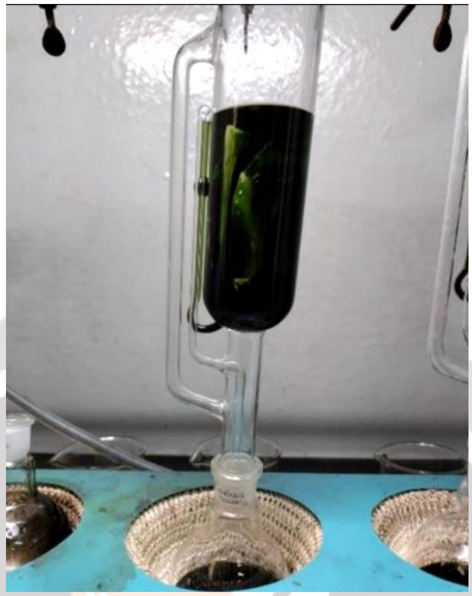
2.2 HERB PROCESSING AND EXTRACTION

Fresh leaves of Cynodon dactylon were cleaned (garbled), ground using a blender, and filtered. The extract was prepared using the Soxhlet extraction method with ethanol as the solvent. A thimble filled with powdered herb was extracted in ethanol at 37°C and gradually heated to 100°C for 48 hours [7]. The extract was concentrated and stored at room temperature for further use.

Herb extraction

2.3 FABRIC FINISHING PROCEDURE

The prewashed modal fabric was treated with the herbal extract using a boiling method. Fabric samples were immersed in the extract solution and heated at 100°C for 60 minutes to allow absorption. After finishing, samples were dried in shade and conditioned as per ISO standard atmospheric conditions [8].



2.4 ANTIMICROBIAL TESTING

Antimicrobial activity was assessed using the AATCC 147 (parallel streak method). Test organisms included Escherichia coli and Staphylococcus aureus. Nutrient agar plates were inoculated, and treated and control samples were placed on the surface. After 24 hours of incubation at 37°C, zones of inhibition were measured in millimeters [9].

2.5 UV PROTECTION ASSESSMENT

UV protection was evaluated using UPF (Ultraviolet Protection Factor) testing based on AATCC 183 and EN 13758-1 standards. A UV-Vis spectrophotometer was used to determine the percentage of UV radiation blocked by the fabric [10]

After UV Protection test

After UV Protection test

2.6 PHYSICAL TESTING

Fabric Weight (GSM): Measured using a GSM cutter and digital balance on a 100 cm² swatch [11].

Tensile Strength: Determined using an Instron tensile tester, measuring warp and weft strength and elongation [12].

Tear Strength: Evaluated using a pendulum tear tester, following standard ISO textile procedures [13].

2.7 PRODUCT DEVELOPMENT AND SUBJECTIVE EVALUATION

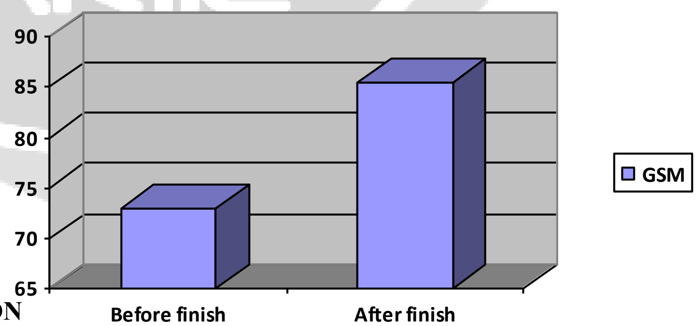
The finished fabric was used to develop a peplum top and a mask. These garments were evaluated by 25 trained judges specializing in textiles and apparel design. Criteria included finish, texture, appearance, and functionality [14].

3. RESULTS AND DISCUSSION

3.1 FABRIC WEIGHT (GSM)

The GSM of the fabric increased after finishing, indicating successful deposition of herbal extract on the surface.

Fabric Type	GSM (g/m²)
Before Finish	72.9
After Herbal Finish	85.5

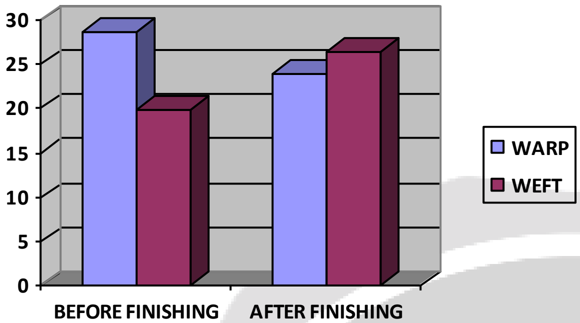


3.2 TENSILE STRENGTH AND ELONGATION

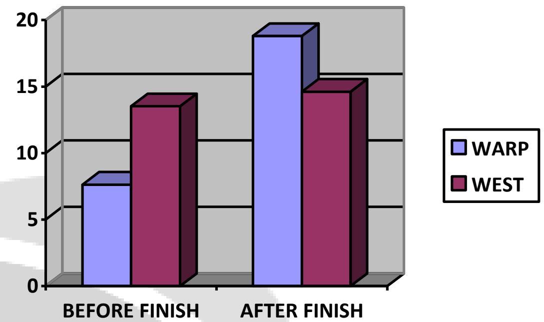
The fabric's tensile strength and elongation in both warp and weft directions were evaluated. Minor reductions in warp strength were observed, but improvements were seen in weft strength and elongation, demonstrating that the finish retained the mechanical integrity of the fabric.

Parameter	Before Finish	After Finish
Warp Strength (N)	28.67	24.02

Weft Strength (N)	19.93	26.38
Warp Elongation (%)	7.62	18.80
Weft Elongation (%)	13.52	14.61



Fabric strength



Fabric elongation

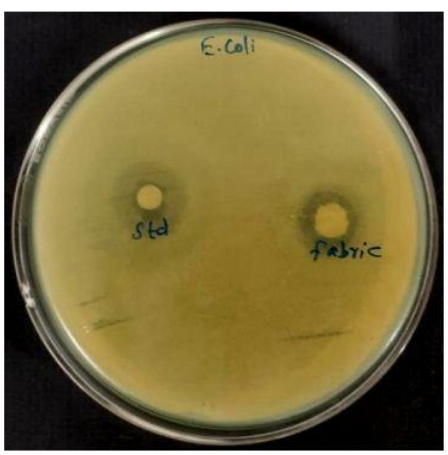
3.3 TEAR STRENGTH

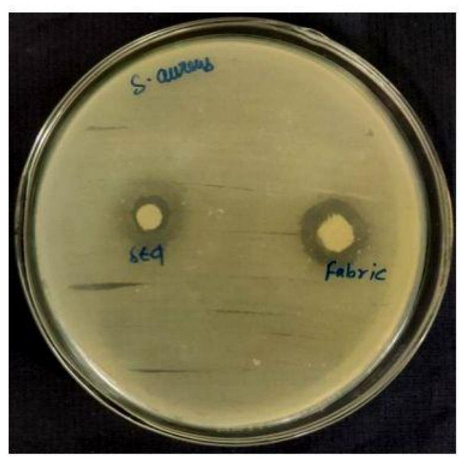
The tear strength of the fabric showed negligible variation after herbal treatment. The finished fabric maintained resistance to tearing, suitable for garment construction.

3.4 ANTIMICROBIAL ACTIVITY

The antimicrobial property was evaluated using the agar diffusion (zone of inhibition) method. The finished fabric showed a larger clear zone around the sample when tested against E. coli and S. aureus, confirming antimicrobial efficacy.

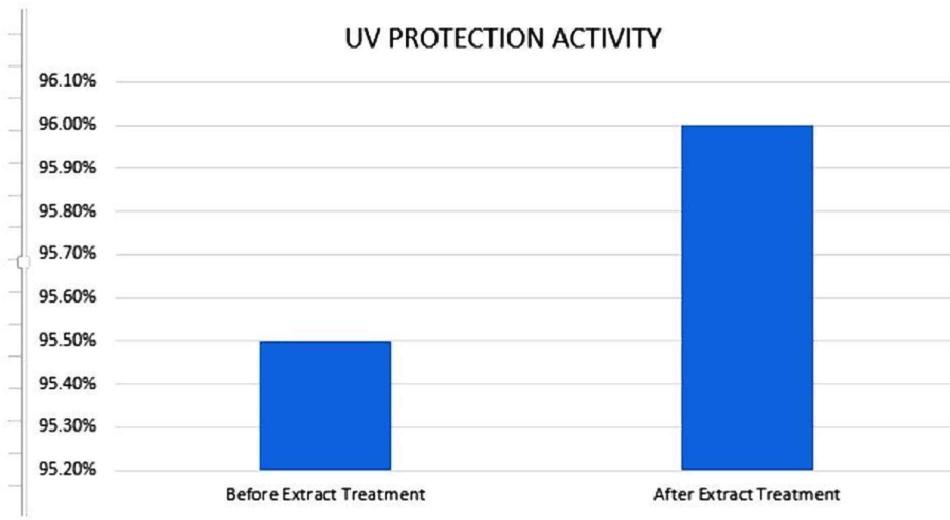
Fabric Type	E. coli	S. aureus
Untreated Fabric	1.0 mm	1.0 mm
Herbal-Finished Fabric	1.5 mm	2.0 mm





3.5 UV PROTECTION ASSESSMENT

UV protection was assessed using UPF testing. Visual analysis and surface density of the finished fabric indicated improved UV blocking ability. The herbal extract acted as a natural UV absorber, darkening the fabric and reducing transmittance.



3.6 SUBJECTIVE EVALUATION OF FINISHED FABRIC

The herbal-finished fabric was evaluated by 25 textile experts for appearance, texture, evenness of finish, and luster.

Attribute	Good (%)	Fair (%)	Poor (%)
General Appearance	95	5	0
Evenness of Finish	96	4	0
Texture	95	5	0

3.7 PRODUCT DEVELOPMENT AND EVALUATION

Two products were created using the treated fabric:

Peplum Top (for age group 20–25 years)

Face Mask

Product	**Design (G%)**	**Finish (G%)**	**Appearance (G%)**
Peplum Top	96	98	97
Face Mask	97	98	94

Peplum Top Face Mask

SUMMARY AND CONCLUSION

The present research successfully explored the potential of Cynodon dactylon as a natural finishing agent for enhancing the antimicrobial and UV-protective properties of modal woven fabric. Through a systematic approach involving extraction, application, and multi-level evaluations, the study confirms the viability of herbal-based functional finishing in textiles.

The finishing treatment led to a measurable increase in GSM, suggesting deposition of active compounds. Tensile and tear strength evaluations showed that the structural integrity of the fabric was retained. Antimicrobial analysis confirmed significant improvement in activity against common pathogens such as E. coli and Staphylococcus aureus. Additionally, the fabric exhibited increased resistance to UV radiation after treatment, making it suitable for protective apparel.

The aesthetic appeal of the treated fabric was validated through subjective evaluation by textile experts, and the practical application was demonstrated through the development of a peplum top and face mask. These findings highlight the dual benefits of functional and visual quality enhancement through herbal finishing.

This study not only supports the use of eco-friendly herbal agents in textile processing but also opens avenues for sustainable innovations in fashion, healthcare, and children's wear. The work paves the way for further exploration into durability, user safety, and commercial scalability.

REFERENCES

1. Mishra, A. et al. (2020). UV protective textiles: Mechanisms and materials.
2. Bushway, R. J. (1996). Properties and benefits of modal fiber.
3. Radhika, D. et al. (2019). Antimicrobial textiles and natural dyes.
4. Deepika Priya, A. (2023). Medicinal properties of Cynodon dactylon.
5. Mongkholrattanasit, R. (2012). Bioactive herbal finishes for UV and antimicrobial protection.
6. Mongkholrattanasit, R. (2012). Herbal Extracts for Functional Textiles.
7. Ismail, W. N. W. (2016). Sol-Gel Applications in Textile Finishing.

8. Choudhury, A. K. R. (2017). Textile Preparation and Finishing.
9. Teufel, L., & Redl, B. (2006). Antimicrobial Textile Testing Methods.
10. Mishra, A., et al. (2020). UV Protective Finishes for Apparel Fabrics.
11. Paul, R. (Ed.). (2014). Functional Finishes in Textiles.
12. ASTM D5034. (2020). Standard Test Method for Breaking Strength and Elongation of Textile Fabrics.
13. ISO 13937-2. (2021). Tear Properties of Fabrics — Determination of Tear Force.
14. Radhika, D., et al. (2019). Evaluation Techniques for Herbal-Finished Fabrics.