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Effect of *Amaltas* Leaves Extract Finish on Geometrical Properties of Cotton Fabric

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ABSTRACT

Textiles have been integral to the advancement of human culture, driving both technological innovations and artistic expressions throughout history. Cotton, a widely used natural fiber, holds significant economic importance due to its versatility as a raw material in fabric production. The functionality of cotton fabric is largely determined by its physical properties, including geometrical attributes like fabric count, weight, and thickness. This study investigates the impact of applying a finish derived from *Cassia fistula* (*Amaltas*) leaves, a plant known for its rich bioactive compounds and therapeutic properties—on the geometrical properties of cotton fabric. The research utilized two finishing techniques: the exhaust method and the pad-dry-cure method, to assess the effects on fabric count, weight, and thickness using standard test procedures. Results indicated that while both methods altered the fabric's physical characteristics, the pad-dry-cure method demonstrated superior efficacy in enhancing the structural attributes of the cotton fabric. These findings suggest that the pad-dry-cure method is more effective in integrating plant-based finishes into fabric, offering a promising, eco-friendly approach to textile enhancement.

Keywords: Textiles**,** *Cassia fistula* (*Amaltas*), Geometrical Properties

INTRODUCTION

Textiles have always played a fundamental role in the evolution of human culture, standing at the intersection of technological innovation and artistic expression. Over the centuries, fabrics have not only provided protection and comfort but have also been a medium of cultural identity and a reflection of societal progress. As a material that is in direct contact with our skin, textiles significantly influence our well-being, contributing to a healthier and infection-free lifestyle (Hooda *et al.*, 2013). Among these, cotton holds a unique place due to its widespread use, versatility, and economic significance as a primary raw material for cloth production (Saleemuddin, 2013).

Cotton is predominantly composed of cellulose, with non-cellulosic constituents surrounding its core, giving it unique structural and physical properties (Chung, 2004). The physical properties of textiles, especially their geometrical properties like fabric count, weight, and thickness, play a pivotal role in determining the fabric's functionality and performance. These geometrical characteristics are essential as they influence the mechanical and comfort properties of the fabric, directly impacting its usability in various applications (Poonia, 2018).

In recent years, the integration of plant-based extracts into textile processing has gained attention due to their potential to enhance fabric properties while maintaining environmental sustainability. Plant extracts can be applied as finishing agents or encapsulated to provide controlled release properties, thereby enhancing the fabric's performance. One such plant, '*Cassia fistula'* (commonly known as *Amaltas*), has shown promising results in this regard. Native to Asia, Africa, and other regions, '*Cassia fistula*' is a member of the Fabaceae family, known for its vibrant yellow flowers and its wide distribution in tropical and subtropical areas.

Amaltas is rich in bioactive compounds, including

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tannins, flavonoids, oxalic acids, anthraquinone derivatives, essential oils, and other secondary metabolites, which have been recognized for their therapeutic properties in Ayurveda (Sharma, 2017). The incorporation of *Amaltas* leaf extract into textiles not only harnesses these natural compounds for their antimicrobial and curative abilities but also promotes eco-friendly, non-toxic processing methods that enhance the fabric's inherent functionality.

The challenge in applying natural extracts to textiles lies in maintaining or improving the fabric's geometrical properties, which are crucial for its overall performance. Any significant alteration in these properties could compromise the fabric's quality and utility. Therefore, it becomes imperative to evaluate how such finishes affect the geometrical aspects of the fabric to ensure that the enhancements are both functional and beneficial.

This study aims to explore the potential benefits of applying an *Amaltas* leaves extract finish to cotton fabric, specifically focusing on its impact on the geometrical properties. The objective is to determine whether the application of this natural finish can improve the fabric's quality without compromising its core attributes. Additionally, the use of *Amaltas* leaves extract aligns with sustainable textile practices, offering an environmentally friendly alternative that reduces industrial waste and minimizes ecological impact (Sharma, 2017). Through this investigation, we seek to contribute to the development of innovative, sustainable solutions in the textile industry by utilizing plant-based resources to enhance fabric performance.

METHODOLOGY

Selection and Procurement of Materials:

A medium-weight grey cotton fabric was chosen for this study because it had not undergone any finishing treatments, ensuring that the fabric's original properties were intact. This selection was made to eliminate any variables that could interfere with the research results, thus providing unbiased and accurate data. Fresh green *Amaltas* leaves (*Cassia fistula*) were collected from the campus to ensure a sufficient supply for the preparation of the leaf extract.

Application of *Amaltas* Leaf Extract Finish on Cotton Fabric:

The antibacterial *Amaltas* leaf extract finish was applied to desized and scoured cotton fabric using two standardized methods: the exhaust method and the pad-dry-cure method. These methods were performed under optimized conditions to ensure the effective binding of the extract to the fabric surface (Singh, 2017).

Application by Exhaust Method:

In the exhaust method, the quantity of *Amaltas* leaf extract and citric acid (used as a cross-linking agent) was determined based on the fabric's weight. The extract was prepared in a bath at a concentration of 5 g/l with controlled factors, including pH and treatment temperature. The fabric samples were then immersed in the antibacterial solution with a material-to-liquor ratio of 1:20 for 30 minutes.

After the initial treatment, a post-finish with citric acid (amounting to 8% of the fabric's weight) was applied at room temperature to enhance the durability of the finish. The treated samples were thoroughly rinsed in cold water to remove any unreacted substances and subsequently dried in the shade to preserve the integrity of the fabric (Singh *et al.*, 2016).

Application by Pad-Dry-Cure Method:

For the pad-dry-cure method, the concentration of *Amaltas* leaf extract and citric acid was similarly determined based on the fabric's weight. The fabric samples were immersed in the solution with a material-to-liquor ratio of 1:20, allowing the solution to be absorbed evenly. The samples were then subjected to a controlled treatment process.

The fabric was passed through a trough containing the *Amaltas* extract solution (5 g/l concentration), where it was uniformly pressed between two pneumatic padding mangle rollers at a pressure of 2.5 psi. This step, known as a "two dip, two nips" process, was repeated to ensure maximum absorption of the solution into the fabric.

Following the padding operation, the samples were dried at 80 °C for 3 minutes and subsequently cured at 120 °C for 2 minutes using a laboratory model curing mangle. A post-treatment with 8% citric acid was then applied to the samples to act as a fixing agent, which was followed by a second round of padding, drying, and curing at the same conditions to stabilize the finish on the fabric surface (Singh, 2017).

Determination of Geometrical Properties of the Cotton Fabric:

The geometrical properties of the cotton fabric were

evaluated based on three primary parameters: fabric count, weight, and thickness. Prior to testing, the fabric samples were conditioned under standard atmospheric conditions, maintaining a relative humidity of 65 ± 2% and a temperature of 27 ± 2 °C. These controlled conditions were essential to ensure consistency and accuracy in the results.

The impact of the *Amaltas* leaf extract finish on the geometrical properties of the fabric was assessed using a variety of standard test methods. These tests provided a comprehensive analysis of how the finishing treatment influenced the structural attributes of the cotton fabric, enabling a better understanding of the overall effects on the material's performance and quality.

RESULTS AND DISCUSSION

To evaluate the influence of the *Amaltas* leaf extract finish on the geometrical properties of cotton fabric, three key parameters were analyzed: fabric count, weight, and thickness. The results were compared between the untreated control samples and those treated with *Amaltas* leaf extract using both the exhaust and pad-dry-cure methods.

Fabric Count:

The fabric count of the desized and scoured cotton fabric, which served as the control, was recorded at 62.6 ± 0.88 ends and 44.4 ± 1.20 picks per square inch. When the fabric was treated with the *Amaltas* leaf extract using the exhaust method, the fabric count decreased to 56.40 ± 0.25 ends and 46.0 ± 0.55 picks per square inch. This represents a reduction of approximately 4.3%, with t-values of 1.76 for warp and 1.24 for weft, indicating a notable yet modest change compared to the untreated fabric.

In contrast, the pad-dry-cure method showed a more pronounced decrease in fabric count, with values dropping to 55.41 ± 0.52 ends and 45.82 ± 0.36 picks per square inch. This corresponds to a 5.39% reduction, with t-values of 5.07 for warp and 1.86 for weft, suggesting a statistically significant decrease at the 1% level of significance. The greater reduction in fabric count observed with the pad-dry-cure method indicates that this finishing technique exerts a more substantial impact on the structural integrity of the fabric.

The reduction in fabric count following the application of the *Amaltas* leaf extract is attributed to the fabric's slight contraction during the finishing process, which may lead to tighter binding of the fibers. Notably, the pad-dry-cure method caused a more significant decrease in fabric count compared to the exhaust method, highlighting its greater influence on the fabric's structure.

Fabric Weight:

The initial weight of the desized and scoured cotton fabric was recorded as 131.4 ± 1.87 g/m². After the application of the *Amaltas* leaf extract using the exhaust method, the fabric weight increased to 140.7 ± 0.67 g/m², reflecting a 7.0% increase with a t-value of 1.59. The pad-dry-cure method led to a further increase in fabric weight to 141.0 ± 0.96 g/m², representing a 7.3% rise with a t-value of 1.69.

Although both methods resulted in an increase in fabric weight, the changes were found to be statistically non-significant. The gain in weight is likely due to the deposition of the *Amaltas* leaf extract on the fabric surface, which adds bulk to the fibers. The slight yet consistent increase in weight observed in the pad-dry-cure method compared to the exhaust method suggests that this technique allows for a more efficient absorption and retention of the extract, thereby enhancing the fabric's

Table 1: Effect of *Amaltas* leaf extract finish on geometrical properties of cotton fabric

Properties / Fabric	Fabric count (Ends and picks per square inch)				Fabric weight (g/m^2)		Fabric thickness (mm)	
	Warp Mean ± S.E	Weft Mean ± S.E	Mean ± S.E (m)	Per cent Change	Mean ± S.E(m)	Per cent Change	Mean ± S.E(m)	Per cent Change
Exhaust method	56.40±0.25	46.00±0.55	51.2	-4.3	140.70±0.67	+7.0	0.26±0.04	+4
t-value	1.76	1.24	-	-	1.59	-	2.22	-
Pad dry cure method	55.41±0.52	45.82±0.36	50.61	-5.39	141.00±0.96	+7.3	0.27±0.006	+8
t-value	5.07	1.86	-	-	1.69	-	4.57	-
Controlled	62.6±0.88	44.4±1.20	53.50	-	131.4±1.87	-	0.25±0.021	-

**Significant at 1% level of significance, *Significant at 5% level of significance

density.

Fabric Thickness:

The initial thickness of the desized and scoured cotton fabric was measured at 0.25 ± 0.021 mm. After finishing with the exhaust method using a 5 g/l concentration of *Amaltas* leaf extract, the thickness slightly increased to 0.26 ± 0.04 mm, indicating a 4% rise with a t-value of 2.22.

In the case of the pad-dry-cure method, the thickness increased more substantially from 0.27 ± 0.006 mm to 0.38 ± 0.01 mm, representing an 8% increase with a t-value of 4.57. This significant increase in fabric thickness observed with the pad-dry-cure method indicates a more robust integration of the extract within the fabric's fibers, leading to a thicker and potentially more durable textile.

While the increase in thickness for the samples treated by both methods was found to be statistically non-significant, the trend towards greater thickness in the pad-dry-cure method highlights its effectiveness in enhancing the physical properties of the fabric.

Based on the data presented, the following conclusions can be drawn regarding the impact of the *Amaltas* leaf extract finish on the geometrical properties of the cotton fabric:

Fabric Count:

The application of the Amaltas leaf extract finish led to a significant reduction in fabric count, particularly with the pad-dry-cure method. The decrease was statistically significant at the 1% level, indicating a more compact fabric structure.

***Fabric Weight**:*

Both the exhaust and pad-dry-cure methods resulted in a non-significant increase in fabric weight, with the pad-dry-cure method showing a slightly higher gain. This suggests that the finishing process leads to an overall increase in fabric density without compromising its flexibility.

***Fabric Thickness**:*

The thickness of the fabric increased more notably with the pad-dry-cure method than with the exhaust method. Although the increase was not statistically significant, it suggests a positive trend towards enhanced durability and improved fabric performance.

Conclusion:

The findings indicate that the application of *Amaltas* leaf extract finish has a noticeable impact on the geometrical properties of cotton fabric, particularly when using the pad-dry-cure method. The changes in fabric count, weight, and thickness were more pronounced with this method, suggesting it is more effective in enhancing the structural attributes of the fabric. While the increase in weight and thickness was non-significant, the significant reduction in fabric count points to a compact and potentially more durable textile product.

These results underscore the potential of using *Amaltas* leaf extract as an eco-friendly finishing agent that not only improves the functional properties of cotton fabric but also contributes to sustainable textile production practices. The pad-dry-cure method, in particular, demonstrates a higher efficacy in optimizing the fabric's characteristics, making it a preferred technique for applying plant-based finishes.

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