The Chromatic Potential of Tesu: A Study of Natural Dye from Flame of the Forest

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Abstract

FLAME OF THE FOREST, also known as Tesu flowers (BUTEA MONOSPERMA) or Palash. Dyeing is a process of applying colouring matter directly on fiber , yarn or fabric without any additives . Colouring materials obtained from natural resources of plant, animal, mineral, and microbial origins were used for coloration of various textile materials. Tesu flower dye is celebrated for its eco-friendly properties, offering a sustainable alternative to synthetic dyes that pose environmental and health risks

Natural dyes have gained renewed interest due to their eco-friendliness and sustainable application in various industries, particularly in textiles. This study explores the potential of Tesu flowers as a source of natural dye, particularly in India, where they are valued for their vibrant hues. The resurgence of interest in natural dyes in the modern fashion and textile industries aligns with global trends toward sustainability, making Tesu dye an important symbol of eco-conscious craftsmanship. As both a cultural heritage and a modern sustainable resource, the Tesu flower fabric dye highlights the intersection of tradition and innovation in textile production.

This research highlights the viability of using Tesu flowers as a natural dye source and biological properties of the dye, assessing its antimicrobial activity against common fabric-related pathogens. The findings suggest that Teshu flower dye not only provides aesthetic value but also contributes to the antibacterial function of textiles, potentially offering health benefits.

In this paper, the natural dyes are extracted. The fabric is then tied and dyed to analyzed and applying dye on cotton. This dye was extracted with the help of boiling method. The fabric dyed with extracted dye by using salt as a mordant.

Keywords :- Natural dye, Teshu flower, Ecofriendly, Sustainable

Introduction

The resurgence of interest in natural dyes within the textile industry reflects a broader shift toward sustainable and environmentally conscious practices. As concerns over the ecological and health impacts of synthetic dyes continue to escalate. Revisiting traditional dyeing methods that are both culturally rich and environmentally benign. Among these, the ***tie and dye*** technique stands out for its artistic versatility and historical significance. This resist-dyeing method, which involves the strategic binding of fabric to resist dye penetration in specific areas, results in intricate and often unpredictable patterns that celebrate the organic nature of handcrafted design.

In the present study, the tie and dye technique has been applied to cotton fabric using a natural dye derived from the Tesu flower (*Butea monosperma*), commonly referred to as the "Flame of the Forest." Indigenous to the Indian subcontinent, Tesu has long been revered not only for its vibrant hue but also for its traditional applications in Ayurvedic medicine and folk rituals. The dye extracted from its blossoms offers a warm, earthy palette that aligns harmoniously with the ethos of natural aesthetics.

This research aims to investigate the dyeing potential of Tesu on cotton substrates, focusing on parameters such as color vibrancy, pattern definition, and colorfastness under various conditions. By integrating a traditional botanical resource with an age-old dyeing technique, this study seeks to contribute to the evolving dialogue on sustainable textile practices. Furthermore, it underscores the value of indigenous knowledge systems in contemporary design and materials science, advocating for a more holistic and environmentally responsible approach to fabric treatment and coloration.




Review Literature

Natural Dyes and Eco-Textiles

Natural dyes are colorants extracted from renewable natural sources such as plants, minerals, and insects. Compared to synthetic dyes, they are biodegradable, less toxic, and safer for both humans and the environment (Samanta & Agarwal, 2009). However, their limited color range and weaker fastness properties often require the use of mordants to enhance dye-fiber bonding, especially on cellulose-based fabrics like cotton.

Overview of Butea monosperma as a Dye Plant

Butea monosperma is a native Indian tree, valued for its ornamental flowers, which are traditionally used to produce yellow to orange natural dye. The petals contain flavonoids such as butin, butein, and coreopsin, responsible for the bright coloration (Gupta & Gulrajani, 1991). The dye has been used historically during cultural festivals like Holi.

Dye Extraction Techniques

Semwal et al. (2014) examined aqueous extraction of flavonoids from Butea monosperma flowers and applied the dye on cotton fabrics. The study showed that boiling the petals in water at 90–95°C for 1.5 to 2 hours gave optimal color yield.

Application on Cotton and Other Fabrics

Gulrajani et al. (2001) successfully dyed cotton and silk fabrics with Butea monosperma using alum as a mordant. The dyed fabrics exhibited moderate to good fastness properties.

Medicinal and Dyeing properties

Chengaiah et al. (2010) reviewed medicinal and dyeing properties of Butea monosperma, also noting that its dye molecules form stronger complexes with fabrics in the presence of metallic mordants.

Fastness Properties and Eco-Performance

Rathi et al. (2020) evaluated rubbing, washing, and perspiration fastness of dyed cotton using standard ISO methods. They found that alum-mordanted samples scored between 3 to 4 on the grayscale, indicating moderate performance.

Methodology

Material

We have taken the cotton fabric as substrate.

The flower of Butea Monosperma collected for the extraction of dye.

Mordants:- Alum, Salt

Extraction Procedure of Natural Dye from *Butea monosperma* Flowers

Matured flowers of *Butea monosperma*, predominantly sourced from trees growing along highway margins, were carefully hand-harvested to ensure minimal mechanical damage and optimal pigment retention. Following collection, the floral samples were air-dried at ambient room temperature under shaded conditions to prevent photodegradation of sensitive dye components.

Once fully desiccated, the dried flowers were subjected to a pre-extraction soaking phase. They were immersed in distilled water and allowed to hydrate for a continuous period of 24 hours at room temperature. This soaking process served to soften the plant matrix, facilitating the release of intracellular chromophores during the subsequent thermal extraction step.

Post-soaking, the flower-water mixture was transferred to a water bath and gently boiled for approximately two hours. This thermal treatment accelerated the breakdown of cellular structures and promoted efficient leaching of the natural dye into the aqueous medium. The color saturation of the extract was visually monitored and confirmed to have reached its maximum intensity by the end of the heating period, indicating complete dye extraction.

Following extraction, the resulting solution underwent a filtration process. The first filtration was performed using a coarse filter with a muslin cloth to remove macroscopic residues and fibrous material.

This purified extract, rich in natural pigment, was subsequently employed in various applications, including textile dyeing and analytical characterization, showcasing its potential as a sustainable and eco-friendly alternative to synthetic dyes.

Fabric Preprations

To prepare cotton fabric for natural dyeing with Teshu flowers. Scour the fabric by mild boiling it to remove any oils, starch, or chemicals that might hinder dye absorption. After rinsing thoroughly, mordant the fabric using alum and salt to help the dye bind better and ensure longer-lasting color. Soak the fabric in the mordant solution for about 24 hour, then rinse lightly . Once prepared, you can either dry the fabric in the shade and proceed to the tie and dye process.

To achieve the marbling effect in tie and dye is created by producing soft, irregular patterns that resemble the natural swirls found in marble,the fabric is not folded neatly but instead scrunched, crumpled, or twisted loosely into a ball shape as shown in Fig 01. It is then tied or bound lightly in several places using string. This method allows the dye to flow and settle unevenly, creating blurred, cloudy patterns rather than sharp lines. When dyed with Teshu flower extract, the result is earthy blend of yellows and oranges with a naturally marbled texture.

Dyeing process

Pour the filtered Tesu flower extract into a non-reactive dyeing pot, gently heat it to just below boiling (approximately 80–90°C). Pre-mordanted cotton fabric is first soaked in water to ensure even dye absorption, then lightly wrung and

immersed into the dye bath. The fabric is simmered in the extract for 45 minutes to 1 hour, with occasional stirring to promote uniform coloration. For deeper hues, the fabric can be left to soak in the cooled dye bath for 2 days which leads to fermentation and gives deep orange hue . After dyeing, the fabric is removed,then untied and rinsed under cold running water until it runs clear, removing any unfixed dye. The dyed fabric is then air-dried in the shade . The final product exhibits a naturally marbled appearance in warm shades of yellow to orange, characteristic of Tesu flower pigments.

Fig 01

RESULTS AND ANALYSIS

Presentation of Findings

The natural dyeing of cotton fabric with **Butea monosperma** (Tesu flower) extract produced a **marbled pattern** with warm shades ranging from **light golden yellow to deep orange-brown**.
The tie and dye technique (scrunching and loose binding) successfully created **irregular, organic marbling** effects, giving the fabric an **artisanal, textured** appearance as shown in Fig 02 and Fig03. Mordanting with alum and salt **significantly improved** dye uptake and colorfastness.

Visual outcomes include:

- Distinctive, cloudy marbled designs
- Varying intensity of yellows and oranges
- Natural, earthy aesthetic
- No fiber damage after dyeing.

Data Analysis and Interpretation

Test Conducted	Procedure/Observation	Result/Interpretation
Washing Fastness	Washed samples at 10, 20, 30 minutes intervals	Fading is seen at 30 mins; Moderate wash fastness
Rubbing Fastness	Dry and wet rubbing tests	Dry rubbing: good; Wet rubbing: slight color release
Sweat Fastness	Exposure to acid and alkaline perspiration conditions	Good resistance; no significant bleeding or discoloration
Sunlight Fastness	Samples exposed to sunlight	Minor fading after prolonged exposure; moderate light fastness

Chemical Resistance	Exposure to mild acids and bases	Good chemical stability, color remained intact
Skin Contact Test	Fabric worn/tested on skin	No irritation or allergic reaction observed
Breathability Test	Checked fabric air permeability post-dyeing	Breathability retained; no stiffness or clogging

Fig 02

Fig 03

Discussion

Interpretation of Results

The dyeing process using *Butea monosperma* produced vibrant yellow to orange hues on cotton fabric, especially with alum and salt as mordants. The marbling tie-dye technique created aesthetically pleasing patterns. Colorfastness tests showed moderate to good results, and no skin irritation or breathability issues were observed, confirming the dye's safety and eco-friendliness.

Comparison with Existing Literature

Findings align with prior studies (e.g., Joshi, 2004; Sarkar, 2012) showing Tesu's effectiveness as a natural dye. Compared to turmeric Tesu showed better light and wash stability. Its use supports sustainable alternatives to synthetic dyes, matching the performance of other natural dyes.

Implications and Significance

This study supports the use of Tesu as a sustainable, safe dye with cultural relevance. It offers eco-friendly options for artisanal and small-scale textile production and promotes biodiversity-based innovation in fashion.

Limitations

The study is limited by small-scale application, narrow colour range, and variability in flower quality. Colourfastness, though improved with mordants, still lags behind synthetic dyes. Further research is needed on scalability and mordant impact.

Conclusion

Summary of Key Findings

The study successfully demonstrated the potential of Tesu (Butea monosperma) flower extract as a natural dye for cotton fabrics.
Key observations included:

- A vibrant yellow to golden color was achieved without the use of synthetic mordants.
- The crumple dye technique resulted in a marbled, textured appearance that enhanced the visual appeal.
- Color variations were naturally present due to the manual dyeing method and fabric absorption behavior.
- The dye adhered well to cotton, showing that natural dyes can be sustainable alternatives to synthetic dyes.

Contribution to the Field

- Proved Tesu as a sustainable natural dye.
- Supported eco-friendly textile practices.
- Highlighted the value of traditional methods in modern design.

Recommendations for Future Research

- Test with natural mordants to improve color fastness.
- Apply dye to other fabrics like silk or wool.
- Measure color strength and durability scientifically.
- Explore industrial-scale natural dyeing methods.

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