International Journal of Applied Home Science
(An International Double Blind Peer Reviewed / Refereed Research Journal of Home Science)
Volume 12 (11 & 12), November & December (2025) : 590-597

RESEARCH PAPER
ISSN : 2394-1413 (Print)

Received : 06.10.2025; Revised : 21.10.2025; Accepted : 06.11.2025 **DOI:** https://doi-ds.org/doilink/01.2026-11581323/IJAHS/12.11&12/590-597

Green Dyeing Approach: Cascabela Thevetia (Kaner) Extract for Cotton, Silk and Wool Fabric

AMAN DEEP KAUR*[1], HARSHITA BHOWN[2] AND POOJA CHOUDHARY[3]
[1]Assistant Professor, [2]Assistant Professor and [3]M.Sc. Fashion Design
IIS (Deemed to be University), Jaipur (Rajasthan) India

*Corresponding Author

ABSTRACT

Growing environmental concerns associated with synthetic dyes have renewed global interest in natural dye sources as sustainable alternatives for textile colouration. The present study investigates the extraction and application of natural dye obtained from the vibrant yellow, trumpet-shaped flowers of Cascabela thevetia (Kaner, family Apocynaceae) for dyeing 100% cotton, silk, and wool fabrics. Dyeing was carried out using the pre-mordanting method with Harda, alum, and copper sulphate as mordants. The dyed fabrics were assessed for colour strength, shade variation, and colour fastness to washing, rubbing, and light. The results demonstrated that the Cascabela thevetia flower extract produced a diverse range of shades, from bright yellow to earthy olive and crisp green, depending on the fiber type and mordant used. Among the tested substrates, silk exhibited the highest dye uptake and deepest shades, followed by wool, while cotton showed comparatively lighter tones and lower dye affinity. Furthermore, silk and wool samples displayed better overall colour fastness properties than cotton. The findings highlight the potential of Cascabela thevetia as a promising eco-friendly natural dye source for sustainable textile applications, particularly in combination with appropriate mordants. This study reinforces the importance of plant-derived dyes in promoting environmentally responsible and sustainable textile processing.

Keywords: Cascabela thevetia, Natural dye, Mordants, Cotton, Silk, Wool, Colour fastness, Sustainable textiles

INTRODUCTION

The application of colour to textiles is an ancient practice, historically rooted in the use of natural dyes extracted from plants, invertebrates, minerals, and fungi (Mansour, 2013; Tripathi *et al.,* 2015). With the advent of synthetic dyes in the mid-nineteenth century, the textile industry shifted toward artificial colourants due to their expansive colour palette, lower cost, fastness and consistency. However, the widespread use of synthetic dyes has introduced pressing environmental and health challenges, including toxic effluent discharge, persistence of hazardous compounds such as azo derivatives, and risks to both ecosystems and human health. Synthetic dye production contributes to significant pollution and resource consumption, emphasizing the urgent need for environmentally benign alternatives within the textile sector (Mansour, 2013; Chowdhury *et al.*, 2024).

In response, there has been a global resurgence of interest in natural dyes, which are biodegradable, renewable and non-toxic, and offer distinct cultural and aesthetic values. These Colourants, historically produced from roots, stems, leaves, flowers, fruits and animal or mineral sources, do not release harmful substances during production or use, and are generally safe for both wearers and workers. Natural dyeing, especially using plant-derived extracts, aligns with sustainable practice by minimizing environmental impact and encouraging biocompatible textile practices (Devi *et al.*, 2025; Tripathi *et al.,* 2015; Wenhao *et al.,* 2024).

Despite their eco-friendly attributes, natural dyes often face drawbacks such as a more limited colour range, variability in hue based on source and season and typically lower fastness properties compared to synthetics. The

How to cite this Article: Kaur, Aman Deep, Bhown, Harshita and Choudhary, Pooja (2025). Green Dyeing Approach: Cascabela Thevetia (Kaner) Extract for Cotton, Silk and Wool Fabric. *Internat. J. Appl. Home Sci.,* **12** (11 & 12) : 590-597.

effective use of mordants substances that bind dyes to fibers is thus crucial for improving colour strength and durability in naturally dyed textiles. Both traditional and modern mordants, including alum and plant-derived tannins, can significantly enhance dye uptake and fastness attributes (Bhandari *et al.*, 2024; Singh *et al.*, 2020; Devi *et al.*, 2025).

Given the increased demand for sustainable textile solutions, scientific exploration into novel natural dye sources remains a priority. This study examines the dyeing potential of Cascabela Thevetia (Kaner) flowers a vibrant, trumpet-shaped bloom from a drought-tolerant tropical shrub widely distributed in India—on cotton, silk, and wool fabrics. By assessing dye extraction, application, and the role of different mordants, the research aims to establish Cascabela Thevetia as a viable, environmentally responsible alternative for textile Colouration (Singh and Srivastava, 2015; Kombey *et al.*, 2023; Patel, 2022)

Objectives of the study:

- To extract the dye from Cascabela Thevetia (Kaner Flower).
- To dye 100% Cotton, 100% Silk and 100% Wool Fabric with Cascabela Thevetia.
- To compare the effect of different mordants used in dyeing.
- To assess the washing, rubbing and light fastness of dyed fabric.

Limitation of the study:

- The study will be limited to 100% Cotton, 100% Silk and 100% Wool fabric only.
- The study will be limited to Cascabela Thevetia (Kaner flower) fresh flower only.
- Mordanting using only Alum, Harda and Copper Sulphate.

Research Design:

The research was conducted to study the dyeing potential of Cascabela thevetia (Kaner) flower extract on cotton, silk, and wool fabrics. The experimental procedure comprised the following sequential stages:

Dye Extraction:

Fresh Cascabela thevetia (Kaner) flowers were collected, cleaned, and subjected to aqueous extraction.

The extracted dye solution was filtered to remove residues and stored for further use in the dyeing process (Mohan *et al.*, 2012; More *et al.*, 2022; Utami *et al.*, 2024).

Pre-treatment of Fabric (Scouring):

To ensure effective dye absorption, all fabrics were pre-treated through scouring.

Fabric Type	Scouring Agent	Method
100% Cotton	Ezee Wash detergent	Scoured in hot aqueous detergent solution to remove natural impurities such as waxes and oils.
100% Wool	Ezee Wash detergent	Gently scoured at mild temperature to preserve fiber integrity.
100% Silk	Ezee Wash detergent	Mild scouring carried out to eliminate sericin and surface impurities.

Pre-Mordanting:

Each fabric was treated with different mordants prior to dyeing to enhance dye fixation and Colour development.

Fabric Type	Mordants Used
100% Cotton	Harda, Alum, Copper Sulphate
100% Silk	Harda, Alum, Copper Sulphate
100% Wool	Harda, Alum, Copper Sulphate

Pre-mordanting was performed using aqueous solutions of each mordant under controlled temperature and time conditions appropriate to the fiber type.

Dyeing Process:

The pre-mordanted fabrics were dyed using an IR (Infrared) dyeing machine to ensure uniform temperature control and even dye penetration.

Dyeing parameters such as time, temperature, and material-to-liquor ratio were standardized for all samples.

Evaluation of Colour Fastness:

The dyed samples were evaluated for their Colour fastness properties according to standard testing methods:

Test Type	Purpose
Washing Fastness	To determine Colour retention after laundering.
Rubbing (Crocking) Fastness	To assess Colour transfer during dry and wet rubbing.
Light Fastness	To evaluate resistance of the Colour to fading under sunlight exposure.

METHODOLOGY

The flowers of Cascabela Thevetia (Kane Flower) were collected from the garden of local area SFS area, Mansarover, Jaipur, and Rajasthan. Fresh flowers of Cascabela Thevetia were used for this study. 100% pure 1-meter cotton fabric from Sanganer, Jaipur and 100% pure 1-meter silk fabric and 100% 1-meter pure Wool fabric was purchased from Nikunj, a Fabric Hub Store, RIICO Industrial Area, Mansarover, New Sanganer Road, Jaipur. Alum, Harda and Copper Sulphate were used as mordants. Alum and Harda was used as natural mordants and Copper Sulphate was used as a chemical mordants.

Equipments/ Instruments used:

- Weighing balance
- Dye bath
- Crockrmeter for rubbing fastness
- Laundr-o-meter for washing fastness

Pre-treatment of Fabrics (Scouring):

100% cotton fabric was scoured by washing in a solution containing 2 g/L of non-ionic detergent at 50ºC for 25 minutes, maintaining a liquor ratio of 1:40. Following scouring, the fabric was thoroughly rinsed with tap water and dried at room temperature. Before dyeing or mordanting, the cotton fabric was soaked in clean water for 30 minutes to prepare the fibers. Silk and wool fabrics were scoured by washing in a liquid detergent solution (Ezee Wash) under similar conditions 25 minutes at a 1:40 liquor ratio then rinsed and dried at room temperature.

Dye Extraction:

Fresh petals of Cascabela thevetia (Kaner flower) were immersed in distilled water and heated in a water bath for 40–45 minutes to facilitate dye extraction. The resulting solution was filtered, and the filtrate was concentrated until reaching a viscous state. This concentrated extract was subsequently used for dyeing cotton, silk, and wool fabrics.

Pre-mordanting of Fabrics:

Scoured cotton, silk, and wool samples underwent pre-mordanting prior to dyeing. Samples were treated with 1 g of chemical mordants Harda (natural), Alum, and Copper sulphate at 60ºC for 30 minutes with a material-to-liquor ratio of 1:20. Specifically, Copper sulphate was used at 2% concentration.

Dyeing Procedure:

The mordanted fabric samples were dyed using the prepared Cascabela thevetia extract at a material-to-liquor ratio of 1:20. Dyeing was conducted at 80ºC for 20 minutes to achieve optimal Colour uptake.

Fastness Testing:

The dyed fabrics were evaluated for wash fastness, rubbing fastness (crocking), and sunlight fastness. Colour fastness was assessed by measuring the loss of Colour depth before and after tests using the Grey scale. Fastness tests were performed at IIS (Deemed to be University), Jaipur, employing an Innowash Washing Fastness Tester for wash fastness and a Crock Meter for rubbing fastness evaluations.

Phase 1:

A pilot study was conducted to evaluate the dyeing process of cotton fabric, which involved three main steps: pre-treatment, pre-mordanting, and dyeing. Dye extraction from Cascabela thevetia (Kaner flower) was performed by soaking fresh petals in distilled water and heating the mixture in a water bath for 40–45 minutes to facilitate rapid Colour extraction. Cotton samples were dyed at temperatures of 60ºC and 80ºC using a 4% dye concentration. Mordants—Alum, Harda, and Copper Sulphate—were applied at concentrations of 2% and 3%. The resulting dyeing demonstrated satisfactory Colouration.

Phase 2:

The cotton fabric dyeing process followed the same three steps: pre-treatment, pre-mordanting, and dyeing. Preparation of Raw Material: Cotton fabric was scoured by washing in a solution with 2 g/L non-ionic detergent at 50ºC for 25 minutes with a liquor ratio of 1:40, followed by thorough rinsing and drying at room temperature. Prior to mordanting or dyeing, the fabric was soaked in clean water for 20 minutes.

Dye Extraction: Fresh Kaner flower petals were soaked and heated in distilled water using a water bath for 40–45 minutes. The extract was filtered and concentrated to a viscous consistency for use in dyeing.

Dyeing and Mordanting: Cotton samples were dyed with the concentrated flower extract at a material-to-

liquor ratio of 1:20, maintaining a dyeing temperature of 80ºC for 20 minutes.

Mordanting:

The one method of mordanting *i.e.* pre-mordanting will be used to dye cotton, silk and wool fabrics with natural colouring matter extracted from Kaner flower.

Mordanting Conditions:

The fabrics were treated with Harda, Alum, and Copper Sulphate as mordants at concentrations of 2% and 3% (on the weight of fabric). Mordanting was carried out at a temperature of 80°C for a duration of 20 minutes.

Harda: It is also called Haritaki, plays an important role in natural dyeing as a mordant and pre-treatment agent. It helps fix the dye onto the fabric by improving dye absorption and colour fastness. Rich in tannins, Harda binds well with both the fiber and the dye, especially when working with plant-based dyes on cotton or silk.

Alum: (Potassium aluminium sulphate) is the most common mordant, it is an alkaline mordant. It does not affect colour. It is usually used with cream of tartar (potassium bitartrate), which helps evenness and brightens slightly. Attracts moisture from the air and used as a dye fixative, colour brightener.

Copper Sulphate: Copper sulphate acts as a mordant in natural dyeing. It helps fix the dye to the fabric, improves colourfastness, and can change the dye shade, often making colours darker or greener (Bhandari *et al.,* 2024; Singh *et al.*, 2020; Wenhao *et al.*, 2024).

RESULTS AND DISCUSSION

Various shades of yellow were obtained from the dye extracted from Cascabela thevetia (Kaner) flowers. The shade variations were achieved through the use of different mordants Harda, Alum, and Copper Sulphate which not only enhanced dye fixation on the fabric but also influenced the resulting hue. A single dyeing approach, the pre-mordanting method, was employed for all fabric samples. Each mordant produced distinct tonal differences in the dyed fabrics. As certain mordants are light-sensitive, the dyeing of cotton, silk, and wool samples was carried out immediately following mordanting to prevent oxidation or shade alteration. The dyed samples were then evaluated for their Colour fastness properties, including resistance to washing, rubbing (crocking), and exposure to sunlight. All washing fastness tests were conducted at the Textile Testing Laboratory, IIS (Deemed to be University), Jaipur.

Fabric properties of fabrics Cotton, Silk and Wool:

The physical characteristics of the fabrics used in the study are summarized in Table 1. Cotton fabric exhibited a thread count ranging from 80 to 100, with a fabric weight of approximately 90 g/m² and a thickness of 0.15mm. Silk showed the highest thread density (120–140 threads per inch) and the lowest GSM (33 g/m²), indicating its lightweight and fine texture. Wool, on the other hand, had the lowest thread count (56–64) but the greatest thickness (0.27mm) and highest GSM (123 g/m²), reflecting its dense and bulky structure.

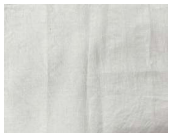
Table 1: The physical properties of fabrics

Fabric Properties	Cotton	Silk	Wool
Thread Count	80-100	120-140	56-64
GSM	90 g/m²	33 g/m²	123 g/m²
Thickness	0.15mm	0.08mm	0.27mm

Application of Dye on Cotton, Silk and Wool fabric with Kaner Flower:

The dyeing of cotton, silk, and wool fabrics was carried out using the natural extract derived from Cascabela thevetia (Kaner flower) in conjunction with Harda and Alum as mordants to enhance dye fixation and achieve shade variation. The combined use of Harda and Alum yielded light to medium yellow hues across all fabric types, with noticeable distinctions in tone and brightness (Table 2).

Table 2 : Dyed Application of cotton, silk and wool fabric with Harda and Alum

Harda + Alum	Control Fabric	Mordanting	After dyeing
Cotton			
Silk			
Wool			

Cotton exhibited a soft and subdued yellow Colouration, whereas silk produced a brilliant and lustrous golden shade, accentuated by its inherent sheen. Wool presented a deeper and warmer yellow tone, demonstrating greater Colour saturation and depth. These variations underscore the influence of fiber composition and mordant-fiber interaction on the resultant hue, chromatic intensity, and dye affinity in natural dyeing processes.

Table 3: Dyed Application of cotton, silk and wool fabric with Harda and Copper Sulphate

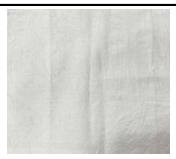
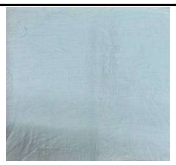
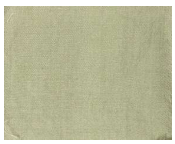
Harda + Copper Sulphate	Control Fabric	Mordanting	After dyeing
Cotton			
Silk			
Wool			

The dyeing of cotton, silk, and wool fabrics using Cascabela thevetia (Kaner flower) extract in combination with Harda and Copper Sulphate as mordants was undertaken to enhance dye fixation and achieve varied tonal effects. The interaction between these mordants produced distinct shades across the three fabric types (Table 3).

Cotton exhibited an earthy yellow-green hue with moderate brightness, while silk developed a rich olive-golden tone with enhanced luster due to its smooth surface and natural sheen. Wool displayed deeper and more muted greenish-yellow shades, reflecting stronger mordant–dye–fiber bonding. These results indicate that the combination of Harda and Copper Sulphate not only improved the depth of Colour but also influenced shade variation, depending on the fiber composition and its affinity toward the natural dye.

Dyeing cotton, silk, and wool fabrics with Cascabela thevetia (Kaner flower) extract using Copper Sulphate as a mordant produced deeper yellow-green to olive tones. Cotton showed a muted yellow-green shade, silk

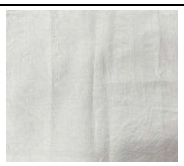
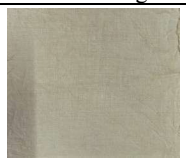
Table 4 : Dyed Application of cotton, silk and wool fabric with Copper Sulphate

Copper Sulphate	Control Fabric	Mordanting	After dyeing
Cotton			
Silk			
Wool			

developed a rich olive-yellow hue, and wool displayed the darkest, warm greenish-yellow Colour. The use of Copper Sulphate enhanced dye absorption and Colour depth across all fabrics (Table 4).

Dyeing with Cascabela thevetia (Kaner flower) extract using Alum as a mordant produced bright yellow shades on all fabrics. Cotton showed a light, soft yellow tone, silk developed a clear and glossy golden-yellow hue, and wool exhibited a slightly deeper yellow shade. Alum enhanced Colour brightness and uniformity across the fibers.

Table 5 : Dyed Application of cotton, silk and wool fabric with Alum

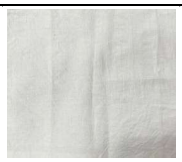
Alum	Control Fabric	Mordanting	After dyeing
Cotton			
Silk			
Wool			

Dyeing of cotton, silk, and wool fabrics with Cascabela thevetia (Kaner flower) extract using Harda

as a mordant resulted in warm yellow to golden-brown shades across the fabrics. Cotton exhibited a soft, muted yellow tone, silk developed a bright golden hue with enhanced luster, and wool showed a deeper and more saturated shade. The use of Harda effectively improved dye fixation and contributed to the overall warmth and depth of the obtained Colours (Table 5) (Singh *et al.*, 2020; Geeta and Sumathy, 2013).

During the dyeing process using Cascabela thevetia flower extract, three distinct shades—yellow, earthy olive, and crisp green—were obtained (Singh *et al.,* 2020; Wenhao *et al.,* 2024), depending on the type of mordant applied. Fabrics treated with Alum and Harda produced lighter, softer hues, while those mordanted with Copper Sulphate developed deeper and more intense tones. Cotton samples displayed relatively lighter shades, whereas silk and wool exhibited higher dye absorption, resulting in richer and darker Colouration. Among all the tested fabrics, silk demonstrated the highest Colour vibrancy and brilliance. Post-washing evaluations indicated satisfactory Colour retention on both silk and wool, highlighting their strong affinity for the natural dye and confirming the effectiveness of the mordanting process (Table 6) (Mansour, 2013; Mohan *et al.*, 2012).

Table 6 : Dyed Application of cotton, silk and wool fabric with Harda

Harda	Control Fabric	Mordanting	After dyeing
Cotton			
Silk			
Wool			

Determining of Washing Fastness:

The washing fastness of the dyed cotton, silk, and wool samples was evaluated by subjecting them to washing in a solution containing detergent and Ezee liquid wash at 60°C to assess their resistance to Colour fading and dye removal (Table 7).

The washing fastness of Cascabela thevetia dyed fabrics varied with mordant type and fiber composition. Fabrics treated with Alum and Harda showed the best overall results, with silk rated excellent, wool very good, and cotton good. Copper Sulphate–based mordanting produced excellent fastness on silk and wool but poor results on cotton. Harda alone gave the lowest ratings across all fabrics, while Alum alone provided moderate to very good fastness. Overall, silk and wool exhibited superior washing fastness compared to cotton, reflecting their higher dye affinity and mordant compatibility.

Table 7: Colour fastness test of Washing Fastness

Mordants	Fabrics	Rating	Remarks
Alum and	Cotton	3	Good
Harda	Silk	5	Excellent
	Wool	4	Very Good
Harda and	Cotton	1	Poor
Copper	Silk	2/3	Fair good
Sulphate	Wool	5	Excellent
Copper	Cotton	1	Poor
Sulphate	Silk	4/5	Excellent
	Wool	4/5	Excellent
	Cotton	1/2	Poor
Harda	Silk	2/3	Fair good
	Wool	2	Fair good
	Cotton	2/3	Fair good
Alum	Silk	3/4	Very Good
	Wool	4	Very Good

Determination of Colour Fastness by Crocking/ Rubbing:

The rubbing fastness of Cascabela thevetia–dyed fabrics varied with mordant type. Alum and Harda

Table 8: Colour fastness of Crocking/Rubbing Fastness

Mordants	Fabrics	Rating	Remarks
Alum and	Cotton	3	Good
Harda	Silk	4	Very good
	Wool	3/4	Very Good
Harda and	Cotton	2	Fairy good
Copper	Silk	4/5	Excellent
Sulphate	Wool	4	Very good
Copper	Cotton	4/5	Excellent
Sulphate	Silk	5	Excellent
	Wool	4/5	Excellent
Harda	Cotton	4	Very good
	Silk	4/5	Excellent
	Wool	4/5	Excellent
Alum	Cotton	4	Very good
	Silk	4/5	Excellent
	Wool	3/4	Very Good

produced good to very good results, while the Harda and Copper Sulphate combination enhanced fastness, especially on silk and wool. Copper Sulphate alone gave the best performance, showing excellent fastness across all fabrics. Harda and Alum individually also yielded very good results. Overall, silk showed the highest rubbing fastness, followed by wool, with cotton exhibiting lower resistance (Table 8) (Bhandari *et al.*, 2024; Devi *et al.*, 2025; Singh *et al.*, 2020).

Determination of Sunlight Fastness:

The light fastness of fabrics dyed with Cascabela thevetia extract varied with mordant type. The Harda and Copper Sulphate combination gave the best results, showing excellent fastness for silk and wool and very good for cotton. Alum and Harda also produced good to excellent resistance to fading, while Harda and Alum alone showed moderate performance. Overall, silk and wool exhibited superior light fastness compared to cotton, indicating better dye affinity and resistance to fading under sunlight (Table 9).

Table 9: Colour fastness of Light Fastness

Mordants	Fabrics	Rating	Remarks
Alum and	Cotton	3	Good
Harda	Silk	4/5	Excellent
	Wool	3/4	Very Good
Harda and	Cotton	3/4	Very Good
Copper	Silk	5	Excellent
Sulphate	Wool	4/5	Excellent
Copper	Cotton	4/5	Excellent
Sulphate	Silk	3/4	Very Good
	Wool	4/5	Excellent
Harda	Cotton	3	Good
	Silk	4	Very good
	Wool	3	Good
Alum	Cotton	2	Fair good
	Silk	2/3	Good
	Wool	2/3	Fair good

Summary and Conclusion:

This study emphasizes the potential of Cascabela thevetia (Kaner) flowers as a sustainable and eco-friendly source of natural dye for textile Colouration. The extraction and application processes developed in this research were simple, safe, and environmentally responsible, making them well-suited for green textile practices (Devi *et al.*, 2025; Tripathi *et al.*, 2015; Wenhao *et al.*, 2024).

The results demonstrated that the use of different mordants through pre-mordanting significantly influenced shade variation, dye uptake, and Colour fastness. Fabrics dyed with Cascabela thevetia extract produced a range of aesthetically appealing shades with satisfactory wash fastness, supporting the feasibility of replacing synthetic dyes with natural alternatives in the textile industry.

The findings further confirmed that natural dyes, when used with appropriate mordants, provide considerable environmental benefits—such as non-toxicity, biodegradability, and reduced pollution—while ensuring uniform and durable Colouration. Among the tested fibers, silk exhibited the highest dye affinity and brightness, followed by wool and cotton, both of which also showed good dye absorption and retention.

Overall, the study highlights the potential of Cascabela thevetia as a valuable, renewable, and drought-tolerant dye source. Its evergreen nature, adaptability to semi-arid regions, and abundant floral yield make it a promising candidate for sustainable textile dye production, aligning with global efforts toward eco-conscious and resource-efficient Colourant development.

REFERENCES

Bhandari, V., Badanayak, P. and Jose, S. (2024). Plant based Colourants: Isolation and application (pp. 159–188). https://doi.org/10.1002/9783527839032.ch7

Chowdhury, M.R., Khan, A.N. and Sultana, S. (2024). Study on the effect of natural dyes and synthetic dyes on textile fabric. *J. Materials Science Res.*, **13**(2) : 25–33. https://doi.org/10.5539/jmsr.v13n1p25

Devi, S., Panghaal, D., Kumar, P., Malik, P., Ravi, E. and Mittal, S.P. (2025). Eco-friendly innovations in textile dyeing: A comprehensive review of natural dyes. *Advances in Research*, **26**(1) : 204–212. https://doi.org/10.9734/air/2025/v26i11247

Devi, S. (2019). Traditional natural dyes used for dyeing fibre and fabrics of Manipur. *Internat. J. Res. Review*, **6**(1).

Geeta, B. and Sumathy, V.J.H.J. (2013). Extraction of Natural Dyes from Plants. *International Journal of Chemistry and Pharmaceutical Science,* **1**(8) : 502–509.

Kombey, P., Rai, K. and Chaudhary, V. (2023). Natural dyes extracted from flower crops. *Ecology, Environment & Conservation*, **12**(5) : 397. https://doi.org/10.31838/ecb/2023.12.5.397

Mansour, H. F. (2013). Textile dyeing: Environmentally friendly Osage orange extract on protein fabrics. InTech. https://doi.org/10.5772/54410

Mohan, C., Salini, T. and Thiyagarajan, A. (2012). Dyeing of cotton with natural dye obtained from flower of Tecoma stans. *Universal Journal of Environmental Research and Technology*, **2**(1) : 41–46.

More, U.A., Deshpande, A., More, D.D. and Malode, S. (2022). Extraction of natural dyes from Nerium oleander L. flowers for cotton and silk colouration. *Aayushi International Interdisciplinary Research Journal,* Sp. Issue, 9: 234-237.

Patel, P. (2022). Extraction and determining the dyeing potential of floral dyes on various fabrics (pp. 93–102). https://doi.org/10.9734/bpi/ist/v2/1634b

Prajapati, M. and Modi, N. (2020). Extraction of natural dye from *Cascabela thevetia* L. flowers for cotton fabric colouration. *International Journal for Innovative Research in Multidisciplinary Field*, **6**(7) : 143-147. https://doi.org/10.2015/IJIRMF.2455.0620/202007026

Singh, M., Patel, F.R. and Modi, N. (2020). Effect of mordant on natural dye extracts. *International Journal of Research Culture Society*, 4(6) : 109-113.

Singh, R. and Srivastava, S. (2015). Exploration of flower-based natural dyes. *Research Journal of Recent Sciences*, **4**. ISSN 2277-2502.

Tripathi, G., Mukesh, K., Yadav, M.K. and Upadhyay, P. (2015). Natural dyes with future in dyeing of textiles. *International Journal of PharmTech Research*, **8**(1) : 96–100.

Utami, H., Harahap, K., Pista, A.F. and Azizah, A.A. (2024). Extraction of natural dyes from cocoa pod husk (*Theobroma cacao* L.) using ultrasound-assisted extraction as a natural fabric dye. *Journal Rekayasa Kimia & Lingkungan*, **19**(2) : 200-211. https://doi.org/10.23955/rkl.v19i2.38384

Wenhao, S., Yaohui, D., Teng, L., Xin, J. and Mingming, W. (2024). Research on the application of biological mordant dyeing with natural dyes. *Advances in Engineering Innovatio, 9,* EWA Publishing, 9. https://doi.org/10.54254/2977-3903/9/2024091

****