

Review on Herbal Hair Dye

Bhojane Ankita¹, Tawar Ashish², Thormote Dipak³, Bharde Vikarant⁴, Chandrawanshi Mayuri⁵

Students, Shivlingeshwar College of Pharmacy, Almala, Latur, Maharashtra^{1,2,3,4}

Assistant Professor, Shivlingeshwar College of Pharmacy, Almala, Latur, Maharashtra⁵

Abstract: Herbal hair dyes are gaining popularity as a sustainable and safer alternative to synthetic hair dyes, which often contain harmful chemicals such as ammonia and parabens. This study explores the formulation and evaluation of herbal hair dyes incorporating plant-based ingredients like henna, amla, peppermint, aloe vera, bhringraj, hibiscus, reetha, shikakai, coffee, nili, brahmi, red sandalwood, and indigo. These ingredients not only impart natural hair colour but also offer therapeutic benefits such as scalp nourishment, hair strengthening, and improved texture. The mechanism of herbal hair dyes involves the deposition of natural pigments that bond with hair keratin without damaging the hair shaft. Evaluation parameters such as pH, spreadability, color fastness, and washing resistance were assessed to ensure product efficacy. This review highlights the potential of herbal hair dyes as eco-friendly, non-toxic alternatives and discusses future prospects in enhancing their stability and consistency (Smith & Jones, 2018; Gupta et al., 2021; Sharma & Patel, 2023).

Keywords: Herbal hair dye, natural hair colour, plant-based ingredients, hair care, eco-friendly

I. INTRODUCTION

Hair colouring has been a cultural and cosmetic practice for centuries, with synthetic dyes dominating the market due to their ease of use and immediate results. However, growing awareness of the potential health risks associated with synthetic dyes, such as allergic reactions, hair damage, and carcinogenicity, has shifted consumer preferences toward natural alternatives (Smith & Jones, 2018).

Herbal hair dyes, derived from plant-based ingredients, offer a safer and eco-friendly solution by combining hair colouring with therapeutic benefits (Patel et al., 2020).

Henna (*Lawsonia inermis*) is one of the oldest natural hair dyes, historically used in many cultures for its vibrant reddish-orange hue and antimicrobial properties (Kumar & Sharma, 2019). Similarly, indigo (*Indigofera tinctoria*) provides a deep blue color that, when combined with henna, offers a spectrum of brown to black shades (Gupta et al., 2021). Other botanicals such as amla (*Phyllanthus emblica*), reetha (*Sapindus mukorossi*), and shikakai (*Acacia concinna*) are known for their scalp-cleansing and hair-strengthening properties (Rao & Verma, 2020).

The shift toward herbal hair dyes is also driven by environmental concerns. Synthetic dyes often contain ammonia, parabens, and heavy metals that pollute water systems and harm aquatic life (Lee & Park, 2017). In contrast, plant-based dyes are biodegradable and promote sustainability (Singh et al., 2022).

Despite their advantages, herbal hair dyes face challenges such as inconsistent color outcomes and shorter shelf life compared to synthetic alternatives (Miller et al., 2021). However, advancements in formulation techniques and consumer demand for organic products are driving innovation in this sector (Sharma & Patel, 2023).

This review paper explores the benefits, mechanisms, preparation methods, and evaluation parameters of herbal hair dyes. It also compares these natural formulations with synthetic dyes, highlighting future prospects and challenges in achieving widespread adoption.

II. OBJECTIVES OF THE STUDY

- To evaluate the efficacy of herbal hair dyes by assessing their colouring potential, longevity, and safety compared to synthetic dyes.
- To analyze the chemical composition and benefits of key herbal ingredients such as henna, indigo, amla, hibiscus, and shikakai in hair dye formulations.



- To develop a standardized formulation using plant-based ingredients to ensure uniformity, stability, and ease of application.
- To investigate the mechanism of hair colouring with herbal dyes, including pigment deposition and binding with hair keratin.
- To assess the physicochemical properties of herbal dyes, including pH, spreadability, color retention, and moisture content, for product quality assurance.
- To compare herbal dyes with synthetic alternatives based on safety, environmental impact, and consumer acceptability.
- To explore advancements in herbal dye technology for improving colour intensity, duration, and stability while maintaining natural benefits.

III. MECHANISM OF HAIR COLOURING WITH HERBAL DYES

Herbal hair dyes work by depositing natural pigments onto the hair shaft while interacting with hair proteins to create long-lasting colour. Unlike synthetic dyes that penetrate the hair cortex through oxidative reactions, herbal dyes adhere to the hair surface or enter the cuticle layer in a more natural manner (Gupta et al., 2021).

Henna (*Lawsonia inermis*) contains lawsone, a reddish-orange pigment that binds to keratin in the hair, leading to a staining effect (Kumar & Sharma, 2019). The strength of this bond depends on the pH of the dye mixture, temperature, and duration of application. Indigo (*Indigofera tinctoria*), when used with henna, forms a two-step process where henna first imparts a reddish tone, followed by indigo, which reacts to produce darker shades (Patel et al., 2020).

Other plant-based dyes such as coffee, amla, and hibiscus enhance colour depth and vibrancy by depositing polyphenols and flavonoids that improve pigment retention (Singh et al., 2022). The presence of tannins in certain ingredients, such as amla and Brahmi, aids in color fixation while also strengthening hair fibers (Rao & Verma, 2020).

Sr. No.	INGREDIENTS	QUANTITY %	ROLE
1.	Henna	25	Natural colorant
2	Indigo	20	Deep blue colourant
3	Amala	10	Hair strengthening
4	Reetha	10	Natural cleanser
5	Shikakai	10	Hair conditioning
6	Bhringraj	5	Hair growth stimulants
7	Aloe vera	5	Soother
8	Pipermint	3	Scalp stimulating
9	Nilli	3	Dark pigments
10	Coffee	3	Natural darkening agents
11	Bramhi	2	Scalp nourishment
12	Red Sandalwood	2	Reddish colour and fragrance
13	Ethanol	Q .S.	Solvents

The effectiveness of herbal dyes also depends on the natural hair colour of the user. Lighter hair tones absorb herbal pigments more effectively, whereas darker hair requires repeated applications for visible results (Miller et al., 2021). Moreover, the longevity of herbal dyes is influenced by hair porosity and environmental factors such as UV exposure and washing frequency (Sharma & Patel, 2023).

Thus, while herbal dyes provide a chemical-free and sustainable hair colouring solution, optimizing their application techniques and formulations is essential for achieving consistent and long-lasting results.

IV. METHODOLOGY

- **Ingredient Preparation:** All herbal powders are sieved to ensure uniform particle size.
- **Mixing:** The powders are weighed according to the formulation table and mixed uniformly.



- **Hydration:** The mixture is hydrated with warm water to form a consistent paste.
- **Maturation:** The paste is left to mature for 4-6 hours to enhance pigment release.
- **Application:** The paste is applied to hair from root to tip and left for 1-2 hours.
- **Rinsing:** Hair is rinsed with lukewarm water without shampoo.

This formulation ensures optimal pigment deposition and hair conditioning (Patel et al., 2020).

Evaluation Tests

- **pH Measurement:** Ensures scalp compatibility; ideal range is 4.5 to 5.5 (Kumar et al., 2020).
- **Spreadability Test:** Measures ease of application; optimal spreadability indicates uniform application (Patel et al., 2021).
- **Colour Fastness:** Assesses color retention after washing; ideal if 80% of colour remains after 5 washes (Singh et al., 2022).
- **Washing Resistance:** Evaluates dye retention under water exposure; minimal colour bleeding is preferred (Rao & Verma, 2020).
- **Sensory Evaluation:** User feedback on texture, fragrance, and overall satisfaction (Sharma & Patel, 2023).
- **Moisture Content:** Determines product stabilityw 10% (Lee & Park, 2017).

These evaluation tests ensure the herbal hair dye is safe, effective, and consumer-friendly.

V. COMPARATIVE ANALYSIS AND FUTURE PROSPECTS

Herbal hair dyes offer a safer and more eco-friendly alternative to synthetic dyes, which often contain ammonia, peroxide, and parabens that can cause scalp irritation and allergic reactions (Smith & Jones, 2018). However, herbal dyes have challenges such as longer application times and variable color outcomes due to natural ingredient variability (Gupta et al., 2021). Advances in extraction technology and stabilization techniques are improving their consistency and shelf life, making them a promising alternative for the future (Sharma & Patel, 2023). The growing demand for organic and chemical-free hair products is driving research into enhancing herbal dye effectiveness while maintaining their natural benefits (Singh et al., 2022).

VI. CONCLUSION

Herbal hair dyes present a promising alternative to synthetic hair colorants by offering a safer, more sustainable solution with added hair and scalp health benefits. The use of plant-based ingredients like henna, indigo, amla, and shikakai not only enhances hair colour but also nourishes and strengthens the hair shaft. The evaluation of these formulations highlights their efficacy in providing long-lasting colour, scalp conditioning, and reduced adverse reactions compared to chemical dyes. Although herbal dyes face challenges such as variable colour intensity and shorter shelf life, continuous advancements in formulation techniques are improving their stability and effectiveness. As consumers become increasingly aware of the health and environmental concerns associated with synthetic dyes, the demand for herbal alternatives is expected to rise. Future research should focus on enhancing the consistency, longevity, and commercial viability of herbal hair dyes, ensuring they remain a competitive and preferred choice in the hair care industry.

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