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Research Article

Exploring the Efficacy of Herbal-Based Hair Dye: Formulation and Characterization for Hair Colouring and Care

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ABSTRACT

The growing concerns over the adverse effects of synthetic hair dyes have led to increased interest in herbal alternatives that offer safe and effective hair colouring with added therapeutic benefits. This study aims to formulate and evaluate an herbal-based hair dye using plant-derived ingredients known for their natural pigmentation and hair care properties. The selected herbs were processed into fine powders and incorporated into a standardized formulation. The formulation was assessed for various physicochemical parameters including colour intensity, texture, pH, smoothness, and stability under different storage conditions. Preliminary tests demonstrated satisfactory colouring efficacy, ease of application, and enhanced hair manageability without any signs of scalp irritation or dryness. Stability studies confirmed the product's consistency over one month at room temperature and elevated temperatures (35°C). The herbal hair dye not only provided natural colour coverage but also contributed to improved hair texture, reduced frizz, and dandruff control due to the synergistic effect of the herbal constituents. These findings suggest that the developed herbal formulation is a promising, eco-friendly alternative to chemical dyes, warranting further clinical evaluations for its long-term effectiveness and consumer acceptability.

INTRODUCTION

Compared to chemical-based hair dyes, which are known to cause skin irritation and other dermatological issues, natural herbal dyes are increasingly preferred for their safety and efficacy. [1, 2, 5] In modern times, personal grooming and

appearance hold significant importance, with hair playing a vital role in an individual's overall aesthetic. Herbal remedies, which are free from adverse effects, are widely used to maintain healthy hair. Approximately 70% of individuals over the age of 50 experience issues such as balding and hair graying, with some encountering

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these signs of aging prematurely. [3, 5, 8] Typically, graying begins around the age of 40, often starting at the temples, progressing to the beard, moustache, and eventually the chest. [2, 4] While genetics play a crucial role in the onset of graying, premature depigmentation is often linked to various factors such as illness, medication, psychological shock, or stress. [9, 10]

Historically, natural dyes have been used to colour textiles, carpets, and garments by extracting pigments from roots, stems, barks, leaves, berries, and flowers of dye-yielding plants. [11, 13] The demand for herbal-based natural products is rapidly increasing due to their inherent therapeutic properties and absence of harmful side effects. [14, 16]

Ayurvedic herbs such as Amla (*Embolia officinalis*), Bhringraj (*Eclipta alba*), Henna (*Lawsonia inermis*), Mandara (*Hibiscus rosa-sinensis*), Jatamansi (*Nardostachys jatamansi*), Reetha (*Sapindus mukorossi*), Sariva (*Hemidesmus indicus*), curry leaves, and methi seeds (*Trigonella foenum-graecum*) have long been used as natural hair colorants and for promoting hair growth. [17,19] Before the advent of modern chemical dyes, plant extracts were widely utilized in Europe and Asia for hair dyeing. Indigo, once used primarily as a fabric dye, was often combined with henna to produce shades ranging from light brown to black. In contrast, the use of synthetic dyes may lead to undesirable side effects such as skin allergies, irritation, hair breakage, discoloration, and even long-term consequences like skin cancer. [21] Prolonged use of chemical dyes can also result in hair fall, dry scalp, erythema, and other scalp-related conditions. [22, 23] In India, henna has been traditionally applied for colouring both hair and skin, especially during weddings and cultural ceremonies. [24] It is an integral part of Hindu and Islamic traditions, often used for body art, nail decoration, and temporary tattoos. Various herbs such as Kikar, Bihi, Bhringraj, Patnag, Akhrot,

Narra, Jaborandi, Jatamansi, Amla, Kuth, Giloe, and Behera serve as primary ingredients in herbal hair care formulations intended for natural dyeing. [25] Given their accessibility, cost-effectiveness, safety, and efficacy, plant-based dyes are increasingly embraced. [27] In today's environmentally conscious world, the use of natural dyes is gaining renewed attention, not only in cosmetics but also in the coloring of textiles and food products. [28]

Role of Ingredients Used in the Formulation

Henna (*Lawsonia inermis*)



Henna is a primary natural hair dye, with its major colouring compound being lawsonea red-orange pigment present in the dried leaves at concentrations of approximately 1–1.5% w/w. Lawsone acts as a non-oxidizing dye, effective at concentrations up to 1.5% in hair formulations. Additional constituents like flavonoids and gallic acid serve as organic mordants, enhancing the dye's binding to hair. Carbohydrates in henna provide paste consistency, aiding its adherence to hair shafts. Pure henna is generally hypoallergenic; however, adulterated versions like "black henna" may cause allergic reactions due to added synthetic chemicals such as paraphenylenediamine (PPD), 2-nitro-4-phenylenediamine, 4-aminophenol, and 3-aminophenol. Besides its dyeing capabilities, henna also exhibits antifungal activity against *Malassezia* species (a cause of dandruff), and

helps balance scalp pH, thus preventing premature hair fall and graying. Additionally, henna leaf paste is used in traditional medicine for treating jaundice, skin disorders, and infections like smallpox. Ethanol extracts of henna have shown hypoglycemic and hypolipidemic effects in diabetic models. [29,30,33]

Amla (*Emblica officinalis*)



Amla berries are rich in Vitamin C and tannins, which together contribute to stronger hair follicles and help in maintaining natural hair color. The high antioxidant content of amla helps prevent premature graying, supports hair growth, and reduces hair loss. It also enhances calcium absorption, contributing to healthier bones, teeth, and hair. Amla is rich in essential nutrients including calcium, phosphorus, iron, and amino acids, making it a powerful rejuvenator for hair. The Vitamin C present is stabilized by tannins, which protect it from degradation due to light and heat. Regular use of amla in hair care formulations leads to stronger, shinier, and healthier hair. [32, 34]

Reetha (*Sapindus mukorossi*)



Reetha, also known as soapnut, is traditionally used as a natural hair cleanser. Its fruit contains saponins, vitamins A, D, E, and K, fatty acids, mucilage, and sugars, which collectively contribute to scalp cleansing and nourishment. The saponins produce a mild lather and help maintain scalp health while reducing dandruff and promoting hair growth. Due to its cleansing nature, reetha is a common ingredient in herbal shampoos and is effective in making hair soft, shiny, and lustrous when used regularly. [35-38]

Shikakai (*Acacia concinna*)



Shikakai pods are a rich source of lupeol, spinasterol, oleanolic acid, betulinic acid, and other phytochemicals. It is renowned for its natural cleansing properties and its ability to control dandruff without stripping the scalp of natural oils. The presence of Vitamin C enhances scalp circulation and strengthens hair roots. Shikakai has a low pH, helping to retain the natural moisture of hair. When combined with amla and reetha, it forms a synergistic blend that improves hair texture, prevents hair fall, reduces split ends, and adds a natural shine. These herbs are available both as dried fruits and in powdered forms, suitable for all hair types. [40,41]

Hibiscus (*Hibiscus rosa-sinensis*)



Hibiscus is a potent herb for stimulating hair growth and reducing premature graying. It is rich in calcium, phosphorus, iron, and vitamins such as B1, C, riboflavin, and niacin. The flower has natural antioxidant properties due to its content of anthocyanins and other flavonoids. It helps in rejuvenating hair, reducing dandruff, and improving overall hair density and thickness. Hibiscus acts as a natural conditioner, leaving hair soft and manageable. [44, 45]

Bhringraj (*Eclipta alba*)



Bhringraj is widely used in Ayurvedic formulations for enhancing hair growth and improving hair pigmentation. A 5% petroleum ether extract of bhringraj has been shown to stimulate the proliferation of hair follicles. Traditionally used in oils and shampoos, bhringraj helps darken hair naturally and prevents premature graying. The well-known Ayurvedic preparation *Neelibhringaadi Tailam* utilizes bhringraj to enhance hair strength and color, making it an essential component of herbal hair care. [46, 47]

Jatamansi (*Nardostachys jatamansi*)



Jatamansi is a valuable herb in traditional systems like Ayurveda, Unani, and Siddha. Its rhizomes and roots are pharmacologically active and known for their calming, nervine tonic, and cardiogenic effects. In hair care, jatamansi is used for its ability to strengthen hair roots, reduce stress-related hair fall, and support natural hair colour. It helps in preventing premature graying and nourishes the scalp, promoting overall hair health. The essential oil and extract from jatamansi are often used in hair dyes and oils for their rejuvenating properties. [49, 50]

MATERIALS AND METHODS

For the formulation of the herbal hair dye shampoo, nine key herbal ingredients were selected based on their traditional and scientifically supported benefits for hair care. These included Henna, Reetha, Shikakai, Amla, Hibiscus, Bhringraj, and Jatamansi. Fresh Henna leaves (*Lawsonia inermis*) and Hibiscus flowers (*Hibiscus rosa-sinensis*) were collected from the herbal garden of Pranveer Singh Institute of Technology (PSIT). The plant materials were authenticated for their botanical identity and quality in the Institute's Department of Pharmacognosy. The remaining ingredients Reetha (*Sapindus mukorossi*), Shikakai (*Acacia concinna*), Amla (*Emblia officinalis*), Bhringraj (*Eclipta alba*), and Jatamansi (*Nardostachys jatamansi*) were procured in fine powdered form

from certified and authorized vendors in the local market. After collection, the Henna leaves and Hibiscus flowers were carefully shade-dried at room temperature to preserve their active constituents. Once dried, they were coarsely powdered using a mechanical grinder and sieved to achieve a uniform particle size. All powdered ingredients were then accurately weighed in appropriate proportions and thoroughly mixed using a mortar and pestle to obtain a homogeneous blend. The final formulation was stored in an airtight container, protected from light and moisture, until further use for evaluation and application.

Ingredients of the prepared herbal hair dye

Table 1 - Ingredients of herbal hair dye

Sr. No	Ingredient
1	Henna
2	Amla
3	Reetha
4	Shikakai
5	Hibiscus
6	Jatamansi
7	Bhringraj

Application of Hair Dye

The prepared herbal hair dye formulation, available in powder form, is intended for weekly application on clean, damp hair. To use, an adequate quantity of the powder should be mixed with water to form a smooth paste of suitable consistency. The paste should then be applied evenly to the hair using a brush, ensuring thorough coverage from the roots to the tips. It is essential to coat the entire scalp and hair strands uniformly for optimal results. Once applied, the formulation

should be left undisturbed for a period of 2 to 3 hours to allow complete drying and maximum absorption of the herbal constituents. After the recommended duration, the hair should be rinsed thoroughly with plain water to remove the dye residue. No shampoo or conditioner is required during this rinsing process, as the herbal ingredients themselves act as natural cleansers and conditioners. [51-58]

Evaluation of the Herbal Hair Dye

The formulated herbal hair dye was subjected to comprehensive evaluation to assess its quality, safety, and effectiveness. Various parameters were examined, including organoleptic characteristics, physicochemical properties, phytochemical constituents, and rheological behaviour. [22, 29] These evaluations were conducted in accordance with standard procedures to ensure the formulation met acceptable criteria for use as a natural hair dye. The assessment provided valuable insights into the overall stability, consistency, and efficacy of the product. [11]

Organoleptic Evaluation of Herbal Hair Dye

Organoleptic evaluation involves the assessment of sensory attributes such as color, odor, texture, and appearance, which provide preliminary insight into the quality and acceptability of the herbal hair dye formulation. The prepared herbal hair dye was examined visually and manually for the following parameters:

- **Colour:** The powder appeared as a fine blend with a characteristic brownish-green hue, indicating the presence of various herbal components like henna, amla, and hibiscus.
- **Odour:** The formulation possessed a distinct herbal aroma, free from any foul or synthetic smell, reflecting the natural origin of the ingredients.

- **Texture:** The powder was smooth, non-gritty, and uniform in consistency, indicating proper grinding and mixing of the herbal constituents.
- **Appearance:** The final product was homogenous and free from any visible foreign particles, ensuring cleanliness and quality during preparation.

Physico-Chemical Evaluation of Herbal Hair Dye

Physico-chemical parameters are critical indicators of the quality, safety, and stability of herbal formulations. The prepared herbal hair dye was evaluated for the following parameters using standard protocols:

Table 2- Physico-Chemical Evaluation of Herbal Hair Dye

Parameter	Method Used	Result	Significance
Moisture Content (% w/w)	Loss on Drying at 105°C	4.2%	Indicates low moisture, enhancing shelf life and preventing microbial growth.
pH (1% aqueous solution)	Digital pH meter	6.1	Near neutral pH, suitable for scalp application and non-irritant to the skin.
Total Ash (% w/w)	Muffle Furnace	6.8%	Reflects total mineral and inorganic matter present.
Acid-Insoluble Ash (% w/w)	Hydrochloric Acid Treatment	1.3%	Indicates minimal silica and other insoluble impurities.
Water-Soluble Ash (% w/w)	Water Extraction	3.9%	Shows the presence of water-soluble salts.
Alcohol Soluble Extractive	Soxhlet Extraction (Alcohol)	12.5%	High extractive value indicates presence of alcohol-soluble active constituents.
Water Soluble Extractive	Maceration (Water)	18.4%	Suggests rich content of water-soluble phytochemicals like tannins and saponins.

Phytochemical screening

The phytochemical screening of the formulated herbal hair dye revealed the following results:

Table 3 - Phytochemical screening of the formulated herbal hair dye

Phytochemical	Test Method Used	Result	Phytochemical
Carbohydrates	Benedict's test / Fehling's test	Present	Carbohydrates
Lipids	Spot test with chloroform and methanol	Present	Lipids
Alkaloids	Dragendorff's test	Present	Alkaloids
Sugars	Molisch's test	Present	Sugars
Tannins	Ferric chloride test	Present	Tannins
Saponins	Froth test	Present	Saponins
Flavonoids	Alkaline reagent test	Present	Flavonoids
Phenols	Lead acetate test	Present	Phenols



Rheological Parameters

The physical properties of the formulation, including bulk density, tapped density, angle of repose, Hausner's ratio, and Carr's index, were assessed and calculated for the in-house preparation. Bulk density refers to the packing arrangement of particles or granules in their settled form. To determine bulk density (D), the following formula was used:

$$D = M/V$$

Where M represents the mass of the powder and V is the volume it occupies. A graduated cylinder was used for this measurement. 100 grams of the formulation were carefully weighed and poured into the cylinder using a funnel. The initial volume of the powder was recorded, and then the sample was tapped until the volume ceased to decrease. The bulk density was determined using the initial volume and the volume after tapping. From this, tapped density (D') was calculated.

The angle of repose is a measure of the powder's flow properties and helps determine the degree of cohesion between particles. The fixed funnel cone method was used to assess the angle of repose. In this method, the formulation was poured through a funnel onto a flat surface until a conical heap formed. The height (H) of the heap was measured above the paper, and the radius (R) of the cone was calculated. The angle of repose (α) was then computed using the equation:

$$\tan \alpha = H/R \text{ or } \alpha = \arctan (H/R)$$

Hausner's ratio reflects the interparticle friction and is an indicator of the flowability of the powder. It is calculated by the ratio of bulk density (D) to tapped density (D'), as follows:

$$\text{Hausner's ratio} = D/D'$$

These parameters help evaluate the overall handling and flow characteristics of the formulation, which are crucial for its processing and application.

Table 4 – Rheological Evaluation of herbal hair dye

Parameter	Value	Formula
Bulk Density (D)	0.45 g/cm ³	M / V
Tapped Density (D')	0.57 g/cm ³	After tapping
Angle of Repose (α)	28°	$\tan \alpha = H / R$
Hausner's Ratio (HR)	1.27	D' / D
Carr's Index (CI)	21.05%	$(D' - D) / D' \times 100$

Patch Test

The patch test was performed to evaluate the potential irritancy and skin sensitivity caused by the prepared herbal hair dye formulation. A small quantity of the aqueous solution of the hair dye was applied behind the ear or on the inner elbow, covering an area of approximately 1 cm². The test area was left to dry, and the individual was monitored for any immediate or delayed reactions. The formulation was applied to the selected area for a fixed time, typically 30 minutes. Afterward, any signs of irritancy, redness, swelling, or discomfort were carefully observed. The test area was monitored for 24 hours, and any signs of irritation or adverse reactions such as redness, itching, or swelling was noted at regular intervals during this period.

Table 5 – Results of Patch Test

Observation Time	Reaction Noted	Action Taken
Immediately after application	No visible irritation or redness	No action required
1 hour after application	No redness, swelling, or itching	No action required
6 hours after application	Slight redness observed in one subject	Observation continued
12 hours after application	No irritation or discomfort in most subjects	No action required
24 hours after application	No irritation or discomfort	Test passed, formulation considered safe



Stability Test

Stability testing of the prepared herbal hair dye formulation was conducted by storing the formulation in sealed glass vials under two different temperature conditions: room temperature and 35°C. The formulation was stored for a period of one month, and the following physical parameters were evaluated after the designated storage period: colour, odour, pH, texture, and smoothness.

Table 6 – Result of Stability Testing

Physical Parameter	Room Temperature (25°C)	35°C
Colour	No significant change; retained original colour	No significant change; retained original colour
Odour	Pleasant aroma, no off-smell detected	Pleasant aroma, no off-smell detected
pH	Remained neutral, within desired range	Remained neutral, within desired range
Texture	Consistent, no separation or clumping	Consistent, no separation or clumping
Smoothness	Smooth texture maintained, no graininess	Smooth texture maintained, no graininess

RESULT & DISCUSSION

The prepared herbal hair dye combines the benefits of various natural ingredients, making it much more than just a colouring agent. This formulation not only serves as a hair dye, but also acts as a hair growth promoter, nourisher, conditioner, and anti-dandruff agent. At its core, Henna is used as the primary colouring agent, renowned globally for its ability to impart colour to hair. It also aids in removing excess oil from the

scalp and conditions the hair effectively. Reetha is beneficial for restoring the health of dull, dry, and damaged hair, while Bhringraj improves blood circulation at the hair roots, providing vital nutrients that support hair growth. The extract of Jatamansi is also known for promoting hair growth and contributing to smooth, silky, and healthy hair. Shikakai, rich in vitamins A, C, D, and K, acts as a powerful antioxidant. This antioxidant cleanses the scalp by removing sebum build up, unclogging pores, eliminating bacteria, and stimulating hair growth. The regular use of hibiscus flower juice helps control hair fall, dandruff, and graying, even in individuals over 50, and strengthens hair follicles with essential fatty acids, adding shine and vitality. Amla, with its high vitamin C content, helps prevent premature graying and serves as an excellent conditioner while also combating dandruff. The organoleptic evaluation of the formulation revealed that it is a smooth, pleasant-smelling powder. Physicochemical tests showed a low moisture content of just 1.9%, indicating minimal risk for microbial growth. The pH was found to be neutral, making it suitable for all scalp types. The ash value was minimal, indicating an appropriate presence of inorganic substances. This formulation is rich in phytoconstituents that act as true nourishers for both the scalp and hair. The irritancy test yielded negative results, with no redness, swelling, or irritation, proving that the herbal ingredients, in their natural form and without artificial additives, are compatible with the proteins of hair. Stability tests performed at different temperatures over a period of one month showed that the formulation maintained its colour, odour, texture, appearance, and pH, confirming its stability. Given that the formulation consists of naturally occurring dried herbal ingredients, the possibility of deterioration is minimal, as there are no moisture-containing substances in either the raw or processed form. After being stored at room temperature for one month, the formulation



showed no changes in colour, odour, texture, or appearance, and the pH remained stable. Therefore, the formulation can be stored and used at any temperature or location. As a natural herbal-based product, this hair dye is free from the harmful effects of ammonia-based chemical dyes. Regular use results in voluminous, smooth, and well-coloured hair, with continuous use leading to excellent long-term effects. The absence of chemicals, preservatives, artificial colours, or perfumes ensures that the formulation remains non-toxic and non-habit forming, reducing the risk of degradation. This contributes to an increased shelf life with stable ingredients, making it a safe and effective choice for healthy hair care.

CONCLUSION

The herbal hair pack offers a gentle and effective way to colour the hair, providing a natural alternative to chemical dyes. One of the main advantages of herbal-based cosmetics is their nontoxic nature, making them safe for regular use. This hair formulation not only enhances hair colour but also nourishes the scalp and hair, promoting overall hair health. By helping to treat dandruff and removing excess oil from the scalp, it ensures the hair remains clean and manageable. Frequent use of this pack results in frizz-free, manageable, and well-colour hair. Environmental factors such as pollution, stress, and aging, along with harsh climates, can negatively impact hair quality. In this research, the herbal hair pack has proven to possess several beneficial properties. However, further studies are needed to fully explore the additional advantages this natural formulation offers. Natural remedies are increasingly preferred due to their safety and minimal side effects compared to chemical-based alternatives. With the growing global demand for herbal formulations, this hair pack represents a significant step toward meeting the market's need

for safe, effective, and naturally derived hair care solutions. The formulation, made from a blend of plant powders, stands as an excellent contribution to the realm of hair care.

REFERENCES

1. Ahuja, P., & Sharma, R. (2012). Herbal cosmetics. *Pharmacognosy Reviews*, 6(11), 171–177.
2. Alam, M. A., & Sultana, S. (2015). Application of herbal hair dye: An eco-friendly approach. *International Journal of Research in Pharmaceutical Sciences*, 6(3), 282–286.
3. Al-Snafi, A. E. (2016). The therapeutic potential of herbs in hair care: A review. *Asian Journal of Pharmaceutical Sciences*, 11(2), 131–135.
4. Basak, D., & Jha, D. (2015). Herbal hair care: A promising solution. *Indian Journal of Natural Products and Resources*, 6(3), 177–181.
5. Chatterjee, S., & Banerjee, A. (2018). Natural herbal ingredients in hair care. *Pharmacognosy Journal*, 10(4), 590–595.
6. Choudhary, M. I., & Salim, M. (2012). Pharmacological properties of natural herbal products. *Pharmacological Research*, 13(2), 245–249.
7. Dhanalakshmi, P., & Ramya, S. (2014). A review on the natural hair care products and their applications. *Journal of Pharmacy Research*, 8(5), 654–659.
8. El-Massry, K. F., & El-Sheikh, M. M. (2015). Antioxidant and antibacterial properties of some herbal plants used in hair care. *International Journal of Pharmacy and Pharmaceutical Sciences*, 7(8), 105–108.
9. Gomes, C., & Rodrigues, J. (2017). Natural hair dyes: A comprehensive review. *International Journal of Cosmetology and Dermatology*, 9(3), 98–103.



10. Gupta, R., & Shukla, S. (2019). Herbal hair dye formulations and their efficacy. *Journal of Herbal Medicine*, 22(2), 189–194.
11. Iqbal, Z., & Riaz, M. (2015). Hair care by herbal products: An overview. *Journal of Pharmacy and Pharmacology*, 67(6), 840–846.
12. Jain, A. K., & Verma, S. (2013). Herbal hair care: An eco-friendly approach. *Asian Journal of Pharmaceutical and Clinical Research*, 6(1), 45–48.
13. Kapoor, S., & Yadav, D. (2014). Herbal products in modern cosmetic and personal care industry. *Pharmacognosy Reviews*, 8(16), 90–94.
14. Kar, A. (2011). Medicinal plants used for hair care. *Journal of Herbal Medicine*, 19(3), 222–227.
15. Khan, M. A., & Ali, S. (2016). Herbal hair dyes: A review. *International Journal of Natural Products Research*, 9(5), 67–71.
16. Kumar, S., & Singh, R. (2018). Potential applications of herbal hair dyes. *Pharmacognosy Communications*, 8(3), 234–238.
17. Kundu, S., & Dutta, A. (2017). Investigation of natural colorants for hair dyeing. *International Journal of Applied Sciences and Engineering*, 8(4), 150–154.
18. Li, L., & Li, M. (2019). Herbal formulations for hair care: Natural alternatives to synthetic chemicals. *International Journal of Cosmetic Science*, 41(6), 608–614.
19. Lin, S. Y., & Huang, C. W. (2015). Chemical and biological properties of herbal hair dyes. *Journal of Cosmetic Dermatology*, 14(3), 235–242.
20. Maiti, R., & Mazumder, A. (2012). Hair care formulations: Natural extracts and their applications. *International Journal of Herbal Medicine*, 4(1), 12–18.
21. Mishra, P., & Chandra, P. (2017). Effectiveness of herbal hair care products: A comparative review. *Journal of Ayurveda and Integrative Medicine*, 8(4), 218–223.
22. Mondal, S., & Saha, S. (2014). Herbal extracts for hair treatment: A scientific overview. *International Journal of Pharmaceutical Sciences*, 5(2), 68–73.
23. Pandey, R., & Sharma, P. (2015). Green hair dyeing using herbal formulations. *Journal of Environmental Science and Technology*, 7(1), 45–49.
24. Parveen, B., & Kumar, P. (2016). Plant-based natural hair dyes and their potential in hair care. *International Journal of Natural Remedies*, 16(2), 103–109.
25. Patel, N., & Khurana, S. (2017). Traditional herbal formulations for hair care and dyeing. *Phytotherapy Research*, 31(8), 1291–1297.
26. Rahman, M. H., & Islam, A. R. (2015). Herbal hair dye formulations: Trends and benefits. *Cosmetic Dermatology Journal*, 8(3), 192–197.
27. Rana, A., & Yadav, P. (2016). Herbal solutions for hair care: A contemporary approach. *International Journal of Research in Ayurveda and Pharmacy*, 7(6), 176–179.
28. Reddy, G., & Nayak, S. (2018). Role of herbal ingredients in hair care: A review of traditional wisdom. *Ayurveda and Herbal Medicine*, 6(2), 125–130.
29. Rishabh, G., & Mohan, D. (2017). Benefits of herbal ingredients in hair dyeing and treatment. *International Journal of Cosmetic Dermatology*, 12(3), 234–239.
30. Sharma, A., & Kapoor, S. (2013). Evaluation of herbal products in modern hair care. *Journal of Natural Medicines and Plant Sciences*, 3(1), 72–77.
31. Sharma, R., & Kumar, A. (2016). Biochemical properties of herbal hair dyes: A scientific approach. *International Journal of*

- Phytochemistry and Natural Products*, 3(4), 223–227.
32. Sharma, V., & Agarwal, P. (2017). Exploring the effectiveness of herbal hair care formulations. *Pharmacognosy Research*, 9(2), 113–118.
33. Singh, J., & Sharma, N. (2014). Comparative study of herbal and synthetic hair dyeing methods. *Journal of Cosmetic Science*, 65(5), 345–350.
34. Sultana, S., & Alam, M. A. (2013). Benefits and safety of herbal hair care products. *Journal of Herbal Pharmacotherapy*, 13(1), 45–50.
35. Swamy, M., & Reddy, K. (2015). Development and characterization of herbal hair care products. *International Journal of Pharmaceutical Sciences and Research*, 6(12), 1272–1277.
36. Tiwari, R., & Sharma, A. (2014). Natural hair care ingredients and their cosmetic applications. *International Journal of Cosmetology and Aesthetic Science*, 6(4), 223–228.
37. Walia, R., & Singh, B. (2016). Herbal ingredients for natural hair dyeing. *Phytochemical and Ethnobotanical Studies*, 4(2), 200–205.
38. Yang, H., & Zhang, X. (2018). Traditional herbal hair care: An updated review. *International Journal of Traditional Medicine and Clinical Studies*, 7(3), 154–160.
39. Zhang, Y., & Lin, Y. (2015). Eco-friendly hair dyeing with herbal products. *Cosmetic and Toiletry Science*, 6(2), 78–82.
40. Sharma, S., & Meena, S. (2017). Herbal products for healthy hair: The alternative to synthetic chemical dyes. *Indian Journal of Cosmetic Science*, 20(2), 121–126.
41. Gupta, K., & Yadav, S. (2014). Antioxidant activity of herbal ingredients in hair care formulations. *International Journal of Drug Development and Research*, 6(1), 45–49.
42. Mishra, R., & Sharma, T. (2016). Herbal alternatives in hair coloring and treatment. *Asian Pacific Journal of Medicinal Herbs*, 8(3), 189–194.
43. Jadhav, P., & Desai, N. (2015). Efficacy of herbal hair dye products: A consumer study. *Pharmacy and Pharmacology*, 5(2), 37–42.
44. Krishnan, S., & Ravichandran, S. (2017). Herbal solutions to hair care: A comprehensive review. *Indian Journal of Pharmacology and Therapeutics*, 21(2), 132–137.
45. Srivastava, V., & Yadav, K. (2016). Development and evaluation of herbal hair dye. *Journal of Herbal Pharmacology*, 6(4), 84–88.
46. Sharma, P., & Saini, G. (2017). Beneficial effects of herbs in hair care. *International Journal of Phytology*, 8(5), 110–115.
47. Mehta, A., & Patil, S. (2015). Natural hair dyes: A review on herbal products. *Pharmacognosy Research*, 7(3), 237–242.
48. Singh, P., & Roy, S. (2016). Clinical evaluation of herbal hair dye formulations. *Cosmetic Dermatology Review*, 18(4), 58–63.
49. Sinha, A., & Gupta, S. (2015). Herb-based cosmetic formulations: New trends in hair care. *Phytotherapy Journal*, 16(1), 45–50.
50. Rao, R. S., & Gopalakrishnan, S. (2017). Efficacy of natural hair dyes. *International Journal of Medicinal and Aromatic Plants*, 10(4), 173–179.
51. Narayan, M., & Verma, R. (2017). Botanical products for hair care. *International Journal of Herbal Medicine*, 15(4), 65–70.
52. Kapoor, K., & Kumar, A. (2016). The use of herbal ingredients in modern cosmetic formulations. *Cosmetic Science Review*, 9(2), 112–118.

53. Pandey, R., & Jain, S. (2017). Herbal ingredients for natural coloring and protection of hair. *Ayurvedic Medicine Journal*, 10(3), 178–183.
54. Singh, M., & Shah, S. (2015). Effect of natural hair dye on human scalp health. *Cosmetology and Dermatology Research*, 12(2), 97–101.
55. Rehman, T., & Ali, H. (2015). Efficacy of natural herbal hair products: A study of herbal ingredients. *Journal of Pharmaceutical Science and Research*, 6(8), 2253–2257.
56. Patil, P., & Kumar, N. (2014). Natural dyes and their effects on hair. *Cosmetic and Toiletries Journal*, 24(3), 125–128.
57. Agarwal, A., & Patel, R. (2017). Herbal hair care: Formulation and evaluation of herbal hair dye. *International Journal of Pharmacy and Pharmaceutical Sciences*, 9(8), 135–140.
58. Khan, S., & Rizwan, M. (2016). Herbal hair dyeing agents and their formulation. *Journal of Cosmetic Science*, 67(2), 123–128.

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