STM JOURNALS

Research & Reviews: A Journal of
Pharmacognosy

ISSN: 2394-7276
Volume 12, Issue 3, 2025
September–December
DOI (Journal): 10.37591/RRJoPC

https://journals.stmjournals.com/rrjopc

Research RRJoPC

Formulation of Natural Hair Dye by Using Natural Herbs and Their Characterization

T. Sudhamani[1,*], L. Lathamani[2], J. Dhanasekar[2], M. Selvakumar[2], S. Nandhakumaran[2]

Abstract

The development of herbal hair dyes using natural herbs offers a safer alternative to chemical-based hair coloring products. This study investigates the development of herbal hair dye formulated from a blend of natural ingredients renowned for their hair care benefits. The selected herbs include black catechu, henna, indigo, bhringraj, aloe-vera, amla, jatamansi, black cumin seeds, charcoal, alkanet root and extract of black tea, pomegranate & logwood. These herbs were carefully processed and combined to create a paste-like formulation, with solvents, like aloe-vera gel or tea decoction, used for preparation. The herbal hair dye was assessed using various parameters, including organoleptic, physicochemical, phytochemical, and micrometric characteristics. Additionally, the dye's coloring effects, retention capacity, and safety were assessed through patch tests and microscopic studies. The findings suggest that the formulated herbal hair dye provides a natural, effective solution for hair coloring, with added benefits, such as conditioning, nourishment, and scalp care, while minimizing the risks associated with synthetic dyes.

Keywords: Herbal hair dye, natural hair dye, herbal constituents, hair colorants, natural herbs

INTRODUCTION

The term "cosmetic" has a broad definition that makes it difficult to apply to the care of various body parts. According to the Drugs and Cosmetics Act of 1940 and the Rules of 1945, the term "cosmetic" refers to any substance intended to be rubbed, poured, sprinkled, sprayed on, introduced into, or otherwise applied to the human body or any part of it for the purpose of cleansing, beautifying, enhancing attractiveness, or altering appearance. It also includes any substance intended for use as a component of a cosmetic product [1].

Botanicals typically contain a variety of vitamins, antioxidants, oils, essential oils, natural pigments, tannins, alkaloids, carbohydrates, proteins, terpenoids, and other bioactive compounds. These constituents help to maintain or improve the health of the skin and hair, playing a key role in enhancing the overall appearance and attractiveness of both men and women [2]. Herbal cosmetics are defined as products formulated using approved cosmetic bases combined with one or more herbal ingredients, intended to deliver specific cosmetic benefits. Unlike synthetic products, herbs offer a natural approach, promoting harmony between the body and nature rather than offering instant results [3].

Grey hair is common and typically connects to middle age or over. It builds up gradually beginning in childhood. It could result in compromising a person's future, particularly women. One such issue

***Author for Correspondence**
T. Sudhamani
E-mail: tsmkrishv28@gmail.com

[1]Professor & Head, Department of Pharmaceutics, Vivekanandha Pharmacy College for Women (Affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India), Sankari, Salem, Tamil Nadu, India
[2]Assistant Professor, Department of Pharmaceutics, Vivekanandha Pharmacy College for Women (Affiliated to the Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India), Sankari, Salem, Tamil Nadu, India

Received Date: August 10, 2025
Accepted Date: August 25, 2025
Published Date: August 26, 2025

Citation: T. Sudhamani, L. Lathamani, J. Dhanasekar, M. Selvakumar, S. Nandhakumaran. Formulation of Natural Hair Dye by Using Natural Herbs and Their Characterization. Research and Reviews: A Journal of Pharmacognosy. 2025; 12(3): 8–16p.

could be resolved by the deft application of hair color and cooling system. Cosmetics impact on society is blatantly obvious given the existence of a lot of beauty salons and parlors and salons used by hair stylists. In current context, creative self-expression and self-identity are said to be the primary elements contributing to the popularity of cosmetics [4].

Most of the currently marketed available herbal dyes are not containing 100% herbs [5]. So this current work was aimed to formulate and characterize the natural hair dye by using natural 100% herbs, such as henna, indigo, amla, jatamansi, bhringraj, black cumin seeds, charcoal, alkanet root, iron metal powder, logwood, aloe-vera gel, black catechu extract, pomegranate and logwood extract along with tea decoction, for better dyeing efficiency which produce better coloring efficiency with no side effects and helps to improve the healthy hair.

MATERIALS AND METHODS

Materials

Black catechu, indigo, bhringraj, amla, jatamansi, black cumin seeds, charcoal, alkanet root black tea leaves, pomegranate and logwood were from Shree Ramjaya store in Bhavani, Erode, district, Tamil Nadu. Henna was purchased from H.M. Herbals, Tirupattur district, Tamil Nadu and aloe vera was collected around Salem, Tamil Nadu.

METHOD OF EXTRACTION

Extraction of Dried Pomegranate Skin and Logwood

Powdered pomegranate peels are first soaked in water for 12 hours to allow the release of bioactive compounds. After soaking, the mixture is gently heated to a simmering point and maintained for 30 minutes to 1 hour. The resulting solution is then filtered through a cotton cloth to obtain the liquid extract, which serves as the natural dye. Ferrous sulphate is employed as the mordant in this process due to its versatility and strong binding properties. It can be used either directly in the dye bath or in combination with alum [6].

Even in small quantities, ferrous sulphate yields significant color changes. When used with pomegranate peel extract, it produces a rich dark olive-green shade on cotton fabric. Pre-mordanting is performed by treating the cotton samples with ferrous sulphate based on a material-to-liquor (M:L) ratio of 1:10. The treatment is carried out at 80°C for 45 minutes using two different mordant concentrations – 4% and 10%. Following mordanting, the samples are directly subjected to the dyeing process without washing. Next, 4 g of finely powdered crude logwood powder with 100 mL of distilled water was taken, the mixture was finally brought to a boil for one hour, with the ratio of the powder to the distilled water being maintained at 1:25. After extraction, the solution was filtered to separate the undissolved powder and then the dye solution was stored at 4°C for further process [7].

Extraction of Black Tea

The tea leaves and water mixture is incubated over a water bath for 1 and 15 min for ethanol at 95ºC. The mixture is allowed to stand for 15 minutes and then filtered. The resulting filtrate is subsequently used for the dyeing process [8].

Extraction of Black Catechu

50 gm of dried powder sample soaked in 125 ml of ethanol for 16 hours in a rotary shaker. Whatmann No.1 paper was used to separate the extract of the plant [9].

FORMULATION OF HERBAL HAIR DYE

For the preparation of the herbal hair dye, all selected ingredients were used in powdered form, except for aloe vera. The ingredients were accurately weighed and thoroughly mixed to obtain a uniform, homogenous paste-like formulation. The composition details of the formulations are presented in Table 1 [10].

Table 1. Ingredients of the prepared herbal hair dye formulations.

S.N.	Ingredients	Working Formula for 100 gm			
		F1	*F2*	*F3*	*F4*
1	Henna	15 gm	15 gm	15 gm	15 gm
2	Indigo	45 gm	45 gm	45 gm	45 gm
3	Amla	3 gm	3 gm	3 gm	3 gm
4	Jatamansi	7 gm	7 gm	7 gm	7 gm
5	Bhringraj	3 gm	3 gm	3 gm	3 gm
6	Black Cumin seeds	7 gm	7 gm	7 gm	7 gm
7	Charcoal	10 gm	7 gm	10 gm	7 gm
8	Alkanet Root	3 gm	3 gm	3 gm	3 gm
9	Iron metal powder	–	3 gm	–	3 gm
10	Aloe Vera gel	q.s	–	–	q.s
11	Black Catechu extract	q.s	–	–	q.s
12	Pomegranate + logwood extract	–	q.s	–	q.s
13	Tea decoction	–	–	q.s	q.s

Application of Herbal Hair Dye

The prepared paste-like pack should be applied once a week to damp hair. It must have an optimal consistency to ensure easy application. Using a brush, the dye should be evenly spread from the roots to the tips, ensuring complete coverage of the scalp. The applied pack should be left on the scalp for 1–2 hours to allow thorough drying. After this period, it should be washed off using plain water [11].

EVALUATION OF HERBAL HAIR DYE

The formulated herbal hair dyes were subjected to various evaluations, including organoleptic, physicochemical, phytochemical, and micromeritic analyses [5, 10].

- *Organoleptic Evaluation:* The herbal dye ingredients were examined for organoleptic characteristics such as color, odor, texture and overall appearance [11].
- *Extraction of Herbal Hair Dye:* A 5 gm sample from ach formulation (F1–F4) was soaked separately in sterile containers containing 50 mL of distilled water. These were kept at room temperature for a minimum of 3 days with occasional shaking to facilitate the dissolution of soluble components. The resulting aqueous extracts were then filtered and stored in a refrigerator for further use [11].
- *Phytochemical Evaluation:* The aqueous extracts of herbal dyes were analyzed for the presence of secondary metabolites including alkaloids, saponins, glycosides, carbohydrates, flavonoids, tannins, coumarins, anthraquinones and terpenoids [11].
- *Physico-Chemical Evaluation:* The herbal dyes were tested for their physiochemical properties, primarily focusing on the following:

pH Determination

The pH levels of formulations F1–F4 were measured using a calibrated pH meter [11].

Moisture Content

The moisture content of the herbal hair dyes (F1–F4) can be determined by 5 g of the herbal hair dye (F1–F4). All samples were placed in the hot air oven that operates at temperature 50°C. Final weight of the herbal hair dyes should be weighed after 10 minutes [11].

$$\% \text{ Loss of drying} = \frac{Initial\ weight - Final\ weight}{Initial\ weight} \times 100$$

Micrometric Evaluation

To assess the physical characteristics of the powdered dye, various micromeritic properties were measured, including bulk density, tapped density, angle of repose, Hausner's ratio, and Carr's index [11].

Bulk Density

To determine bulk density, 10 grams of the powdered dye was accurately weighed and gently transferred into a 100 ml measuring cylinder. The powder was leveled without applying any pressure or compacting. The volume occupied by the powder was then recorded [11].

Typically, the bulk density of such powders ranges between 0.1 and 0.7 g/ml.

$$\text{Bulk density} = \frac{Mass\ of\ powder}{Bulk\ volume}$$

Tapped Density

Weighing accurately 10 gm of powder dye, transferred in 100 ml measuring cylinder. The measuring cylinder was tapped gently wooden surface from the height of 1 inch at an interval of 2 seconds until the maximum volume is recorded. Then the final volume was measured by tapped volume from the obtained [11].

$$\text{Tapped density} = \frac{Mass\ of\ powder}{Tapped\ volume}$$

Angle of Repose

Angle of Repose can be performed by fixed funnel method. A good funnel was fixed in a burette stand and below that a graph sheet was placed. The distance between the lower tip of funnel and graph sheet was adjusted to a specific height. The orifice of funnel was closed using cotton or open paper. Approximately 15 grams of the sample was gently poured through a funnel to form a pile. Without disturbing the pile, the outline of its base was carefully marked with a pencil to determine its circumference. The radius (r) of the base was measured in centimeters, along with the height (h) of the pile. Using these measurements, the angle of repose was calculated, which helped in evaluating the flow properties of the sample [11].

$$Ø = \tan^{-1}(h/r)$$

% Carr's Index

Carr's index was used to measure powder flow from obtained bulk density values [11],

$$\%\ \text{Carr's index} = \frac{Tapped\ density - Bulk\ density}{Tapped\ density} \times 100$$

Hausner's Ratio

The Hausner's ratio is calculated from tapped density and bulk density, as follows [11],

$$\text{Hausner's Ratio} = \frac{Tapped\ density}{Bulk\ density}$$

Study on Dyeing Effect

This parameter is used to assess the color grade, physical appearances, duration of exposure, coloring effects and pH of formulations [11].

Color Grade

Hair color was assessed by comparing with experimental color grade scale and it was graded as 1 to 10 [11].

Physical Appearance

The physical appearance of the hair – such as smoothness, volume, shine, and softness was observed with the naked eye [11].

Duration of Exposure

The prepared hair dye formulations were mixed with a suitable solvent and applied to human white hair samples. The samples were kept at room temperature in a petri dish for durations of 1 hour, 2 hours, and 3 hours [9].

Coloring Effect

After being kept at room temperature for 1 hour, 2 hours, and 3 hours, the dyed white hair samples were washed with water and observed for their coloring effect [11].

RETENTION CAPACITY

The retention capacity of the herbal hair dyes was determined by measuring the number of alternate-day shampoo washes the color could withstand on white or blonde human hair. The color retention was observed up to 4 washes [5].

STABILITY TEST

Stability testing of the prepared formulations was conducted by storing them under different temperature conditions for a period of one month. The formulations, packed in glass vials, were stored at room temperature and at 35°C. They were evaluated for physical parameters such as color, odor, pH, texture, and smoothness (Figures 1–3) [12, 13].

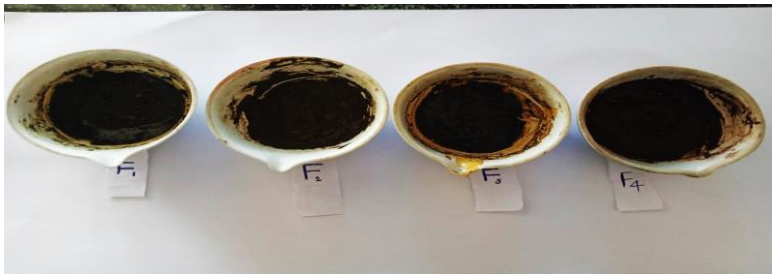

Figure 1. Photo image of herbal hair dye [F1–F4].

Figure 2. Color grade scale.

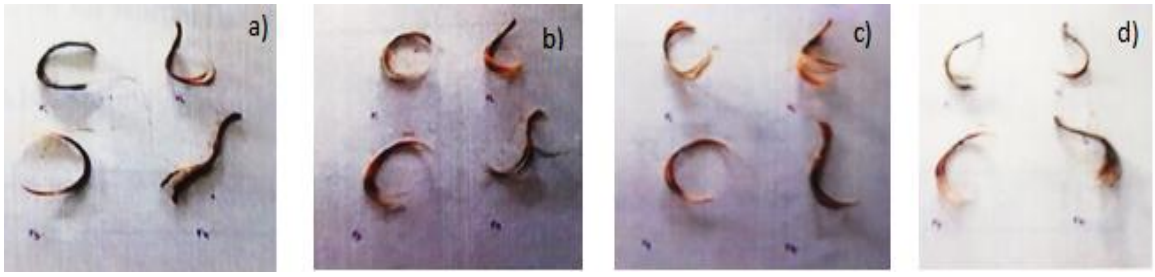

Figure 3. Retention capacity after 1st washes (a) 2nd washes, (b) 3rd washes, (c), 4th washes of F1–F4 formulations.

RESULTS

Following results were observed as stated in Tables 2–9.

Table 2. Organoleptic properties of herbal ingredients.

S.N.	Herbal Ingredients	Color	Odor	Texture	Appearance
1.	Henna	Green	Characteristic (earthy tones)	Fine	Powder.
2.	Indigo	Green	Characteristic (earthy)	Fine	Powder.
3.	Black catechu	Brown	Odorless	Fine	Powder.
4.	Bhringraj	Green	Aromatic	Fine	Powder.
5.	Black tea	Brown	Earthy	Coarse	Powder.
6.	Aloe vera	Green	Aromatic	Gel	Gel.
7.	Pomegranate	Brown	Characteristic (earthy)	Fine	Powder.
8.	Logwood	Brown	Characteristic (earthy)	Fine	Powder.

Table 3. Phytochemical analysis from the aqueous extraction of herbal ingredient.

S.N.	Phytoconstituents	Henna	Indigo	Black Catechu	Bhringraj	Tea	Aloe era	Pomegranate
1	Alkaloid	–	–	–	–	+	–	+
2	Glycosides	–	–	–	–	+	+	+
3	Tannins	+	+	+	+	+	_	+
4	Anthraquinones	+	+	+	+	+	+	–
5	Carbohydrates	+	+	+	+	+	+	+
6	Terpenoids	+	+	+	+	+	–	+
7	Coumarins	+	+	+	+	–	+	–
8	Flavonoids	+	+	_	+	+	+	–
9	Saponins	–	–	–	+	+	+	–

Note: "+" Positive, "–" Negative.

Table 4. Physico–chemical evaluation of herbal ingredients.

S.N.	Herbal Ingredients	pH	L.O.D.
1	Black catechu	6.2	1.4%
2	Pomegranate	4.2	2.1%
3	Black tea	6.4	1.4%
4	Henna	7.2	1.2%
5	Indigo	6.2	1.6%
6	Bhringraj	6.3	1.2%
7	Aloe vera	6.5	–
8	Log wood	3.2	1.2%

Table 5. Organoleptic evaluation of herbal hair dye.

S.N.	Parameters	F1	F2	F3	F4
1	Color	Black	Black	Black	Black.
2	Odor	Characteristic (earthy)	Characteristic (earthy)	Characteristic (earthy)	Characteristic(earthy).
3	Texture	Fine	Fine	Fine	Fine.
4	Appearance	Powder	Powder	Powder	Powder.

Table 6. Phytochemical evaluation aqueous extraction of herbal hair dye.

S.N.	Phyto-Constituents	F1	F2	F3	F4
1	Alkaloid	+	+	+	+
2	Glycosides	+	+	+	+
3	Tannins	+	+	+	+
4	Anthraquinones	+	+	+	+
5	Carbohydrates	+	+	+	+
6	Terpenoids	+	+	+	+
7	Coumarins	+	+	+	+
8	Flavonoids	+	+	+	+
9	Saponins	+	+	+	+

Note: "+" Positive, "–" Negative.

Table 7. Physico–chemical & micrometrics evaluation of herbal hair dye.

S.N.	Parameters	F1	F2	F3	F4
1	pH	6.5	6.8	6.4	6.9
2	L.O.D.	1.2%	1.2%	1.4%	1.6%
3	Bulk density (g/ml)	±0.003	±0.03	±0.005	±0.04
4	Tapped density (g/ml)	±0.02	±0.006	±0.03	±0.006
5	Angle of repose (degree)	±0.84	±0.14	±0.84	±0.17
6	Carr's index	±2.85	±2.35	±2.85	±2.35
7	Hausner's ratio	±0.05	±0.05	±0.05	±0.05

Table 8. Study on dyeing effect of herbal hair dye.

S.N.	Study on Dyeing Effect	F1	F2	F3	F4
1	Appearance	No damage	No damage	No damage	No damage.
2	Duration of Exposure	1 hour	1 hour	1 hour	1 hour.
3	Coloring Effect	Dark Brown	Medium Light Brown	Lightest Brown	Darkest Brown.

Table 9. Stability test for herbal hair dye at room temperature.

S.N.	Parameters	F1	F2	F3	F4
1	Color	No change	No change	No change	No change.
2	Odor	No change	No change	No change	No change.
3	Texture	Fine	Fine	Fine	Fine.
4	Smoothness	Smooth	Smooth	Smooth	Smooth.
5	pH	6.5	6.8	6.4	6.9

DISCUSSION

In this research work, natural hair dye in paste form (F1–F4) was prepared by using 11 natural herbs & 2 minerals stated in Table 1 and Figure 1. Primarily, henna was used as a colored cosmetic accepted universally, as basic hair dye in hair care products [10]. Indigo made hair shiny and strong which

stimulates new hair growth and color grey hair [14]. Amla prevents hair falling and prevents premature greying [15]. Jatamansi helps to reduce scalp inflammation and control hair fall [16]. Black catechu is known to promote hair growth, reduce dandruff, and add shine to the hair [17]. Bhringraj helps prevent hair loss and is effective in treating dandruff and scalp dryness [18]. Black cumin seeds are used to combat premature greying and bring a natural shine to the hair, while also nourishing hair follicles [19]. Charcoal acts as a cleansing agent and may help prevent hair loss [20]. Alkanet root supports hair growth, helps prevent hair fall, and delays premature greying [19]. Iron contributes to the dyeing effect and strengthens the hair strands [14]. Tea leaf extract promotes hair growth, fights dandruff, and helps enhance the overall color when used with other herbs [15]. Aloe vera gel soothes an itchy scalp, treats dandruff, and stimulates hair growth [15]. Pomegranate peel strengthens hair follicles and boosts blood circulation to the scalp [19]. Logwood is traditionally used for its dyeing properties and offers medicinal benefits [19]. Phytochemical screening, organoleptic studies, and physicochemical evaluations were carried out for each herbal ingredient. These results confirmed the purity of the ingredients, all falling within acceptable standards (refer to Tables 2–4). Similar evaluations were also conducted for the final polyherbal dye formulation – both in powder and paste form – with findings summarized in Tables 5–7. The formulations were found to be effective and showed the presence of key phytoconstituents, making them not only a natural dye but also a nourishing treatment for both scalp and hair. From Figure 2 and Table 8, the dyeing effect of herbal hair dye was found such as F-1 (Dark Brown), F-2 (Medium Light Brown), F-3 (Lightest Brown), F-4 (Darkest Brown). For F4, the dark brown color remained after 4 washes with mild shampoo. The formulated herbal hair dye showed color differences in the following order: F-4 > F-1 > F-2 > F-3. The retention capacity of F4 was also found to be best after 4 washes. Finally, it was found that F4 herbal hair dye was the best formulation than others. This may be due to the presence of all 14 ingredients in this formulation only (Table 9), and formulation F4 was found to be stable and best [11, 20].

CONCLUSIONS

The traditional process of coloring hair involves the use of chemicals, which can have unfavorable side effects such as skin discoloration, hair breaking, inflammation, and cancer. The consumer finds it cumbersome to have to process marked hair colors using crude plant powder before using them, and these goods also have poor rinsability. Therefore, it is necessary to create hair dyes with crude drugs that are ready to use, have a good coloring impact, and can also be rinsed and work as conditioner and dandruff remover in addition to preventing hair damage and skin irritation. In the current study, an appropriate combination of herbals, including henna, black catechu, indigo, bhringraj, aloe vera, amla, jatamansi, black cumin seeds, charcoal, alkanet root and extract of black tea, pomegranate & logwood were used to make herbal hair dye to achieve the desired results. Future work may extend to check the interaction between the chemical constitutions present in this combination, for the reason behind best coloring effect.

REFERENCES

1. Kuchekar BS. Pharmaceutical Jurisprudence. Pune: Pragati Books Pvt. Ltd; 2014.
2. Chopra RN, Nayar SI, Chopra IC. Glossary of Indian Medicinal Plants. New Delhi: Publications & Information Directorate, CSIR; 1956.
3. Parish LC, Crissey JT. Cosmetics: A historical review. Clin Dermatol. 1988;6(3):1–6.
4. Burlando B, Verotta L, Cornara L, et al. Herbal Principles in Cosmetics. Boca Raton: CRC Press; 2010.
5. Sudhamani T, Palanisamy V, Ranganathan Y, Rajasekar S, Ramesh R, Sangameswaran B. A detailed report on herbal hair colorants in Indian market. Res Rev J Pharmacogn. 2023;10(2):43–59.
6. Shree LG, Srinithi M, Sasvanth S, et al. Extraction of natural dye pomegranate rind and its fastness properties. Int Res J Eng Technol. 2020;7(5):5271–9.
7. Naheed S, Haider S, Adeel S, et al. Eco-friendly utilization of microwaves for extraction of dye from logwood and its application onto silk. Results Eng. 2024;24:103372.

8. Bydoon EA. Extraction of natural dye from tea leaves and its application on Egyptian cotton fabric. Int J Adv Sci Eng. 2016;3(4):455–62.
9. Najm AS, Mohamad AB, Norasikin A, Ludin NA. The extraction and absorption study of natural dye from Areca catechu for dye sensitized solar cell application. AIP Conf Proc. 2017;1838:020019. doi:10.1063/1.4982191.
10. Pal RS, Pal Y, Rai AK, et al. Synthesis and evaluation of herbal based hair dye. Open Dermatol J. 2018;12:90–8. doi:10.2174/1874372201812010090.
11. Shahi Z, Mehrizi MK. A review of the natural resources used for hair color and hair care products. Int J Curr Res. 2017;9(7):1.
12. Rani S, Hiremanth R. Formulation and evaluation of poly-herbal face wash gel. World J Pharm Pharm Sci. 2015;4(6):585–8.
13. Singh M, Shalini S, Singh LK, et al. Preparation and evaluation of herbal cosmetic cream. Pharmacologyonline. 2011;3:1258–64.
14. Pal RS, Pal Y, Rai AK, et al. Synthesis and evaluation of herbal based hair dye. Open Dermatol J. 2018;12:90–8.
15. Sarkate G, Sarode A. Formulation and evaluation of herbal hair dye. Int J Innov Sci Res Technol. 2022;7(8):631–7.
16. Jain PK, Dass DJ. Evaluating hair growth potential of some traditional herbs. Asian J Pharm Clin Res. 2015;8(6):150–2.
17. Thakur RS, Puri HS, Hussain A. Major Medicinal Plants of India. Lucknow: CIMAP; 1989.
18. Black Catechu. Available from: https://www.pharmacy180.com/article/black-catechu-323. [cited 2025 May 25].
19. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 52nd ed. Pune: Nirali Prakashan; 2016. p.9.1–11.2.
20. Sarkate G, Sarode A, Selmokar O, et al. Formulation and evaluation of herbal hair dye. Int J Innov Sci Res Technol. 2022;7(8): 2165–2456.
21. Charcoal. Available from: https://en.m.wikipedia.org/wiki/Characoal. [cited 2025 Apr 12].

