WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Assessment of Organoleptic, Stability, and Dermatological Safety of Herbal Hair Dye

Meshvi Aghara[a], Disha Gadara[a], Sakshi Patel[a], Parth Kathiriya[a], Dr. Dhara Chavda[b], Vishal Vora[c]*

[a]*Reserch Scholar, Department of Pharmacy, Shree H N Shukla Institute of Pharmaceutical Education and Research, Rajkot, Gujarat, India.*

[b]*Head of Department, Department of Pharmacy, Shree H N Shukla Institute of Pharmaceutical Education and Research, Rajkot, Gujarat, India.*

[c]*Assistant Professor, Department of Pharmacy, Shree H N Shukla Institute of Pharmaceutical Education and Research, Rajkot, Gujarat, India.*

A B S T R A C T

Background: Herbal hair dyes have gained significant attention as a safer alternative to synthetic dyes due to their natural composition and minimal adverse effects. The present study aims to formulate and evaluate a herbal hair dye composed of natural ingredients known for their hair coloring and conditioning properties.

Methods: The formulation was prepared using Henna, Amla, Reetha, Shikakai, Hibiscus, Neem, Jatamansi, Bhringraj, Tea, Tulsi, Brahmi, Methi, and Orange Peel Powder. The prepared formulation underwent organoleptic, physicochemical, phytochemical, rheological, and stability evaluations. A patch test was conducted to determine its dermatological safety.

Results: The herbal hair dye exhibited a greenish-brown color with a characteristic odor and fine texture. Physicochemical analysis confirmed the formulation's pH range of 5–6, a moisture content of 0.8%, and an ash value of 0.23%. Phytochemical screening indicated the presence of bioactive compounds essential for hair nourishment. Rheological studies demonstrated favorable flow properties with a bulk density of 0.5 g/cm³ and a tapped density of 0.625 g/cm³. The patch test revealed no signs of irritation, redness, or swelling, confirming its dermatological safety. Stability studies showed no significant changes in color, odor, or pH over one month at varying storage conditions.

Conclusion: The formulated herbal hair dye is a stable, safe, and effective alternative to synthetic hair dyes, providing natural color enhancement while ensuring scalp and hair health. The findings support its potential application in cosmetic formulations, with further studies recommended for long-term efficacy and consumer acceptance.

Keywords: Herbal hair dye, formulation, evaluation, stability, phytochemical analysis, dermatological safety

1. Introduction

Hair dyes have been widely used for centuries for cosmetic purposes, with increasing demand due to aesthetic preferences and the desire to conceal gray hair (Anjali, 2016). Synthetic hair dyes, though effective, are associated with adverse effects such as allergic reactions, scalp irritation, and hair damage due to the presence of harsh chemicals like para-phenylenediamine (PPD) and ammonia (Da França et al., 2015; He et al., 2022). As a result, there is a growing inclination towards herbal-based hair dyes, which offer a safer and eco-friendly alternative while providing additional benefits for scalp and hair health (More & Somani, 2023).

Herbal hair dyes utilize natural pigments derived from plant sources such as Lawsonia inermis (Henna), Indigofera tinctoria (Indigo), Emblica officinalis (Amla), and Acacia catechu (Black Catechu) (Nadkarni, 1976). These herbal ingredients not only impart color but also provide therapeutic benefits like antimicrobial, antioxidant, and anti-inflammatory properties, thereby promoting overall hair health (Gupta et al., 2022). Henna, for instance, is widely recognized for its ability to impart a reddish-orange hue, while Indigo is traditionally used to achieve darker shades when combined with Henna (Rathi & Pant, 2018). Similarly, Amla and Brahmi are known for their hair-strengthening and nourishing properties (Ahmed et al., 2025).

* *Corresponding author.* Tel.: +91 88660 80360
E-mail address: vvr132b@gmail.com

A major advantage of herbal hair dyes is their biocompatibility and biodegradability, making them preferable over synthetic alternatives that contribute to environmental pollution through the release of harmful byproducts (Mirjalili et al., 2011). Furthermore, herbal formulations have been reported to reduce common hair dye-associated concerns such as dryness, scalp irritation, and premature graying (Pal et al., 2018). In India, the use of herbal hair dyes has deep-rooted traditional significance, being a crucial component of Ayurvedic hair care practices (Palaniappan et al., 2024).

The present study focuses on the formulation and evaluation of a herbal hair dye containing a blend of natural ingredients, including Henna, Amla, Reetha, Shikakai, Hibiscus, Neem, Jatamansi, Bhringraj, Tulsi, Black Catechu, Brahmi, and Orange Peel Powder. These ingredients have been selected based on their historical and scientific evidence supporting their efficacy in hair dyeing and hair care (Karwate et al., 2023). The study aims to assess the organoleptic, physicochemical, and stability parameters of the formulated herbal hair dye to ensure its safety, efficacy, and long-term usability. The findings from this study will contribute to the growing body of research supporting the transition from synthetic to natural hair dyes for safer and sustainable hair care solutions.

2. Materials and Methods

2.1. Materials

The herbal hair dye formulation was prepared using natural ingredients, including Henna, Amla, Reetha, Shikakai, Hibiscus, Neem, Jatamansi, Bhringraj, Tea, Tulsi, Brahmi, Methi, and Orange peel. These active pharmaceutical ingredients were sourced from Vora Kaderbhai Gandhi & Co., Rajkot, Gujarat. The quantities of each ingredient used in the formulation are detailed in Table 1.

Table 1: Ingredients Used in Herbal Hair Dye Formulation

SR. NO.	INGREDIENTS	QUANTITY
1	Henna	100 gm
2	Amla	30 gm
3	Reetha	15 gm
4	Shikakai	20 gm
5	Hibiscus	15 gm
6	Neem	20 gm
7	Jatamansi	25 gm
8	Bhringraj	25 gm
9	Coffee	15 gm
10	Tulsi	15 gm
11	Black catechu	15 gm
12	Lohbhasma	5 gm
13	Brahmi	20 gm
14	Methi	15 gm
15	Orange peel powder	15 gm
16	Excipients	Q.S.

2.2. Methods

2.2.1. Formulation of Herbal Hair Dye

The formulation process began with accurately weighing the powdered ingredients, including Henna, Amla, Reetha, Shikakai, Hibiscus, Neem, Jatamansi, Bhringraj, Tea, Tulsi, Black Catechu, Lohbhasma, Brahmi, Methi, and Orange Peel Powder. These components were then mixed thoroughly on a large paper sheet. To ensure uniform blending, the mixture was screened using sieve No. 85. The final homogeneous powder was scraped together using a spatula and stored in a suitable container at a controlled temperature of 37°C.

2.2.2. Evaluation of Hair Dye

2.2.2.1. Organoleptic Evaluation

The organoleptic properties of the herbal hair dye, including color, odor, texture, and appearance, were observed and recorded to ensure consistency and aesthetic appeal.

2.2.2.2. Physicochemical Evaluation

The physicochemical characteristics of the herbal hair dye were assessed by determining its pH, moisture content, and ash value. These parameters were measured to ensure product stability, compatibility, and the presence of inorganic matter.

2.2.2.3. Phytochemical Evaluation

The formulation underwent phytochemical screening to identify the presence of essential phyto-constituents such as carbohydrates, lipids, alkaloids, and sugars. The aqueous extract of the herbal hair dye was prepared and subjected to standard phytochemical tests, including the foam test, Molisch test, and Fehling test.

2.2.2.4. Rheological Evaluation

To assess the flow properties of the herbal hair dye, rheological parameters such as bulk density, tapped density, angle of repose, Hausner's ratio, and Carr's index were determined. Bulk density was calculated as the mass of the formulation divided by its volume. The angle of repose was measured using the fixed funnel cone method to evaluate particle cohesiveness. Hausner's ratio and Carr's index were used to assess the interparticle friction and flow characteristics.

2.2.2.5. Patch Test

A patch test was performed to evaluate skin compatibility and potential irritant effects. A small amount of the aqueous solution of the herbal hair dye was applied behind the ear or on the inner elbow in an area of 1 cm^2 and allowed to dry. The presence of irritancy, redness, or swelling was monitored for 24 hours.

2.2.2.6. Stability Test

The stability of the formulated herbal hair dye was assessed by storing the packed glass vials at room temperature and at 35°C for one month. Parameters such as color, odor, pH, texture, and smoothness were observed to determine any changes over time.

3. Results

3.1. Organoleptic Characteristics

The organoleptic properties of the formulated herbal hair dye were assessed and recorded. The results are presented in Table 2.

Table 2: Organoleptic Evaluation.

SR. NO.	PARAMETERS	RESULTS
1	Colour	Greenish Brown
2	Odour	Characteristic
3	Texture	Fine
4	Appearance	Powder

3.2. Physicochemical Properties

The physicochemical parameters were analyzed to ensure stability and compatibility. The results are shown in Table 3.

Table 3: Physicochemical Evaluation

SR. NO.	PARAMETERS	RESULTS
1	pH	5-6
2	Loss on drying	0.8%
3	Ash value	0.23

3.3. Phytochemical Analysis

The phytochemical composition of the herbal hair dye was evaluated, and the presence of key constituents was confirmed. The findings are provided in

Table 4**.**

Table 4: Phytochemical Evaluation

SR. NO.	PARAMETERS	RESULTS
1	Foam test	Present
2	Molisch test	Present
3	Fehling test	Present

3.4. Rheological Properties

The rheological behavior of the herbal hair dye was examined to determine its flow characteristics. The results are displayed in Table 5**.**

Table 5: Rheological Evaluation

SR. NO.	PARAMETERS	RESULTS
1	Bulk density	0.5
2	Tapped density	0.625
3	Angle of repose	1.14
4	Carr's index	20
5	Hausner's ratio	1.25

3.5. Patch Test Results

The patch test results confirmed the absence of irritation, making the formulation safe for application. The results are summarized in Table 6**.**

Table 6: Patch Test

SR. NO.	PARAMETERS	RESULTS
1	Swelling	Negative
2	Redness	Negative
3	Irritation	Negative

3.6. Stability Study

The stability of the formulation was assessed under different conditions, with the findings presented in Table 7**.**

Table 7: Stability Test

SR. NO.	PARAMETERS	ROOM TEMPERATURE	35°C
1	Colour	No Change	No Change
2	Odour	No Change	No Change
3	pH	5-5.5	5.5-6
4	Texture	Fine	Fine
5	Smoothness	Smooth	Smooth

The results indicate that the herbal hair dye is a stable, safe, and effective alternative to synthetic hair dyes. Further research is recommended to explore its long-term effects and user acceptability.

4. Discussion

The results of the study indicate that the formulated herbal hair dye demonstrates effective stability, safety, and desirable cosmetic properties. The herbal ingredients used in the formulation, such as Henna and Indigofera tinctoria, have been widely reported for their natural dyeing properties while exhibiting minimal adverse effects compared to synthetic dyes (Arun Kumar et al., 2024; Singh et al., 2020). Phytochemical analysis confirmed the presence of essential bioactive compounds, which contribute to the formulation's antioxidant and antimicrobial properties, supporting previous studies on the efficacy of plant-based dyes (Rathi & Pant, 2018).

Rheological analysis indicated favorable flow characteristics, which ensure ease of application and uniform distribution. Similar findings have been reported in studies evaluating the physicochemical properties of herbal powders (Aparnna et al., 2024). Additionally, the absence of irritation in the patch

test underscores the safety profile of the formulation, aligning with prior dermatological assessments of herbal hair products (Draelos, 2022). Stability studies confirmed that the dye retained its characteristics over time, reinforcing its commercial viability and consumer acceptance.

5. Conclusion

The formulated herbal hair dye presents a promising alternative to synthetic dyes, offering natural color enhancement while minimizing potential risks associated with chemical-based products. The physicochemical and phytochemical evaluations affirm its stability and bioactive potential, and its non-irritant nature supports its safe use. Future research should focus on long-term efficacy studies and consumer trials to further validate its application in cosmetic and therapeutic domains.

Acknowledgements

We are very grateful to our professors and mentor who gave us a chance to work on this project. We would like to thank our mentor Dr. Dhara Chavda for giving us valuable suggestions and ideas. It's a great opportunity to show our experimental skills and delve further into preparation of our pharmaceutical formulation. Also, we would like to express our sincere gratitude to Mr. Vishal Vora for his continuous encouragement and motivation throughout our academic work. Lastly, we are immensely grateful to all involved in this project as without their inspiration and valuable suggestion it would not have been possible to develop the project within the prescribed time.

REFERENCES

Ahmed, A., Alali, A. M., Abdullah, E., Alharbi, M. N., & Alayoubi, H. M. (2025). Herbal Remedies for Hair Loss: A Review of Efficacy and Safety. *Skin Appendage Disorders*, 1-5.

Anjali, J. (2016). Hair care formulations. *World Journal of Pharmacy and Pharmaceutical Sciences*, *5*(6), 630-648.

Aparnna, V. P., Chauhan, A. K., Singh, S., Prakash, R., & Maiti, P. (2024). Rheological, Textural and Sensorial Properties of Quarg-Type Cheese Incorporated with Encapsulated Terminalia Arjuna. *Food Chemistry Advances*, *4*, 100549.

Arun Kumar, K. V., Asnah, K. P., Shabna, C. H., Hajara, & Mohammed Azharudheen, P. A., Afiya. (2024). Formulation and Evaluation of Herbal Hair Dye Shampoo. *International Journal of Pharmaceutical Sciences*, *2*(11), 308-311.

Cui, H., Xie, W., Hua, Z., Cao, L., Xiong, Z., Tang, Y., & Yuan, Z. (2022). Recent Advancements in Natural Plant Colorants Used for Hair Dye Applications: A Review. *Molecules*, *27*(22), 8062.

Da França, S. A., Dario, M. F., Esteves, V. B., Baby, A. R., & Velasco, M. V. (2015). Types of hair dye and their mechanisms of action. *Cosmetics*, *2*(2), 110-126.

Draelos, Z. D. (2022). A clinical evaluation of a permanent hair dye designed to reduce allergic contact dermatitis and hair damage. *Journal of Cosmetic Dermatology*, *21*(9), 3925-3928.

Gupta, P., Tiwari, Y., & Mukopadayay, S. (2022). Formulation and evaluation of herbal hair dye: A review article. *International Journal of Health Sciences*, *6*(S6), 3591-3609.

He, L., Michailidou, F., Gahlon, H. L., & Zeng, W. (2022). Hair Dye Ingredients and Potential Health Risks from Exposure to Hair Dyeing. *Chemical Research in Toxicology*, *35*(6), 901-915.

Karwate, G. D., Wankhade, M. B., Deshmukh, S. P., & Muthal, P. V. (2023). Formulation and Evaluation of Herbal Hair DYE. *International Journal of Pharmaceutical Research and Applications*, *8*(6), 226-234.

Mirjalili, M., Nazarpoor, K., & Karimi, L. (2011). Eco-friendly dyeing of wool using natural dye from weld as co-partner with synthetic dye. *Journal of Cleaner Production*, *19*(9-10), 1045-1051.

More, M. G., & Somani, M. S. (2023). A Review on Hair Care Cosmetics and Indian Medicinal Plants for Hair. *Volume 5*, *Issue 6*.

Nadkarni, K. M. (1976). *Indian Materia Medica*. Popular Prakashan.

Pal, R. S., Saxena, Y., Rai, A. K., Wal, P., & Wal, A. (2018). Synthesis and evaluation of herbal-based hair dye. *Open Dermatology Journal*, *12*(1), 90-98.

Palaniappan, V., Karthikeyan, K., & Anusuya, S. (2024). Dermatological adverse effects of hair dye use: A narrative review. *Indian Journal of Dermatology, Venereology and Leprology*, *90*(4), 458-470.

Rathi, A., & Pant, S. (2018). Phytochemical properties of Lawsonia inermis in natural hair dyeing. *Journal of Ethnopharmacology*, *227*, 64-72.

Singh, R., Sharma, S., & Mittal, A. (2020). Herbal hair dyes: A comprehensive review. *Journal of Pharmaceutical Sciences and Research*, *12*(6), 982-990.