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Formulation and Evaluation of Herbal Hair Dye

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Abstract: *In recent years, the demand for natural and chemical-free hair dyes has increased due to concerns about the harmful effects of synthetic dyes. This study focuses on the formulation and evaluation of a herbal hair dye using plant-based ingredients known for their hair coloring and conditioning properties. The key ingredients include Wedelia chinensis, Lawsonia inermis (Henna), Emblica officinalis (Amla), Hibiscus flower, and Fenugreek powder, each contributing to hair color enhancement, nourishment, and scalp health. The herbal powders were extracted using a boiling method with distilled water, followed by filtration and evaporation to obtain concentrated extracts. These extracts were then blended in specific proportions to create a homogeneous herbal dye mixture. Wedelia chinensis acts as the primary coloring agent, supported by Henna and Hibiscus Amla, Fenugreek. The dye was evaluated for organoleptic, rheological, physicochemical, and stability parameters. This study highlights the potential of herbal hair dye as a sustainable, eco-friendly, and non-toxic option for hair care. Further research is recommended to evaluate color retention, stability, and user satisfaction.*

Keywords: Wedelia chinensis, Lawsonia inermis

I. INTRODUCTION

Nowadays, most human beings are very careful about their beauty, and hair plays an significant role in enhancing beauty. Herbal drugs without any adverse effects are used for healthy hair. Herbal hair dye is a natural alternative to chemical-based hair coloring products. Made from plant-based ingredients, herbal hair dyes are designed to color hair while minimizing exposure to harsh chemicals[1]. In market different materials from plants like Henna, Indigo, Amla, Bhringraj, Black Walnut Hull, chamomile so forth were utilized to color the silver-colored hair to get a regular dark colour[2].

Wedelia chinensis is a perennial herb with a height of between 0.3 and 0.9 cm. The leaves are oval in form, succulent, often 4–9 cm long and 2–5 cm broad, irregularly serrated or serrate, and usually include a pair of lateral lobes. Flowers are 4-5 cm in diameter, yellow, tubular, and found in terminal or axillary heads[3]. The plant contains wedelolactone, Nor-Wedilicacid, tannin, flavonoids, lactone, saponins, alkaloids, and saponins. An oil-soluble black pigment, waxy substances, phytosterols, carotene, and resin are all found in *Wedelia chinensis* expressed juice. The herb has been used traditionally for dying hair[4].

II. MATERIAL AND METHOD

Collection of Plant Material

Powder of *Wedelia chinensis* was prepared. Lawsonia Inermis (henna leaves), Emblica officinale (amla fruit), Hibiscus flower, and fenugreek powder were taken from the local[5].

Extraction Procedure-

100gm of each of all herbal powder was taken separately and boiled with 100 ml of distilled water for 1h and the extract was filtered and evaporated[6]

Formulation table -

Sr. No.	Ingredients	Quantity (gm)			Use
1	*Wedelia chinensis*	5	6	7	Coloring agent
2	Amla	3	3	2	Antioxidant, maintain natural hair color
3	Hibiscus	2	1	1	Coloring agent, promote hair growth
4	Fenugreek	1	1	1	Conditioning and nourishing hair

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5	Henna	4	4	4	Coloring agent, Antifungal
	Total	15	15	15	

Preparation of Herbal Hair Dye -

All the dried herbal extract was taken as per the quantities mentioned in the table. Then all ingredients are mixed uniformly to prepare a homogeneous mixture of a powder form of dye. The homogeneous mixture is weighed and packed in a plastic[6].

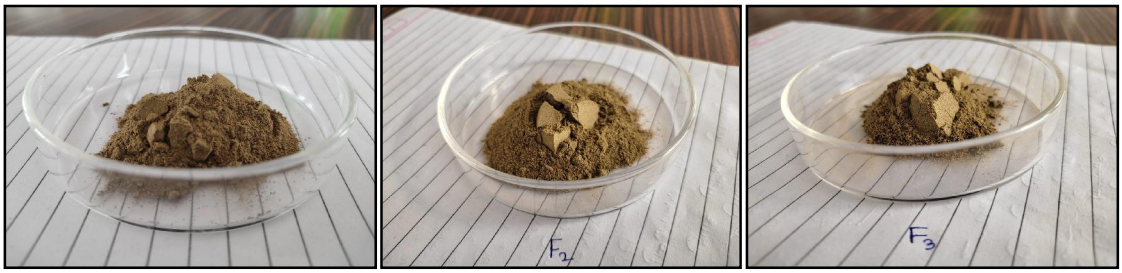

Fig-Batches of Herbal Hair Dye

The prepared herbal hair dye was evaluated for its various parameter such as organoleptic, rheological evaluation, physio- chemical aspect.

- Organoleptic evaluation-
- Color of formulation
- Odor of formulation
- Appearance
- Texture

Rheological Evaluation-

Bulk Density: To determine the bulk density, 5g of dye powder was accurately measured and transferred to a 100ml measuring cylinder. The powder was gently leveled without compressing, and the initial volume was recorded. The bulk density was then calculated using the formula.

Bulk density = Mass / Bulk volume

Tapped Density: To measure the tapped density, 5g of dye powder was precisely weighed and transferred to a 100ml measuring cylinder. The cylinder was then tapped for 1 minute to settle the powder, and the resulting volume was carefully recorded. The tapped density was subsequently calculated using the given formula.

Tapped density = Mass/ Tapped volume

Angle of Repose: The angle of repose was measured using a funnel method to assess powder flow ability, and the resulting value was calculated using the specified formula.

$\tan \theta = H/R$

Where,

θ = Angle of repose, H= height of pile of the powder, R= radius of pile of the powder

Carr's index: Tapped density- Bulk density/ Tapped density * 100

Housner's Ratio: The formula of housner's ratio.

Housner ratio = Tapped density/ bulk density[8]

Physicochemical Evaluation

pH – A 1g sample of the powder was dissolved in distilled water, and the pH of the resulting solution was measured using a pH meter.

Wash ability – The formulation was applied to the skin, subsequently rinsed with water, and then evaluated manually for its effects.

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Moisture content – Moisture content was determined using the Loss on Drying (LOD) method, where the crude drug was heated at a constant temperature and the weight loss was calculated to determine the moisture content.

Solubility - Solubility is defined as the ability of solute to dissolve in a given solvent. 1g of powder was accurately weighed and mixed with 100ml of water in a beaker. The mixture was agitated, warmed, cooled, filtered, and the leftover residue was weighed and recorded.

Patch test – A small amount of paste was applied to the back of the ear for 20 minutes, then removed and washed off, revealing no signs of irritation or allergic reactions..

Stability study- The stability of the prepared formulation was assessed by storing it at room temperature and 35°C for one month. Physical parameters such as pH, color, odor, texture, and smoothness were evaluated to determine its stability[9].

III. RESULT AND DISCUSSION

1. Organoleptic Evaluation –

Sr. No.	Parameters	F1	F2	F3
1	Colour	Brown	Brown	Brown
2	Texture	Fine	Fine	Fine
3	Appearance	Powder	Powder	Powder

2. Rheological Evaluation –

Sr. No.	Parameters	F1	F2	F3
1	Angle of repose	34.60	35.37	35.37
2	Bulk density	0.57gm/ml	0.53gm/ml	0.63gm/ml
3	Tapped density	0.83gm/ml	0.75gm/ml	0.75gm/ml
4	Carr's index	31.2%	29.3%	17.3%
5	Housner's ratio	1.45	1.41	1.19
6	Flow rate	0.50gm/sec	0.53gm/sec	0.46gm/sec

3. Physicochemical evaluation-

Sr.No.	Parameters	F1	F2	F3
1	pH	6.7	6.8	6.8
2	wash ability	Easy washable	Easy washable	Easy washable
3	solubility	Soluble in water	Soluble in water	Soluble in water
4	LOD	9.8%	10%	8%

4. Patch Test-

Sr.No.	Parameters	F1	F2	F3
1	Swelling	Negative	Negative	Negative
2	Redness	Negative	Negative	Negative
3	Irritation	Negative	Negative	Negative

IV. CONCLUSION

Herbal hair dyes provide a natural, safe, and eco-friendly alternative to chemical dyes, offering numerous benefits for hair health. Made from plant-based ingredients like henna, hibiscus, fenugreek , *Wedelia chinensis* and amla, they not only color the hair but also nourish the scalp, strengthen hair strands, and promote overall hair health. They are free from harmful chemicals, reducing the risk of scalp irritation and hair damage. Additionally, their environmentally friendly nature makes them a sustainable choice.

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