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A COMPREHENSIVE REVIEW & REFORMULATION STRATEGY OF HERBAL HAIR DYE SHAMPOOS: ADVANCING NATURAL COSMETICS FOR SAFE HAIR COLOURING

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Abstract:

In recent years, people have been attracted to natural dye shampoos because they provide gentler, safer and more eco-friendly alternatives to traditional chemical hair dyes. This review drives deep into the preparation, functionality and increasing popularity of these shampoos among users. The natural ingredients used in the preparation of dye Lawsonia inermis, Indigofera tinctoria, Hibiscus rosasinesis, Phyllanthus embilica, Terminalia chebula, Aloe vera, Eclipta alba, salt, Camellia sinensis, Coffea arabica, Acacia catechu and Potash alum. These ingredients provide conditioning, strengthening and soothing effects on the scalp along with better pigmentation. This review focuses on the extraction of these plant-based dyes, intensity of colour and how it is influenced by factors like pH, temperature and processing time and how they are blended with shampoo bases that contains herbal surfactants and gentle cleansing systems.

This review also discusses that the natural colorants depend mostly on the quality of the plants, the harvest timing and the storage conditions and extraction conditions. Another important issue highlighted in the review is the rising consumer interest in eco-friendly beauty products rather than products that contain most of the harsh chemicals, wastage and non-renewable sources.

In summary, natural dye shampoos emphasizes a unique combination of haircare and herbal colouring. This review highlights their potential as a sustainable and a healthier option while also printing out the scientific and formulation challenges that still need to be review.

KEYWORDS : *Lawsonia inermis , Indigofera tinctoria , Hibiscus rosa-sinensis, Phyllanthus embilica, Terminalia chebula, Aloe vera, Eclipta alba ,Camellia sinensis, Potash alum and Coffea arabica.*

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1. INTRODUCTION:

Natural dye shampoos have drawn increasing interest due to their positioning as a much safer alternative for synthetic hair dyes. These include plant-based pigments from henna, indigo, hibiscus, amla, catechu, tea, and other botanicals that impart mild, gradual coloration with an added benefit of promoting hair health.[1] This review covers phytochemistry, a mechanism of action, considerations in formulation, benefits, and limitations of natural dye shampoos. The results show that, though natural dye shampoo exhibits superior safety, nourishing effects, and environmental compatibility, further studies are needed to enhance pigment stability, colour range, and grey coverage.

Hair colouring remains one of the most popular cosmetical applications worldwide. Unfortunately, a vast range of synthetic dyes cause many side effects, from allergic reactions to oxidative hair damage and scalp irritation mainly because of ammonia, PPD, and peroxide. Natural dye shampoos will provide a more comprehensive approach: combining herbal pigments with cleansing agents for soft, better pigmentation.[2]

These formulations depend on the traditional use of botanicals with familiar dyeing properties, blending ancient knowledge with modern cosmetic science. This review focuses on the scientific basis of natural dye shampoos and evaluates their potential as viable substitution to commercial dyes.[3]

Hair is an important standard of beauty, personality, and cultural identity. To enhance and alter hair appearance, dyeing is a common global practice. However, modern synthetic dyes pose significant health concerns including:

- Allergic reactions
- Oxidative stress to hair fibres
- Skin irritation and dermatitis
- Follicular damage
- Potential carcinogenic effects

PPD and amino phenols are heavily involved in toxicity and are restricted or banned in several countries. This has led to a rising desire for natural formulations that doesn't have harsh chemical constituents.

Herbal dyes provide **coloration with therapeutic hair benefits** such as strengthening roots, reducing dandruff, nourishing the scalp, and reducing premature greying. Approximately 80% of the world's healthcare relies on plant-based remedies, indicating their vast safety acceptance.

2. OBJECTIVE OF THE STUDY

This review summarizes research focused on:

1. Formulating a safe polyherbal hair dye [4]
2. Determining phytochemical characteristics [5]
3. Evaluating physicochemical and rheological properties
4. Studying colouring performance on natural grey hair [6]
5. Comparing results with a commercial synthetic dye [7]
6. Assessing safety and stability

3. HERBAL INGREDIENTS AND FUNCTIONAL ROLES

The polyherbal formulation includes:

Ingredient	Image	Botanical Name	Major Benefits
Henna		*Lawsonia inermis*	Primary colorant; antifungal; scalp cleansing
Indigo		*Indigofera tinctoria*	Black pigment; hair growth support

Amla		*Phyllanthus emblica*	Antioxidant; enhances pigment retention
Hibiscus		*Hibiscus rosa-sinensis*	Conditioning; dandruff control
Aloe Vera		*Aloe vera*	Moisturizing; improves shade adherence
Bhringraj		*Eclipta alba*	Strengthens roots; prevents hair fall
Tea Extract		*Camellia sinensis*	UV protection; darkening agent
Black Catechu		*Acacia catechu*	Deepens tone; provides tannins
Myrobalan		*Terminalia chebula*	Acts as mordant; increases colour binding

Coffee		*Coffea arabica*	Strong antioxidant; protects hair from damage
Alum		*Potash alum*	Natural mordant; helping herbal dyes bind better to hair for deeper and longer lasting colour

These botanicals collectively enhance **colour intensity, nourishment, safety, and aesthetics**. [8,4,6,1]

4. PREPARATION PROCEDURE OF HERBAL HAIR DYE FORMULATIONS

This study required separate dye activation protocols for henna-rich and indigo-rich formulations to achieve optimum colour staining capacity. [8,6,1]

F1 — HENNA-BASED BROWN DYE (25 G BATCH)

1. Henna Dye Release
• Place Henna 19 g + Amla 1.1 g in a beaker
• Add warm water (45–50°C) to the beaker
• Rest 4–6 hours to release lawsone pigment

2. Herbal Colour Extract
• Place Hibiscus 2.7 g + Bhringraj 1.1 g + Tea 1.1 g in a beaker
• Boil in 50–70 ml water for 5 minutes
• Cool, filter and add Aloe 1.1 g

3. Final Mixing & Use
• Combine herbal extract and henna paste
• Apply for 5–10 minutes
• Rinse with water

F2 — BROWNISH-BLACK DYE (HENNA + INDIGO) — 25 G BATCH

Indigo must be added fresh just before use

1. Henna Dye Release (4–6 hours)
• Add Henna 10.8 g + Amla 1.1 g + warm water in a beaker

2. Herbal Decoction (5–7 minutes boil)
• Put Hibiscus 2.7 g + Bhringraj 1.1 g + Black Catechu 2.7 g + Tea 1.1 g in another beaker
• Add Aloe 1.1 g to the same beaker

3. Indigo Activation (Use within 10–15 min)
• Add Indigo 5.4 g + warm water in another beaker

4. Final Mixing & Use
• Combine all pastes
• Apply immediately for 10 minutes
• Rinse with water

F3 — NATURAL BLACK DYE (HIGH INDIGO) — 25 G BATCH

Highest dye staining requires fresh indigo incorporation

1. Henna Activation (4–6 hours)
• Henna 5 g + Amla 1 g + warm water

2. Dark Tannin-Rich Decoction (5–7 min boil)
• Hibiscus 2.5 g + Bhringraj 1 g + Black Catechu 2.5 g + Myrobalan 1 g + Tea 1 g
• Add Aloe 1 g

3. Fresh Indigo (Use instantly)
• Indigo 10 g + warm water

4. Final Mixing & Use
• Apply to hair for 10–15 min
• Avoid chemical shampoos for 24 hours

5.PREPARATION AND PROCEDURE OF HERBAL SHAMPOO FORMULATION [POWDER] [5,7,9]

➢ Ingredients

- Reetha powder (soapnut powder) - main cleanser
- Shikakai powder - soft foam
- Hibiscus powder – conditioner + dye retention
- Bhringraj powder - scalp benefits + hair growth
- Amla powder - strengthening and supports natural dye binding
- Fenugreek powder (methi) – smoothness and anti-frizz

➢ Final mixing and using

- Mix 1 tablespoon of each of the powder with warm water
- Make that into a paste
- Apply it to the scalp
- Finally massage and rinsing

6.PROCEDURE FOR MIXING HERBAL DYE WITH HERBAL SHAMPOO [4,6]

➢ Method – 1

- Herbal dye is prepared
- 1-2 tablespoon of the herbal shampoo powder is added to the herbal dye (100g)
- Everything is mixed together with tea decoction or warm water
- Henna is rested for 3-4 hours for the dye to release
- It should be applied as usual

➢ Method – 2

- Dye paste is applied normally
- Rinsed with plain water
- Then the herbal shampoo is used gently to remove residue after 24 hours

7. FORMULATION STRATEGY [8,6,1]

Three formulations (F1–F3) were prepared with different Henna: Indigo ratios:

Code	Ratio	Resulting Shade
F1	1:0	Reddish Brown
F2	2:1	Brownish Black
F3	1:2	Natural Deep Black

F3 demonstrated optimal coloration, closely matching natural hair melanin.

8. EVALUATION PARAMETERS

✓ 5.1 Physicochemical Properties [4,5,6,7,9]

- **pH 6.5–6.9** → Ideal for scalp
- **Low moisture content** → Mold prevention
- **Smooth texture** → Even application
- **Good flow** → Storage stability

These indicate excellent pharmaceutical quality.

✓ 5.2 Skin Sensitivity Test

- Conducted on rabbits
- **No irritation or redness detected**

Thus, formulation is dermatologically safe.

✓ 5.3 Stability

- No change in colour, odour, texture after 1 month storage
- No preservatives required
- High shelf-life due to inherent stability

9. DYEING PERFORMANCE STUDY

Time	F1	F2	F3
30 min	Orange	Red	Brownish-black
60 min	Brown	Black	Deep black

Marketed synthetic dye: [8,4,6,1]

✓ Fast darkening

✗ Hair cortex damage and irritation observed

Herbal F3 = best balance: natural shade + safety.

10. MECHANISM OF NATURAL COLOUR FORMATION

1. Henna's **lawsone** bonds to hair keratin → Orange base

2. Indigo's **indigotin** overlays → Deep black colour

3. Tannins act as **mordants** → Strong colour fixation

This results in a **progressively enhanced natural black shade**, lasting up to ~20 days. [10,8,4,1]

11. DISCUSSION:

The herbal dye provides:

Benefit	Description
Safety	No PPD, ammonia, or carcinogens
Haircare	Strengthens, conditions, prevents dandruff
Scalp friendly	No irritation or burning
Sustainability	Biodegradable & eco-safe
Aesthetics	Natural-looking black shade

Thus, it fulfils consumer needs for nourishment-based cosmetics. [3,6,7,1]

12. FUTURE SCOPE

Future improvement strategies include: [10,11,8]

- UV-protective additives for longer shade retention
- Cream-based ready-to-apply formats
- Clinical studies on diverse hair types
- Microencapsulation for enhanced stability
- Development of multiple shades (brown, burgundy, black variations)

13. CONCLUSION:

A polyherbal dye using Henna and Indigo (1:2) achieved safe, stable, and natural hair colouring. [4,6,7,1]It ensures:

- No structural hair damage
- Natural melanin-like shade
- Scalp and dermatological safety
- Nourishment to follicles
- Eco-friendly and renewable

Herbal hair dyes are safer substitutes to synthetic dyes and support the growing green-cosmetic market.

FIGURE DESCRIPTIONS

Figure 1. Hair Fiber Structure

Below diagram representing cuticle (outer), cortex (middle pigment layer), and medulla (inner layer).

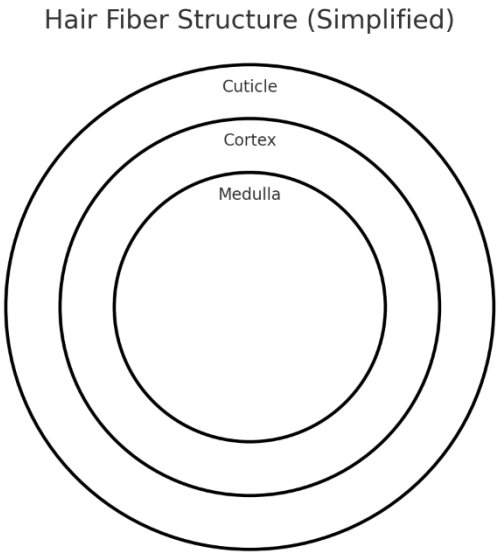
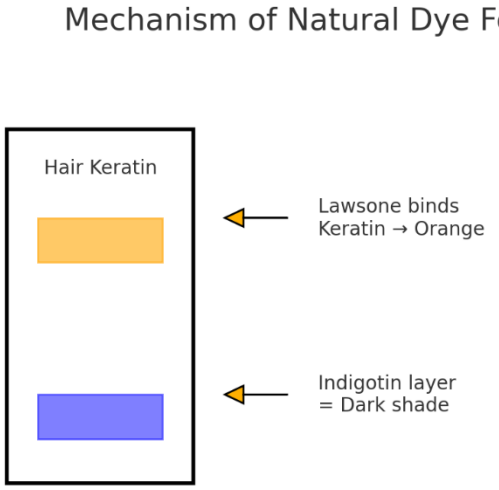


Figure 2. Dyeing Mechanism

Below diagram represents that Orange henna layer attaches first → Blue indigo layer → Black appearance.



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