

Formulation and Evaluation of Herbal Hair Dye

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Abstract—The present study focuses on the formulation and evaluation of a herbal hair dye using natural ingredients as a safer alternative to synthetic hair coloring agents. Synthetic hair dyes are commonly associated with adverse effects such as scalp irritation, hair damage, allergic reactions, and weakening of hair texture. Due to these concerns, the demand for herbal and eco-friendly cosmetic formulations has increased significantly. The herbal hair dye was prepared using plant-based ingredients including henna, amla, shikakai, hibiscus, coffee powder, and bhringraj, which are traditionally known for their colouring, conditioning, and nourishing properties.

The prepared formulation was evaluated for various physicochemical and cosmetic parameters such as colour, odour, texture, pH, consistency, spreadability, washability, irritancy, stability, and dyeing effectiveness. Stability studies were also carried out under suitable storage conditions to assess the physical stability of the formulation. The evaluation results showed that the herbal hair dye possessed good coloring's ability, satisfactory spreadability, acceptable consistency, and skin-friendly pH. No significant changes in colour, odour, or texture were observed during the stability study. Irritancy studies indicated that the formulation was safe for topical application

Index Terms—Natural hair colorants, Dye yielding Plants, Hair care plants, Indigo, Heena

I. INTRODUCTION

In recent years, the demand for herbal and natural cosmetic products has increased significantly due to growing awareness regarding the harmful effects associated with synthetic chemicals. Hair is considered an important part of human appearance and personality, and hair colouring has become a common practice among people of different age groups. Synthetic hair dyes are widely used for changing hair colour; however, continuous use of these products may lead to several

adverse effects such as scalp irritation, hair damage, dryness, allergic reactions, and weakening of hair roots. Chemicals such as ammonia, hydrogen peroxide, and para-phenylenediamine present in synthetic dyes are mainly responsible for these undesirable effects. Therefore, there is an increasing interest in the development of herbal hair dye formulations that are safer, economical, and environmentally friendly

The use of natural substances for hair colorings dates back to ancient civilizations such as Egypt, Greece, Rome, and India. Traditionally, herbs, flowers, fruits, and seeds were used for imparting natural colour and improving hair health. Herbal formulations are preferred because they not only provide colouring action but also nourish the scalp and strengthen the hair shaft. These preparations contain phytoconstituents such as flavonoids, tannins, alkaloids, and essential oils that contribute to various cosmetic and therapeutic benefits. Compared to synthetic dyes, herbal hair dyes provide gradual and natural-looking coloration with minimal side effects and better compatibility with the scalp and hair.

Herbal hair dyes are commonly prepared using medicinal plants possessing colouring, cleansing, conditioning, antioxidant, and antimicrobial properties. In the present study, ingredients such as shikakai, hibiscus, coffee, clove, and reetha were selected due to their beneficial effects on hair care. Shikakai acts as a natural cleanser and conditioner that improves hair texture and scalp hygiene. Hibiscus promotes hair growth and provides softness and shine to the hair. Coffee acts as a natural colouring agent and contributes to dark pigmentation, while clove possesses antioxidant and antimicrobial properties that help protect the scalp from infections. Reetha acts as a natural surfactant and cleansing agent that removes dirt and excess oil effectively.

Therefore, the present study focuses on the formulation and evaluation of a herbal hair dye prepared from selected plant-based ingredients. The aim of the study is to develop a safe, stable, and effective herbal formulation that provides satisfactory hair colouring along with nourishing and conditioning benefits for healthy hair maintenance.

Aim: To formulate and evaluate a safe and effective herbal hair dye prepared from natural ingredients

Ingredients: Shikakai, Coffee, Hibiscus, Custard apple pulp powder, Reetha, Clove

II. TYPES OF HERBAL HAIR DYE

1. Temporary

- These type of hair colours used to colour the hair for temporary
- The colorants which are used doesn't penetrate into the hair or surrounding.
- Can be easily rinsed off water one shampooing.

2. Semi-permanent:

- Most of them are basic dye stuff is, whose cationic character gives them a Natural affinity for the hair.
- Metalized dye stuffs in combination with nitro derivatives of Aromatic diamines or aminophenol
- Performance of colorants can be enhanced by the inclusion of solvent.

3. Permanent:

- Most popular hair dye products.
- The dyes are formed during the dyeing process and are not present, as Such in the solution before application
- During dying of hair, the intermediate solutions are mixed and applied to the Hair.

Advantages:

- Prepared using natural plant-based ingredient
- Causes fewer side effects compared to synthetic hair dyes.
- Helps nourish and condition the hair.
- Improves hair texture, softness, and shine
- Suitable for regular and long-term use.

Disadvantages:

- It takes more time to develop color compared to chemical dyes.
- The color may not be very strong or long-lasting.
- Frequent application may be required to maintain the shade.
- Results may vary depending on hair type and texture.
- Shelf life of herbal dye is usually shorter than synthetic dyes.

III. NEED OF STUDY

The need of this study is based on increasing demand for cosmetic enhancement through safe and natural products. Hair coloring plays an important role in improving appearance and boosting self-confidence. Herbal hair dye helps in improving hair volume, texture, and provides smoother and silkier hair without harmful effects of synthetic dyes. It also nourishes hair and supports healthy growth. Herbal formulations give protection against environmental factors such as pollution, dust, and UV rays. Unlike chemical dyes, herbal products are safer for regular use and reduce the risk of scalp irritation. Therefore, development of herbal hair dye is important for cosmetic and health benefits.

IV. ROLE OF INGREDIENTS USED IN THE FORMULATION

1. Shikakai (Acacia concinna)

Shikakai acts as a natural cleanser for hair. It gently removes dirt and excess oil from the scalp without stripping natural oils. It also strengthens hair roots, reduces dandruff, and promotes healthy hair growth. In hair colorants, herbs can be used in the form of powder, aqueous extract or their seed oil to impart shades of different colour varying from reddish brown to blackish brown. The herbal drugs like coffee powder obtained from its seed are used as hair colorant. Coffee is a super versatile and incredibly effective all-natural beauty ingredient. Dying your hair with coffee is a great way to achieve that classic dark shade of brown



Fig 1: Shikakai

2. Coffee: Coffee is used as a natural coloring agent. It provides a dark brown to blackish tint to the hair and enhances overall color depth. It also improves hair texture and may stimulate hair follicles, supporting hair



Fig 2: Coffee

3. Hibiscus (*Hibiscus rosa-sinensis*):
Hibiscus is rich in amino acids and vitamins which help in strengthening hair strands. It promotes hair growth, prevents premature graying, and adds natural shine and softness to the hair



Fig 3: Hibiscus

4. Custard Apple Pulp Powder:
Custard apple pulp powder acts as a conditioning agent. It helps in moisturizing the scalp, reducing

dryness, and improving hair texture. It also supports scalp health and reduces hair fall by strengthening roots



Fig 4: custard apple pulp powder

5. Reetha (*Sapindus mukorossi*):
Reetha is a natural foaming and cleansing agent. It helps in removing impurities from the scalp and hair while maintaining natural pH balance. It also reduces dandruff and makes hair smooth and manageable.



Fig 5: Reetha

6. Clove:
Clove has antimicrobial and stimulating properties. It improves blood circulation in the scalp, which promotes hair growth. It also helps in reducing scalp infections and adds a mild natural fragrance to the formulation



Fig 6: Clove

Formulation of Herbal Hair Dye

Table: 1: - Formulation of herbal hair dye

Sr. No	Ingredient	Quantity
1	Shikakai	10gm
2	Coffee	30gm
3	Hibiscus	25gm
4	Custard apple pulp powder	10gm
5	Reetha	15gm
6	Clove	10gm

V. METHODS OF HAIR DYE PREPARATION

1. Weighing

All the herbal ingredients used in the formulation were accurately weighed according to the required quantity using a weighing balance. Proper weighing ensured uniformity and consistency of the formulation.

2. Mixing

The accurately weighed ingredients were mixed thoroughly in a clean and dry mortar to obtain a homogeneous mixture. Proper blending was carried out to ensure uniform distribution of all herbal constituents.

3. Filling

The prepared herbal hair dye formulation was transferred carefully into suitable containers. The containers were filled with the measured quantity of the formulation under hygienic conditions.

4. Packaging

The filled containers were properly sealed and labeled with necessary product information such as formulation name, date of preparation, and storage conditions. The packaged products were stored in a cool and dry place until further use

VI. EVALUATION OF THE HERBAL HAIR DYE

The prepared herbal hair dye formulation was evaluated for various parameters such as organoleptic properties, physicochemical characteristics, phytochemical constituents, stability, and rheological behavior

1. Organoleptic Evaluation: The organoleptic characteristics of the herbal hair dye formulation, including color, odor, texture, and appearance, were carefully evaluated and recorded. These parameters were used to assess the overall acceptability and

quality of the formulation.

2. Physicochemical Evaluation: The physicochemical parameters such as pH, moisture content, and ash value of the herbal hair dye formulation were determined using standard procedures. These evaluations were carried out to ensure stability, compatibility, and quality of the formulation

3. Phytochemical Evaluation: The prepared herbal hair dye formulation was subjected to phytochemical screening to identify the presence of various phytoconstituents such as carbohydrates, alkaloids, glycosides, flavonoids, tannins, and saponins.

VII. RESULT AND INTERPRETATION

Table: 2 Organoleptic evaluations of herbal hair dye

Sr.no	parameters	Observation
1	colour	Greenish Brown
2	Odor	Characteristics pleasant odor
3	texture	Smooth
4	Appearance	Homogeneous

Table: 3 Physicochemical Evaluation of herbal hair dye

Sr.no	Parameters	Observation
1	pH	6.5
2	moisture content	25%
3	Ash value	0.25 %
4	Extractive value Water Soluable	20%



Fig:-7: Organoleptic evaluation of herbal hair dye

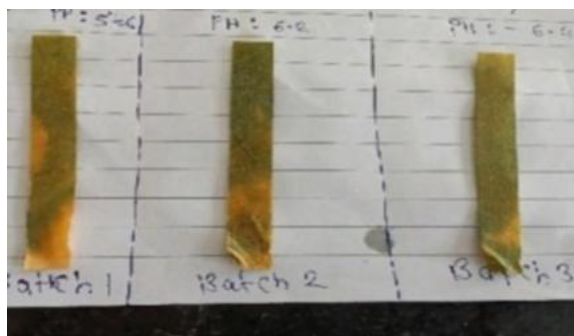


Fig: 8 pH tests

VIII. PHYTOCHEMICAL EVALUATION

A. Molisch test:

- Take the sample solution in a test tube.
- Add 2–3 drops of Molisch's reagent (α -naphthol).
- Carefully add concentrated H_2SO_4 along the side to form a layer.
- Formation of a violet/purple ring indicates presence of carbohydrates.

B. Fehlings test

- Take equal volumes of Fehling's solution A and Fehling's solution B.
- Mix them in a test tube to prepare Fehling's reagent.
- Add the sample solution to the mixture.
- Heat the test tube gently in a water bath.
- Formation of a brick-red precipitate indicates the presence of reducing sugars.

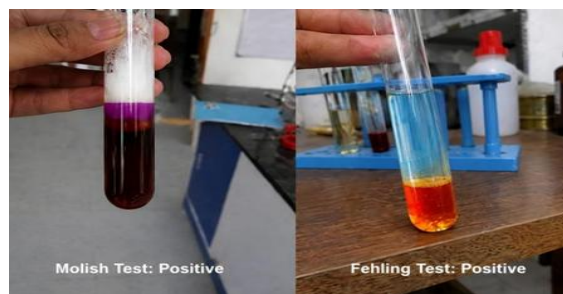


Fig 9: Molisch and Fehling test

C. Foam test:

- Take the sample solution in a test tube and dilute with distilled water if required
- Shake the test tube vigorously for 1-2 minutes
- Allow it to stand for some time
- Formation of a stable persistent foam indicates the presence of saponins

D. Volatile oil test

- Take the sample in a test tube
- Add a few drops of alcoholic solution of Sudan III reagent.
- Shake the mixture gently
- Observe the development of red/orange coloration, which indicates the presence of volatile oils or lipids.

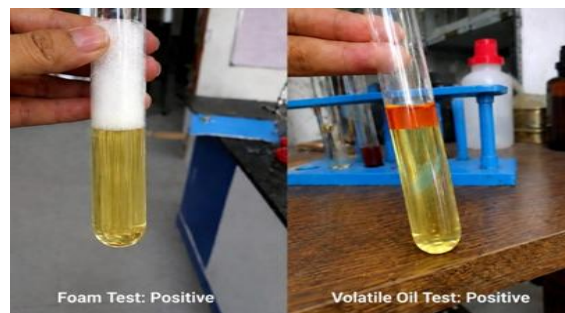


Fig 10: Foam & volatile oil test

Sr.no	Test	Observation
1	Fehling test	Positive
2	Molisch test	Positive
3	Foam test	Positive
4	volatile oil test	Positive

Table 4: Phytochemical evaluation of herbal hair dye

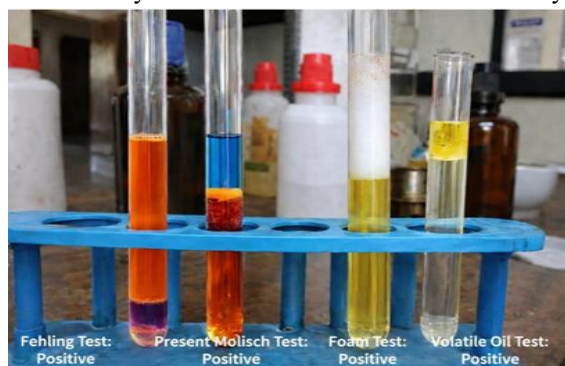


Fig 11: Phytochemical evaluation of herbal hair dye

1. Patch Test

safety of the prepared herbal hair dye formulation. For this, a small amount of the formulation was applied on a limited area of skin, preferable on the inner forearm or behind the ear of a healthy individual. The area was left undisturbed for 24 hours under normal room conditions. During this period, the site was observed for any signs of skin reaction such as redness, itching,

swelling, burning, or irritation. After the observation time, no such adverse effects were noticed at the applied area. The results indicate that the formulation does not cause any skin irritation or allergic reaction. Hence, it can be considered safe for topical use.

Sr.no	Parameters	Observation
1	Swelling	Absent
2	Redness	Absent
3	Irritation	Absent

Table 5: Patch test

2. Stability test

A stability test was carried out to evaluate the physical stability of the prepared herbal hair dye formulation. The formulation was stored under normal room temperature conditions for a specific period of time. During the storage period, the formulation was observed at regular intervals for any changes in color, odor, texture, or phase separation. The pH of the formulation was also checked initially and after the storage period. No significant changes were observed in the physical appearance or consistency of the formulation. The odor and color remained stable throughout the study period. The results indicate that the prepared herbal hair dye formulation is physically stable under normal storage conditions.

Sr. No	parameters	Room Temperature	35°C
1	Colour	No Change	No Change
2	odour	No Change	No Change
3	pH	6.5	6.7
4	Texture	Smooth	Smooth

Table 6: Stability test

IX. CONCLUSION

The present study focused on the formulation and evaluation of a herbal hair dye prepared using natural ingredients such as Shikakai, Reetha, Coffee, Hibiscus, Clove, and Custard apple pulp powder. The formulated product was evaluated for various parameters including organoleptic properties, physicochemical characteristics, phytochemical

screening, stability, and skin compatibility. The results showed that the formulation possessed good physical appearance, acceptable odor, and smooth texture. Phytochemical screening confirmed the presence of important constituents such as carbohydrates, saponins, and volatile oils, which contribute to the effectiveness of the formulation. Stability studies indicated that the product remained stable without any significant changes in color, odor, or texture under normal storage conditions. The patch test results showed no signs of irritation, redness, or allergic reaction, indicating that the formulation is safe for topical application. From the overall findings, it can be concluded that the prepared herbal hair dye is effective, safe, and eco-friendly, and can be considered a suitable alternative to synthetic hair dyes.

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