

**FORMULATION AND EVALUATION OF HERBAL HAIR DYE GEL****Pragati G. Ingale, Pratik B. Bargat\*, Pratik D. Bhonde, Pratik D. Jadhav, Pratiksha D. Mahajan, Farah M. Khan**

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**ABSTRACT**

Herbal hair care products are becoming popular because they are safer and cause fewer side effects than chemical products. Chemical hair dyes can damage hair and irritate the scalp. So, this study aimed to prepare a herbal hair dye gel using natural ingredients like henna, amla, palash, hibiscus, and reetha. These ingredients help in coloring, cleaning, and strengthening the hair. The extracts of these herbs were prepared and mixed with a gel base made of Carbopol 940, glycerin, methyl paraben, triethanolamine, and distilled water. The prepared gel was evaluated for different parameters such as colour, smell, pH, viscosity, spreadability, homogeneity, and stability. The results showed that the gel had a suitable pH (around 6–7), good thickness, and was easy to apply on hair. It provided natural colour, improved hair texture, and helped in cleaning the scalp due to reetha. No irritation was observed and the gel remained stable during storage. Overall, the herbal hair dye gel was found to be safe, effective, and a good natural alternative to chemical hair dyes, with added benefits for hair health and scalp care.

**KEYWORDS:** Herbal hair dye gel, Henna, Amla, Palash, Hibiscus, Reetha, Natural hair color, Carbopol 940.**INTRODUCTION**

Hair coloring or dyeing are methods of altering the color of one's hair. The main motivation for this is to recolor grey and white hair or to bring back the original color of hair that has been discolored by sun exposure or cosmetics. Herbal dyes have all of the benefits of natural substances. These formulations, in addition to working as a hair color, function as a hair growth stimulant and nourishment due to the right amalgamation of herbs.<sup>[1]</sup>

Herbal hair dye gel is a semi-solid cosmetic formulation prepared using natural plant-based ingredients to impart color while simultaneously nourishing the hair and scalp. Unlike synthetic dyes, these formulations are designed to minimize chemical damage and provide safer, long-term hair care benefits. The use of multiple herbs in a single preparation enhances effectiveness through synergistic action.

Key ingredients commonly include henna (*Lawsonia inermis*), palash (*Butea monosperma*), amla (*Phyllanthus emblica*), reetha (*Sapindus mukorossi*), and hibiscus (*Hibiscus rosa-sinensis*). Henna acts as a natural coloring

agent and conditioner, while palasha contributes additional coloring and antimicrobial properties. Amla is rich in vitamin C and antioxidants, promoting hair strength and preventing premature greying. Reetha serves as a natural cleanser due to its saponin content, helping remove dirt and excess oil. Hibiscus supports hair growth, conditioning, and scalp health. Together, these herbs help maintain scalp pH, improve texture, and provide a natural tint while addressing issues such as dandruff and hair fall.<sup>[2,3]</sup>

**HAIR DYE**

A dye is a coloured substance that has a link with the fibre, fur, or hair. Hair colouring, often known as dyeing is the process of transforming one's hair colour. The key reasons for the use of hair dye gel in cosmetics is to conceal grey or white hair, to change to a more elegant or perfect hue, or to restore the natural hair colour after it has been discoloured through hairdressing techniques or solar bleaching. Hair dye makes the hair look thicker and voluminous. Balding and greying of hair affect approximately 70% of people over the age of 50. Some people experience age-related symptoms considerably

earlier than others. Greying begins on the scalp around the age of 40, first at the temples, then the beard, moustache, and finally the chest. A person's hair becomes grey at a certain age, which is mostly determined by hereditary. However, early pigment loss in adults can be caused by a variety of different circumstances such as disease, certain medicines, fear, or even shock, and it is permanent. However, if hair becomes white in childhood, it might be a result of malfunctioning in the body and medical guidance. A number of side effects, including erythema, irritation of the pores and skin, hair loss or damage, and the majority of malignancies are caused by the continuous use of chemical dye-containing substances on hair. The extended shade resistance in oxidation systems is caused by a strong diffusion of the chemical into the cortex. In addition to giving hair distinctive characteristics, hair dyes also include dye modifiers, antioxidants, alkalizers, soaps, ammonia, wetting agents, fragrance and a variety of other chemical substances used in trace amounts to soften the texture of hair. The proportion of melanin types-eumelanin and pheomelanin determines the colour of your natural hair. Herbal hair dyes are prominent among eco-conscious consumers simply because of their low environmental impact and use of sustainably obtained botanicals rather than toxic chemicals.<sup>[4,5]</sup>

## TYPES OF HAIR DYE

1. Permanent hair dye
2. Semi-permanent hair dye
3. Demi-permanent hair dye
4. Temporary hair dye

### 1. Permanent hair dye

These dyes enter the hair shaft and stay there until the hair is removed or grows out.

Ammonia and other alkalizers found in them aid in releasing the hair's cuticle, which permits the colour to enter.

### 2. Semi- permanent hair dye

These dyes add colour to the hair shaft but do not soak in as well as permanent dyes. After a few washes, they ultimately disappear

### 3. Demi- permanent hair dye

These colours include semi-permanent and permanent dyes. Though not as much as permanent dyes, they do contain some ammonia and not as long-lasting as permanent dyes, but they outlast semi-permanent dyes.

**4. Temporary hair dye:** These dyes add colour to the hair shaft but are removed after just one shampoo. They are frequently used for special events or to give hair a splash of colour.

## BENEFITS OF HERBAL HAIR DYE GEL



## HERBAL MATERIALS USED IN THE FORMULATION

### 1. HENNA (*Lawsonia inermis*)



Fig1: Henna.

#### ➤ Taxonomy

- Family: Lythraceae
- Genus: Lawsonia
- Species: *Lawsonia inermis*
- Active Constituents: Lawsone, tannins, flavonoids

#### • Medicinal Properties

1. Natural hair coloring agent
2. Strengthens hair
3. Prevents dandruff
4. Provides cooling effect to scalp.<sup>[6]</sup>

ii. AMLA (*Emblca officinalis*)

Fig 2: Amla.

## ➤ Taxonomy

- Kingdom: Plantae
- Family: Phyllanthaceae
- Active Constituents: Vitamin C, tannins, gallic acid

## • Medicinal Properties

1. Promotes hair growth
2. Prevents premature greying
3. Strengthens hair roots.<sup>[7]</sup>

iii. PALASH (*Butea monosperma*)

Fig 3: Palash.

## ➤ Taxonomy

- Family: Fabaceae
- Active Constituents: Flavonoids, butrin

## • Medicinal Properties

1. Natural coloring agent
2. Antimicrobial activity
3. Improves scalp health.<sup>[8,9]</sup>

IV. HIBISCUS (*Hibiscus rosa-sinensis*)

Fig 4: Hibiscus.

## ➤ Taxonomy

- Family: Malvaceae
- Active Constituents: Flavonoids, mucilage

## • Medicinal Properties

1. Conditions hair
2. Promotes hair growth
3. Reduce hair fall.<sup>[10,11]</sup>

V. REETHA (*Sapindus mukorossi*)

Fig 5: Reetha.

## ➤ Taxonomy

- Family: Sapindaceae
- Active Constituents: Saponins

## • Medicinal Properties

1. Natural cleanser
2. Removes dandruff
3. Adds shine to hair

## CHEMICAL INGREDIENT USED IN THE FORMULATION

## I. CARBOPOL 940



Fig 6: Carbopol 940.

IUPAC name: poly(1-carboxyethylene)

Molecular formula: C<sub>42</sub>H<sub>80</sub>O<sub>8</sub>

Odour: odourless

Boiling point: 141.2°C (286 °F)

Melting point: 305 °C (581°F)

Use: thickening agent, stabilizer, gelling agent.

**ii. METHYL PARABEN****Fig 7: Methyl paraben.**

IUPAC name: methyl 4-hydroxybenzoate  
 Molecular formula: C<sub>8</sub>H<sub>8</sub>O<sub>3</sub>  
 Odour: faint odour  
 Boiling Point: 275-280°C  
 Melting point: 125–128°C  
 Use: Preservative, fungicide, they are added to food cosmetics and pharmaceuticals to increase shelf life and avoid bacterial and fungal growth.

**iii. GLYCERINE****Fig 8: Glycerine.**

IUPAC name: Propane-1,2,3-triol  
 Molecular formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>  
 odour: odourless  
 Boiling point: 290°C  
 Melting Point: 17.8 °C  
 Use: Used as sweetening agent, solvent, pharmaceutical agent, emollient.

**iv. TRIETHANOLAMINE****Fig 9: Triethanolamine.**

IUPAC Name: 2,2',2-Nitrilotri(ethan-1-ol)  
 Molecular Formula: C<sub>6</sub>H<sub>15</sub>NO<sub>3</sub> or (CH<sub>2</sub>OHCH<sub>2</sub>)<sub>3</sub>N  
 Odour: mild ammonia odour  
 Boiling point: 335.4°C  
 Melting point: 21.60°C  
 Use: used as an excipient in the formulation of topical and oral medications, as well as solubilizing agent.

**AIM AND OBJECTIVE**

**Aim:** To Formulate and Evaluate Herbal Hair Dye Gel.

**Objective:** The objectives of this study are to prepare herbal extracts and mix them into a gel base, to make a smooth and stable gel, and to test it for basic parameters like colour, odour, pH, thickness, spreadability, and stability. The study also aims to check its ability to give natural colour, clean the scalp, and improve hair condition without causing side effects.

**MATERIALS AND METHODS****Plant Materials and Chemicals**

Formulation of herbal hair dye gel, the plant materials such as Heena (*Lawsonia inermis*), amla (*Emblica officinalis*), palash (*Butea monosperma*), hibiscus (*Hibiscus rosa-sinensis*), reetha (*Sapindus mukorossi*) were procured from local market of Nagpur (India).

All the plant materials were thoroughly washed with distilled water to remove dirt and impurities and then shade-dried for 4–5 days to preserve their active constituents. The dried materials were further subjected to pulverization using a mechanical grinder and passed through sieve no. 100 to obtain a fine powder suitable for extraction.

Excipients such as Carbopol 940 were used as a gelling agent, glycerin as a humectant and methyl paraben as a preservative. Triethanolamine was used for pH adjustment. All chemicals and reagents used were of analytical grade and procured from standard pharmaceutical suppliers. Distilled water was used throughout the formulation process to maintain purity and consistency.

**Extraction of plant materials**

The extraction of herbal materials was carried out using Soxhlet extraction method with a hydroalcoholic solvent system consisting of ethanol and water in the ratio of (80:20). Accurately weighed quantities of dried powdered plant materials, namely henna (*Lawsonia inermis*), amla (*Emblica officinalis*), palash (*Butea monosperma*), hibiscus (*Hibiscus rosa-sinensis*), and reetha (*Sapindus mukorossi*), were individually subjected to Soxhlet extraction. Each powdered drug was placed in a thimble and extracted with the hydroalcoholic solvent for sufficient cycles until complete extraction was achieved.

The extracts obtained were then filtered using Whatman filter paper and concentrated using a water bath to

remove excess solvent, resulting in semi-solid extracts.

All the prepared extracts were stored in airtight containers under refrigerated conditions for further use.

### PHYTOCHEMICAL SCREENING OF HERBAL EXTRACT

The above prepared herbal extract was subjected to phytochemical screening to reveal the various

phytoconstituents as carbohydrates, tannin, glycosides, flavonoids and saponins. The extract was individually dissolved in 5 ml of water and filtered; the filtrates were used to perform the chemical test -and the result was shown in Table 1.

**Table 1: Phytochemical evaluation of herbal extract.**

Sr. No.	Phytoconstituents	Henna	Hibiscus	Reetha	Amla	Palash
1	Tannins	+	+	+	+	+
2	Glycosides	+	+	+	+	+
3	Flavonoids	+	+	-	+	+
4	Carbohydrates	+	+	+	+	+
5	Saponins	-	+	+	-	+

+ = Present - = Absent

### Method of Preparation for gel base

1. Weigh required quantity of Carbopol 940 and dispersed in required quantity of distilled water in beaker.
2. Keep beaker aside for half an hour to swell Carbopol 940 and then start stirring at 1200 rpm by using mechanical stirrer for 30 min.
3. Ensure complete hydration and swelling of Carbopol.
4. Add preservatives, humectants (e.g., glycerin), and other required ingredients with continuous stirring.
5. Adjust the volume with distilled water and ensure uniform consistency.

### Incorporation of Extracts

#### Pre-Incorporation Checks

Before adding extract Ensure gel base is lump-free and homogeneous Check pH compatibility of extracts Ensure extracts are cool (room temperature). Hot extracts can break gel structure.

### Method of Incorporation

Add herbal extracts slowly in small portions into the gel base. Use continuous gentle stirring (avoid vigorous mixing). Prefer geometric dilution method: Mix small quantity of extract with gel first then gradually add remaining extract. This ensures uniform distribution.<sup>[13]</sup>

### METHOD OF PREPARATION OF GEL CONTAINING EXTRACTS<sup>[14]</sup>

To prepare the gel base, required quantities of chemical ingredients are weighed such as Carbopol 940, methyl paraben, glycerine and triethanolamine. Take 1g of Carbopol 940 and dissolve it in required quantity of water of in a clean beaker and kept 30 min for hydration. After the hydration of Carbopol 940 continuous constant stirring by using a mechanical stirrer and add the remaining chemical ingredients such as methyl paraben and glycerine. Later add the herbal extracts and add sufficient amount of water qs to produce 100 mL and mix it until uniform distribution is obtained, then add triethanolamine to adjust the pH and add sufficient drops of perfume for fragrance. The details of formulation are shown in table 2.

**Table 2: Formulation of herbal hair dye gel batches by trial-and-error method.**

Sr. No.	Ingredients	F1	F2	F3
1	Carbopol 940	1g	1g	1g
2	Henna extract	4g	6g	8g
3	Amla extract	2g	3g	4g
4	Hibiscus extract	1g	2.5g	3g
5	Palash extract	1.5g	2.5g	3g
6	Reetha extract	1.5g	1.5g	2g
7	Glycerine	5g	5g	5g
8	Methyl Paraben	0.5g	0.5g	0.5g
9	Triethanolamine	2 drops	2 drops	2 drops
10	Distilled Water	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml

**Table 3: Optimize formulation of herbal hair dye gel.**

Sr. No.	Ingredients	F2
1	Carbopol 940	1g

2	Henna extract	6g
3	Amla extract	3g
4	Hibiscus extract	2.5g
5	Palash extract	2.5g
6	Reetha extract	1.5g
7	Glycerine	5g
8	Methyl Paraben	0.5g
9	Triethanolamine	2 drops
10	Distilled Water	q.s. to 100ml

## Evaluation

### 1. Organoleptic Evaluation

The prepared herbal hair dye gel was evaluated for its colour, odour, texture, consistency and appearance by visual inspection.<sup>[13]</sup>



**Fig. 10: Formulation of hair dye gel.**

### 2. Physical assessment

#### a. Determination of pH

The pH of different formulations was determined using a digital pH meter. 1 g of gel was dispersed in 10 ml distilled water and the pH was recorded.



**Fig 11: pH meter.**

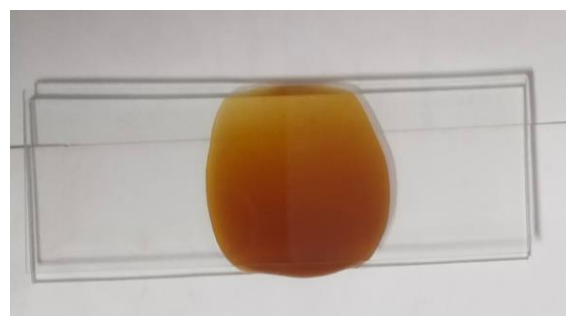
#### b. Determination of Viscosity

The viscosity of the prepared gel was measured using a Brookfield viscometer at suitable rpm (e.g., 10 rpm), and the corresponding dial reading was noted.

#### c. Spreadability

Spreadability was determined by placing a known quantity of gel between two glass slides and applying a

fixed weight (50 g). The time required for the slides to separate was noted.



**Fig. 12: Spreadability.**

#### d. Homogeneity

The formulated gel was tested for homogeneity by visual inspection after placing it in a suitable container. The gel was examined for appearance and presence of any aggregates or lumps.

#### e. Dyeing Effect

The dyeing effect of the gel was evaluated by applying 1 g of gel on hair strands. After 60 minutes, the hair was washed with water and observed for color intensity and shade.



Fig. 13: Dyeing effect.

#### f. Washability

The washability of the gel was evaluated by applying it on hair and rinsing with water. The ease of removal was observed.

#### g. Stability Study

The hair dye gel was stable for the time period of two months at room temperature. The formulation was evaluated for the physical parameters like colour, odour, pH, texture and consistency.



Fig. 14: Stability Study.

#### RESULTS AND DISCUSSION

The formulated herbal hair dye gel was examined for various parameters such as organoleptic, physiochemical and phytochemical evaluation.

Three formulations (F1, F2, F3) had an acceptable consistency, appearance, odour and colour. The pH of three formulations was found to be closer to the neutral pH 6.0. F2 is considered to be best because it shows neutral pH. Viscosity of F was found to be higher than the other formulations. The results of the spreadability test and homogeneity indicates that all 3 gel formulations had good spreadability properties and homogeneity.

From the results, formulation F2 has excellent dyeing effects. The Dye study on human hair shows a brown hair colour after 1 hr as compared to other formulations. There was no change in colour, odour and consistency observed during stability studies.

Table 4: Physical Evaluation Table.

Sr.no	Parameters	F1	F2	F3
1	pH	5.8	6.0	6.9
2	Spredability	High	Moderate	Low
3	Washability	Easy	Moderate	Difficult
4	Dyeing effect	Light	Moderate	Excellent (Dark)
5	Homogeneity	Good	Good	Good
6	Viscosity	240cP	290cP	250cP

Table 5: Organoleptic Evaluation Table.

Sr. No.	Parameters	F1	F2	F3
1	Color	Light brown	Brown	Dark brown
2	Appearance	Smooth gel	Smooth & uniform gel	Thick gel
3	Odour	Mild Herbal	Pleasant & Herbal	Strong Herbal
4	Consistency	Semi-solid	Semi-solid	Highly viscous

**Table 6: Stability study table.**

Parameters	Batch	Initial	7days at room temperature	7 days at refrigerated condition
Color	F1	Light brown	No change	No change
	F2	Brown	No change	No change
	F3	Dark brown	No change	No change
Odor	F1	Mild Herbal	No change	No change
	F2	Pleasant & Herbal	No change	No change
	F3	Strong Herbal	Slight change	No change
pH	F1	5.8	5.6	5.9
	F2	6.0	5.9	6.1
	F3	6.7	6.8	7.0
Consistency	F1	Semi-solid	No change	No change
	F2	Semi-solid	No change	No change
	F3	Highly viscous	Slightly increase viscosity	No change

### SUMMARY AND CONCLUSION

**Summary:** The present study focused on the formulation and evaluation of an herbal hair dye gel using suitable natural ingredients such as henna, amla, hibiscus, and reetha. The prepared gel was evaluated for organoleptic properties such as color, odour, appearance, texture, consistency, homogeneity, spreadability, washability, and stability. The formulation showed satisfactory results with good physical appearance and acceptable organoleptic properties. The gel was smooth, homogeneous, and free from any lumps or phase separation, indicating proper formulation. Overall, the herbal hair dye gel was found to be safe, effective, and suitable for topical application, providing natural colouring along with conditioning benefits to the hair.

**Conclusion:** From the present study, it can be concluded that the herbal hair dye gel was successfully prepared and evaluated. The results showed that the formulation possessed acceptable organoleptic and physical properties. The developed gel has good potential for use as a natural hair colouring agent, providing effective colouring along with conditioning benefits.

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