Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2019; 8(2): 1363-1365
Received: 19-01-2019
Accepted: 21-02-2019

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# Development and evaluation of herbal hair dye formulation

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**Abstract**
Conventional methods of hair dyeing involve use of chemicals that result in unpleasant untoward effects which include irritation, breakage of hair, skin discoloration and cancer. Marketed hair colors containing crude plant powders require processing prior to use, which is inconvenient to the consumer and these products also have poor rinsability. Hence, there was a need to develop a formulation of hair dye with colour extract from plant source which is ready to use with good rinsability. In the context of above objective, the attempt was made to formulate a gel for hair dye containing herbal extract and other additives from plant source. Five different formulations were prepared and formulation G5 was found to be most optimized formulation with the most promising results on hair color.

**Keywords:** Herbal hair dye formulation

## 1. Introduction
Graying of hair is attributed to reasons like genetics, stress, nutritional deficiency and disease. The primary reason of premature graying is hereditary and it is reported that by the age of fifty, half of the world's population will have fifty percent gray hair. Hence there is a huge demand for hair dyes in the market. Natural dyes are the colors derived from plant, animal or insect matter without any chemical processing. In the past natural organic substances were mixed with metals such as copper and iron, to produce more lasting or richer shades. Many plants like *Lawsonia inermis, Acacia arabica, Eclipta alba, Juglans regia, Pterocarpus indicus, Pilocarpus jaborandi, Nardostachys jatamansi, Phyllanthus emblica, Saussurea lappa, Tinospora cordifolia, Terminalia bellirica, Uncaria gambir, Aloe barbadensis, Cinnamomum zeylanicum, Hibiscus rosasinensis, Centella asiatica etc.* are used as main ingredients in hair care preparations mainly for coloring the hair. Natural dyes also act as mordants because they contain tannins. Tannins create affinity between dyes and hair and thus improve color and fastness of dye. Natural hair colorants that are currently marketed mainly contain henna along with plant components that need to be used in the paste form. However, such preparations have several disadvantages like lengthy preparation time, messy application, poor rinsability, lack of a standard coloring and limited color shades. Formulations promoted as natural hair colorants also contain synthetic dyes and chemicals. Synthetic hair colorants involve the use of chemicals like 1-3% phenylenediamine, ammonia, peroxide and coal tar dyes that are capable of removing and replacing or covering the natural hair color. Inorganic salts like aluminum sulphate, copper sulphate, lead acetate and potassium dichromate act as mordants are also added to improve and protect the color produced by the dye. Use of these chemicals can result in unpleasant side effects, including temporary skin irritation and allergy, hair breakage, skin discoloration, unexpected hair color and cancer. Since the conventional methods of hair coloring by the use of natural or synthetic colorants has limitations, an attempt has been made in this study to formulate a gel for hair dye using herbal extracts and other additives from plant source having good coloring property that is safe and ready to use. [1]

## 2. Materials and Methods
### 2.1 Plant Sources
The following plant materials were collected from the garden and authenticated by the botanist. The materials were dried in shade and powdered.

### 2.1.1 Henna
The botanical name of Henna is *Lawsonia inermis* which is the only species of the genus *Lawsonia* and belongs to the family *Lythraceae*. The leaves of this plant posess a red dye molecule called lawsone (2- Hydroxy-1yl-naphthaquinone), which has the ability to bond with

the protein. The other components like Lawsone 1, 4-naphtha quinone; 2-methoxy-3-methyl-1,4-naphthaquinone; flavonoids, coumarins, phenolic acids; 5-10% gallic acid and tannins. Henna balances the pH of the scalp preventing premature hair fall and graying of hair [2].

**2.1.2Black Catechu**
The botanical name of Black Catechu is *Acacia catechu / Acacia chundra*. It belongs to Family Leguminosae. It is used as colour ing and dyeing agent.

**2.1.3 Black Tea**
The tannins present in tea are known to increase the color intensity of hair [2].

**2.1.4 Aloe Vera**
The botanical name of Aloe Vera is Gawar Patha, It belongs to Liliaceae family. Aloe Vera is effective for scalp and can be used not only to treat hair loss, but to promote hair growth as well. Aloe Vera contains aloe emodin which promotes hair growth by stimulating hair follicles. It is also useful in treating the scalp from sun burn. It is used as a natural mordant. It is also known for its emollient effect. [2]

**2.2 Preparation of Plant Extracts**
**2.2.1 Procedure for extraction of Henna**
10 gm of dried henna powder was soaked in mixture of 200ml of methanol and 200ml water for overnight in a rotary shaker. Extract was filtered through Whatman No.41 filter paper. Extract was concentrated by evaporating of solvent [4].

**2.2.2 Procedure for Extraction of Black Tea**
50 gm of dried powder sample soaked in 125ml of methanol for 16 hrs in a rotary shaker. What man No.1 filter paper was used to separate the extract of the plant.[7]

**2.2.3 Procedure for Extraction of Black Catechu**
50gm of dried powder sample soaked in 125ml of ethanol for 16hrs in a rotary shaker. Whatman No.1 filter paper was used to separate the extract of the plant.[4]

**2.2.4 Procedure for extraction of Aloe Vera**
Take 20 matured aloe Vera leaves were taken and washed it with water to to remove dirt. The upper green layer was removed by using knife. With the help of spoon, inner transparent sticky material was taken and allowed to dry to get the powder form [6].

**2.3 Formulation of Gel**
**2.3.1 Chemicals**
Carbopol 934, Methyl paraben, Propyl paraben, Propylene glycol and Triethanolamine

**2.3.2 Method of Preparation of Gel containing extracts**
The required quantity of Carbopol 934 was slowly sprinkled into weighed amount of purified water with constant stirring to get uniform dispersion and then kept overnight for hydration. The accurately weighed amounts of dried extracts along with other additives were poured into the fixed amount of hydrated Carbopol dispersion with constant stirring. The composition of Herbal gel prepared from various extract of Henna, Black Catechu, Black tea, Aloe Vera are tabulated follows [5].

**Table 1:** Formulation Composition

| Formul-ation | Ingredients | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Carbapol 934 (gm) | Methyl Paraben (gm) | Propyl Paraben (gm) | Propylene Glycol (ml) | Plant Extracts | | | | Triethanol-amine (ml) | Distilled water Q.S. (ml) |
| | | | | | Henna (gm) | Black Catechu (gm) | Black Tea (gm) | Aloe Vera (gm) | | |
| G1 | 1 | 0.5 | 0.2 | 0.1 | 5 | 3 | 1 | 1 | 1.2 | 100 |
| G2 | 1 | 0.5 | 0..2 | 0.1 | 3 | 1 | 5 | 1 | 1.2 | 100 |
| G3 | 1 | 0.5 | 0.2 | 0.1 | 5 | 1 | 3 | 1 | 1.2 | 100 |
| G4 | 1 | 0.5 | 0.2 | 0.1 | 1 | 5 | 3 | 1 | 1.2 | 100 |
| G5 | 1 | 0.5 | 0.2 | 0.1 | 5 | 2 | 2 | 1 | 1.2 | 100 |

**2.4 Dye Study**
Each formulated gel (G1, G2, G3, G4, G5) was applied to the white hair. After 15, 30, 45, 60 minutes the hair were washed and the colour of hair was observed of each batch. [2]

## Results and Discussion
### 3.1 Practical Yield of Herbal Extracts

| Name of extracts | Practical Yield |
|---|---|
| Henna | 4.522gm (45.22%) |
| Black Tea | 2.878 gm (5.75%) |
| Black Catechu | 35.152 gm (70.30%) |
| Aloe vera | 16 gm. (80%) |

### 3.2 Phytochemical Study of Plant Extract
### 3.2.1 Morphological Studies

**Table 2:** Morphological Observations

| Extract | Colour | Odour | Taste |
|---|---|---|---|
| Henna | Reddish Brown | Characteristic | Bitter and Astringent |
| Black Catechu | Light brown to black | Odorless | Astringent |
| Black Tea | Brownish black | Characteristic | Bitter |
| Aloe Vera | Greenish brown | Characteristic | Bitter |

### 3.2.2 Chemical Studies

**Table 3:** Observations of Chemical Tests

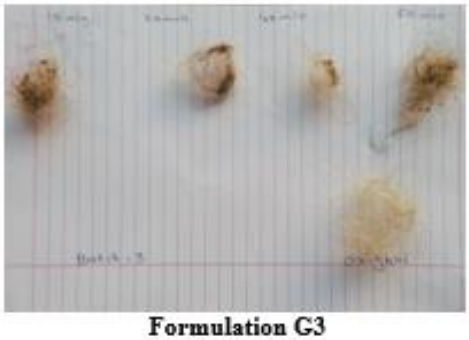
| Extract | Chemical Test | Observation | Inference |
|---|---|---|---|
| Henna | Extract henna leaves with water by boiling and filterand cooled | This decoction fades on addition of acid while deepens by addition of alkali | Lawsone is Present. |
| Black Catechu | 1)Test solution+$FeCl_3$<br>2)Decolorization of<br>- $KMNO_4$<br>- Bromine water<br>3)Aqueous extract+Lime water | Dark Colouration<br>Decolorization<br>Brown colour, on standing turns Red colour | Presence of Catechin<br>Presence of Catechin<br>Presence of Catechin |
| Aloe Vera | Aloevera extract+Ruthenium red solution | Pink Colour | Mucilage Present |
| Black Tea | Black tea+Ferric Chloride solution | Bluish black | Tannin Present |

### 3.3 Dye Study

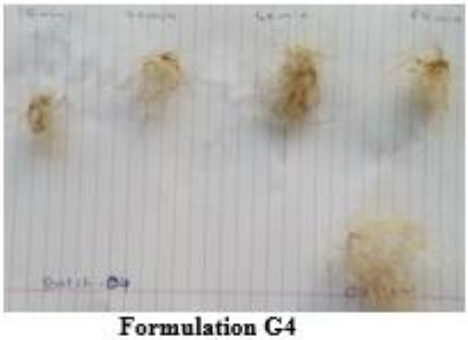
Following visual observations were made.

**Formulation G1**

**Formulation G2**



**Formulation G3**



**Formulation G4**

**Formulation G5**

From the result it is evident that all the gel formulations showed good gelling property and homogeneity. Formulation G5 showed the desired dyeing effect. Dye study of formulated gel on human hair indicated an appealing reddish hair colour after 60 min as compared to other formulations (G1, G2, G3 & G4). So formulation G5 has excellent dyeing properties and good reusability with adequate stability.

## 4. Conclusion

The limitations of currently marketed natural hair colorants used as a paste includes a lengthy soaking time, messy application and difficultly to rinse it off. This study exhibits a gel based formulation of plant powders which is stable and ready to use. Also, this developed formulation has excellent dyeing properties and good rinsability. It also imparts additional benefits such as promotion of hair growth and prevention of hair greying while being safe and ecofriendly.

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