

Original Article

FORMULATION AND EVALUATION OF NATURAL HAIR COLORANTS

RASHMI MALLYA*, PADMINI RAVIKUMAR

SVKM's. Bhanuben Nanavati College of Pharmacy, SVKM College Campus, Vile Parle (W), Mumbai, India 400056

Email: rashmikey@gmail.com

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ABSTRACT

Objective: Conventional methods of hair dyeing involve use of chemicals that result in unpleasant side 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 is a need to formulate hair dyes containing crude drugs which are ready to use with good rinsability.

Methods: In this study, gel formulations containing natural colorants like *Lawsonia inermis*, *Emblca officinalis*, *Rubia cordifolia*, *Terminalia belerica* and *Juglans regia* were prepared.

Results: The results indicate that except henna extract, other plant extracts used in this study do not impart color to human hair. A combination of extracts prepared by cold and/or hot extraction methods did not give encouraging results, but a formulation containing a combination of the studied plant powders in 2% carbopol 934 gel shows promising results and does not produce skin irritation in rats.

Conclusion: Thus, the formulated hair color gel being reported in addition to being consumer friendly is effective, stable and safe.

Keywords: Hair colorants, Henna, Gel formulation.

INTRODUCTION

Graying of hair occurs due to various 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 [1]. 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 [2]. 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*, *Petrocarpus indicus*, *Pilocarpus jaborandi*, *Nardostachys jatamansi*, *Phyllanthus emblica*, *Saussurea lappa*, *Tinospora cordifolia*, *Terminalia belerica* [3], *Uncaria gambier* [4], *Aloe barbadensis*, *Cinnamomum zeylanicum*, *Hibiscus rosasinensis*, *Centella asiatica* [5] 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 [6].

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 which act as mordants are also added to improve and protect the color produced by the dye [7]. 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 [9-11].

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 hair dye using crude drugs having good coloring property that is safe and ready to use.

MATERIALS AND METHODS

Formulation and dyeing studies

Powders of *Juglans regia* (Walnut bark) [3], *Lawsonia inermis* (Henna leaves), *Terminalia belerica* (Beheda fruits) [6], *Embelica officinalis* (Amla fruit) [12], *Rubia cordifolia* (Manjistha roots) [13] were procured from the local market. Pharmacognostic and preliminary phytochemical screening studies were conducted to check the authenticity of powders. To test the dyeing properties, unpigmented hair samples were collected, shampooed, dried and used along with natural fibers of vegetable origin e. g cotton and jute; of animal origin e. g silk, wool, human hair and synthetic fibers viz nylon and rayon.

Preparation of plant extracts

Aqueous extracts of Manjistha, Beheda, Amla, and Walnut were prepared by boiling powders in distilled water for 1 hour. The filtrate was evaporated under controlled temperature to obtain respective extracts. The dyeing properties of individual plant extracts and their blend were evaluated at the end of 3 hours on natural and synthetic fibers after application.

Dyeing studies of blends of henna and plant powders

Dyeing studies on human hair samples were conducted to optimize the concentration of henna required to be added along with plant powders in the formulation. A powder blend (PB) containing equal quantities of Manjistha, Beheda, Amla and Walnut was mixed with varying concentrations of henna powder (PB: henna ratio being 1:1, 1:2, 1:3). This was applied on the hair samples in the form of a paste in distilled water and the evaluation was done after 3 hours of application.

Optimization of method of extraction

As per the results of dyeing studies as described earlier, a Final Mixture (FM) was prepared using PB and henna in the ratio of 1:2.

Two extracts of FM namely cold extract and hot extract were prepared as follows

Cold extract: FM powder was macerated in distilled water in 1:5 ratio for 7 days and the filtrate was evaporated to dryness at room temperature.

Hot extract: FM powder was extracted by boiling in distilled water in 1:5 ratio at 100°C for 1 hour and filtrate evaporated to dryness at 50°C on a water bath.

Formulation studies

Formulations were prepared by incorporating FM powder, and cold and hot extracts of FM into 2% Carbopol gel in the ratio 1:4. The dyeing property of the three formulations was checked on synthetic and natural fibers.

Evaluation of herbal hair dye gel

Studies on dyeing effect

1) Colored hair was pasted on a white paper sheet covered with transparent cellophane tape and kept for 30 days under the following conditions:

- Room temperature 25°C±3°C
 - Sunlight 2 hours/day
- 2) Effect of natural detergent on colored hair:

10 % w/v aqueous dispersion of Reetha (*Sapindus mukorossi*) was prepared and the dyed hair was washed with the same on alternate days for a period of 30 days.

Physical evaluation of the gel

The prepared gel was evaluated for its organoleptic parameters, pH and spreadability for a period of 3 months as per ICH guidelines.

Skin irritation study

Wistar albino rats (n=6) were housed in polypropylene cages with free access to standard laboratory diet and water. Animals were acclimatized for at least 7 days before experimentation. The dorsal abdominal skin of the rats was shaved 24 h before study. The formulation (200mg / rat) was applied and the site of application was covered with cotton bandage [14]. The patch was removed after 24 h and the score of erythema was recorded as follows:

1- No reaction, 2 -Slight, patchy erythema, 3-Slight but confluent or moderate but patchy erythema, 4-Moderate erythema, 5-Severe erythema with or without edema.

The experimental protocol was approved by Institutional animal ethical committee of Dr. Bhanuben Nanavati College of Pharmacy (CPCSEA/ IAEC/BNCP/P-05/2011)

RESULTS

Formulation and dyeing studies

As presented in table 1, aqueous extracts of Beheda, Amla, Walnut exhibited poor coloring on natural and synthetic fibers. Rubia extract and the blend of extracts exhibited moderate to very good coloring property on jute, silk and wool but exhibited poor coloring of human hair.

Since neither the plant extracts nor their blend exhibit good coloring of human hair samples, henna was incorporated along with the

selected plants for further studies. It was observed that Henna alone, dyed hair an unappealing orange-red color whereas a 1:1 combination of Henna and powder blend(PB) showed reddish color with moderate dyeing. The 1:2 and 1:3 combinations showed similar results with reddish brown color and good dyeing effect. Thus an increase in concentration of Henna beyond 2 parts of the powder blend, did not exhibit beneficial effect. A mixture labeled as FM containing a combination of 2 parts of Henna along with 1 part of PB (Rubia, Walnut, Amla, Beheda in equal quantity) which displayed the desired dyeing effect was used for further studies.

Results of dyeing studies of FM extracts and its formulations on various fibers are tabulated in table 2. Hot extract of FM and gel formulations of FM extracts exhibited poor dyeing effect on hair whereas cold extract of FM and FM powder in 2% carbopol gel showed good dyeing effect. It showed that use of heat to concentrate the aqueous extracts induces loss of the dyeing property but the liquid forms of aqueous extracts of the plants as dyeing materials and not commercially viable.

Hence, FM incorporated in 2% carbopol gel was evaluated for its stability and skin irritation. Evaluation of the formulated gel for a 3 months period displayed no change in appearance, with a spreadability of 8 to 9 gm. cm/sec and pH of 7.0-7.5.

Dyeing studies of formulated gel (fig. 1) on human hair indicate an appealing reddish brown color. Exposure to 2 hours of sunlight daily caused hair color to fade after 16 days whereas it remained unchanged for 30 days when kept at room temperature protected from sunlight. There was no change in color after washing the hair every alternate day in natural soap solution for 10 days after which the intensity of the color started reducing. The effect of the color lasted for around 20 days even after frequent washing and exposure to sunlight.

Skin irritation studies showed absence of erythema and or edema indicating absence of sensitivity or reaction on the skin.

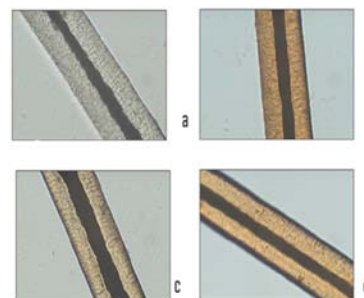


Fig. 1: Microscopic Features (40X) (a) human grey hair (b) human grey hair 1 hour after application of natural hair colorant gel (c) colored human grey hair on day 30 after washing with natural soap solution (d) colored human grey hair on day 30 after exposure to sunlight

Table 1: Preliminary dyeing studies of extracts on fibers

Plants	Cotton	Jute	Wool	Silk	Human hair	Nylon	Rayon
Walnut	poor	poor	poor	poor	poor	poor	poor
Amla	poor	poor	poor	poor	poor	poor	poor
Beheda	poor	poor	poor	poor	poor	poor	poor
Rubia	poor	good	moderate	very good	poor	poor	poor
Extract Blend	poor	good	moderate	very good	poor	poor	poor

(Extract Blend: equal mixture of Walnut, Amla, Beheda and Rubia extract)

Table 2: Dyeing studies of FM extracts and its formulations on fibers

Type of extract	Poor dyeing	Moderate dyeing	Good dyeing
Cold extract	Cotton, nylon, rayon	Wool	Silk, jute and human hair
Hot extract	Cotton, nylon, human hair, rayon	Wool	Silk, jute
Cold extract in gel base	Cotton, nylon, rayon, human hair	Silk, jute, wool	-
Hot extract in gel base	All	-	-
Paste formulation with FM and water	Cotton, nylon and rayon	Wool	Silk, jute and human hair
Gel based formulation with FM and 2% carbopol	Cotton, nylon and rayon,	Wool	Silk, jute and human hair

DISCUSSION

Traditionally, Rubia and Walnut are used as hair rinses to prevent graying of hair and Amla as a hair growth promoter. Beheda, Amla and Walnut are rich in tannins and hence have proven activity as mordants. In the present study extracts of Beheda, Amla, Rubia and Walnut when used individually or in combination exhibit a very faint coloring on human hair samples. Henna when used alone as colorant, gave an unappealing orange-red color whereas a combination of Henna and the above mentioned powders show appealing reddish brown color with good dyeing effect and the color lasts for about 20 days even after frequent washing and exposure to sunlight. This effect can be attributed to the tannins present in the powders which improved effect as mordants that help to improve the light and wash fastness of the dye [15]. Also, addition of mordants helps to create various color shades with the same dye [16].

CONCLUSION

The limitations of currently marketed natural hair colorants used as a paste includes a lengthy soaking time, messy application and difficulty 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 eco friendly.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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