

## Formulation and evaluation of commonly used natural hair colorants

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### Abstract

Loss of colour in hair is due to varied reasons like genetic influence, effect of environmental factors, use of alcoholic preparations, etc. Though the permanent synthetic hair dyes are available in different colour ranges and retain natural lustre, they have the chief disadvantage of producing hypersensitive reactions in some individuals. In the present investigation various combinations of powdered leaves, fruits and flowers of dye yielding and hair care plants like Henna, Indigo, *Bhringraj*, *Amla*, Catechu and *Centella* were evaluated for their colouring and sensitivity reactions. Henna and Indigo formulation was found to be suitable natural colorant.

**Keywords:** Natural hair colorants, Dye yielding plants, Hair care plants, Henna, Indigo.

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[*Centella asiatica* (Linn.) Urban]<sup>10</sup>.

### Preparation of natural hair colorants

The leaves of henna, indigo, *brahmi*, tea and *bhringraj*, fruits of *amla*, shoe flowers, and Cinnamon bark were collected from different places and dried in shade. They were made into powders and used for the preparation of hair colorants.

### Collection of unpigmented hair

The human hair was collected from barber shops and temples from which white hairs were separated and used for the studies.

### Preliminary preparation of natural hair colorants

One gram each of henna, indigo, *amla*, *bhringraj*, hibiscus, *brahmi*, catechu, cinnamon and tea powder was taken separately and added 200mg (20%) of urea in each sample. A smooth paste was made with water separately. The pastes were kept aside for 1 h for imbibition. The hair was kept in the above pastes for 1h and then washed with water and observed for its colouring.

### Selection of suitable combination with henna

One gram of henna was mixed with same proportion of indigo, tea, *amla*, *bhringraj* and 20% urea and

### Introduction

From ancient days various materials from plants like Henna, Chamomile, Indigo, etc. are used to dye the grey hair to get natural black colour. But instead of getting black colour people get red to copper colour. Loss of colour in hair is due to varied reasons like genetic influence, effect of environmental factors, use of alcoholic preparations, etc.<sup>1</sup>. Though permanent synthetic hair dyes are available in varied colour and ranges retain natural lustre, they have the chief disadvantage of producing hypersensitive reactions in some individuals. Some hair dyes marketed as natural dye, contain 1-3% of phenylenediamine which is a synthetic hair dye and stain the skin and clothes during use<sup>2</sup>.

A need was felt to formulate a product containing only plant products, which is safe for use and does not have the problems of staining skin during use and hypersensitive reactions. In the present

investigation the formulations are developed to get natural black colour using combination of different plant materials. This investigation was planned based on experiences of several people who were using different plant products for colouring their hair without having any problems of irritancy, allergy or sensitivity.

The main aim of the present investigation is to formulate natural and safe hair colorants.

### Materials and Methods

The plants used in the study are: Henna (*Lawsonia inermis* Linn.)<sup>3</sup>, Indigo (*Indigofera tinctoria* Linn.)<sup>4,5</sup>, *Bhringraj* [*Eclipta alba* (Linn.) Hassk.]<sup>6</sup>, *Amla* (*Emblica officinalis* Gaertn.)<sup>7</sup>, Shoe flower (*Hibiscus rosa-sinensis* Linn.)<sup>8,9</sup>, Black catechu (*Acacia catechu* Willd.)<sup>3</sup>, Cinnamon (*Cinnamomum zeylanicum* Breyn.), Tea [*Camellia sinensis* (Linn.) O. Kuntze]<sup>3</sup>, and *Brahmi*

water was added to that in order to make a smooth paste. The paste was kept aside for 1 h for imbibition. The hair was kept in above paste for 1 hour. After that it was washed with water and observed for its colouring.

### **Selection of suitable combination of henna and indigo**

Henna was mixed with indigo in different ratios from 1:1 to 1:5, mixed with water to make smooth paste and processed similarly as above to observe colouring.

### **Effect of pH on the selected combination on henna and indigo**

1:3 Ratios of henna and indigo were selected because it produced altered colour and effect of pH was studied. To the paste of above ratio, dilute ammonia solution was added in order to obtain the pH of 6, 7, 8, 9. Further process was same for observing its effect.

### **Effect of successive application of selected combination of henna and indigo**

1 : 3 Ratios of henna and indigo were selected and to that successive application of paste was studied. The henna and indigo paste was applied 2 to 4 times and washed repeatedly with shampoo and observed for its colouring.

### **Effect of modifying agents over hair colorants**

One gram of henna and three grams of indigo powders were weighed and taken in a dish; 20% of urea and 1% of ferric chloride were added and made into paste. The paste was kept for 1 hour. Similarly, preparations containing

3 and 6% of ferric chloride were also prepared. The above pastes were applied to the white hair, waited for 1 hour. The hair colour was observed under microscope after washing with water. Similarly, same concentrations of copper sulphate were also prepared and observed.

### **Comparative evaluation of the formulation with marketed brands**

For comparison with the prepared paste with 1:1 henna and indigo with 20% of urea prepared paste two marketed herbal hair colorants [containing para phenylenediamine (PPD) in their formulation]. The above three pastes were applied to the hair, waited for 1 h and observed after washing.

### **Sensitivity test**

*Primary irritation testing:* This test<sup>11</sup> was conducted on two albino rabbits to detect the potential primary irritants present in the developed formulation. The animal ethical committee approval was also taken. It was ascertained that the animals did not have any skin sensitization or irritation history. The right side of back of each rabbit was clipped with sharp blade, which was sterilized previously. The henna and indigo was applied on the lightly scarified skin of the right side and the left side of the rabbit's back and the areas were covered with closed patches. The covered patches were kept in position for 24 hours. The applied areas were examined at intervals of four hours for assessment of changes on the skin associated with irritation.

*Predictive sensitivity testing:* The ascertainment of the irritant and sensitizing potential of formulation is prophetic or predictive sensitivity

testing. Under this test the ingredients of the formulation and the formulation as a whole were tested for their irritation and sensitivity<sup>12</sup>. This testing was conducted on 8 female volunteers hence, human ethical committee approval was obtained (No. is UCPSC/s/2006-01). The formulation was applied to 1 cm<sup>2</sup> area of cotton gauze. The gauze was backed with adhesive tape in order to hold it in position. Then 8 female volunteers were asked to apply this patch to the inner surface of forearm. The purpose of selection of this site for application was to enable the volunteer to readily remove the patch if any irritation is encountered. The volunteers were asked to remove patch immediately, if they feel itching or burning. Further they asked to keep the patch site dry, avoid rubbing or scratching test site. The patch was kept in position for 24 hours. After 24 h, the patch was removed. The test site was observed up to 40 min from the time of removal. This time interval is necessary so that the skin may recover from the effects of pressure of certain patch test substances.

## **Results and Discussion**

In the preliminary selection individual powders (Henna, Indigo, *Bhringraj*, *Amla*, Shoeflower, Cinnamon, Black Catechu, Tea, and *Brahmi*) were tested for their hair colouring property. The colour produced by these plant products can be seen in Fig. 1. From the figure it can be seen that among these dyes henna and indigo produced good coloration because henna gives an orange-red colour and indigo gives an intense violet colour. By using these two powders a suitable brown colour can be developed. The other plants did not



Fig. 1 : The different colours produced by grey hair (white) after treatment with different herbal powders in the form of paste

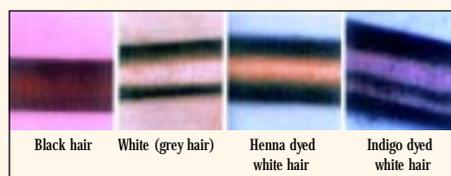


Fig. 2 : Microscopic observation of different hairs

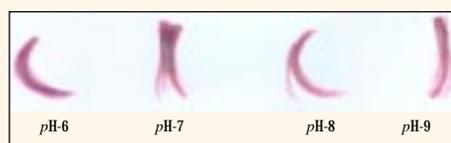


Fig. 3: Effect of pH on colour produced with henna and indigo



Fig. 4 : Microscopical observation of colour produced after repeated application of henna and indigo 3 times

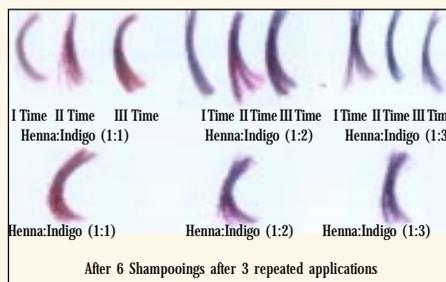


Fig. 5 : Effect of repeated application of henna and indigo on colour development

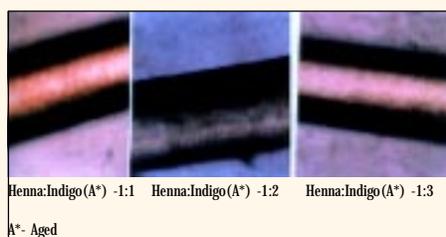


Fig. 6 : Microscopical observation of the effect of modifier (1% ferric chloride) on colour modification with henna and indigo

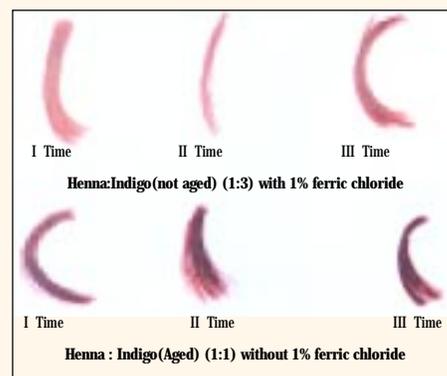


Fig. 7 : Effect of ageing of the indigo leaves on colour produced with 1% ferric chloride in 1 hour after each application with repeated 3 times of application

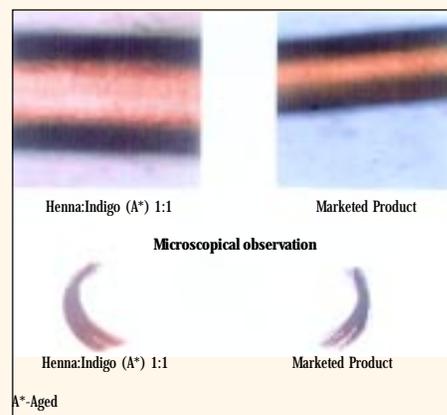


Fig. 8 : Comparison of the colour produced by the herbal dye with marketed product

produce the desired coloration to the hair. Microscopic pictures of black and white hairs and white hairs dyed with henna and indigo are shown in Fig. 2.

Henna and indigo were made into paste in different ratios as 1:1, 1:2, 1:3, 1:4, and 1:5. In these preparations, 1:1, 1:2 gives yellowish orange shades 1:4, 1:5 gives bluish violet shades whereas 1:3 ratio gives a brown shade. Hence 1:3 ratio of henna and indigo was selected for further study.

The effect of pH was studied on

this ratio of henna and indigo. The colour which was obtained at pH 7 was better than that of pH 6, 8 and 9 as can be seen from the Fig. 3. Hence, all the pastes were adjusted to pH 7 for further studies.

The henna and indigo pastes when applied repeatedly i.e., 3 times or 4 times, there was an increase in intensity of brown coloration. The microscopical observation of this can be seen in Fig. 4. When hair was washed with shampoo 6 times after repeated application of henna and indigo pastes 3 times and every time

the hair was soaked in the paste for 1h and then washed with water, their brown colour was retained as such which can be seen Fig. 5.

The effect of modifier on hair coloration was studied by using 1% ferric chloride. The effect of 1% ferric chloride was studied for the preparation containing with and without ferric chloride which was subjected to the shampoo washings. After adding 1% ferric chloride, it was observed that there was an increase in the intensity of brown colour and colour

retaining property was also increased. Penetration of colour intensity of henna and indigo with different ratios 1:1, 1:2 and 1:3 with 1% ferric chloride was studied. There was an increase in intensity of hair colour observed microscopically, which can be seen in Fig. 6.

There was an increase in violet colouring property, when the indigo leaves were subjected to ageing. The henna and indigo aged and tender leaves powders were taken in the ratios 1:1, 1:2, 1:3 and made into paste, kept aside for 1h for imbibition. Then these pastes were applied on to grey hair and after 1h the hairs were washed with water and colour of the hair was observed. The brown colour obtained with henna and indigo (not aged) (1:3) with 1% ferric chloride was same as that obtained with henna and indigo (aged) 1:1 ratio without 1% ferric chloride itself which can be seen in Fig. 7. The brown coloration was more in the later one. Hence a dark brown colour was obtained with pure plant products itself in the ratio of 1:1.

The preparation thus made was compared for the intensity of colour with that of marketed products, which contains PPD in their formulation. The dark brown colour which was obtained with henna, indigo 1:1 after 3 applications was comparable with the marketed product as shown in Fig. 8. The penetration efficacy of hair colour into the cortex was studied microscopically. There was not much difference between henna and indigo and the marketed product which can be seen in Fig. 8. The intensity of colour penetration was also studied after subjecting to 6 shampooing. There is no difference between marketed product and

henna, indigo combination as seen in Fig. 8.

Henna and indigo paste was subjected to predictive test and preliminary sensitivity test. These tests were carried out initially on the albino rabbits. No irritation or hypersensitivity reactions were observed. The preliminary sensitivity test, performed on human volunteers also shown no sign of irritation or hypersensitivity.

### Conclusion

It can be concluded from the investigation that by changing the proportion of henna and indigo a suitable brown colour could be obtained for hair. A pH of 7 was best for penetration of hair colorant. Repeated application of the henna and indigo product gives an increase in the colour intensity. Addition of ferric chloride enhance the colour retaining property. It was observed that when indigo leaves are subjected to ageing give more colour intensity. No influence of ageing was observed in colour intensity with henna powder.

Advantage of this natural hair colorant is that it does not cause any irritation. Staining of nails or fingers is not seen while preparing the hair colorant formulation or paste which is the main problem with marketed products. At the same time the colour does not stick to the clothes which come into contact with the product. Hence it is a suitable natural hair colorant and can be recommended for further studies and use.

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