Research Article

Evaluation and Stability Study of Hair Colourants – A Comparison

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ABSTRACT

Hair colorants are products acts to lighten the hairs natural pigment to form a new base and then to add a new permanent color to the hair. The study includes the comparison of different evaluation and stability tests of seven different marketed hair colorant formulations. Organoleptic, physicochemical, phytochemical, rheological and stability evaluations were done on the selected formulations.

Keywords: Hair Colorants, Natural and Synthetic Hair Colorant, Evaluation Test, Stability Studies.

INTRODUCTION

Aim: To evaluate and to carry out stability studies of hair colorants as a comparison.

Hair dyes are colorants which are used for enhancing the appearance, confidence of a person. Hair dyes are normally used for mask the grey color of the hair, but now a day it is used as a trendin youth.[8]

Natural Hair Colorants

Traditional hair dyes often contain harsh chemicals like ammonia and peroxide, whichcan be harsh on hair and scalp. Natural hair dye, in essence, derive their color from plant-based ingredients rather than synthetic chemicals. The appeal lies in the promise of a less chemicallyintensive and more environmentally friendly hair color experience and also provides additional benefits to the hair.

1. Henna: Helps in adjusting the scalp pH, thus preventing premature graying of hair and alsohas antifungal activity
2. Amla: Helps in maintaining hair color and promote hair pigmentation.
3. Tea: Enhances hair color, support hair growth and promote shiny hair.
4. Coffee: Helps to restore growth, Soft and shiny hair, detoxifies your scalp, used for color and darken the shade of hair.
5. Hibiscus: Promote thicker hair growth, as they are rich in antioxidants, vitamins andmelanin, they help in keeping your hair look naturally black and prevent whitening.
6. Bhringraj: Promote hair growth and color hair naturally.[2,7,9]

Synthetic Hair Colorants

Synthetic hair dyes are typically more vibrant and long lasting, but they can be more damaging tothe hair and scalp and may contain harsh chemicals that can irritate the skin and cause allergic reactions. The best type of hair dye depends on individual needs and preferences. There are different ingredients used in preparation of hair colorants, they are;

1. Ammonia: It maintains in keeping the hair dye alkaline, which helps to open the hair cuticle, allowing the color to penetrate and deposit in
2. Hydrogen Peroxide: it helps in develop of color by oxidizing and it helps fix the color onto hair shaft and lightens the hair breaking down the pigment,
3. Paraphenylenediamine: It serves as the main colorant in hair dye, playing a crucial role in applying color to the hair shaft. It activates hydrogen peroxide, which facilitates color development and aids the colorant in penetrating the hair shaft.[12]

They are of different types:

- Permanent Hair Dye
- Demi permanent Hair Dye
- Semipermanent Hair Dye
- Temporary Hair Dye[3]

METHODOLOGY

Selected randomly seven different marketed hair colorants/dyes (C1, C2, C3, C4, C5, C6) & C7 which included cream, shampoo and powder formulations.

Evaluation

1. **Organoleptic Evaluation**: All the preparations were evaluated for color, odor and texture.[4,9]
2. **Physicochemical Evaluation**: The physical and chemical features of the hair dyes wereevaluated by determining the pH, moisture content and ash value.[6]
   a) **Ash Value**: Added 2gm of the sample into previously tared crucible. Then weight of the crucible with sample was taken. Ash sample at a temperature of

300°C for 1 hour. Cool in desiccator and weighed within one hour after reaching room temperature. Recorded the weight and calculated ash value.

$$\text{Ash value} = \frac{[(\text{Ashed weight}) - (\text{Crucible weight})]}{[(\text{Crucible and sample weight}) - (\text{Crucible weight})]} \times 100$$

b) **Moisture Content**: Noted the initial weight of the sample before drying. Using hot air oven set parameters (time, temperature etc.) and dry. Weigh after drying and calculate loss of drying (LOD).

% Moisture = (Loss in moisture (g) / Initial weight of the sample) x 100

c) **pH Determination:** Determined the pH of each sample using pH paper.[6,10]

3. **Phytochemical Evaluation**: Prepared dye was subjected to phytochemical screening to reveal the presence or absence of various phytoconstituents as carbohydrates, lipids, alkaloids, sugars, etc. the formulation when dissolved individually in 5ml of water and filtered; the filtrates were used to test the presence of carbohydrates. The aqueous extract of the pack was evaluated for the presence or absence of different phytoconstituents as per the standard procedures and norms

a) **Molisch's Test**: To1 gm of sample added 2 ml of distilled water followed by 2 to 3 drops of Molisch's reagent. Added Con. Sulphuric acid through the sides of the test tube and observed the ring formation.

b) **Volatile Oil Test**: To 1 gm of sample add 2ml of alcoholic solution of Sudan III & observe the color.

c) **Mayer's Test**: To1 gm of sample add 2ml of Mayer's reagent and observe the color. [5,9]

4. **Rheological Evaluation for Powder Formulations:**

a) **Bulk Density**: Weighed accurately 5g of powdered dye and transferred in 100ml measuringcylinder. Carefully level the powder blend without applying pressure and noted the volumeoccupied as bulk volume.

Bulk density= Bulk density / Bulk volume

b) **Tapped Density**: Weigh accurately 5gm of powder dye and transfer in 100ml measuring cylinder. Then tapped the raising the cylinder and permitting it to drop under its own weight from a height of 1inch at a speed of 2 seconds manually and note the volume after tapping.

Tapped density = Mass of the powder / Tapped volume

Carr's Index = [(Tapped density - Bulk density) / Tapped density] ×100[5,6,9]

5. **Irritation test:** Spotted a small quantity of hair color behind the ear lobe and internal elbow and allow it to dry. The indication of disturbance or feeling of non-health is noted. Irritancy redness and enlarging were checked and noticed for standard stretch as long as 24 hours.[9]

6. **Viscosity**: The viscosity was measured using a Brookfield rotating spindle viscometer.[7]

7. **Hair Strand Testing:** At first shampooed the hair to get rid of any leftover products, gave it a good rinse and then towel dried it. Picked a section of hair that's about an inch wide and applied hair colorant. Allowed the color to develop. Rinsed the color out of that strand until the water runs clear. Finally, blow dried it to see how it turned out.[11]

8. **Stability Studies**: The samples stability under accelerated settings was carried out using the heating and cooling methods at a temperature of 45°C and -4°C for 24 hours. All the evaluations were repeated.[9]

RESULTS AND DISCUSSION

1. **Organoleptic Character**: Color and odor were same as specified in their respective packaging. The formulations C1 to C5were found to be semisolid were as C6 and C7 were found to be powder form. All formulations have a smooth texture. All the seven were homogeneous without any lumps and were uniformly colored. The colorants C1 to C5 were consistent while application and were easy to apply. The formulations C6 and C7 were mixed with water into a smooth paste consistency before applicationand they were also found to be consistent while application.

2. **Physicochemical Evaluation:**

a) Ash Value: Ash value of the colorants was found to be in the range of 1% - 47%. The colorant C6 were found to be have the highest ash value and C2 were found to be having least ash value.

b) **Moisture Content:** Moisture content of the colorants was found to be in the range of 10% - 99%. Colorant C4 were found to be have the highest moisture content and the colorant C6 were found to be having least moisture content. This large difference may be due to the physical nature of the formulations, C1 to C5 where semi liquid in consistency were C6 and C7 was powder which was converted to smooth paste for ease of application.

c) **pH Determination:** General pH range of hair colorant is given as 7 to 8 and our results were found to be within the limit. The colorants C4 were found to have the highest pH value.

3. **Phytochemical Evaluation**: All the seven formulations answered the phytochemical test showing the presence of carbohydrates, alkaloids and volatile oil.

4. **Rheological Evaluation for Powder Formulations:** Both the powderformulations have good flow property.

5. **Irritancy Test**: None of the formulations produced any redness, itching, or irritation while the application or during the 24 hours of application.

6. **Viscosity**: Viscosities of the colorants were found to be in the range of 1131- 5849 cps.

7. **Hair Strand Testing**: After conducting a hair strand testing, it is found that the hair gets colored and completely masks the gray color of the hair within 2 hours. It improves the attractiveness of the hair. Prior to hair coloring the hair is bleached to remove the natural color of the hair and then the colorant is applied and observed for hair coloring. The semisolid formulations show the results earlier than the powdered form.
8. **Stability studies**: Stability study of all the seven brands was done at 45°C and -4°C for 24 hours. No variations are found in the odor, homogeneity, texture and pH but changes were found in color and physical state and in the viscosity. The results were reported in the table.

Table 1: Organoleptic & Physicochemical evaluation results & viscosity of hair colorants

S.NO	Brand code	Colour	Odour	pH	Moisture content	Ash value	Viscosity (cps)
1	C1	MarshGreen	Fruity	7	86%	4%	1131
2	C2	Nori Seaweed Green	Aloe Vera	7	85%	1%	3599
3	C3	Light Yellow	Fruity	7	85%	2%	5849
4	C4	Ash Brown	Characteristic	8	99%	5%	2359
5	C5	Rusty Brown	Fruity	7	97%	4%	2027
6	C6	Darker Reddish	Henna	7	10%	47%	4919
7	C7	OliveGreen	Henna &Indigo	7	15%	45%	1686

Table 2: Rheological Evaluation for Powder Formulations

S.NO	Brand Code	Angle of repose (⁰)	Bulk Density (g/cc)	Carr's Index (%)
1	C6	20.927	0.5	20%
2	C7	22.56	0.5	29.97%

Table 3: Color and viscosity after stability test at temperature 45°C and -4°C

S.NO	Brand code	Colour	Viscosity (cps)	
			At 45°C	At -4°C
1	C1	Black	756	1188
2	C2	Dark Brown	1380	3095
3	C3	Black	3401	5249
4	C4	Black	612	3491
5	C5	Black	5691	276

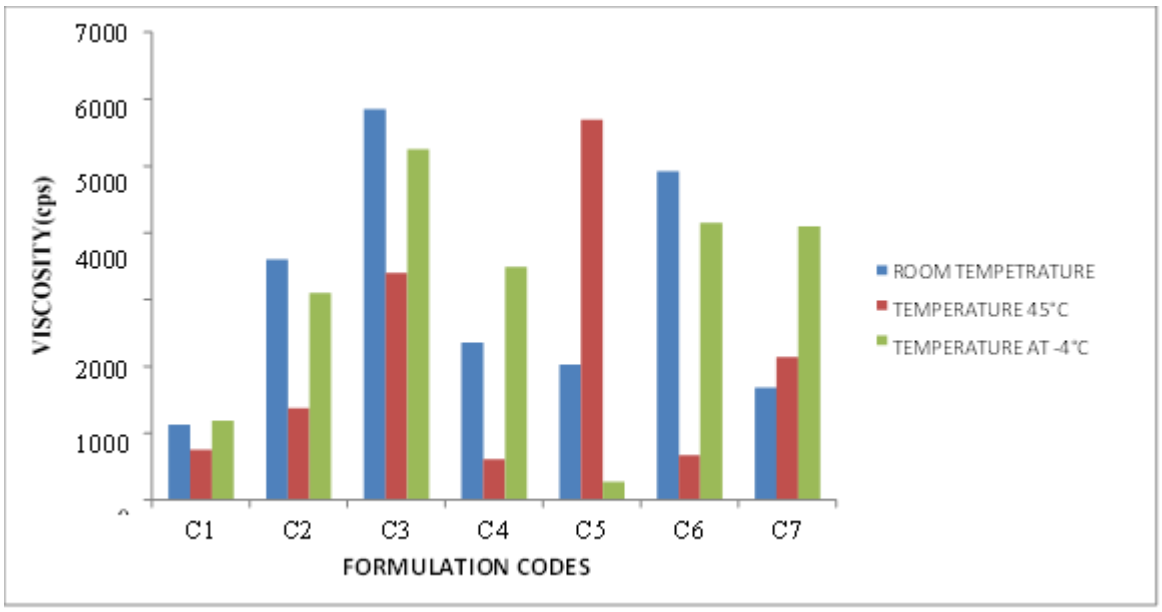

Figure 1: Graph representing Viscosity before and after stability study

Viscosity values and plots were as shown above. C5 showed a significant change in viscosity after stability study and brand C4 also showed decrease in viscosity after stability study at 45°C. The variations in the viscosity may be due to thechange in physical state during the stability study. The color and physical state have changed during organoleptic evaluation after the stability studies. But there is no change in color developed and time of coloring during the hair

strand testing but the ease of application has changed after the stability studies due to the change in physical state.

CONCLUSION

The hair colorants used for the evaluation are commercially available in market. Using these hair colorants various evaluations are done such as organoleptic evaluation, phytochemical evaluation, rheological evaluation, patch test, viscosity, hair strand test, stability testing. During the organoleptic evaluation the hair colorant show variation in the color and physical state afterthe stability test. The color and odor of all hair colorants were characteristic and same as that mentioned in their packaging. All seven brands were homogenous in visual appearance and moreor less smooth in texture. The physical state varied from powder to semisolid from C1 to C7. ThepH results were found to be within the limit and all of them showed a viscosity relatable to their physical state. No irritation was indicated, ease of application varied with the physical state. The stability test shows variations on physical state and color which in turn affected the ease of application and consistency. The physical state and change in properties and tests related to its physical state were more significant in C6 and C7. Semisolid formulations showed greater easiness inapplication at normal condition. As a comparison semisolid hair colorants were more effective and more work should be done for maintaining consistency and physical state at accelerated stability studies. The powder formulations (C6 & C7) show highest ash value than semisolid formulation (C1 to C5). Colorant C4 were found to be have the highest moisture content and the colorant C6 were found to be having least moisture content. The rheological test value indicates good flow property for the formulations. The semisolid formulations (C1 to C5) show the results earlier than the powdered form (C6 & C7) during hair strand testing. There is no change in color developed and time of coloring during the hair strand testing but the ease of application has changed after the stability studies due to the change in physical state and the effectiveness and depth of coloring was also affected.

Conclude that, after the organoleptic evaluation the colour and appearance of the hair colorant get changed after the stability test. Similarly, viscosity has also been shown variations after the stability test. The other phytochemical evaluation, pH test etc. does not show any variation after the stability studies in this case further evaluations can be done such as toxicity, long term stability test, microbial test, sensitivity test and irritancy test.

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