



DEVELOPMENT AND EVALUATION OF ECO-FRIENDLY POLYHERBAL HAIR DYE

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Abstract

The present work is aimed to develop and evaluate Eco-friendly poly-herbal hair dye by using mixed herbal of henna, indigo, amla, jatamansi, black catechu, bhringraj, black cumin seeds, charcoal, alkanetroot and Loha Bhasma with either aloe-vera gel or tea decoction or coconut shell oil as solvent (F1-F6). Conventional methods of hair dyeing involve use of chemicals that results unpleasant side effects like skin irritation, allergy, hair breakage, loss or damage of hair, allergic reaction, asthma, hair fall, skin rashes, itchy scalp, skin discoloration, erythema, skin cancer and unwanted effect on pregnancy. This herbal hair dyes contain only herbs and no harsh additives or chemicals. By using this which avoid such side effects and also very helpful in coloring the hair, act as hairgrowth promoter, hair nourisher, conditioner, anti-dandruff agent, anti-fungal, anti-microbial, anti-inflammatory, prevent skin irritation and allergic reaction. Formulated herbal hair dye was evaluated for their organoleptic, physico-chemical, micromeritics, dyeing effect, retention capacity and stability studies. In this attempt polyherbal hair dye paste containing natural colorant (formulation F2) has shown the better dyeing efficiency which produce darkest brown colour as compared to the other formulation and also stable at any place with no side effects.

Key words: poly-herbal, hair dye, Loha Bhasma, henna, indigo.

I. Introduction

“Cosmetic” means any article intended to be rubbed, poured, sprinkled or sprayed on or introduced into or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting, attractiveness or altering the appearance and includes any article intended for use as a component of cosmetics^[1]. Historically, the absence of regulation of the manufacture and use of cosmetics, as well as the absence of scientific knowledge regarding the effects of various compounds on the human body for much of this time period, led to a number of negative adverse effects upon those who used cosmetics, including deformities, blindness and in some cases death. Many cosmetic products available at this time were still either chemically dubious or derived from natural resources commonly found in the kitchen, such as food colouring, berries and beetroot. By the middle of the 20th century, cosmetics were in widespread use by women in nearly all industrial societies around the world, with the cosmetics industry becoming a multibillion-dollar enterprise by the beginning of the 21st century^[2]. The grooming and beautifying of natural hairs by various products are not new. By compulsion profession or by the preference of the user, these cosmetic products are selected and used, example of some hair cosmetics are: Hair shampoo, hair tonic & conditioner, Hair colorant, Hair bleachers and depilatories^[3]. The global herbal hair care product market size was valued at 724.62 billion in 2019 and is expected to grow at a compound annual growth rate (CAGR) of 4.7% from 2020 to 2027. The global natural dyes market size will reach 414.54 billion by 2024, growing at a CAGR of 11% during 2019-2024^[3]. Synthetic Dye Market size was estimated to be 522.32 billion in 2022 and is forecasted to grow to 721.30 billion by 2027, at a CAGR of 6.5%, during the forecast period, according to a new report by Markets and MarketsTM^[4]. This statistics and drawback of chemical hair dyes indicates that there should be more research done under herbal hair colorant.

Hair coloring is the practice of changing the hair colour^[5]. Natural and synthetic hair dyes are classified based on source of origin. 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^[6]. 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^{[7],[8]}. So the need of herbal based natural hair dyes is increasing fastly due to their natural goodness and lack of side effects. Natural dyes are the colours derived from plant, animal or insect matter without any chemical processing. Natural dyes can also act as mordants because they contain tannins. Natural hair colorants that are currently marketed mainly contain henna along with plant components that need to be used in the paste form. Herbal hair colour used in various disorders such as dandruff, premature greying and head lice etc. Natural hair dyes solve the problem of the destruction of the scalp and hair cuticle, which are safe for use^[9]. Natural colours include many pigments such as carotene (golden), lutein (yellow), anthocyanins (red) and etc^[10]. Because of the manufacturing hazards, environmental pollution, its side and toxic effects there is a vital need for an alternative to the existing synthetic dye, natural herbal dye can only be overcome by nontoxic ingredients derived from herbal resources. So in the present study aimed to develop eco-friendly polyherbal hair dye by suitable blend of herbals such as Henna, Indigo, Amla, Jatamansi, Black catechu, Bhringraj, Black cumin seeds, Alkanet root, Loha bhasma, charcoal Tea leaf powder, coconut shell oil and Aloe vera, which also acts as a hair growth promoter, hair nourisher, anti-dandruff, conditioner, prevent from damage of hair, skin irritation & reduced staining of skin.

II. MATERIALS USED

Herbal powders of Henna, Indigo, Amla, Jatamansi, Black catechu, Bhringraj, Black cumin seeds, Charcoal, Alkanetroot, Charcoal, Tea leaf and Loha Bhasma were purchased from the local market of Shree Ramajayam stores, Bhavani. Aloe vera gel was collected from the home garden of Thevur, salem. Coconut shell oil was purchased from Kaviraj Pharmaceutical Pvt. Ltd. Erode.

III. METHODOLOGY

1. Evaluation of Herbal Ingredients

Organoleptic Evaluation was performed to find out the colour, odour, texture and appearance of the herbal ingredients. The phytochemical analysis was done from the aqueous extraction of herbal ingredients. Physico- Chemical Evaluation of the herbal ingredients was evaluated to determine the pH and its moisture content^[11].

2. FORMULATION OF HERBAL HAIR DYE (F1-F6)

All Herbal powders, according to the formulation table no: 1, all powder ingredients were weighed & mixed well. Then made by paste by using suitable solvent either tea decoction or Aloe vera gel or Coconut shell oil.

3. EVALUATION OF HERBAL HAIR DYE

The formulated herbal hair dye was evaluated for their organoleptic studies, phytochemical estimation, physico- chemical parameters, dyeing effect, retention capacity and Stability testing were performed.

Organoleptic evaluation

The colour, odour, texture & appearance of the herbal hair dye formulation F1-F6 were performed^[12] and reported in the Table No.2.

Phytochemical evaluation of herbal ingredients and dye

The phytochemical estimation of aqueous extract of herbal hair dye analyzed for the presence of secondary metabolites such as alkaloids, saponins, glycosides, carbohydrates, flavonoids, tannins, coumarins, anthraquinones, terpenoids, and the results were reported in the Table No.3. For that aqueous extract was prepared by cold maceration method. 5g of each herbal powders and mixed polyherbal dye formulations F1-F6 were separately soaked in sterile containers, containing 50ml distilled water. They were kept at a Room temperature for a period of at least 3 days with frequent agitation until the soluble matters are dissolved. The aqueous extraction were filtered successively & stored in refrigerator for further use^[12].

Physico – chemical evaluation

The physical and chemical features of the herbal hair dye were evaluated to determine the pH by using pH meter and its moisture content were observed and calculated by following formula.^[12]

$$\text{Percentage loss on drying} = \frac{\text{Initial weight} - \text{Final weight} \times 100}{\text{Initial weight}}$$

Micromeritics evaluation:

Physical parameters like untapped or bulk density, tapped density, the angle of repose, Hausner's ratio and Carr's index were observed for hair dye powder mixer and calculated from the below mentioned formulae^[12] The results were reported in the Table No.5,

Bulk density = Mass of powder /Bulk volume occupied by powder

Tapped density = Mass of powder /Tapped volume occupied by powder

Angle of Repose: $\theta = \tan^{-1} (h/r)$

%Carr's index = (Tapped density – Bulk density) / tapped density*100

Hausner's ratio = Tapped density / Bulk density

Study on Dyeing Effect:

Hair colour was graded as 1 to 10 by comparing with experimental colour grade scale. The physical appearance of hair like smoothness, volume, shine and softness were observed with naked eye. Colouring Effect was checked by apply the prepared hair dye paste formulations to the human white hair samples, then kept at room temperature for 1hr. Then washed with water and observed for its coloring effect^[13].

Retention capacity:

The retention capacity of herbal hair dyes were determined in terms of shampoo wash that a colour can withstand on white hair upto seven wash^[14].

Stability Test:

Stability testing for the prepared formulations were performed by storing at different temperature condition for the time of period of one month. The packed glass vials of formulation were stored at different temperature condition viz., room temperature and 35°C and were evaluated for the physical parameter like colour, odour, pH, texture and smoothness^[12].

RESULTS

Table No.1: Formulation of Herbal Hair Dye

S. No	Ingredients	Working Formula for 100 gm					
		F1	F2	F3	F4	F5	F6
1	Henna	15	15	15	15	15	15
2	Indigo	45	45	45	45	45	45
3	Amla	3	3	3	3	3	3
4	Jatamansi	7	7	7	7	7	7
5	Black Catechu	7	7	7	7	7	7
6	Bhringraj	3	3	3	3	3	3
7	Black Cumin seeds	7	7	7	7	7	7
8	Charcoal	10	7	10	7	10	7
9	Alkanet Root	3	3	3	3	3	3
10	Loha Bhasma	-	3	-	3	-	3
11	Tea Decoction	q.s	-	-	qs	-	-
12	Aloe Vera gel	-	q.s	-	-	q.s	-
13	Coconut Shell Oil	-	-	q.s	-	-	q.s

Table No.2: Organoleptic Evaluation of Herbal Ingredients

S.No	Herbal Ingredients	Colour	Odour	Texture	Appearance
1.	Henna	Green	Characteristic	Fine	Powder
2.	Indigo	Green	Characteristic	Fine	Powder
3.	Amla	Brown	Odourless	Fine	Powder
4.	Jatamansi	Brown	Aromatic	Fine	Powder
5.	Black catechu	Brown	Characteristic	Fine	Powder
6.	Bhringraj	Green	Aromatic	Fine	Powder
7.	Black cumin seeds	Black	Pungent	Fine	Powder
8.	Charcoal	Black	Aromatic	Fine	Powder
9.	Alkanet root	Brown	Characteristic	Fine	Powder
10.	Loha bhasma	Brown	Characteristic	Fine	Powder
11.	Tea	Brown	Earthy	Coarse	Powder
12.	Aloe vera gel	Green	Aromatic	Gel	Gel
13.	Coconut shell oil	Brown	Aromatic	Non greasy	Liquid

Table No.3: Phytochemical Evaluation of Herbal Ingredients

S.No	Phytoconstitution	Henna	Indigo	Amla	Jatamansi	Black catechu	Bhringraj	Black cumin seed	charcoal	Alkanet root
1	Alkaloids	-	-	-	+	-	-	+	+	+
2	Glycosides	-	-	+	-	-	-	+	+	+
3	Tannins	+	+	+	+	+	+	+	+	+
4	Anthraquinones	+	+	+	-	+	+	+	-	+
5	Carbohydrates	+	+	+	+	+	+	+	+	-
6	Terpenoids	+	+	+	+	+	+	+	+	+
7	Coumarin	+	+	+	+	+	+	+	+	-
8	Flavonoids	+	+	+	-	-	+	+	-	+
9	Saponins	-	-	+	-	-	+	+	-	+

Table No.4: Physico - chemical Evaluation of Herbal Ingredients

S.No	Herbal Ingredients	pH	L.O.D
1.	Henna	7.2	1.2%
2.	Indigo	6.2	1.6%
3.	Amla	4.2	1.4%
4.	Jatamansi	6.5	1.6%
5.	Black catechu	6.2	1.4%
6.	Bhringraj	6.3	1.2%
7.	Black cumin seeds	6.7	1.5%
8.	Charcoal	6.7	1.2%
9.	Alkanet root	6.4	1.0%
10.	Loho bhasma	6.7	1.2%
11.	Tea decoction	6.4	1.4%
12.	Aloe vera gel	6.5	-
13.	Coconut shell oil	4.6	-

Table No.5: Micromeritics Evaluation of Herbal Hair Dye

S. No	Parameters	F1	F2	F3	F4	F5	F6
1.	Bulk density (gm/ml)	0.32 ±0.004	0.33 ±0.01	0.31 ±0.004	0.34 ±0.01	0.32 ±0.004	0.33 ±0.01
2.	Tapped density (gm/ml)	0.45 ±0.01	0.51 ±0.009	0.46 ±0.01	0.54 ±0.009	0.45 ±0.01	0.54 ±0.009
3.	Angle of repose	56 °.52' ±0.81	56°.59'±0.16	56 °.53' ±0.81	56 °.60' ±0.16	56 °.52' ±0.81	56 °.59' ±0.16
4.	Carr's index	27.28 ±2.88	35.25±2.39	27.29 ±2.88	35.23 ±2.39	27.26±2.88	35.24±2.39
5.	Hausner's ratio	1.37 ±0.05	1.55 ±0.05	1.36 ±0.05	1.57 ±0.05	1.37 ±0.05	1.55 ±0.05



Fig.No.1: Paste form of Herbal Hair dye F1-F6



Fig.No.2: Colour Grade Scale



Fig.No.4: Dyeing effect of Formulation F1-F6 after 1 hour



Fig.No.5: Retention capacity after 7th Wash

IV.DISCUSSION

Usage of herbs for hair cosmetic was found from ancient history that Egyptians, Greek and Roman. They were using dye several thousand years ago. The need of herbal based natural medicine is increasing fastly due to their natural goodness and lack of side effects. In the present study eco-friendly polyherbal hair dyes paste were prepared according to table no:1 shown in figure no:1, which was black in colour, smooth texture with characteristic odour.. Here Henna acting as the base powder, acts as the universal hair dye as it used for itscolouring properties throughout the globe. It is also beneficial in the removal of excess oil from the scalp and conditions the hair well^[12]. Indigo will make hair shiny and strong, stimulates new hair growth and color your grey^[15]. The sufficient amount of vitamin C in Amla helps to halt pre-mature greying. It is a great hair conditioner and also remover of dandruff^[16]. The jatamansi is helpful in the growth of hair. It is beneficial for smooth, silky and healthy hair too. Black catechu is used in hair to promote hair growth, reduce dandruff and add shine^[12]. Bhringraj aidsin improving the circulation of blood flow at the root of the hair by providing more nutrients to support hair growth. Black cumin seeds used for premature greying. It brings shine to tresses and nourishes the hair follicles^[16]. Charcoal is used in cleansing agent and prevent hair loss^[17]. Alkanet root prevents hair loss, promotes hair growth and arrests premature greying of hair. Loha bhasma imparts the dyeing effects and also gives strength to hair^[18]. Tea imparts perfect colour to the hair in combination with other herbs. It is good for the growth of hair and fights against dandruff^[16]. Aloe vera treats dandruff, itchy scalp and stimulates hair growth^[19]. Coconut shell oil gives your hair a smooth and lustrous texture and also repairs the damaged hair^[20].

The phytochemical screening, organoleptic studies and physico- chemical parameter of herbal ingredients were done and reported in Table No.2,3,4 which was found to be pure within the acceptable criteria^[11]. The above same evaluations were done for poly herbal dye powder and paste were reported. Organoleptic evaluation findings revealed that the dye paste is smooth and characteristic smelling. Physicochemical parameters reflected that the moisture content was as minimal as 1.2%. pH was found neutral to suit the requirements of different scalp types. It shown the presence of major phytoconstituents, which acts as true nourisher for the scalp as well as hair. The micromeritics of the herbal hair dye powders were studies such as bulk density, tapped density, the angle of repose, Hausner's ratio and Carr's index were observed in the table (Table.No.6). By comparing the colour grade scale in figure 2, the dyeing effect of herbal hair (fig.3) dye was found that, F-1 (medium brown color), F-2 (darkest brown color), F-3 (lightest blonde color), F-4 (dark brown color), F-5 (lightest brown color), F6 (lightest blonde color). For F2, the dark brown color remained for after 7 days washed with mild shampoo, the order of coloring in human hair by herbal formulations was-F- 2 >F-4 >F-1 >F-5 >F-6 >F-3. The retention capacity for the herbal hair dyes were shown in Fig.No.4. From the result, it was found that F2 herbal hair dye was the best formulation than others and had remained for the longest duration of period up to 7 days. This was maximum due to the presence of all herbal powders along with Loha Bhasma by using aloe vera gel as solvent. From the stability studies the formulated formulation was found to be stable. There was no change in colour, odour, texture and pH. The chances of its degradation are almost close to the minimal.

IV. CONCLUSION

Finally it was concluded that F2 was found to be best because it produced maximum coloring effect and the color remained for the long duration of period as compared to other formulations because this formulation contain high amount of tannins with iron containing loha bhasma forming a coordination complex with the dye. Along with iron tannins create affinity quickly and easily between dyes and hair. Thus improve color and fastness of dye. Thus, the formulated polyherbalhair dye is effective, good in colouring effect, free from any obnoxious odour, totally biodegradable and very simple to use which was highly economical one, stable, safe, consumer and eco- friendly.

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