Formulation and Evaluation of Herbal Hair Dye

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Abstract: Herbal products are being preferred due to the advantages in contrast to the synthetic one which has adverse effects on human health because of chemicals. Herbal based hair dyes are being preferred on large scale, due to vast number of advantages it exerts to overcome the ill effects of a chemical-based hair dye. The word "Herbal" is a symbol of safety. Loss of colour in hair is because of shifted reasons like hereditary impact, impact of ecological variables, utilization of alcoholic arrangements, and so forth. Hair dyes encompass dyes modifiers, antioxidants, alkalizers, ammonia, wetting sellers, fragrance, and a ramification of different chemical substances used in small amounts that impart unique qualities to hair along with softening the texture or supply a desired movement to the dye. The ratio of melanin, eumelanin and pheomelanin that determines our natural hair shade. Thus, our current research was aimed to prepare the herbal hair dye using the herbal extract from the diverse powders of herbals such as, Ratanjot, Kapoor kachri, Arapu powder, Chia seeds, Fenugreek powder, Amla, Henna. They have good anti-bacterial, anti-oxidant properties. The prepared herbal hair dye was evaluated by various parameters such as organoleptic evaluation, physico-chemical evaluation, dying effect, patch test was observed.

Keywords: Herbal hair dye, Kapoor kachri, Arapu powder, Ratanjot, eumelanin, antioxidant properties.

I. INTRODUCTION:

Hair coloring, or hair dyeing, is the exercise of converting the hair colour. The primary reasons for this are cosmetic: to cover grey or white hair, to trade to a color regarded as extra elegant or ideal, or to repair the original hair colour after it's been discolored with the aid of hairdressing procedures or solar bleaching. This gives a look of thicker, voluminous hair. In this situation it's miles continually an awesome concept to head for semi-everlasting hair color, it provides strength in your hair and makes them look healthier.

In the current scenario, the world is shifting more towards natural resources for beautification and medicinal purposes. The chemical-based synthetic and semisynthetic hair dyes, herbal hair dyes are the best option. People nowadays are very conscious of their beautiful lifestyles, and hair plays a vital role in these lifestyles. Herbal resources that are free of side effects are frequently used to promote healthy hair. Almost 70% of people over the age of 50 face the problem of balding and graying hair. To maintain their personality, people keep on coloring their hair to prevent graying of hair. To fulfill this need, people use chemical-based hair dyes that are synthetic and semisynthetic. The use of chemical-based hair dyes regularly causes hair damage. It sometimes also causes skin infections, irritation, and other skin-related problems. A need was felt to form an item containing just plant items which is safe for use and does not have the issues of staining skin during use and easily affected responses.

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 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. Use of chemicals like aluminum sulphate, copper sulphate, lead acetate and potassium dichromate in hair dye 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 using natural or synthetic colorants has limitations, an attempt has been made in this study to formulate a hair dye using herbal extracts and other additives from plant source having good coloring property that is safe and ready to use.

1.1. Herbal hair dye:

Herbal hair dye offers a natural alternative to traditional chemical-based dyes, relying on plant-derived ingredients like henna, indigo, and amla. Unlike their chemical counterparts, herbal dyes are renowned for their gentle formulation, free from harsh chemicals like ammonia and peroxide. This gentleness extends to the scalp and hair, as herbal dyes retain the hair's natural oils, promoting healthier locks. One of the key attractions of herbal hair dye is its versatility in

producing a spectrum of shades, from vibrant reds to deep browns and blacks, depending on the specific botanicals used. Beyond color, these dyes often boast conditioning properties, particularly henna, which can leave hair feeling soft, nourished, and fortified against breakage.

While herbal dyes may not deliver the same immediate color intensity or longevity as their chemical counterparts, they offer a gradual fade that lends a more natural transition between colors. Moreover, users can personalize their color by adjusting ingredient proportions or combining herbal extracts, offering a bespoke approach to hair coloring. However, achieving lighter shades or drastic color changes may require multiple applications or additional techniques. In essence, herbal hair dye provides a gentle, customizable, and natural approach to coloring hair, appealing to those seeking to minimize chemical exposure while enjoying the benefits of botanical-based hair care.

1.2. Types of hair dye:

A. Temporary

- The colorants which are used would not penetrate the hair or surrounding.
- Herbal hair dye can be easily rinsed off with just one shampooing.
- Temporary hair colouring some time used to use finely floor metals via a Puffer Spray.
- In rinse aqueous or hydro alcoholic solution of simple dye stuffs are used.

B. Semi-permanent

- Semi-permanent dye includes particularly either Nitrophenylene diamines or Nitroaminophenes or both Aminoantrhaquinoes.
- Overall performance of colorants may be enhanced by the inclusion of solvent.
- Most of them are primary dye stuffs, whose cationic person offers them a natural affinity for the hair.

C. Permanent

- Maximum popular hair dye merchandise.
- The dyes are shaped throughout the dyeing technique and aren't present, as such in the solution before application.
- Permanent dye systems are capable of dye hair a lighter colour than the original.
- Includes elements like dye intermediate and oxidizing agent.

1.3. Benefits of herbal hair dye:

- Herbal hair dyes use natural ingredients derived from plants, minimizing exposure to harsh chemicals often found in traditional dyes.
- It can help nourish the hair and scalp with vitamins and minerals, promoting overall hair health.
- They may be gentler on sensitive skin, reducing the risk of irritation or allergic reactions.
- Herbal hair dyes tend to fade gradually, resulting in less noticeable regrowth lines compared to synthetic dyes.
- Some herbal ingredients, like henna, can add strength and thickness to the hair shaft, reducing breakage and split ends.
- Herbal dyes can be a preferred option for individuals seeking a more holistic approach to hair care, aligning with natural living principles.

1.4. Advantages of herbal hair dye:

- Gentler on the scalp, less irritation.
- Contains conditioning agents for soft, shiny hair.
- Eco-friendly and biodegradable.
- Some types strengthen hair and promotes its health.
- Causes less damage compared to chemical dyes.

1.5. Disadvantages of herbal hair dye:

- Longer wait times.
- Results can be unpredictable.
- Color fades faster.
- Can be more expensive.
- Fewer color options.

1.6. Uses of herbal hair dye:

- Conditioning hair.
- Promoting scalp health.
- Covering grey hair.
- Adding shine to hair.
- Customizing hair shades.
- Reducing scalp irritation compared to chemical dyes.

II. MATERIALS

2.1. Henna

Fig 1: Henna

Biological source: It is obtained from the leaves of the plant Lawsonia inermis. These leaves contain a natural pigment called lawsone, which is responsible for the characteristic reddish-brown color imparted by henna.

Family: Lythraceae.

Active constituents: Primary active constituent is lawsone and it also contains tannins, flavonoids, polysaccharides.

Uses: Natural colorant.

Acts as Hair conditioner.

Promotes hair growth.

Contains antioxidant property.

2.2. Ratanjot

Fig 2: Ratanjot

Biological source: Ratanjot, also known as alkanna tinctoria, derives from the roots of the Alkanna tinctoria plant. This plant, commonly referred to as dyer's alkanet.

Family: Boraginaceae.

Active constituents: Alkannin, shikonin are the primary active constituents and it also contain terpenoids, flavonoids, tannins.

Uses: Used as traditional medicine.

Culinary uses.

Used in cosmetics.

2.3. Kapoor kachri

Fig 3: Kapoor kachri

Biological source: It is the rhizomes of Hedychium spicatum. This plant is commonly known as spiked ginger lily or perfume ginger.

Family: Zingiberaceae.

Active constituents: Essential oils (Eucalyptol, Camphor, Linalool), Flavonoids, Phenolic compounds (Gallic acid, ferulic acid) and terpenoids.

Uses: Improves scalp health.

Strengthens hair.

Acts as conditioning agent.

Gives natural shine.

2.4. Chia seeds

Fig 4: Chia seeds

Biological source: Chia seeds are the edible seeds of flowering plant Salvia hispanica and it is an annual herbaceous plant.
Family: Lamiaceae.
Active constituents: Omega-3 fatty acids, Dietary fiber, Proteins and antioxidants.
Uses: Helps in moisture retention.
Acts as natural texture enhancer.
Strengthens hair.
Nourishes the scalp.

2.5. Fenugreek powder

Fig 5: Fenugreek powder

Biological source: It is an annual herbaceous plant with trifoliate leaves, comes from the seeds of Trigonella foenum-graecum plant.
Family: Fabaceae.
Active constituents: Saponin (diosgenin, yamogenin, gitogenin), Galactomannan gum, Flavonoids, Alkaloids.
Uses: Controls dandruff.
Natural shine enhancer.
Color enhancer.
Acts as hair conditioner.

2.6. Amla

Fig 6: Amla

Biological source: It has feather, pinnate leaves with greenish yellow flowers, obtained from the tree Phyllanthus emblica L., also known as Emblica officinalis Gaertn.
Family: Phyllanthaceae.
Active constituents: Vitamin C (Ascorbic acid), Polyphenols (Gallic acid, Ellagic acid, Corilagin, Quercetin), Tannins (Emblicanin A and B), Flavonoids and Amino acids.
Uses: Promotes hair growth.
Prevents premature graying.
Adds shine and luster.
Moisturizes hair.

2.7. Arapu powder

Fig 7: Arapu powder

Biological source: It is obtained from the leaves of Albizia amara, it is a small to medium sized deciduous tree with spreading crown.

Family: Fabaceae.
Active constituents: Saponins, Flavonoids, Tannins, Phenolic compounds and Alkaloids.
Uses: Acts as natural cleanser.
Acts as conditioner.
Balances oil production.
Strengthens hair.

2.8. Flax seed powder

Fig 8: Flax seed powder

Biological source: Flax seeds consists of the strands of pericyclic fibers of the stem Linum usitatissimum Linn.
Family: Linaceae.
Active constituents: Alpha-linolenic acid which is an omega-3 fatty acid, lignans which have antioxidant properties and Vitamin E.
Uses: Acts as conditioner.
Acts as thickening agent.
Improves scalp health.

Formulation table

S.NO	INGREDIENTS (gm)	F1	F2	F3	F4	F5	F6	F7
1.	Henna (gm)	10	15	5	20	-	20	20
2.	Ratanjot (gm)	10	5	15	-	20	-	-
3.	Kapoor kachri (gm)	5	5	5	5	5	5	5
4.	Chia seeds powder (gm)	5	5	5	5	5	5	5
5.	Fenugreek powder (gm)	5	5	5	5	5	5	5
6.	Amla (gm)	5	5	5	5	5	5	5
7.	Arapu powder (gm)	5	3	7	5	5	-	10
8.	Flax seeds powder (gm)	5	7	3	5	5	10	-

III. METHODOLOGY

Ingredients were weighed according to the formulation table for 50g of herbal hair dye. Henna, Amla, Ratanjot, Kapoor kachri, flax seed powder, fenugreek powder, chia seed powder, Arapu powder was mixed in large paper. For uniform mixing it can be screened by using sieve no 120. Then scab all the powder mixture by using spatula, fill in a suitable container. Thus, herbal hair dye was prepared.

IV. EVALUATION TESTS

4.1. Organoleptic evaluation

The prepared herbal hair dye was evaluated for various parameters.

4.1.1. Color: The color of the herbal hair dye formulation was visually analyzed.

4.1.2. Odour: The odour of the hair dye was assessed by sniffing it.

4.1.3. Appearance: It was determined by visual inspection.

4.1.4. Texture: It was determined manually.

4.2. Physicochemical assessment

4.2.1. pH: The herbal hair dye was dissolved in water and the pH of the resulting solution was recorded by dipping the electrode in the solution using a digital pH meter.

4.2.2. Loss on drying: This method is commonly used for moisture content determination is the loss on drying method or LOD. The crude drugs heated at 105℃ to constant weight and calculated the total loss of weight.

4.2.3. Total ash value: The 2 gm of sample was taken in a silica crucible then ignited by gradually increasing the heat to 400oC until it appeared white indicating absence of carbon. It is then cooled in a desiccator and total ash of air-dried material is calculated.

4.2.4. Patch test: The results obtained from the animal study for swelling, redness, and irritation were negative, which means the preparation was safe, non-toxic, and free from any kind of adverse effects on skin or hairs.

4.3. Rheological evaluation

The parameters like untapped or bulk density, tapped density, the angle of repose, Hausner's ratio, and Carr's index were observed.

4.3.1. Angle of repose: Angle of repose was determined using the funnel to estimate the flow behavior of the sample and it was determined by using the formula.

$$\text{Tan } \alpha = H/R$$

Where,

α = angle of repose

H = height of the pile of powder

R = radius of the pile of powder

4.3.2. Determination of bulk density and tapped density: Bulk density and tapped density was determined by placing the cylinder containing sample (W1) in bulk density apparatus and the volume was noted as V1 (ml), then the apparatus adjusted for 100 tapping and operated. The volume occupied by the powder as V2 (ml) was recorded.

Bulk Density = Mass/Bulk volume = W1/ V1 g/ml

Tapped Density = Mass/Tapped volume = W1/ V2 g/ml

4.3.3. Hausner's ratio: Hausner's ratio is the ease of index of powder flow and calculated by using following formula:

Hausner's ratio = Tap density/Bulk density.

4.3.4. Carr's index: Per cent compressibility of blend was determined by Carr's compressibility index, which was calculated by using following formula:

Carr's index = Tap density – Bulk density × 100 Tap density

4.4. Phytochemical evaluation

Various tests were performed, to identify the phytoconstituents present in the products and their effect is shown on the body. Every plant exhibits certain phytochemical properties, which show several beneficial effects.

4.4.1. Detection of carbohydrates

4.4.1.1. Molisch's Test: To 2-3 ml aqueous extract, add few drops of alpha-naphthol solution in alcohol, shake and add conc H_2SO_4 from sides of the test tube violet ring is formed at the junction of two liquids.

4.4.1.2. Fehling's Test: Mix 1ml Fehling A and 1 ml Fehling B solutions, boil for 1min. Add equal volume of test solution. Heat in boiling water bath for 5-10 min. First yellow, then brick red ppt is observed.

4.4.2. Detection of alkaloids

4.4.2.1. Hager's test: 2-3 ml filtrate with Hager's reagent gives yellow ppt.

4.4.2.2. Mayer's test: 2-3 ml filtrate with few drops Mayer's reagent gives creamy ppt.

4.4.3. Detection of proteins

4.4.3.1. Biuret test: To 3 ml T.S. add 4% NaOH and few drops of 1% CuSO4 solution. Violet or pink color appears.

4.4.4.. Foam test

Shake the drug extract or dry powder vigorously with water. Persistent stable foam observed.

V. RESULTS

4.1. Organoleptic evaluation

Formulation code	Color	Odour	Appearance	Texture
F1	Reddish brown	Characteristic	Coarse powder	Fine
F2	Reddish brown	Characteristic	Coarse powder	Fine
F3	Reddish brown	Characteristic	Coarse powder	Fine
F4	Greenish brown	Characteristic	Coarse powder	Fine
F5	Reddish brown	Characteristic	Coarse powder	Fine
F6	Reddish brown	Characteristic	Coarse powder	Fine
F7	Greenish brown	Characteristic	Coarse powder	Fine

4.2. Physicochemical assessment

4.2.1. pH

Formulation code	pH
F1	6.5
F2	6.2
F3	6.3
F4	6.5
F5	6.4

F6	6.3
F7	6.4

4.2.2. Loss on drying

Formulation code	Loss on drying
F1	8.5%
F2	8.54%
F3	8.46%
F4	8.5%
F5	8.5%
F6	8.6%
F7	8.4%

4.2.3. Total ash value

Formulation code	Total ash value
F1	5.3%
F2	5.31%
F3	5.29%
F4	5.6%
F5	5%
F6	5.25%
F7	5.95%

4.2.4. Patch test

Formulation code	Swelling	Redness	Irritation
F1	Absent	Absent	Absent
F2	Absent	Absent	Absent
F3	Absent	Absent	Absent
F4	Absent	Absent	Absent
F5	Absent	Absent	Absent
F6	Absent	Absent	Absent
F7	Absent	Absent	Absent

4.3. Rheological evaluation

4.3.1. Angle of repose

Formulation code	Angle of repose
F1	26.5
F2	27.4
F3	26.7
F4	28.5
F5	27.5
F6	28.2
F7	25.4

4.3.2. Determination of bulk density and tapped density

Formulation code	Bulk density	Tapped density
F1	0.32	0.38
F2	0.31	0.38
F3	0.30	0.39
F4	0.31	0.36
F5	0.30	0.38
F6	0.31	0.36
F7	0.33	0.40

4.3.3. Hausner's ratio

Formulation code	Hausner's ratio
F1	1.18
F2	1.22
F3	1.30
F4	1.16
F5	1.26
F6	1.16
F7	1.21

4.4.4. Carr's index

Formulation code	Carr's index
F1	15
F2	18
F3	20
F4	13
F5	21
F6	13
F7	17

4.4. Phytochemical evaluation

4.4.1. Detection of carbohydrates

4.4.1.1. Molisch's test

Formulation code	Molisch's test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

4.4.1.2. Fehling's test

Formulation code	Fehling's test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

4.4.2. Detection of alkaloids

4.4.2.1. Hager's test

Formulation code	Hager's test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

4.4.2.2. Mayer's test

Formulation code	Mayer's test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

4.4.3. Detection of proteins

4.4.3.1. Biuret test

Formulation code	Biuret test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

4.4.4. Foam test

Formulation code	Foam test
F1	Present
F2	Present
F3	Present
F4	Present
F5	Present
F6	Present
F7	Present

VI. CONCLUSION

Based on the findings, it is possible to conclude that the herbal hair dye formulation, which is made up of naturally occurring dried herbal ingredients, can be easily prepared on a laboratory scale without the use of sophisticated equipment, making the preparation cost-effective. Because it is a natural herbal-based formulation, it is free of the negative effects of ammonia-based chemical dyes as well as adverse skin reactions. Regular use results in voluminous, smooth, and well colored hair. Natural ingredients are known for their nontoxic, non-habit-forming properties, and the pack contains no chemicals, preservatives, artificial colors, or perfumes, so the chances of it degrading are almost non-existent. The research confirms that a natural herbal hair dye can be prepared easily as well as it confirms the benefit to human hair. As this preparation does not require sophisticated instrument so it can benefit to small industries, start-up, and human being in terms of cost as well as benefit of application and it will bring a change in cosmetic industry. Prepared formulations were evaluated for physical parameters like color, odour, texture, physicochemical, rheological, and phytochemical evaluations. This study revealed that the developed herbal formulation of batch F1 was comparatively better than other formulations.

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