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Exploring the Hair Dyeing Potential of Tectona Grandis Leaves: Formulation and Characterization

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ABSTRACT

Researchers have been looking for new medications in nature since ancient times. Bark, leaves, flowers, seeds, and other plant parts can all be used to make useful items. Approximately 80% of the world's population receives their basic healthcare from traditional medicines that use plant extracts. In conventional Siddha, Ayurvedic, Unani, and homeopathic systems Medications derived from plants accounted for over 90% of prescriptions. The silver hair is dyed using various plant materials like as henna, indigo, Aloe vera, Amla, and so on to give it a normal dark colour. Tibkawin et al. reported the use of teak leaf extract (quercetin is the main colorant) as a plant hair dye for bleached human hairs. In the current examination the details are created to get normal dark variety utilizing mix of various plant materials. The main aim of the present investigation is to formulate natural and safe hair colorants.

Keywords: Hair Dye, Natural Ingredients, Teak leaf extract.

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INTRODUCTION

A dye is natural or synthetic substance used to add a color to or change the color of something. Since ancient times, researchers have been exploring nature in search of new drugs. Useful products can be derived from any part of the plant like bark, leaves, flowers, seeds etc. Plant products have been part of phytomedicine [1]. Hairs are an important part of human beauty. People are using herbs for cleaning, beautifying and hair growth since the ancient era [2]. Herbal based hair dyes are being preferred on large scale, due to the vast number of advantages it exerts to overcome the ill-effects of a chemical based hair dye. In comparison to natural hair dyes, synthetic hair dyes are reported to cause skin and other skin related diseases [3]. A dye can generally be described as a coloured substance that has an affinity to the fibre, fur or hair. The dye is generally applied as aqueous solution, and may require a mordant to improve the fastness of the dye on the fibre, fur or hair. Natural dyes also referred as mordant dyes [1] The need of herbal based natural medicines is increasing fastly due to their natural goodness and lack of side effects well – known Ayurvedic herbal drugs traditionally used as hair colorant and for hair growth are Amla, Indigo, Henna, Reetha, Methe seed [9]. Natural hair dye gives our hair a natural black colour without harming it. Even after repeated colouring, our hair remains healthy as a result of this. Because traditional hair colouring procedures based on natural or synthetic colourants have limitations, this study aimed to develop a hair dye based on crude medicines with good colouring properties that is both safe and ready to use [2]. Loss of variety in hair is because of fluctuated reasons like hereditary impact, impact of natural variables, utilization of alcoholic arrangements, and so forth. In the current examination the details are created to get normal dark variety utilizing mix of various plant materials. This examination was arranged in view of encounters of a few groups who were involving different plant items for shading their hair without having any issues of irritancy, sensitivity, or responsiveness. The main aim of the present investigation is to formulate natural and safe hair colorants [4]. Formulations for hair dyes contain dye modifiers, antioxidants, alkalizers, soaps, ammonia, wetting agents, fragrance, and a number of additional compounds used in trace amounts to give hair unique properties like smoothing the texture or giving the dye the desired effect [5].

Teak (*Tectona grandis* L.f.) has a worldwide reputation as the most valuable tropical timber and is also known as the “King of Timber”. Teak is a Lamiaceae tree native to the Indian–Burmese floristic region, with naturalized populations in India, Myanmar, the Lao People’s Democratic Republic, and Thailand, in addition to naturalized populations in Java, Indonesia [6].

Tibkawin et al. reported the use of teak leaf extract (quercetin is the main colorant) as a plant hair dye for bleached human hairs wherein the colour obtained is dependent on the harvest states of leaves (young leaf extract produces reddish brown while mature leaf extract produces brown colour). Quercetin (2-(3, 4-dihydroxyphenyl)-3,5,7-trihydroxy-4-Hchromen-4-one)) is a polyphenolic flavonoid found in teak. Quercetin is also known for its medicinal bioactivities, such as anticancer and antiviral activities. Teak also contains anthraquinones, naphtha-quinones and flavonoids and their extracts can be used as natural dye [7].

MATERIALS AND METHOD:

Material:

Sr. No	Ingredient	Use	H.H.D I	H.H.D II	H.H.D III
1	Henna	Colouring Agent	15g	10g	5g
2	Teak	Colouring Agent	5g	10g	15g
3	Bhiringraj	Hair Growth Promoter	2g	2g	2g
4	Fenugreek	Conditioning and Nourishing Hairs	2g	2g	2g
5	Guava	Antimicrobial, Maintain Scalp Health	2g	2g	2g
6	Amla	Anti-oxidant	2g	2g	2g
7	Tulsi	Hair Growth Promoter	3g	3g	3g
8	Black catechu	Hair Nourisher	5g	5g	5g
9	Loha bhasma	Darken Hairs	2g	2g	2g
10	Water	Solvent	q.s	q.s	q.s

Method:

For the preparation of herbal hair dye, we have selected different herbal ingredients such as Henna, Amala, Guava leaf, Bhringraj, Tulsi, Black catechu. Fenugreek, Loha Bhasma, Teak. Teak Leaves were collected from local street garden and authentication is done at Yashwantrao Chavan College of Science, Satara.

1. This all ingredients were collected from the authorized store Bagawan Ayurvedic, Karad in powdered form.
2. The all the ingredients was weighed and passed through Sieve no. 24.
3. Then all ingredients were mixed uniformly to prepare homogenous mixture of a powder form of dye.
4. The homogenous mixture was weighed and packed in a plastic bag [4].

Extraction of Teak Leaves:

Teak leaves were collected from the local street garden. Washed thoroughly and shed dried. After shade drying, leaf was grinded to gain fine powder.100 gm of leaf powder was macerated with 1000ml of methanol for 10 days. After maceration, the extract was kept on electric water

bath for the evaporation of the solvent. The powdered drug extract was collected and used in further formulation [6].

EVALUATION PARAMETERS:

The developed herbal hair dye formulations were examined for several parameters, including organoleptic, physicochemical, phytoconstituents, and rheological features.

Organoleptic Evaluation

Organoleptic properties were meticulously recorded for a variety of sensory attributes, such as colour, taste, odour, etc. Organoleptic and morphological characteristics, such as colour, texture, odour, and appearance, were used to independently examine the raw medications and powders [8].

Physico-chemical Evaluation

The physical and chemical features of the herbal hair dye were evaluated to determine the pH, its moisture content and its loss on drying for the purpose of stability, compatibility and the amount of inorganic matter present in it.

i. pH : The pH of formulated herbal hair dye was determined using pH meter.

ii. Moisture content: A method commonly used for moisture constant determination is the loss on drying method or LOD. The crude drugs heated at 105oC to constant weight and calculate the total loss of weight [2].

Stability Test

Stability testing of the prepared formulation was performed by storing it at different temperature conditions for the time period of one month. The packed formulation were stored at different temperature conditions, viz., room temperature and 35°C and were evaluated for the physical parameters. The prepared dye formulations were evaluated for the physical parameters like colour, odour, pH, texture, and smoothness [4].

Phytochemical Evaluation

i. Molish Test

Materials Required:

- Herbal hair dye formulations as a sample,
- Distilled water,
- α-Naphthol,
- Absolute Ethanol,
- Sulphuric Acid.

The Molisch test is a chemical method for detecting the presence of carbohydrates in a material. Test solution preparation: Take 1 g of the sample to be tested and dissolve it in a test tube

containing 2 mL distilled water test. Pretreatment or extraction procedures according to the specific sample can be performed. Molisch Reagent Preparation: Prepare the Molisch reagent by adding 1 g of α-Naphthol to 100 mL of ethanol. Mix thoroughly to ensure complete dissolution. Perform the Test: Add a few drops of the prepared test solution to a clean test tube. Carefully add 2-3 mL of the Molisch reagent to the test tube and mix gently by swirling. Add strong sulfuric acid slowly and gently down the edges of the test tube to produce a layer over the mixture. Be careful not to combine the layers. Examine the test tube to see if a violet or purple ring forms at the intersection of the two layers. The formation of a violet or purple ring indicates the presence of carbohydrates in the sample. The colour's intensity might change based on the proportion of carbohydrates.

ii. Volatile Oil Test

Material required:

- Herbal hair dye formulations as a sample,
- Sudan (III) reagent,
- Absolute ethanol,
- Distilled Water.

One popular technique for evaluating and identifying essential oils is the volatile oil test. To identify the presence of volatile oils, an alcoholic solution of Sudan III is used as a reagent. In the presence of volatile oils, Sudan III causes a distinctive colour shift or staining in the sample. Sudan III's affinity for the lipid-based components present in essential oils is the cause of this response. Important details regarding the amount and calibre of volatile oils present in the sample can be gleaned from the intensity of the resulting hue. A quick and easy qualitative evaluation method for identifying the presence of essential oils in a variety of natural goods, such as plants and herbs, is the volatile oil test.

The procedure for conducting the volatile oil test involves the-

Preparation of Sudan III Solution: Prepare a solution of Sudan III dye in ethanol or a suitable alcohol solvent at a specified concentration. Test Sample Preparation: Obtain the sample suspected to contain volatile oils, such as a plant extract, herbal material, or any substance believed to contain essential oils. Place a small portion of the test sample in a clean test tube or on a spotting plate. Add a few drops of the prepared alcoholic Sudan III solution to the sample.

Observation: Observe the sample for any changes in colour or staining effects that occur upon the addition of Sudan III solution. The presence of volatile oils typically results in the development of a distinct color, often ranging from orange-red to reddish-brown.

Interpretation: To ascertain if volatile oils are present in the sample or not, compare the staining or color seen with established standards or references

iii. Mayer's Test (For Alkaloid)

Weigh 5 g of Potassium Iodide (KI) and 1.358 g of mercuric chloride using a precise balance. Dissolve the weighted potassium iodide in 60 mL of distilled water in a clean container. To ensure the KI is well dissolved, stir the mixture. Stirring constantly, add the mercuric chloride to the KI solution. Keep stirring until all of the mercuric chloride has been dissolved. Take a tiny quantity of the finely ground sample and put it in a test tube after the solution is uniform. Using a pipette or dropper, add a few drops of Mayer's reagent to the test tube. Watch the test tube's color change. If the sample contains alkaloids, turbidity, or a creamy precipitate, will form in a matter of minutes. Examine the test tube against a control tube that has Mayer's reagent and distilled water in it. The absence of alkaloids should be indicated by the control tube being clear [8].

Rheological Evaluation

Physical characteristics such as angle of repose, bulk or untapped density, tapped density, Housner's Ratio, and Carr's index were measured and computed for the internal formulation. Bulk density (D) can be calculated using the formula D=M/V, where M is the particle's mass and V is the total volume they occupy. The graduated cylinder is used to measure this. A funnel was used to add 100 g of the weighted formulation to the cylinder. The sample was heavily tapped after the first loudness was recorded. By comparing the initial volume with the volume found following tapping, the bulk density value was determined. The tapped density was then computed using this value. Because it influences the degree of cohesiveness between the various particles, the angle of repose gauges the flow characteristics of the powder. The height (H) above the paper placed on a level surface is calculated using the fixed funnel cone method. Until the peak formed, the pack was gradually poured into the funnel. Here, tan is equal to either H/R or arc tan H/R, and an angle of repose. The conical heap's radius is denoted by R. The antiparticle friction has an impact on Housner's Ratio, which is related to the powder flow [2].

i. Bulk Density:

Weigh accurately 5gm of powdered dye and transfer in 100ml of measuring cylinder. Carefully level the powder blend without compacting, and read the unsettled apparent value.

Bulk density= Bulk mass/Bulk volume

ii. Tapped Density:

Weigh accurately 5gm of powder dye and transfer in 100ml measuring cylinder.

Then precisely tap the chamber containing the example by raising the chamber and permitting it to drop under its own weight utilizing mechanical tapped thickness analyser at ostensible pace of 300 drops each moment.

Tapped Density = Mass/Tapped volume

iii. % Carr's index= (Tapped density- Bulk density)/ tapped density*100

iv. Housner's Ratio =Tapped density/Bulk Density [4]

v. Angle of Repose: Angle of repose was determined using the funnel to estimate the flow behaviour of the sample and it was determined by using the formula;

Tan θ = H/R

Where, θ = angle of repose; H = height of the pile of powder;

R = radius of the pile of powder [2]

RESULTS AND DISCUSSION:

Organoleptic Evaluation

Prepared formulation of H.H.D I, H.H.D II and H.H.D III was evaluated for the organoleptic characteristic such as colour, odour, texture, Appearance, etc.as given in Table 1.

Table 1: Organoleptic evaluation of herbal hair dye

Sr NO.	Parameter	H.H.D I	H.H.D II	H.H.D III
1.	Colour	Green	Green	Green
2.	Odour	Characteristic	Characteristic	Characteristic
3.	Texture	Fine	Fine	Fine
4.	Appearance	Powder	Powder	Powder

Physio-chemical Evaluation

The physical and chemical features of the herbal hair dye were evaluated to determine the pH, its moisture content for the purpose of stability, compatibility and the amount of inorganic matter present in it as given in Table 2.

Table 2: Physiochemical evaluation of herbal hair dye

Sr No.	Parameter	H.H.D I	H.H.D II	H.H.D.III
1.	pH	6.9	6.8	6.8
2.	L.O.D	1.4%	1.6%	1.3%

Stability Test

Stability test was performed for approximately one month period at different temperature to observe the changes in its colour, odour, texture, appearance, pH of the prepared hair dye formulations. The formulations were found to be stable during this period. Thus, the result

conclude that the prepared formulations were could be easily stored and used at any stability conditions [4].

Table 3: Stability Testing of Herbal Hair Dye

Sr No	Parameters	Room Temp.20 °C	35 °C
1	Colour	No Change	No Change
2	Odour	No Change	No Change
3	pH	No Change	No Change
4	Texture	No Change	No Change
5	Appearance	No Change	No Change

Rheological Evaluation:

The prepared air dye formulation I, II and III was evaluated for the flow characteristics such as bulk density, Tapped Density, Angle of repose, Carr's index and Hausner's ratio as given in Table 4

Table 4: Rheological Evaluation of Herbal Hair Dye

Sr No.	Parameter	H.H.D I	H.H.D II	H.H.D III
1.	Bulk Density	0.5 g/cm^3	0.45 g/cm^3	0.58 g/cm^3
2.	Tapped Density	0.58 g/cm^3	0.5 g/cm^3	0.71 g/cm^3
3.	Angle of repose	33.69	32.00	28.39
4.	Housner's Ratio	1.16	1.11	1.22
5.	%Carr's Index	13.79%	10%	18.30%

Phyto-chemical Evaluation:

Phytochemical testing was done on the formulations of herbal hair dye in order to determine which phytoconstituents were present including volatile oil, carbohydrates, and alkaloids. Several phytoconstituents were detected in the aqueous extract of the resulting herbal hair dye using standard operating procedures and established methodologies. Table 5 highlights the phytochemical screening outcomes.

Table 5: Phytochemical Evaluation of Herbal Hair Dye.

Sr No.	Test	H.H.D I	H.H.D II	H.H.D III
1	Molish Test	Carbohydrates was present.	Carbohydrates was present.	Carbohydrates was present.
2	Volatile Oil Test	Volatile oil was present.	Volatile oil was present.	Volatile oil was present.
3	Mayer's Test	Alkaloid was present.	Alkaloids was present.	Alkaloids was present.

CONCLUSION:

It can be concluded from the investigation that by changing the proportion of Henna and Teak leaf extract a suitable reddish-brown colour could be obtain for hair. A pH of 6.9 (H.H.D-II) was best for penetration of hair colorant. Repeat application of henna and teak leaf product given increasing the colour intensity. Advantage of this natural hair dye is, it does not cause any skin

irritation, erythrema formation and edema. It is prepared from100% water soluble plant ingredients; hence it is free from any noxious odour. The raw materials used and the final product is totally biodegradable. The solvent and carrier used in the whole preparation is only distilled water. The product is stable at room temperature. This 100% natural herbal hair dye is suitable for all age groups. The composition and mode of preparation is Environment friendly**.**

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