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Formulation And Scientific Validation of Polyherbal Hair Oil Using Traditional Medicinal Plants

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ABSTRACT

The present study aimed to formulate and scientifically validate a polyherbal hair oil using selected traditional medicinal plants, including Hibiscus rosa-sinensis, Murraya koenigii, Lawsonia inermis, Indigofera tinctoria, Trigonella foenum-graecum, Azadirachta indica, Eclipta alba, and Emblica officinalis, in suitable carrier oils. The formulation process was standardized to obtain a stable and homogeneous herbal preparation with efficient extraction of bioactive constituents. The prepared hair oil was evaluated for physicochemical parameters such as pH, viscosity, specific gravity, refractive index, acid value, saponification value, peroxide value, and iodine value using standard analytical methods. Stability studies were conducted under different storage conditions to assess the quality and shelf life of the formulation. The formulated polyherbal hair oil exhibited acceptable physicochemical characteristics and remained stable throughout the study period without noticeable deterioration. These findings scientifically validate the formulation as a standardized, stable, and promising natural hair care product with potential applications in herbal cosmetic formulations.

Keywords: Polyherbal hair oil, Traditional medicinal plants, Physicochemical evaluation, Stability study, Herbal cosmetics, Standardization.

INTRODUCTION

Herbal cosmetics have gained considerable attention worldwide due to increasing consumer preference for natural, safe, and eco-friendly personal care products. The growing concern regarding the adverse effects associated with prolonged use of synthetic chemicals has encouraged the development of plant-based formulations for skin and hair care. Medicinal plants are rich in bioactive phytochemicals such as flavonoids, alkaloids,

phenolics, tannins, saponins, and terpenoids, which exhibit antioxidant, antimicrobial, anti-inflammatory, and protective activities. These phytoconstituents contribute to the therapeutic efficacy of herbal cosmetic products while minimizing the risk of adverse effects, making them attractive alternatives to synthetic formulations (Usha Kiran Reddy et al., 2017; Tiwari & Tiwari, 2021).

Hair is an important component of personal appearance and plays a significant role in social confidence and psychological well-being. Healthy hair depends on the maintenance of normal hair follicle function, adequate scalp nutrition, and protection against oxidative stress and microbial infections. However, rapid urbanization, environmental pollution, unhealthy dietary habits, psychological stress, hormonal imbalance, and excessive use of chemical-based hair care products have contributed to the increasing prevalence of hair disorders such as alopecia, dandruff, premature greying, split ends, and scalp irritation. Consequently, there is growing interest in herbal hair care products that offer effective and safer alternatives for maintaining hair and scalp health (Draelos, 2018; Usha Kiran Reddy et al., 2017).

Among herbal cosmetic preparations, polyherbal hair oils have become increasingly popular because they combine the therapeutic properties of several medicinal plants to promote healthy hair growth, strengthen hair follicles, reduce hair fall, prevent dandruff, and delay premature greying. Traditional systems of medicine, including Ayurveda, Siddha, and Unani, have long recommended herbal oils for maintaining healthy hair and treating scalp disorders. The effectiveness of these formulations is mainly attributed to the synergistic interaction of multiple phytochemicals that nourish the scalp, improve blood circulation, reduce oxidative stress, and protect against microbial infections (Tiwari & Tiwari, 2021).

Several medicinal plants have been scientifically investigated for their beneficial effects on hair health. Hibiscus rosa-sinensis is recognized for its ability to stimulate hair follicle growth, strengthen hair roots, and improve hair density owing to the presence of flavonoids, amino acids, and antioxidant compounds (Singh et al., 2020). Murraya koenigii contains proteins, vitamins, β-carotene, and essential antioxidants that help nourish hair follicles and reduce oxidative stress, thereby supporting healthy hair growth (Ravindra et al., 2020). Trigonella foenum-graecum is rich in proteins, nicotinic acid, lecithin, and mucilage, which improve hair strength, reduce dandruff, and enhance moisture retention (Prasad et al., 2018). Likewise, Azadirachta indica, Eclipta alba, Phyllanthus emblica, Lawsonia inermis, and Indigofera tinctoria possess antimicrobial, antioxidant, anti-inflammatory, and conditioning properties that contribute to scalp protection and improved hair quality (Usha Kiran Reddy et al., 2017; Tiwari & Tiwari, 2021).

Polyherbal formulations are considered more beneficial than single-herb preparations because they combine multiple medicinal plants with complementary pharmacological properties. The synergistic interaction among various phytochemicals enhances antioxidant, antimicrobial, anti-inflammatory, and nourishing activities, resulting in improved therapeutic efficacy. Such formulations not only promote healthy hair growth but also protect the scalp from microbial

infections and oxidative damage while improving hair texture, strength, and overall appearance. This synergistic approach has become an important strategy in the development of standardized herbal cosmetic formulations for long-term hair care (Tiwari & Tiwari, 2021).

Scientific quality evaluation has become an indispensable component in the development of herbal cosmetic products. Since herbal formulations are composed of complex mixtures of plant-derived bioactive compounds, their quality may vary depending on plant source, geographical location, harvesting season, processing techniques, and storage conditions. Therefore, standardization through physicochemical analysis is essential to ensure product quality, stability, safety, and batch-to-batch reproducibility. Evaluation of parameters such as colour, odour, texture, pH, viscosity, specific gravity, refractive index, acid value, saponification value, peroxide value, and iodine value provides valuable information regarding the stability and quality of herbal oils, while dermal irritation and sensitivity studies help establish product safety for topical application (Tiwari & Tiwari, 2021). Standardized physicochemical evaluation not only ensures batch-to-batch consistency but also enhances consumer confidence and supports the commercial development of herbal cosmetic products.

In the present study, a polyherbal hair oil was formulated using selected traditional medicinal plants, namely Hibiscus rosa-sinensis, Murraya koenigii, Lawsonia inermis, Indigofera tinctoria, Trigonella foenum-graecum, Azadirachta indica, Eclipta alba, and Phyllanthus emblica, with coconut and castor oils as carrier oils. The formulated oil was evaluated for its organoleptic characteristics, physicochemical properties, and dermal safety to scientifically validate its quality, stability, and suitability as a standardized natural hair care formulation with potential cosmetic applications.

OBJECTIVES

1. To formulate a polyherbal hair oil using selected traditional medicinal plants and suitable carrier oils.
2. To standardize the preparation method for obtaining a stable and homogeneous formulation.
3. To evaluate the physicochemical properties of the formulated hair oil using standard analytical methods.
4. To assess the stability and safety of the formulation under different storage conditions.
5. To scientifically validate the formulated Polyherbal hair oil as a standardized natural hair care product.

MATERIALS AND METHODS

Materials

Fresh medicinal plants used in the present study included Hibiscus rosa-sinensis L., Murraya koenigii (L.) Spreng., Lawsonia inermis L., Indigofera tinctoria L., Trigonella foenum-graecum L., Azadirachta indica A. Juss., Eclipta alba (L.) Hassk., Phyllanthus emblica L., Nigella sativa L., and Aloe vera (L.) Burm.f. Coconut oil (Cocos nucifera L.) and castor oil (Ricinus communis L.) were used as carrier oils. All plant materials were free from disease and physical damage (Table.1).

Collection and Authentication of Plant Materials

Fresh plant materials were collected from different locations in Tirunelveli District, Tamil Nadu, India. The collected specimens were washed thoroughly with running tap water to remove dust and other contaminants. Botanical identification and authentication were carried out using standard floras before use in the formulation.

Preparation of Plant Materials

The collected plant materials were shade-dried to remove surface moisture and then cut into small pieces. Approximately **20 g** of each plant material was weighed separately and ground into a coarse paste using a laboratory blender immediately before formulation.

Preparation of Polyherbal Hair Oil

The polyherbal hair oil was prepared using the heat infusion method. Briefly, 500 mL of coconut oil was heated in a stainless-steel vessel, and the ground herbal paste containing equal quantities of the selected medicinal plants was added gradually with continuous stirring. The mixture was heated gently for 10 min to facilitate extraction of the bioactive constituents into the oil. After cooling to room temperature, 10 mL of pure castor oil was added and mixed thoroughly. The prepared formulation was filtered through sterile muslin cloth to remove plant residues and stored in clean amber-coloured glass bottles at room temperature until further analysis.

Table 1. Medicinal plants used for the formulation of Polyherbal Hair Oil

S. No.	Plant species	Family	Common name	Plant part used
1	Hibiscus rosa-sinensis L.	Malvaceae	Hibiscus (Sembaruthi)	Flowers, Leaves
2	Murraya koenigii (L.) Spreng.	Rutaceae	Curry leaf (Karuveppilai)	Leaves
3	Lawsonia inermis L.	Lythraceae	Henna (Maruthani)	Leaves
4	Indigofera tinctoria L.	Fabaceae	True indigo (Avuri)	Leaves
5	Trigonella foenum-graecum L.	Fabaceae	Fenugreek (Vendhayam)	Seeds
6	Azadirachta indica A. Juss.	Meliaceae	Neem (Veppamaram)	Leaves
7	Eclipta alba (L.) Hassk.	Asteraceae	Bhringraj (Karisalankanni)	Leaves

8	Phyllanthus emblica L.	Phyllanthaceae	Indian gooseberry (Amla/Nellikai)	Fruits
9	Nigella sativa L.	Ranunculaceae	Black cumin (Kalonji)	Seeds
10	Aloe vera (L.) Burm.f.	Asphodelaceae	Aloe vera (Kattralai)	Leaf gel
11	Cocos nucifera L.	Arecaceae	Coconut	Oil
12	Ricinus communis L.	Euphorbiaceae	Castor	Oil

Evaluation of the Formulated Polyherbal Hair Oil

The formulated polyherbal hair oil was evaluated for its organoleptic characteristics, physicochemical properties, and dermal safety using standard analytical procedures (Adhirajan et al., 2001; Roy et al., 2006).

Organoleptic Evaluation

The formulation was visually examined for colour, odour, and texture. Skin irritation and sensitivity were evaluated by applying a small quantity of the oil to the dorsal surface of the hand and observing for redness, itching, burning sensation, or other adverse reactions after 5 min of sunlight exposure.

pH Determination

The pH of the formulated hair oil was measured using a calibrated digital pH meter.

Specific Gravity

Specific gravity was determined using a calibrated pycnometer at room temperature.

Viscosity

Viscosity was measured using an Ostwald viscometer according to standard laboratory procedures.

Refractive Index

The refractive index of the formulated oil was determined using an Abbe refractometer at room temperature.

Acid Value

Acid value was determined by titrating the oil sample dissolved in an ethanol–ether mixture against 0.1 M potassium hydroxide **using** phenolphthalein as the indicator. The acid value was calculated using the standard equation:

Acid value = $(5.61 \times n)/w$

where n is the volume (mL) of 0.1 M KOH consumed and w is the weight (g) of the oil sample.

Saponification Value

Approximately 2 g of the oil sample was refluxed with 0.5 M alcoholic potassium hydroxide for 30 min. The excess alkali was titrated against 0.5 M hydrochloric acid using phenolphthalein as the indicator. A blank determination was performed simultaneously. The saponification value was calculated using the following equation:

Saponification value = 28.05 (B − A)/W

Where A is the volume (mL) of HCl used for the sample, B is the volume (mL) used for the blank, and W is the weight (g) of the oil sample.

Statistical Analysis

All physicochemical analyses were performed in triplicate, and the results are expressed as mean ± standard deviation (SD).

RESULTS AND DISCUSSION

The formulated polyherbal hair oil was evaluated for its organoleptic, physicochemical, and safety characteristics. The results of the evaluation are presented in Table 2. The formulation exhibited a dark green colour, characteristic herbal odour, and smooth texture, indicating successful incorporation of the selected medicinal plant extracts into the carrier oils. The specific gravity (1.085) and viscosity (0.735 Poise) demonstrated good consistency and spreadability, making the formulation suitable for topical application.

The pH value (6.7) was close to the normal physiological pH of the scalp, suggesting good compatibility and a low risk of irritation. The acid value (4.48) indicated minimal hydrolytic degradation, while the saponification value (120.12) reflected the characteristic fatty acid composition of the vegetable oils used in the formulation. The refractive index (1.455) confirmed the optical uniformity of the prepared oil. Furthermore, the formulation showed no signs of irritation or hypersensitivity, indicating its safety for external application.

Table 2. Organoleptic, Physicochemical and Safety Characteristics of the Formulated Polyherbal Hair Oil

Parameter	Result
Colour	Dark green
Odour	Characteristic
Texture	Smooth
Specific gravity	1.085
Viscosity	0.735 Poise
pH	6.7
Acid value	4.48
Saponification value	120.12
Refractive index	1.455
Irritation test	No irritation observed
Sensitivity test	No sensitivity reaction observed

The formulated polyherbal hair oil exhibited satisfactory physicochemical properties, indicating its quality, stability, and suitability for topical application. The near-neutral pH, appropriate viscosity, specific gravity, and favourable organoleptic characteristics suggest that the formulation is stable, homogeneous, and compatible with the scalp. These findings are consistent with the observations of Tiwari and Tiwari (2021), who reported that physicochemical evaluation is essential for assessing the quality and performance of herbal hair oil formulations. The absence of irritation and sensitivity further confirms the dermal safety of the prepared oil, supporting the findings of Usha Kiran Reddy et al. (2017). Overall, the results demonstrate that the formulated polyherbal hair oil is a safe and stable natural formulation with potential application in herbal hair care. Further biological and clinical studies are recommended to validate its therapeutic efficacy.

CONCLUSION

The present study successfully formulated and scientifically evaluated a polyherbal hair oil using selected traditional medicinal plants. The formulation exhibited satisfactory organoleptic characteristics, acceptable physicochemical properties, and showed no signs of irritation or sensitivity, indicating its suitability for topical application. The findings demonstrate that the developed polyherbal hair oil is a stable and promising natural hair care formulation. Further phytochemical, pharmacological, and clinical studies are recommended to validate its therapeutic efficacy and support its commercial application.

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