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Research Article

FORMULATION AND EVALUATION OF A POLYHERBAL HAIR MASK CONTAINING *MALATYADI KERA TAILA*, ALOE VERA, AND VITAMIN E

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ABSTRACT

Hair disorders, including alopecia, telogen effluvium, trichorrhexis nodosa, and scalp dysbiosis, have prompted growing interest in natural, plant-derived cosmeceuticals that balance therapeutic efficacy with favorable safety profiles. Combining classical Ayurvedic medicated oils with modern dermatological hydrating bases offers a synergistic platform for hair and scalp revitalization. **Objective:** To formulate a polyherbal conditioning hair mask combining *Malatyadi Kera Taila*, commercially available standardized Aloe vera gel (Aloe barbadensis), and Vitamin E (tocopherol), and to rigorously evaluate its organoleptic, physicochemical, phytochemical, and analytical stability profiles. **Methods:** The formulation was prepared by cold-emulsifying standardized *Malatyadi Kera Taila* and alpha-tocopheryl acetate into a commercial cosmetic-grade Aloe vera gel vehicle. Standard pharmacopoeial protocols were executed, including organoleptic characterization, determination of physicochemical constants (loss on drying, ash values, extractive values), qualitative phytochemical profiling of aqueous and alcoholic fractions, and cosmetic analytical metrics (pH, homogeneity, spreadability, washability, foamability, and lipid rancidity testing via the Kreis test). **Results:** The hair mask presented as a homogeneous, glossy, pastel/pistachio green semi-solid with a mild herbal aquatic fragrance, exhibiting smooth consistency and effortless spreadability. Physicochemical evaluation yielded a loss on drying (LOD) of 56.1%, total ash value of 2.0%, acid-insoluble ash of 6.0%, water-soluble ash of 1.0%, alcohol-soluble extractive value of 10.1%, and water-soluble extractive value of 11.2%. Qualitative screening confirmed the presence of carbohydrates, saponins, tannins, flavonoids, phytosterols, proteins, free amino acids, anthraquinones, and glycosides in both aqueous and ethanolic extracts, whereas alkaloids, free quinones, simple phenols, and anthocyanins were absent. The preparation demonstrated an optimal cutaneous pH of 4.5, passed tests for homogeneity, washability, and foamability, and was verified negative for oxidative rancidity. **Conclusion:** Having successfully satisfied all quality evaluation parameters, this herbal mask represents a stable, safe, and bioactive-rich topical delivery system suitable for immediate practical use, with strong potential for further advanced cosmetic and clinical evaluation.

INTRODUCTION

Hair serves an integral function in human social communication, psycho-emotional well-being, and biological protection of the cranium against ultraviolet radiation and mechanical trauma[1]. However, daily environmental exposure to actinic damage, airborne particulate pollution, harsh chemical hair dyes, and heat-induced styling leads to progressive structural degradation of the hair shaft[2]. This damage manifests as cuticle weathering, keratin protein cross-link cleavage, lipid extraction from the cell membrane complex (CMC), and accelerated trichoptilosis (split ends)[3]. Concurrently, micro-inflammatory states of the scalp, such as seborrheic dermatitis, pityriasis capitis (dandruff), and diffuse hair shedding, compromise follicular vitality[4].

While commercial synthetic conditioning formulations predominantly rely on silicones (e.g., dimethicone, cyclopentasiloxane), quaternary

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ammonium salts, and synthetic preservatives, these agents can cause bioaccumulation, scalp build-up, contact sensitization, and long-term follicular occlusion[5]. Consequently, contemporary cosmetic science is turning to Ayurvedic phytomedicine, which pairs traditional multi-target botanicals with natural biopolymer hydrogels [6].

Among classical Ayurvedic pharmacopoeial oils, *Malatyadi Kera Taila* is an established formulation indicated for *Indralupta* (alopecia areata/localized patch baldness), *Keshapatana* (hair fall), and *Darunaka* (dandruff) [7]. Formulated in a pure coconut oil *(Kera Taila)* vehicle, it contains extracts of Malati (*Jasminum grandiflorum*), *Naktamala* (Pongamia pinnata), *Karaveera* (*Nerium indicum*), and *Chitraka* (*Plumbago zeylanica*) [8]. Coconut oil's primary constituent, lauric acid, possesses a high affinity for hair keratin proteins and a low molecular weight, allowing deep penetration into the hair cortex [9].

To transition this potent, traditionally viscous oily preparation into a modern, cosmetically elegant rinse-off or leave-in emulsion, a commercially available standardized *Aloe vera* gel (*Aloe barbadensis*) serves as an optimal biocompatible hydrogel matrix [10]. Utilizing a processed, commercially standardized gel provides consistent rheology, high batch reproducibility, and stable hydration characteristics while delivering Aloe's native acemannan polysaccharides, essential enzymes, and moisture-retentive glycoproteins that relieve scalp pruritus, hydrate dry hair shafts, and close flared cuticle scales [11]. The inclusion of Vitamin E (alpha-tocopherol) serves a dual functional role: biologically, it interrupts free radical-mediated lipid peroxidation in hair follicle cell membranes [12]; technologically, it acts as a chain-breaking antioxidant that inhibits oxidation within the unsaturated fatty acid chains of the botanical oil [13].

Establishing standard quality benchmarks for polyherbal cosmetic formulations remains critical to ensure reproducibility, consumer safety, and therapeutic efficacy [14]. This investigation reports the formulation of a tri-component botanical hair mask and details its comprehensive characterization across organoleptic, physicochemical, qualitative phytochemical, and functional analytical parameters.

MATERIALS AND METHODS

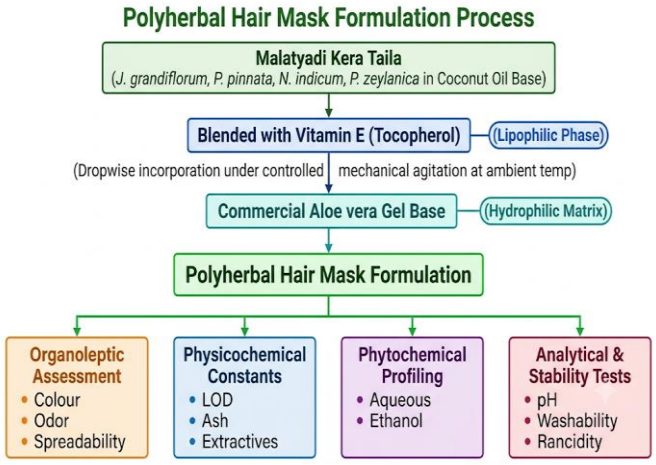
Materials

Standard commercial *Malatyadi Kera Taila* conforming to Ayurvedic Pharmacopoeial specifications was obtained from an authorized manufacturer. A commercially available, standardized cosmetic-grade aloe vera gel (Aloe barbadensis) was procured from a certified supplier and utilized directly as the hydrogel base. Pure pharmaceutical-grade Vitamin E capsules (containing d-alpha-tocopheryl acetate, 400IU) were procured locally. Standard laboratory reagents, testing solutions, and solvents required for qualitative phytochemical assays, ash determinations, and extractive values were procured from laboratory inventory and used as received.

Formulation of the Herbal Hair Mask

The hair mask was prepared through cold-process incorporation to preserve thermolabile phytoconstituents and tocopherol:

1. Hydrogel Matrix Preparation: The commercial Aloe vera gel was weighed accurately and subjected to slow mechanical equilibration at ambient temperature to ensure a uniform, bubble-free hydrogel phase.
2. Lipophilic Phase Preparation: Measured volumes of *Malatyadi Kera Taila* and the oily content of Vitamin E capsules were blended at a standardized ratio, producing a clear, lipid-rich phase.
3. Emulsification: The lipophilic blend was incorporated dropwise into the vortex of the prepared aloe vera gel base under continuous mechanical stirring at 800rpm for 20 minutes until a glossy, homogeneous, stable pseudo-emulsion formed. The final product was stabilized, packaged in clean airtight containers, and kept protected from direct light.





Organoleptic Characterization

The formulation was inspected for physical appearance, macroscopic clarity, consistency, and color under standardized white illumination. Sensory attributes, including fragrance notes, tackiness, skin-feel, and primary spreadability upon application to the dorsal surface of the hand, were cataloged systematically [15].

Physicochemical Evaluation

Standard pharmacopoeial testing for raw and finished herbal products was performed in triplicate [14,16]:

- Loss on Drying (LOD): 2.0gm sample was placed in an open, pre-tared porcelain crucible and dried in a hot-air oven at 105°C until constant weight was achieved, determining the combined percentage of free water and volatile fractions.
- Total Ash Value: A dried crucible containing 2.0gm of the mask was placed in a muffle furnace at 550°C until carbonaceous material was completely eliminated, yielding inorganic ash residue.
- Acid-Insoluble Ash: The total ash was boiled with 25mL of dilute hydrochloric acid (10%) for 5 minutes, filtered through ashless filter paper, thoroughly washed with hot deionized water, ignited in a furnace, cooled, and weighed.
- Water-Soluble Ash: Total ash was boiled with 25ml of distilled water, collected on ashless filter paper, ignited at 450°C and subtracted from total ash weight to determine water-soluble mineral components.
- Extractive Values: Air-dried mass equivalent to 5.0gm of the preparation was macerated with 100mL of absolute ethanol (for alcohol-soluble extractive) or distilled water with chloroform preservative (for water-soluble extractive) in a mechanical shaker for 24 hours. Filtrates were evaporated to dryness on a steam bath, desiccated, and quantified as dry mass percentages.

Qualitative Phytochemical Screening

Aqueous and alcoholic extracts were prepared, filtered, and subjected to standard diagnostic chemical assays[17]

- Carbohydrates: Molisch's test (alpha-naphthol/ sulfuric acid ring test) and Fehling's test for reducing sugars.
- Saponins: Foam test (shaking vigorously with distilled water in a graduated cylinder for 15 minutes; persistence of honeycomb froth > 1cm.
- Tannins: Gelatin precipitation test and dilute ferric chloride coloration.
- Flavonoids: Alkaline reagent test (addition of sodium hydroxide solution yielding intense yellow coloration that becomes colorless on addition of dilute acid) and Shinoda's reduction test (magnesium ribbon and concentrated hydrochloric acid).
- Phytosterols: Liebermann-Burchard test and Salkowski's reaction (chloroform extract treated with concentrated sulfuric acid).
- Proteins and Amino Acids: Biuret test (copper sulfate in alkaline medium) and Ninhydrin test (heating with 0.2% ninhydrin solution).
- Anthraquinones: Bornträger's reaction (partitioning with benzene followed by ammonia phase coloration).
- Glycosides: Legal's test and Keller-Kiliani test for deoxysugars.
- Alkaloids: Dragendorff's reagent (potassium bismuth iodide), Mayer's reagent (potassium mercuric iodide), and Wagner's iodine reagent.
- Phenols: Ferric chloride test and Folin-Ciocalteu interaction.
- Anthocyanins: Dilute hydrochloric acid and sodium hydroxide differential color shift.
- Quinones: Concentrated sulfuric acid drop test.

Analytical and Cosmetic Testing

- pH Measurement: A 10% aqueous dispersion was prepared with freshly boiled and cooled neutral distilled water. The pH was recorded using a digital pH meter standardized with reference buffer solutions of pH 4.01, 7.00, and 9.21 at 25°C [18].
- Homogeneity and Texture: The formulation was spread between two clear glass slides and examined visually and tactilely for lumps, grit, or phase separation.
- Washability Test: A measured amount 1.0gm was applied onto human forearm skin, allowed to rest for 15 minutes, and rinsed under running tap water 25°C without soap. Ease of removal and presence of residual greasy films were evaluated[19].
- Foamability: A 1.0 g sample was dispersed into 50mL} of distilled water in a 100mL graduated cylinder, shaken vigorously 10 times, and inspected for transient bubble/froth formation.
- Lipid Rancidity (Kreis Test): To evaluate lipid peroxidation within the oil fraction, 1.0ml of the separated lipid phase was blended with 1.0mL} of concentrated hydrochloric acid, followed by 1.0ml phloroglucinol in diethyl ether. The appearance of a red or pink color in the acid layer denotes epihydrinaldehyde and oxidative rancidity [20].

RESULTS

Organoleptic Characteristics

The tri-component formulation presented an aesthetically balanced profile suited for direct cosmetic application.

Table 1: Organoleptic Characteristics of the Polyherbal Hair Mask

Parameter	Observed Characteristic
Physical State	Semi-solid, cohesive gel-cream
Appearance	Glossy, smooth, non-gritty matrix
Colour	Pastel green / pistachio green
Odour	Fresh, mild herbal aquatic fragrance
Texture & Consistency	Lightweight, non-greasy, uniform
Spreadability	Easily spreadable without heavy drag

Physicochemical Parameters

Standardization parameters for drying loss, mineral ash residue, and extractive fractions are summarized in Table 2.

Table 2: Physicochemical Constants of the Formulated Hair Mask

Evaluation Parameter	**Results**	**Interpretation & Quality Significance**
Loss on drying (at 105°C)	56.1%	High moisture fraction from hydrating *Aloe* gel vehicle
Total Ash Value	2%	Organic-rich formulation with physiological mineral salts
Acid-Insoluble Ash	6%	Siliceous and acid-resistant non-volatile inorganic matter
Water-Soluble Ash	1%	Soluble physiological electrolytes (potassium, sodium)
Alcohol-Soluble Extractive	10.1%	Phytosterols, lipids, tocopherol, and aglycones
Water-Soluble Extractive	11.2%	Hydrophilic polysaccharides, saponins, and free proteins

Phytochemical Screening

Qualitative screening confirmed diverse secondary metabolites from both the Aloe hydrogel vehicle and the herbal constituents of *Malatyadi Kera Taila* (Table 3).

Table 3: Qualitative Phytochemical Profile of Aqueous and Ethanolic Extracts

Chemical Class	**Aqueous Extract**	**Alcoholic Extract**	**Inference**
Carbohydrates & Polysaccharides	+	+	Acemannan, mucilage sugars present
Saponins	+	+	Natural foamers and cleansers detected
Tannins	+	+	Astringent protective polyphenols present
Flavonoids	+	+	Free-radical scavengers confirmed
Phytosterols	+	+	Plant sterols from lipid oil phase present
Proteins and Amino Acids	+	+	Keratin-binding amino fractions present
Anthraquinones	+	+	Characteristic *Aloe* markers confirmed
Glycosides	+	+	Glycosidic botanical complexes detected
Alkaloids	–	–	Absent in detectable concentrations
Quinones (free)	–	–	Absent
Phenols (simple monomeric)	–	–	Absent
Anthocyanins	–	–	Absent

Denotes presence; (–) denotes absence. (+)

Analytical and Functional Performance

Cosmetic performance, cutaneous compatibility, and chemical integrity metrics are detailed in Table 4.

Table 4: Analytical, Performance, and Stability Parameters

Analytical Test	**Metric / Status**	**Regulatory / Dermatological Criteria**
PH	4.5	Matches natural scalp mantle (4.0 - 5.5)
Homogeneity	Pass (Uniform)	Absence of phase separation, aggregates, or grit
Washability	Pass (Complete)	Easily rinses off with water; leaves no oily film
Foamability	Pass (Mild Froth)	Stable transient micro-bubbles via natural saponins
Rancidity (Kreis Test)	Negative	No pink/red coloration; absence of epihydrinaldehyde

DISCUSSION

The development of botanical hair masks requires balancing therapeutic botanical efficacy with consumer-oriented cosmetic elegance[21]. The organoleptic assessment confirms that blending

Malatyadi Kera Taila into a commercially standardized Aloe vera gel base produces an aesthetically pleasing, cohesive semi-solid system. The characteristic pastel/ pistachio green hue and fresh herbal aquatic fragrance ensure high sensory acceptability and consumer compliance, avoiding the heavy, unctuous greasiness typical of crude Ayurvedic oils.

Physicochemical evaluation provides quantitative baselines for assessing purity and batch-to-batch reproducibility [16]

- Loss on Drying 56.1%: Reflects the high water and volatile carrier content supplied by the Aloe gel vehicle. This water fraction functions as a primary humectant reservoir, rehydrating desiccated hair shafts before oil occlusives seal the cuticle [23].
- Ash Values: Total ash 2.0% demonstrates low levels of overall non-volatile inorganic matter, consistent with pure botanical sourcing. The water-soluble ash 1.0% reflects physiological minerals (calcium, magnesium, potassium) found naturally in Aloe vera [10]. The acid-insoluble ash value 6.0% indicates the presence of acid-resistant minerals and structural silicates.
- Extractive Values: The balanced alcohol-soluble 10.1% and water-soluble 211.2% extractive values confirm that the mask contains a balanced dual-nature composition capable of solubilizing both hydrophilic constituents (mucopolysaccharides, amino acids, glycosides) and lipophilic components (phytosterols, tocopherol, fatty acids) [24].

Qualitative phytochemical screening confirmed the presence of saponins, carbohydrates, tannins, flavonoids, phytosterols, proteins, amino acids, anthraquinones, and glycosides across both extract polarities. The presence of proteins and free amino acids is particularly advantageous: low-molecular-weight amino groups penetrate damaged cuticle cracks, electrostatically binding to anionic sites on damaged keratin to improve hair tensile strength [3,25]. Phytosterols and coconut-derived fatty acids reinforce the intercellular lipid cement of the hair's cell membrane complex[9,26]. Flavonoids and tannins provide antioxidant defenses against photo-induced oxidation while exerting mild astringent effects that soothe the scalp[27]. The absence of free alkaloids, quinones, simple phenols, and anthocyanins highlights the selective phytochemical profile of this preparation, minimizing potential skin irritants [28].

The formulation's pH of 4.5 represents a major cosmetic and dermatological asset. Pristine scalp and hair fiber surfaces possess an acidic mantle with a physiological pH between 4.0 and 5.5[29]. Commercial alkaline preparations cause the outer cuticle layers to swell and lift, increasing friction, mechanical tangling, fiber breakage, and dullness[30]. At an isoelectric pH of 4.5, cuticular scales remain compressed against the cortex, increasing hair shaft light reflectivity (gloss), minimizing static charge, and preventing colonization by pathogenic scalp microflora [29,31].

The formulation passed tests for homogeneity, washability, and foamability. The foamability is attributable to native phytogenic saponins present in the botanical components, providing gentle, non-irritating cleansing that assists with water rinse-off without requiring synthetic sulfate surfactants [32].

Finally, the negative Kreis test confirms the absence of lipid peroxidation products (such as malondialdehyde and epihydrinaldehyde). The coconut oil base of *Malatyadi Kera Taila* consists primarily of medium-chain saturated fatty acids resistant to oxidative rancidity, while added Vitamin E (tocopherol) terminates free radical propagation within any unsaturated fatty components [12,13].

CONCLUSION

The formulated polyherbal hair mask composed of *Malatyadi Kera Taila*, Aloe barbadensis gel, and vitamin E successfully met all pharmacopoeial and cosmetic evaluation parameters. It demonstrated an ideal scalp-compatible pH of 4.5, complete homogeneity, easy spreadability, excellent water-washability, and negative lipid rancidity. Furthermore, phytochemical screening confirmed the presence of vital bioactives-including proteins, amino acids, phytosterols, and flavonoids-essential for hair fiber repair and scalp nourishment.

Having successfully passed all physicochemical, phytochemical, and preliminary analytical tests, the formulation is considered safe, stable, and ready for practical use as a natural alternative to synthetic conditioners. To establish deeper clinical efficacy and enable scalable commercial translation, further evaluation through advanced analytical testing-including rheological profiling, accelerated stability studies under ICH guidelines, patch testing, and in vivo hair tress efficacy trials-is recommended.

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