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Review Article

Formulation and Evaluation of Herbal Anti-Dandruff Shampoo

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ABSTRACT

Dandruff is a common, recurrent scalp condition characterized by visible flaking and may be accompanied by itching and irritation. Its development is multifactorial and is associated with Malassezia yeasts, scalp sebum, epidermalbarrier function, and individual susceptibility. Herbal anti-dandruff shampoos have attracted interest because botanical extracts and essential oils may provide antifungal, anti-inflammatory, soothing, and conditioning activities alongside cleansing. This review summarizes the basic pathophysiology of dandruff, the role of shampoo as a topical cleansing dosage form, and the evidence supporting selected herbal ingredients such as neem (Azadirachta indica), tea tree (Melaleuca alternifolia), aloe vera (Aloe barbadensis), hibiscus (Hibiscus rosa-sinensis), amla (Phyllanthus emblica), tulsi (Ocimum tenuiflorum), and fenugreek (Trigonella foenum-graecum). The review also discusses extract preparation, excipient selection, a proposed formulation-development workflow, and physicochemical, microbiological, stability, and safety evaluation. Published evidence is uneven: tea tree oil has clinical trial evidence in dandruff, while many multi-herb shampoo reports mainly describe laboratory formulation attributes and in-vitro antimicrobial screening. A herbal label alone does not establish superiority, clinical efficacy, or freedom from irritation. Therefore, a rational formulation should be standardized, use appropriate controls, and be assessed with validated methods. This paper is a review and proposed development framework; it does not report newly performed experiments or claim experimental results.

INTRODUCTION

Shampoo is a liquid or semisolid cleansing preparation designed to remove excess sebum, sweat, dirt, environmental particles, and residues from the scalp and hair. An anti-dandruff shampoo adds an ingredient or combination intended to reduce flaking and related scalp symptoms. A successful product must balance cleansing performance, scalp tolerability, physical stability, acceptable sensory characteristics, and delivery of its active ingredients.

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Dandruff is generally described as scalp scaling with variable itch and usually without the marked inflammation that may occur in seborrhoeic dermatitis. The two conditions are often considered part of a clinical spectrum, but severe, persistent, painful, or inflamed scalp symptoms may need assessment by a healthcare professional. The role of Malassezia species is important, although dandruff is not simply a contagious fungal infection; host susceptibility, sebum composition, and barrier responses also contribute [1–3].

Botanical materials have a long history in hair and scalp care. Neem, tea tree oil, aloe vera, hibiscus, amla, tulsi, and other herbs are commonly discussed in herbal shampoo research.



Figure None: Natural Ingredients Used for the Formulation of Herbal Anti-Dandruff Shampoo

Their potential functions differ: some are investigated for antimicrobial activity, others for soothing, antioxidant, conditioning, or cleansing support. Evidence from an isolated extract cannot automatically be generalized to a finished shampoo because solvent, concentration, processing, surfactants, pH, and contact time affect

performance. [5,6,7,9,10]

The purpose of this review is to connect the biological rationale for dandruff management with practical formulation science and a transparent evaluation plan.

AIM AND OBJECTIVES

Aim: To review the scientific basis, herbal ingredients, formulation considerations, and evaluation methods relevant to the development of a herbal anti-dandruff shampoo.

- To summarize the clinical features and multifactorial pathophysiology of dandruff.
- To explain the functions of cleansing agents and other shampoo excipients.
- To review selected herbs and essential oils used or investigated in anti-dandruff formulations.
- To describe collection, authentication, extraction, and standardization of botanical raw materials.
- To outline a proposed herbal shampoo formulation strategy without presenting unperformed experiments as results.
- To discuss physicochemical, performance, microbiological, stability, and safety tests.
- To identify limitations in current literature and recommend a more reproducible research design.

Scope: This is a narrative review and formulation-development framework. Exact ingredient concentrations should be selected only after compatibility, tolerability, and preliminary efficacy studies. A laboratory formulation should not be described as clinically effective unless supported by suitable clinical evidence.

DANDRUFF: DEFINITION AND CLINICAL FEATURES

Dandruff is characterized by shedding of visible flakes from the scalp. Flakes may be white or yellowish and may be more noticeable on dark clothing. Itching can occur, but its severity varies. Scalp scaling may fluctuate with weather, washing practices, stress, and individual skin characteristics. Dandruff is common and tends to recur, so management often focuses on symptom control rather than a permanent cure.

Dandruff should be distinguished from psoriasis, tinea capitis, allergic or irritant contact dermatitis, and more inflammatory seborrhoeic dermatitis. Thick plaques, marked redness, pain, oozing, patchy hair loss, or symptoms that do not improve with routine care should not be assumed to be ordinary dandruff. A clinician can help establish the diagnosis and advise on appropriate treatment.

Dandruff can affect confidence and social comfort even when the physical condition is mild. A shampoo therefore needs not only activity against relevant

biological factors but also acceptable smell, texture, rinseability, and ease of use. Excessively harsh cleansing can cause dryness or irritation and may reduce user adherence.

Feature	Typical observation	Formulation relevance
Scaling	Visible flakes	Assess anti-flaking performance
Pruritus	Variable itch	Consider tolerability and soothing support
Sebum	Often contributes to scalp environment	Balance cleansing and dryness
Recurrence	Symptoms may return	Assess repeat-use suitability
Differential diagnosis	Other scalp disorders can resemble dandruff	Avoid unsupported disease claims

PATHOPHYSIOLOGY AND ROLE OF MALASSEZIA

Dandruff is understood as a multifactorial disorder involving interactions among Malassezia yeasts, sebum, scalp barrier function, and host susceptibility. Malassezia organisms are normal members of the skin microbiota in many people. In susceptible scalps, their lipid metabolism and interactions with the skin may contribute to irritation, altered barrier function, and increased shedding [1–3]. [1–3,11]

Species such as Malassezia globosa and Malassezia restricta have frequently been discussed in dandruff research. These lipid-associated yeasts can metabolize sebum lipids. The resulting lipid products may affect the stratum corneum in susceptible individuals. However, microbial presence alone does not fully explain why some people develop dandruff while others do not.

This biology explains why anti-dandruff strategies commonly target fungal activity while also supporting scalp tolerability. A shampoo must deliver the active ingredient during a limited contact period, disperse across the scalp, and rinse without leaving unacceptable residue. In-vitro inhibition is useful for screening but does not directly predict real-world benefit because the scalp environment, product dilution, contact time, and ingredient availability differ from laboratory conditions. [1·4, 11, 25]

Contributing factor	Possible role	Research implication
Malassezia	Lipid metabolism and interaction with scalp	Use a relevant validated antifungal assay
Sebum	Provides a lipid-rich environment	Consider cleansing and formulation compatibility
Barrier function	Influences sensitivity and scaling	Monitor irritation and scalp comfort
Host susceptibility	May modify inflammatory response	Avoid claiming one mechanism explains all cases

CONVENTIONAL MANAGEMENT AND RATIONALE FOR HERBAL PRODUCTS

Established anti-dandruff products may contain active agents such as ketoconazole, selenium sulfide, or other locally permitted ingredients. The choice depends on the product label, local regulation, symptoms, and professional advice where required. A botanical product should not be assumed to be more effective or safer merely because its ingredients are plant-derived.

Interest in herbal shampoos is driven by consumer preference for botanical ingredients, traditional hair-care practices, and the possibility of combining cleansing with conditioning or soothing functions. Plant extracts may contain complex mixtures of phenolics, terpenoids, flavonoids, saponins, or other constituents. These classes can provide useful leads for laboratory investigation, but composition varies with species, plant part, season, location, extraction solvent, and storage.

A useful comparison evaluates the finished products rather than making a general natural-versus-synthetic claim. Relevant endpoints include reduction in scaling, itch scores, tolerability, microbial activity where justified, product stability, and user acceptability. Clinical claims require well-designed studies with suitable comparators and defined outcomes. [4, 14·16, 19, 21·25]

The rationale for this review is therefore not that herbal products are automatically superior, but that a standardized and scientifically tested herbal formulation may be worth investigating as a complementary productdevelopment approach.

OVERVIEW OF HERBAL ANTI-DANDRUFF SHAMPOO

An herbal anti-dandruff shampoo is a cleansing preparation containing one or more botanical extracts, essential oils, or derived ingredients selected for a defined purpose. The formula generally includes a surfactant system, water, a viscosity modifier, a pH-adjusting agent, a preservative system, and optional conditioning or fragrance ingredients. Botanicals may be supplied as aqueous or hydroalcoholic extracts, powders, gels, or essential oils, depending on the material and compatibility requirements.

Plant extracts are chemically complex. The formulation scientist must consider solubility, colour, odour, residual solvent, pH, compatibility with surfactants, potential precipitation, preservative efficacy, and the possibility of irritation or sensitization. Essential oils can be difficult to disperse in water and may require a compatible solubilizer; increasing their concentration without safety justification is not an appropriate optimization strategy.

A finished shampoo should have consistent appearance and odour, suitable viscosity, acceptable pH, good cleansing and rinseability, and microbiological quality appropriate for a water-containing cosmetic. Foam volume may influence consumer perception but is not a direct measure of dandruff control or cleansing efficacy. [5·10, 15·17, 22]

Component	Typical function	Key consideration
Botanical extract	Potential active/conditioning component	Identity and marker standardization
Surfactant	Cleansing and soil removal	Mildness and compatibility
Thickener	Controls flow and texture	Electrolyte and extract compatibility
Humectant/con ditioner	Improves sensory feel	Avoid excessive residue
Preservative	Controls microbial growth	Compatibility and challenge testing
pH adjuster	Sets target pH	Measure in a defined dilution
Purified water	Continuous phase	Microbiological quality

HERBAL INGREDIENT: NEEM

Neem (Azadirachta indica A. Juss.) is widely used in traditional personal-care preparations. Neem leaves, bark, seedderived materials, and oils have different chemical profiles; therefore, the plant part and extract type should be stated clearly. Neem is often selected in herbal shampoo research because laboratory studies have investigated antimicrobial properties of some preparations.

For formulation development, neem extract should be authenticated and prepared using a reproducible method. Extraction solvent, plant-to-solvent ratio, time, temperature, filtration, concentration, and yield should be recorded. The extract should be checked for appearance, odour, pH, microbial quality, and chemical consistency. The presence of a plant-derived material does not guarantee that it is non-irritating or suitable for every scalp.

Neem may contribute to a multi-ingredient formula, but its specific anti-dandruff contribution must be demonstrated in the finished product. A useful study compares the base shampoo, shampoo containing neem, and the complete combination, where practical. This helps separate the effect of neem from surfactant cleansing or the activity of other ingredients. [23, 24]

Research gap: many student-level reports describe neem as an antifungal herb without providing a validated marker profile or a strong clinical outcome. Future work should use standardized raw material and a relevant test organism, and should report concentration, controls, replicate numbers, and uncertainty.

HERBAL INGREDIENT: TEA TREE OIL

Tea tree oil is the essential oil of Melaleuca alternifolia. Unlike many crude plant extracts, it is a volatile oil whose composition depends on source material, processing, storage, and oxidation. It must be properly dispersed in a shampoo and protected from avoidable degradation. Oxidized essential oils can pose a sensitization concern, so storage, packaging, and safety evaluation are important.

A randomized, single-blind study of 126 participants evaluated a shampoo containing 5% tea tree oil for mildtomoderate dandruff over four weeks. The tea tree oil group showed a 41% improvement in the study's dandruff severity score compared with 11% for placebo, and the report described improvements in several symptoms [4].

This is useful clinical evidence for tea tree oil shampoo, but it does not prove that every herbal blend or concentration will have the same outcome.

The study should be interpreted within its design, product concentration, population, duration, and endpoints. A student formulation should not copy a clinical concentration without considering local rules, sensitization risk, and formulation compatibility. Essential oil identity, quality, solubilization, and concentration should be documented. Tea tree oil is a potential candidate ingredient when its safety and compatibility are addressed. A finished product requires testing rather than relying solely on published evidence for a different product. [4, 14, 18]

HERBAL INGREDIENT: ALOE VERA

Aloe vera (Aloe barbadensis Mill.) is widely used in personal-care products. The inner leaf gel contains water and polysaccharide-rich material, while whole-leaf and latex-containing preparations differ substantially. For cosmetic formulation, the source and processing method must be defined because raw gel can vary in composition and microbial quality.

Aloe vera is commonly included in shampoo concepts for its conditioning and soothing profile. These properties may support product acceptability, but they should not be treated as proof of direct antifungal efficacy against

Malassezia. Any claim about anti-dandruff activity should be supported by testing of the specific ingredient or finished formula. [5,8,9]

Aloe-containing formulas can present challenges such as viscosity variation, microbial contamination, colour change, and interactions with preservatives. A standardized commercial-grade ingredient may improve reproducibility compared with unprocessed fresh gel, although supplier specifications and quality documentation still need review.

Useful evaluation includes ingredient identity, microbial limits, compatibility with surfactants, pH, viscosity, stability, and user tolerability. If fresh plant material is used in a laboratory project, careful handling and microbial quality assessment are essential. [8, 9, 22]

HERBAL INGREDIENT: HIBISCUS

Hibiscus (Hibiscus rosa-sinensis L.) is used in traditional hair-care practices and is frequently included in herbal shampoo studies. Leaves and flowers may differ in mucilage, pigments, phenolics, and other constituents. The plant part should therefore be reported rather than referring to the material simply as hibiscus.

Hibiscus extracts may contribute to conditioning, texture, and botanical appeal. Depending on the extraction method, pigments and plant solids can affect colour, odour, clarity, and sedimentation. These are important product-quality considerations because a formulation that separates or changes markedly during storage is unlikely to be acceptable.

The evidence base for hibiscus as a stand-alone anti-dandruff active is less definitive than the clinical evidence reported for some other ingredients. In a multi-herbal shampoo, its contribution should be assessed by comparing formulations with and without the extract where feasible. This approach avoids attributing the whole formulation's activity to a single herb.

A suitable study should authenticate the plant, standardize the extract, record extraction yield, check compatibility, and include relevant microbiological testing. Any scalp-related benefit should be expressed cautiously unless validated clinical evidence is available. [9, 10, 22]

HERBAL INGREDIENT: AMLA

Amla (Phyllanthus emblica L.), also known as Indian gooseberry, is used in traditional hair and personal-care preparations. Its fruit contains a range of polyphenolic compounds and other constituents, with composition influenced by maturity, drying, storage, and extraction method. Amla is often discussed for antioxidant and conditioning properties.

For a shampoo, amla extract may influence colour, odour, pH, and solids content. Extract standardization

should include botanical authentication, processing details, yield, and an appropriate chemical measure when available. Amla's antioxidant potential should not automatically be interpreted as clinically meaningful anti-dandruff activity.

In a polyherbal formulation, amla may be combined with ingredients selected for other functions. The overall formulation should be optimized so that the ingredients remain dispersed, the product is not excessively acidic, and the preservative system remains effective. Stability testing should look for colour change, precipitation, odour changes, and pH drift.

Future research should distinguish antioxidant screening from antifungal testing and clinical outcomes. Amla's contribution to a finished shampoo should be assessed with appropriate controls rather than inferred from

traditional use alone. [8, 9, 22]

HERBAL INGREDIENT: TULSI AND OTHER BOTANICALS

Tulsi (Ocimum tenuiflorum L., also known as Ocimum sanctum) is commonly cited in herbal-care literature. Extracts may contain phenolic and volatile constituents, but the profile depends on plant part and extraction process. Laboratory reports have investigated tulsi in multi-herbal shampoo preparations, including studies that assess physical characteristics and antifungal activity. [6–10]

Other ingredients discussed in the literature include fenugreek (Trigonella foenum-graecum), reetha/soapnut

(Sapindus species), shikakai (Acacia concinna and related nomenclature in older literature), curry leaves (Murraya koenigii), and rosemary (Salvia rosmarinus, formerly Rosmarinus officinalis). Their roles may include cleansing support, conditioning, fragrance, or exploratory biological activity.

Traditional use and preliminary in-vitro findings are useful for selecting candidates but are not interchangeable with clinical proof. Botanical nomenclature can change, and common names may refer to more than one species. Reports should include the accepted scientific name, plant part, authentication details, supplier or collection source, and extraction method.

A focused formulation is often easier to standardize than a very large mixture of herbs. Too many extracts can increase colour and odour variability, compatibility problems, preservation demands, and difficulty determining which ingredient contributes to a measured effect. [5–10] [5·10, 15, 22]

BOTANICAL AUTHENTICATION AND RAW-MATERIAL QUALITY

Reproducible herbal formulation begins with correct identification of the raw material. The scientific name, family, plant part, collection location or supplier, collection date or batch, and authentication method should be recorded. A voucher specimen is useful for research traceability when plant material is collected directly. [13]

Raw materials should be inspected for foreign matter, visible mould, abnormal odour, infestation, and signs of poor storage. Drying conditions should reduce excess moisture while limiting degradation of relevant constituents. Dried material should be stored in clean, moisture-resistant containers away from excessive heat and light.

Quality checks may include foreign matter, loss on drying, ash values, extractive values, microbial quality, and a chromatographic fingerprint such as TLC or HPTLC where suitable. The exact tests depend on the plant material and applicable pharmacopoeial or herbal-material guidance. A marker assay is particularly useful when a reproducible constituent can be identified. [13, 22·24, 27]

Quality step	Purpose	Documentation
Authentication	Confirm species identity	Botanist/supplier certificate
Plant-part confirmation	Reduce variability	Leaves, flowers, fruit, or other part
Drying/storage	Protect material quality	Temperature/time/container
Foreign matter and moisture	Assess physical quality	Test results and batch ID
Fingerprint/marker	Compare chemical consistency	TLC/HPTLC/HPLC record

Quality step	Purpose	Documentation
Microbial quality	Support product safety	Validated test record

EXTRACTION AND STANDARDIZATION

Extraction is used to transfer selected constituents from botanical material into a suitable solvent. The solvent should be chosen according to the plant part, target constituents, safety, and compatibility with the intended shampoo. Water and hydroalcoholic solvents are common options for polar constituents; other solvents may be appropriate in research but require complete consideration of residual-solvent control and intended use.

A general workflow includes cleaning, drying, size reduction, weighing, extraction, filtration, concentration, and storage. The plant-to-solvent ratio, extraction time, temperature, agitation, number of extraction cycles, and solvent composition should be kept consistent. The percentage yield can be calculated from the dry extract mass relative to the starting dry plant mass.

Standardization can include preliminary phytochemical screening, total phenolic or flavonoid estimation, and a chromatographic fingerprint. Such assays provide comparative information but are not always specific measures of the ingredient responsible for biological activity. If a validated marker is available, its concentration can be monitored across batches and during stability testing.

Extracts should be assessed for colour, odour, pH, solubility, microbial quality, and compatibility with the surfactant system. The extract concentration in the finished product should be justified by compatibility and safety data rather than selected only to maximize herbal content.

SHAMPOO EXCIPIENTS AND THEIR FUNCTIONS

Surfactants are the principal cleansing ingredients. They lower interfacial tension and help remove sebum and particulate soil. Anionic surfactants provide cleansing and foam, while amphoteric and non-ionic surfactants may be used to modify mildness, viscosity, and formulation behaviour. The final system should be chosen based on performance, scalp tolerability, and compatibility with botanical ingredients.

Thickeners such as suitable cellulose derivatives, gums, or other cosmetic rheology modifiers control flow and consumer handling. Salt may thicken some surfactant systems but can also reduce viscosity beyond an optimum, so it should be added gradually during development. Humectants and conditioning agents can improve sensory feel, but excessive levels may affect rinseability or leave residue.

Preservatives are important in water-containing products because botanical extracts can introduce nutrients or microbial contamination. Preservative selection must comply with applicable cosmetic requirements and should be supported by compatibility and preservation-efficacy testing. Fragrance is optional and can introduce sensitization concerns; fragrance-free prototypes may be useful during early tolerability assessment.

Excipient class	Function	Development concern
Primary surfactant	Cleansing and foam	Mildness; extract compatibility
Co-surfactant	Modify mildness/viscosity	Clouding and salt response
Thickener	Flow and consistency	Electrolyte sensitivity
Humectant/conditioner	Sensory and conditioning	Residue and stability
Preservative	Microbial protection	Efficacy in final formula
Chelator/antioxidant	Support stability where appropriate	Compatibility and justified need
pH adjuster	Adjust target pH	Avoid abrupt pH changes

PROPOSED FORMULATION DESIGN

A suitable development approach begins with a simple base and adds standardized botanical ingredients one at a time. The formula should be considered a prototype, not a validated product. Ingredient selection must be adjusted to the intended product type, supplier specifications, safety data, local cosmetic requirements, and preliminary compatibility studies.

Ingredient category	Illustrative role	Selection note
Purified water	Vehicle	Quality-controlled water
Mild surfactant blend	Cleansing	Choose compatible surfactants
Standardized neem extract	Botanical candidate	Concentration based on testing
Aloe vera ingredient	Conditioning/soothing candidate	Use standardized grade
Hibiscus or amla extract	Conditioning/botanical component	Check colour, pH, sediment
Tea tree oil (optional)	Exploratory essential-oil active	Safety, solubilization, oxidation
Thickener	Viscosity control	Select by compatibility
Preservative system	Microbial control	Verify final-product efficacy
pH adjuster	pH control	Use measured additions

This illustrative composition intentionally avoids fixed percentages because the correct concentrations depend on the selected raw materials and compatibility data. The literature contains many different formulations, and results from one formula cannot be assumed to apply to another. Any final batch sheet should list exact ingredient names, grades, concentrations, batch size, order of addition, mixing conditions, and in-process controls. [15, 16, 19]

A useful experimental design varies a limited number of factors, such as total extract level, surfactant ratio, and thickener concentration, while keeping other variables controlled. The selected prototype should be confirmed in independent batches.

GENERAL METHOD OF PREPARATION

A proposed laboratory workflow is provided below for planning purposes. The exact procedure must be adapted to the chosen ingredients and equipment, and should be performed under appropriate laboratory supervision.

1. Verify botanical identity, batch records, and raw-material quality.
2. Prepare and standardize the extracts using a documented extraction method.
3. Check extract solubility and compatibility with the intended surfactant system.
4. Weigh the ingredients accurately and prepare the aqueous phase using suitable purified water.
5. Add surfactants slowly with controlled mixing to minimize unnecessary aeration.
6. Add compatible extracts and other water-soluble ingredients in a defined order.
7. Incorporate oil-soluble ingredients only with a validated solubilization or dispersion approach.
8. Add the selected thickener gradually and allow adequate hydration where required.
9. Add preservative and adjust pH according to supplier instructions and the product specification.
10. Make up to final batch mass, mix until uniform, allow bubbles to dissipate, and fill into clean suitable containers.
11. Record appearance, pH, viscosity, batch yield, and any deviation from the procedure.

Mixing speed, temperature, order of addition, and resting time can change viscosity, foam, and uniformity. A manufacturing record should allow another researcher to reproduce the same batch.

EVALUATION: ORGANOLEPTIC AND PHYSICOCHEMICAL TESTS

Appearance, colour, odour, homogeneity, and visible sediment should be checked under defined conditions. These tests are simple but should use a consistent observation method and preferably a reference sample. A strong herbal odour or dark colour is not evidence of higher activity. [5–7,9,10] pH should be measured using a calibrated pH meter with a stated sample dilution and temperature. The target should be selected based on product type, scalp tolerability, ingredient stability, and applicable standards rather than treating a single pH number as universally correct. Viscosity should be measured with the instrument, spindle, speed, temperature, and equilibration time reported.

Foaming ability and foam stability may be assessed by a standardized cylinder method. Foam supports consumer perception but does not independently measure

cleansing or antifungal performance. Surface tension, wetting time, dirt dispersion, and detergency may provide additional information if methods are standardized and results are interpreted cautiously.

Test	Typical approach	What it indicates
Appearance	Visual examination	Uniformity and visible defects
pH	Calibrated pH meter	Acid/base condition
Viscosity	Viscometer/rheometer	Flow and handling
Foam height/stability	Defined shake method	Foaming behaviour
Wetting time	Standardized substrate test	Wetting performance
Dirt dispersion/detergency	Defined model test	Cleaning-related behaviour
Rinseability	Standardized use simulation	Product removal
Solids content	Evaporation/validated method	Non-volatile fraction

EVALUATION: ANTIFUNGAL ACTIVITY

Antifungal testing is important when a formulation is intended to target Malassezia-associated dandruff. The test organism, culture conditions, medium, inoculum, incubation conditions, and endpoint must be suitable for the organism and validated protocol. Malassezia species have particular growth requirements, so methods used for routine bacteria cannot automatically be transferred without adaptation.

Possible laboratory approaches include agar-based screening, broth dilution, and viable-count methods. Agar diffusion is convenient for preliminary screening but depends on diffusion through the medium; a poorly diffusing ingredient can appear less active than it is. Broth-based methods can provide a concentration-related endpoint but require suitable solubilization, controls, and organism-specific conditions.

A sound comparison includes the base shampoo without herbal ingredients, each selected extract where feasible, the complete shampoo, a suitable positive control, and a negative or solvent control. Replicates and statistical analysis should be planned in advance. Any inhibition zone should be reported with units, variability, and the exact method.

Laboratory antifungal activity is not equivalent to clinical effectiveness. The shampoo is diluted during use and remains on the scalp for a limited period. Clinical assessment should use a suitable design, ethical approval, informed consent, defined dandruff scoring, tolerability monitoring, and appropriate comparator products. [4, 14, 21, 25, 26]

Control or sample	Purpose
Untreated/negative control	Baseline growth
Vehicle/base shampoo	Separate surfactant or vehicle effects
Extract alone	Assess botanical contribution
Finished herbal shampoo	Test complete formulation
Positive control	Confirm assay responsiveness
Replicates	Estimate variability and reproducibility

STABILITY, PRESERVATION AND PACKAGING

Stability testing evaluates whether a shampoo maintains acceptable physical, chemical, and microbiological quality during storage. Relevant observations include appearance, colour, odour, pH, viscosity, precipitation, phase separation, and packaging compatibility. If a suitable marker can be measured, its content may be monitored over time. [12]

A short preliminary study can identify obvious instability but cannot establish a commercial shelf life. A planned stability protocol should define storage conditions, time points, test methods, acceptance criteria, and sample handling. Temperature cycling or other stress conditions may be useful where appropriate, but must be justified for the formulation.

Preservation is a critical issue because shampoos contain water and botanical materials. A preservative system should be selected according to applicable regulations and compatibility data. Microbial limits and, where required, preservative efficacy testing should be conducted using appropriate validated

methods. A product should not be considered safe merely because it looks or smells normal.

Packaging can affect essential-oil retention, oxidation, colour, odour, and product dispensing. Containers should be compatible with the formulation and protect it from foreseeable environmental exposure. The label should provide appropriate directions, warnings, batch details, and storage information according to applicable rules.

SAFETY AND QUALITY CONSIDERATIONS

Botanical ingredients can cause irritation or allergic contact reactions, and essential oils may be sensitizers, particularly when oxidized or used inappropriately. "Natural" is not a safety classification. Risk assessment should consider ingredient identity, concentration, exposure, intended user population, impurities, and foreseeable use.

Early development should include review of supplier safety data, ingredient specifications, residual-solvent concerns, and compatibility information. The final formulation should be evaluated for pH, microbial quality, stability, and scalp/skin tolerability using methods appropriate to the development stage. Eye exposure should be considered because shampoo can run into the eyes during use.

Human testing requires an appropriate ethical and regulatory framework, informed consent, defined inclusion and exclusion criteria, adverse-event monitoring, and a plan for stopping if irritation occurs. Animal testing should not be undertaken casually and must follow applicable institutional and legal requirements; validated non-animal approaches should be considered where appropriate.

Claims such as "cures dandruff," "zero side effects," "clinically proven," or "better than all chemical shampoos" require evidence and should not be used without adequate support. Product development should prioritize consumer safety, reproducibility, and transparent reporting.

REVIEW OF SELECTED LITERATURE

Published literature includes broad reviews of dandruff pathophysiology, studies of tea tree oil shampoo, and formulation reports describing polyherbal shampoos. These sources answer different questions and should not be treated as equivalent evidence. [1–11] The foundational reviews describe the multifactorial nature of dandruff [1– 3,11]; the tea tree oil study provides clinical evidence for one defined product [4]; and herbal-shampoo reviews and formulation reports describe ingredient selection and common evaluation parameters, but vary in the depth of standardization and clinical evidence 27 Nov 2026

Source	Focus	Interpretation
Schwartz et al. (2013) [1]	Dandruff/seborrhoeic dermatitis pathophysiology	Supports multifactorial disease model
Hay (2011) [2]	Malassezia and scalp conditions	Reviews organism–host relationship
Borda & Wikramanayake (2015) [3]	Comprehensive review	Summarizes clinical and biological factors
Satchell et al. (2002) [4]	5% tea tree oil shampoo trial	Clinical evidence for one specific product
Potluri et al. (2013) [5]	Herbs and shampoo evaluation	Overview of ingredients and tests
Revansiddappa et al. (2018) [6]	Herbal anti-dandruff shampoo formulation	Example of multi-herb formulation research
Katkale et al. (2024/2025) [7]	Polyherbal shampoo formulation	Reports physical and microbiological evaluation
Aloe/tulsi/Withania dataset (2024) [8]	Herbal extracts and Malassezia testing	Illustrates the need for controls and assay detail

The tea tree oil trial offers a stronger clinical design than many formulation-only reports, but its findings should be limited to the tested product and population. Polyherbal studies can inform ingredient selection and evaluation methods, yet some reports provide limited standardization, incomplete controls, or no clinical

outcomes. This evidence pattern supports a careful development plan rather than a broad claim that all herbal shampoos are

effective. [4,6–10]

The present review therefore emphasizes method transparency, standardized botanical materials, relevant antifungal testing, safety evaluation, and a distinction between proposed work and published findings.

PROPOSED RESEARCH WORKFLOW AND DATA ANALYSIS

A reproducible project can be divided into phases: literature review; raw-material selection and authentication; extract preparation; preliminary phytochemical assessment; prototype formulation; physicochemical evaluation; antifungal screening; stability testing; and interpretation. Each phase should have predefined objectives and records.

Phase 1: Define the intended product, target population, and measurable outcomes.

Phase 2: Select a small number of botanicals based on evidence, availability, safety, and compatibility.

Phase 3: Standardize extracts and document the batch-to-batch profile.

Phase 4: Prepare a base shampoo and a limited set of prototypes using controlled variables.

Phase 5: Evaluate pH, viscosity, appearance, foam behaviour, wetting, detergency, and stability.

Phase 6: Conduct an appropriate antifungal assay with positive, negative, and vehicle controls.

Phase 7: Analyze results using suitable descriptive statistics and inferential tests where justified.

Results should be reported as mean with a suitable measure of variability, together with replicate number and statistical method. Do not invent or fill in results when experiments have not been conducted. If no experimental work has been performed, tables should be labelled as proposed study plans or literature summaries, not results.

A useful development decision considers several responses together. A formula with strong foam but poor stability or irritation is not an optimal product. A multi-criteria approach can rank prototypes based on acceptable pH, stable viscosity, good cleansing, low visible sediment, microbial quality, and reproducible antifungal activity.

RESEARCH GAP AND FUTURE SCOPE

A key limitation in herbal anti-dandruff shampoo literature is variation in plant identity, plant part, extraction solvent, extract concentration, surfactant base, and test methods. This makes direct comparison between studies difficult. Reports may also use the terms antimicrobial, antifungal, and anti-dandruff interchangeably even though they describe different endpoints.

Another gap is the difference between in-vitro findings and actual use. Laboratory inhibition does not demonstrate reduction in scalp flaking or itch. Clinical studies should assess standardized outcomes, appropriate comparators, tolerability, use frequency, and recurrence. Long-term data and systematic adverse-event reporting are particularly valuable.

Future work should prioritize: (i) botanical authentication and chemical fingerprinting; (ii) transparent reporting of extraction yield and marker content; (iii) formulation compatibility and preservation; (iv) Malassezia-relevant methods; (v) validated stability protocols; (vi) safety assessment; and (vii) well-designed clinical research where justified.

A smaller, standardized botanical combination may be preferable to a large mixture because it simplifies quality control and interpretation. Research should also evaluate the contribution of each ingredient and the finished product rather than attributing all observed activity to the herbal category as a whole.

ABBREVIATIONS AND ACKNOWLEDGEMENT

Abbreviation	Meaning
HPLC	High-performance liquid chromatography
HPTLC	High-performance thin-layer chromatography
MIC	Minimum inhibitory concentration
MBC	Minimum bactericidal concentration
QC	Quality control
pH	Measure related to acidity/alkalinity
SD	Standard deviation
ICH	International Council for Harmonisation

Abbreviation	Meaning
TLC	Thin-layer chromatography

CONCLUSION

Herbal anti-dandruff shampoos are a relevant area of cosmetic and pharmaceutical formulation research because botanical ingredients may contribute antifungal, conditioning, antioxidant, or soothing functions. Dandruff itself is multifactorial and involves interactions among Malassezia yeasts, sebum, scalp barrier function, and host susceptibility; it should not be described as a simple infection in every case.

A scientifically defensible formulation requires correct botanical authentication, standardized extraction, compatible surfactants and excipients, controlled pH and viscosity, effective preservation, suitable packaging, and systematic stability assessment. Evaluation should extend beyond visual appearance and foam to relevant antifungal testing, safety, and—if therapeutic claims are intended—clinical outcomes.

The available literature contains encouraging findings for selected ingredients, including a clinical trial of a 5% tea tree oil shampoo, but these results cannot be generalized to every herbal blend. Many polyherbal studies primarily report formulation properties and preliminary antimicrobial tests. Therefore, the finished product must be tested directly and claims must match the strength of evidence.

In conclusion, the most valuable future approach is a standardized, reproducible, and safety-focused herbal shampoo development program with appropriate controls and transparent reporting. This review provides a foundation for planning such work; it does not claim that a new formulation has already been prepared or experimentally validated.

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REFERENCES

1. Schwartz JR, Messenger AG, Tosti A, Todd G, Hordinsky M, Hay RJ, et al. A comprehensive pathophysiology ofdandruff and seborrheic dermatitis—towards a more precise definition of scalp health. Acta Dermato-Venereologica. 2013;93 (2):131–137. doi:10.2340/00015555-1382. Available at: https://pubmed.ncbi.nlm.nih.gov/22875203/
2. Hay RJ. Malassezia, dandruff and seborrhoeic dermatitis: an overview. British Journal of Dermatology.2011;165 (Suppl2):2–8.doi:10.1111/j.1365-2133.2011.10570.x.Available at:https://pubmed.ncbi.nlm.nih.gov/21919896/
3. Borda LJ, Wikramanayake TC. Seborrheic Dermatitis and Dandruff: A Comprehensive Review. Journal of Clinical & Investigative Dermatology. 2015;3 (2). doi:10.13188/2373-1044.1000019.Availabl at: https://pmc.ncbi.nlm.nih.gov/articles/PMC4852869/
4. Satchell AC, Saurajen A, Bell C, Barnetson RStC. Treatment of dandruff with 5% tea tree oil shampoo. Journal of the American Academy of Dermatology. 2002;47 (6):852–855. doi:10.1067/mjd.2002.122734. Available at: https://pubmed.ncbi.nlm.nih.gov/12451368/
5. Potluri A, Shaheda SKA, Rallapally N, Durrivel S, Harish G. A Review on Herbs Used in Anti-Dandruff Shampoo and Its Evaluation Parameters.

Research Journal of Topical and Cosmetic Sciences. 2013;4 (1):5–6.. Available at: https://indianjournals.com/article/rjtcs-4-1-002

6. Revansiddappa M, Sharadha R, Abbulu K. Formulation and evaluation of herbal anti-dandruff shampoo. Journal of Pharmacognosy and Phytochemistry. 2018;7 (4):764–767. Available at: https://www.phytojournal.com/archives/2018.v7.i4.5008/formulation-andevaluation-of-herbal-anti-dandruff-shampoo
7. Katkale A, Jadhav R, Sonawane S. Formulation and evaluation of polyherbal antidandruff shampoo. Research Journal of Topical and Cosmetic Sciences. 2024;15 (2):63–69. doi:10.52711/2321-5844.2024.00011. Available at: https://indianjournals.com/article/rjtcs-15-2-001
8. Experimental dataset on leaf-based extracted antidandruff shampoo derived from Aloe vera, Ocimum sanctum, and Withania somnifera: advancing Ethiopian local herbs via formulation. Data in Brief. 2024. Available at: https://pubmed.ncbi.nlm.nih.gov/39416715/
9. Formulation and Evaluation of Polyherbal Anti-Dandruff Shampoo. International Journal of Ayurvedic Medicine. Available at: https://www.ijam.co.in/index.php/ijam/article/view/2696
10. Formulation and Evaluation of Herbal Anti-Dandruff Shampoo. IJCOPE Journal. Available at: https://ijcope.org/article/formulation-and-evaluation-of-herbal-anti-dandruff-shampoo/
11. Wasim I, Mondal NS, Dey J, Saikia L, Law D, Sen S, et al. Seborrheic dermatitis and dandruff: an overview of pathogenesis, role of Malassezia spp., and natural treatment approaches. Journal of Medical
12. Mycology.2026;36 (1):101604.doi:10.1016/j.mycmed.2026.101604. Availableat:https://pubmed.ncbi.nlm.nih.gov/41616707/
13. International Council for Harmonisation. ICH Q1A (R2): Stability Testing of New Drug Substances and Products. Use as general background for stability principles; cosmetic requirements may differ by jurisdiction.
14. World Health Organization. Quality Control Methods for Herbal Materials. WHO Press. Use the current edition and applicable local guidance for herbal raw-material quality.
15. Carson CF, Hammer KA, Riley TV. Melaleuca alternifolia (Tea Tree) oil: a review of antimicrobial and other medicinal properties. Clinical Microbiology Reviews. 2006;19 (1):50–62. doi:10.1128/CMR.19.1.50-62.2006.
16. Gubitosa J, Rizzi V, Fini P, Cosma P. Hair care cosmetics: from traditional shampoo to solid clay and herbal shampoo, a review. Cosmetics. 2019;6 (1):13. doi:10.3390/cosmetics6010013.
17. Al Badi K, Khan SA. Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoos.
18. Arora P, Nanda A, Karan M. Shampoos based on synthetic ingredients vis-à-vis shampoos based on herbal ingredients: a review. International Journal of Pharmaceutical Sciences Review and Research. 2011;7 (1):42–46.
19. Carson CF, Riley TV. Antimicrobial activity of the major components of the essential oil of Melaleuca alternifolia.Journal of Applied Bacteriology. 1995;78 (3):264–269. doi:10.1111/j.1365-2672.1995.tb05025.x.
20. ainkar AR, Jolly CI. Evaluation of commercial herbal shampoos. International Journal of Cosmetic Science. 2000;22 (5):385–391. doi:10.1046/j.1467-2494.2000.00047.x.
21. Punyoyai C, Sirilun S, Chantawannakul P, Chaiyana W. Development of antidandruff shampoo from the fermented product of Ocimum sanctum Linn. Cosmetics. 2018;5 (3):43. doi:10.3390/cosmetics5030043.
22. Aburjai T, Natsheh FM. Plants used in cosmetics. Phytotherapy Research. 2003;17 (9):987–1000. doi:10.1002/ptr.1363.
23. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological activities and medicinal properties of neem (Azadirachta indica). Current Science. 2002;82 (11):1336–1345.

24. Natarajan V, Venugopal PV, Menon T. Effect of Azadirachta indica (neem) on dermatophytes. Indian Journal of Medical Microbiology. 2003;21 (2):98–101.
25. Dawson TL Jr. Malassezia globosa and restricta: breakthrough understanding of dandruff. Journal of Investigative Dermatology Symposium Proceedings. 2007;12 (2):15–19. doi:10.1038/sj.jidsymp.5650048.
26. International Organization for Standardization. ISO 11930:2019. Cosmetics—Microbiology—Evaluation of the antimicrobial protection of a cosmetic product. Geneva: ISO; 2019.
27. World Health Organization. Quality Control Methods for Herbal Materials. Geneva: World Health Organization; 2011.
28. Bakr RO, Amer RI, Fayed MAA, Ragab TIM. A completely polyherbal conditioning and antioxidant shampoo: a phytochemical study and pharmaceutical evaluation. Journal of Pharmaceutical and Bioallied Sciences. 019;11 (2):105–115. doi:10.4103/JPBS.JPBS_214

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