e - ISSN - 2249-7722
Print ISSN - 2249-7730

International Journal of Phytotherapy

www.phytotherapyjournal.com

DESIGN AND DEVELOPMENT OF ANTI-DANDRUFF SHAMPOO USING MULTIPLE HERBAL EXTRACTS

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ABSTRACT

Dandruff, primarily caused by the fungal infection Malassezia furfur, cannot be fully eliminated but can be effectively controlled. This study aims to formulate and evaluate a polyherbal anti-dandruff shampoo that not only cleans dirt and dandruff but also enhances hair softness, luster, and growth. The formulation eliminates harmful chemical ingredients that damage hair, replacing them with beneficial herbs such as Neem, Bhringraj, Shikakai, Tulsi, Aloe vera, Lemon juice, Ginger, Curry leaves, and Hibiscus. These ingredients collectively create an effective anti-dandruff shampoo that provides smooth, shiny hair and promotes hair growth. The prepared shampoo was subjected to various evaluation parameters, including visual inspection, pH, viscosity, dirt dispersion, surface tension, foaming ability, foam stability, antidandruff efficacy, and stability studies. The primary goal of this study is to develop and assess an anti-dandruff shampoo that addresses various hair issues without using harmful chemicals. Dandruff is a common scalp disorder caused by the yeast Pityrosporum, which leads to flaky scalp conditions. While dandruff cannot be completely eradicated, it can be managed and controlled with proper hair care products. Shampoos are essential for removing oils, dirt, skin particles, dandruff, environmental pollutants, and other contaminants that accumulate in hair. In this study, herbal anti-dandruff shampoos were formulated using natural ingredients like Lemon Grass Oil, Neem oil, Henna, and Aloe Vera gel. The formulated shampoos were evaluated based on visual inspection, pH, viscosity, percentage of solid contents, dirt dispersion, surface tension, foaming ability, and foam stability. The main objective was to eliminate harmful synthetic ingredients from anti-dandruff shampoo formulations and substitute them with safe, natural alternatives. This approach ensures an effective, safe, and natural solution for dandruff and hair care.

Keywords: Anti-dandruff shampoo, polyherbal formulation, Neem, Bhringraj, Shikakai, Aloe vera, natural ingredients, hair care, dandruff control, Malassezia furfur

INTRODUCTION

PLANTS

Plants are eukaryotes that belong to the kingdom Plantae. In other words, they use chloroplasts derived from endosymbiotic cyanobacteria to make sugars from carbon dioxide and water using the green pigment chlorophyll. Parasite plants, which lack chlorophyll and photosynthesis, obtain their energy from other plants or fungi. Grain, fruit, and vegetables are basic human foods that have been domesticated for millennia. Besides being used for building materials, ornaments, and writing materials, plants are also used for medicine in a wide variety of ways. Plants are studied scientifically by botany, a branch of biology [1].

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HERBAL PLANTS

In general use, herbs are a widely distributed and widespread group of plants, excluding vegetables and other plants consumed for macronutrients, with savory or aromatic properties that are used for flavoring and garnishing food, for medicinal purposes, or for fragrances. Culinary use typically distinguishes herbs from spices [2]. Herbs generally refers to the leafy green or flowering parts of a plant (either fresh or dried), while spices are usually dried and produced from other parts of the plant, including seeds, bark, roots and fruits [3].

Uses

- Culinary
- Teas
- Medicine
- Ritual
- Cosmetics
- Other

Strewing herbs are scattered (strewn) over the floors of dwelling places and other buildings. Such plants usually have fragrant or astringent smells, and many also serve as insecticides (e.g. to repel fleas) or disinfectants. For example, meadowsweet (Filipendula ulmaria) was sometimes strewn across floors in the Middle Ages because of its sweet smell [4- 7].

Hair

Hair is a protein filament that grows from follicles found in the dermis. Hair is one of the defining characteristics of mammals. The human body, apart from areas of glabrous skin, is covered in follicles which produce thick terminal and fine vellus hair. Most common interest in hair is focused on hair growth, hair types, and hair care, but hair is also an important biomaterial primarily composed of protein, notably alpha-keratin.

Attitudes towards different forms of hair, such as hairstyles and hair removal, vary widely across different cultures and historical periods, but it is often used to indicate a person's personal beliefs or social position, such as their age, gender, or religion.

There are a number of disorders that are particular to the scalp. Symptoms may include:

- Abnormal odor
- Bleeding
- Bumps
- Caking skin buildup that appears white or another color than one's natural skin tone
- Chafes
- Clumps of hair falling out
- Clumpy flakes that do not easily slough off the scalp skin
- Dandruff and clumps
- Dry hair & scalp
- Excessive itchiness that doesn't go away with a few hair wash, redness of scalp skin
- Patches of thinning
- Pus-like drainage
- Shedding

Any of these symptoms may indicate a need for professional assistance from a dermatologist or trichologist for diagnosis.

Scalp skin can suffer from infestations of mites, lice, infections of the follicles or fungus. There could be allergic reactions to ingredients in chemical preparations applied to the hair, even ingredients from shampoo or conditioners. Common concerns surrounding dandruff (often associated with excessive sebum); psoriasis, eczema, or seborrheic dermatitis.

General hair loss

Some choose to shave their hair off entirely, while others may have an illness (such as a form of cancer—note that not every form of cancer or cancer treatment necessarily means one will lose their hair) that caused hair loss or led to a decision to shave the head.

Hair care and nutrition

Genetics and health are factors in healthy hair. Proper nutrition is important for hair health. The living part of hair is under the scalp skin where the hair root is housed in the hair follicle. The entire follicle and root are fed by a supply of arteries, and blood carries nutrients to the follicle/root. Any time an individual has any kind of health concern from stress, trauma, medications of various sorts, chronic medical conditions or medical conditions that come and then wane, heavy metals in waters and food, smoking etc. these and more can affect the hair, its growth, and its appearance.

When the body is under strain, it reprioritizes its processes. For example, the vital organs will be attended to first, meaning that healthy, oxygenated blood may not feed into the hair follicle, resulting in less healthy hair or a decline in growth rate. While not all hair growth issues stem from malnutrition, it is a valuable symptom in diagnosis.

The essential omega-3 fatty acids, protein, vitamin B12, and iron, found in fish sources, prevent a dry scalp and dull hair color. Dark green vegetables contain high amounts of vitamins A and C, which help with production of sebum and provide a natural hair conditioner. Legumes provide protein to promote hair growth and also contain iron, zinc, and biotin. Biotin functions to activate certain enzymes that aid in metabolism of carbon dioxide as well as protein, fats, and carbohydrates. A deficiency in biotin intake can cause brittle hair and can lead to hair loss. In order to avoid a deficiency, individuals can find sources of biotin in cereal-grain products, liver, egg yolk, soy flour, and yeast. Nuts contain high sources of selenium and therefore are important for a healthy scalp. Alpha-linolenic acid and zinc are also found in some nuts and help condition the hair and prevent hair shedding that can be caused by a lack of zinc.

Protein deficiencies or low-quality protein can produce weak and brittle hair, and can eventually result in loss of hair color. Dairy products are good sources of calcium, a key component for hair growth. A balanced diet is extremely necessary for a healthy scalp and furthermore healthy hair [6].

Shampoo

Shampoo (/ʃæmˈpuː/) is a hair care product, typically in the form of a viscous liquid, that is used for cleaning hair. Less commonly, shampoo is available in solid bar format. Shampoo is used by applying it to wet hair, massaging the product into the scalp, and then rinsing it out. Some users may follow a shampooing with the use of hair conditioner. Shampoo is typically used to remove the unwanted build-up of sebum (natural oils) in the hair without stripping out so much as to make hair unmanageable. Shampoo is generally made by combining a surfactant, most often sodium lauryl sulfate or sodium laureth sulfate, with a co-surfactant, most often cocamidopropyl betaine in water. The sulfate ingredient acts as a surfactant, trapping oils and other contaminants, similarly to soap. Shampoos are marketed to people with hair. There are also shampoos intended for animals that may contain insecticides or other medications to treat skin conditions or parasite infestations such as fleas.

TYPES

Shampoos can be classified into four main categories:

Deep cleansing shampoos, sometimes marketed under descriptions such as volumizing, clarifying, balancing, oil control, or thickening, which have a slightly higher amount of detergent and create a lot of foam;

- conditioning shampoos, sometimes marketed under descriptions such as moisturizing, 2-in-1, smoothing, anti-frizz, color care, and hydrating, which contain an ingredient like silicone or polyquaternium-10 to smooth the hair;
- baby shampoos, sometimes marketed as tear-free, which contain less detergent and produce less foam; and
- anti-dandruff shampoos, which are medicated to reduce dandruff.

Composition

Typical liquid shampoo

Shampoo is generally made by combining a surfactant, most often sodium lauryl sulfate or sodium laureth sulfate, with a co-surfactant, most often cocamidopropyl betaine in water to form a thick, viscous liquid. Other essential ingredients include salt (sodium chloride), which is used to adjust the viscosity, a preservative and fragrance. Other ingredients are generally included in shampoo formulations to maximize the following qualities.

- pleasing foam
- ease of rinsing
- minimal skin and eye irritation
- thick or creamy feeling
- pleasant fragrance
- low toxicity
- good biodegradability
- slight acidity (pH less than 7)
- no damage to hair
- repair of damage already done to hair[howcom/health/herbs-for-hair-growth#herbal-hair-oils.

Specialized shampoos

Dandruff

Cosmetic companies have developed shampoos specifically for those who have dandruff. These contain fungicides such as ketoconazole, zinc pyrithione and selenium disulfide, which reduce loose dander by killing fungi like Malassezia furfur. Coal tar and salicylate derivatives are often used as well. Alternatives to medicated shampoos are available for people who wish to avoid synthetic fungicides. Such shampoos often use tea tree oil, essential oils or herbal extracts.

Colored hair

Many companies have also developed color-protection shampoos suitable for colored hair; some of these shampoos contain gentle cleansers according to their manufacturers. Shampoos for color-treated hair are a type of moisturizing shampoo.

Baby

Shampoo for infants and young children is formulated so that it is less irritating and usually less prone to produce a stinging or burning sensation if it were to get into the eyes. For example, Johnson's Baby Shampoo advertises under the premise of "No More Tears". This is accomplished by one or more of the following formulation strategies.

1. Dilution, in case the product comes in contact with eyes after running off the top of the head with minimal further dilution
2. Adjusting pH to that of non-stress tears, approximately 7, which may be a higher pH than that of shampoos which are pH adjusted for skin or hair effects, and lower than that of shampoo made of soap
3. Use of surfactants which, alone or in combination, are less irritating than those used in other shampoos (e.g. Sodium lauroamphoacetate)
4. User of nonionic surfactants of the form of polyethoxylated synthetic glycolipids and

polyethoxylated synthetic monoglycerides, which counteract the eye sting of other surfactants without producing the anesthetizing effect of alkyl polyethoxylates or alkylphenol polyethoxylates.

MATERIALS AND METHODS

A collection of herbals samples

There are several parts of the plants chosen for the study that have properties that are proven to be effective in hair care.

Almost all of the ingredients for this recipe were purchased from the local market. Listed below are the herb lists that were used in the formulations presented in Table 1.

Table 1: Herbal ingredients used in the formulation of the product

S. No	Drug Name	Part of Plant	Weight taken	Main Use
1	Tulsi	Fresh Leaves	20gm	Antifungal/ Antibacterial agent
2	Aloe Vera	Latex of Leaves	20 gm	Soothing agent
3	Neem	Fresh Leaves	20 gm	Antifungal/ Antibacterial
4	Hibiscus	Fresh Leaves	5 gm	Antifungal/ Antibacterial agent
5	Bhringraj	Powder of Leaves	5 gm	Antifungal/ Antibacterial agent
6	Curry Leaves	Fresh Leaves	5 gm	Antifungal/ Antibacterial agent
7	Shikakai	Leaves	20 gm	Nourish follicles
8	Ginger	Rhizome	5 gm	Hair growth
9	Lemon Juice	Fresh Ripe Fruit Juice	2 ml	Preservative, antifungal

Making Plant Extracts: The Process of Preparation

A simple decoction process was used to prepare the composition in order to make it as effective as possible. A digital balance was used to accurately weigh all the herbs used in the preparation. As can be seen in Table 1, the amount of herbs used for this experiment can be found there. A collection of crude herbs was taken, and these ingredients were then individually ground to powder using a hand operated mixer. After passing the fine powder through sieve no.120, the powder was mixed with 100ml of distilled water, and then boiled until the water had been reduced to one quarter. In the final stage of extraction, after the extract has been boiled and cooled to room temperature, the extract has been filtered with muslin cloth, and the filtrate has been collected.

Formulation of Herbal Shampoo

All the herbs (Table 1.) extract, 2 ml each was measured accurately and added in 100ml beaker and mixed with the help of magnetic stirrer. Guar gum weighed and was triturated separately with small quantity of water with help of mortar and pestle. In beaker containing uniform herbal extract solution, guar gum was added and stir to get uniform mixture subsequently other required ingredients were added and mixed. Sodium chloride was added to adjust the pH near to neutral which is compatible to skin. The final antidandruff mixture was stored in suitable plastic container and used for further evaluation parameters. Table 2.

Table 2: Formulation of an anti-dandruff shampoo based on poly herbal extracts

S. No.	Ingredients	Qty (50ml)	Role
1	Herbal extract(Table 1)	12ml	Anti-dandruff/ Antifungal / Antibacterial agent
2	Sodium Laurel Sulphate	3gm	Surfactant
3	Guar gum	1gm	Stabilizer
4	NaCl (0.1M)	q.s.	pH Neutralizer
5	Glycerin	1ml	Humectant
6	Vitamin E	400mg	Antioxidant
7	Lavender oil	2 drops	Flavouring agent
8	Water	q.s.(to 50ml)	Diluent/vehicle

Evaluation Parameters for Antidandruff Shampoo

Organoleptic properties

The formulations that have been developed were evaluated for their color, physical state, odor, and solubility using a manual test [8].

pH

It was decided to prepare 10% v/v shampoo solution in distilled water for the purpose of measuring the pH of the solution at room temperature with a pH meter and found that it was between 30±2°C [9].

Determination of percentage solids contents

A clean, dry dish was weighed and then 4 grams of shampoo were added to the dish. A dish containing shampoo was weighed after it had been washed and dried. A calculation was made to determine the exact weight of the shampoo. It was decided to place the dish with shampoo on the hot plate until the liquid portion of the shampoo had evaporated. This weight was calculated after the drying process was completed [10].

Wetting time (sec)

There was taken a cotton ball with a weight of about 0.4gm and added to the container containing shampoo by adding it to the container. A wetting time measurement was made based on the time that it took for cotton to sink at the bottom of the formulation [11].

Viscosity

The resistance to flow index was determined using a Brookfield viscometer DV-II + Pro located at room temperature i.e. 30 degrees Celsius with varying RPMs and torques at room temperature.

Surface tension measurement

Using distilled water, dilute the shampoo to a concentration of 10% using distilled water. It was conducted using stalagnometers in order to make the measurements [12].

Foam formation/Foam stability

There was a cylinder shake method that was used. It is necessary to take 25 ml of 1% shampoo solution in a graduated cylinder (one ml in 100 ml of water), shake vigorously for ten minutes and record the amount of foam that is produced after one minute. 4-5 minutes after the foam has been formed, take note of its stability [13, 14].

In-vitro anti-dandruff activity

This study was conducted using the well diffusion assay method. By using an agar well diffusion assay method, the antimicrobial efficacy of polyherbal anti dandruff shampoo was evaluated against Malassezia furfur. Using a sterilized stainless steel cork borer and a 500µl suspension of fungal cells, 8mm diameter wells were created on the Sabouraud Dextrose Agar (SDA) plates containing the fungal cells suspension. There were 20µl of each shampoo poured into the wells, and each well was filled with the shampoo. There was an incubation period of 48 hours at 35 ºC ± 2 to see whether any inhibition zones were present around the wells of the plates. A digital antibiotic zone reader was used to measure the diameter of the inhibition zones from the images taken using digital antibiotic zone reader [15, 16].

Stability studies

The stability studies were performed in accordance with the ICH guidelines for accelerated testing, with the modifications that were required. As a result, a sample taken of the formulation was taken and stored at room temperature (30 ± 2°C) and in the refrigerator (4 ± 2°C) for a period of one month. Physical appearance, pH, viscosity, percentage cleaning effect, and foam stability were all measured in the samples for each product.

RESULTS AND DISCUSSION

Evaluation Parameters for Antidandruff Shampoo

Organoleptic properties

The formulations that have been developed were evaluated for their color, physical state, odor, and solubility using a manual test.

Table 3: Organoleptic properties

Parameter	**Observation**
Color	Light brown
Odor	Lavender like
Clarity	Non-transparent
Appearance	Viscous

pH

pH was measured at room temperature using a calibrated digital pH meter for the polyherbal anti-dandruff shampoo.

The recorded pH values for the shown below he table.

Table 4: Determination of pH

Parameter	Observation
pH	6.1
% Solid content	29%
Wetting time	13 sec

Viscosity	3700 cps at 50 rpm
Surface tension	34.16 dyne/cm
Foam formation and foam stability	20 ml, stable foam

As long as the pH of the shampoo is maintained within this range, this will protect the scalp's acid mantle, a natural barrier that provides protection against and fungal infections on the scalp.

Determination of percentage solids contents

An important parameter that plays a crucial role in evaluating a shampoo formulation's quality and consistency is the percentage solids content. Routine monitoring of this parameter during production is imperative to ensure that the product continues to provide effective relief from dandruff and other symptoms.

Wetting time (sec)

Wetting time of a shampoo is an important factor that indicates how well it penetrates and spreads through the hair and scalp. It was established through the use of a standardized method that the wetting time of a polyherbal anti-dandruff shampoo was determined. Herbal formulations utilize natural surfactants, which not only reduce wetting time but also minimize scalp irritation and dryness through a gentler alternative to synthetic surfactants.

Viscosity

The viscosity of the formulated polyherbal anti-dandruff shampoo at 30°C was measured using a Brookfield viscometer. Furthermore, it is the rheological behavior of this shampoo that makes it easy to apply and retain on the scalp and hair while still remaining stable and clinging to them during use. It is characterized by shear-thinning properties, which allow this shampoo to flow easily when applied.

Surface tension measurement

An anti-dandruff shampoo formulated with polyherbal ingredients was measured at room temperature for its surface tension. The polyherbal anti-dandruff shampoo had a significant surface tension reduction when compared with distilled water, suggesting the presence of surfactants.

Foam formation/Foam stability

Foam formation and Foam stability values are shown below the table, A polyherbal anti-dandruff shampoo's foam formation and stability are important indicators of its performance. There was good foam formation with the polyherbal shampoo. Nevertheless, the shampoo's foam volume was within acceptable ranges, indicating that it can effectively clean the scalp and hair.

In-vitro anti-dandruff activity

The agar-well diffusion method was used to assess the antifungal activity of the antidandruff formulation. The polyherbal antidandruff formulation possesses inhibitory activity against M. furfur. This antimalassezial activity was observed with ZOI value 20 mm. Therefore, the topical use of polyherbal antidandruff shampoo is useful in the treatment of dandruff.

Stability studies

Stability of formulation: It was checked for selected parameters (Table 4) after the interval of one month. There was marginal increase in pH reported for the developed formulation with increase in temperature, i.e. at 45±2ºC after one month. When % cleansing action was assessed for developed formulation after one month, it was evident that % cleansing action was dropped at negligible level. Overall stability of shampoo developed from natural ingredients was good at a temperature ranging between 4 to 42ºC (18). Stability of prepared antidandruff shampoo formulation was checked for particular parameters after the interval of one month. Table 4. There was slight decrease in pH reported for the developed formulation with increase in temperature, i.e. at 45±2º after one month. When % cleansing action was assessed for developed formulation after one month, it was evident that % cleansing action was slightly increased. Overall stability of polyherbal antidandruff shampoo was good at a temperature ranging between 4 to 42ºC (9, 10, 11).

Table 5: Stability studies

Evaluation parameters	Before 1 month	After 1 month
Color	Light brown	No Change
Odor	Pleasant	No Change
Transparency	Thick	No Change
pH	6.1 ± 0.4	6.2 ± 0.4
Wetting time	13 sec	12.3 sec
Solid content	29 ± 3%	29 ± 2%
Foam volume	20 ± 3ml	21 ± 2ml

Surface tension	34.16±0.3 dyne/cm	34.27±0.3 dyne/cm

CONCLUSION

The aim of developing a stable and effective herbal anti-dandruff shampoo while minimizing synthetic ingredients was successfully achieved in this study. The formulated herbal shampoo demonstrated significant anti-dandruff and antimicrobial properties, effectively preventing dandruff and scalp infections. Although the formulation includes a small amount (6%) of the synthetic ingredient sodium lauryl sulfate, this concentration is significantly lower than that found in conventional synthetic shampoos and remains within safe, acceptable limits. The shampoo's pH of approximately 6.3, close to neutral, indicates good compatibility with the skin. Evaluation studies revealed that the herbal shampoo possesses excellent wetting ability, rinsing action, foam stability, and dirt dispersion activity. These positive attributes, combined with its antimicrobial efficacy, highlight the success of the polyherbal anti-dandruff formulation developed in this research. This study underscores the potential of herbal ingredients in creating effective and safer personal care products

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