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FORMULATION AND EVALUATION OF A POLYHERBAL ANTI-DANDRUFF SHAMPOO CONTAINING EXTRACTS OF *Clitoria ternatea* FLOWERS, *Urtica dioica* LEAVES AND *Nigella sativa* SEEDS

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ABSTRACT

The present study aimed to formulate and evaluate a polyherbal anti-dandruff shampoo incorporating *Clitoria ternatea*, *Urtica dioica*, and *Nigella sativa* extracts with a herbal base prepared from Reetha (*Sapindus mukorossi*), Shikakai (*Acacia concinna*), and Bhringraj (*Eclipta alba*). The herbal base was prepared as an aqueous decoction (Kwatha) and combined with the selected extracts and suitable excipients, including xanthan gum, glycerin, phenoxyethanol, and citric acid. The prepared shampoo was evaluated for organoleptic, physicochemical, and performance characteristics, including appearance, odour, consistency, texture, pH, foam volume, foam stability, wetting time, dirt dispersion, percentage solid content, surface tension, spreadability, washability, relative viscosity, and stability. The formulation exhibited a bluish-brown colour, smooth and homogeneous texture, pleasant herbal odour, and moderately viscous consistency with satisfactory performance characteristics. The formulation was also evaluated for its potential antifungal activity against *Malassezia furfur*. The findings suggest that the developed formulation is a promising polyherbal shampoo combining natural cleansing agents with selected herbal extracts for scalp hygiene and potential anti-dandruff application.

KEYWORDS: Polyherbal shampoo, anti-dandruff, *Malassezia furfur*, *Clitoria ternatea*, *Urtica dioica*, *Nigella sativa*.

1. INTRODUCTION

Hair is an important component of the human body and plays both protective and cosmetic roles. It is an epidermal derivative formed from the ectoderm during embryonic development and is closely associated with structures such as hair follicles, sebaceous glands, and sweat glands. In addition to its biological functions, scalp hair has considerable social and aesthetic importance and contributes significantly to an individual's appearance and self-confidence. Throughout history, hair has been styled, cut, coloured, and treated using various cosmetic preparations, demonstrating its importance in personal grooming and cultural practices.[1,2]

Maintaining clean and healthy hair requires the regular removal of excess sebum, sweat, dead cells, environmental dust, and cosmetic residues. Shampoo is one of the most widely used cosmetic preparations for cleansing the hair and scalp. Modern shampoos are designed not only to remove impurities but also to improve hair appearance, softness, manageability, and shine. Depending on their composition, shampoos may contain synthetic surfactants, conditioning agents, preservatives, fragrances, and other functional ingredients. In recent years, increasing attention has been given to herbal shampoos containing plant-derived ingredients because of their traditional use and potential compatibility with the hair and scalp.[3]

Herbal shampoos commonly incorporate natural cleansing agents and medicinal plants with reported antioxidant, antimicrobial, anti-inflammatory, and conditioning properties. Plants such as Reetha (*Sapindus mukorossi*) and Shikakai (*Acacia concinna*) are traditionally used for cleansing because of their natural saponin content. Bhringraj (*Eclipta alba*), *Clitoria ternatea*, *Urtica dioica*, and *Nigella sativa* have also attracted attention because of their traditional and reported applications in hair and scalp care. The combination of multiple herbs in a single formulation may provide complementary cleansing and scalp-supporting effects.[4,5]

METHODOLOGY

4.1 Materials

The materials used for the formulation of the polyherbal anti-dandruff shampoo included herbal drugs, herbal extracts, excipients, and distilled water. Reetha (*Sapindus mukorossi*),

Shikakai (*Acacia concinna*), and Bhringraj (*Eclipta alba*) powders were used to prepare the herbal decoction (Kwatha). The herbal extracts used were *Clitoria ternatea* extract, *Urtica dioica* glycerin extract, and *Nigella sativa* extract. Xanthan gum, glycerin, phenoxyethanol, citric acid, and distilled water were used as formulation excipients.

4.2 Preparation of Herbal Kwatha (Decoction)[7-9]

The herbal decoction was prepared using Reetha, Shikakai, and Bhringraj powders in a 3:2:1 ratio.

Table 1: 1 Composition of Herbal Kwatha.

Ingredient	Quantity
Reetha powder	15 g
Shikakai powder	10 g
Bhringraj powder	5 g
Distilled water	150 ml
Final Kwatha obtained	Approximately 75 ml

The accurately weighed powders of Reetha, Shikakai, and Bhringraj were mixed thoroughly. The mixed herbal powder was transferred into a suitable beaker containing 150 mL of distilled water. The mixture was heated at approximately **80–90°C for 30–40 minutes** with intermittent stirring until the volume was reduced to approximately **70 ml**.

The prepared decoction was allowed to cool to room temperature and filtered initially through a double-layer muslin cloth to remove coarse particles. The filtrate was subsequently passed through Whatman No. 1 filter paper to obtain a clear herbal decoction. The filtered Kwatha was used as the herbal base for the preparation of the polyherbal shampoo.

4.2 Formulation of Polyherbal Anti-Dandruff Shampoo

Table 2: Formulation of Polyherbal Anti-Dandruff Shampoo.

Ingredient	Quantity
Herbal Kwatha	70 ml
Clitoria ternatea extract	10 ml
Urtica dioica glycerin extract	5 ml
Nigella sativa extract	5 ml
Xanthan gum	0.5 g
Glycerin	2 ml
Phenoxyethanol	0.8 ml
Citric acid solution	q.s.
Distilled water	q.s. to 100 ml

4.4 Method of Preparation of Polyherbal Anti-Dandruff Shampoo

Xanthan gum (0.5 g) was dispersed in 20 ml of distilled water and allowed to hydrate for 20–30 minutes. The prepared herbal Kwatha was added with continuous stirring to obtain a uniform base. *Clitoria ternatea* extract (10 ml), *Urtica dioica* glycerin extract (5 ml), and *Nigella sativa* extract (5 ml) were incorporated sequentially with stirring for 10–15 minutes. Glycerin (2 ml) and phenoxyethanol (0.8 ml) were added, and the pH was adjusted to 5.0–5.5 using citric acid solution. Distilled water was added to make the final volume 100 ml, and the formulation was stirred until homogeneous. The prepared shampoo was transferred into clean, dry, amber-coloured polyethene bottles, labelled, tightly closed, and stored at room temperature until evaluation.

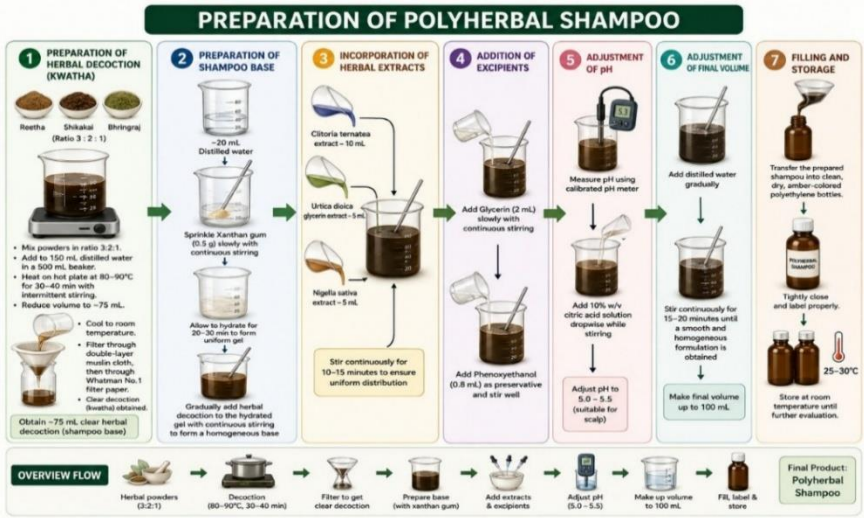


Fig. 1: Method of Preparation of Polyherbal Anti-Dandruff Shampoo.

4.5 Evaluation of Polyherbal Anti-Dandruff Shampoo

The prepared polyherbal shampoo was evaluated for its organoleptic, physicochemical, and performance characteristics.

The following parameters were evaluated:

4.5.1 Organoleptic Evaluation[10]

The formulation was visually examined for appearance, colour, odour, consistency, and texture.

4.5.2 Determination of pH[11]

The pH of the prepared shampoo was determined using a calibrated digital pH meter.

Prepare a 10% w/v shampoo solution by dissolving 10 g of shampoo in 100ml of distilled

water. Calibrate the pH meter using standard buffer solutions (pH 4.0 and 7.0). Immerse the electrode into the shampoo solution. Wait until the reading stabilises. Record the pH. Repeat the determination three times and calculate the average value.

4.5.3 Determination of Relative Viscosity[11]

The relative viscosity of the shampoo formulation was determined using an Ostwald viscometer by comparing its flow time with that of distilled water.

4.5.4 Determination of Percentage Solid Content[11]

Weigh the empty dish (W_1). Add approximately 4g of shampoo and record the weight (W_2). Dry the sample at 105°C until constant weight. Cool in a desiccator. Record the final weight (W_3). Calculate the percentage solid content.

4.5.5 Determination of Surface Tension[12]

Prepare a 10% shampoo solution. Fill the stalagmometer with distilled water. Count the number of drops formed between the two calibration marks. Repeat with the shampoo solution. Calculate the surface tension using the standard formula.

4.5.6 Foam Volume[10]

Transfer 1ml of shampoo into a 50ml graduated cylinder. Add distilled water to make the volume up to 50ml. Stopper the cylinder and shake vigorously 10 times. Immediately measure the foam height or foam volume. Repeat the test three times.

4.5.7 Foam Stability[10]

Perform the foamability test. Record the initial foam volume. Allow the cylinder to stand undisturbed for 5 minutes. Measure the remaining foam height. Record the observations.

4.5.8 Wetting Time[13]

Wetting time was determined by measuring the time required for a standard canvas disc to become completely wetted and sink in the diluted shampoo solution.

4.5.9 Dirt Dispersion[11]

The shampoo's dirt-dispersion ability was evaluated by adding ink to the shampoo solution and observing the distribution of ink between the foam and aqueous phases.

4.5.10 Spreadability[12]

Place 1g of shampoo between two glass slides. Apply a 100g weight for 5 minutes. Attach a 2g weight to the upper slide. Measure the time taken to travel 7.5cm. Calculate spreadability.

4.5.11 In-vitro anti-dandruff assay by agar-well diffusion[3,14]

The antifungal activity of the prepared polyherbal anti-dandruff shampoo was evaluated by observing the inhibition of *Malassezia furfur* growth around the wells containing the test formulations. Using SDA agar, the formation of a clear zone surrounding a well indicated inhibition of fungal growth. The diameter of the zone of inhibition was measured in millimetres (mm), with a larger zone indicating greater antifungal activity of the formulation. The optimised polyherbal shampoo was diluted with sterile distilled water to obtain three concentrations of 5%, 10%, and 15% w/v, designated as F1, F2, and F3, respectively. The antifungal activity was compared with a 2% ketoconazole preparation as the positive control.

5.1 RESULTS AND DISCUSSION

Table 1: Organoleptic Evaluation.

Parameter	Observation
Appearance	Bluish-brown, smooth, semi-opaque, and homogeneous; free from visible particles and phase separation.
Odour	Pleasant, mild herbal odour with characteristic earthy notes.
Consistency	Smooth and moderately viscous.
Texture	Soft, smooth, and homogeneous; free from visible aggregates.

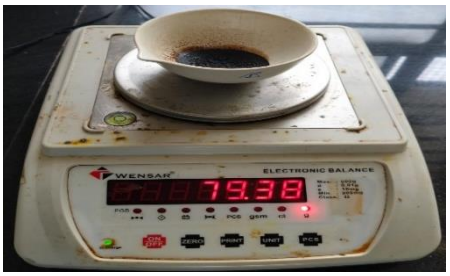
The formulated polyherbal anti-dandruff shampoo was evaluated for appearance, odour, consistency, and texture. The observations are presented in Table 1.

5.2. Physicochemical Evaluation

The physicochemical properties of the formulated shampoo were evaluated to assess its pH, solid content, surface tension, and viscosity.

Table 2: Physicochemical Evaluation.

Parameter	Result and discussion	Figures
pH	The formulated shampoo exhibited a mean pH of **5.06 ± 0.01**, indicating a mildly acidic formulation. This pH is within the commonly preferred range for hair and scalp products and may help maintain scalp compatibility.	

Percentage solid content	The mean solid content was **24.58 ± 0.14%**, indicating the proportion of non-volatile material present in the formulation. Solid content is an important physicochemical parameter for evaluating shampoo composition and application characteristics.	
Surface tension	The mean surface tension was **39.0 ± 0.2 dynes/cm**, suggesting that the formulation reduced the surface tension of water. This property is relevant to the wetting and cleansing characteristics of the shampoo.	

Relative viscosity

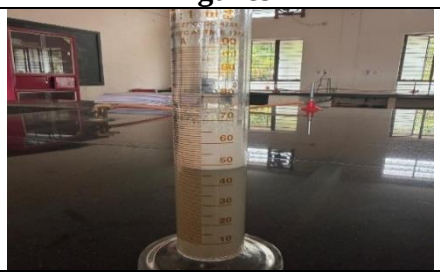
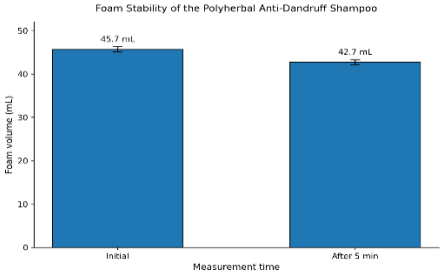
Table 3: Evaluation of viscosity.

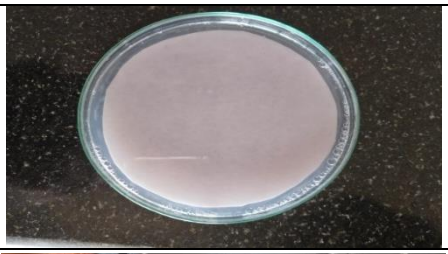
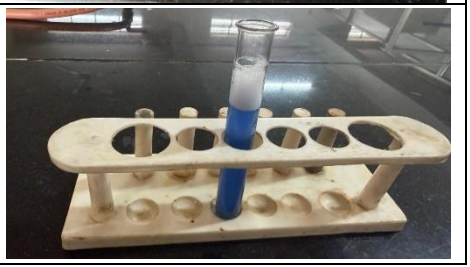
Parameter	Distilled water	Shampoo
Mean flow time	61.8 seconds	150.0 seconds
Density	1.00 g/mL	1.03 g/mL

The relative viscosity of the formulated shampoo was determined using an Ostwald viscometer. The mean flow times of distilled water and shampoo were 61.8 seconds and 150.0 seconds, respectively. Based on their densities and flow times, the relative viscosity was calculated as 2.50 (dimensionless). This indicates that the shampoo exhibited greater resistance to flow than distilled water under the test conditions.

5.3 Evaluation of Cleansing and Foaming Properties

Table 4: Evaluation of Cleansing and Foaming Properties.

Parameter	Result and discussion	Figures
Foam volume	The mean foam volume was **80.00 ± 1.00 ml**, indicating good foam-forming ability under the experimental conditions. Foam formation contributes to the consumer acceptability of shampoo, although it does not directly establish cleansing efficacy.	
Foam stability	The mean initial foam volume was **45.7 ± 0.6 ml**, which decreased to **42.7 ± 0.6 ml** after 5 minutes. The calculated foam retention was approximately **93.4%**, indicating that most of the foam was retained during the observation period.	

Wetting time	The mean wetting time was **17.0 ± 1.0 seconds**. Wetting time indicates how quickly the formulation facilitates wetting under the specified test conditions; a shorter time generally indicates better wetting ability.	
Dirt dispersion	The formulation showed **Grade A dirt dispersion**, with negligible ink retained in the foam. This suggests that most of the dispersed ink remained in the liquid phase rather than the foam, which is a desirable observation in the dirt dispersion test.	

5.4 In-vitro Anti-dandruff assay by Agar-well diffusion

Table 5: In-vitro Anti-dandruff assay by Agar-well diffusion.

Sample	Treatment / Formulation	Zone of Inhibition (mm)
A	Negative control	0 mm
B	Positive control (Ketoconazole 2%)	24 mm
C	Shampoo formulation F1(5%)	18 mm
D	Shampoo formulation F2(10%)	20 mm
E	Shampoo formulation F3(15%)	22 mm

The optimised polyherbal shampoo was diluted with sterile distilled water to obtain three concentrations of 5%, 10%, and 15% w/v, designated as F1, F2, and F3, respectively. The antifungal activity was compared with a 2% ketoconazole preparation as the positive control. The in-vitro antifungal activity of the polyherbal anti-dandruff shampoo is presented in Table 5, The negative control showed no zone of inhibition (0 mm), confirming the absence of inhibition in the control. The 2% ketoconazole positive control produced a 24 mm zone, demonstrating strong antifungal activity. The shampoo formulations showed a concentration-dependent increase in inhibition, with F1 (5%) showing 18 mm, F2 (10%) showing 20 mm, and F3 (15%) showing the highest zone of 22 mm. The observed activity may be attributed to the combined bioactive constituents of *Clitoria ternatea*, *Urtica dioica*, and *Nigella sativa*. Overall, F3 (15%) demonstrated the best antifungal activity among the tested shampoo formulations, although its inhibition zone was slightly lower than that of ketoconazole.

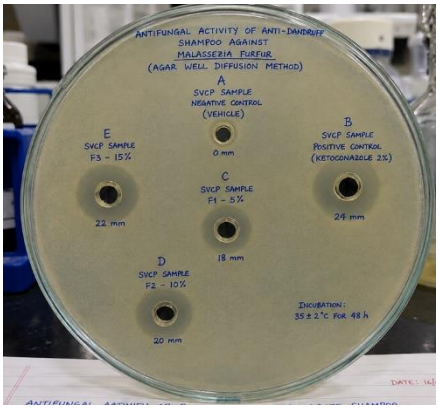


Fig. 2: Evaluation of the antifungal activity against M. furfur well diffusion assay.

CONCLUSION

The polyherbal anti-dandruff shampoo was successfully formulated using **Reetha, Shikakai, Bhringraj, *Clitoria ternatea*, *Urtica dioica*, and *Nigella sativa***. The prepared formulation was evaluated for various physicochemical and performance parameters, including organoleptic properties, pH, solid content, surface tension, foamability, foam stability, wetting time, dirt dispersion, spreadability, viscosity, washability, and stability. The formulation showed satisfactory physical characteristics with a **pH of 5.06, solid content of 24.58%, wetting time of 17.0 seconds, relative viscosity of 2.50, and surface tension of 39.0 dynes/cm**. In-vitro antifungal evaluation demonstrated concentration-dependent activity, with **F3 (15%) showing the highest inhibition zone of 22 mm**, compared with **24 mm for 2% ketoconazole**. Overall, the developed polyherbal shampoo demonstrated acceptable physicochemical properties and promising anti-dandruff activity, indicating its potential as a plant-based herbal shampoo formulation.

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