

Formulation and Evaluation of Polyherbal Antidandruff Shampoo

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Abstract: *Background: Dandruff is a common scalp disorder caused mainly by Malassezia species, leading to itching, irritation, dryness, and hair fall. Synthetic anti-dandruff shampoos may cause side effects such as scalp irritation, dryness, and hair damage after prolonged use. Hence, herbal shampoos are gaining importance due to their safety, effectiveness, and eco-friendly nature. Objective: To formulate and evaluate a polyherbal anti-dandruff shampoo using Reetha (Sapindus mukorossi), Methi seeds (Trigonella foenum-graecum), and Dagadi pala (Tridax procumbens) extracts and to assess its physicochemical and antifungal properties. Materials and Methods: The herbal extracts were prepared using decoction and maceration methods. Preliminary phytochemical screening was carried out to identify the presence of active constituents. Nine formulations (F1–F9) of polyherbal shampoo were prepared using different concentrations of guar gum and citric acid. The formulations were evaluated for physical appearance, pH, foaming ability, dirt dispersion, percentage solid content, viscosity, wetting time, washability, skin irritation, stability, and antifungal activity against Malassezia furfur. Results and Discussion: All formulations showed acceptable physicochemical properties with pH, good foam stability, satisfactory cleansing ability, suitable viscosity, and no skin irritation. Phytochemical studies confirmed the presence of important bioactive constituents responsible for cleansing and antifungal activity. Among all formulations, batch F5 showed optimum viscosity, foam stability, dirt dispersion, wetting time, and significant antifungal activity against Malassezia furfur. The mildly acidic pH helped maintain scalp health and reduce hair damage. Conclusion: The formulated polyherbal anti-dandruff shampoo was found to be safe, stable, economical, and effective for routine hair care. Effective batch F5 exhibited the best overall performance and can be considered a promising natural alternative to synthetic anti-dandruff shampoos with minimal side effects.*

Keywords: Polyherbal shampoo; Anti-dandruff shampoo; Sapindus mukorossi; Trigonella foenum-graecum; Tridax procumbens; Antifungal activity- Malassezia furfur; Herbal formulation.

I. INTRODUCTION

The word cosmetic was derived from the Greek word “kosm tikos” meaning having the power, arrange, skill in decorating. The origin of cosmetics was associated with hunting, fighting, religion, superstition and associated with medicine herbal cosmetics, here in after reoffered as product, are formulated using various permissible cosmetic ingredients form in which one or more herbal ingredients used called as “Herbal cosmetics”.¹

Different types of hairs

Hair is a keratinized filament that grows from hair follicles present in the skin. Hair protects the scalp, helps in temperature regulation, and enhances appearance. Hair can be classified according to curl pattern, texture, and thickness.



- A. Straight Hair (Type I)
- B. Wavy Hair (Type II)
- C. Curly Hair (Type III)

Ideal characteristic of herbal shampoo¹⁰

- Should effectively and completely remove the dust, excessive sebum.
- Should effectively wash hair.
- Should produce a good amount of foam
- The shampoo should be easily removed by rinsing with water.
- Should leave the hair non dry, soft, lustrous with good, manageability.

Advantages Over Synthetic Shampoo

Table 1. Advantages and disadvantages Over Synthetic Shampoo

Advantages	Disadvantages
Made from natural herbal ingredients	Works slowly compared to chemical shampoos
Fewer side effects compared to chemical shampoos	May not remove severe dandruff quickly
Helps reduce dandruff and scalp infection	Needs regular and long-term use for results
Gentle on scalp and suitable for sensitive skin.	Short shelf life in some herbal products

Dandruff is a common scalp disorder characterized by excessive shedding of dead skin cells from the scalp, often associated with itching, irritation, and fungal infection mainly caused by *Malassezia* species. Synthetic anti-dandruff shampoos available in the market may produce side effects such as scalp irritation, dryness, and hair damage after prolonged use. Therefore, herbal shampoos have gained significant importance due to their better safety profile, biodegradability, and minimal adverse effects. Herbal formulations contain natural ingredients possessing cleansing, antifungal, antimicrobial, conditioning, and nourishing properties that help maintain healthy hair and scalp.¹²

Need of Study:

In the present project, preparation and evaluation of polyherbal anti-dandruff shampoo using Reetha (*Sapindus mukorossi*), Methi seeds (*Trigonella foenum-graecum* L.), and Dagadi pala (*Tridax procumbens* L.). The combination of these herbal ingredients provides natural cleansing, anti-dandruff action, scalp nourishment, and hair conditioning without the harmful effects associated with synthetic chemicals. Hence, polyherbal anti-dandruff shampoos are considered safer, economical, and eco-friendly alternatives for routine hair care.

II. LITERATURE OF REVIEW

1. N.Devi et al. (2018) The origin of cosmetics forms a continuous narrative Throughout the history of man as they developed. The man in prehistoric times 3000 BC used colours for decoration to attract the Animals that he wished to hunt and also the man survived attack from the enemy by colouring his skin and adorned his body for protection to Provoke fear in an enemy (whether man or animal). The origin of Cosmetics was associated with hunting, fighting, religion and superstition and later associated with medicine.

2. Lekshmi M.S Panicker et al. (2023) Antidandruff shampoos are designed to help those who suffer from dandruff, a common scalp condition that causes flakes of dead skin to appear. These shampoos work by targeting the yeast or fungus that can lead to flakiness. They may contain ingredients such as salicylic acid, coal tar, or selenium sulphide. For the formulation of the herbal shampoo, we use natural ingredients like tea tree oil, mango extract, neem. To get the most benefit from an anti-dandruff shampoo, it's important to use it consistently and follow the instructions carefully. With regular use, many people find relief from dandruff symptoms.



3. Gayatri M. Penkar et al. (2023) Hair is a thread-like structure numerous found in vertebrates. It is also considered as one of the symbols of beauty in humans. In this expeditious world, many problems associated with face, nails, hair etc. are seen. The provided information emphasizes on various herbal ingredient that owns numerous benefits for hairs and related hair complications in humans. Among various problems, people are experiencing many hairs related problems such as hair loss, split ends, dandruff, increased sebum production, hair thinning. The synthetic or the chemical products causes side effects and adverse effects when used, thus now people have high approach towards organic natural and herbal formulations that tends to show minimum side effects. Generally, herbal preparations are known for its “no side effects” property. Utilization of herbal components is extending progressively.

4. Sunil Baile’s et al. (2024) A weed that grows wild across India is *Tridax procumbens* Linn. The plant was introduced to tropical Africa, Asia, and Australia from tropical America, where it is native. The results of the phytochemical screening indicated the presence of tannins, alkaloids, carotenoids, flavonoids, fumaric acid, and sitosterol. Ca-rotenoids, saponins, oleanolic acid, and ions like sodium, potassium, and calcium are abundantly present in it. Its blooms have been found to contain glucoluteolin, quercetin, and isoquercetin. It is well-known for a variety of pharmacological effects, including hepatoprotective, anti-inflammatory, wound-healing, antidiabetic, hypotensive, immunomodulating, anti-cancer, antioxidant, bronchial catarrh, dysentery, diarrhoea, and antimicrobial activity against both gram-positive and gram negative bacteria. It also prevents hair loss and stimulates hair growth. Conjunctivitis may be treated with the use of the leaf juice's antiseptic, insecticidal, and parasiticidal capabilities. It can also be used as an insect repellent and to stop bleeding from cuts, bruises, and wounds. This study focuses on the plant *Tridax procumbens*' widespread phytochemical composition and pharmacological properties.

III. AIM AND OBJECTIVES

Aim:

To formulate and evaluate the polyherbal antidandruff shampoo.

Objectives of Study :

Prepare and standardize extracts of Reetha (*Sapindus mukorossi*)-fruit part, Methi seeds (*Trigonella foenum-graecum* L.), and Dagadi pala (*Tridax procumbens* L.) using suitable extraction methods.

- To perform preliminary phytochemical screening of the extracts to identify major bioactive constituents such as saponins, flavonoids, alkaloids, tannins, and glycosides.
- To formulate a polyherbal shampoo using the prepared extracts in different ratios and optimize the formulation for desired physicochemical properties.
- To evaluate physicochemical parameters of the formulated shampoo including pH, viscosity, foaming ability, wetting time, dirt dispersion, and stability.
- To assess in-vitro anti-dandruff (antifungal) activity of the individual extracts and the formulated shampoo against dandruff-causing organisms (e.g., *Malassezia* species) using suitable methods.
- To compare the anti-dandruff efficacy of the polyherbal shampoo with standard antifungal agents (e.g., ketoconazole-based formulations).

IV. PLAN OF THE WORK

1. Collection of Materials and Methodology for preparation of polyherbal antidandruff shampoo
2. Formulation of polyherbal antidandruff shampoo.
3. Characterization and Evaluation of formulated polyherbal antidandruff shampoo.
4. Discussion and Conclusion.
5. Dissertation writing and Submission of the Research Work
6. Publication of the Research Work.



V. MATERIAL AND METHODS

Methods of Extraction

1) Collection and authentication: - The Dagadi Pala (*Tridax procumbens* L.) leaves and stem are collected from local area of Shri Ganpati institute of pharmaceutical sciences and research, Tembhurni. The Methi seeds (*Trigonella foenum-graecum* L.) and Reetha (*Sapindus mukorossi*) collected from local market. Authentication was done by Department of botany at Department of Botany, Walchand College of Arts and Science (Autonomous), Walchand Hirachand Marg, Ashok Chowk, Solapur- 06 (MS).

2) Plant material drying and powdering: The newly gathered Dagadi Pala (*Tridax procumbens* L.) leaves from plant were washed. The fresh leaves of the plant, reetha fruit and methi seeds were blended into a coarse powder using a mixer, after being dried in the shade for approximately two weeks and kept at 25°C.

3) Preparation of extract:

a. Decoction- Crushing dried reetha (*Sapindus mukorossi*) peel into powder with the granularity of 20- 80 meshes, 10gm of powder adding 100ml of water, and uniformly stirring at the temperature of 40- 60°C. After cooling filter using muslin cloth, the extract and stored in a bottle in freeze at 20-25°C.16



Figure 1. Extraction process of Reetha

b. Crushing methi seeds (*Trigonella foenum-graecum* L.) into powder with the granularity of 20- 80 meshes, 30gm powder adding 250ml were subjected to methanol extraction at room temperature through a maceration process lasting 7 days. After extraction, the blend was filtered and evaporated to dryness at a regulated temperature between 30 and 40°C. The obtained extract was placed in an airtight container in the fridge for future analysis. 17

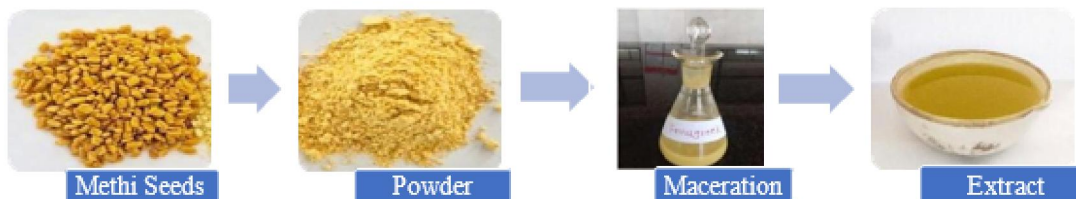


Figure 2. Extraction Process of Methi Seeds

c. The Dagadi Pala (*Tridax procumbens* L.) leaves powder were subjected to methanol extraction at room temperature through a maceration process lasting 7 days. After extraction, the blend was filtered and evaporated to dryness at a regulated temperature between 30 and 40°C. The obtained extract was placed in an airtight container in the fridge for future analysis.xvi





Figure 3. Extraction Process of Dagadi Pala

4) Phytochemical screening:

For initial phytochemical assessment, the freshly prepared crude leaves extracts of *P. guajava* L. and fruit extract of reetha and methi seeds extract were tested to determine the existence of phytoconstituents like reducing sugars, tannins, flavonoids, saponins steroids and alkaloids etc. through standard phytochemical methods.18

Formulation of polyherbal antidandruff shampoo

VI. FORMULATION TABLE

Table 2. Formulation Table

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9
Guar Gum (%)	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	0.75
Citric Acid (%)	0.10	0.10	0.10	0.2	0.20	0.20	0.30	0.30	0.30
<i>Tridax procumbens</i> L. (%)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
<i>Sapindus mukorossi</i> (%)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
<i>Trigonella foenum-graecum</i> L. (%)	5	5	5	5	5	5	5	5	5
Glycerin (%)	1	1	1	1	1	1	1	1	1
Preservative- Methyl paraben (%)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Essential Oil (Almond) (%)	Few drops (3 to 4 drops)								
Water q.s. to	50 ml	50 ml	50 ml	50 ml	50 ml	50 ml	50 ml	50 ml	50 ml

Procedure for herbal shampoo formulation19 :- A herbal shampoo formulation procedure using guar gum, methyl paraben, glycerine, citric acid, and herbal extracts (Dagadi pala, Reetha, Methi seeds). This type of procedure is based on standard shampoo formulation methods Required quantity of deionized water was heated to 65–70°C in a water bath. Methyl paraben was added and dissolve completely. Guar gum was slowly dispersed with continuous stirring to form a uniform gel base. The mixture was cooled to 50–55°C, then with gentle stirring to avoid excess foam formation. After that, Dagadi Pala, Reetha, and Methi seeds extracts were incorporated and mixed thoroughly. Glycerine was added as a humectant. Citric acid solution was added dropwise to adjust the pH to 5.5–6.5. Finally, a few drops of essential oil were added, and the volume was made up with deionized water to 50ml. The preparation was stirred well to obtain a uniform consistency.

VII. EVALUATION PARAMETER 20,21

1. **Physical appearance:** The attractiveness of shampoos for consumers tends to be judged visually to observe clarity, colour, odour it shows physical appearance of the formulation.
2. **pH:** The pH levels of the shampoo tested in 1% and 10% solutions were evaluated using a pH meter at a room temperature of 25±2 °C.



3. **Dirt dispersion:** 1% solution of shampoo solution with water from that 10 ml of diluted shampoo was taken and 1 drop of India ink was added; the test tube was stoppered and shaken 10 times. The amount of ink in the foam was estimated as none, light, moderate, or heavy. Shampoos that cause the ink to concentrate in the foam are considered poor quality. The dirt should remain in the water portion. Dirt that remains in the foam will be difficult to rinse away and will be redeposited on the hair.
4. **Foaming ability and foaming stability:** The cylinder shake method is the most widely used method for determining foaming ability. At room temperature, 50 ml of the shampoo solution was filled into a 250 ml graduated cylinder, which was then covered by hand and shaken ten times. The total volume of the foam content after 60 sec of shaking was recorded. The height of the foam generated was measured immediately. To evaluate foam stability, the same procedure was performed and the foam volume after 20 min was measured.
5. **Percentage of solid contents:** Four grams of formulated shampoo was placed onto a clean, dry evaporating dish. The evaporating dish holding the shampoo was weighed using electronic balance, and the total weight was recorded as W_1 . Then, the evaporating dish was placed on the hot air oven at 50 °C and was kept until the liquid content was completely evaporated. Finally, the cooled evaporating dish holding the solid content was weighed and recorded as W_2 . The percentage (%) of the solid content was calculated as $[(W_1 - W_2) \div W_1] \times 100$.
6. **Rheological evaluation:** The viscosity of the shampoo was calculated by using Brookfield viscometer.
7. **Wetting Time:** Wetting time of a substance is a function of its concentration. Drave's test is the official test but generally canvas disc method is used as it is easy and time saving. First, prepare a 1% shampoo solution by mixing 1 mL of shampoo with 99 mL of distilled water. Then take 50 mL of this prepared solution in a beaker. Carefully place a canvas paper disc on the surface of the solution and start the stopwatch immediately. Note the time required for the disc to sink completely. Repeat the same procedure three times and calculate the average sinking time.
8. **Skin Irritation Test:** Prepared polyherbal anti-dandruff shampoo was applied on skin for 5 minutes after washed and test for irritation or inflammation on the skin.
9. **Washability:** Wash your hands after applying of shampoo to hand.

VII. RESULTS AND DISCUSSION

Phytoconstituents screening (Identification Test)

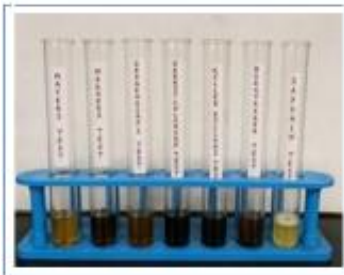
Table 3. Phytochemical Evaluation

Sr No.	Phytochemical Constituents	Name of the test	<i>Sapindus mukorossi</i> Extract (Decoction)	<i>Trigonella foenum-graecum</i> L. methanolic extract	<i>Tridax procumbens</i> L. leaves methanolic extract
1	Alkaloids	Mayers test	+	+	-
		Dragondraff test	+	+	+
		Wagner Test	+	+	+
2	Carbohydrates	Molish Test	+	+	+
		Benedicts Test	+	+	+
3	Tannins	FeCl ₃ test	+	+	+
4	Glycosides	Killer killani test	+	+	+
5	Saponins	Foam test	+	+	-
6	Flavonoids	Ammonia test	+	+	+
7	Phenols	Ferric chloride	+	+	+
8	Coumarin	Sodium chloride test	-	+	+



9	Flavones	Shinoda Test	-	+	+
10	Anthraquinone	Borntrager's test	-	-	-

(+ = Present, - = Absent)



Reetha



Methi Seeds



Dagadi Pala

Figure 4. Phytochemical Screening

Physical appearance:

Table 4. Physical appearance results

Parameter	F1	F2	F3	F4	F5	F6	F7	F8	F9
Color	Brown								
Odour	Characteristic								
Clarity	Homogenous and Smooth								

pH

The pH of shampoo is an important parameter for maintaining hair and scalp health. It helps to improve hair-quality, reduce eye irritation, and maintain the natural ecological balance of the scalp. Nowadays, shampoos with suitable pH are preferred because they help in minimizing hair damage. Mildly acidic shampoos prevent swelling of hair fibres and tighten the cuticle scales, which gives smoothness and shine to the hair. In the present study, all shampoo formulations were found to be acid balanced, with pH values ranging from 5.5 to 6.5, which is close to the natural pH of scalp. (Table 7.)



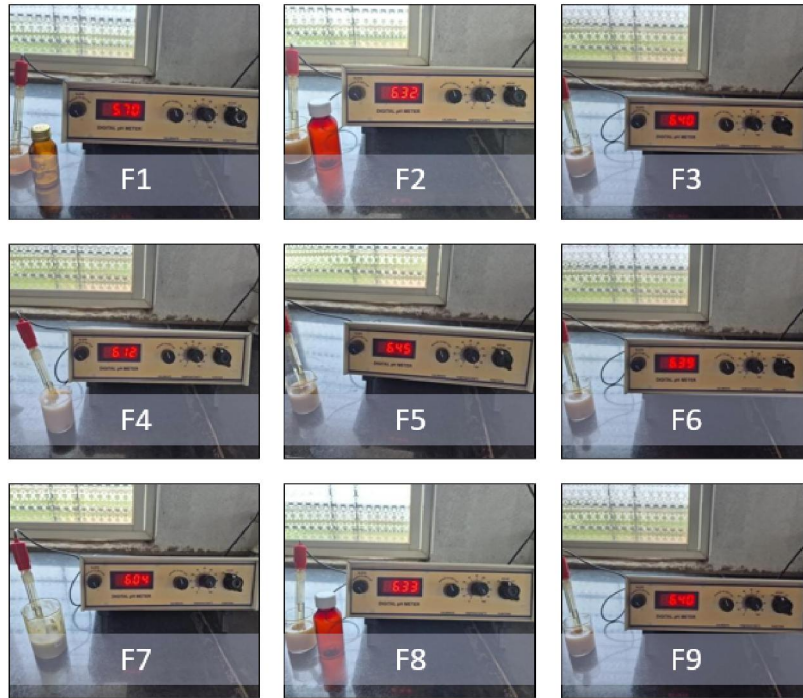


Figure 5. Results of pH test

Dirt Dispersion Test: . Effective formulations show little to no ink in the foam, keeping dirt in the water, which indicates superior cleaning. (Table 7.)

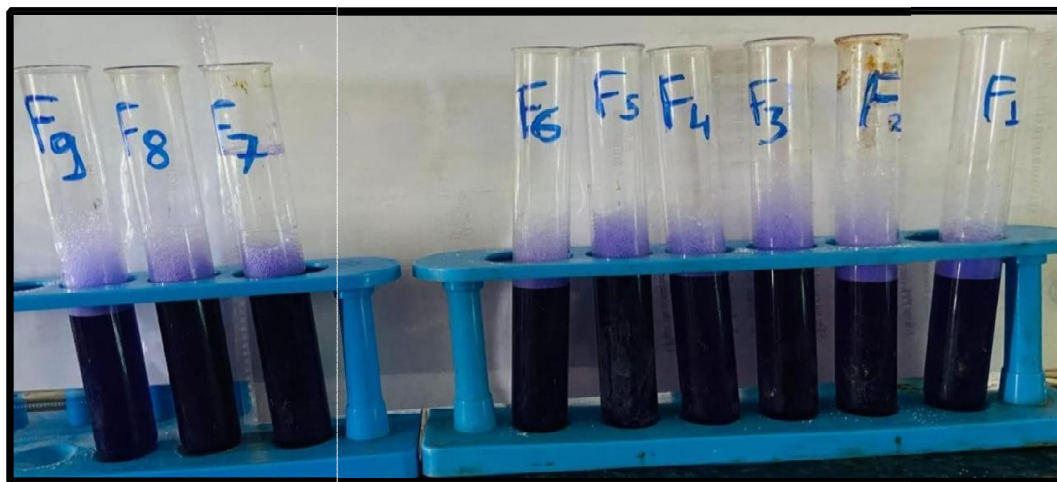


Figure 6. Dirt Dispersion Test



Foaming ability: A high-quality shampoo should maintain at least foam that persists for at least 5 minutes. (Table 7.)

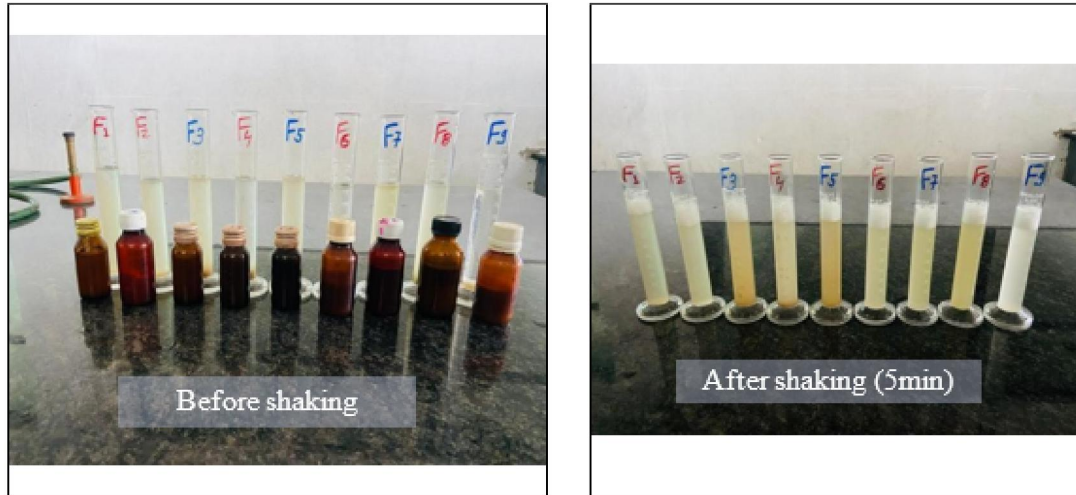


Figure 6. Result for foaming test

Percentage of solid contents: For a high-quality, stable, and easily washable herbal shampoo, the ideal percentage of solid content ranges between 20%- 30%. (Table 7.)

Rheological evaluation: Brookfield Viscometer Spindle No.3 RV-C model-According to the literature, optimal herbal shampoos typically have a viscosity limit ranging between 2,000 to 4,000 mPa•s (or 2 to 4 Pa•s). This range is pseudoplastic (shear-thinning), allowing the shampoo to be easily poured from the bottle but thick enough to stay on the hands and hair during application. (Table 7.)

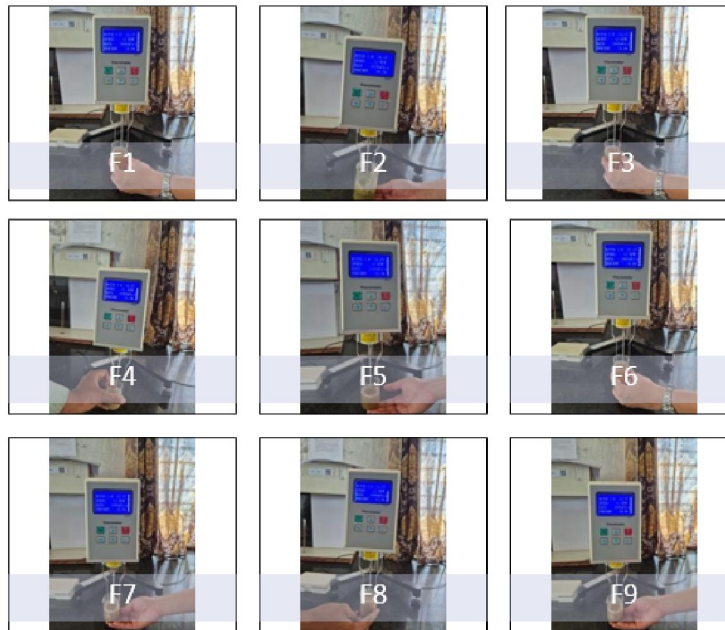


Figure 7. Results of viscosity test



Wetting time: Wetting ability determines how quickly a shampoo can spread across the hair, penetrate the scalp, and displace dirt and oil. (Table 7.)

Fast Wetting (< 10 seconds): Highly effective at penetrating hair cuticles and removing grime, which is more typical of synthetic or heavily formulated shampoos. **Moderate Wetting (10–30 seconds):** Highly common in safe, well-balanced herbal shampoos. It indicates a gentler formula utilizing natural surfactants (like Reetha/Soapnut) rather than harsh synthetic chemicals.

Practical Application: When washing, you should leave the lather on the scalp for about 1 to 2 minutes. This gives the herbal surfactants enough time to fully wet the scalp, dissolve oils, and distribute beneficial plant extracts.

Table 5. Results for pH, dirt dispersion, foam test, percentage of solid contents, viscosity and wetting time of 9 formulation

Parameters	F1	F2	F3	F4	F5	F6	F7	F8	F9
pH	5.70	6.32	6.40	6.12	6.45	6.39	6.04	6.33	6.40
Dirt Dispersion	Light	Light	Moderate	Light	Light	Light	Light	Moderate	Light
Foam Height (ml)	12.5	13	12.5	11.8	12.7	11.3	10.2	11.5	12
Percentage of solid contents(%)	22.3	24.30	26.40	25.53	22.45	24.32	26.59	26.54	25.56
Viscosity (mPa.s)	2440	3420	2480	4380	2310	2425	3349	4380	3990
Wetting Time (sec.)	25	28	26	24	22	27	29	25	23

Skin Irritation Test: Prepared polyherbal anti-dandruff shampoo was applied on skin for 5 minutes after washed and test for irritation or inflammation on the skin. All formulation found to be no any redness, itching, swelling and irritation. (Figure 16)

Washability: Wash your hands after applying of shampoo to hand. While cleaning well, good washability ensures the hair is not stripped of its natural moisture, maintaining softness and manageability. (Figure 16)



Figure 8. Result of Skin irritation and washability test



**Antifungal Activity (In vitro Antidandruff activity Malassezia Furfur ATCC-14521):
Malassezia Furfur ATCC-14521**

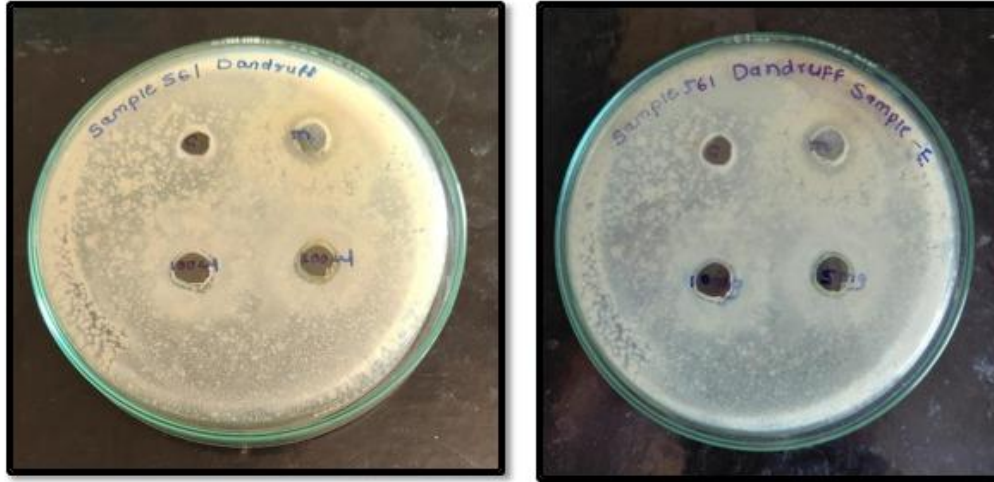


Figure 9. Antifungal test F5 Batch Figure 10. Antifungal test of Tridax procumbens L.leaves extract
Table 6. Antifungal Activity of Sample–F5 and Extract Against Malassezia furfur by Zone of Inhibition Method

Sr. No.	Sample	Concentration	Zone of Inhibition (mm) <i>M. furfur</i>
1.	Control		
2.	Standard Ketoconazole	1mg/ml	14
3	Sample -F5	100µl	05
		200µl	07
4	Sample -Extract	5mg	07
		10mg	12

Conclusion of Antifungal result: The study concludes that both Sample– F9 and the extract possess antifungal activity against Malassezia furfur. The extract showed comparatively better activity than F9, while Ketoconazole demonstrated the higher antifungal effect. The findings suggest that the extract may serve as a potential natural antifungal agent.

Stability Testing: After one month

All formulations remained physically and chemically stable throughout the storage period of 1 month. Among all formulations, batch F5 showed better stability and maintained optimum physicochemical characteristics during the study period.

Table 7. Results for Stability Testing

Parameters Evaluated	Initial Observation	Observation After 1 Month	Result
Colour	Brown	No change	Stable
Odour	Characteristic	No change	Stable
Appearance	Homogeneous and smooth	No change	Stable
pH	5.5 – 6.5	No significant change	Stable
Foam Stability	Good foam stability	Maintained	Stable
Viscosity	Acceptable consistency	No significant change	Stable
Phase Separation	Absent	Absent	Stable
Precipitation	Absent	Absent	Stable



Skin Irritation	No irritation observed	No irritation observed	Safe
Microbial Growth	Not observed	Not observed	Stable

Discussion:

The present study successfully formulated and evaluated a polyherbal anti-dandruff shampoo containing Reetha, Methi seeds, and Dagadi pala (*Tridax procumbens*). The prepared formulations showed acceptable physicochemical characteristics and good cleansing properties. Phytochemical screening confirmed the presence of important active constituents such as alkaloids, saponins, flavonoids, glycosides, tannins, and phenolic compounds in the herbal extracts. These phytoconstituents are responsible for the cleansing, foaming, antifungal, conditioning, and anti-dandruff activities of the formulation.

The shampoo formulations exhibited:

- Good foaming ability and foam stability
- Acceptable dirt dispersion property
- Smooth texture and pleasant appearance
- Proper cleansing action
- Good conditioning effect on hair
- Suitable viscosity for easy application and stable.

Overall, the developed herbal anti-dandruff shampoo demonstrated good quality, stability, safety, and effectiveness for routine hair cleansing and scalp care

IX. CONCLUSION

The present study successfully formulated and evaluated a polyherbal anti-dandruff shampoo containing Reetha (*Sapindus mukorossi*), Methi seeds (*Trigonella foenum-graecum* L.), and Dagadi pala (*Tridax procumbens* L.) extracts. The prepared formulations demonstrated satisfactory physicochemical properties such as suitable pH, good foaming ability, acceptable viscosity, effective dirt dispersion, washability, and stability. Phytochemical screening confirmed the presence of bioactive constituents responsible for antifungal, cleansing, conditioning, and scalp-nourishing activities. Among all the formulations, batch F5 showed the most effective overall performance with optimum viscosity, satisfactory foam stability, acceptable wetting time, and better antifungal activity against *Malassezia furfur*. The formulation was found to be safe, non-irritant, economical, and eco-friendly compared to synthetic shampoos. Therefore, the developed polyherbal anti-dandruff shampoo, particularly effective batch F5, can be considered a promising natural alternative for maintaining healthy hair and scalp with minimal side effects, which is natural, eco-friendly, and cost-effective.

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