

# DEVELOPMENT OF POLYHERBAL ANTI-DANDRUFF FORMULATION: AN APPROACH TO GREEN COSMETICS

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## Abstract

**Background:** Dandruff is a common scalp disorder caused by fungi of the genus *Malassezia*. Many anti-dandruff medications comprise keratinolytic agents and antimicrobial agents. Thus the main objective of this study aims to utilize different medicinal plant extracts to develop polyherbal shampoo by assessing physicochemical functions and antifungal property that emphasizes safety, and efficacy, eliminating unfavourable synthetic ingredients, and substituting them with safe natural ingredients.

**Materials and methods:** The formulation of polyherbal shampoo using the extracts in different proportions was prepared. Evaluation of organoleptic, physicochemical, and performance tests in terms of visual assessment, pH, assurance of solid contents, dirt dispersion, conditioning performance, foam volume, and stability was performed. The minimum inhibitory concentration for the *Malassezia globosa* was performed through the Agar Cup method at different concentrations to check the efficiency of 5 different concentrations of polyherbal formulations, and two marketed shampoos.

**Result:** The created cleanser was clear and good appealing. The physicochemical and antifungal evaluation of the formulated shampoo showed ideal results.

**Conclusion:** The present study in the field of cosmetics is a cost-effective approach to producing polyherbal shampoo which has substantial antidandruff potential with fewer side effects. The research produced a good herbal shampoo which can be added to the fleet of green cosmetics after clinical trials.

**Keywords:** Antidandruff; Nourishment; Herbal Shampoo; Green cosmetics.

## Introduction

This world believes in the concept of green pharmacy or green cosmetics, hence there is a huge scope for shampoo developed from natural origin. With the hastening pace of current life, the demand of operating pressure, increasing artificial dandruff and worried, the problem of dandruff has become and has been only second to alopecia and the second largest hair healthy problem that confuses the consumer.[1]Currently, shampoo is not

used for cleansing dirt on the hair and scalp but also promotes hair growth and prevents hair loss. Shampoos are mostly utilized as beautifying agents and are a viscous solution of detergents containing suitable additives preservatives and active ingredients. [ 2]

In the present world, the common problem related to hair globally is dandruff which produces flakes on the scalp skin and itching. *Malassezia restricta* and *M. globosa* are fungi that produce dandruff. *Malassezia* is a yeast that causes skin and scalp infections and was formerly known as *Pityrosporum-lipophilic* yeast. Redness, flakes, itching of the scalp, hair breakage, unexpected hair colour and skin discolouration are frequent symptoms.[3] Fungistatic compounds in anti-dandruff shampoos are known to manage dandruff. There are several anti-dandruff shampoos and scalp treatments on the market, all of which include ingredients that may cause negative effects. Synthetic shampoos have greater adverse effects and leave room for issues like itching, irritation, hair loss, and skin discolouration to reoccur.[4] Thus, herbal shampoo is used not only for cleansing the hair but also for conditioning and smoothing, the hair surface, and fine health of the hair.[5]

The present research deals with the preparation and assessment of Poly-herbal anti-dandruff formulations containing the goodness of Okra, Bhringraj, Ashwagandha, Marigold petal, Aloe vera gel, and Xanthan gum.

## Materials and methods

### A. Preparation of extract

Fresh plant materials as mentioned in table 1 were collected from the herbal garden of Adamas University, Kolkata. The plant materials were extracted by decoction method using water as solvent separately. Excipients and chemicals used in the formulation were of analytical grade.

Table 1: Ingredients used in the Polyherbal anti-dandruff shampoo

Common Name	Botanical name	Category
Okra Powder	<i>Abelmoschus esculentus</i>	Antidandruff activity and conditioning agent [6]
Bhringaraj Powder	<i>Eclipta alba</i>	Antidandruff activity[7]
Ashwagandha	<i>WithaniaSomnifera</i>	Hair growth promoter
Marigold Petal	<i>Tagetes erecta</i>	Antidandruff activity[8]
Shikakai	<i>Acacia concinna</i>	Antidandruff activity [9]
Tea tree oil	<i>Melaleuca alternifolia</i>	Antibacterial and antifungal [10]
Aloe vera	<i>Aloe barbadensis miller</i>	Hydration and nourishment [11]
Xanthan Gum	<i>Xanthomonas campestris.</i>	Thickening agent [12]

Two marketed shampoos were used as standards for evaluating the antifungal activity as indicated in table 2.

Table 2: List of marketed shampoos used as standards

Name of Anti-dandruff shampoo	Active Ingredients	Manufacturer
Head & Shoulders	Zinc Pyrithione	Procter & Gamble
Himalaya Herbals Anti-Dandruff Shampoo	Tree Tea Oil	Himalaya Herbals Healthcare

### B. Formulation of herbal shampoo:

The extracts were filtered using a muslin cloth separately. The filtrates were combined and incorporated with excipients to prepare polyherbal shampoo according to the novel formula. Different concentrations of ingredients were used for the preparation of five different formulas namely F1, F2, F3, F4, and F5 as shown in table 3.

Table 3: Formula of Polyherbal antidandruff shampoo.

Ingredients	F1	F2	F3	F4	F5
Okra extract	40ml	45ml	50ml	55ml	60ml
Bhringraj extract	2.5ml	2.0ml	1.5ml	1.0ml	0.5ml
Aswagandha extract	5.0 ml	5.0ml	5.0ml	5.0ml	5.0ml
Marigold extract	5.0ml	5.0ml	5.0ml	5.0ml	5.0ml
Shikakai extract	0.5ml	0.5ml	0.5ml	0.5ml	0.5ml
Aloe vera extract	1ml	1ml	1ml	1ml	1 ml
Xanthan Gum	2ml	2ml	2ml	2ml	2ml
Glycerin (ml)	5ml	5ml	5ml	5ml	5ml
Sodium Hydroxide	To adjust pH	To adjust pH	To adjust pH	To adjust pH	To adjust pH
Water	q.s	q.s	q.s	q.s	q.s
Rose oil	q.s	q.s	q.s	q.s	q.s
Total	100ml	100 ml	100ml	100ml	100ml

### C. Evaluation of formulated shampoo

Each prepared shampoo was evaluated for different parameters as stated below:

#### i) Physical Appearance/ Visual inspection:

The prepared herbal shampoos were evaluated by measuring the physical appearance such as colour, odour and clarity. [13]

#### ii) Physicochemical evaluation:

Physical and chemical evaluations of each formulated shampoo including determination of pH, solid content, and dirt dispersion were performed. [14]

### iii) pH determination:

The pH of 10% shampoo solutions in distilled water was determined at room temperature 25°C.[15]

### iv) Percentage of solids:

4 grams of each shampoo were placed in a clean, dry evaporating dish and weighed. An evaporating dish on a hot plate was used to evaporate the liquid portion of the shampoo. The dried solid contents were weighed. The percentage of solid contents of each shampoo was then calculated using the following equation:

$$\% \text{ of solid content} = [(A - B)/4] \times 100]$$

Where A was the total weight of the sample and evaporating dish after evaporation and B was the total weight before evaporation. The experiment was carried out in triplicate.[16].

v) **Foam productivity determination:** For 2 minutes, 10 ml of each shampoo was swirled in a graduated cylinder with a glass rod at a specific speed. The volume of foam created was immediately measured after shaking. The amount of foam produced was recorded at every 1min interval for 5 mins. [17]

### vi) Dirt Dispersion system:

Two drops of each shampoo were put into 5 big test tubes holding 10 ml of distilled water. 1 drop of Indian ink was applied to each test tube and shaken 10 times. The amount of ink in the foam was evaluated to be none, light, moderate, or excessive. A high concentration of shampoo suggested low quality. [18]

### vii) Stability:

The stability studies were performed by storing at different temperature conditions like 40°C, 25°C & 37°C for 4 weeks. The stability and acceptability of organoleptic properties (odour and colour) of formulations during the storage period of 2 months indicated that they are chemically and physically stable. [19]

### viii) Anti-fungal Activity

The Agar Cup technique was used to test the antifungal activity of shampoos. Dixon's medium was used to produce plates. This experiment relied on a two-day-old inoculation culture of *Malassezia globosa* in Dixon's broth. On the Petri plates, 500 L of culture suspension were dispersed. Each plate had a 0.6 cm diameter well in which 100 L of 100% concentrations of several test shampoos and a standard were introduced using a micro-pipette. Experiments were carried out in duplicate, with appropriate controls.[20]

### b. Minimum Inhibitory Concentration (MIC)

The agar cup method was used to perform MIC in Dixon's agar plates. This study made use of a 24-hour active culture of the test organisms. For inoculation, a culture of *Malassezia globosain* Dixon's broth was utilised and incubated at 30°C for 24 hours. The above-mentioned process was followed. 2.5%, 5%, 10%, 15%, 20%, 25%, 50%, 75%, and 100% (v/v) concentrations were used to determine the MIC for a specific sample. Distilled sterile water was used for the dilutions. Experiments were carried out in duplicate with appropriate controls.[21]

### c. Zone of Inhibition (ZOI)

ZOI was performed on Dixon's plates using the agar cup technique. A sterilised glass spreader was used to disseminate a 24-hour active culture across the surface of Dixon agar. All of the shampoos were dissolved in distilled sterile water. The same approach as described above was performed to verify the zone of inhibition, and the plates were incubated at 30 0C for 18 hours. The plates were examined after incubation. The inhibitory zone was measured and recorded using a zone-measuring scale.[22]

## Results

The physical appearance shown in table 4 indicated appropriate shampoo formulations.

Table 4: Physical appearance of test formulations

Formula tion	Colour	Transparency	Fragrance	*pH	Solid contents	Foam Type	Dirt Dispersion
F1	Light yellowish	Semi- Transparent	Characteristic	6.5	22.65%	Dense	Light
F2	Light yellowish	Semi- Transparent	Characteristic	6.5	21.56%	Dense	Light
F3	Light yellowish	Semi- Transparent	Characteristic	6.5	22.12%	Dense	Light
F4	Light yellowish	Semi- Transparent	Characteristic	6.5	21.15%	Dense	Light
F5	Light yellowish	Semi- Transparent	Characteristic	6.5	22.25%	Dense	Light

\*pH of the 10% solution

The physicochemical properties of the most stable formula i.e F4 have shown in table 5

Table 5: Physicochemical properties of F4 shampoo.

Days	Temperature	Appearance	Odour	Foamability	pH	Dirt Dispersion
Initial days	At 4 °C	Brown colour	Characteristic	Good	5.5	Light
	At RT			Good	5.0	Light
	At 45 °C			Good	4.9	Light
After 30 °C	At 4 °C	Brown colour	Characteristic	Good	4.8	Light
	At RT			Good	5.3	Light
	At 45 °C			Good	5.1	Light
After 60°C	At 4 °C	Brown colour	Characteristic	Good	5.8	Light
	At RT			Good	5.4	Light
	At 45 °C			Good	5.1	Light

RT: At room temperature

The foam Value of the prepared formulation of Shampoos shown in table 6 indicated that F4 is superior to other shampoos.

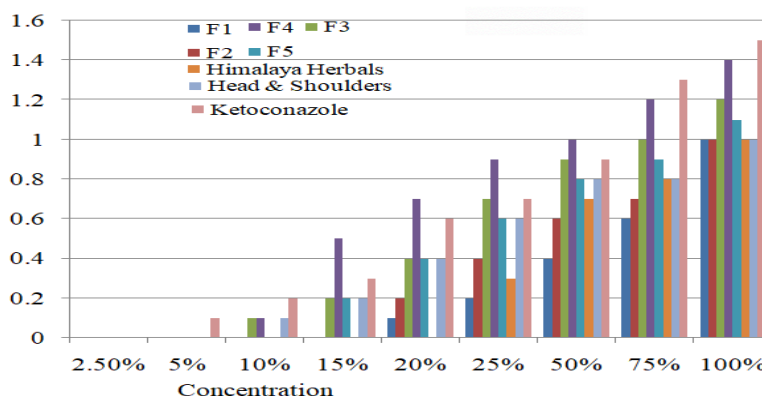
Table 6: Foam value of each shampoo

Time in minutes	Foam Volume (ml)				
	F1	F2	F3	F4	F5
1 min	-	170	140	160	170
2min	168	178	139	178	177
3min	167	175	134	176	174
4min	165	178	135	178	174
5min	166	175	135	174	173

**Broth microdilution method:**

The MIC was done to see what percentage of different shampoo concentrations might suppress the growth of *Malassezia globosa*. The results have been shown in figure 1 indicate test formulations particularly F4 have a higher zone of inhibition among all formulations including both standards.

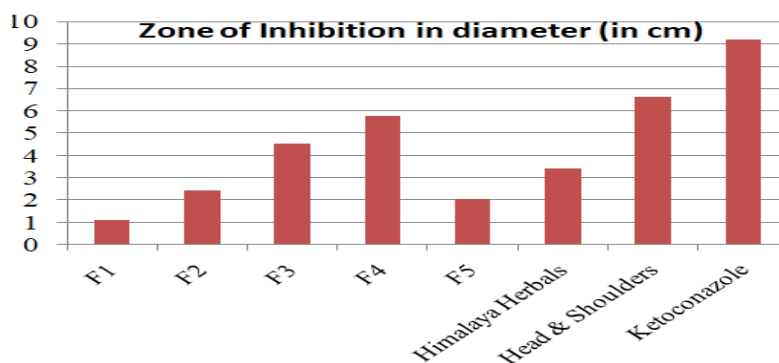
Figure 1: Effect of different concentrations of different samples of shampoos on *Malassezia globosa* and the measurement of their zone size in diameter (in cm). Values are means SD (mm) from triplicate experiments.  $P \leq 0.5$  &  $P \leq 0.01$



**Agar Cup Method:**

The zone size of test formulations was compared with the standard shampoos as shown in figure 2. The formulation labelled as F4 has shown a substantial inhibitory effect when compared with the standards.

Figure 3: Zone size in diameter (in cm) for test and standard. Values are means SD (mm) from triplicate experiments.  $P \leq 0.5$  &  $P \leq 0.01$



## Discussion

The main aim behind this investigation was to develop stable and functionally effective shampoo by excluding major synthetic additives through an approach of green chemistry. The disadvantage of synthetic products for hair is damage to the hair cuticle leaving it brittle, dull and dry.[23]The appropriate physical appearance and physicochemical properties of the test formulations indicated that the products are attractive, producing optimum foam and carrying minimum dirt which is required for cleansing of the hair in accordance with the previous study. [24] The zone of inhibition study with the test formulations for dandruff-producing bacteria has shown a significant result when compared with the standard commercial products. [25]These aqueous preparations of the polyherbal mixture have been able to produce a substantial zone of inhibition in *Malassezia* growth, suggesting the possibility of using it as an anti-dandruff for the elimination of dandruff.

## Conclusion

The present study in the field of cosmetics is a cost-effective approach to produce polyherbal shampoo which has substantial antidandruff potential with fewer side effects. The research produced a good herbal shampoo which can be added to the fleet of green cosmetics after clinical trials.

## Conflict of interest

The authors have no conflict of interest

## References

- [1] Dini I, Laneri S. The New Challenge of Green Cosmetics: Natural Food Ingredients for Cosmetic Formulations. *Mol Basel Switz*2021;26:3921.
- [2] Chiu C-HT, Huang S-H, Wang H-MD. A Review: Hair Health, Concerns of Shampoo Ingredients and Scalp Nourishing Treatments. *Curr Pharm Biotechnol*2015;16:1045–52.
- [3] Meray Y, Gençalp D, Güran M. Putting It All Together to Understand the Role of *Malassezia* spp. in Dandruff Etiology. *Mycopathologia*2018;183:893–903.
- [4] Veraldi S, Barbareschi M, Martella A, Milani M. Efficacy and tolerability of 1% ciclopirox shampoo in the treatment of moderate-to-severe scalp seborrheic dermatitis: a multicenter, prospective, assessor-blinded trial. *G Ital Dermatol E VenereolOrganoUff Soc Ital Dermatol E Sifilogr*2019;154:342–6.

- [5] Pekmezci E, Dündar C, Türkoğlu M. A proprietary herbal extract against hair loss in androgenetic alopecia and telogen effluvium: a placebo-controlled, single-blind, clinical-instrumental study. *Acta Dermatovenerol Alp PannonicaAdriat*2018;27:51–7.
- [6] Javed R, Ghonaim R, Shathili A, Khalifa SAM, El-Seedi HR. Chapter 3 - Phytonanotechnology: a greener approach for biomedical applications. In: Patra C, Ahmad I, Ayaz M, Khalil AT, Mukherjee S, Ovais M, editors. *Biog. Nanoparticles Cancer Theranostics*, Elsevier; 2021, p. 43–86.
- [7] Jahan R, Al-Nahain A, Majumder S, Rahmatullah M. Ethnopharmacological Significance of *Eclipta alba* (L.) Hassk. (Asteraceae). *Int Sch Res Not* 2014;2014:385969.
- [8] Soto KM, López-Romero JM, Mendoza S, Peza-Ledesma C, Rivera-Muñoz EM, Velazquez-Castillo RR, et al. Rapid and facile synthesis of gold nanoparticles with two Mexican medicinal plants and a comparison with traditional chemical synthesis. *Mater Chem Phys* 2023;295:127109.
- [9] Ashwini K, Muralidharan NP. ANTIFUNGAL PROPERTY OF *Acacia concinna* AGAINST *Candida albicans* IN COMPARISON WITH COMMERCIALY AVAILABLE ANTI-DANDRUFF SHAMPOO. *PLANT CELL Biotechnol Mol Biol* 2020:52–7.
- [10] Roana J, Mandras N, Scalas D, Campagna P, Tullio V. Antifungal Activity of *Melaleuca alternifolia* Essential Oil (TTO) and Its Synergy with Itraconazole or Ketoconazole against *Trichophyton rubrum*. *Mol Basel Switz*2021;26:461.
- [11] Tanaka M, Yamamoto Y, Misawa E, Nabeshima K, Saito M, Yamauchi K, et al. Effects of Aloe Sterol Supplementation on Skin Elasticity, Hydration, and Collagen Score: A 12-Week Double-Blind, Randomized, Controlled Trial. *Skin PharmacolPhysiol*2016;29:309–17.
- [12] Steffens T, Vorhölter F-J, Giampà M, Hublik G, Pühler A, Niehaus K. The influence of a modified lipopolysaccharide O-antigen on the biosynthesis of xanthan in *Xanthomonas campestris* pv. *campestris* B100. *BMC Microbiol*2016;16:93.
- [13] Kumari I, Sarkar I, Sanyashi I, Das S, Das R. Formulation and Evaluation of herbal shampoo using neem, amla and reetha extract. *J PharmacognPhytochem*2022;11:179–84.
- [14] Sánchez-Macías D, Castelo-Latorre MJ, Damián-Sinchiguano D, Torres-Pizarro C. Effects of goat milk addition on physicochemical characteristics and conditioning performance of shampoo. *J ApplAnim Res* 2022;50:603–11.
- [15] Reddy VS. Formulation and Evaluation of Synthetic Anti-Dandruff Shampoo. *Asian J Pharm AJP* 2018;12.
- [16] AlQuadeib BT, Eltahir EKD, Banafa RA, Al-Hadhairi LA. Pharmaceutical evaluation of different shampoo brands in the local Saudi market. *Saudi Pharm J* 2018;26:98–106.
- [17] Sarubbo LA, Silva M da GC, Durval IJB, Bezerra KGO, Ribeiro BG, Silva IA, et al. Biosurfactants: Production, properties, applications, trends, and general perspectives. *BiochemEng J* 2022;181:108377.
- [18] Pavan AR, Hima BK, Kumari MP, Maddileti R, Lakshmi GA. Formulation, evaluation & comparison of traditional polyherbal shampoo powders with the marketed formulation. *J Drug Deliv Ther*2019;9:500–3.
- [19] Charoenchai L, Chankana N, Theanphong O, Jongrungruangchok S, Meksuriyen D, Lipipun V. Formulation Development of Canine Antifungal Shampoo Containing *Senna tora* (L.) Roxb. Seed Extract. *Key Eng Mater* 2020;859:181–7.
- [20] Belekar AR, Raut SV. Characterization of Normal and Dandruff Causing Micro-Flora from Human Scalp of Various Age Groups. *Res J PharmacognPhytochem*2015;7:146.
- [21] Leong C, Wang J, Toi MJ, Lam YI, Goh JP, Lee SM, et al. Effect of zinc pyrithione shampoo treatment on skin commensal *Malassezia*. *Med Mycol*2021;59:210–3.
- [22] Pant G, Nayak N, GyanaPrasuna R. Enhancement of antidandruff activity of shampoo by biosynthesized silver nanoparticles from *Solanum trilobatum* plant leaf. *ApplNanosci*2013;3:431–9.
- [23] Panda A, Kumar A, Mishra S, Mohapatra SS. Soapnut: A replacement of synthetic surfactant for cosmetic and biomedical applications. *Sustain Chem Pharm* 2020;17:100297.
- [24] Cornwell PA. A review of shampoo surfactant technology: consumer benefits, raw materials and recent developments. *Int J Cosmet Sci* 2018;40:16–30.
- [25] Maurya AK, Devi R, Kumar A, Koundal R, Thakur S, Sharma A, et al. Chemical Composition, Cytotoxic and Antibacterial Activities of Essential Oils of Cultivated Clones of *Juniperus communis* and Wild *Juniperus* Species. *Chem Biodivers* 2018;15:e1800183.