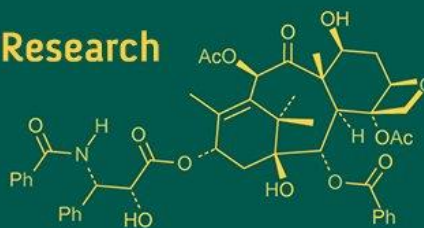


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(5): 797-801
www.biochemjournal.com
Received: 08-02-2026
Accepted: 11-03-2026

Dipika Kumari Gupta
School of Pharmacy and
Research, Dev Bhoomi
Uttarakhand University,
Dehradun, Uttarakhand, India

Satish Kumar
School of Pharmacy and
Research, Dev Bhoomi
Uttarakhand University,
Dehradun, Uttarakhand, India

Vishal Bansal
School of Pharmacy and
Research, Dev Bhoomi
Uttarakhand University,
Dehradun, Uttarakhand, India

Karabi Kalita
School of Pharmacy and
Research, Dev Bhoomi
Uttarakhand University,
Dehradun, Uttarakhand, India

Corresponding Author:
Karabi Kalita
School of Pharmacy and
Research, Dev Bhoomi
Uttarakhand University,
Dehradun, Uttarakhand, India

Development and characterization of Antidandruff hair serum from *Ziziphus mauritiana*

Dipika Kumari Gupta, Satish Kumar, Vishal Bansal and Karabi Kalita

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i5Sj.8475>

Abstract

Aims: The study aimed to formulate and evaluate a herbal anti-dandruff hair serum containing *Ziziphus mauritiana* leaf extract for its physicochemical properties, antifungal activity, and anti-inflammatory potential.

Methodology: *Ziziphus mauritiana* leaves were collected, authenticated, shade dried, and extracted by maceration method using distilled water. Herbal hair serum formulations were prepared by emulsification technique using jujuba oil, vitamin E, glycerin, Tween 80, arginine, rosemary oil, and clove oil. The prepared formulations were evaluated for appearance, homogeneity, pH, viscosity, odour stability, and spreadability. Antifungal activity was studied against *Malassezia globosa* by agar well diffusion method using ketoconazole as standard. Anti-inflammatory activity was evaluated by protein denaturation assay using diclofenac sodium as reference drug.

Results: Among all formulations, F2 showed better physicochemical stability and was selected as the optimized formulation. The formulation showed good homogeneity, acceptable odor stability, pH 6, viscosity of 496.3 cP, and spreadability of 5.55 cm. The serum exhibited moderate antifungal activity against *Malassezia globosa*. In anti-inflammatory evaluation, sample 2 showed 64.6% inhibition of protein denaturation.

Conclusion: The formulated herbal anti-dandruff hair serum containing *Ziziphus mauritiana* extract showed satisfactory physicochemical properties along with promising antifungal and anti-inflammatory activities. The study suggests that the formulation may be useful as a natural alternative for dandruff management and scalp care.

Keywords: *Ziziphus mauritiana*, hair serum, herbal, anti-dandruff, anti-fungal, anti-inflammatory

1. Introduction

Dandruff is a common scalp condition that affects roughly half of the global population [1]. The term “dandruff” is formed by combining the words “tan” which means “tetter” and “drof”, which means “dirty” [2]. Dandruff is a common scalp condition characterized by the shedding of dead skin cells from the scalp, which often appears as visible white or yellowish flakes. Itching and scalp irritation are possible symptoms. While the exact cause of dandruff is not fully understood, several factors are thought to contribute. Its causes include yeast overgrowth, sebum production, skin sensitivity, and poor hygiene [3].

Dandruff is a common scalp condition mainly caused by the fungus *Malassezia*, which leads to irritation, itching, excess oil production, and disrupted keratinocyte activity involved in scalp cell growth and immune responses, particularly during the responses, particularly during the winter season [4]. Dandruff is one of the most common dermatological disorders affecting the scalp. It is a chronic and non-inflammatory condition characterized by flaking of the scalp skin. The condition may arise due to multiple factors, such as excessive sebum production, fungal growth associated with poor hygiene, and irregular hair cleansing practices, particularly when hair is not washed for prolonged periods [5].

Dandruff mainly occurs on the scalp and is marked by itching and shedding of flakes without obvious inflammation. *Seborrheic dermatitis* can affect not only the scalp but also the face, upper chest, and the area behind the ears, leading to scaling, irritation, itching, and sometimes redness. In both conditions, the flakes may be dry or oily and usually appear white to yellow in colour [6].

1.1 Fungi and bacteria associated with dandruff:

Four fungal species associated with dandruff belong to the genus *Malassezia*, including *Malassezia globosa*, *Malassezia pachydermatis*, *Malassezia furfur*, and *Malassezia restricta* (Fig.1) [17].

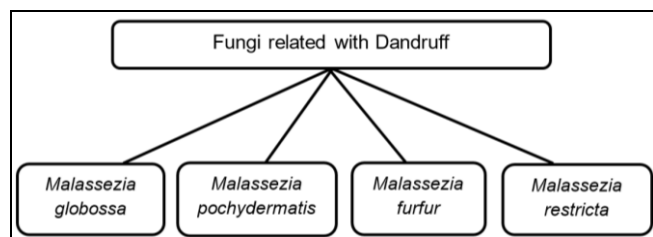


Fig 1: Fungi related to dandruff

1.2 Hair Serum

Serum is a cosmetic formulation containing a high concentration of active ingredients designed to provide intensive nourishment to the deeper layers of the skin while offering a non-greasy finish suitable for regular skin application [8].

- Hair serum is a styling product that forms a coating on the outer surface of the hair.
- It is a liquid hair care formulation with a consistency thicker than water.
- Hair serum is used not only for styling but also for managing hair problems such as dryness, dullness, frizz, and unmanageable hair.
- Different types of hair serums are available for specific hair care needs and desired hair outcomes. Depending on the formulation, hair serum may help in reducing frizz, enhancing shine, and straightening the hair.
- Most hair serums are silicone-based products that provide smoothness, hydration, shine, and protection against humidity and environmental pollutants [9].

Herbal hair serums are prepared from natural plant extracts, herbs, and oils that contain essential vitamins, minerals, and antioxidant compounds beneficial for hair health. These ingredients are mild in nature and are commonly used as safer alternatives to synthetic hair care products. Natural oils such as coconut oil, argan oil, and jojoba oil present in herbal serums help maintain moisture in the hair, reduce dryness and breakage, and improve softness and manageability of the hair strands [10].

1.3 Phytochemical Constituents to *Ziziphus Mauritiana*

Ziziphus Mauritiana belongs to the family Rhamnaceae and is popularly known by several common names, including Ber, Indian plum, Malay apple, and Chinese apple. It is a tropical fruit tree commonly grown in tropical and subtropical climatic regions [11, 12].

Nearly 170 species of *Ziziphus* have been identified across different geographical areas worldwide. Among them, the commonly recognized species include *Ziziphus jujuba* Lam, *Ziziphus lotus* Lam, *Ziziphus joazeiro*, *Ziziphus jujuba* (Chinese jujube), *Ziziphus parryi* Torr, *Ziziphus rotundata* D.C, *Ziziphus talanai*, *Ziziphus abyssinica* Hochst, *Ziziphus quadrilocularis*, and *Ziziphus xylopyrus* [11, 13].

Z. mauritiana is rich in nutrients such as proteins, fats, dietary fiber, and important minerals including calcium, phosphorus, magnesium, potassium, and iron. The aerial parts of the plant contain various phytochemicals, including

alkaloids like protopine and berberine, flavonoids such as quercetin and kaempferol, and sterols including sitosterol and stigmasterol [14]. The leaves of *Z. mauritiana* contain several phytoconstituents, including flavonoids, tannins, mucilage, triterpenoids, and cardiac glycosides. Both fresh and dried fruits are reported to possess carbohydrates, natural sugars, dietary fiber, carotenoids, pectin, citric acid, and vitamins such as thiamine [15].

Alkaloids are found throughout the entire plant and are present in the stem bark of *Ziziphus* species. Zizogenin was extracted from *mauritiana* stem. Cyclic peptide alkaloids such as mauritine-A, mucronine-D, amphibine-H, nummularine-A and B, sativanine compounds, and frangulanine were isolated from *Z. jujuba* bark and stem bark [16]. Leaves of *Z. jujuba* contained coclaurine, isoboldine, norisoboldine, asimilobine, iusiphine, and iusirine. Cyclopeptide and peptide alkaloids showed sedative properties. Seeds of *Z. jujuba* var. *spinosa* contained sanjoinine, franguloine, amphibine-D, and sanjoinine alkaloids [17].

Ziziphus species contain bioactive flavonoids such as quercetin 3-O-rutinoside, quercetin 3-O-galactoside, quercetin 3-D-glucoside, luteolin 7-O-malonylglucoside, myricetin 3-O-malonylglucoside, and naringenin triglycoside [18]. Triterpenoids are one of the most significant and active components of the plant. Main terpenoids include triterpene saponins, colubrinic acid, aliphatic acid, maslinic acid, and oleanolic acid [19].

2. Methodology

Ziziphus mauritiana leaves were collected from Vikasnagar near Dehradun, Uttarakhand India. The collected plant material was taxonomically identified and authenticated as *Ziziphus mauritiana* Lam. belonging to the family Rhamnaceae, commonly known as Ber or India plum. The authentication was carried out by the office of the Range, Forest Officer, kalsi Range, Uttarakhand, India, based on the morphological and taxonomical characteristics of the plant specimen. An authentication certificate/reference letter (Ref. No. DBUU/D-PR (15)/2023-24/31/13 dated 22-06-2024) was obtained and preserved for future reference. The authenticated plant material was then utilized for further phytochemical evaluation and formulation studies.

2.1 Extraction of *Ziziphus Mauritiana* Leaves:

The aqueous leaf extract was prepared using the maceration technique followed by drying on a water bath. Fresh leaves were collected and washed properly to remove dust and other impurities (Fig. 2).



Fig 2: Drying & milling of *Ziziphus*

The leaves were then shade-dried and converted into a cross powder. The powdered material was soaked in distilled water in a 1:10 (w/v) ratio and kept undisturbed for 7 days with occasional shaking to facilitate effective extraction of the phytoconstituents (Fig. 3).



Fig 3: Soaked powered leaves

After completion of the maceration process, the mixture was filtered through muslin cloth followed by Whatman No.1 filter paper to obtain a clear filtrate. The filtrate was concentrated using a water bath maintained at 40-50 °C until a thick extract was obtained. Further drying on the water bath produced a semi-solid mass. The dried extract was collected and stored in an airtight container at 4 °C for further experimental use.

2.2 Preparation of Herbal Anti-Dandruff Hair Serum:

The herbal anti-dandruff hair serum containing *Ziziphus mauritiana* leaf extract was formulated by the emulsification method. Initially, the polar phase was prepared by dissolving arginine in glycerin with continuous stirring at a temperature of 50-60 °C. In a separate beaker, the oil phase containing jujuba oil, vitamin E, isopropyl myristate (IPM), *Ziziphus mauritiana* extract, and Tween 80 was heated at 70-75 °C until a clear and uniform mixture was obtained (Table 1).

Table 1: Formulation of 50 ml Serum of 4% of *Ziziphus Mauritiana* Leaves Extract

S. No.	Ingredients	F1	F2	F3	F4	F5
1	<i>Ziziphus mauritiana</i>	2 g	2 g	2 g	2 g	2 g
2	Jujuba Oil	25 mL	24 mL	23 mL	22 mL	21 mL
3	Isopropyl Myristate	10 mL	10 mL	9 mL	9 mL	8 mL
4	Vitamin E	1 mL	1 mL	1.5 mL	1.5 mL	2 mL
5	Tween 80	2 mL	2.5 mL	2.5 mL	3 mL	3 mL
6	Glycerin	9 mL	8 mL	8 mL	7 mL	7 mL
7	Arginine	1 g	1 g	1.5 g	1.5 g	2 g
8	Rosemary Oil	0.5 mL	0.5 mL	1 mL	1 mL	1.5 mL
9	Clove Oil	0.5 mL	0.5 mL	0.5 mL	1 mL	1 mL

After complete preparation of both phases, the polar phase was gradually added to the oil phase under high-speed homogenization for about 3-5 minutes to obtain a stable emulsion. Stirring was continued during the cooling process to maintain uniform distribution of the extract and to prevent sedimentation. Once the temperature dropped below 40 °C, rosemary oil and clove oil were added to the formulation. The final serum was mixed thoroughly to ensure proper blending of all ingredients and then transferred into airtight containers for further evaluation studies.

3. Results and Discussion

The developed herbal anti-dandruff hair serum formulation (F1-F2) were assessed for different physicochemical parameters to determine their stability and suitability for topical application. Based on the observed characteristics, formulation, F2 showed comparatively better performance and was selected as the optimized formulation.

3.1 Appearance: Formulation F2 appeared brown with slight turbidity. The uniform appearance of the formulation suggested proper dispersion of the herbal extract within the serum system.

3.2 Homogeneity: The optimized formulation showed a smooth and uniform consistency throughout the preparation. No signs of lump formation, creaming, or phase separation were observed during the evaluation period, indicating good formulation stability.

3.3 Odour Stability: The characteristic Odour of the formulation remained unchanged after 72h of storage. The observation indicates adequate stability of the volatile constituents present in the serum.

3.4 pH Determination: The pH of the optimized serum was found to be 6, which falls within the acceptable range for scalp application. The obtained pH suggests that the formulation is compatible with the natural pH of the skin may minimize the risk of irritation upon topical use.

3.5 Viscosity: The viscosity of formulation F2, determined using a Brookfield viscometer at 20 RPM, was recorded as 496.3 cP. The viscosity value indicated suitable consistency of the serum, allowing easy spreading and convenient application over the scalp surface (Fig. 4).

3.6 Spreadability Study: The spreadability of the prepared herbal serum was evaluated by determining the extent of spreading between two glass slides. The formulation exhibited good spreading behavior, with spread diameter of 5.5 cm, 5.5 cm, and 5.6 cm recorded in three consecutive trials. The average spreadability was calculated to be 5.55 cm. The obtained results indicate that the formulation possesses suitable consistency and can be spread easily over the scalp surface. Good spreadability is an important characteristic for topical preparations, as it helps in uniform distribution of the formulation and improves ease of application as well as patient acceptability (Fig. 5).

3.7 Antifungal Activity by Agar Well Diffusion Method

The antifungal activity of the prepared herbal serum was evaluated against *Malassezia globosa* using the agar well diffusion method. Ketoconazole was used as the standard antifungal agent for comparison. After incubation at 32-35°C for 48-72h, antifungal activity was assessed by measuring the diameter of the inhibition zone around each well.

The formulated serum showed moderate antifungal activity with ketoconazole produced a larger inhibition zone of 7 mm. No zone of the inhibition was observed with the base formulation, indicating the absence of antifungal activity in the formulation base alone. The observed antifungal effect of the herbal serum may be associated with the presence of phytoconstituents in the plant extract, which could contribute to the inhibition of fungal growth (Fig. 6).

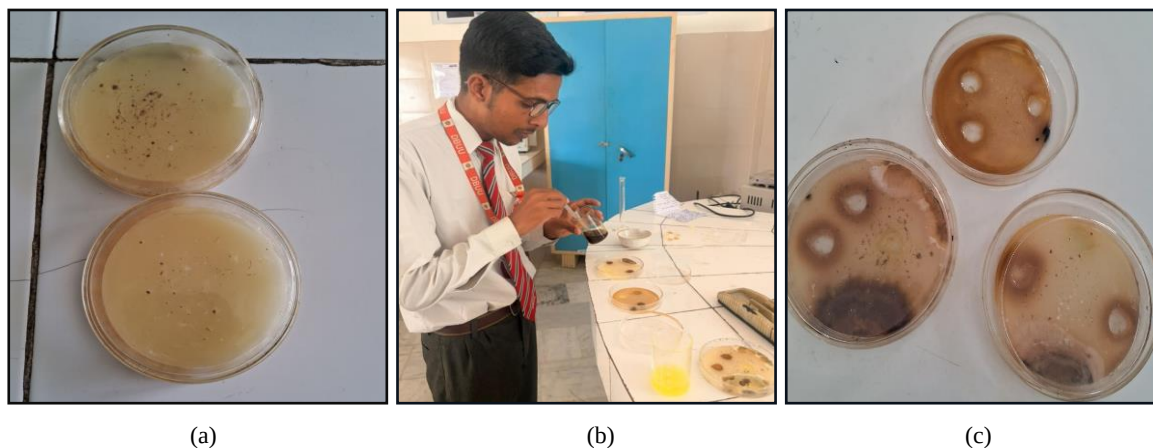


Fig 6: (a) Growth of *Malassezia globosa* (b) Sample application in agar

3.8 Anti-Inflammatory Activity (Protein Denaturation Assay)

The anti-inflammatory activity of the formulated herbal serum was evaluated by the protein denaturation method using egg albumin as the protein source. The assay was based on the ability of the formulation to inhibit heat-induced protein denaturation, which is considered one of the mechanisms involved in inflammation. Diclofenac sodium was used as the standard reference drug. The absorbance of the samples was recorded at 660 nm using a spectrophotometer, and the percentage inhibition of protein denaturation was calculated. The standard Diclofenac sodium showed strong anti-inflammatory activity with 92.06% inhibition, confirming the reliability of the experimental method. Among the tested formulation, sample 2 (100mg) exhibited moderate anti-inflammatory activity with 64.6% inhibition. However, sample 1 (150mg) and sample 3 (50 mg) showed negative inhibition values, indicating minimal or no significant anti-inflammatory effect at those concentrations. The activity observed in sample 2 may be related to the presence of phytoconstituents in the herbal extract that help stabilize proteins and reduce denaturation under inflammatory conditions.

4. Conclusion

The present study successfully developed and evaluated a herbal anti-dandruff hair serum containing *Ziziphus mauritiana* leaf extract. The formulated serum showed satisfactory physicochemical properties, including good homogeneity, acceptable pH, suitable viscosity, and good spreadability, indicating its suitability for topical scalp application. The optimized formulation also demonstrated moderate antifungal activity against *Malassezia globosa* and appreciable anti-inflammatory activity in the protein denaturation assay. The observed activities may be attributed to the presence of bioactive phytoconstituents such as flavonoids, tannins, alkaloids, and phenolic compounds present in the plant extract. Overall, the findings suggest that the developed herbal serum may serve as a safe and effective natural alternative for the management of dandruff and scalp irritation. Further stability studies and clinical investigations are recommended to establish its long-term safety and therapeutic effectiveness.

References

- Mayser P, Genrich F, Meunier L, Nordziede S. Scalp microbiome and dandruff—Exploring novel biobased esters. *Cosmetics*. 2024;11(5):174. doi:10.3390/cosmetics11050174.
- Ranganathan S, Mukhopadhyay T. CME article. *Indian J Dermatol*. 2010;55:130-134.
- Gupta S, Singhal R, Khatri R, Jadhav S. Role of phytochemicals in the management of hair fall: A review. *Int J Res Pharm Sci*. 2021;12:2860-2866. doi:10.26452/ijrps.v12i3.4184.
- Nafisy AT. A review of traditional medicine in Iran. Isfahan: Isfahan University Publications; 1989. p. 133.
- Kaur G, Kriplani P, Dhingra A, Chopra B, Deswal G. Formulation and evaluation of anti-dandruff polyherbal powder shampoo. *J Qual Assur Pharma Anal*. 2016;2(1):115-121.
- Borda LJ, Wikramanayake TC. Seborrheic dermatitis and dandruff: A comprehensive review. *J Clin Investig Dermatol*. 2015;3(2). doi:10.13188/2373-1044.1000019.
- Nawaf A, Sanusi J, Ibrahim S, Babangida I, Liadi S. Prevalence of dandruff among the pupils and staff of some selected public schools in Katsina State. *UMYU Scientifica*. 2023;2(3):121-127.
- Budiasih S, Masyitah I, Jiyauddin K, Kaleemullah M, Samer AD, Mohd Fadli A, *et al*. Formulation and characterization of cosmetic serum containing argan oil as moisturizing agent. *Sci Technol Publ*. 2018;297-304.
- Vakhariya RR, Oza SA, Bhingardeva CS, Patil SJ, Mujawar SF, Mohite SK. Formulation, development and evaluation of herbal hair serum: A classical approach to enhance hair quality. *Int J Pharm Sci Rev Res*. 2022;76(2):100-103. doi:10.47583/ijpsr.2022.v76i02.017.
- Saha R, Hossain MS, Roy P, Islam MS. Formulation and evaluation of herbal hair oil. *Int J Pharm Sci Res*. 2017;8(12):4930-4949. doi:10.13040/IJPSR.0975-8232.8(12).4930-49.
- CSIR. The wealth of India: Raw materials. Vol. XI, X-Z. New Delhi: CSIR; 1989. p. 111-124.
- Warrier PK, Nambiar VPK, Ramankutty C. *Indian medicinal plants: A compendium of 500 species*. Vol. 5. Chennai: Orient Longman Private Limited; 1996. p. 439-444.
- Khare CP. *Ziziphus mauritiana*. In: *Encyclopedia of Indian medicinal plants*. New York (NY): Springer; 1995. p. 493-498.
- Cheng G, Bai Y, Zhao Y, Tao J, Liu Y, Tu G, *et al*. Flavonoids from *Ziziphus jujuba* Mill var. *spinosa*. *Tetrahedron*. 2000;56:8915-8920.

15. Thanatcha R, Pranee A. Extraction and characterization of mucilage in *Ziziphus mauritiana* Lam. Int Food Res J. 2011;18(1):201-212.
16. Tschesche R, Shah AH, Eckhardt G, Ziyaev R, Irgashev T, Israilov IA, *et al.* Alkaloids of *Ziziphus jujuba*. Structure of iusiphine and iusirine. Khim Prir Soedin. 1977;2:239-243.
17. Han BH, Park MH, Han YN. Cyclic peptide and peptide alkaloids from seeds of *Ziziphus vulgaris*. Phytochemistry. 1990;29(10):3315-3319.
18. Pawlowska AM, Camangi F, Bader A, Braca A. Flavonoids of *Zizyphus jujuba* and *Zizyphus spina-christi* (L.) wild (Rhamnaceae) fruits. Food Chem. 2000;112:858-862.
19. Elaloui M, Laamouri A, Ennajah A, Cerny M, Mathieu C, Vilarem G, *et al.* Phytoconstituents of leaf extracts of *Ziziphus jujuba* Mill. plants harvested in Tunisia. Ind Crops Prod. 2016;83:133-139.