



# FORMULATION DEVELOPMENT AND EVALUATION OF BANYAN TREE AERIAL ROOT EXTRACT AS ANTIDANDRUFF SERUM

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## ABSTRACT

This study aimed to formulate and evaluate a herbal antidandruff serum containing aerial root extract of *Ficus benghalensis* (Banyan Tree). The extract was obtained by Soxhlet extraction and showed the presence of important phytoconstituents such as flavonoids, tannins, saponins, glycosides, and phenolic compounds. The formulated serum was evaluated for pH, spreadability, homogeneity, washability, and antifungal activity. Results showed good physicochemical properties, stability, and significant antifungal activity against dandruff-causing fungi. Among the formulations, F3 showed the highest antifungal activity. The study concludes that Banyan aerial root extract can be effectively used in a herbal antidandruff serum for dandruff management and scalp care.

**Keywords:** *Ficus benghalensis*, Banyan Tree, Antidandruff Serum, Herbal Formulation, Antifungal Activity, *Malassezia*, Phytochemical Screening.

## INTRODUCTION

Hair is considered an important part of human personality and scalp health plays a vital role in maintaining healthy hair growth. Among various scalp disorders, dandruff is one of the most prevalent conditions affecting individuals of all age groups. It is characterized by excessive flaking of scalp skin accompanied by itching, irritation and dryness. The condition is mainly associated with the proliferation of *Malassezia* species, excessive sebum secretion, poor scalp hygiene, environmental pollution and stress. Persistent dandruff may lead to discomfort, scalp inflammation and weakening of hair roots, thereby affecting both physical appearance and self-confidence.

Conventional antidandruff preparations containing synthetic agents such as ketoconazole, selenium sulfide and zinc pyrithione are widely used for the treatment of dandruff. Although these agents are effective, their prolonged use may produce several adverse effects including scalp irritation, erythema, dryness and hair fall. In recent years, there has been increasing interest in herbal cosmetic formulations due to their better safety profile, therapeutic potential and reduced side effects. Herbal products

containing bioactive phytoconstituents have gained considerable attention in the field of hair care and scalp treatment.

The Banyan Tree is a well-known medicinal plant belonging to the family Moraceae and has been extensively used in traditional systems of medicine. Various parts of the plant including bark, leaves, latex and aerial roots possess significant therapeutic activities. The aerial roots of *Ficus benghalensis* are rich in phytoconstituents such as flavonoids, tannins, saponins, glycosides and phenolic compounds which exhibit antimicrobial, antifungal and antioxidant properties. These bioactive constituents may help in inhibiting dandruff-causing microorganisms and improving overall scalp condition.

## IMPORTANCE

- The aerial roots of *Ficus benghalensis* contain important phytoconstituents such as flavonoids, tannins, glycosides and phenolic compounds.
- The roots possess significant antifungal and antimicrobial activities which help in controlling dandruff-causing microorganisms.
- The extract exhibits antioxidant properties that protect scalp tissues from oxidative stress and environmental damage.
- The anti-inflammatory activity of the aerial roots helps reduce scalp irritation, itching and redness.
- Banyan aerial roots are traditionally used in Ayurvedic medicine for treatment of skin and scalp disorders.
- The extract helps nourish the scalp and improve overall hair health.

## BANYAN TREE

**Synonym:** Indian Banyan Tree, Bengal Fig, Vat Vriksha.

**Biological Source:** Banyan consists of the aerial roots and bark obtained from *Ficus benghalensis* Linn.

**Family:** Moraceae

**Geographical Source:** It is commonly found throughout India, especially in tropical and subtropical regions.

**Chemical Constituents:** Tannins, flavonoids, glycosides, sterols, saponins, and phenolic compounds.  
**profile:-**



**Fig.01: Banyan Tree**



**Fig.02: Banyan Aerial Root**

### Habitat and distribution

*Ficus benghalensis* is widely distributed throughout India and other tropical regions of Asia including Bangladesh, Sri Lanka and Pakistan. The plant commonly grows in tropical and subtropical climates. It is usually found in forests, roadsides, village areas, gardens and open fields. The tree grows well in fertile and well-drained soil under warm climatic conditions.

### Morphology

<b>Leaves</b>	Simple, broad, leathery and dark green leaves.
<b>Stem</b>	Thick, hard and woody stem with rough bark.
<b>Flowers</b>	Small, unisexual and enclosed within receptacle.
<b>Fruit</b>	Small, round, reddish figs occurring in pairs.
<b>Root System</b>	Strong tap root along with aerial roots.
<b>Seeds</b>	Small and numerous.
<b>Habit</b>	Large evergreen tree with extensive spreading canopy.
<b>Stem</b>	Thick, hard and woody stem with rough bark.
<b>Aerial Roots</b>	Numerous hanging roots arising from branches; become woody on maturation
<b>Branches</b>	Wide spreading branches forming dense crown

## CHEMICAL CONSTITUENTS OF FICUS BENGHALENSIS

*Ficus benghalensis* contains a variety of important phytoconstituents responsible for its medicinal and pharmacological activities. The major chemical constituents present in the aerial roots include flavonoids, tannins, phenolic compounds, glycosides, saponins, steroids, carbohydrates, and proteins.

### .PHARMACOLOGICAL ACTIVITIES

#### ANTIFUNGAL ACTIVITY

The aerial root extract of *Ficus benghalensis* has shown significant antifungal activity against various pathogenic fungi including dandruff-causing *Malassezia species*. The antifungal property is mainly attributed to the presence of flavonoids, tannins and phenolic compounds present in the plant extract. Studies have demonstrated inhibition of fungal growth and reduction in scalp infection.

**ANTIMICROBIAL ACTIVITY** Various extracts of *Ficus benghalensis* have demonstrated antimicrobial activity against Gram-positive and Gram-negative bacteria. Studies reported inhibitory effects against microorganisms such as *Staphylococcus aureus* and *Escherichia coli*. The antimicrobial effect helps in maintaining scalp hygiene and preventing microbial infections.

#### ANTI-INFLAMMATORY ACTIVITY

Studies have shown that extracts of *Ficus benghalensis* possess significant anti-inflammatory activity. The plant extract helps reduce inflammation, redness and irritation by inhibiting inflammatory mediators

#### ANTIOXIDANT ACTIVITY

The aerial root extract of *Ficus benghalensis* exhibits strong antioxidant activity due to the presence of phenolic compounds and flavonoids. Antioxidants help neutralize free radicals and protect scalp tissues from oxidative stress and cellular damage.

#### AIM

To formulate and evaluate an herbal antidandruff serum containing aerial root extract of Banyan Tree for effective dandruff control and scalp care.

#### OBJECTIVES

- 1) To collect and authenticate aerial roots of Banyan Tree.
- 2) To prepare aerial root extract using suitable extraction method.
- 3) To formulate herbal antidandruff serum containing banyan aerial root extract.
- 4) To evaluate physicochemical parameters of the formulated serum.
- 5) To study antifungal activity against dandruff-causing microorganisms.
- 6) To perform stability studies of the prepared formulation.
- 7) To assess the suitability of the formulation for scalp application.

#### MATERIAL AND METHODS

##### Materials

##### Plant Material

The aerial roots of Banyan Tree were collected from local areas and authenticated by a qualified botanist.

##### Chemicals and Excipients

The chemicals and excipients used in the formulation were Carbopol 940, glycerin, propylene glycol, triethanolamine, methyl paraben, propyl paraben, ethanol and distilled water. All chemicals used were of analytical grade.

### Instruments and Equipment

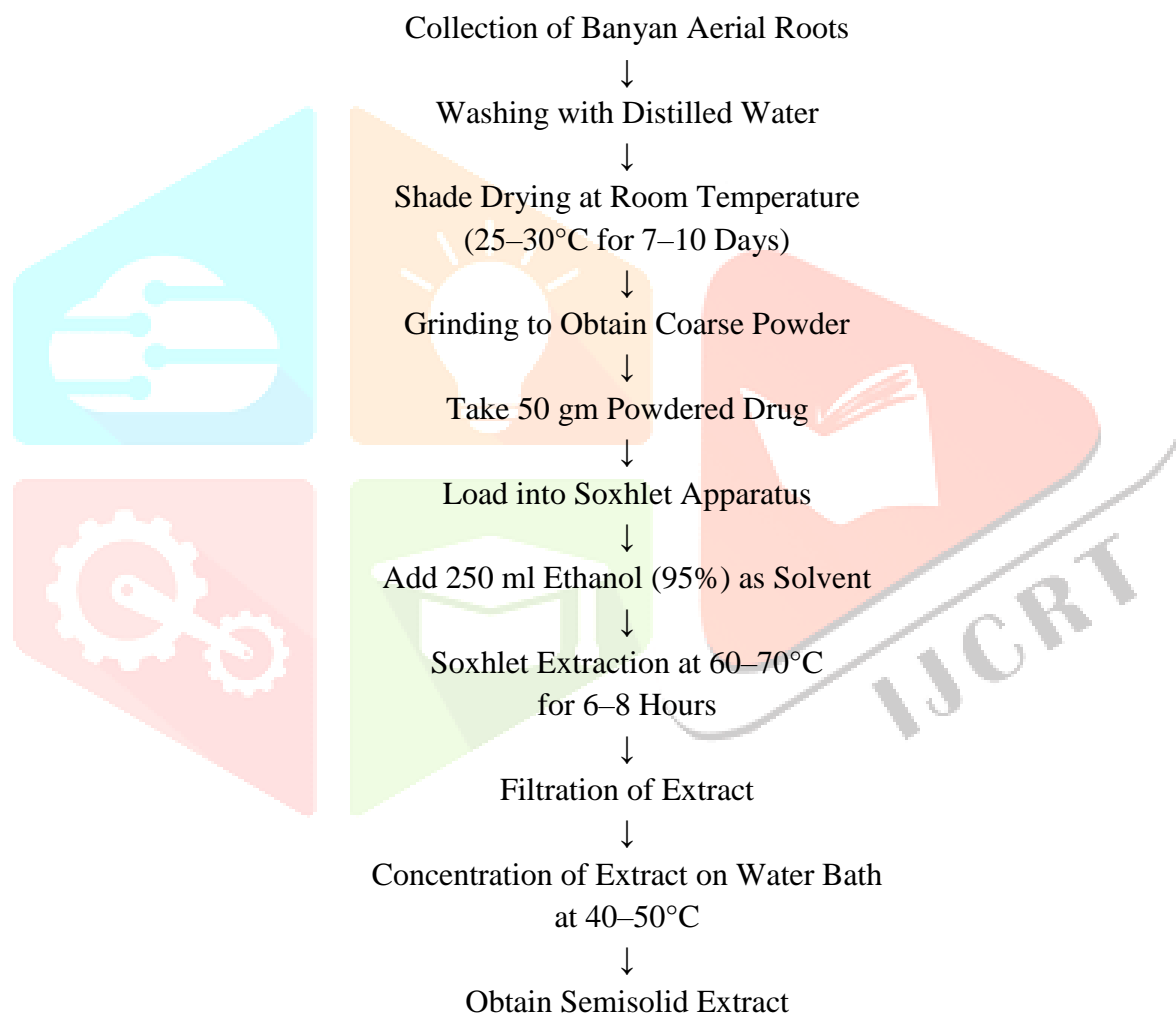
The instruments used during the study included Soxhlet apparatus, hot air oven, magnetic stirrer, digital weighing balance, pH meter and Brookfield viscometer.

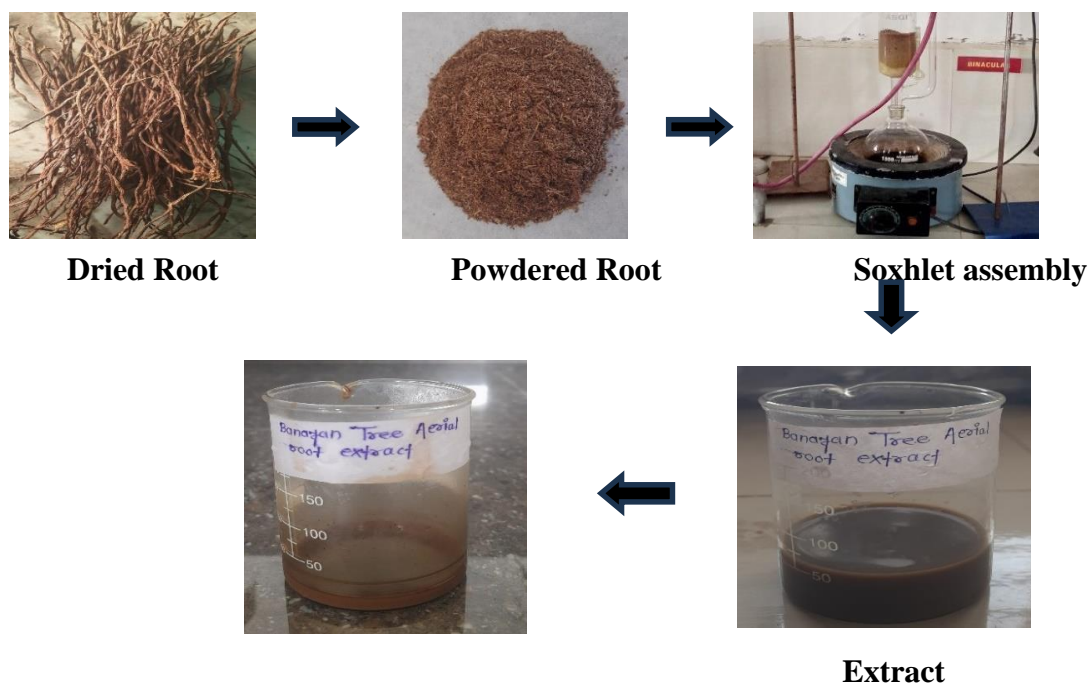
### Methodology

#### Collection and Preparation of Plant Material

The collected aerial roots of *Ficus benghalensis* were washed thoroughly with water to remove dirt and foreign particles. The roots were shade dried at room temperature for several days and then powdered using mechanical grinder. The powdered material was stored in an airtight container for further use.

## **EXTRACTION OF BANYAN AERIAL ROOTS**





**Fig 03. Extraction Process**

## PHYTOCHEMICAL SCREENING

### Qualitative Analysis

The aerial root extract of *Ficus benghalensis* was subjected to phytochemical screening for detection of various phytoconstituents such as alkaloids, flavonoids, tannins, phenolic compounds, glycosides, saponins, steroids, carbohydrates and proteins using standard qualitative procedures.

### Quantitative Analysis

Quantitative estimation was carried out to determine the total phenolic content, flavonoid content and other important phytoconstituents present in the aerial root extract.

#### Test for alkaloids

##### A) Wagner's test:

1 ml of extract was treated with few drops of Wagner's reagent. Formation of brown or reddish-brown precipitate indicated the presence of alkaloids.

#### Test for Flavonoids

**A) Lead Acetate Test:** Few drops of lead acetate solution were added to the extract. Formation of yellow precipitate indicated the presence of flavonoids

#### Test for Phenols

##### A) Ferric Chloride Test

Few drops of ferric chloride solution were added to the extract. Appearance of blue-green or dark coloration indicated presence of phenolic compounds.

#### Test for Tannins

##### A) Ferric Chloride Test

Addition of ferric chloride solution produced blue-black or greenish-black colour indicating presence of tannins.

#### Test for Proteins

##### A) Ninhydrin Test

The extract was treated with ninhydrin reagent. Formation of blue or purple colour indicated presence of proteins and amino acids.

#### Test for Carbohydrates

##### A) Benedict's Test

The extract was mixed with Benedict's reagent and heated. Formation of green, yellow or brick-red precipitate indicated presence of reducing sugars.

## Test for Saponins

### A) Foam Test

1 ml of extract was mixed with 5 ml distilled water and shaken vigorously. Formation of stable foam indicated presence of saponins.

## Test for Glycosides

### A) Keller-Killiani Test

The extract was treated with glacial acetic acid, ferric chloride and concentrated sulfuric acid. Formation of brown ring indicated presence of glycosides.

## Test for Steroids

### A) Salkowski Test

The extract was treated with chloroform and concentrated sulfuric acid. Appearance of reddish-brown ring indicated presence of steroids.

## HERBAL ANTIDANDRUFF SERUM

A herbal antidandruff serum is a topical cosmetic preparation used for scalp care and dandruff control. It is generally non-greasy, easily spreadable and provides better penetration of active ingredients into the scalp. The serum containing *Ficus benghalensis* aerial root extract possesses antifungal, antimicrobial and anti-inflammatory properties useful in treatment of dandruff and scalp disorders.

## APPLICATION

- The herbal serum helps reduce dandruff and scalp flaking.
- The antifungal activity helps inhibit dandruff-causing microorganisms.
- The anti-inflammatory property provides relief from itching and scalp irritation.
- The antioxidant activity protects scalp tissues from oxidative stress.



Fig 04: Herbal Serum

## FORMULATION OF HERBAL SERUM

The present work focuses on the formulation of a herbal anti-dandruff serum using Banyan (*Ficus benghalensis*) aerial root extract, which is traditionally known for its antimicrobial, soothing, and scalp-conditioning properties. The serum is designed to reduce dandruff, control scalp irritation, and maintain scalp health.

### Procedure for preparation of herbal serum

- a) The base of serum was prepared by mixing humectants, solvent system, and emulsifying agents in a clean beaker under constant stirring.
- b) Ingredients such as glycerin, propylene glycol, and water were added and stirred until a uniform transparent base was formed.
- c) Separately, the Banyan tree aerial root extract was weighed accurately and slowly incorporated into the base.

d) Active anti-dandruff agents (if used like neem extract or tea tree oil) were added dropwise with continuous stirring.

e) The mixture was homogenized using magnetic stirring for 20–30 minutes until a clear or slightly opalescent serum was obtained.

Sr. No.	Ingredients	Function/ Purpose	Quantity to be taken (gm)
1	Purified water	Solvent	q.s.
2	Glycerin	Humectant, moisturizer	3–5%
3	Propylene glycol	Penetration enhancer	2–4%
4	Carbopol / HPMC	Gelling agent	0.5–1%
5	Triethanolamine	pH adjuster	q.s.
6	Banyan aerial root extract	Antidandruff, antimicrobial	2–5%

Table 4: Formation of Serum Base

Formulation code	Banyan Aerial Root Extract (g)	Serum Base q.s. (ml)
F1	2 %	20 ml
F2	3%	20 ml
F3	5%	20 ml

Table 5: Formulation of Herbal Antidandruff Serum.



Fig: F1



Fig: F2



Fig:F3

## PHYSICOCHEMICAL PARAMETERS OF HERBAL ANTIDANDRUFF SERUM (BANYAN TREE AERIAL ROOT EXTRACT)

### Colour and Odour

Colour and odour of the prepared herbal antidandruff serum were examined by visual inspection and sensory evaluation. The formulation showed a pale yellow to light brown colour with a mild herbal odour.

### Consistency

The serum showed smooth, uniform consistency with no phase separation or grittiness, indicating good homogeneity of formulation.

### PH

The pH of the prepared herbal serum was measured using a digital pH meter. A small amount of serum was diluted with distilled water (100 mL) and allowed to stand for 2 hours before measurement. The pH was determined in triplicate and the average value was found to be 6.2, which is suitable for scalp application and non-irritating.

### Spreadability

Spreadability was evaluated by placing a small amount of serum between two glass slides under a fixed weight. The time required for separation of slides was recorded.

### Loss on Drying

LOD was determined by placing the sample in a petri dish and drying at 105°C until constant weight. The LOD value was found to be 18–22%, indicating acceptable moisture content.

### Solubility

The prepared serum was found to be partially soluble in water and completely miscible in alcohol-based solvents, ensuring good dispersion on scalp.

## ANTIFUNGAL ASSAY OF HERBAL ANTIDANDRUFF SERUM

Antifungal activity of Banyan Tree aerial root extract serum was determined by agar well diffusion method. Sterilization of Petri plates and Sabouraud Dextrose Agar medium was carried out in autoclave at 121°C for 15 minutes. The sterile molten agar medium was allowed to cool and then inoculated with test fungal organism. The inoculated agar medium was poured into sterile Petri plates and allowed to solidify. Wells were prepared on agar plates using sterile cork borer. Different formulations of herbal antidandruff serum were introduced into the wells.

## RESULT

### A) PHYTOCHEMICAL SCREENING

Sr.no	Chemical constituent	Test performed	Observation	inference
1	Alkaloid	a. Hager's test	Yellow precipitate observed	Present
2	Flavonoid	Lead acetate test	Yellow Precipitated Formed	Present
3	Saponin	Froth formation test	Stable persistent foam	Present
4	Carbohydrate	a. Fehling's test	Brick-red ppt berved	Present
5	Phenol Compounds	Ferric Chloride Test	Bluish green coloration observed	Present
6	Protein	a. Xanthoproteic Test	Yellow Colourobserved	Present

**Table 6: Phytochemical screening of leaves extract of Aerial Banyan Tree**



Fig.05: Phytochemical screening of aerial root extract of *Ficus benghalensis*.

**B) PHYSICOCHEMICAL PARAMETERS OF HERBAL ANTIDANDRUFF SERUM**

Sr. No.	Parameters	F1	F2	F3
1	Colour	Light brown	Brown	Dark brown
2	Odour	Characteristics	Characteristics	Characteristics
3	pH	5.5	5.7	5.8

Table 7: Physicochemical parameters.

**C)ANTIMICROBIAL ASSAY OF SERUM**

Formulationcode	Zone of inhibition <i>Malassezia s</i>
F1	1.0m
F2	1.5cm
F3	2.1cm
Standard	2.5cm

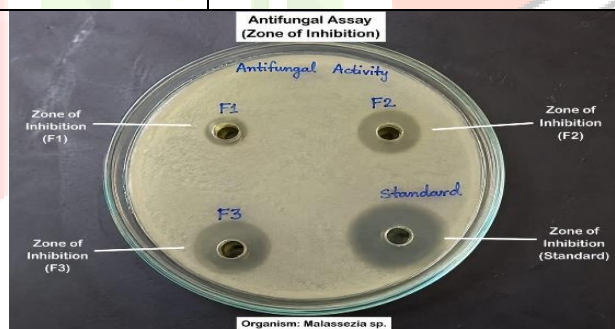


Table 8: Zone of inhibition of standard,F1, F2, F3.

**CONCLUSION AND FUTURE PERSPECTIVE**

The present study concluded that the ethanolic extract of Banyan Tree aerial roots showed significant antifungal activity against dandruff-causing fungal organisms. This activity was maintained when the extract was incorporated into the herbal serum base for topical scalp application. The prepared antidandruff serum showed satisfactory physicochemical properties including good spreadability, homogeneity, suitable pH and non-irritant nature. The formulation spread easily on scalp surface and was found suitable for dandruff management and scalp care due to its antifungal and antimicrobial

properties. Among all formulations, F3 showed maximum antifungal activity and better evaluation parameters

## ACKNOWLEDGEMENT

Authors would like to thank Shri Keshavrao Mankar (Secretary of Bhawabhuti Shikshan Sanstha, Amgaon), Dr. D. K. Sanghi (Technical Advisor of Bhawabhuti Shikshan Sanstha, Amgaon) for providing facilities and for creating a nurturing and creative environment, and for their valuable support in the present study.

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