



Research Article

## PHARMACEUTICAL AND ANALYTICAL STUDY OF MALATYADI SCALP SERUM IN RELATION TO MALATYADI TAILA AND THEIR COMPARATIVE IN-VITRO ANTIMICROBIAL STUDY

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### ABSTRACT


Dandruff (Pityriasis capitis), correlated with *Darunaka* in Ayurveda, affects approximately 50% of the global population. While classical *Malatyadi Taila* is a recognized treatment, modern lifestyles demand less greasy, more user-friendly delivery systems. This study aimed to reformulate the classical oil into two scalp serums - *Malatyadi Scalp Serum-1* (MSS-1, extract-based) and *Malatyadi Scalp Serum-2* (MSS-2, oil-based) and perform their analytical profiles and compare their in-vitro antimicrobial efficacy against *Staphylococcus epidermidis* and *Malassezia furfur*. **Methods:** *Malatyadi Taila* was prepared per Chakradatta texts. MSS-1 was formulated using hydroalcoholic extracts of *Jati*, *Karanja*, *Karavira*, and *Chitraka* while MSS-2 utilized solubilized *Malatyadi Taila*. Both serums were evaluated for stability, HPTLC profiles, and in-vitro antimicrobial activity against *S. epidermidis* and *M. furfur* via the Kirby-Bauer agar well diffusion method. **Results:** Analytical results confirmed that both serums maintained a scalp-friendly pH and stayed stable without phase separation. In antimicrobial assays, all formulations showed significant concentration-dependent activity ( $p < 0.001$ ). MSS-1 (extract-based) demonstrated the highest antibacterial activity against *S. epidermidis*. For antifungal activity against *M. furfur*, MSS-1 and *Malatyadi Taila* showed comparable high efficacy, while MSS-2 followed closely. **Conclusion:** The study validates the traditional use of *Malatyadi* ingredients and demonstrates that reformulating them into serums particularly the extract-based MSS-1 offers a more potent and cosmetically acceptable alternative to traditional oils for managing dandruff.

### INTRODUCTION

Dandruff (Pityriasis capitis), known as *Darunaka* in Ayurveda, affects approximately 50% of the global adult population, with a higher prevalence in males<sup>[1]</sup>. Pathophysiologically, it involves the hyperproliferation of the epidermis triggered by *Malassezia* yeast<sup>[2]</sup>. In Ayurveda, it is classified as a *Kshudraroga* caused by the vitiation of *Vata* and *Kapha doshas*. Traditional Ayurvedic treatment (*Bahir Parimarjana Chikitsa*) primarily utilizes medicated oils. However, modern consumers often avoid these due to:

- **High Viscosity:** Greasiness and stickiness.
- **Microbial Growth:** Lipophilic microbes (like *Malassezia*) thrive in lipid-rich environments; excess oil can clog pores and attract dust.
- **Lifestyle Constraints:** Application and subsequent *Abhyanga* (massage) are time-consuming.

With the global hair care market growing at a CAGR of 6.6%, there is a significant shift toward effective, safe, and convenient formulations<sup>[3]</sup>. Scalp Serums represent a modern "Yukti" (logical innovation) to traditional science. They offer a non-greasy, fast-absorbing delivery system that maintains the potency of classical herbs while improving user compliance and scalp hygiene. Developing sophisticated, globally acceptable delivery systems such as gels, creams, and serums is now the "need of

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the hour" to align traditional wisdom with modern standards.

## AIMS

To prepare *Malatyadi taila* and *Malatyadi scalp serum* (by two method) from the ingredients present in *Malatyadi taila* and comparative evaluation of their In-vitro antimicrobial activity.

## OBJECTIVES

- Preparation of *Malatyadi Taila* as mentioned in *Chakradatta (Darunaka)*.
- Extraction of the constituents present in *Malatyadi taila (Jati, Karanja, Karavira, Chitraka)*.
- Preparation of the scalp serum 1 & 2 from the extracts of constituents present in *Malatyadi taila*.
- Comparative assessment of In-vitro anti-microbial effect of prepared MSS-1, MSS-2 and *Malatyadi Taila*.

## MATERIAL & METHODS

- Identification, authentication and analytical study of raw materials
- Pharmaceutical and analytical study of *Malatyadi Taila*
- Pharmaceutical and analytical study of *Malatyadi Scalp serum 1 (MSS-1)*
- Pharmaceutical and analytical study of *Malatyadi Scalp serum 2 (MSS-2)*

E. Comparative in-vitro antimicrobial study of *Malatyadi Taila*, MSS-1 (hydroalcoholic extract Based) & MSS- 2 (Oil based) on the Following Strains:

1. *Staphylococcus epidermis*
2. *Malassezia furfur*

## Identification and Authentication of Raw materials.

Raw materials required for the preparation of *Malatyadi taila* and MSS-1 & MSS-2 were procured from the natural habitat of Kurukshetra and certified vendors. Respective *Taila* was prepared at Dept. of *Rasashashtra evum Bhaishajya Kalpana*, Institute for Ayurved Studies & Research, faculty of Ayurved, Kurukshetra Haryana after proper collection, cleaning and authentication of drugs. Raw drug identification and authentication was done by PG Department of Dravyaguna, Institute for Ayurved Studies and Research, Kurukshetra and Central Ayurvedic Research Institute (CARI), Jhansi. Identification was done based on morphological characters and powder microscopy that are mentioned in API.

## Pharmaceutical Study

### Pharmaceutical Study of *Malatyadi Taila*

*Malatyadi Taila* was prepared in accordance with the reference described in the *Ksudrarogadhikara* chapter of *Chakradatta* for the management of *Darunaka*.<sup>[4]</sup>

**Table 1: Ingredients of *Malatyadi Taila***

S.No	Name of Drug	Botanical name	Part Used	Quantity	Eq. wt.
1.	<i>Jati</i>	<i>Jasminum officinale</i>	Leaves	1 Pala	48 gm
2.	<i>Karavira</i>	<i>Nerium indicum</i>	Root	1 Pala	48 gm
3.	<i>Chitraka</i>	<i>Plumbago zeylanica</i>	Root	1 Pala	48 gm
4.	<i>Karanja</i>	<i>Pongamia pinnata</i>	Seed	1 Pala	48 gm
5.	<i>Tila Taila</i>	<i>Sesamum indicum</i>	Oil	4 times of <i>Kalka dravya</i>	768 gm
6.	Water	-	-	4 times of <i>Sneha</i>	3072 gm

## Method of preparation of *Malatyadi taila*:

By the reference as mentioned in the *Chakradutta, Kshudrarogadhikar 55/94* preparation was carried out.

*Kalka* of *Jatipatra, Chitrakamoola, Karanja beeja* and *Karaviramoola* was prepared by taking 1/4<sup>th</sup> part of coarse powder of these 4 drugs in equal quantity and *Kalka* was prepared using sufficient quantity of water. Then *Tila taila* was taken in a vessel and heated first, then *Kalka* and *Jala* was added into it in the specified quantity and heated in *Mandagni* to *Madhyamagni till taila siddhi lakshana* appears. Then the final product was filtered through a clean cloth.

## Pharmaceutical Study of *Malatyadi Scalp Serum 1*

MSS-1 was prepared from the hydroalcoholic extracts of *Jatipatra, Karanja beeja, Karaviramoola* and *Chitrakamoola* as active herbal drug. Extraction process was carried out by using different alcohol: water ratio (70:30) by Soxhlet extractor. It is prepared by hit and trial method. The final batch was chosen on the basis of optimal consistency, spreadability, and scalp-friendly pH and was therefore selected for further evaluation.

**Table 2: Formulation of Malatyadi Scalp Serum (MSS-1)**

S.No.	Name of the Ingredient	Purpose in Formulation	Quantity (%)	Quantity (gm)
1.	<i>Jati</i> extract	Active herbal drug	4.5	4.5
2.	<i>Chitraka</i> extract	Active herbal drug	4.5	4.5
3.	<i>Karanja</i> extract	Active herbal drug	4.5	4.5
4.	<i>Karavira</i> extract	Active herbal drug	4.5	4.5
5.	Xanthum gum	Thickener	0.4	0.4
6.	Euxyl PE 9010	Preservative	0.8	0.8
7.	Sodium gluconate	Chelating agent	0.1	0.1
8.	Sodium benzoate	Preservative	0.3	0.3
9.	Distilled Water	Vehicle	80	80

#### Method of preparation of Malatyadi Scalp Serum 1

- The aqueous phase was prepared by dispersing xanthan gum in distilled water under continuous stirring to obtain a smooth gel.
- Sodium gluconate and sodium benzoate were added to the hydrated gel and mixed until completely dissolved.
- Active herbal extracts of *Jati*, *Karanja*, *Karavira* and *Chitraka* were incorporated gradually with continuous stirring for uniform dispersion.
- Euxyl PE 9010 was added as a preservative blend and mixed thoroughly.

- The pH was adjusted to 5.0–6.0
- The prepared scalp serum was transferred into sterilized airtight containers.

#### Pharmaceutical Study of Malatyadi Scalp Serum 2

The oil-based *Malatyadi Scalp Serum* (MSS-2) was successfully formulated using classical hydrolipoextraction (*Taila Kalpana*) and a modern serum delivery system to improve stability, ease of application, and scalp compatibility. MSS-2 was prepared from *Malatydi taila*. In this quantity of *Malatydi taila* was reduced to 3%.

**Table 3: Formulation of MSS-2**

S.No.	Name of the Ingredient	Purpose in Formulation	Quantity (%)	Quantity (gm)
1.	Xanthan gum	Thickener	0.4	0.4
2.	Euxyl PE 9010	Preservative	0.8	0.8
3.	Sodium gluconate	Chelating agent	0.1	0.1
4.	Sodium benzoate	Preservative	0.3	0.3
5.	Distilled water	Vehicle	86	86
6.	RH 40 (PEG-40 HCO)	Solubilizer/emulsifier	9	9
7.	<i>Malatyadi Taila</i>	Active herbal oil	3	3
8.	Vitamin E	Antioxidant	0.1	0.1

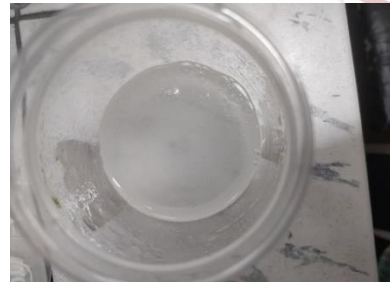
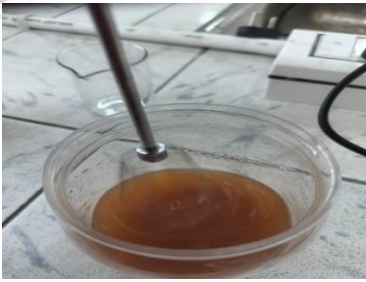


#### Method of preparation of Malatyadi Scalp Serum 2:

- Xanthan gum was hydrated by dispersing it slowly in distilled water under continuous stirring to obtain a uniform gel.
- Sodium gluconate and sodium benzoate were added to the hydrated gel and mixed until completely dissolved.
- *Malatyadi Taila* was blended with RH-40 and Vitamin E separately to form a clear oil-solubilizer phase.
- The oil-solubilizer blend was gradually incorporated into the aqueous xanthan base with continuous stirring and homogenization.
- Euxyl PE 9010 was added at room temperature and mixed gently to obtain a homogeneous serum; pH was checked.
- The finished scalp serum was filled into sterilized containers and stored in a cool, dry place.

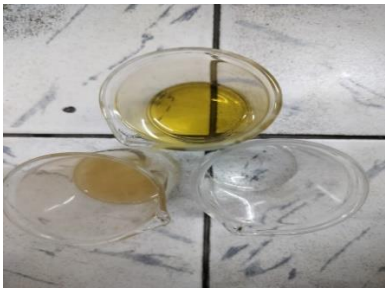



**Preparation of Malatyadi Taila**

	
<p><b>Fig: Jati Kalka Preparation</b></p>	<p><b>Fig: Soaking of dry drugs for Kalka Preparation</b></p>
	
<p><b>Fig: Addition of Kalka to Tila taila</b></p>	<p><b>Fig: Addition of Drava Dravya</b></p>
	
<p><b>Fig: During Taila Paka</b></p>	<p><b>Fig: Malatyadi taila packed in bottles</b></p>

**Preparation of MSS -1**

	
<p><b>Fig: Serum base after adding excipients &amp; stirring</b></p>	<p><b>Fig: Serum after adding extracts</b></p>
	
<p><b>Fig: After adding Preservatives</b></p>	<p><b>Fig: Packed Scalp Serum (MSS-1)</b></p>

### Preparation of MSS -2

	
<b>Fig: RH40, M.T&amp; PE9010</b>	<b>Fig: Preparation of Oil phase</b>
	
<b>Fig: After Adding oil phase &amp; stirring</b>	<b>Fig: Packed MSS-2</b>

## RESULTS

The results of the study are systematically categorized into two sections, comprising

1. Analytical profiling of *Malatyadi Taila*, MSS-1 & MSS-2
2. In-vitro antimicrobial evaluation.

### Analytical Study of *Malatyadi Taila*, MSS-1 & MSS-2

A systematic analytical evaluation was undertaken to assess *Malatyadi Taila* and MSS-1 & MSS-2 formulations with respect to their physicochemical and quality control parameters.

Testing of *Malatyadi Taila* was carried out as per the guidelines and analytical protocols recommended by the Central Council for Research in Ayurvedic Sciences (CCRAS). The analytical data generated for the formulation were observed to fall within the normal and acceptable range.

An in-house analytical protocol was established for the scalp serum formulations, under which the following tests were carried out.

Description, pH value, specific gravity refractive index, viscosity, spreadability, skin irritancy, HPTLC, microbial analysis and stability test (0, 3 months). The results obtained complied with the prescribed acceptable limits.

### In-Vitro Antimicrobial Evaluation

The antimicrobial activity of *Malatyadi Taila* and *Malatyadi Scalp Serum* formulations (MSS-1: extract based; MSS-2: oil based) was evaluated using the Kirby-Bauer agar well diffusion method against *Staphylococcus epidermidis* (MTCC 96) and *Malassezia furfur* (MTCC 1374). The study was conducted using standard cultures, and procedures were followed in accordance with pharmacopoeial antimicrobial sensitivity protocols under controlled microbiological conditions. Gentamycin and fluconazole were used as standard antibacterial and antifungal agents respectively, while DMSO served as the negative control.

### Results 1: *Malatyadi Taila* Antimicrobial Activity

A. Antimicrobial Activity						
	Antimicrobial activity (Values are mean of triplicate)	As per standard antimicrobial sensitivity protocol of pharmacopoeia	Zone of Inhibition (mm)			
			Standard	Test Sample (in DMSO)		
			Positive control	50%	100%	DMSO Negative control
1.	<i>Staphylococcus epidermis</i>		26	12	14	8
2.	<i>Malassezia furfur</i>		26	16	22	8

**Results 2: Malatyadi Scalp Serum-1 (Extract Based) Antimicrobial Activity**

B. Antimicrobial Activity						
	Antimicrobial Activity (Values are mean of triplicate)	As per standard antimicrobial sensitivity protocol of pharmacopoeia	Zone of Inhibition (mm)			
			Standard	Test Sample (in DMSO)		
			Positive control	50%	100%	DMSO Negative control
1.	<i>Staphylococcus epidermis</i>		26	16	20	8
2.	<i>Malassezia furfur</i>		26	18	22	8

**Results 3: Malatyadi Scalp Serum-2 (Oil Based) Antimicrobial Activity**

C. Antimicrobial Activity						
	Antimicrobial Activity (Values are mean of triplicate)	As per standard antimicrobial sensitivity protocol of pharmacopoeia	Zone of Inhibition (mm)			
			Standard	Test Sample (in DMSO)		
			Positive control	50%	100%	DMSO Negative control
1.	<i>Staphylococcus epidermis</i>		26	14	18	8
2.	<i>Malassezia furfur</i>		26	16	20	8

**Effect against Staphylococcus epidermidis**

**Table 1: One-way ANOVA for Staphylococcus epidermidis**

Formulation	Group	Zone of Inhibition (Mean ± SD)	ANOVA (p value)
<i>Malatyadi Taila</i>	Positive control	26.00 ± 0.00	<0.001
	50%	12.00 ± 2.00	
	100%	14.00 ± 1.15	
	DMSO	8.00 ± 0.00	
MSS-1 (Extract)	Positive control	26.00 ± 0.00	<0.001
	50%	16.00 ± 2.00	
	100%	20.00 ± 2.00	
	DMSO	8.00 ± 0.00	
MSS-2 (Oil based)	Positive control	26.00 ± 0.00	<0.001
	50%	14.00 ± 2.00	
	100%	18.00 ± 2.00	
	DMSO	8.00 ± 0.00	

**Table 2: Tukey Post-hoc Comparison for Staphylococcus epidermidis**

Comparison	<i>Malatyadi Taila</i>	Serum-1 (Extract)	Serum-2 (Oil)
Positive Control vs DMSO	Significant	Significant	Significant
100% vs 50%	Significant	Significant	Significant
100% vs DMSO	Highly Significant	Highly Significant	Highly Significant
MSS-1 vs Taila (100%)	-	Significant	-
MSS-1 vs MSS-2 (100%)	-	Significant	-

One-way ANOVA revealed a statistically highly significant difference among the treatment groups for all three formulations (p < 0.001).

*Malatyadi Taila* exhibited moderate antibacterial activity, with mean zones of inhibition of 12.00±2.00mm at 50% concentration and

14.00±1.15mm at 100% concentration. Tukey post-hoc analysis showed a significant increase in activity at 100% compared to 50% concentration, indicating a concentration-dependent antibacterial effect.

*Malatyadi Scalp Serum-1* (extract-based) demonstrated superior antibacterial activity,

producing zones of inhibition of 16.00±2.00mm at 50% and 20.00±2.00mm at 100% concentration. Post-hoc analysis confirmed that the 100% concentration was significantly more effective than the 50% concentration and also significantly superior to *Malatyadi Taila* at equivalent concentration.

*Malatyadi Scalp Serum-2* (oil-based) showed antibacterial activity with zones of inhibition of **Effect against *Malassezia furfur***

14.00±2.00mm at 50% and 18.00±2.00mm at 100%. Although statistically significant compared to the negative control, its activity was inferior to the extract-based serum.

DMSO showed no inhibitory activity, confirming the validity of the experimental procedure, while the positive control (Gentamycin) showed the highest inhibition (26mm).

**Table 3: One-way ANOVA for *Malassezia furfur***

Formulation	Group	Zone of Inhibition (Mean ± SD)	ANOVA (p value)
<i>Malatyadi Taila</i>	Positive Control	26.00 ± 0.00	<0.001
	50%	16.00 ± 2.00	
	100%	22.00 ± 2.00	
	DMSO	8.00 ± 0.00	
MSS-1 (Extract Based)	Positive Control	26.00 ± 0.00	<0.001
	50%	18.00 ± 2.00	
	100%	22.00 ± 2.00	
	DMSO	8.00 ± 0.00	
MSS-2 (Oil based)	Positive Control	26.00 ± 0.00	<0.001
	50%	16.00 ± 2.00	
	100%	20.00 ± 2.00	
	DMSO	8.00 ± 0.00	

**Table 4: Tukey Post-hoc Comparison for *Malassezia furfur***

Comparison	<i>Malatyadi Taila</i>	Serum-1 (Extract)	Serum-2 (Oil)
100% vs 50%	Significant	Significant	Significant
100% vs DMSO	Highly Significant	Highly Significant	Highly Significant
MSS-1 vs Taila (100%)	Not Significant	-	-
MSS-1 vs MSS-2 (100%)	-	Significant	-

Statistical analysis was performed using One-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc test. A p value < 0.05 was considered statistically significant.

Statistical analysis using one-way ANOVA showed a highly significant difference among treatment groups for antifungal activity (p < 0.001).

*Malatyadi Taila* demonstrated strong antifungal activity, with mean zones of inhibition of 16.00±2.00mm at 50% and 22.00±2.00mm at 100% concentration. Post-hoc analysis indicated a significant enhancement of antifungal activity at higher concentration.

*Malatyadi Scalp Serum-1* exhibited comparable antifungal efficacy, showing zones of inhibition of 18.00±2.00mm at 50% and 22.00±2.00mm at 100%.

The difference between MSS-1 and *Malatyadi Taila* at 100% concentration was statistically not significant, indicating equivalent antifungal potency.

*Malatyadi Scalp Serum-2* showed moderate antifungal activity, with inhibition zones of 16.00±2.00mm at 50% and 20.00±2.00mm at 100%. Post-hoc analysis revealed that its antifungal efficacy was significantly lower than the extract-based serum at equivalent concentration.

#### DISCUSSION

➤ The present study demonstrates that all *Malatyadi* formulations possess statistically significant antimicrobial activity against both *Staphylococcus epidermidis* and *Malassezia furfur*, with clear evidence of concentration-dependent efficacy.

- The superior performance of *Malatyadi Scalp Serum-1* (extract-based) can be attributed to enhanced diffusion of active phytoconstituents through the agar medium.
  - From an Ayurvedic perspective, the observed antimicrobial activity can be explained by the *Krimighna, Kandughna, Kaphahara*, properties of the ingredients of *Malatyadi* formulations. The formulations act by reducing *Kapha Vata* dominance and obstructive pathological factors, thereby inhibiting microbial proliferation. The concentration-dependent increase in activity further supports the classical Ayurvedic concept of *Dravya-Prabhava* and *Matra-Prabhava*.
  - In contrast, oil-based formulations, including *Malatyadi Taila* and MSS-2, showed comparatively reduced antibacterial activity against *Staphylococcus epidermidis*.
  - *Malatyadi Taila* exhibited strong antifungal activity against *Malassezia furfur*, comparable to the extract-based serum at higher concentration.
- iv. MSS-2 showed the higher antibacterial activity, significantly superior to *Malatyadi Taila*.
- v. *Malatyadi Taila* and MSS-1 showed comparable and strong antifungal activity against *Malassezia furfur*, highlighting their potential utility in fungal scalp condition.
- vi. The findings validate the traditional Ayurvedic use of *Malatyadi* formulations and support their potential application as effective topical antimicrobial agents, particularly in scalp disorders of bacterial and fungal origin.
- vii. Overall, the study establishes a scientifically validated antimicrobial profile of *Malatyadi* formulations, with extract-based serum showing superior overall efficacy.

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#### CONCLUSION

Based on the results of the present study, it can be concluded that:

- i. All *Malatyadi* formulations exhibit statistically significant antimicrobial activity against *Staphylococcus epidermidis* and *Malassezia furfur* ( $p < 0.001$ ).
- ii. A concentration-dependent increase in antimicrobial efficacy was observed across all formulations.
- iii. MSS-1 demonstrated the highest antibacterial activity, significantly superior to both *Malatyadi Taila* and oil-based serum.

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