RESEARCH PAPER

Evaluation of Anti-fungal activity of Gandhaka taila- An in-vitro study

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Received: 12th Mar, 2026 | **Revised:** 24th Mar, 2026 | **Accepted:** 14th Apr, 2026 | **Available Online:** 30th Apr, 2026

ABSTRACT

Introduction:

In India, it is estimated that approximately 57 million people will be affected by serious fungal infections in 2027. The rising incidence of these infections, along with increasing drug resistance and recurrence rates, poses significant socioeconomic burdens. Gandhaka (sulphur), a mineral component used in Ayurvedic medicine, is traditionally applied to treat various skin diseases after appropriate processing.

Material and methods:

Gandhaka purification was done with Cow's milk as per classical reference. Gandhaka taila was prepared by using cow's milk as per Rasendra Chintamani. GCMS and anti fungal activity on Trichophyton, Epidermophyton, Microsporum, Aspergillus, Candida species was done by cup plate method.

Results and conclusion:

The colour of Gandhaka taila showed brownish colour with characteristic odour. The QC parameters showed the results as LOD 0.190%, Acid value 3.655, Saponification value 141.30, Iodine value 58.75, Refractive index at 40°C 1.485. GCMS profile of Gandhaka taila identified a total of forty distinct compounds, each showing a range of beneficial biological activities. The antifungal activity of the purified Gandhaka taila increased linearly with an increase in concentration (µg/ml). So the classical indication of Purified Gandhaka taila substantiates that it may be used in different skin conditions externally also.

Keywords: Gandhaka, Skin Diseases, Gas Chromatography-Mass Spectrometry, Antifungal Agents, Ayurveda

Abbreviations: Gas Chromatography-Mass Spectrometry: GC-MS

How to cite this article: Hiremath RR, Vinay PS, Savalagimath MP, Gundakalle MB. Evaluation of Anti-fungal activity of Gandhaka taila- An in-vitro study. Int J Drug Deliv Technol. 2026;16(38s): 342-351. DOI: 10.25258/ijddt.16.38s.30

Source of support: Nil.

Conflict of interest: None

INTRODUCTION:

Superficial fungal infections, predominantly caused by dermatophytes, affect the skin, hair, and nails, and represent a significant global health concern. With an estimated prevalence of 20% to 25% and a rising incidence, these infections pose a[1] several species including *Trichophyton rubrum*, *T. mentagrophytes* var. *interdigitale*, *Microsporum canis*, and *Epidermophyton floccosum*, exhibit worldwide distribution. Geological conditions and high temperatures are significant factors contributing to the increased incidence of fungal infections, particularly in nations with dense populations who are especially vulnerable. Migration, food and lifestyle modifications,

medication therapy, and socioeconomic circumstances all influence the prevalence of these illnesses, making tinea infections endemic in some parts of India[2]. In Ayurveda, skin diseases are explained under the heading of *Kushta* and *Kshudra rogas*. *Viruddharaha* (incompatible food consumption), *Krimi* (microorganisms), unhealthy lifestyles, inadequate personal hygiene, and psychological stress etc are some etiological factors of skin diseases. *Dadru,* a condition described in Ayurvedic texts, closely aligns with the clinical presentations of contemporary fungal infections[3].

Herbal and herbomineral formulations are described in Ayurvedic literature for the management of various dermatological conditions. Gandhaka-based preparations, derived from purified sulphur (Shuddha Gandhaka), are widely utilized for their therapeutic efficacy in skin diseases.

Classical Ayurvedic texts, *Rasendra Sangraha* (Chapter 6), describe *Gandhaka Taila* as an effective formulation in the management of *Kushtha* (skin disorders), and contemporary studies further support these traditional claims by demonstrating notable antifungal activity, particularly against *Aspergillus niger*.

Pharmaceutico-analytical investigations have reported that Gandhaka Taila prepared by classical methods exhibits distinct physicochemical properties, including mildly alkaline pH, appropriate specific gravity, and high lipid content, along with essential inorganic constituents such as calcium, magnesium, iron, and sulfur predominantly in sulfide form, thereby substantiating its therapeutic potential (Kotrannavar et al., 2013). VS K, Kotrannavar SS, Vaidya SS. Article Details Pharmaceutico Analytical Study of Gandhaka Taila [12].

Among these, Gandhaka Taila, holds significant clinical importance due to its traditional application in infectious and inflammatory dermatoses. In the present study, *Gandhaka taila* was subjected to antifungal studies on common fungus strains involved in skin manifestations to assess its efficacy. So, here we propose a study to evaluate the efficacy of Gandhaka taila on fungal infections through invitro methods. This study aims at evaluate the antifungal potentials of Gandhaka in the form of Taila in invitro methods on *Trichophyton species, Epidermophyton species, microsporum species , aspergillus species and candid species.*

MATERIALS AND METHODS

Gandhaka Taila Preparation:

Gandhaka Taila was prepared in accordance with the classical method described in *Rasendra Chintamani*[5]. Initially, 100 g of *Shuddha Gandhaka* (purified sulfur) was subjected to boiling with fresh cow's milk for three hours over a moderate flame. Following this, a small quantity of curd was added to induce coagulation. The mixture was allowed to cool and stored under refrigerated conditions overnight. Same procedure was repeated with fresh cow's milk for a total period of fifteen days. Overall, 1500 g of *Shuddha Gandhaka* and approximately 15 liters of cow's milk were utilized throughout the process. The curd obtained from each cycle was collected and pooled. The combined curd was then churned to obtain butter (*Navaneeta*), which was subsequently heated over a moderate flame to yield ghee (*Ghrita*), representing the final form of *Gandhaka Taila*. The prepared formulation was stored in a clean, dry glass container.

Antifungal Study:

Microbial Cultures and Growth Media

Authenticated fungal strains, including *Trichophyton* spp., *Epidermophyton* spp., *Microsporum* spp., *Aspergillus* spp., and *Candida* spp., were used for the study. The organisms were cultured and maintained on Sabouraud Dextrose Agar (SDA) and/or Dermatophyte Test Medium (DTM) under appropriate incubation conditions.

Test Samples and Controls

The following samples and controls were employed for antifungal evaluation:

1. Test sample I: *Gandhaka Taila*
2. Positive control: Standard antifungal agent (e.g., Fluconazole or Amphotericin B)
3. Negative control: Sterile distilled water and dimethyl sulfoxide (DMSO), depending on the solvent system used

Equipment and Supplies

All experiments were conducted using standard microbiological equipment, including sterile Petri dishes, sterile cotton swabs, cork borers for well diffusion method, and/or sterile filter paper discs

for disc diffusion assay. Micropipettes with sterile tips were used for accurate sample dispensing. Procedures were performed under aseptic conditions in a laminar airflow chamber. Incubation was carried out at 25–28°C for filamentous fungi and 35–37°C for yeast forms. The zones of inhibition were measured using a Vernier caliper or a standard ruler

Methodology for In Vitro Antifungal Activity[7]
Preparation of Fungal Inoculum: Fungal cultures are grown on Sabouraud Dextrose Agar (SDA) or Dermatophyte test medium (DTM) plates at an appropriate temperature (28°C for molds, 37°C for yeasts) for 48–72 hours. A spore suspension (for filamentous fungi) is prepared in sterile saline (0.85% NaCl) or sterile distilled water. The turbidity is adjusted to 0.5 McFarland standards.

Agar Plate Preparation: Sabouraud Dextrose Agar (SDA) or DTM medium is prepared, autoclaved, and poured into sterile Petri dishes. Plates are allowed to solidify under aseptic conditions.
Inoculation of Fungal Culture: The prepared fungal suspension is evenly spread over the surface of solidified agar using a sterile cotton swab (lawn culture method). The plates are allowed to dry for 10–15 minutes in the laminar airflow.

Incubation: The plates are incubated upside-down at appropriate temperatures: Molds (e.g., *Trichophyton*): 25°C –28°C for up to 21 days.
Measurement of Antifungal Activity: After incubation, plates are examined for zones of inhibition (clear areas around the wells or discs). The diameter of the inhibition zone (in mm) is measured using a ruler or Vernier caliper.

Interpretation of Results: Larger zones of inhibition indicate stronger antifungal activity. Smaller or no inhibition zones indicate weak or no antifungal activity. The results can be compared to standard antifungal drugs for relative effectiveness.
Assessment parameters: the plates will be observed for the formation of a zone of inhibition

RESULTS AND OBSERVATIONS

The authentication and quality analysis of both the Gandhaka and the prepared drugs will adhere to the standards outlined in the Ayurvedic Pharmacopoeia[6] . Quality Analysis was done at Central Research Facility and Nisarga laboratory.
Shodita Gandhaka is yellowish in colour with MP 118ºC and insloluble in water and HCl. Gandhaka taila is Brownish with Characteristic of *Gandhaka* odour.

Table 1 Physico chemical standards of *Gandhaka* taila

Sl No	Tests	Results
1	Loss on drying	0.190%
2	Acid value	3.655
3	Saponification value	141.30
4	Iodine value	58.75
	Refractive index at 40ºC	1.485

Figure 2. GCMS profile of Gandhaka taila

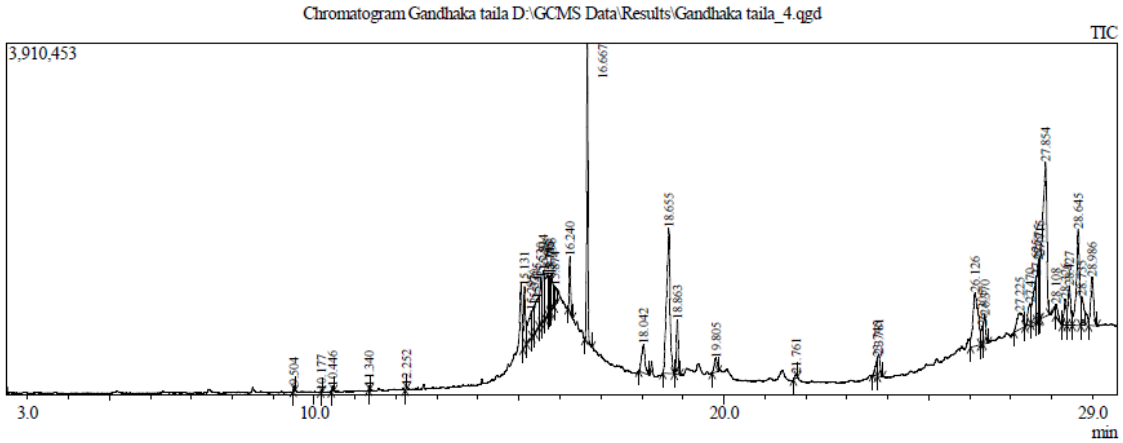


Fig 4: Indicates the retentions values, the types of possible compound, their molecular formulae, molecular mass, peak area and their medicinal roles of each compound as shown in the GC MS profile of Gandhaka taila.

Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height	Height%	A/H	Name
1	9.504	9.485	9.535	74370	0.09	52058	0.26	1.43	Benzene, heptyl-
2	10.177	10.160	10.200	12857	0.02	10814	0.05	1.19	Benzene, (5-methyl-1-hexenyl)-
3	10.446	10.420	10.480	89468	0.11	55496	0.28	1.61	Benzene, octyl-
4	11.340	11.325	11.360	39277	0.05	37003	0.19	1.06	Benzene, nonyl-
5	12.252	12.220	12.270	53003	0.06	38719	0.20	1.37	2-Heptadecanone
6	15.131	15.095	15.175	1960422	2.35	671019	3.39	2.92	(E)-13-Docosenoic acid
7	15.295	15.190	15.310	1752783	2.10	297479	1.50	5.89	Z,Z-8,10-Hexadecadien-1-ol
8	15.370	15.310	15.385	1330000	1.60	312442	1.58	4.26	trans-Dodec-5-enal
9	15.435	15.385	15.485	1972144	2.37	342602	1.73	5.76	Oleic Acid
10	15.530	15.485	15.550	1686363	2.02	512746	2.59	3.29	o-Dodecylphenol
11	15.594	15.550	15.630	2412381	2.90	560846	2.83	4.30	Oleic Acid
12	15.695	15.630	15.700	1873540	2.25	455548	2.30	4.11	Butyl 9-decenoate
13	15.745	15.720	15.750	734675	0.88	403997	2.04	1.82	Cyclopropaneacetic acid, 2-hexyl-
14	15.755	15.750	15.775	550375	0.66	396751	2.00	1.39	9,12-Octadecadienoic acid (Z,Z)-
15	15.796	15.775	15.840	1287071	1.55	400111	2.02	3.22	Glycidyl palmitoleate
16	15.874	15.860	15.930	753291	0.90	215412	1.09	3.50	2-Tridecyne
17	16.240	16.200	16.310	1488512	1.79	612439	3.09	2.43	Hexadecanoic acid, 1-[[[(2-aminoetho:
18	16.667	16.605	16.780	7073230	8.49	3324296	16.79	2.13	Glycidyl palmitate
19	18.042	17.925	18.180	1819305	2.18	318552	1.61	5.71	(E)-13-Docosenoic acid
20	18.655	18.510	18.790	9586459	11.51	1613850	8.15	5.94	Glycidyl palmitoleate
21	18.863	18.790	18.930	1682072	2.02	601359	3.04	2.80	Glycidyl palmitate
22	19.805	19.710	19.865	786862	0.94	156047	0.79	5.04	(Z)6,(Z)9-Pentadecadien-1-ol
23	21.761	21.700	21.795	160484	0.19	45765	0.23	3.51	3-Pentanol, 2,4-dimethyl-
24	23.745	23.630	23.750	706590	0.85	210142	1.06	3.36	2H-Pyran, 6-heptyltetrahydro-2,2-dim
25	23.781	23.750	23.875	930377	1.12	246494	1.25	3.77	Butyric acid, 2-pentadecyl ester
26	26.126	26.020	26.265	5145841	6.18	593794	3.00	8.67	Phytol
27	26.305	26.265	26.325	648661	0.78	204412	1.03	3.17	Pentadecyl decanoate
28	26.370	26.325	26.450	1244758	1.49	316659	1.60	3.93	Butyric acid, 3-pentadecyl ester
29	27.225	27.080	27.350	1855957	2.23	182843	0.92	10.15	Octadecanoic acid, 2,3-bis[(1-oxotetra
30	27.470	27.350	27.490	1070654	1.29	231845	1.17	4.62	Undecanal
31	27.625	27.490	27.630	2907137	3.49	501774	2.53	5.79	Hexanoic acid, cyclohexyl ester
32	27.675	27.630	27.690	2172969	2.61	662774	3.35	3.28	1-Dodecanoyl-3-myristoylglycerol
33	27.715	27.690	27.725	1420479	1.71	702404	3.55	2.02	5,16-Heptadecadiene-1,2,4-triol
34	27.854	27.725	27.945	12092290	14.52	1716065	8.67	7.05	Hexadecanoic acid, 1-[[[(2-aminoetho:
35	28.108	28.090	28.235	556696	0.67	139872	0.71	3.98	Octanoic acid, 4-pentadecyl ester
36	28.326	28.260	28.370	1125120	1.35	291419	1.47	3.86	Vinyl decanoate
37	28.427	28.370	28.505	2038282	2.45	429703	2.17	4.74	Octanoic acid, 4-pentadecyl ester
38	28.645	28.505	28.710	5840548	7.01	1071413	5.41	5.45	Hexanoic acid, 4-tetradecyl ester
39	28.735	28.710	28.825	1660207	1.99	324401	1.64	5.12	Succinic acid, dodec-2-en-1-yl tetrahy
40	28.986	28.900	29.110	2700067	3.24	534202	2.70	5.05	Cholest-5-ene, 3-methoxy-, (3.beta.)-
				83295577	100.00	19795567	100.00		

Table No 2. showing biological activities of compounds of Gandhaka taila:

S.No	Compound	Area %	Biological activity
1.	Hexadecanoic acid, 1-[[[(2-aminoethoxy)hydroxyphosphinyl]oxy]methyl]-	14.52	inhibitory effects on bacteria and inflammation[9]
2.	Glycidyl palmitoleate	11.51	ABHD6 inhibitors[17]
3.	Glycidyl palmitate	8.49	antioxidant, anti-inflammatory, and anticancer

			effects
4.	Hexanoic acid, 4-tetradecyl ester	7.01	Anti-inflammatory and Analgesic Properties: The compound is associated with reducing inflammation and acting as a pain reliever. Antimicrobial and Antifungal Activity: It forms part of the lipophilic components of plant extracts that show inhibitory activity against various pathogens. Antioxidant Activity: It is linked to plant extracts that possess antioxidant properties, helping to counteract oxidative stress[13]
5.	Phytol	6.18	-carcinogen, inducing hepatic fatty cells[18]

Table 3: Antifungal Activity of Purified *Gandhaka taila*

Organism		Concentration						Control
		100	75	50	25	10	5	No Drug
Trichophyton rubrum	*Gandhaka taila*	36mm	32 mm	28 mm	23 mm	18 mm	12 mm	NZ
	Clortimazole	29mm	26 mm	24 mm	22 mm	18 mm	14 mm	NZ
Trichophyton tonsurans	*Gandhaka taila*	32 mm	29 mm	22 mm	18 mm	12 mm	10 mm	NZ
	Clortimazole	34 mm	29 mm	26 mm	21 mm	17 mm	12 mm	NZ
Microsporum gypseum	*Gandhaka taila*	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	Clortimazole	33 mm	29 mm	27 mm	20 mm	18 mm	14 mm	NZ
Epidermophyton	*Gandhaka taila*	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	Clortimazole	32 mm	26 mm	24 mm	23 mm	18 mm	16 mm	NZ
Trichophyton mentagrophytes	*Gandhaka taila*	30 mm	28 mm	24 mm	19 mm	15 mm	13 mm	NZ
	Clortimazole	31 mm	29 mm	29 mm	22 mm	17 mm	12 mm	NZ

* *Gandhaka taila* (Alcohol Soluble Extract), NZ – no zone of inhibition around the drug

Discussion and conclusion

Fungal infections of the skin, hair, and nails are mostly caused by dermatophytes, Trichophyton, Microsporum, and Epidermophyton. Trichophyton rubrum is the most common isolated species and the leading cause of dermatophytosis worldwide.

Candida albicans is the most common causative agent of cutaneous candidiasis, which is the predominant yeast infection affecting the human skin. Other notable fungal pathogens include *Aspergillus* and *Candida* species, which are typically associated with specific conditions: *Aspergillus* with aspergillosis and *Candida* with candida. Overall, these fungal infections often present with symptoms such as erythema, pruritus, and inflammation. *Trichophyton* species remain the most common cause of superficial fungal infections, while *Aspergillus* and *Candida* contribute to more localized or systemic infections under particular conditions.

In Ayurveda *Gandhaka is said to be Madhura*[4], *Katu, Tikta, Kashaya in rasa, Ushna, Sara, Snigdha Guna, Ushna Virya, Katu Vipaka, Deepana, Pachana, Vishahara, Jantughna Karma, Kapha Vatahara, Pittavardhaka, Kandu, Visarpa, Krimi, Kustha, Kashaya, Pleeha, Rasayana.*

Gandhaka (sulfur) is a primary drug indicated for many diseases, either as a single drug or in formulations, after purification. Purified *Gandhaka*

powder and its different formulations are used to treat different skin diseases[8].

It is mainly used in clinical conditions such as *Kandu* (itching), *Kushtha* (dermatological diseases), *Visha Vikara* (poisoning), *Agnimandya* (subdued digestive and metabolic factors), *Grahani* (chronic diarrhea with malabsorption of nutrients), *Shula* (abdominal colic),[4,5]. Sulfur is an important biological element essential for various biochemical functions within the body. Cysteine, cystine, methionine, and vitamins are dependent on organosulfur compounds. Several bioactive sulfur-containing compounds, like glutathione, hydrogen sulfide, and taurine, are essential for maintaining cellular redox homeostasis and overall biological equilibrium.[1]

In the present study, raw *Gandhaka* (sulfur) successfully showed all the quality parameters as per Ayurvedic Pharmacopoeia of India (API) limits, indicating its acceptance for further use. After purification, *Gandhaka* changed into a yellowish powder with a melting point of 118°C and notable insolubility in water, which is a significant property for its further use.

A comprehensive analysis was conducted using Gas Chromatography-Mass Spectrometry (GC-MS) on the methanol fraction derived from the Gandhaka taila. This analytical technique identified a total of fourty distinct compounds, each exhibiting a range of beneficial biological activities. The GC-MS profile is shown in a chromatogram (Fig. 1), which visually represents the separation and detection of these compounds. The identified chemical constituents are detailed in a corresponding table (Table. 1), which includes their retention times (RT), molecular formulas, molecular weights (MW), and concentrations expressed as a percentage within the methanol fraction of *Gandhaka taila*.

The maximum area of five bioactive compounds include: - Hexadecanoic acid, 1-[[[(2-aminoethoxy)hydroxyphosphinyl]oxy]methyl]-, Glycidyl palmitoleate, Glycidyl palmitate, Hexanoic acid, 4-tetradecyl ester, Phytol.

The presence of these compounds underscores the rich chemical diversity of *Gandhaka* taila. The biological activities of the identified compounds showed Hexadecanoic acid, 1-[[[(2-aminoethoxy)hydroxyphosphinyl]oxy]methyl]- showed inhibitory effects on bacteria and inflammation, Glycidyl palmitoleate showed ABHD6 inhibitors[17]. Glycidyl palmitate showed antioxidant, anti-inflammatory, and anticancer effects, Hexanoic acid, 4-tetradecyl ester showed Anti-inflammatory and Analgesic Properties: The compound is associated with reducing inflammation and acting as a pain reliever, Antimicrobial and Antifungal Activity: It forms part of the lipophilic components of plant extracts that show inhibitory activity against various pathogens. Antioxidant Activity: It is linked to plant extracts that possess antioxidant properties, helping to counteract oxidative stress, Phytol showed - carcinogen, inducing hepatic fatty cells [9,10,11,12,13,18]. *Gandhaka* is used in different forms, such as *Gandhaka rasayana, Gandhaka taila, and Gandhaka druti*. However, references are available regarding the use of *Gandhaka* in powder form or purified *Gandhaka* for different skin diseases.

The present study evaluated the antifungal efficacy of *Gandhaka Taila* (alcohol-soluble extract) against dermatophytic fungi and compared its activity with the standard antifungal drug *Clotrimazole*. The results demonstrate a concentration-dependent antifungal activity of *Gandhaka Taila* against selected organisms. Among the tested fungi, *Trichophyton rubrum* exhibited the highest susceptibility to *Gandhaka Taila*, with a zone of inhibition measuring 36 mm at 100% concentration, which was notably higher than that of *Clotrimazole* (29 mm). A gradual reduction in the zone of inhibition was observed with decreasing concentrations, indicating a dose-dependent response. Similarly, *Trichophyton mentagrophytes* showed considerable sensitivity, with inhibition zones comparable to *Clotrimazole* across concentrations, suggesting that the formulation possesses potent antifungal activity against common dermatophytes.

In the case of *Trichophyton tonsurans*, *Gandhaka Taila* demonstrated moderate activity, although slightly lower than *Clotrimazole* at higher concentrations. However, the activity remained consistent across dilution levels, supporting its therapeutic relevance. Interestingly, no antifungal activity (NZ) was observed against *Microsporum gypseum* and *Epidermophyton* species, indicating organism-specific selectivity of the formulation. The observed antifungal activity can be attributed to the presence of sulfur compounds (Gandhaka), which are known for their keratolytic and antimicrobial properties. Sulfur in sulfide form may interfere with fungal metabolism by disrupting

protein synthesis and enzymatic activity. Additionally, the lipid-rich base of *Taila* may enhance drug penetration through fungal cell walls and keratinized tissues, thereby improving bioavailability and efficacy. When compared with *Clotrimazole*, a broad-spectrum azole antifungal, *Gandhaka Taila* demonstrated comparable or superior activity against certain species, particularly *Trichophyton rubrum*. However, the absence of activity against some fungi highlights the need for further standardization and possibly formulation modification to broaden its antifungal spectrum. These findings are consistent with classical Ayurvedic claims regarding the efficacy of *Gandhaka Taila* in *Kushtha* (skin disorders), and also align with modern pharmaceutico-analytical studies that report the presence of bioactive inorganic and lipid constituents contributing to its therapeutic action.

Conclusion

The study concludes that purified *Gandhaka Taila* (alcohol-soluble extract) exhibits significant antifungal activity against selected dermatophytes, particularly *Trichophyton rubrum* and *Trichophyton mentagrophytes*, with efficacy comparable to the standard drug *Clotrimazole*. The antifungal effect is concentration-dependent and likely mediated by sulfur-based bioactive compounds along with enhanced penetration due to its lipid matrix. However, the formulation showed no activity against *Microsporum gypseum* and *Epidermophyton* species, indicating a selective antifungal spectrum. This suggests that while *Gandhaka Taila* holds promise as an effective topical antifungal agent, further studies are required to optimize its formulation and expand its spectrum of activity. Overall, the findings scientifically validate the traditional use of *Gandhaka Taila* in dermatological conditions and support its potential integration into contemporary antifungal therapy, subject to further pharmacological and clinical investigations.

6. Conflicts of interest

There are no conflicts of interest.

7. Funding / financial support: Acknowledgement to KLE Academy of Higher Education and Research, Deemed to be university, Belagavi for granting this project.

8. Author contributions:

Dr Rudramma Hiremath PI of this project, Dr Vinay P S Co PI & Microbiologist, Dr M P savalagimath and Dr M B Gundakalle Co PI of this project

Conceptualization, RH.; methodology, RH.; software, RH.; validation, VP.; formal analysis, VP.; investigation, VP.; resources, MS. and MG.; data curation, MS. and MG.; writing—original draft preparation, RH.; writing—review and editing, MS. and MG.; visualization, MS. and MG.; supervision, RH. All authors have read and agreed to the published version of the manuscript.

9. Acknowledgements: The authors extend their sincere gratitude to KLE Academy of Higher Education and Research (Deemed-to-be-University), Belagavi and KAHER's Shri B.M. Kankanawadi Ayurveda Mahavidyalaya, Shahapur, Belagavi, for their support.

REFRENCES:

1. https://www.sciencedirect.com/science/article/abs/pii/S0738081X09002478
2. Animesh Ray, Adarsh Aayilliath K, Sayantan Banerjee, Arunaloke Chakrabarti, David W Denning, Burden of Serious Fungal Infections in India, *Open Forum Infectious Diseases*, Volume 9, Issue 12, December 2022, ofac603, https://doi.org/10.1093/ofid/ofac603
3. Charaka Chikitsa stana, Kustachikitsa
4. Rasa Vagbhatacharya, Rasaratnasamucchya, Chapter3.edited by Prof. D.A. Kulkarni, Mahendra Lakhamadas Publications, 2006.
5. Dhundhunkanatha, Rasendra Chintamani Chapter-5, Edited by Siddhinandana Mishra, 1st edition, Chaukhambha Orientalia, Varanasi, 2006.
6. Sadananda Sharma, Rasa tanrangini, Chap 8, edited by Kashinath Shastri, , Motilal Banarasidas publications, 2012, pp174-198.
7. Sujatha K, Revanasiddappa Sarashetti, Antimicrobial study of Gandhaka taila in Journal of Biological & Scientific opinion Vol 3(3), 2015:105-109
8. Himsiksha Verma, Sameet Masand *, Sudhaldev Mohapatra, Antimicrobial Study Of Gandhak Taila: An Ayurvedic Wound Healer' On Staphylococcus Aureus, Escherichia Coli And Candida Albicans, / Int. J. Res. Ayurveda Pharm. 10 (3), 2019: 52-54
9. **Antimicrobial and Anti-inflammatory:** Derivatives of hexadecanoic acid, such as its methyl ester, exhibit potential inhibitory effects on bacteria and inflammation (https://sarpublication.com/media/articles/SAR

JPS_74_125-127.pdf#:~:text=CONCLUSION.%20n%2DHexadecanoic%20acid%2C%20extracted%20from%20algae%2C%20is,new%20avenues%20for%20therapeutic%20and%20industrial%20applications)

10. **Emollient Properties:** Used in cosmetic and pharmaceutical formulations for its skin-softening abilities (https://atamankimya.com/sayfalar.asp?LanguageID=2&cid=3&id=8&id2=13417#:~:text=These%20properties%20make%20Hexadecanoic%20acid,Softens%20and%20smoothes%20the%20skin)
11. antioxidant, anti-inflammatory, and anticancer effects (https://hefjournal.org/index.php/HEF/article/view/504#:~:text=The%20extract%20exhibited%20potent%20antioxidant%20activity%20in:,Hexadecanoic%20acid%20*%20Estra%2D1%2C3%2C5%2Dtrien%2D17%C3%9F%2Dol%20*%20Caryophyllene%20oxide)
12. Kotrannavar V.S. etal, Pharmaceutico Analytical Study Of Gandhaka Taila, Indian drugs, Year 2013 | Volume No. 50 | Issue No.8 | Page No. 42-46
13. **Antioxidant Activity:** It is linked to plant extracts that possess antioxidant properties, helping to counteract oxidative stress https://www.phcogres.com/sites/default/files/PharmacognRes-17-4-1241.pdf
14. Tisgratog R, Sukkanon C, Grieco JP, Sanguanpong U, Chauhan KR, Coats JR, Chareonviriyaphap T. Evaluation of the Constituents of Vetiver Oil Against Anopheles minimus (Diptera: Culicidae), a Malaria Vector in Thailand. J Med Entomol. 2018 Jan 10;55(1):193-199. doi: 10.1093/jme/tjx188. PMID: 29029183.
15. Samar J, Butt GY, Shah AA, Shah AN, Ali S, Jan BL, Abdelsalam NR, Hussaan M. Phycochemical and Biological Activities From Different Extracts of *Padina antillarum* (Kützing) Piccone. Front Plant Sci. 2022 Jul 22;13:929368. doi: 10.3389/fpls.2022.929368. PMID: 35937357; PMCID: PMC9354264.
16. Rajaganesh R, Murugan K. Anti-dengue potential and mosquitocidal effect of marine green algae-stabilized Mn-doped superparamagnetic iron oxide nanoparticles (Mn-SPIONs): an eco-friendly approach. Environ Sci Pollut Res Int. 2024 Mar;31(13):19575-19594. doi: 10.1007/s11356-024-32413-y. Epub 2024 Feb 16. PMID: 38363508.
17. PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. PubChem Bioassay Record for AID 1931120, Source: ChEMBL; [cited 2025 Apr. 20]. Available fromhttps://pubchem.ncbi.nlm.nih.gov/bioassay/1931120
18. Hashimoto T, Shimizu N, Kimura T, Takahashi Y, Ide T. Polyunsaturated fats attenuate the dietary phytol-induced increase in hepatic fatty acid oxidation in mice. J Nutr. 2006 Apr;136(4):882-6. doi: 10.1093/jn/136.4.882. PMID: 16549445.

IMAGES:

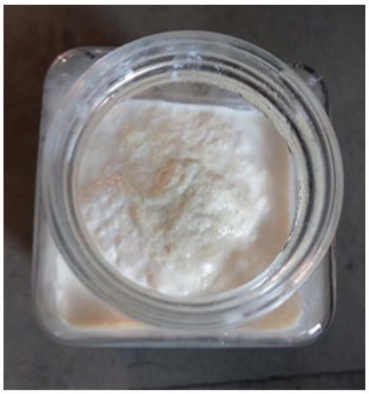
Raw Gandhaka

Shuddha Gandhaka

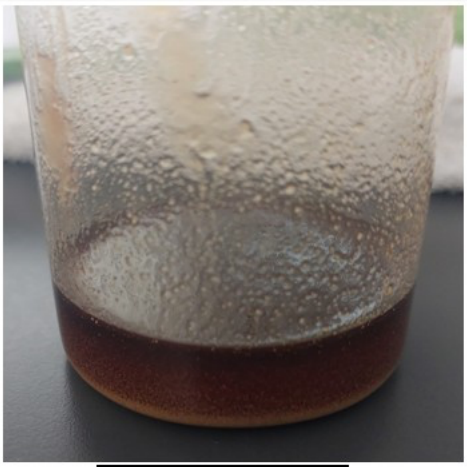
Gandhaka boilling with Godugdha

Gandhaka Curd

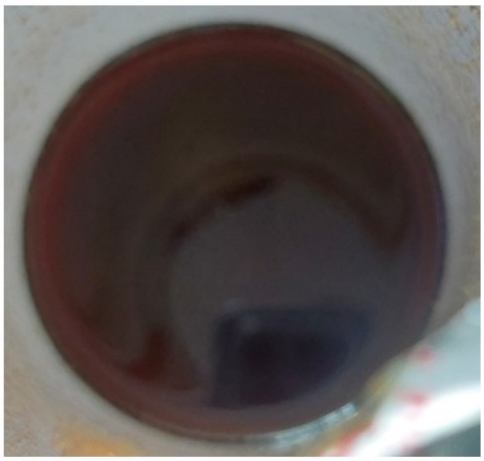
Gandhaka Butter



Gandhaka Butter



Gandhaka Taila



Gandhaka Taila

Figure 2: Effect of trial drug on *Trichophyton rubrum*

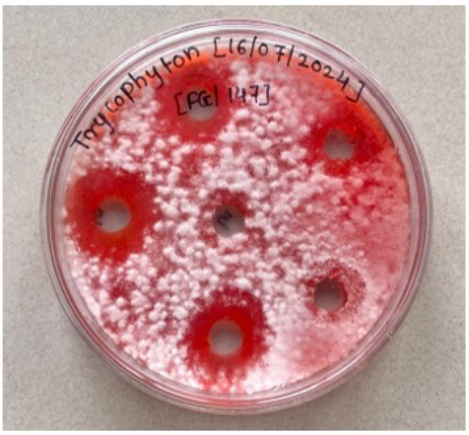


Figure 2: Effect of trial drug on *Trichophyton tonsurans*

Figure 3: Effect of trial drug on Microsporum gypseum

Figure 5: Effect of trial drug on *Trichophyton mentagrophytes*