Open Access, Peer Reviewed, Referred Research Journal

Print & Online available on https://jbsd.in
ISSN: 2229-3469 (Print); ISSN: 2231-024X (Online)
Research Article

Antimicrobial Activity of *Kerria lacca* Resin Obtained From Indigenous Hosts Plants from Nanded District, (M. S.) India

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Article Info

Received: 10-09-2025,
Revised: 19-11-2025,
Accepted: 26-12-2025

Keywords: *Kerria lacca*, lac resin, antimicrobial activity, host plants.

Abstract

Lac resin, secreted by the lac insect *Kerria lacca* (Kerr) is a versatile natural biopolymer with emerging applications in antimicrobial therapeutics. This study evaluates the antimicrobial properties of lac resin sourced from host plants in the Nanded district region of Maharashtra, specifically from Palash (*Butea monosperma* (Lam) Taub. commonly called flame of the forest, and Ber (*Ziziphus mauritiana* Lam.), Banyan (*Ficus benghalensis* L., Umber (*Ficus racemosa* L.), and Khair (*Acacia catechu* (L.) Willd.). An investigation was carried out to study the antimicrobial activity of lac resin secreted lac insect *Kerria lacca* (Kerr) against selected laboratory bacterial and fungal pathogens such as *Staphylococcs aureus* (MTCC-3160) and *Escherichia coli* (MTCC-739) by the agar well diffusion method. Zone of inhibition measured (mm) was compared with standard antibiotic amoxicillin and *Aspergillus niger, Fusarium oxysporum* and *Alternaria solani* by spore germination method.. Lac samples tested for antibacterial and antifungal activity revealing host-specific variations influenced by plant physiology and regional edaphoclimatic factors. Palash, *Samanea saman* and Ber-derived lac exhibited superior antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*, attributed due to higher laccaic acid-content. Banyan and Umber lac showed exceptional antifungal activity against *Verticillium* sp. Comparative analysis highlights the impact of semi-arid conditions of Nanded on resin quality particularly in case of Palash, *Samanea saman*, Ber, Banyan and Umber host plants. These findings indicate that the lac resin, a promising eco-friendly antimicrobial agent. This warranting further clinical exploration.

INTRODUCTION

Lac resin, a scarlet-red exudates produced by female lac insect *Kerria lacca* during sap-feeding on host plants. This is a cornerstone of Indian ethno medicine and industry. Nanded district is a semi-arid part of Marathwada region, Maharashtra. Lac cultivation thrives on native hosts such as Palash (*Butea monosperma)*, Ber (*Ziziphus mauritiana*), Banyan (*Ficus benghalensis*), Umber (*Ficus racemosa*) and Khair (*Acacia catechu*), supporting rural economies and biodiversity conservation (Pal et al., 2022). Many surveys reveal that the natural infestations of the Rangeeni strain across the five sites of Nanded such as Shitakhandi, Warkwadi near Tamsa, Limboti near Kandhar and Patnurghat near Lahan were observed and lac samples were collected. It is important to boost fair and equitable access to economic resources in the form of lac cultivation and production to the farmer of Nanded region which will increase the employability and also helps to improve the economy. It was found that Palash and *Samania* are more infested by Kerria *lacca* as compared to ber, banyan and umber tree. Beyond traditional applications in varnishes and dyes, lac resin contains anthraquinone derivatives (e.g., laccaic acids A–E) with potent antimicrobial properties, inhibiting bacterial cell wall synthesis and fungal spore germination

(Singh *et al*., 2017; Qureshi *et al*., 2019). These bioactivities vary with host plant, insect strain (Rangeeni vs. Kusmi), and environmental factors, as host sap influences resin composition (Kumar *et al*., 2021). In Nanded, where lac cultivation integrates traditional knowledge with economic potential, understanding these variations is critical for pharmaceutical applications.

This study synthesizes literature on antimicrobial activity lac, evaluates host-derived samples from Nanded region and provides cultivation guidelines to optimize bioactive yield. It aims to bridge ethnobotanical insights with modern pharmacology, highlighting role of lac resins in sustainable antimicrobial development.

MATERIALS AND METHODS

Sample Collection

Lac resin was collected from natural infestations on different host plants viz. Palash, *Samanea saman,* Ber, Banyan and Umber from different sites of Nanded district (19°08'–19°29'N, 77°16'–77°39'E) such as Shitakhandi, Warkwadi, near Tamsa, Limboti near Kandar and Patnurghat near Lahan during October–November.

Preparation

Stick lac (Rangeeni morph) was harvested post-settling, scraped, and processed into technical-grade resin in hot-water extraction and filtration, following IINRG (Indian Institute of Natural Resins and Gums, Ranchi) protocols (Sharma, 2020). Host-specific samples (n=10 per type) were authenticated against IINRG standards. Extracts were prepared by successive solvent fractionation (petroleum ether, chloroform, ethyl acetate & methanol in aqueous phases). Bioactive fractions (ethyl acetate, methanol) were concentrated using rotary evaporation and dissolved in 1% DMSO solution (stock: 1 mg/mL).

Antimicrobial Assays

Antibacterial Activity: Evaluated using agar well diffusion (Perez et.al.1990, Juhee Ansari et.al, 2021) on Mueller-Hinton agar against *S. aureus* (MTCC-3160) and *E. coli* (MTCC-739) (10^5 CFU/mL inoculum). Wells were made using sterile cork borer (6 mm in diameter). A 100 µL of 20 % (w/v) was applied to the corresponding wells for each of the test. The test is allowed to be thoroughly absorbed into the agar by placing the plates in the refrigerator for 30 minutes. Following incubation at 37°C for 24 hours, the presence of antibacterial properties is verified by determining the size of the zones of inhibition in mm (including the width of the wells). A 10% DMSO solution was used as a negative control received 100 µL extract (1000 µg/well); plates were incubated at 37°C for 24 h. Zones of inhibition (mm) were measured in triplicates, with amoxicillin (200 µg/mL) as the positive control.

Antifungal Activity: Spore germination assay were conducted on glass slides in moist chambers (27±2°C, 24 h) using 104 spores/mL suspensions of *Alternaria solani*, *F. oxysporum*, and *Aspergillus niger*. Test concentrations ranged from 250–1000 µg/mL in 1% aqueous methanol. Germination (%) was assessed via light microscopy (n=100 spores/replicate); LC50 was determined using probit analysis. Control: 1% methanol.

Comparative Framework Performance metrics correlated resin weight/stick (g/30 cm) with bioactivity, comparing samples from Nanded to samples of Chhattisgarh/Madhya Pradesh benchmarks (Jaiswal et al., 2015).

Observations and Results

It is evident from the result that hosts *Samania* yielded highest sticklac 8.10 kg/plant followed Palash 5.20 kg/plant, Ber 4.80 kg/plant, Banyan 4.20 kg/plant and Umber 4kg/plant with denser settlements (200+ cells/branch). LC-MS/MS confirmed laccaic acid-A dominance in Palas, Samania and Ber lac (40, 42 and 43%, RT 1.36 min, m/z 538 [M+H]+), Banyan/Umber enriched in laccaic acid-D (26 and 31%).

Table 1: Lac yield on different host plants

Host plants	Stick lac yield (kg/plant)	Laccaic Acid-A (%)	Fresh cell wt. (g/100 cells)
Palash (*Butea monosperma*)	5.20	40	7.12
Samania (*Samanea saman*)	8.10	42	6.90
Ber (*Ziziphus mauritiana*)	4.80	43	6.50
Banyan (*Ficus benghalensis*)	4.20	26	6.10
Umber (*Ficus racemosa*)	4.00	31	5.50

Table 2: Antibacterial Activity of Lac Extracts

Sr. No.	Host plant sample	*S. aureus*	*E. coli*	MIC (E. coli,)
	Zone of inhibition(mm)			
1	**Palash** (*Butea monosperma*)	18	16	0.4
2	**Samania** (*Samanea saman*)	17	14	0.5
3	**Ber** (*Ziziphus mauritiana*)	17	15	0.5
4	**Banyan** (*Ficus benghalensis*)	15	13	0.6
5	**Umber** (*Ficus racemosa*)	14	14	0.7
	Amoxicilin (control)	22	23	0.3

Antibacterial Activity

Palash, Samania and Ber lac exhibited the highest antibacterial activity (18,17,17 mm vs. *S. aureus*, 15 mm vs. *E. coli* at 1000 µg/well; MIC 0.5 mg/mL), followed by Banyan (15 mm, 13 mm), Umber (14 mm, 14 mm), Compared to amoxicillin (74 mm, 27 mm), Palas, Samania and Ber lac was more potent, driven by higher anthraquinone polarity.

Table 3: Antifungal Activity of lac extracts

Fungi	Ber (%)	Palas (%)	Samania (%)	Banyan (%)	Umber (%)
Aspergillus niger	86	82	84	90	95
Fusarium oxysporum	70	72	68	78	71
Alternaria solani	22	21	22	25	22
Carbendazim (control)	12	14	13	15	14

Antifungal Activity

Palash, Samania and Ber lac inhibited *Aspergillus nigar* by 82, 84, 86% at 750 µg/mL (LC50: 500 µg/mL), but was less effective against *A. solani* (21, 22, 22% at 1000 µg/mL). Banyan and Umber lac excelled against *F. Oxysporum* (60–80% inhibition).

Discussion

In the present investigation all the lac samples collected from different host plants showed antibacterial and antifungal activity. Host plant physiology plays a critical role in determining the antimicrobial potential of *Kerria lacca* resin through sap nutrient transfer and modulation of anthraquinone biosynthesis (Kumar et al., 2021). Nanded's semi-arid climate (25–35°C, ~700 mm rainfall) enhances laccaic acid-A production in *Ziziphus mauritiana* (Ber), contributing to stronger Gram-positive inhibition consistent with methylated anthraquinone activity (Singh *et al.,* 2017). Lac resins obtained from *Ficus benghalensis* (Banyan) and *Ficus racemosa* (Umber) showed notable antifungal activity, particularly against *F. Oxysporum* and *Aspergillus nigar*. This may result from the synergistic presence of phenolic compounds and laccaic acid-D, which inhibit fungal spore germination by disrupting membrane integrity (Qureshi *et al.,* 2019). These results support earlier findings highlighting enhanced phenolic conjugation in *Ficus*-based lac resins (Dagur & Ghosh, 2025).

In contrast, *Acacia catechu* lac displayed relatively low antimicrobial efficacy, possibly due to tannin–anthraquinone interactions reducing active compound bioavailability (Pal *et al*., 2022). Comparative analysis of Nanded's Palash, Samania, Ber lac and Chhattisgarh analogs revealed superior yield and bioactivity (8.33:1 ratio), reflecting the edaphoclimatic advantage of the Nanded region (Jaiswal et al., 2015). Semi-arid conditions appear to favor secondary metabolite synthesis, optimizing host–resin chemistry (Thomas & Shah, 2018). At the molecular level, lac's antimicrobial mechanism involves anthraquinone-mediated disruption of microbial cell membranes and inhibition of DNA gyrase (Qureshi *et al*., 2019). The resin's polymeric matrix composed of resin acids, polyesters, and shellolic compounds supports sustained-release antimicrobial action (Sharma, 2020). Traditionally valued for wound healing and antimicrobial uses, lac's bioactivity now finds scientific support through this study (Mishra *et al*., 2019). Combining traditional knowledge with modern analytical chemistry offers eco-friendly biotechnological prospects for natural antimicrobial development (Dagur & Ghosh, 2025).

Moreover, the indigenous lac ecosystem of Nanded holds socioeconomic potential for rural communities. Integrating improved extraction techniques with local cultivation can strengthen both livelihood security and biodiversity conservation (Deshmukh et al., 2021).

Conclusion

In conclusion, *Kerria lacca* resin demonstrates host-dependent antimicrobial diversity, with Palas, Samania, Ber excelling in antibacterial and *Ficus* in antifungal efficacy. These findings emphasize the potential of region-specific lac bioprospecting and its relevance in sustainable pharmacognosy. The lac resin sourced from different host plants from the Nanded region has revealed host-dependent variations in antimicrobial efficacy. Notably, resin derived from Palash, Samania *Ziziphus mauritiana* (Ber) demonstrates pronounced antibacterial activity, while resin from Ficus species exhibits superior antifungal properties. These findings suggest a unique synergy between host plant chemistry and lac resin bioactivity, offering targeted applications in antimicrobial formulations. In vivo trials are recommended to validate clinical efficacy.

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Cite this article

Raut MH and MY Kulkarni. 2026. Antimicrobial Activity of *Kerria lacca* Resin Obtained From Indigenous Hosts Plants from Nanded District, (M. S.) India. *Bioscience Discovery,* **17**(1):34-37.