Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

In vitro experimental antimicrobial and phytochemical evaluation of unsukumbili (Hypericum aethiopicum) against MRSA in wound sepsis.

Mally MaDanger Mncube*, Dr. Nhlanhla Wiseman Nsele, Shanaz Ghuman
Department of Biomedical Sciences, Faculty of Applied and Health Sciences, Mangosuthu University of Technology, Durban, South Africa

Abstract

Background
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a leading cause of nosocomial infections, contributing to severe wound sepsis and high treatment failure rates due to multidrug resistance, resulting in a strain that the healthcare system faces as an uncontrollable, fatal pandemic with a high mortality rate. The increasing prevalence of MRSA necessitates alternative therapeutic strategies, including plant-derived antimicrobials.
Aim: This study evaluated the antimicrobial efficacy of aqueous and ethanolic extracts of *Hypericum aethiopicum* (unsukumbili) against Methicillin-resistant *Staphylococcus aureus* (MRSA), assessing its potential for wound infection management.

Methodology
An in vitro experimental design was employed, following standardized antimicrobial testing protocols. *H. aethiopicum* leaves were extracted using ethanol and water, and antimicrobial activity was assessed via disk diffusion, Minimum Inhibitory Concentration (MIC), and Minimum Bactericidal Concentration (MBC) assays.

Results
Ethanolic extracts exhibited superior antibacterial activity (mean inhibition zone: 26mm) compared to aqueous extracts (4 mm). No significant difference was observed between fresh and dried leaf extracts. The MIC for MRSA was achieved at a 1:8 dilution, demonstrating potent bactericidal effects.

Conclusion
H. aethiopicum ethanol extract shows promising activity against MRSA, suggesting its potential as an alternative treatment for Methicillin-resistant *Staphylococcus aureus* (MRSA) infected wounds.

Recommendation
Further studies are needed to isolate bioactive compounds and assess in vivo efficacy, identifying levels of the plant toxicity against human cells.

Keywords: *Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), Hypericum aethiopicum, Methicillin-resistant Staphylococcus aureus (MRSA), Wound infections, Antimicrobial resistance, Phytochemical analysis.*
Submitted: *October 13, 2025* ***Accepted:*** *November 13, 2025* ***Published:*** *December 04, 2025*

Corresponding author: *Mally MaDanger Mncube**
Email:*mncube.solani@mut.ac.za*
Department of Biomedical Sciences, Faculty of Applied and Health Sciences, Mangosuthu University of Technology, Durban, South Africa

Introduction

The presence of a critical challenge in clinical settings caused by wounds that are infected by Methicillin-resistant *Staphylococcus aureus* (MRSA), particularly in immunocompromised and post-surgical patients (Turner et al., 2023). The rise of antibiotic-resistant strains has limited treatment options, the increasing morbidity and healthcare costs (WHO, 2022). Traditional medicinal plants, such as *Hypericum aethiopicum*, offer a potential

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

alternative due to their bioactive antimicrobial properties. *Hypericum aethiopicum,* known to have high levels of phytochemical profile, has been identified in previous studies as having wound therapeutic properties (Moodley et al., 2021).

Given the ever-increasing healthcare costs and resource limitations in African nations (Murray *et al*., 2022), the validation of ethnomedicinal therapies such as *H. aethiopicum* is both appropriate and essential. This experiment examines the antibacterial components of *H. aethiopicum* ethanol extracts against MRSA, targeting to contribute to alternative wound management approaches amid intensifying antimicrobial resistance (Lima *et al*., 2020; Allel *et al*., 2023).

This study investigates the efficacy of *H. aethiopicum* extracts against MRSA, addressing the urgent need for novel antimicrobial agents in wound care.

Materials and methods

Study design

An in vitro experimental study was conducted in Durban, KwaZulu-Natal, at Mangosuthu University of Technology (MUT) between 2021 and 2022, combining antimicrobial susceptibility testing with phytochemical profiling. This university, where the study was conducted, is known to stand out as a key institution for students aspiring to pursue careers in the Biomedical sciences, with a focus on academic excellence, practical training, and research innovation. MUT prepares its graduates to become leaders in healthcare and Biomedical research, making a tangible impact on society's health and well-being.

Plant collection and extraction

Fresh *H. aethiopicum* leaves were collected from Silverglen Nature Reserve, South Africa (KwaZulu-Natal). Ethanol and aqueous extracts were prepared following the German Homoeopathic Pharmacopoeia (Method 3a) (Benyunes, 2005). In extraction, the plant material was minced and mixed with 100% ethanol in a 1:3 ratio, agitated daily, and stored at 4°C for seven days. Filtration was carried out using muslin cloth and Whatman filter paper, and filtrates were preserved in sterile bottles.

Bacterial strain and culture

MRSA (ATCC 29213) was commercially obtained from Davies Diagnostics. Bacterial suspensions were prepared in nutrient broth and adjusted to 0.5 McFarland turbidity standards. Mueller-Hinton agar plates were inoculated using sterile swabs to ensure even bacterial distribution on the base of the agar.

Antimicrobial assay

Disk Diffusion: The antimicrobial efficacy was assessed using the Kirby-Bauer disk diffusion method (Cappuccino & Sherman, 1992). Sterile antibiotic assay discs were impregnated with plant extract and placed on inoculated plates. Positive controls included vancomycin discs, and 100% ethanol served as a negative control. Plates were incubated at 37°C for 24 hours, and zones of inhibition were measured in millimetres.

MIC/MBC: MIC was determined via broth dilution, followed by incubation at 37°C for 16 hours. Tubes showing no turbidity indicated bacterial inhibition, and MBC was determined by sub-culturing from the nutrient broth that displayed bacterial inhibition onto fresh nutrient agar, incubated at 37°C for 24 hours, and checking for bacterial regrowth.

Phytochemical analysis

Ethanolic extracts were subjected to IR spectroscopy and GC-MS to identify active phytochemical constituents.

Statistical analysis

Fisher's Exact Test and Kruskal-Wallis Test were applied in the analysis of data ($p < 0.05$ considered significant).

Ethical considerations

Ethical clearance was obtained from the Mangosuthu University Ethics Committee (RD5/29/2024)

Results

Antibacterial activity

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

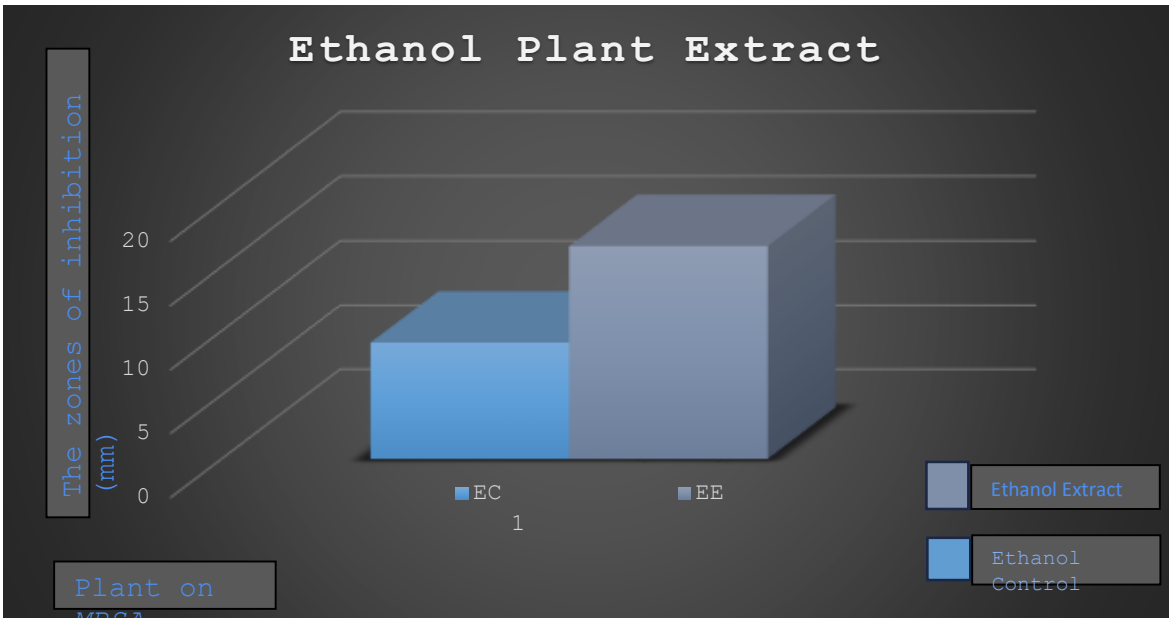

Figure 1: Zones of inhibition for *H. aethiopicum* ethanol extract on MRSA.

The zones of inhibition for the antibacterial screening test are displayed in Figure 1. The inhibitory effects on the bacteria were measured by the size of the zone of inhibition post-treatment with *H. aethiopicum* ethanol extract. Statistical significance of the p-value is indicated in Table 1.
Ethanol extracts showed significant inhibition (28 mm, p = 0.035) against MRSA.

Table 1: Antibacterial screening results

	P-value
MRSA	0.035

MIC and MBC

The ethanol extract of *H. aethiopicum* completely inhibited bacterial growth at 1:4 dilution and higher concentrations. These results underscore the extract's potency at low dosages.

Discussion

The promising *in vitro* results of *H. aethiopicum* ethanol extract against Methicillin-Resistant *Staphylococcus aureus* provide a critical foundation for its potential therapeutic application. However, the generalizability of these findings, that is, the extent to which they can be reliably applied to real-world clinical settings and broader bacterial populations, is contingent upon further rigorous investigation.

Currently, the study's generalizability is constrained by its *in vitro* nature. While the established zones of inhibition and significantly low MIC values offer robust preliminary evidence of bactericidal activity, these results are derived from a controlled laboratory environment. Direct extrapolation to complex human biological systems, with factors like pharmacokinetics, tissue penetration, immune response, and potential toxicity, is not yet warranted. The extract's efficacy must be validated *in vivo* using animal models and subsequently in human clinical trials to confirm its therapeutic potential for managing actual Methicillin-Resistant *Staphylococcus aureus* infections.

Furthermore, the generalizability across diverse bacterial populations requires confirmation. The findings are based on specific Methicillin-Resistant *Staphylococcus aureus* strains tested in the laboratory. To be considered a broad-spectrum or reliably effective option, the extract's activity must be demonstrated against a wider array of Methicillin-Resistant *Staphylococcus aureus* genotypes and phenotypes, as well as other clinically relevant Gram-positive pathogens commonly found in wound sepsis. The

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

mention of its potential to reduce resistance development is a compelling hypothesis, but its generalizability depends on long-term exposure studies across diverse bacterial strains to assess the actual rate and mechanisms of resistance emergence.

Finally, the applicability of these findings is particularly relevant for specific clinical contexts. As noted, the extract holds significant promise for settings with high rates of antimicrobial resistance and limited healthcare infrastructure, where accessible, plant-based remedies are urgently needed. For this potential to be fully realized, subsequent research must focus on standardizing the extraction process, ensuring batch-to-batch consistency, and developing stable formulations suitable for topical wound application in resource-limited environments.

In conclusion, while the *in vitro* findings are a vital and encouraging first step, their generalizability to clinical practice is currently limited. The study successfully provides the necessary scientific underpinning for further pharmacological authentication, but broader endorsement through studies involving diverse bacterial strains, *in vivo* models, and eventual clinical trials is essential to translate these preliminary results into a widely applicable and accessible therapeutic intervention.

Conclusion

H. aethiopicum ethanol extract demonstrates potent anti-MRSA activity, supporting further pharmacological development. This could stipulate a cost-effective therapeutic substitute, predominantly in underserved communities. However, wide-ranging phytochemical reporting and clinical trials are essential to approve safety and therapeutic applicability.

Limitations

This study was restricted to a solitary bacterial strain, limiting the generalizability of the discoveries. Furthermore, the precise bioactive compounds were not isolated or identified. All experiments were conducted *in vitro*; hence, *in vivo* efficacy and potential toxicity remain unverified.

Recommendations

Forthcoming studies should discover:

- In vivo toxicity and efficacy studies
- Bioactive compound isolation
- Broader-spectrum testing

Acknowledgements

We thank the Department of Biomedical Sciences at Mangosuthu University of Technology for their support and resources.

I would also like to express my deepest gratitude to my beloved family for their unwavering support, encouragement, and sacrifices throughout my academic journey. To my devoted husband, Mr. MJ Mncube, thank you for standing by me, offering endless motivation, and being my pillar of strength. Your belief in me kept me going even during the most challenging times.

To my precious trio, Sakhiwo Justice-Junior "Mr JayJay," Sisekelo "SMS MinnieMally," and Thandoluhle "Nashelo kaGogo Swazy, your love, patience, and understanding gave me the strength to pursue my studies. Your joyful spirits and inspiring presence reminded me daily of why this journey was worth every effort.

This achievement is as much yours as it is mine. Thank you for granting me the opportunity to chase my dreams while being my greatest source of love and motivation.

List of abbreviations

MRSA: Multidrug-Resistant *Staphylococcus aureus*
MIC: Minimum Inhibitory Concentration
MBC: Minimum Bactericidal Concentration
EC: Ethanol control
EE: Ethanol extracts
HPLC: High-performance liquid chromatography
WHO: World Health Organization
GC-MS: Gas chromatography
IR spectroscopy: Infrared

Source of funding

This study received no external funding.

Conflict of interest and author declarations

All authors have reviewed and approved the final manuscript.

The work is original, unpublished, and not under consideration elsewhere.

No conflicts of interest, financial or otherwise, are declared.

Author contributions

Mally S.R. MaDanger Mncube conducted the experiments, analysed the data, and drafted the manuscript. Dr. NW Nsele supervised the entire research process, reviewed and edited the manuscript, and

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

provided overall guidance and mentorship. Dr S Ghuman was appointed the main supervisor for the study.

Data availability

Data are available upon reasonable request.

Author biographies

Mally S.R MaDanger Mncube: Medical Technologist specialised in Clinical Pathology registered with HPCSA, recently acquired Masters degree in Health Sciences at Durban University of Technology and currently pursuing the PhD degree at Tshwane University of Technology, employed at Mangosuthu University of Technology as a Laboratory Medical Technologist in Biomedical Sciences, specialising in Microbiology with expertise in the indigenous research therapies and infectious diseases caused by micro organisms.

Dr. NW Nsele: Head of Department and Senior Lecturer in the Department of Biomedical Sciences, specialising in Microbiology with expertise in phytopharmacology and infectious diseases.

References

1. Allel, K., et al. (2023). The impact of inpatient bloodstream infections caused by antibiotic-resistant bacteria in low-and middle-income countries: A systematic review and meta-analysis. PLoS Medicine, 20(6), e1004199. https://doi.org/10.1371/journal.pmed.1004199 PMid:37347726 PMCid:PMC10287017
2. Benyunes, S. (2005). German Homeopathic Pharmacopoeia: First Supplement. Medpharm GmbH Scientific Publishers.
3. Cappuccino, J.G., & Sherman, N. (1992). Microbiology: A Laboratory Manual (3rd ed.). Benjamin Cummings.
4. Das, M., & Goswami, S. (2019). Antifungal and antibacterial property of guava (Psidium guajava) leaf extract: Role of phytochemicals. International Journal of Health Sciences and Research, 9(2), 39-45. https://www.ijhsr.org/IJHSR_Vol.9_Issue.2_Feb2019/7.pdf
5. Ghuman, S. (2019). Antioxidant, anti-inflammatory, and wound healing properties of medicinal plant extracts are used to treat wounds and dermatological disorders. South African Journal of Botany, 126, 232-240. https://doi.org/10.1016/j.sajb.2019.09.008
6. Gibbons, S. (2021). Anti-staphylococcal plant natural products. Natural Product Reports, 38(5), 905-980. https://doi.org/10.1039/D0NP00061F
7. Golkar, Z., Rochelle, L., & Bagasra, O. (2016). CRISPRs/Cas9 may provide a new method for drug discovery and development. Journal of Molecular Biomarkers & Diagnosis, 7(6), 280. https://doi.org/10.4172/2155-9929.1000280
8. Lima, L.M. (2020). β-Lactam antibiotics: An overview from a medicinal chemistry perspective. European Journal of Medicinal Chemistry, 208, 112829. https://doi.org/10.1016/j.ejmech.2020.112829 PMid:33002736
9. Mills, E., et al. (2005). African herbal medicines in the treatment of HIV: Hypoxis and Sutherlandia. Nutrition Journal, 4(1), 19. https://doi.org/10.1186/1475-2891-4-19 PMid:15927053 PMCid:PMC1156943
10. Moodley, R., et al. (2021). African medicinal plants with antimicrobial activity against MRSA. Journal of Ethnopharmacology, 278, 114291. https://doi.org/10.1016/j.jep.2021.114291 PMid:34089809
11. Murray, C.J., et al. (2022). Global burden of bacterial antimicrobial resistance in 2019: A systematic analysis. The Lancet, 399(10325), 629-655. https://doi.org/10.1016/S0140-6736(21)02724-0
12. Nsele, L., & Thembane, N. (2023). Antimicrobial resistance patterns in paediatric patients: A retrospective analysis of microbial isolates and antibiotic susceptibility. Student's Journal of Health Research Africa, 4(6), 9. https://doi.org/10.51168/sjhrafrica.v4i6.467
13. Quave, C.L., et al. (2020). Plant-derived compounds against drug-resistant Staphylococcus aureus. Frontiers in Microbiology, 11, 1456. https://doi.org/10.3389/fmicb.2020.01456
14. Turner, N.A., et al. (2023). MRSA prevalence and resistance patterns in sub-Saharan Africa. The Lancet Infectious Diseases, 23(3), e102-e112. https://doi.org/10.1016/S1473-3099(22)00692-1
15. WHO. (2022). Global antimicrobial resistance and use surveillance system. World Health Organization. https://www.who.int/publications/i/item/9789240062702

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 12 (2025): December 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i12.2166
Original Article

PUBLISHER DETAILS

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa