J. Biodivers. Conservation 9(4): 11-16 ISSN: 2457-0761 (online)
2025 http://www.aprfjournal.in

Research Article

Phytochemical investigation and anti-microbial evaluation of *Amorphophallus paenifolius*: a medico-food of India

Subhalakshmi Rout[1*], Smita Basole[2], Gireesh Tripathi[3], Rajkumari Supriya Devi[1] and Sugimani Marndi[1]

[1]Biodiversity and Conservation Lab., Ambika Prasad Research Foundation, Odisha, India

[2]Department of Botany, Balbhim College, Beed, Maharashtra, India

[3]Department of Pharmacy, Shri Krishna University, Chhatarpur, Madhya Pradesh, India

*Email-id: subhalakshmirout98@gmail.com; ORCID: https://orcid.org/0009-0000-2063-9547

DOI: https://doi.org/10.5281/zenodo.17394359

Article Details: Received: 2025-08-28 | Accepted: 2025-10-20 | Available online: 2025-10-20

Abstract: The present study investigates the phytochemical composition and antimicrobial potential of *Amorphophallus paeoniifolius* corm extracts, emphasizing its significance as a medico-food. Qualitative phytochemical screening revealed the presence of tannins, saponins, flavonoids, alkaloids, terpenoids, phenolic compounds, and steroids in varying concentrations across different extracts. Methanol and acetone were found to be the most effective solvents, yielding a wide range of bioactive constituents. Antibacterial activity was evaluated against *Streptococcus pyogenes* and *Streptococcus mutans* using the agar well diffusion method. Among all extracts, the methanolic extract exhibited the highest inhibition zones (22.3 ± 0.56 mm and 23.7 ± 0.46 mm, respectively), indicating strong antibacterial potential. The study confirms that *A. paeoniifolius* corm contains diverse phytochemicals with significant antimicrobial efficacy, supporting its traditional use as a therapeutic food. These findings highlight its potential application in nutraceuticals and natural antimicrobial product development.

Keywords: Bioactive compounds, methanolic extract, nutraceutical potential, *Streptococcus mutans*, *Streptococcus pyogenes*

Introduction

Amorphophallus paeoniifolius (Dennst.) Nicolson, commonly known as elephant foot yam, is an edible tuberous plant belonging to the family Araceae (Islam et al., 2023, Figure 1). It is widely cultivated and consumed not only as a food crop but also for its therapeutic properties (Dey et al., 2012). In traditional systems of medicine such as Ayurveda, the corm of *A. paeoniifolius* is valued for its analgesic, anti-inflammatory, and anthelmintic properties (Islam et al., 2023). It is used in the treatment of piles,

dysentery, abdominal pain, and skin ailments (Dey et al., 2015). Its dual role as a nutritious food and a source of bioactive compounds has gained recognition as a “medico-food”, a category of natural products that provide both nutritional and health benefits (Manjula et al., 2023). Phytochemical investigations reveal the presence of diverse classes of secondary metabolites, including flavonoids, phenolic compounds, alkaloids, saponins, tannins, terpenoids, and steroids (Dubale et al., 2023). These compounds are known to exhibit a broad spectrum of biological activities such as antioxidant, antimicrobial, and anti-inflammatory effects (Mucha et al., 2021). Understanding the phytochemical profile of *A. paeoniifolius* corms is essential to interpret its medicinal potential and support its traditional uses (Shahbuddin et al., 2025). In recent years, increasing resistance of pathogenic microorganisms to synthetic antibiotics has intensified the search for novel antimicrobial agents from natural sources (Salam et al., 2023). Plants rich in bioactive phytochemicals have become promising alternatives due to their effectiveness, biocompatibility, and low toxicity (Asma et al., 2022). Evaluating the antimicrobial activity not only strengthens the medicinal significance of *A. paeoniifolius* but also emphasises its potential as a functional food with therapeutic relevance (Nayak et al., 2023). Therefore, the present investigation focuses on the qualitative phytochemical screening and antimicrobial evaluation of *A. paeoniifolius* corm extracts using different solvents. The study aims to identify the key bioactive constituents responsible for antibacterial activity and to establish a correlation between the phytochemical composition and antimicrobial efficacy. The findings are expected to contribute to the scientific understanding of *A. paeoniifolius* as a valuable medico-food plant with potential applications in nutraceutical and pharmaceutical formulations.

Methodology

The plant part sample of *A. paeoniifolius* was collected from village areas of Cuttack, Odisha, India (Figure 1) and was authenticated using a regional literature (Kumar et al., 2022). The traditional medicinal and nutritional values were gathered from the local communities of the study area using questionnaires and open-ended interviews (Figure 2). Successive extractions were performed using n-hexane, acetone, methanol, ethanol, and distilled water. Standard protocols were followed for detecting the presence of tannins, saponins, flavonoids, terpenoids, phenolics, reducing sugars, steroids, alkaloids, and carbonyl compounds (Jena et al., 2025). The n-hexane, acetone, methanol, ethanol, and aqueous extracts were tested for Agar Well Diffusion (AWD) assay against *Streptococcus pyogenes* and *Streptococcus mutans* using the standard protocol (Jena et al., 2025). The zone of inhibition was measured, and the results are expressed with mean and standard deviation.

Results and discussion

The qualitative phytochemical screening of *A. paeoniifolius* corm extracts revealed the presence of a wide range of bioactive constituents across different solvent systems (Table 1). Tannins, saponins, flavonoids, terpenoids, phenolic compounds, and alkaloids were predominantly detected in most of the extracts, suggesting that the corm is a rich source of secondary metabolites with potential therapeutic properties. The consistent presence of tannins, flavonoids, and phenolic compounds in all extracts

indicates their high polarity and solubility across solvents, contributing to antioxidant and antimicrobial potential.

Figure 1: Habitat of *Amorphophallus paeoniifolius*

Figure 2: Interaction with local people on traditional uses of *Amorphophallus paeoniifolius*

Terpenoids were absent in the n-hexane extract, while steroids were detected only in the methanolic and n-hexane extracts, implying that nonpolar solvents facilitate the extraction of lipophilic compounds such as steroids. The antibacterial assay using the agar well diffusion (AWD) method demonstrated that all solvent extracts of *A. paeoniifolius* exhibited varying degrees of inhibition against *Streptococcus pyogenes* and *Streptococcus mutans* (Table 2). Among the tested extracts, the methanolic extract

showed the highest antibacterial activity, producing inhibition zones of 22.3 ± 0.56 mm and 23.7 ± 0.46 mm against *S. pyogenes* and *S. mutans*, respectively. The acetone extracts also exhibited substantial activity, followed by ethanol and n-hexane extracts. In contrast, the aqueous extract displayed the least activity, indicating that water is less effective in extracting antibacterial principles from the corm. The superior antibacterial efficacy of the methanolic and acetone extracts can be attributed to their rich phytochemical content, especially phenolics, flavonoids, and alkaloids, which are known to disrupt microbial cell walls, interfere with nucleic acid synthesis, and inhibit essential enzymatic pathways (Stan et al., 2021). The relatively lower activity of aqueous extracts suggests that key bioactive compounds are better solubilized in organic solvents (Sasidharan et al., 2011). The observed variations in activity among solvents reflect the influence of solvent polarity on the extraction of different classes of phytochemicals (Lee et al., 2024). The findings suggest that *A. paeoniifolius* possesses potent antibacterial potential, particularly against oral pathogens such as *S. mutans* and *S. pyogenes*. The presence of diverse phytochemicals supports its ethnomedicinal use and provides a biochemical basis for its traditional application in treating infections. Further quantitative analysis and isolation of specific active compounds could help in developing plant-based antimicrobial agents.

Table 1: Qualitative phytochemical analysis of *Amorphophallus paeoniifolius* corm extract

Bioactive compounds	Aqueous	Ethanol	Methanol	Acetone	n-Hexane
Tannin	Detected	Detected	Detected	Detected	Detected
Saponin	Detected	Detected	Detected	Detected	Detected
Flavonoids	Detected	Detected	Detected	Detected	Detected
Terpenoids	Detected	Detected	Detected	Detected	Not detected
Phenolic compounds	Detected	Detected	Detected	Detected	Detected
Steroids	Not detected	Not detected	Detected	Not detected	Detected
Alkaloids	Detected	Detected	Detected	Detected	Not detected

Table 2: Antibacterial activity using AWD assay of *Amorphophallus paeoniifolius* corm extracts

Extracts at a concentration of 0.5 mg/ml	*Streptococcus pyogenes* (MTCC1926)	*Streptococcus mutans* (MTCC 497)
	Zone of inhibition (in mm)	
n-Hexane	21.00 ± 0.86	21.1 ± 0.62
Acetone	22.1 ± 0.46	22.5 ± 0.34
Methanol	22.3 ± 0.56	23.7 ± 0.46
Ethanol	21.4 ± 0.59	21.2 ± 0.37
Aqueous	11.5 ± 0.45	11.8 ± 0.22

Conclusion

The present study revealed that the corm extracts of *Amorphophallus paeoniifolius* possess a rich composition of bioactive phytochemicals, including tannins, flavonoids, saponins, alkaloids, terpenoids, phenolic compounds, and steroids, depending on the solvent used for extraction. The variation in phytochemical distribution across solvents indicates that both polar and non-polar compounds contribute to the plant's medicinal potential. Methanol and acetone proved to be the most efficient solvents in extracting a diverse range of phytoconstituents, reflecting their ability to solubilize both hydrophilic and moderately lipophilic compounds. The antimicrobial evaluation demonstrated that all extracts exhibited inhibitory effects against *Streptococcus pyogenes* and *Streptococcus mutans*, with methanolic and acetone extracts showing the highest antibacterial activity. These results suggest that the antibacterial efficacy of *A. paeoniifolius* is strongly linked to the presence of phenolic and flavonoid compounds known for their ability to interfere with bacterial cell membranes and metabolic processes. The comparatively lower activity of the aqueous extract further emphasizes the importance of solvent selection in extracting potent antimicrobial agents. The present study supports the ethnomedicinal claims and traditional uses of *A. paeoniifolius* as both a food and a therapeutic agent. Its significant phytochemical richness and notable antibacterial properties establish it as a promising medico-food with potential applications in the development of plant-based antimicrobial formulations. Future studies focusing on the isolation, characterisation, and mechanism of action of individual bioactive compounds could pave the way for their incorporation into nutraceutical and pharmaceutical products aimed at promoting health and preventing microbial infections.

References

Asma ST, Acaroz U, Imre K, Morar A, Shah SRA, Hussain SZ, Arslan-Acaroz D, Demirbas H, Hajrulai-Musliu Z, Istanbullugil FR, Soleimanzadeh A, Morozov D, Zhu K, Herman V, Ayad A, Athanassiou C and Ince S. (2022). Natural products/bioactive compounds as a source of anticancer drugs. Cancers. 14(24): 6203. https://doi.org/10.3390/cancers14246203

Dey YN, Mahor S, Kumar D, Wanjari M, Gaidhani S and Jadhav A. (2015). Gastrokinetic activity of *Amorphophallus paeoniifolius* tuber in rats. Journal of intercultural Ethnopharmacology. 5(1): 36-42. https://doi.org/10.5455/jice.20151211063819

Dey YN, Ota S, Srikanth N, Jamal M and Wanjari M. (2012). A phytopharmacological review on an important medicinal plant - *Amorphophallus paeoniifolius*. Ayu. 33(1): 27-32. https://doi.org/10.4103/0974-8520.100303

Dubale S, Kebebe D, Zeynudin A, Abdissa N and Suleman S. (2023). Phytochemical Screening and antimicrobial activity evaluation of selected medicinal plants in Ethiopia. Journal of Experimental Pharmacology. 15: 51-62. https://doi.org/10.2147/JEP.S379805

Islam F, Labib RK, Zehravi M, Lami MS, Das R, Singh LP, Mandhadi JR, Balan P, Khan J, Khan SL, Nainu F, Nafady MH, Rab SO, Emran TB and Wilairatana, P. (2023). Genus *Amorphophallus*: a comprehensive overview on phytochemistry, ethnomedicinal uses, and pharmacological activities. Plants. 12(23): 3945. https://doi.org/10.3390/plants12233945

Jena N, Vimala, Singh B, Patra A, Sharma BP, Hossain E and Kumar S. (2025). Methods for ethnobotanical data collection, phytochemistry, antioxidant, anthelmintic, and antimicrobial activities for pharmacological evaluation of medicinal plants. Journal of Biodiversity and Conservation. 9(2): 87-107.

Kumar S, Mishra S, Mishra AK and Kumar SN. (2022). Floral Diversity of Koira and Barsuan Ranges of Bonai Forest Division, Odisha. Divisional Forest Officer, Bonai Forest Division, Bonaigarh, Sundargarh, Odisha, India and Ambika Prasad Research Foundation, Odisha, India.

Lee JE, Jayakody JTM, Kim JI, Jeong JW, Choi KM, Kim TS, Seo C, Azimi I, Hyun JM and Ryu BM. (2024). The influence of solvent choice on the extraction of bioactive compounds from Asteraceae: A Comparative Review. Foods. 13(19): 3151. https://doi.org/10.3390/foods13193151

Manjula BL, Bhat SS, Sharma BP, Chandra S and Kumar S. (2023). Unexplored Food Plants. Ambika Prasad Research Foundation, Odisha, India.

Mucha P, Skoczyńska A, Małecka M, Hikisz P and Budzisz E. (2021). Overview of the antioxidant and anti-inflammatory activities of selected plant compounds and their metal ions complexes. Molecules. 26(16): 4886. https://doi.org/10.3390/molecules26164886

Nayak A, Sowmya BR, Gandla H, Kottrashetti V, Ingalagi P and Srinivas VSC. (2023). Determination and comparison of antimicrobial activity of aqueous and ethanolic extracts of *Amorphophallus paeoniifolius* on periodontal pathogens: an *in vitro* study. Journal of Indian Society of Periodontology. 27(1): 40-44. https://doi.org/10.4103/jisp.jisp_182_22

Salam MA, Al-Amin MY, Salam MT, Pawar JS, Akhter N, Rabaan AA and Alqumber MAA. (2023). Antimicrobial Resistance: a growing serious threat for global public health. Healthcare. 11(13): 1946. https://doi.org/10.3390/healthcare11131946

Sasidharan S, Chen Y, Saravanan D, Sundram KM and Yoga Latha L. (2011). Extraction, isolation and characterization of bioactive compounds from plants' extracts. African Journal of Traditional, Complementary, and Alternative Medicines. 8(1): 1-10.

Shahbuddin D, Reddy M, Ridzuan R and Sjahril R. (2025). Botanical aspects, nutritional benefits and cultivation of Elephant Foot Yam (*Amorphophallus paeoniifolius*). Malaysian Journal of Fundamental and Applied Sciences. 21: 2423-2446. https://doi.org/10.11113/mjfas.v21n4.3656

Stan D, Enciu AM, Mateescu AL, Ion AC, Brezeanu AC, Stan D and Tanase C. (2021). Natural compounds with antimicrobial and antiviral effect and nanocarriers used for their transportation. Frontiers in Pharmacology. 12: 723233. https://doi.org/10.3389/fphar.2021.723233