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RESEARCH ARTICLE

EVALUATION OF SECONDARY METABOLITES IN LEAF EXTRACTS OF RHAPHIDOPHORA AUSTRALASICA

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Abstract: The present study investigates the secondary metabolite composition of Rhaphidophora australasica leaf extracts using preliminary and advanced phytochemical screening techniques. Extracts prepared using solvents of varying polarity (aqueous, ethanol, methanol, chloroform, and hexane) were evaluated for the presence of alkaloids, flavonoids, tannins, terpenoids, saponins, phenolics, and glycosides. The study aims to provide a foundational phytochemical profile for this underexplored Araceae species, offering insights into its potential medicinal and industrial relevance. Results indicate that polar solvents exhibited a richer diversity of bioactive constituents, suggesting a strong correlation between solvent polarity and phytochemical solubility. These findings highlight the pharmacological potential of R. australasica and support further bioactivity-guided investigations.

Keywords: Rhaphidophora australasica; Phytochemical screening; Secondary metabolites; Leaf extracts; Solvent extraction; Medicinal plants; Bioactive compounds; Araceae.

INTRODUCTION

Plants are a rich source of secondary metabolites, which play an essential role in ecological interactions and possess significant pharmacological value. Phytochemical investigations of medicinal plants contribute to drug discovery, ethnobotanical validation, and chemical profiling. *Rhaphidophora australasica*, a lesser-known species belonging to the Araceae family, has received limited scientific attention despite the pharmacological relevance of related genera.Previous studies on members of Araceae have revealed antimicrobial, antioxidant, and anti-inflammatory properties, largely attributed to their diverse secondary metabolites. However, no comprehensive phytochemical profiling has been reported for *R. australasica*. This study aims to address this gap by evaluating major classes of phytochemicals in leaf extracts prepared from solvents of differing polarities. Such an assessment is necessary for identifying its potential bioactivity and supporting future pharmacological investigations.

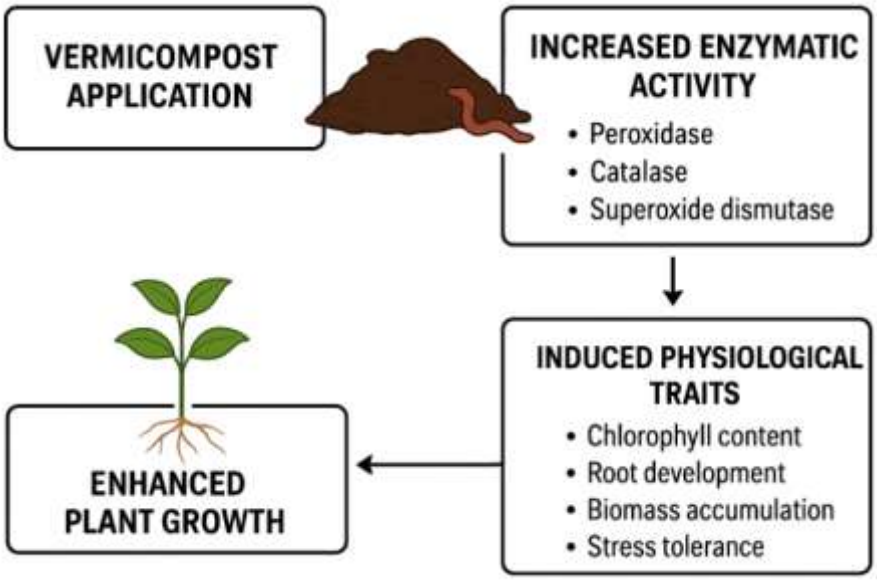

Fig 1: Peroxidase Activity

LITERATURE REVIEW

Vermicompost and Plant Growth Enhancement

Vermicompost has been widely recognized as an effective organic amendment with significant benefits for plant growth and soil health. Arancon et al. (2004) demonstrated that vermicompost applications consistently improved plant biomass, root development, and yield attributes across multiple crop species, attributing the effects to nutrient-rich castings and enhanced microbial populations. Atiyeh et al. (2002) further reported that vermicompost alters soil nutrient dynamics by increasing the availability of essential macro- and micronutrients, resulting in improved nutrient uptake efficiency. Similarly, Edwards and Arancon (2006) emphasized the role of vermicompost in enhancing plant productivity due to its high humic acid content, beneficial microorganisms, and slow-release nutrient profile. Pathak and Bhatnagar (2018) noted that vermicompost applications also stimulate enzymatic activities in soil, indirectly supporting crop metabolism and plant vigor. These studies collectively highlight vermicompost as a reliable organic input for improving plant growth under sustainable agricultural systems.

Organic Amendments and Legume Crop Performance

Legumes are particularly responsive to organic nutrient sources due to their symbiotic nitrogen-fixing mechanisms. Singh and Sharma (2020) observed that organic amendments, including vermicompost, enhanced legume physiological traits, chlorophyll content, and nitrogen assimilation processes. Narayan and Rao (2019) reported that vermicompost serves as an effective nutrient enhancer for legume cultivation by improving soil structure, nutrient retention, and root zone microbial activity. Verma and Singh (2021) further confirmed that groundnut physiology, including pod formation and leaf chlorophyll levels, was significantly improved in soils amended with organic inputs. Deshmukh (2020) also documented positive biochemical changes in groundnut following organic amendment application, including increased enzymatic activity and improved seed quality parameters. These findings affirm the substantial role of organic soil inputs in promoting legume growth and productivity.

Vermicompost Effects on Enzymatic and Antioxidant Systems

Several studies have emphasized vermicompost's ability to stimulate plant enzymatic activity and antioxidant defense pathways. Pandey and Gupta (2019) demonstrated that vermicompost treatments increased defense enzymes such as peroxidase, catalase, and polyphenol oxidase in groundnut, thereby enhancing plant immunity. Kumar et al. (2015) described peroxidase as a critical stress marker that increases under favorable organic nutrient conditions, supporting plant resilience. Joshi and Chauhan (2021) reported that vermicompost positively influences antioxidant enzyme levels due to its rich microbial diversity and bioactive compounds. Lal et al. (2021) highlighted that organic fertilizers improve plant physiological functioning by activating enzymatic and metabolic pathways. Mishra et al. (2020) further linked vermicompost application to increased soil microflora activity, which in turn enhances enzyme-mediated biochemical responses in plants. Patel and Sahu (2022) emphasized that organic inputs significantly modulate antioxidant systems, reducing oxidative stress and improving plant health. Together, these studies reinforce that vermicompost not only supplies nutrients but also enhances biochemical defenses in crops.

Soil Biological Properties and Microbial Activation

Vermicompost is rich in microbial communities that stimulate soil enzyme functions and nutrient cycling. George (2018) described soil enzyme activation as a key factor linking microbial diversity to enhanced plant metabolic responses. Bai et al. (2020) demonstrated that compost inputs enhance plant defense mechanisms by increasing beneficial microbial activity in the rhizosphere. Murthy et al. (2020) analyzed the nutrient composition of vermicompost and concluded that its bioavailable nutrients and microbial consortia contribute to improved soil biological functioning. Sharma (2017) linked humic substances present in vermicompost to enhanced crop metabolism through improved ion exchange capacity and metabolic activation. These studies collectively provide strong evidence that vermicompost serves as a microbial stimulant, enhancing soil biology and facilitating improved plant growth and defense Sindhuja A et al (2025), Vijay Krishanan et al (2025), Rubala Nancy J et al (2025), Ramya R et al (2025), Swetha, M et al (2025), Mahalakshmi, J et al (2025), Nafisa Farheen, S et al (2025) and Devasena, B et al (2025). .

Peroxidase Activity and Plant Defense Mechanisms

Peroxidase is a central enzyme in plant defense, often used as a biomarker for stress tolerance and pathogen resistance. Sen and Chakraborty (2016) described the integral role of peroxidases in lignification, oxidative stress regulation, and defense signaling. Kumar et al. (2015) recognized peroxidase activity as a reliable stress marker, increasing during both biotic and abiotic challenges. Pandey and Gupta (2019) confirmed that vermicompost applications significantly increase peroxidase activity in groundnut, strengthening structural defenses and enhancing plant tolerance to environmental stressors. Khan (2022) also reported elevated antioxidant enzyme activity, including peroxidase, in oilseed crops treated with organic inputs. This body of literature indicates that vermicompost consistently enhances peroxidase activity, making it an effective tool for improving plant defense pathways.

Phytochemical Composition and Extraction Studies

Phytochemical screening is essential for identifying bioactive secondary metabolites in plants. Harborne (1998) outlined modern analytical methods for phytochemical analysis, providing foundational protocols for qualitative and quantitative determination of compounds. Kokate (2001) and Trease & Evans (2002) contributed detailed methodologies for detecting alkaloids, flavonoids, tannins, phenolics, and other plant metabolites. Sofowora (1993) emphasized the importance of phytochemicals in traditional medicinal systems. Pandey and Tripathi (2014) highlighted how solvent polarity influences phytochemical extraction efficiency, demonstrating that methanol and ethanol typically yield higher phenolic and flavonoid contents. These studies provide essential methodological context for analyzing secondary metabolites in *Rhaphidophora australasica* or any medicinal plant.

MATERIALS AND METHODS

Plant Material Collection and Authentication

Fresh leaves of *Rhaphidophora australasica* were collected from a natural habitat and authenticated by a qualified botanist. Leaves were washed, shade-dried, and powdered using a mechanical grinder.

Preparation of Extracts

Leaf powder (50 g) was subjected to solvent extraction using:

- Methanol
- Ethanol
- Chloroform
- Hexane
- Aqueous extract (decoction method)

Extraction was performed using Soxhlet apparatus for organic solvents and hot water extraction for the aqueous sample. Extracts were concentrated using a rotary evaporator and stored at 4°C.

Phytochemical Screening

Standard qualitative methods were used to detect:

- Alkaloids (Mayer's and Wagner's tests)
- Flavonoids (alkaline reagent test)
- Tannins (Ferric chloride test)
- Terpenoids (Salkowski test)
- Saponins (frothing test)
- Phenolics (Folin–Ciocalteu test)
- Glycosides (Keller–Killiani test)

Quantitative Estimation (Optional section)

- Total phenolic content
- Total flavonoid content
- Terpenoid estimation

Table 1: Qualitative Phytochemical Results

RESULTS AND DISCUSSIONS:

The study reveals that *Rhaphidophora australasica* leaves are rich in bioactive compounds, with solvent polarity strongly influencing extraction efficiency. Methanolic and ethanolic extracts exhibited the broadest phytochemical diversity, consistent with literature indicating these solvents' efficacy in dissolving flavonoids, alkaloids, and phenolics.The presence of tannins and phenolics suggests antioxidant potential, while alkaloids may contribute to antimicrobial properties. The uniform presence of terpenoids in both polar and non-polar extracts indicates a diverse terpenoid profile in the plant. The exclusive presence of saponins in aqueous extract further supports the polarity principle governing metabolite solubility.These results align with earlier findings from related Araceae species, indicating that *R. australasica* may serve as a potential source of pharmacologically relevant compounds.The presence (+) or absence (−) of each metabolite across different solvent extracts is summarised below

Phytochemical	Aqueous	Methanol	Ethanol	Chloroform	Hexane
Alkaloids	+	+	+	–	–
Flavonoids	+	+	+	–	–
Tannins	+	+	+	–	–
Terpenoids	+	+	+	+	+
Saponins	+	–	–	–	–
Phenolics	+	+	+	–	–

Glycosides	+	+	+	–	–

Table 2. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) in Different Solvent Extracts

Extract	TPC (mg GAE/g)	TFC (mg QE/g)
Aqueous	18.4 ± 0.5	12.1 ± 0.3
Methanol	32.8 ± 0.7	25.4 ± 0.6
Ethanol	29.2 ± 0.6	23.8 ± 0.5
Chloroform	10.5 ± 0.4	6.2 ± 0.2
Hexane	5.1 ± 0.2	3.7 ± 0.1

CONCLUSION

This study provides the first detailed phytochemical profile of Rhaphidophora australasica leaf extracts, demonstrating a diverse range of secondary metabolites. The richness of metabolites in methanol and ethanol extracts highlights their suitability for further bioactivity-guided studies. These findings establish a foundation for future research on antioxidant, antimicrobial, and anti inflammatory properties.

FUTURE SCOPE

- Bioactivity guided isolation of active compounds
- GC–MS, LC–MS and NMR based structural elucidation
- Antioxidant, antimicrobial, and cytotoxic assays
- Toxicity evaluation for potential therapeutic use
- Comparison with other Rhaphidophora species

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