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RESEARCH ARTICLE
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Phytochemical, Antioxidant and Antimicrobial Analysis of *Embelia philippinensis* A.DC. Extracts

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ABSTRACT

This study evaluated the phytochemical properties, antioxidant, and antimicrobial activities of *Embelia philippinensis* A.DC. extracts. Phytochemical screening, conducted according to standardized qualitative protocols, confirmed the presence of flavonoids, tannins, alkaloids, saponins, and glycosides in all plant parts. Antioxidant activity, measured via UV-Vis spectrophotometry, was highest in the leaves. Antimicrobial assays conducted using the disc diffusion method revealed that leaf and stem extracts strongly inhibited bacterial strains, including *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Salmonella typhimurium,* respectively. In antifungal testing, root extracts inhibited *Aspergillus brasiliensis*, while stem and leaf extracts showed activity against *Candida albicans*; however, all extracts were inactive against *Saccharomyces cerevisiae*. These results support the traditional medicinal use of *E. philippinensis*.

Keywords: Antimicrobial, Antioxidant, Embelia philippinensis, Medicinal Plant, Phytochemical, Primulaceae.

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INTRODUCTION

Embelia philippinensis A.DC. is a climbing woody vine in the family Primulaceae that remains relatively understudied yet holds cultural and ethnomedicinal value in the Philippines. Indigenous communities across the country continue to include this species in traditional healthcare practices, and it is frequently documented in ethnobotanical surveys of native medicinal plants (Domingo et al., 2024). Bioactivity studies of related *Embelia* species like *E. ribes* indicate that plants in this genus often contain antioxidant compounds and exhibit antibacterial potential, suggesting valuable pharmacological properties worthy of further investigation (Sharma et al., 2022). Although comprehensive pharmacological evaluations of *E. philippinensis* are still limited, research on plant parts such as roots has demonstrated phenolic-driven antioxidant activity and identified compounds common to medicinal *Embelia* plants (Odchimar et al., 2016; Nuneza et al., 2016). Additionally, folkloric reports continue to describe antioxidant and antibacterial activities for *E. philippinensis* that may underlie its traditional applications.

Interest in plant-based antioxidants and antimicrobials has intensified over the past few years due to increasing awareness of oxidative stress–related diseases and concerns about adverse effects associated with synthetic drugs. In response, research has expanded to evaluate botanical sources with health-promoting and antimicrobial properties. Plant-derived antioxidants are broadly studied for their ability to scavenge free radicals, mitigate inflammation, and protect against oxidative damage implicated in chronic conditions such as diabetes, cancer, and cardiovascular diseases (Zafar et al., 2023). Similarly, plant-based antimicrobials are gaining recognition as alternative or complementary agents to conventional antibiotics in the face of rising antimicrobial resistance and the shrinking pipeline of new antibiotics (Angelini, 2024). This renewed scientific attention has prompted extensive phytochemical and pharmacological investigations of medicinal plants across regions with rich biodiversity and traditional medicinal knowledge, highlighting the potential of botanical extracts in pharmaceutical, food, and agricultural applications (França et al., 2026).

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The growing global demand for plant-based products is fueled not only by health consciousness but also by increasing concerns regarding the safety of synthetic additives. Synthetic antioxidants, while effective in preventing oxidative deterioration, have been associated with adverse toxicological effects, prompting consumers and researchers to favor natural alternatives (Gulcin, 2025; Pereira et al., 2025). Within this context, underutilized native plant species such as *E. philippinensis* present a dual opportunity: the scientific substantiation of traditional medicinal practices and the identification of safer, sustainable bioactive compounds. This research direction is particularly relevant in the Philippines, where extensive biodiversity coexists with a strong tradition of ethnomedicine, yet many native plant species remain poorly documented or insufficiently investigated.

The exploration of medicinal plants often begins with the evaluation of their phytochemical composition. Secondary metabolites such as phenolics, flavonoids, tannins, alkaloids, and saponins are widely acknowledged as key contributors to pharmacological activity. These bioactive compounds exhibit strong antioxidant properties that play a crucial role in mitigating oxidative stress, a pathological process associated with chronic diseases such as cancer, cardiovascular disorders, and neurodegenerative conditions (Pham-Huy et al., 2008; Pisoschi & Pop, 2015). Studies on related species within the genus *Embelia*, particularly *E. ribes*, have reported notable antioxidant and antimicrobial activities, suggesting the likelihood of comparable bioactivities in *E. philippinensis*. However, the phytochemical profile of *E. philippinensis* remains largely unexplored, underlining the need for comprehensive phytochemical characterization.

Concurrent with the interest in antioxidants, antibiotic resistance has emerged as one of the most pressing global public health and agricultural concerns of the 21st century. The widespread and often indiscriminate use of antibiotics in human medicine, livestock production, and aquaculture has accelerated the development of resistant microbial strains (World Health Organization, 2023). Antimicrobial resistance (AMR) threatens the effectiveness of standard treatments, increases healthcare costs, and contributes to rising morbidity and mortality worldwide. In agricultural settings, resistant pathogens can spread through food systems and environmental pathways, creating interconnected risks to human and animal health. This crisis has intensified the search for novel antimicrobial agents, including plant-derived compounds with diverse mechanisms of action (Atanasov et al., 2021). Medicinal plants rich in phenolics, quinones, and other secondary metabolites may offer promising alternatives or adjunct therapies capable of mitigating microbial resistance.

In Southeast Asia, medicinal plants constitute a major component of primary healthcare systems, particularly in rural communities where access to modern pharmaceuticals may be limited. Countries such as the Philippines, Indonesia, Thailand, Malaysia, and Vietnam possess extensive floristic diversity and long-standing traditions of herbal medicine (Wiart, 2021). Ethnobotanical surveys in the region continue to document the reliance on native plants for everyday healthcare, highlighting their roles in managing a range of ailments (Mon et al., 2024). Recent studies have further emphasized the rich phytochemical diversity and pharmacological potential of these species, demonstrating antioxidant, antimicrobial, anti-inflammatory, and antiparasitic activities (Chassagne et al., 2021; Jeeno et al., 2023). Despite this growing body of literature, numerous endemic and lesser-known species remain insufficiently studied. *E. philippinensis*, native to parts of Southeast Asia, represents one such species whose scientific evaluation could not only enhance local ethnopharmacology but also contribute to broader drug discovery initiatives.

From a taxonomic and phytochemical perspective, the family Primulaceae is known to contain diverse secondary metabolites, including benzoquinones, flavonoids, triterpenoids, and saponins, many of which exhibit antimicrobial, antioxidant, and cytotoxic activities (Mabberley, 2017). Members of the genus *Embelia* is particularly noted for the benzoquinone embelin, a bioactive compound predominantly isolated from *Embelia* fruits that has been demonstrated to exhibit antioxidant, antimicrobial, and cytotoxic activities, alongside other therapeutic effects (Jagtap et al., 2022; Rupesh et al., 2025; Thuong et al., 2025). The phytochemical diversity observed within Primulaceae highlights the biological potential of lesser-studied species such as *E. philippinensis* and justifies systematic investigation into their chemical constituents and bioactivities.

Furthermore, the investigation of *E. philippinensis* is consistent with contemporary integrative health approaches and global research priorities. The World Health Organization emphasizes the importance of medicinal plants in primary health care and advocates for scientific studies that evaluate their safety, efficacy, and potential integration into modern health systems (Ekor, 2014; World Health Organization, 2019). Consequently, research on *E. philippinensis* extends beyond academic inquiry, supporting public health, environmental sustainability, and the preservation of cultural heritage.

The present study establishes several objectives to comprehensively explore the potential of *E. philippinensis*. It seeks to identify the phytochemical constituents of its extracts and evaluate their biological activities, particularly antioxidant and antimicrobial properties. These investigations are crucial in the context of increasing antibiotic resistance, where natural plant-based compounds are being explored as sustainable alternatives or complements to conventional drugs.

E. philippinensis remains scientifically underexplored despite its long-standing traditional use, with significant gaps in comprehensive phytochemical profiling as well as validated antioxidant and antimicrobial evaluations. Unlike *E. ribes*, it lacks systematic chemical characterization and experimental evidence supporting its bioactivities, particularly in the context of the growing threat of antimicrobial resistance highlighted by the World Health Organization. The novelty of this study lies in its integrated approach, combining phytochemical screening with biological activity evaluation, thereby generating

foundational data that bridges ethnomedicinal knowledge with evidence-based pharmacological validation.

MATERIALS & METHODS

Study Design

The present study employed a combination of descriptive and experimental research designs to comprehensively examine the potential of *E. philippinensis*. The descriptive component was applied in the phytochemical screening of the species, focusing on identifying and characterizing its bioactive compounds. Meanwhile, the experimental design was central to the antioxidant and antimicrobial assays, where controlled laboratory procedures such as spectrophotometric analysis and disc diffusion methods were utilized.

Study Area

The study was conducted at the University of Rizal System (URS) Tanay Campus (Fig. 1) in Sampaloc, Tanay, a first-class municipality in Rizal Province, Philippines, approximately 57 km east of Manila. The municipality encompasses portions of the Sierra Madre mountain range and is bounded by Antipolo City, Baras, Morong, Teresa, General Nakar (Quezon Province), Pililla, Santa Maria (Laguna Province), and Laguna de Bay. The campus covers approximately 92.45 hectares of land and forest area on a hilly mountainside connected to the Sierra Madre and is located more than 15 km from the town proper, providing a relatively secluded and research-conducive environment. Three sampling sites where *E. philippinensis* occurred were identified within the campus: Site 1 (14°33′28.56″N, 121°22′14.98″E), Site 2 (14°33′23.53″N, 121°22′21.44″E), and Site 3 (14°33′29.50″N, 121°22′25.16″E).

Plant and Extract Preparations

Sample collection was conducted in August 2024 at the URS Tanay Campus. Approximately one kilogram each of leaves, stems, and roots was harvested and authenticated through comparison with botanical literature and online taxonomic databases. A voucher specimen was subsequently deposited in a local herbarium to provide a reference for future research and verification. Plant materials were thoroughly washed with distilled water, chopped into small pieces, and stored in sterile containers before extraction. Extraction was conducted using 70% ethanol in a 1:10 (w/v) ratio via maceration over 72 hours, with occasional agitation to maximize compound recovery. Filtration was performed with Whatman No. 1 filter paper, and the filtrates were concentrated under reduced pressure at 40–45°C using a rotary evaporator. The extracts were stored in amber bottles at 4°C to prevent degradation.

Phytochemical Screening and Antioxidant Activity

Phytochemical screening was performed at the Department of Science and Technology – Industrial Technology Development Institute (DOST-ITDI), following standardized qualitative protocols. Tests were conducted for sterols and triterpenes (Lieberman-Burchard test), flavonoids (Shinoda test), alkaloids (Mayer's test), saponins (Froth test), glycosides (Fehling's test), and tannins (Ferric chloride test). These assays provided insights into the bioactive compounds that may contribute to the plant's medicinal and functional properties.

To assess antioxidant capacity, UV–Visible spectrophotometry was employed, with all antioxidant assays conducted in triplicate to ensure accuracy and reproducibility. Results were expressed as total phenolic content in Gallic Acid equivalents (GAE). This assay provided a quantitative measure of the plant's free radical–scavenging ability, which is closely associated with its potential health-promoting effects.

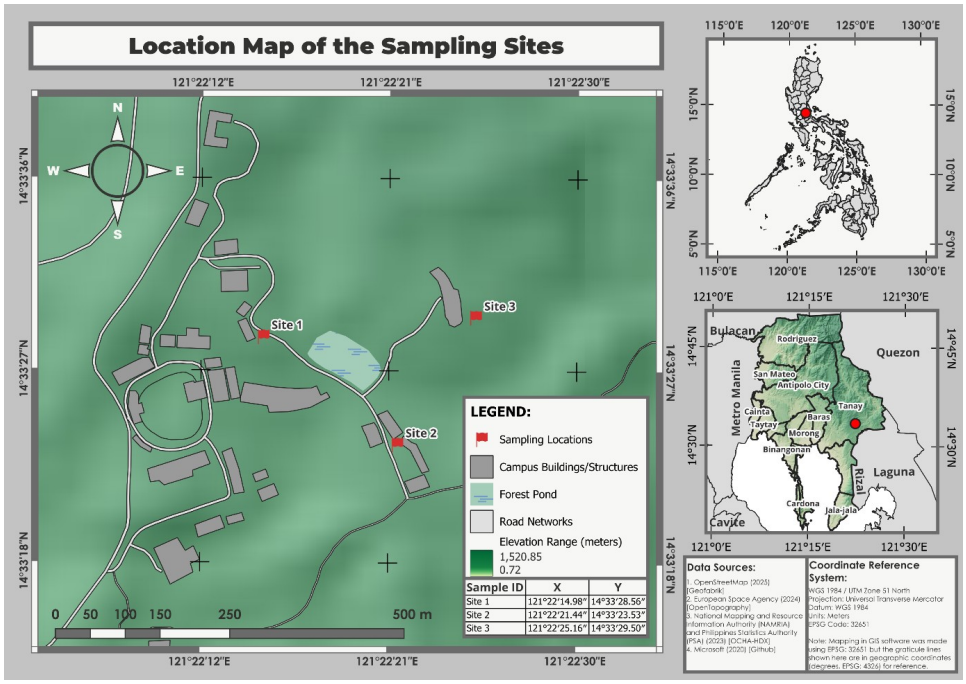


Fig. 1: Map of the University of Rizal System Tanay Campus.

Antimicrobial Activity

Antimicrobial activity, on the other hand, was evaluated through antibacterial and antifungal assays in accordance with USP 3 - NF 25 (2007) standards. Extracts from the leaves, stems, and roots were tested in triplicate using the disc diffusion method. Microbial isolates were standardized with the 0.5 McFarland Standard before inoculation into Mueller-Hinton Agar. Sterile filter paper discs impregnated with extracts were placed alongside commercial antibiotics as positive controls. Following incubation at 35°C, zones of inhibition were measured with calipers to determine efficacy. The reactivity rating scale (0–4) and inhibitory activity rating ((+++), (++), (+), or (–)) provided a framework for interpreting the results, which were further analyzed using one-way ANOVA to establish statistical significance.

Statistical Analysis

The results were analyzed following quantitative and qualitative standards according to AOAC and DOST-FNRI protocols. Data were analyzed using SPSS version 26. One-way Analysis of Variance (ANOVA) was employed to determine significant differences in antibacterial activity among the treatment groups. All tests were conducted at a 95% confidence level ($\alpha = 0.05$).

RESULTS & DISCUSSION

Phytochemical Screening

The qualitative phytochemical screening of *E. philippinensis* (Table 1) demonstrated the widespread presence of key secondary metabolites including sterols, triterpenes, flavonoids, alkaloids, saponins, glycosides, and tannins in the roots, stems, and leaves. This comprehensive profile suggests significant pharmacological potential and aligns with contemporary findings in phytochemical research. Recent reviews emphasize that secondary metabolites such as phenolics, terpenes, and alkaloids are integral to the antioxidant, anti-inflammatory, and therapeutic effects observed across medicinal plants, acting through diverse biochemical mechanisms that mitigate oxidative stress and cellular damage (Hilal et al., 2024). The consistent detection of flavonoids in all plant parts of *E. philippinensis* supports its putative antioxidant role, as flavonoids are widely recognized for their free radical–scavenging properties and their contribution to defense against chronic diseases (Kamble et al., 2020).

Table 1: Phytochemical constituents present in *E. philippinensis* extracts

Phytochemicals	Roots	Stems	Leaves
Sterols	+	+	+
Triterpenes	+	+	+
Flavonoids	+	+	+
Alkaloids	+	+	+
Saponins	+	+	+
Glycosides	+	+	+
Tannins	+	+	+

Legend: (+) Presence of constituents.

Similarly, the presence of alkaloids, saponins, glycosides, sterols, and triterpenes further emphasizes the broad therapeutic relevance of *E. philippinensis*, as these compounds have been linked to antimicrobial, anti-inflammatory, cardioprotective, and anticancer activities (Wijerathna et al., 2025). These findings strengthen the results of the study for further quantitative analysis, bioactivity assays, and isolation of specific bioactive constituents from *E. philippinensis* to elucidate its full pharmacological profile.

Antioxidant Activity

Fig. 2 illustrates variation in antioxidant activity among *Embelia philippinensis* plant parts, with leaves exhibiting the highest total phenolic content (7.05%), followed by stems (6.22%) and roots (1.08%). This pattern aligns with findings in *Solanum aculeatissimum*, where leaves accumulate high phenolic (102.45 mg GAE/g) and flavonoid (71.24 mg QE/g) levels to drive potent antioxidant activity as the primary interface for environmental defense (Del Valle et al., 2020). Similar trends appear in other species with elevated compounds like syringic acid, ellagic acid, rutin, and chlorogenic acid in foliage to counter oxidative damage from UV radiation, drought, and pathogens (Saini et al., 2024; Silva et al., 2024; Mohagheghian et al., 2025).

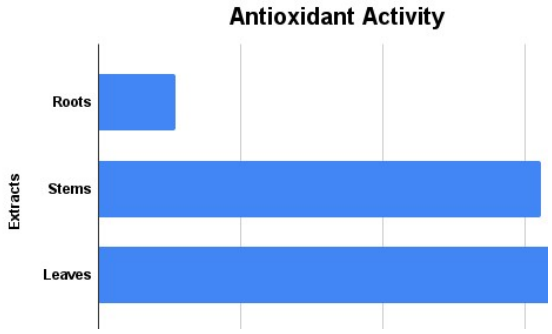


Fig. 2: Antioxidant activity of *E. philippinensis* extracts.

The comparatively lower phenolic content in roots and stems also mirrors findings in other ethnomedicinal plants, where these parts contribute distinct but less potent antioxidant effects (Hariwal et al., 2024). The marked antioxidant profile of *E. philippinensis* leaves highlights their promise as a potent source of natural antioxidants, reinforcing their potential utility in phytopharmaceutical applications. These results support the growing preference for plant-based bioactives over synthetic alternatives, which have been associated with toxicity concerns and limited health benefits (Negi et al., 2025). Collectively, this evidence emphasizes not only the intra-plant variation of antioxidant capacity in *E. philippinensis* but also its relevance within broader studies of plant bioactives with therapeutic potential.

Antibacterial Activity

The antibacterial assay results (Table 2) of *E. philippinensis* extracts reveal noteworthy antimicrobial potential, with several crude extracts producing inhibition zones that equal or exceed those of standard antibiotics under identical test conditions. The stem extract's

Table 2: Antibacterial assays of *E. philippinensis* extracts against selected microorganisms

Sample/Control		Total Mean Zone of Inhibition (mm)	Reactivity	Inhibitory Activity
Bacillus subtilis				
Root Extract (10 mm)		12.65	2	+++
Stem Extract (10 mm)		19.48	3	+++
Leaves Extract (10 mm)		15.17	3	+++
Positive Control:	*Oxacillin 1µg* (6 mm)	18.23	4	+++
Escherichia coli				
Root Extract (10 mm)		11.23	2	++
Stem Extract (10 mm)		18.88	3	+++
Leaves Extract (10 mm)		22.56	4	+++
Positive Control:	*Amikacin 30µg* (6 mm)	14.71	3	+++
Pseudomonas aeruginosa				
Root Extract (10 mm)		13.10	2	+++
Stem Extract (10 mm)		15.34	3	+++
Leaves Extract (10 mm)		17.63	3	+++
Positive Control:	*Amikacin 30µg* (6 mm)	21.50	4	+++
Salmonella typhimurium				
Root Extract (10 mm)		12.16	2	++
Stem Extract (10 mm)		15.80	3	+++
Leaves Extract (10 mm)		18.52	3	+++
Positive Control:	*Amikacin 30µg* (6 mm)	18.66	4	+++
Staphylococcus aureus				
Root Extract (10 mm)		11.75	2	+++
Stem Extract (10 mm)		22.98	4	+++
Leaves Extract (10 mm)		24.56	4	+++
Positive Control:	*Oxacillin 1µg* (6 mm)	22.23	4	+++

Reactivity Rating: 0 – None (No detectable zone around or under specimen; 1 – Slight (Some malformed or degenerated cells under the specimen; 2 – Mild (Zone limited under the specimen); 3 – Moderate (Zone extends to 5 to 10 mm beyond specimen); 4 – Severe (Zone extends greater than 10 mm beyond specimen); Inhibitory Activity Rating: (+++) complete; (++) partial; (+) slight; and (-) negative.

Table 3: Antifungal assays of *E. philippinensis* extracts against selected microorganisms

Sample/Control		Total Mean Zone of Inhibition (mm)	Reactivity	Inhibitory Activity
Aspergillus brasiliensis				
Root Extract (10 mm)		10.00	2	+++
Stem Extract (10 mm)		0.00	0	(-)
Leaves Extract (10 mm)		0.00	0	(-)
Positive Control:	*Clotrimazole* (10 mm)	17.96	3	+++
Candida albicans				
Root Extract (10 mm)		0.00	0	(-)
Stem Extract (10 mm)		10.00	2	+++
Leaves Extract (10 mm)		12.48	2	+++
Positive Control:	*Clotrimazole* (10 mm)	19.10	3	+++
Saccharomyces cerevisiae				
Root Extract (10 mm)		0.00	0	(-)
Stem Extract (10 mm)		0.00	0	(-)
Leaves Extract (10 mm)		0.00	0	(-)
Positive Control:	*Nystatin* (10 mm)	19.22	3	+++

Reactivity Rating: 0 – None (No detectable zone around or under specimen; 1 – Slight (Some malformed or degenerated cells under the specimen; 2 – Mild (Zone limited under the specimen); 3 – Moderate (Zone extends to 5 to 10 mm beyond specimen); 4 – Severe (Zone extends greater than 10 mm beyond specimen); Inhibitory Activity Rating: (+++) complete; (++) partial; (+) slight; and (-) negative.

inhibition against *B. subtilis* (19.48 mm) surpassed the zone exhibited by Oxacillin (18.23 mm), while leaf extracts demonstrated particularly strong activity against *E. coli* (22.56 mm), outperforming Amikacin (14.71 mm). Similarly, against *S. aureus*, both stem and leaf extracts exhibited inhibition zones (22.98 mm and 24.56 mm, respectively) that were comparable to or greater than Oxacillin (22.23 mm). These results align with a growing body of evidence showing that *Punica granatum* and other plant extracts exert potent antibacterial activity against gram-positive and gram-negative bacteria, often producing inhibition zones matching or exceeding antibiotics like ciprofloxacin, alongside Ibn Awadh's findings on phytochemical-rich extracts combating antimicrobial resistance (Asfa et al., 2025; Ibn Awadh, 2025).

Mechanistically, the antibacterial efficacy of *E. philippinensis* extracts arises from secondary metabolites like phenolics, flavonoids, alkaloids, tannins, and quinones (e.g., embelin), which disrupt bacterial cell membranes, inhibit key enzymes, block efflux pumps, and prevent biofilm formation, as widely documented in plant antimicrobials. These compounds permeabilize membranes via lipid interactions, target metabolic pathways and synergize for broad-spectrum effects against Gram-positive/negative strains, mirroring *E. philippinensis*'s leaf/stem activities (Cushnie & Lamb, 2011). Embelin from related *Embelia* species exemplifies quinone-mediated inhibition (Chitra et al., 2003), while phenolics modulate resistance in MDR pathogens (Yan et al., 2024; Zhang et al., 2025).

Taken together, the findings demonstrate the in vitro antibacterial activity of *E. philippinensis* extracts against selected test organisms. These results align with globally reported trends in plant-mediated antimicrobial activity; however, the observed effects were obtained under controlled laboratory conditions and should not be interpreted as direct evidence of clinical efficacy. Nevertheless, the findings provide a scientific basis for

further phytochemical investigation, isolation of active constituents, and subsequent in vivo and mechanistic studies to evaluate their potential therapeutic relevance.

Antifungal Activity

The selective antifungal activity observed in *E. philippinensis* is consistent with current research showing that plant-derived bioactive compounds often exhibit varying efficacy depending on fungal species, concentration, and phytochemical composition. Many medicinal plants contain compounds such as phenolics, flavonoids, alkaloids, and terpenoids that inhibit fungal growth through multiple mechanisms, including disruption of fungal cell membranes, inhibition of ergosterol biosynthesis essential for membrane integrity, suppression of germination and hyphal growth, and interference with fungal enzymatic systems involved in energy metabolism (Alam et al., 2025; Hamzah et al., 2025). Studies on plant compounds active against *Candida* strains emphasize the potential of phytochemicals to overcome antifungal resistance, particularly through modulation of fungal cell walls and biofilm formation (Dantas et al., 2025).

The differential activity across plant tissues suggests that specific classes of phytochemicals are concentrated in distinct organs, with roots potentially enriched in compounds more effective against filamentous fungi like *Aspergillus*, while aerial parts harbor compounds with greater yeast-targeting activity. This pattern aligns with broader findings in medicinal plant research where variation in compound profiles influences antifungal spectra. The lack of activity against *S. cerevisiae* highlights that not all fungal species are equally susceptible to these phytochemicals, which has been noted in other medicinal plants and may reflect differences in cell wall composition, membrane sterol content, or intrinsic resistance mechanisms. Such selective antifungal behavior is not uncommon and may offer therapeutic advantages by targeting pathogenic fungi while sparing non-pathogenic species, potentially reducing dysbiosis in clinical or agricultural contexts. These insights support further phytochemical isolation and bioactivity-guided fractionation to identify the specific compounds responsible, elucidate their modes of action, and explore their applications as alternative or adjunct antifungal agents.

Significant Difference for Antibacterial Assay

To statistically evaluate antibacterial efficacy, one-way ANOVA was conducted across the extracts for all tested bacterial species. Results indicated no statistically significant differences in antibacterial activity among the roots, stems, and leaves of *E. philippinensis* at the 95% confidence level ($\alpha = 0.05$). Nonetheless, meaningful biological trends were observed. This outcome suggests that the antibacterial effects of the various plant parts are generally comparable, likely due to the distribution of bioactive phytochemicals throughout different plant tissues. Medicinal plants are widely reported to contain phenolics, flavonoids, alkaloids, and terpenoids that contribute to antibacterial activity (Cowan, 1999; Mandal & Domb, 2024). These compounds exert antimicrobial effects through mechanisms such as disruption of bacterial cell walls and membranes, inhibition of essential metabolic enzymes, interference with nucleic acid synthesis, and alteration of membrane permeability (Daglia, 2012).

In addition, the antibacterial efficacy of crude plant extracts is often attributed to synergistic interactions among multiple constituents rather than a single active compound. Such interactions can enhance membrane destabilization and simultaneously target multiple bacterial pathways, thereby strengthening overall antimicrobial performance (Wagner & Ulrich-Merzenich, 2009). The absence of significant variation among plant tissues in the present findings may therefore reflect relatively similar phytochemical compositions across roots, stems, and leaves. Nonetheless, more refined analytical approaches, including bioactivity-guided fractionation and advanced phytochemical profiling, may reveal subtle differences in compound concentration or potency that are not evident in crude extract comparisons (Cos et al., 2006).

Conclusion

E. philippinensis contains diverse bioactive compounds, including flavonoids, tannins, alkaloids, saponins, and glycosides, which contribute to its notable antioxidant and antimicrobial activities. Leaves exhibited the highest antioxidant potential, while leaves and stems showed broad-spectrum antibacterial effects, and roots demonstrated selective antifungal activity. These results validate its traditional medicinal use and highlight its promise as a source of natural bioactive agents for therapeutic applications.

DECLARATIONS

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Conflict of Interest: None.

Data Availability: All the data is available in the article.

Ethics Statement: Before the conduct of the research, a collection permit was secured from the Environmental Education and Biodiversity Research Center (EEBRC) of the University of Rizal System. This ensured compliance with ethical and institutional protocols for the collection and utilization of plant samples, particularly given that *E. philippinensis* is a native species. Ethical considerations such as proper documentation, responsible harvesting, and preparation of voucher specimens were observed to promote transparency and sustainability in the research process.

Author's Contribution: All aspects of this research were conducted solely by the author.

Generative AI Statement: The author declares that no Gen AI/DeepSeek was used in the writing/creation of this manuscript.

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