

GRASSES & SEDGES

OF INDIA

Food, Medicinal & Ecological Aspects

BIDHAN CHANDRA ROY
RAJKUMARI SUPRIYA DEVI

Grass & Sedges of India

Food, Medicinal & Ecological
Aspects

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Cover page: Grasses

Back page: Inflorescence of sedges and grasses

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Green guardians of life – powering ecosystem with
food, shelter, and harmony.

Bidhan Chandra Roy

Grasses and sedges are the green bedrock for wildlife
survival.

Rajkumari Supriya Devi



Dr. Padma Mahanti, IFS
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MESSAGE

"Grass & Sedges of India: Food, Medicinal & Ecological Aspects" is a comprehensive book that explores the multifaceted uses of grasses and sedges in India, highlighting their significance in maintaining ecological balance and supporting human livelihoods. The book covers 20 chapters, each focusing on a specific plant species, including their phytochemical properties, antimicrobial activities, and nutritional values. From *Sporobolus diandrus* to *Spinifex littoreus*, each species is explored for its unique characteristics and benefits. This book serves as a valuable resource for researchers, botanists, and anyone interested in ethnobotany and pharmacology. It underscores the importance of conservation and sustainable management of grass and sedge resources, ensuring their continued availability for future generations. By documenting the medicinal, nutritional, and ecological aspects of these plant species, the book promotes a deeper understanding and appreciation of their significance in India, ultimately contributing to the preservation of traditional knowledge and biodiversity.

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Preface

Grasses and sedges are vital components of our ecosystem, providing sustenance, shelter, and habitat for a diverse range of wildlife. In India, these plant species have been an integral part of traditional medicine, food, and cultural practices for centuries. The edited book **"Grass & Sedges of India: Food, Medicinal & Ecological Aspects"** aims to document the multifaceted uses of these plants, highlighting their significance in maintaining ecological balance and supporting human livelihoods.

The book covers 20 chapters, each focusing on a specific species of grass or sedge, including their phytochemical properties, antimicrobial activities, and nutritional values. From *Saccharum spontaneum*, a medicinally important grass used in traditional medicine, to *Spinifex littoreus*, which plays a crucial role in coastal sand dune ecosystems, each species is explored for its unique characteristics and benefits. The documentation of these plant species underscores their importance in supporting biodiversity, ecosystem services, and human well-being.

This edited book compiles extensive research on the ecological, medicinal, and nutritional properties of grasses and sedges, offering a valuable resource for researchers, botanists, and anyone interested in ethnobotany and pharmacology. It emphasizes the urgent need for conservation and sustainable management of these plant resources to ensure their continued availability for future generations. The content aims to promote a deeper understanding and appreciation of the significance of grasses and sedges in India, highlighting their potential to support livelihoods, maintain biodiversity, and deliver essential ecosystem services.

Background

Grasses and sedges are vital components of ecosystems, providing sustenance, shelter, and habitat for a diverse range of wildlife. In India, these plant species have been an integral part of traditional medicine, food, and cultural practices for centuries. The significance of grasses and sedges extends beyond their ecological roles, as they also hold cultural and spiritual value, with many species being used in traditional rituals and ceremonies.

Despite their importance, the documentation of grasses and sedges has been limited, particularly in terms of their medicinal properties and uses. Recent studies have highlighted the potential of these plant species in providing affordable and accessible healthcare to communities, as well as their role in maintaining ecological balance and supporting biodiversity. For instance, *Cynodon dactylon*, a sacred grass in India, has been found to possess antimicrobial, anti-inflammatory, and antioxidant properties, making it a valuable resource for traditional medicine.

The edited book **"Grass & Sedges of India: Food, Medicinal & Ecological Aspects"** aims to fill this knowledge gap by documenting the multifaceted uses of grasses and sedges in India. By compiling research on the ecological, medicinal, and nutritional aspects of these plant species, this book provides a valuable resource for researchers, botanists, and anyone interested in ethnobotany and pharmacology. The significance of this book lies in its potential to promote a deeper understanding and appreciation of the importance of grasses and sedges in India, ultimately contributing to their conservation and sustainable management.

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Chapter 1

Ecological fodder role and phytotherapeutic potential of *Sporobolus diandrus* (Retz.) P. Beauv.

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Abstract: This study highlights the ecological fodder significance and preliminary phyto-therapeutic potential of *Sporobolus diandrus* (Retz.) P. Beauv., integrating its role in wildlife nutrition with qualitative phytochemical and antimicrobial findings.

Keywords: Fodder plants, medicinal uses, wildlife

Introduction

Grasses play a pivotal role in maintaining ecosystem productivity, supporting wildlife populations, and stabilizing soil in fragile landscapes (Sethi et al., 2024). Among them, *Sporobolus diandrus* (Retz.) P. Beauv., of the family Poaceae, occupies sandy and open habitats where it provides seasonally palatable herbage for wild grazers (Figure 1). Its adaptive traits, tolerance to drought, fire, and nutrient-poor soils, enable it to persist in disturbed ecosystems and contribute to vegetation cover continuity (Behera et al., 2025). Systematic documentation of such grasses is vital, not only for taxonomic clarity but also to understand their role in rangeland ecology, succession dynamics, and wildlife nutrition (Álvarez-Holguín et al., 2024). Unfortunately, many native grasses remain underreported in terms of their phytochemistry and bioactivity, leaving a gap in knowledge that limits their inclusion in both habitat management and pharmacological exploration. They have food and medicinal properties (Satapathy et al., 2019; Mishra et al., 2022; Sinha et al., 2023; Dimri et al., 2024). Fodder plants of wildlife are critical components of ecological food webs, influencing the distribution, migration, and reproductive success of herbivorous fauna (Birnie-Gauvin et al., 2017). Seasonal availability of nutritious grasses such as *S. diandrus* can shape grazing pressure and indirectly regulate predator–prey interactions. Keeping this in view, an

attempt has been made to document its fodder values, available secondary metabolites, and antimicrobial activity.



Figure 1: Inflorescence of *Sporobolus diandrus*



Figure 2: Collected sample of *S. diandrus*

Methodology

Whole plant samples of *Sporobolus diandrus* were collected from nearby Mahanadi areas of Cuttack district, Odisha, India (Figure 2). The grass species was identified by Dr. Sanjeet Kumar, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

Published literature identifies *Sporobolus diandrus* as a wildlife fodder grass with generally moderate palatability, yet it is reported to be highly preferred by herbivores within Chandaka Wildlife Sanctuary (Behera et al., 2025). Qualitative phytochemical analysis of *S. diandrus* revealed the presence of tannins, saponins, and reducing sugars across different solvent systems, while flavonoids, phenolics, steroids, alkaloids, and carbonyl compounds were absent (Table 1; Figure 3-5). The consistent presence of tannins and reducing sugars across all extracts suggests a potential role in defense mechanisms and nutritive contributions to wildlife fodder, as tannins can influence protein digestibility and palatability at moderate levels. The detection of terpenoids in n-hexane showed pharmacological potential. These findings indicate that although *S. diandrus* may lack diverse secondary metabolites compared to medicinal dicots, it still contains bioactive components that justify its preliminary pharmacological screening. Antimicrobial evaluation showed that the hydroethanolic extract inhibited the growth of *Escherichia coli* at a minimum inhibitory concentration (MIC) of 50 mg/mL, with no growth observed at 100 mg/mL (Table 2; Figure 6). This moderate antibacterial activity suggests that the species could be explored as a potential source of natural antibacterial agents. The combined results reinforce the dual value of *S. diandrus* as a forage species sustaining wildlife populations and as a plant with promising but underexplored phytotherapeutic potential, emphasizing the need for advanced phytochemical profiling, bioassay-guided fractionation, and *in vivo* validation.

Table 1: Qualitative phytochemical analysis of *Sporobolus diandrus* using different extracts

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present

Saponin	Absent	Absent	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Present	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Absent	Present	Present
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of MIC of hydroethanolic extract against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>S. diandrus</i>	NG	NG	G	G	50
Nutrient broth	NG	NG	NG	NG	~
Microbial broth	G	G	G	G	~

(NG = No Growth; G = Growth observed)

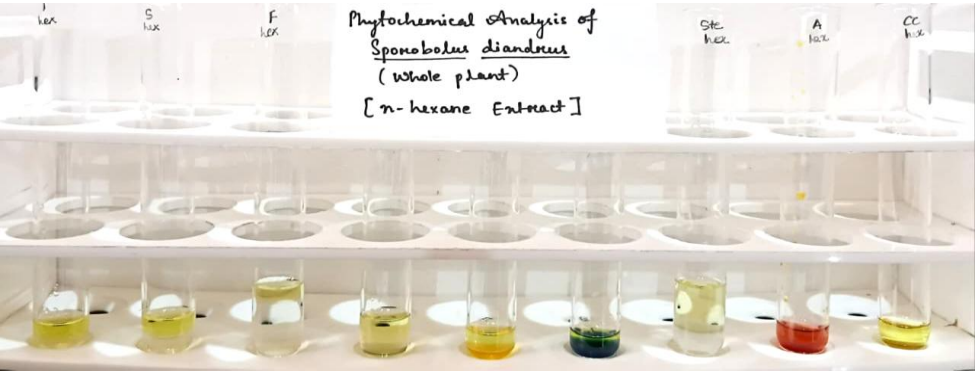


Figure 3: Phytochemical analysis of *S. diandrus* (whole plant) using n-hexane extract



Figure 4: Phytochemical analysis of *S. diandrus* (whole plant) using ethanolic extract



Figure 5: Phytochemical analysis of *S. diandrus* using aqueous extract



Figure 6: Estimation of Minimum Inhibition Concentration (MIC) against *E. coli*

Conclusion

The present study concludes that *Sporobolus diandrus* is a fodder grass with medicinal potential. Future research should focus on detailed phytochemical profiling, bioassay-guided isolation of active constituents, and *in vivo* validation of pharmacological effects, alongside field studies on seasonal forage quality, to integrate *S. diandrus* into both rangeland wildlife management strategies and sustainable natural product discovery programs.

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Chapter 2

Phytochemical screening and antibacterial activity of *Chloris barbata* Sw.: therapeutic potential of an underexplored fodder grass

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Abstract: This study reports the qualitative phytochemical composition and hydroethanolic extract-mediated antibacterial activity of the underexplored fodder grass *Chloris barbata* Sw., highlighting its potential as a natural source of bioactive compounds for therapeutic applications.

Keywords: *Chloris barbata*, fodder grass, phytochemical screening, hydroethanolic extract, antibacterial activity, minimum inhibitory concentration

Introduction

Chloris barbata, a member of the Poaceae family, is a common tropical grass distributed widely across India, thriving in wastelands, roadsides, and open grasslands (Behera et al., 2025). This species plays a critical ecological role as ground cover, preventing soil erosion, and providing habitat and fodder for grazing herbivores (Behera et al., 2025). In many rural landscapes, *C. barbata* is used as a forage grass, though scientific documentation of its phytochemistry and pharmacological potential remains limited. The local grass species possess medicinal uses (Mishra et al., 2022; Sinha et al., 2023), but many have not been reported. Therefore, the study of its phytochemical constituents is crucial to explore its medicinal potential and bioactive compounds, which may contribute to antimicrobial, antioxidant, or other therapeutic properties. The present investigation focuses on qualitative phytochemical profiling of whole-plant extracts using different solvents (n-hexane, ethanol, aqueous) and evaluates their antibacterial potential against *Escherichia coli* by determining the minimum inhibitory concentration (MIC) of its hydroethanolic extract. This approach not only expands the phytochemical database for an underutilized grass species but also aims to highlight its potential value in natural product research, promoting its use in drug discovery, fodder improvement, and ethnomedicinal documentation.



Figure 1: Collected sample of *Chloris barbata*

Methodology

The whole plant of *C. barbata* was collected from the nearby Mahanadi areas of Cuttack district, Odisha, India (Figure 1). The grass species was identified by Dr. Sanjeet Kumar, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

Table 1 revealed the presence of tannins, saponins, reducing sugars, and alkaloids in different extracts of *Chloris barbata* (Figure 2-4). Ethanol and aqueous extracts showed a positive test for tannins and saponins, indicating their ability to solubilize polar phytoconstituents such as polyphenols and glycosides. Terpenoids were exclusively present in the n-hexane extract, reflecting their non-polar nature. Interestingly, alkaloids were detected only in the ethanol extract, suggesting ethanol's superior extraction efficiency for alkaloid compounds compared to aqueous solvents. The absence of flavonoids, steroids, phenolic compounds, and carbonyl compounds across all extracts indicates that these phytochemical groups may be present in negligible concentrations or absent in the whole plant. This phytochemical profile suggests that *C. barbata* is a potential source of condensed tannins, saponins, and terpenoids, which are known to contribute to antimicrobial, anti-inflammatory, and antioxidant activities (Parham et al., 2020). Such findings provide a foundation for further bioassay-guided fractionation studies. The MIC assay results (Table 2, Figure 5) demonstrate that the hydroethanolic extract exhibited growth inhibition (G) of *E. coli* at 25 mg/mL, with a minimum inhibitory concentration determined as 25 mg/mL. No growth (NG) was observed at higher concentrations (100, 50, 25 mg/mL), confirming dose-dependent antibacterial activity. The absence of inhibition in the nutrient broth control validates the specificity of the extract's activity against *E. coli*. This result aligns with the hypothesis that the tannins and saponins in the hydroethanolic extract might disrupt bacterial cell walls or inhibit microbial enzymes, thus exerting a bacteriostatic effect (Huang et al., 2018).

Table 1: Qualitative phytochemical analysis of *Chloris barbata*

Bioactive compounds	n-hexane	Ethanol	Aqueous
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Tannin	Absent	Present	Present
Saponin	Absent	Present	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Present	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Present	Present	Absent
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Present	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of MIC of hydroethanolic extract against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Chloris barbata</i>	NG	NG	NG	G	25
Nutrient broth	NG	NG	NG	NG	~
Microbial broth	G	G	G	G	~

(NG = No Growth; G = Growth observed)

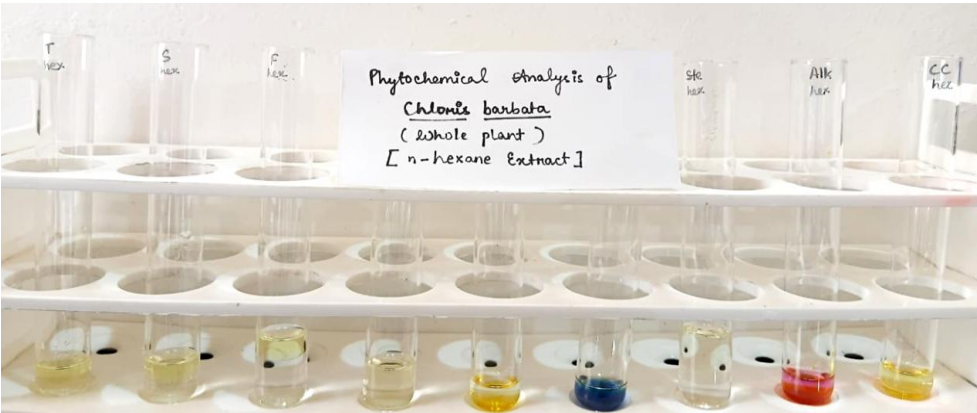


Figure 2: Phytochemical analysis of *Chloris barbata* using n-Hexane extract



Figure 3: Phytochemical analysis of *Chloris barbata* using ethanolic extract



Figure 4: Phytochemical analysis of *Chloris barbata* using aqueous extract

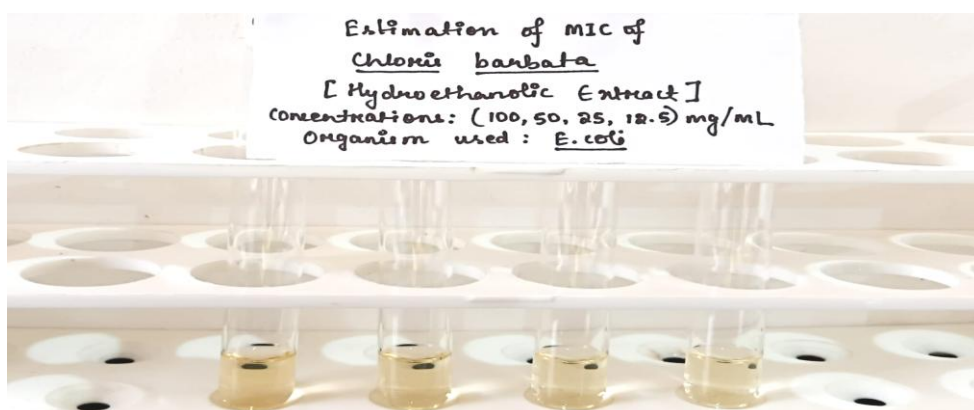


Figure 5: Estimation of Minimum Inhibition Concentration (MIC) against *E. coli* bacteria

Conclusion

The study confirms the presence of pharmacologically significant compounds, particularly tannins, saponins, terpenoids, and alkaloids in *Chloris barbata*. The hydroethanolic extract demonstrated measurable antibacterial activity against *E. coli*, suggesting its potential as a natural antibacterial agent. Future work should include quantitative phytochemical analysis, bioactive fraction isolation, and screening against a broader panel of pathogens to establish its pharmacological relevance and support its possible application in herbal medicine and livestock health management.

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Chapter 3

Phytochemical screening and antimicrobial evaluation of *Paspalum scrobiculatum* L.: an underutilized fodder grass with therapeutic potential

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Abstract: *Paspalum scrobiculatum* L. (Kodo millet) is a nutritionally and ecologically significant fodder grass with emerging medicinal relevance. The present study investigated the qualitative phytochemical analysis and antimicrobial activity of whole-plant extracts to highlight their medicinal potential. Phytochemical screening revealed the presence of tannins, phenolic compounds, and reducing sugars in ethanol and aqueous extracts, while terpenoids were detected in the n-hexane extract. The hydroethanolic extract demonstrated antibacterial activity against *Escherichia coli*, indicating a promising role in controlling enteric pathogens. These findings highlight its potential as a natural source of bioactive compounds for developing plant-based therapeutics and will be helpful in grassland restoration.

Keywords: Fodder plants, pharmaceutical potential, wildlife

Introduction

Paspalum scrobiculatum L., commonly known as kodo millet, is a minor wild millet (Rangaiah et al., 2024). It plays a critical role as a fodder grass, supporting livestock and wild herbivores (Behera et al., 2025). Its resilience to drought, minimal input requirements, and ability to thrive on marginal soils make it an important component of sustainable grassland management. Despite its ecological and economic importance, *P. scrobiculatum* remains underutilized and less explored for its phytochemical and pharmacological potential. Ethnobotanical surveys have documented the use of *P. scrobiculatum* in traditional medicine (Mishra et al., 2022; Sinha et al., 2023). The phytochemical investigation of underutilized grasses like *P. scrobiculatum* is crucial to bridge the gap between traditional knowledge and modern drug discovery. This study aims to qualitatively screen the major phytoconstituents of the whole plant using solvents of varying polarity and to assess its antimicrobial potential against *Escherichia coli*, a

common pathogen associated with intestinal infections. Understanding the phytochemical profile and antimicrobial activity of this fodder grass will not only validate its medicinal applications but also support its utilization as a source of plant-based therapeutics and value-added nutraceuticals for grassland.

Methodology

The whole plant of *P. scrobiculatum* was collected from the nearby Mahanadi areas of Cuttack district, Odisha, India (Figure 1). The grass species was identified by Dr. Sanjeet Kumar, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

Literature survey indicated that it is a fodder grass for livestock and wildlife. Qualitative phytochemical analysis of the whole plant of *Paspalum scrobiculatum* revealed distinct differences among solvent extracts (Table 1; Figure 2-4). Tannins, phenolic compounds, and reducing sugars were consistently present in ethanol and aqueous extracts, suggesting that polar solvents are more efficient in extracting these metabolites. The presence of tannins is noteworthy, as they are associated with antimicrobial, antioxidant, and anti-diarrheal properties, which align with its ethnomedicinal uses. Terpenoids were detected exclusively in the n-hexane extract, indicating that non-polar solvents can recover lipophilic constituents with potential anti-inflammatory and antimicrobial properties. The absence of alkaloids, flavonoids, and steroids suggests that the biological activity of *P. scrobiculatum* is likely mediated by phenolics, tannins, and terpenoids rather than nitrogenous secondary metabolites. The hydroethanolic extract exhibited significant antibacterial potential against *Escherichia coli*, with a minimum inhibitory concentration (MIC) of 12.5 mg/mL (Table 2; Figure 5). No growth was observed at this concentration, confirming its inhibitory effect. The control groups (nutrient broth and microbial broth) validated the reliability of the assay. The antimicrobial effect may be attributed to the synergistic action of phenolic compounds and tannins, which are known to disrupt bacterial cell walls and inhibit enzymatic activity (Takó et al., 2020). This finding substantiates the traditional use of *P. scrobiculatum* in the treatment of gastrointestinal infections and positions it as a candidate for further exploration in plant-based antibacterial drug discovery. Moreover, its dual role as a fodder resource and a medicinally

relevant species underscores its potential contribution to both livestock health and community healthcare practices in rural ecosystems.

Table 1: Qualitative phytochemical analysis of *Paspalum scrobiculatum* (whole plant) using different extracts

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Absent	Absent	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Present	Absent	Absent
Phenolic compounds	Absent	Present	Present
Reducing sugars	Absent	Present	Present
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of MIC of hydroethanolic extract against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Paspalum scrobiculatum</i>	NG	NG	NG	NG	12.5
Nutrient broth	NG	NG	NG	NG	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)



Figure 1: Collected sample of *Paspalum scrobiculatum*



Figure 2: Phytochemical analysis of *Paspalum scrobiculatum* using n-Hexane extract

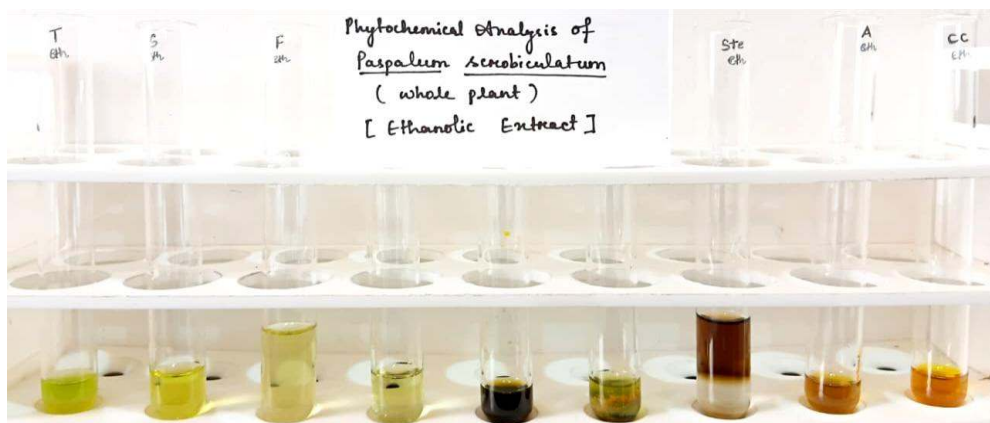


Figure 3: Phytochemical analysis of *Paspalum scrobiculatum* using Ethanolic extract



Figure 4: Phytochemical analysis of *Paspalum scrobiculatum* using Aqueous extract



Figure 5: Estimation of Minimum Inhibition Concentration (MIC) against *E. coli* bacteria

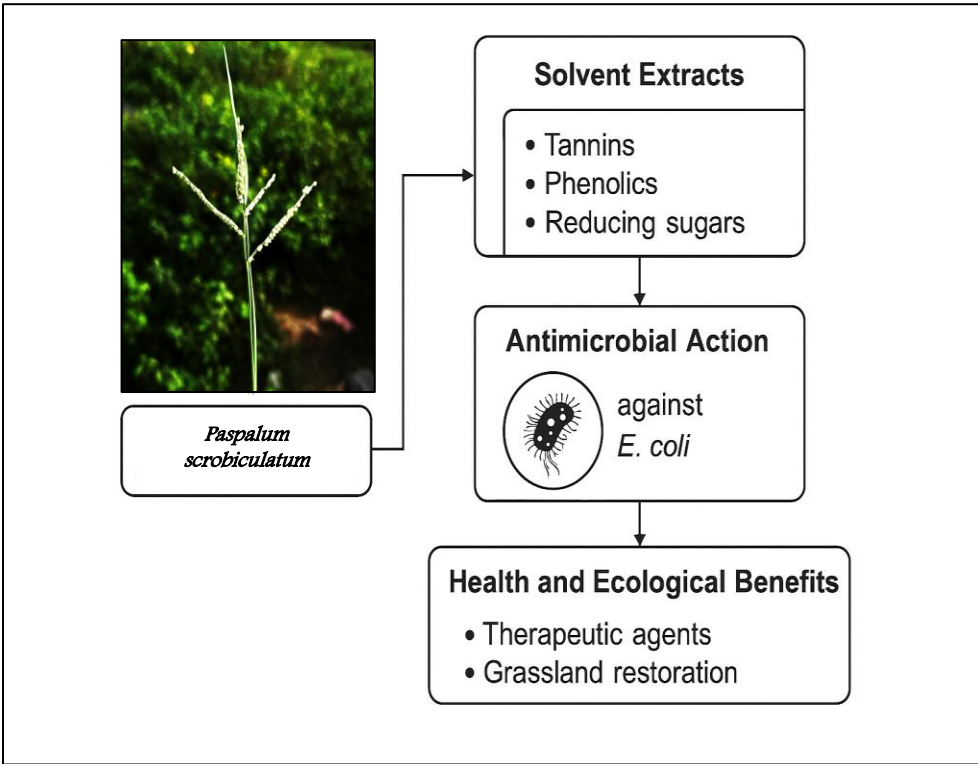


Figure 6: Significance of the present study

Conclusion

The present study highlights *Paspalum scrobiculatum* L. as a multipurpose species with ecological and pharmacological significance (Figure 6). Its phytochemical profile, rich in tannins, phenolics, and reducing sugars, along with its demonstrated antibacterial activity against *E. coli*, supports its traditional medicinal use in treating gastrointestinal disorders. As a resilient fodder grass, *P. scrobiculatum* can play a pivotal role in grassland restoration programs, improving forage availability for wildlife, enhancing soil stability, and contributing to ecosystem resilience. Beyond its ecological contributions, its bioactive compounds hold promise for the development of novel plant-derived therapeutics for human health. Future studies focusing on the isolation, characterization, and *in vivo* validation of these metabolites will further strengthen their dual role in promoting sustainable rangeland management and community healthcare.

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Chapter 4

Phytochemical profiling and antimicrobial evaluation of *Dactyloctenium aegyptium* (L.) Willd.: a nutritive fodder grass with therapeutic potential

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Abstract: The present study investigated the phytochemical analysis and antimicrobial potential of *Dactyloctenium aegyptium*, an underutilized fodder grass. Qualitative phytochemical screening of n-hexane, ethanolic, and aqueous extracts revealed the presence of saponins and reducing sugars, with tannins detected only in the ethanolic extract. The hydroethanolic extract exhibited growth inhibition of *Escherichia coli* at a minimum inhibitory concentration (MIC) of 100 mg/mL, suggesting moderate antibacterial potential. These findings highlight the dual importance of *D. aegyptium* as a sustainable fodder resource and a promising source of bioactive compounds for future therapeutic development.

Keywords: Fodder grass, pharmacology, secondary metabolites

Introduction

Dactyloctenium aegyptium (L.) Willd., commonly known as crowfoot grass or Egyptian grass, is widely distributed in India (Behera et al., 2025). Traditionally used as a pasture grass, it plays a crucial role in sustaining livestock in marginal ecosystems where other fodder sources may be scarce (Shaheen et al., 2020). Its palatability makes it valuable in supporting ruminant health and improving forage diversity. Recent ethnobotanical surveys suggest that many fodder grasses also possess medicinal attributes, including antimicrobial, antioxidant, and anti-inflammatory activities (Mishra et al., 2022; Sinha et al., 2023). The exploration of these dual-purpose species is important, as they contribute both to ecosystem functioning and rural livelihoods. However, *D. aegyptium* remains poorly studied in terms of its phytochemical composition and bioactivity. The present study aims to bridge this gap by performing a qualitative phytochemical screening of whole-plant extracts of *D. aegyptium* and assessing its antibacterial potential against *E. coli*.



Figure 1: Collected whole-plant sample of *Dactyloctenium aegyptium* (L.) Willd.

These findings will contribute to both grassland ecology and pharmacognosy by providing evidence of its bioactive constituents.

Methodology

D. aegyptium was collected from Athgarh Forest Division, Cuttack, Odisha, India (Figure 1). The grass species was identified by the author, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

The qualitative analysis (Table 1; Figure 2-4) showed that saponins were consistently present across all solvent extracts, indicating their abundance and potential contribution to immunomodulatory and antimicrobial activity. Reducing sugars were detected in both n-hexane and ethanolic extracts, suggesting a moderate carbohydrate presence, which could provide additional nutritive value as fodder. Tannins were observed only in the ethanolic extract, which may impart mild astringent properties and potential antimicrobial effects. No steroids, alkaloids, phenolic compounds, flavonoids, or terpenoids were detected, indicating a relatively simple phytochemical profile compared to medicinally dominant grasses. The hydroethanolic extract demonstrated visible inhibition of *E. coli* growth at an MIC of 100 mg/mL (Table 2). Although this indicates a moderate antibacterial effect, the extract's efficacy supports its traditional relevance as a safe fodder option with potential therapeutic benefits. The results are consistent with reports that saponin-rich grasses exert antibacterial activity through membrane disruption mechanisms (Figure 5). Further fractionation and identification of active principles may enhance potency and applicability in livestock health management.

Table 1: Qualitative phytochemical analysis of *Dactyloctenium aegyptium*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Absent
Saponin	Present	Present	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Absent	Absent	Absent

Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Present	Present	Absent
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of Minimum Inhibition Concentration against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Dactyloctenium aegyptium</i>	NG	G	G	G	100
Nutrient broth	NG	NG	NG	NG	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)



Figure 2: Phytochemical analysis of *Dactyloctenium aegyptium* using n-hexane extract

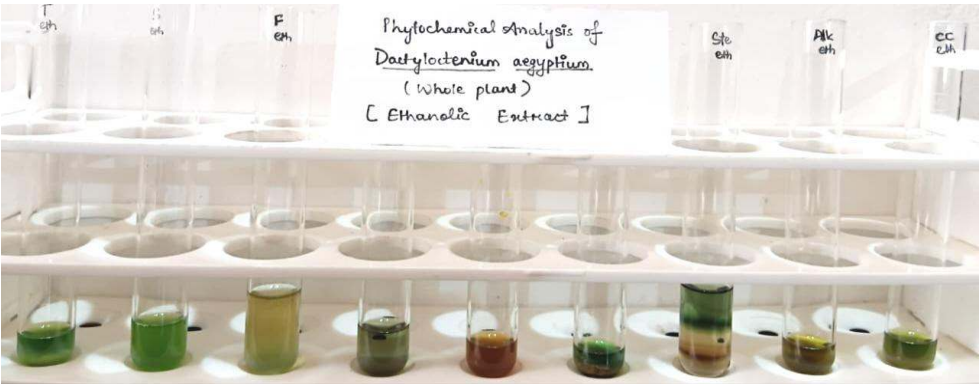


Figure 3: Phytochemical analysis of *Dactyloctenium aegyptium* using ethanolic extract

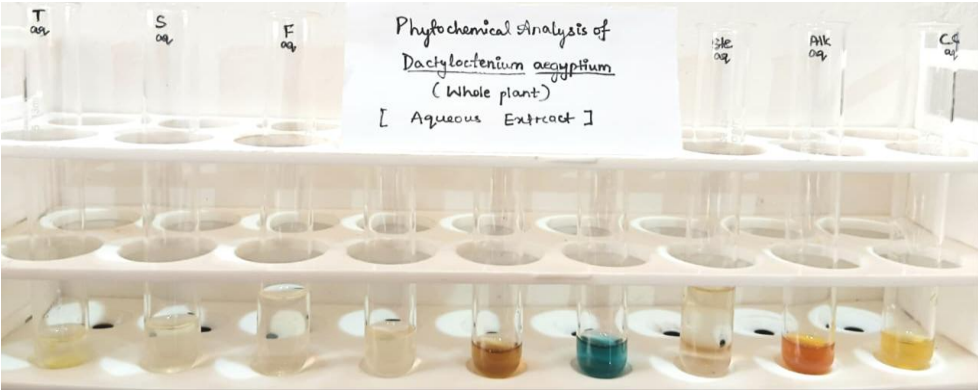


Figure 4: Phytochemical analysis of *Dactyloctenium aegyptium* using aqueous extract

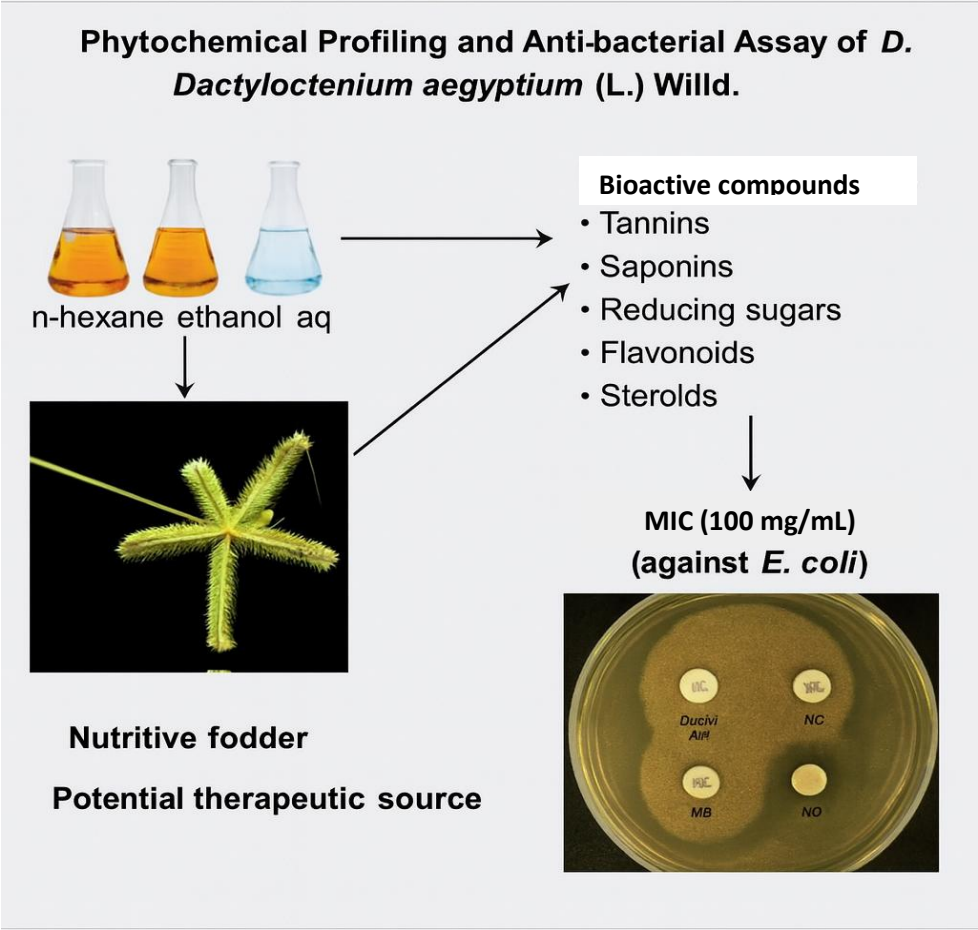


Figure 5: Significance of present study

Conclusion

The present study confirms the presence of bioactive constituents, particularly saponins and tannins, in *Dactyloctenium aegyptium* and demonstrates its moderate antibacterial potential. Beyond its role as a nutritive fodder grass, *D. aegyptium* represents a valuable candidate for future phytopharmacological investigations, especially in developing natural antimicrobial agents for sustainable livestock health and possible human therapeutic applications. It can also be utilized for grassland development in wildlife management initiatives.

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Chapter 5

Phytochemical and antimicrobial evaluation of *Setaria pumila*: a promising fodder grass

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Abstract: The present study investigated the qualitative phytochemical constituents and antimicrobial potential of *Setaria pumila*. Sequential extraction using n-hexane, ethanol, and aqueous solvents revealed the presence of tannins, saponins, flavonoids, reducing sugars, and alkaloids. The hydroethanolic extract exhibited effective antibacterial activity against *Escherichia coli*, with a minimum inhibitory concentration (MIC) of 12.5 mg/mL. These findings highlighted that *S. pumila* as a promising candidate for fodder improvement and the development of plant-based therapeutics.

Keywords: Bioactive compounds, fodder grass, pharmacology, wildlife

Introduction

Setaria pumila (yellow foxtail) is a common grass species distributed in tropical and subtropical regions, known for its adaptability to diverse habitats and its value as a fodder resource (Behera et al., 2025). Despite its ecological prevalence, this species remains underexplored in terms of its phytochemical composition and pharmacological potential. Documenting its bioactive constituents can support its sustainable utilization in livestock nutrition and traditional healthcare systems. Fodder grasses with bioactive metabolites not only enhance livestock productivity but also contribute to overall ecosystem health by supporting herbivore populations (Mishra et al., 2022; Sinha et al., 2023; Mishra et al., 2025). Phytochemicals such as tannins, saponins, and alkaloids are known to exert antimicrobial and anthelmintic effects (Dubale et al., 2023), which may reduce the dependency on synthetic drugs for managing infections in both livestock and humans. This study aims to fill the knowledge gap by profiling the phytochemicals of *S. pumila*, testing its antibacterial activity against *Escherichia coli*, and discussing its potential significance in grassland management and ethnopharmacology.



Figure 1: Collected sample of *Setaria pumila*

Methodology

Setaria pumila was collected from Athgarh Forest Division, Cuttack, Odisha, India (Figure 1). The grass species was identified by the author, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

The qualitative analysis revealed that tannins were present in both ethanol and aqueous extracts, while saponins were consistently present in all three extracts. Alkaloids were detected in ethanol and aqueous extracts, whereas flavonoids were observed only in the aqueous extract. Reducing sugars were present in the ethanol extract. These results suggest that *S. pumila* is a rich source of secondary metabolites, some of which are known to possess antimicrobial and health-promoting properties (Table 1; Figure 2-4). The hydroethanolic extract of *S. pumila* demonstrated a MIC value of 12.5 mg/mL against *E. coli*, indicating notable antibacterial potential (Table 2; Figure 5). The absence of microbial growth (NG) at higher concentrations (100–25 mg/mL) confirms the dose-dependent effect of the extract. These findings align with earlier reports suggesting that grasses with tannins and saponins can exhibit bacteriostatic or bactericidal activity, thus serving as a natural alternative to synthetic antibiotics (Figure 6).

Table 1: Qualitative phytochemical analysis of *Setaria pumila*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Present	Present	Present
Flavonoids	Absent	Absent	Present
Terpenoids	Absent	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Absent	Present	Absent
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Present	Present
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of Minimum Inhibition Concentration of hydroethanolic extract

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Setaria pumila</i> (Whole plant)	NG	NG	NG	NG	12.5
Nutrient broth	NG	NG	NG	NG	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)

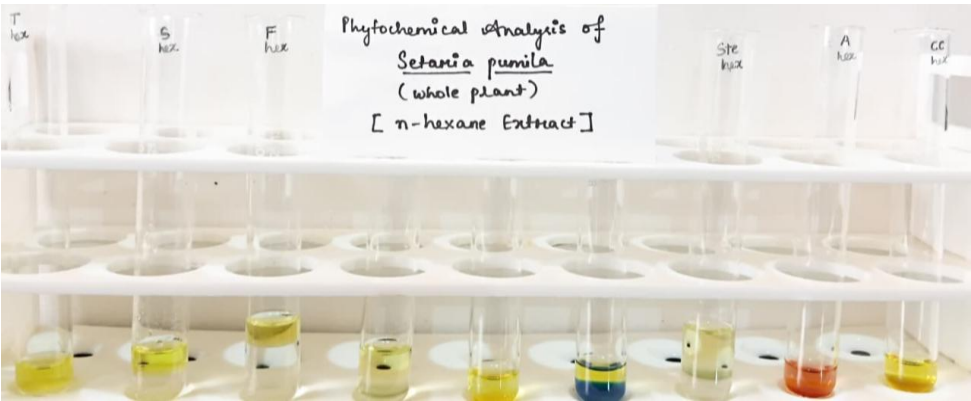


Figure 2: Phytochemical analysis of *Setaria pumila* using n-hexane extract



Figure 3: Phytochemical analysis of *Setaria pumila* using ethanolic extract



Figure 4: Phytochemical analysis of *Setaria pumila* using aqueous extract

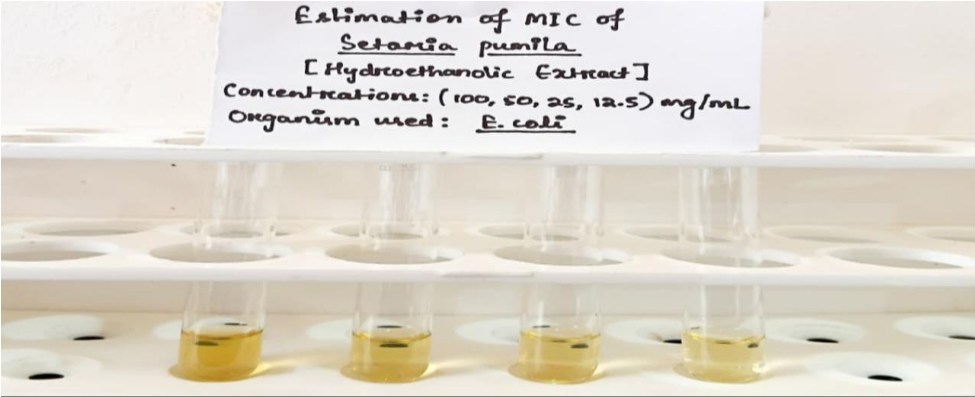


Figure 5: Estimation of Minimum Inhibition Concentration (MIC) against *E. coli*

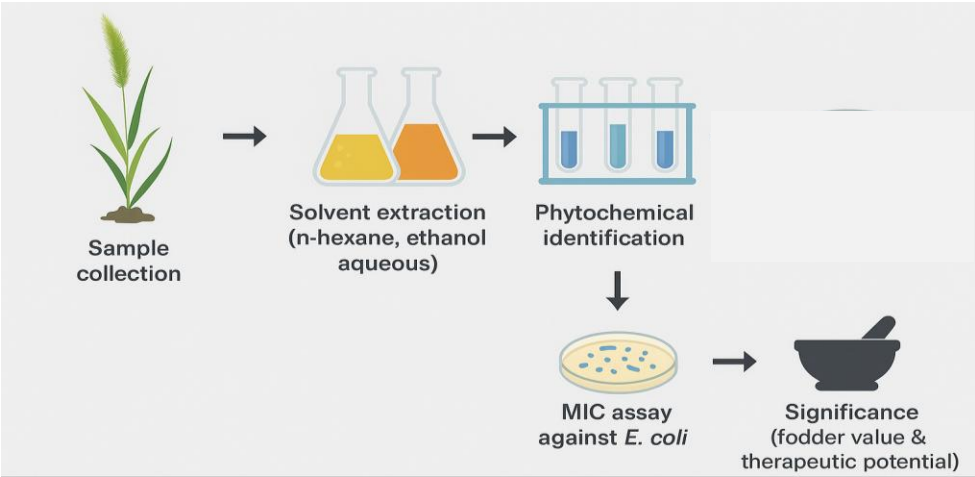


Figure 6: Significance of present study

Conclusion

The study establishes *Setaria pumila* as a promising fodder grass containing bioactive phytochemicals with significant antibacterial properties. Its integration into grassland ecosystems can enhance fodder quality and provide a natural solution for controlling bacterial infections in livestock. Future work should focus on isolating specific active compounds and assessing their pharmacological properties for potential therapeutic applications.

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Chapter 6

Phytochemical profiling and antimicrobial evaluation of *Digitaria ciliaris* (Retz.) Koeler (Poaceae)

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Abstract: *Digitaria ciliaris* (Retz.) Koeler, an important fodder grass species, was investigated for its bioactive compounds and antimicrobial activity. Qualitative phytochemical screening of whole-plant extracts (n-hexane, ethanol, and aqueous) revealed the consistent presence of tannins and saponins across all extracts, with reducing sugars detected exclusively in the ethanolic extract, while flavonoids, terpenoids, phenolics, steroids, alkaloids, and carbonyl compounds were absent. Antimicrobial activity was assessed by determining the minimum inhibitory concentration (MIC) of the hydroethanolic extract against *Escherichia coli*, which exhibited complete growth inhibition at 100 mg/mL. The findings highlight the therapeutic potential of *D. ciliaris*, supporting its dual role as a valuable fodder resource and a source of bioactive compounds with antibacterial properties, suggesting its relevance in livestock health management and future pharmacological studies.

Keywords: *Digitaria ciliaris*, fodder grass, phytochemical screening, antibacterial activity

Introduction

Grasses constitute one of the most ecologically and economically significant plant groups on Earth, forming the backbone of grassland ecosystems and supporting diverse trophic networks (Stevens, 2018). They are essential components of grasslands, pastures, and agricultural landscapes, contributing to soil stability, carbon sequestration, and nutrient cycling (Lisec et al., 2024). Beyond their ecological services, grasses serve as a primary source of fodder for livestock and wild herbivores, thereby sustaining the productivity of animal husbandry and the survival of wild populations (Sethi et al., 2024). Grasslands thus play a vital role in maintaining ecosystem balance and food security for both humans and wildlife. In addition to their ecological significance, grasses possess a wide range of bioactive secondary metabolites that have therapeutic applications (Mishra et al., 2022; Sinha et al., 2023). Phytochemicals, including tannins, saponins, flavonoids, and

phenolics, have been associated with antimicrobial, antioxidant, and anti-inflammatory properties, providing natural alternatives to synthetic drugs (Zahra et al., 2024).



Figure 1: Collected sample of *Digitaria ciliaris*

The ethnomedicinal use of grasses in traditional healing systems underscores their relevance to human health, where plant-based remedies are used to address health problems (Mishra et al., 2022; Sinha et al., 2023). This dual role of grasses as a source of nutrition and as a reservoir of pharmacologically active compounds makes them an important focus for both ecological and biomedical research. *Digitaria ciliaris* (Retz.) Koeler, commonly known as southern crabgrass, is a widely distributed annual grass species found in tropical and subtropical regions. It is an important fodder species, frequently grazed by cattle and wild herbivores due to its palatability and nutritive value (Behera et al., 2025). Despite its abundance, limited information is available on its phytochemical composition and antimicrobial properties. Understanding its bioactive potential is crucial for promoting its sustainable utilization in grassland restoration, livestock health management, and drug discovery initiatives. The present study aims to profile the phytochemicals of *D. ciliaris* using different solvent extracts and evaluate its antimicrobial activity against *Escherichia coli*, thereby contributing to the knowledge base of underutilized fodder grasses with therapeutic relevance.

Methodology

D. ciliaris was collected from Athgarh Forest Division, Cuttack, Odisha, India (Figure 1). The grass species was identified by the author, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

The qualitative phytochemical analysis of *D. ciliaris* revealed the consistent presence of tannins and saponins in all three solvent extracts (n-hexane, ethanol, and aqueous), whereas reducing sugars were detected only in the ethanolic extract (Table 1; Figure 2-4). The absence of flavonoids, terpenoids, phenolic compounds, steroids, alkaloids, and carbonyl compounds indicates that *D. ciliaris* may have a relatively simple secondary metabolite profile compared to other fodder grasses. The presence of tannins is noteworthy, as they are known to improve rumen function in livestock by reducing bloat and enhancing nitrogen utilization. Saponins, on the other hand, are recognized for their antimicrobial, anti-inflammatory, and immune-modulating effects, suggesting that *D. ciliaris* may contribute to livestock health when incorporated into grazing systems. The

hydroethanolic extract of *D. ciliaris* demonstrated antimicrobial potential against *Escherichia coli*, with complete growth inhibition observed at 100 mg/mL (Table 2), whereas partial growth was evident at lower concentrations (50–12.5 mg/mL). This result suggests that the bioactive constituents present in the extract, particularly tannins and saponins, might be responsible for disrupting bacterial cell membranes or inhibiting metabolic pathways. These findings align with previous studies reporting the antibacterial activity of saponin-rich and tannin-containing plant extracts. The observed activity supports the traditional use of grasses in ethnoveterinary medicine and highlights their potential as natural alternatives to synthetic antibiotics, which is particularly relevant in the context of rising antimicrobial resistance and providing fodder grasses (Figure 5). Further bioassay-guided fractionation could help isolate and characterize the specific compounds responsible for the antibacterial effect.

Table 1: Qualitative phytochemical analysis of *Digitaria ciliaris*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Present	Present	Present
Saponin	Present	Present	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Absent	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Absent	Present	Absent
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of Minimum Inhibition Concentration (MIC) against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Digitaria ciliaris</i>	NG	G	G	G	100
Nutrient broth	NG	NG	NG	NG	~
Microbial broth	G	G	G	G	~

(NG = No Growth; G = Growth observed)

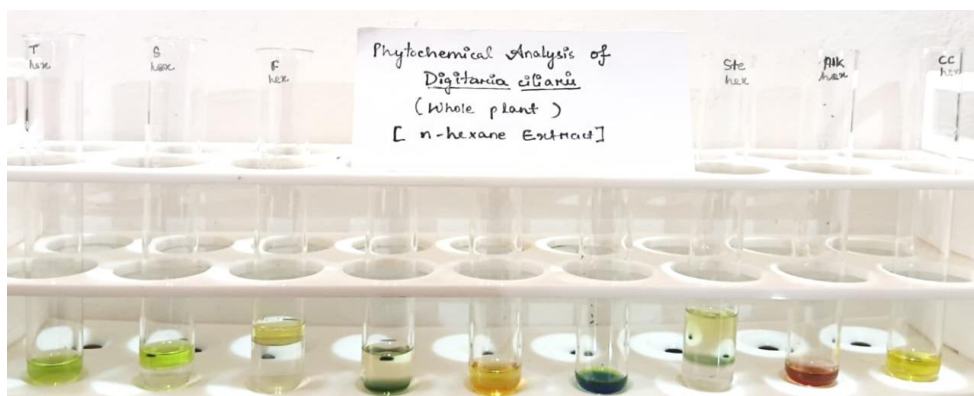


Figure 2: Phytochemical analysis using n-hexane extract



Figure 3: Phytochemical analysis using ethanolic extract

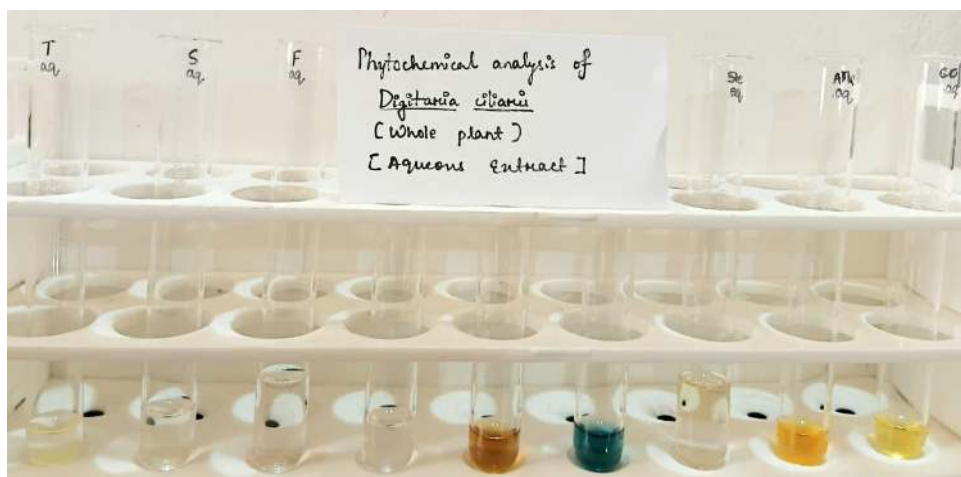


Figure 4: Phytochemical analysis using aqueous extract

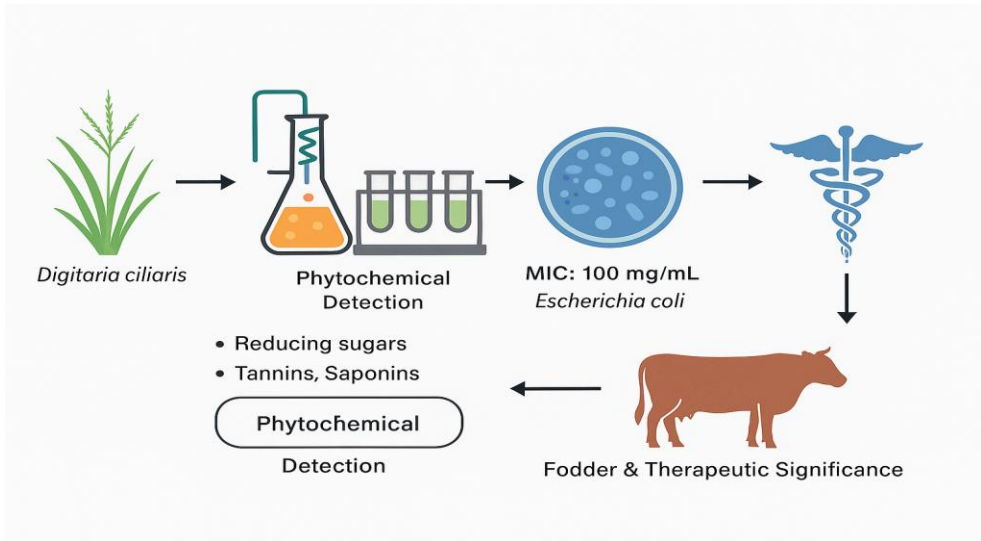


Figure 5: Significance of the present study

Future aspects

Further research on *Digitaria ciliaris* should emphasize bioassay-guided fractionation and purification of its active phytoconstituents to precisely identify the compounds responsible for antimicrobial activity (Figure 6). Advanced analytical techniques such as HPLC, LC-MS, and NMR spectroscopy can be employed to characterize these metabolites.

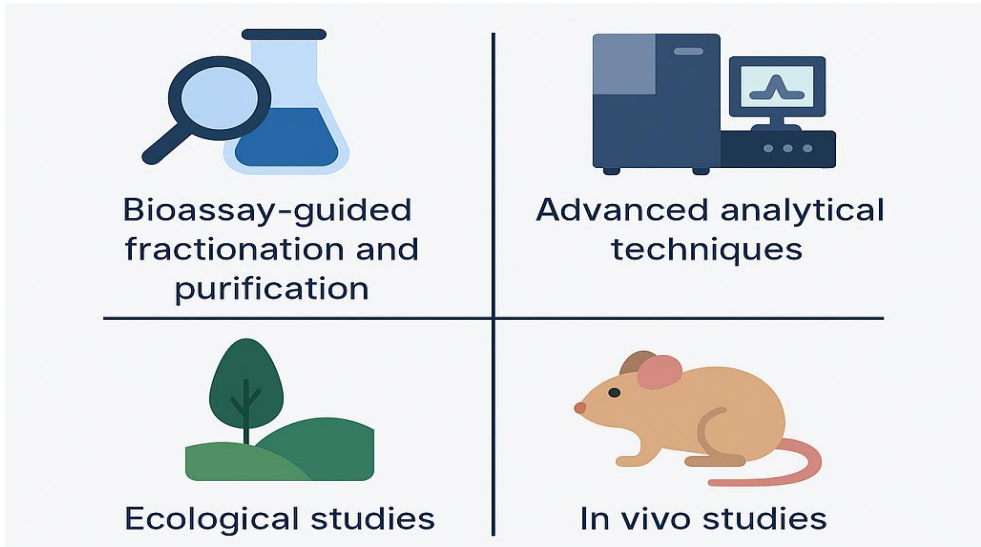


Figure 6: Future aspects of the present study

In vivo studies on livestock models will be essential to validate its therapeutic efficacy, optimal dosage, and safety for long-term use. Ecological studies could explore its role in grassland restoration, soil stabilization, and biodiversity enhancement, particularly in overgrazed or degraded rangelands. Additionally, integrating *D. ciliaris* into ethnoveterinary formulations and sustainable livestock management strategies may reduce dependence on synthetic antibiotics, thereby addressing the growing challenge of antimicrobial resistance. Collaborative research linking plant biotechnology, pharmacology, and range ecology could unlock its full potential as a dual-purpose species for fodder security and natural drug development.

Conclusion

The present investigation highlights *Digitaria ciliaris* as a nutritionally important fodder grass containing bioactive constituents such as tannins and saponins, which contribute to its antimicrobial activity against *Escherichia coli*. These findings not only validate its role in supporting livestock health but also underscore its potential as a natural source of antibacterial agents. Future research should focus on bioassay-guided isolation, structural characterization of active compounds, and *in vivo* studies to evaluate its applicability in grassland restoration programs and as a sustainable alternative in veterinary therapeutics.

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Chapter 7

Phytochemical characterization and antibacterial evaluation of *Dinebra chinensis* (L.) P. M. Peterson & N. Snow

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Abstract: The present study investigated the secondary metabolites and antibacterial activity of *Dinebra chinensis*, an underutilized fodder grass. Qualitative phytochemical analysis of n-hexane, ethanolic, and aqueous extracts revealed the consistent presence of tannins and reducing sugars, whereas saponins and flavonoids were detected exclusively in the aqueous extract, and alkaloids in the ethanolic extract. Minimum Inhibitory Concentration (MIC) assays against *Escherichia coli* demonstrated growth inhibition of the hydroethanolic extract. These findings highlight *D. chinensis* as a promising candidate for ethnoveterinary applications and natural antimicrobial development, supporting its integration into sustainable livestock health management and grassland biodiversity conservation strategies.

Keywords: Antimicrobial activity, fodder grass, phytochemical screening,

Introduction

Grasses are among the most ecologically and economically important plant groups, forming the foundation of grassland ecosystems and serving as a critical food source for livestock and wildlife (Sethi et al., 2024; Sharma et al., 2025). They provide essential ecosystem services such as soil stabilization, carbon sequestration, and nutrient cycling, thereby supporting agricultural productivity and biodiversity conservation (Liu et al., 2022). Beyond their ecological role, many grasses are rich in bioactive compounds that contribute to ethnomedicinal practices and promote animal health by acting as natural growth promoters and disease modulators (Mishra et al., 2022; Sinha et al., 2023). The documentation and scientific evaluation of lesser-known grasses are therefore crucial for both sustainable livestock management and the discovery of plant-based therapeutic alternatives. *Dinebra chinensis*, belonging to the family Poaceae, is a relatively underexplored grass species (Behera et al., 2025). It thrives in open fields, wastelands, and

disturbed habitats, often forming a component of natural grazing lands (Behera et al., 2025).



Figure 1: Collected sample of *Dinebra chinensis*

Despite its abundance, scientific literature on its nutritional and pharmacological potential remains limited. Preliminary observations suggest that *D. chinensis* may serve as a palatable fodder grass while also containing secondary metabolites of pharmacological significance, thereby offering dual benefits in terms of fodder security and natural therapeutics. Phytochemical screening of grass species provides valuable insights into their nutritional value and bioactive compound profile, which can help in developing ethnoveterinary formulations and alternative antimicrobial agents (Jena et al., 2025). In an era where antimicrobial resistance is a global challenge, identifying plant-derived compounds with antibacterial properties is of paramount importance (Chandrashekar et al., 2025). The present study aims to qualitatively analyse the phytochemical constituents of *D. chinensis* using different solvent extracts and evaluate its antibacterial potential through Minimum Inhibitory Concentration (MIC) assay against *Escherichia coli*. The outcomes are expected to enhance our understanding of the medicinal prospects of this species.

Methodology

D. chinensis was collected from Cuttack district, Odisha, India (Figure 1). The grass species was identified by the author, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

Qualitative phytochemical screening of *Dinebra chinensis* revealed a consistent presence of reducing sugars across all three solvent extracts (n-hexane, ethanol, and aqueous), suggesting their abundance and solubility across polar and non-polar phases (Table 1). Tannins are known for their protein-binding capacity and antimicrobial potential, which may contribute to the plant's defense mechanism and therapeutic value (Cosme et al., 2025). Saponins and flavonoids were detected exclusively in the aqueous extract, indicating that water is a better solvent for extracting these highly polar compounds. The ethanolic extract uniquely exhibited alkaloids, a class of bioactive metabolites with well-documented pharmacological properties (Adamski et al., 2020). The absence of terpenoids, phenolic compounds, steroids, and carbonyl compounds indicates that *D. chinensis* has a relatively simple secondary metabolite profile, but the presence of tannins,

alkaloids, and flavonoids enhances its medicinal relevance (Table 1; Figure 2-4). Minimum Inhibitory Concentration (MIC) assay against *Escherichia coli* demonstrated no growth (NG) at 100 mg/mL and 50 mg/mL, confirming the bacteriostatic or bactericidal effect of the hydroethanolic extract at these concentrations (Table 2). Growth was observed at 25 mg/mL and below, establishing the MIC value as 50 mg/mL. Therefore, *D. chinensis* not only provides forage biomass but also contributes to animal health by offering natural antimicrobial protection. Its demonstrated antibacterial activity against *E. coli* suggests potential applications in ethnoveterinary formulations for managing gastrointestinal infections in livestock, thereby reducing dependency on synthetic antibiotics, and mitigating the problem of antimicrobial resistance (AMR). Further bioassay-guided fractionation and structural characterization of active compounds could help unlock its full therapeutic potential.

Table 1: Qualitative phytochemical analysis of *Dinebra chinensis*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Absent	Absent	Present
Flavonoids	Absent	Absent	Present
Terpenoids	Absent	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Present	Present	Present
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Present	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of Minimum Inhibitory Concentration against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Dinebra chinensis</i>	NG	NG	G	G	50
Nutrient broth	NG	NG	NG	NG	~
Microbial broth	G	G	G	G	~

(NG = No Growth; G = Growth observed)

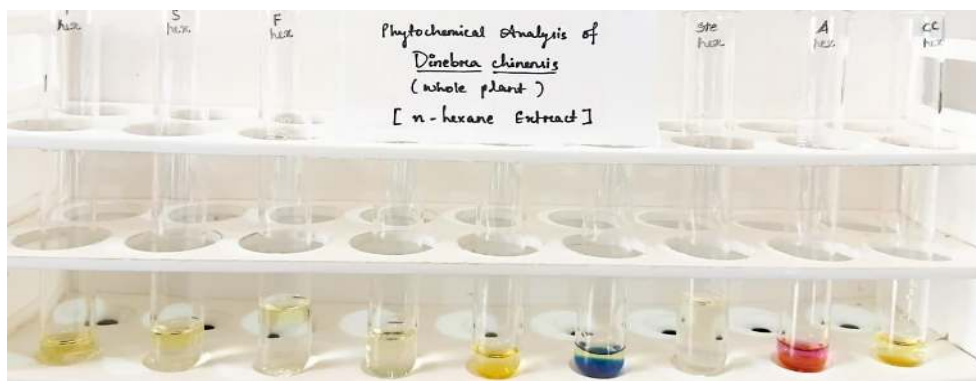


Figure 2: Phytochemical analysis of *Dinebra chinensis* using n-Hexane extract

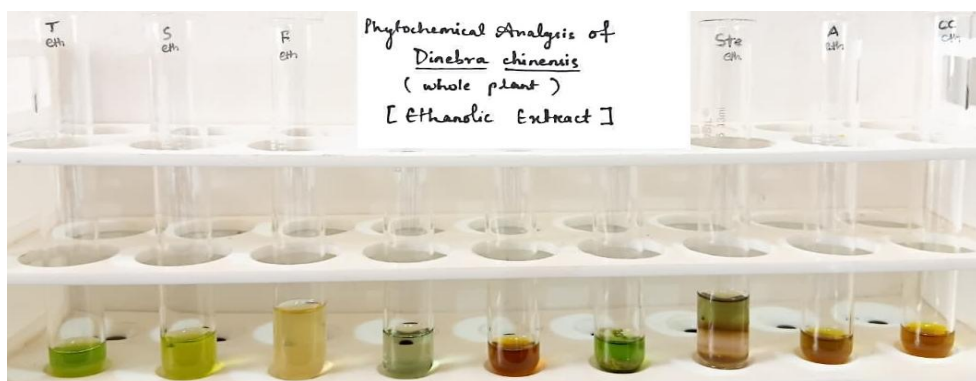


Figure 3: Phytochemical analysis of *Dinebra chinensis* Ethanolic extract

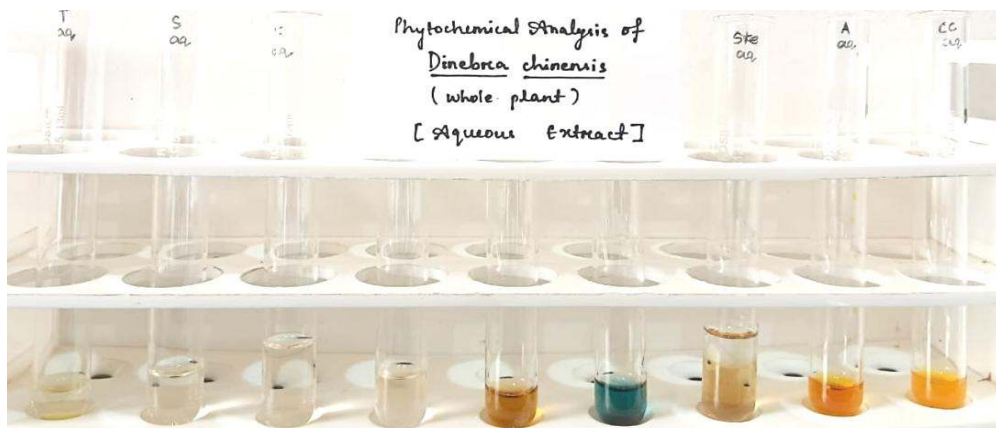


Figure 4: Phytochemical analysis of *Dinebra chinensis* using Aqueous extract

Conclusion

The present investigation establishes *Dinebra chinensis* as a promising underutilized fodder grass with both nutritional and therapeutic relevance. The presence of tannins,

reducing sugars, saponins, flavonoids, and alkaloids across different solvent extracts highlights its rich phytochemical profile. The hydroethanolic extract exhibited moderate antibacterial activity with a minimum inhibitory concentration (MIC) of 50 mg/mL against *Escherichia coli*, demonstrating its potential as a natural antimicrobial source. These findings support its ethnoveterinary applications for controlling gastrointestinal infections in livestock and reducing reliance on synthetic antibiotics. Future research should focus on bioassay-guided fractionation, isolation, and structural elucidation of active compounds, as well as *in-vivo* validation of its therapeutic efficacy and safety in animal models to integrate this species into sustainable livestock health management strategies.

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Sharma S, Gupta PSP, Mahendru N, Sinha MK, Mishra S and Kumar S. (2025). Economic grasses of India and their ecological significance. *Indian Forester*. 151(9): 913-916.

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Chapter 8

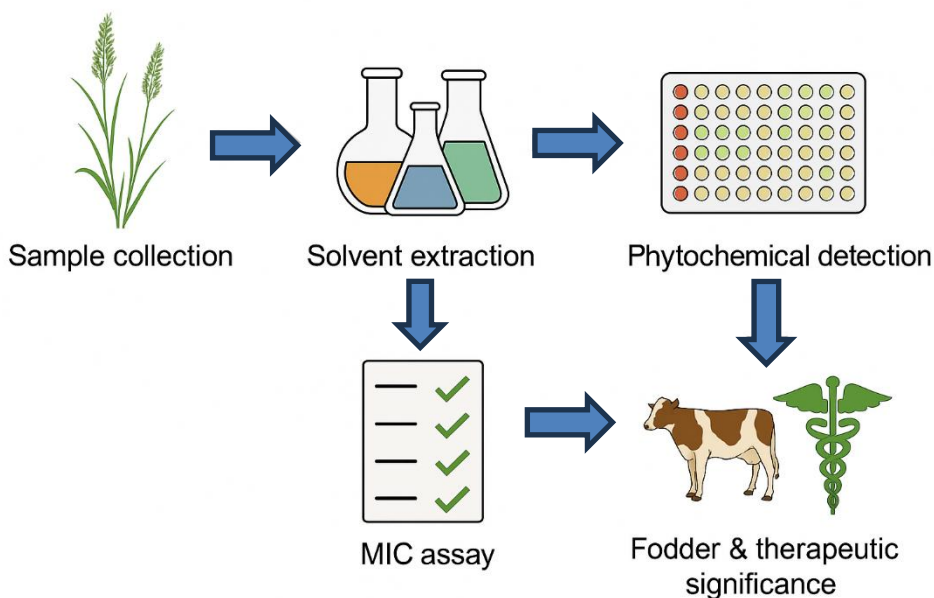
Phytochemical profiling and antimicrobial evaluation of *Echinochloa colona* (Poaceae)

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Abstract: The present study investigated the qualitative phytochemical constituents and antimicrobial efficacy of the whole plant of *Echinochloa colona* (L.) Link. Sequential extraction using n-hexane, ethanol, and aqueous solvents revealed the presence of tannins, saponins, and reducing sugars, with variations across solvents. The hydroethanolic extract demonstrated moderate inhibitory activity against *Escherichia coli*, with a minimum inhibitory concentration (MIC) of 100 mg/mL. These findings highlight the dual significance of *E. colona* as a potential fodder resource and a candidate for phytotherapeutic applications.



Graphical abstract

Keywords: Bioactive compounds, grass, fodder, medicinal

Introduction

Grasses play a vital role in sustaining ecosystem health, providing forage for wildlife, and supporting the livelihoods of local communities (Sharma et al., 2025). Among the wild grass species, *Echinochloa colona*, commonly known as jungle rice (Figure 1), is a widely distributed species that thrives in diverse habitats, including wetlands, paddy fields, and grasslands (Behera et al., 2025). Despite being regarded as a weed in some cropping systems, it offers significant fodder value, particularly during lean periods. Phytochemical exploration of underutilized grasses is crucial, as they may contain bioactive compounds that contribute to animal health and resilience (Gebashe et al., 2020). Tannins, saponins, and phenolic compounds present in grasses often enhance rumen function, reduce parasitic load, and improve overall animal productivity (Besharati et al., 2022). However, scientific documentation of *E. colona*'s phytochemical composition and its antimicrobial potential remains limited. Given the rising concern over antimicrobial resistance (Sharma et al., 2024) and the quest for plant-based alternatives, it is pertinent to evaluate the therapeutic potential of grass species traditionally consumed by herbivores. Therefore, the present study aimed to profile the phytoconstituents of *E. colona* and assess its inhibitory activity against *E. coli*, a common pathogenic bacterium affecting both humans and animals.



Figure 1: Flowers and fruits of *Echinochloa colona*

Methodology

Echinochloa colona was collected from the Mahanadi River areas, Cuttack, Odisha, India. The grass species was identified by the author, followed by published literature (Behera et al., 2025). The whole plant was thoroughly washed under running tap water to remove dust. Further, they were cut into small pieces and air-dried. Extraction was made using Soxhlet extraction (Jena et al., 2025). Phytochemical screening was carried out using a standard method (Jena et al., 2025). Antibacterial activity was tested against *Escherichia coli* (Jena et al., 2025).

Results and discussion

Literature indicated that many grass species have medicinal uses (Mishra et al., 2022; Sinha et al., 2023). Therefore, phytochemical analysis was carried out, and qualitative screening revealed the presence of tannins (ethanol, aqueous), saponins (n-hexane, aqueous), and reducing sugars (n-hexane, ethanol), indicating a moderate abundance of secondary metabolites. Flavonoids, alkaloids, steroids, terpenoids, and phenolics were absent across all extracts (Table 1). The presence of tannins suggests potential antimicrobial and antioxidant activity (Dos Santos et al., 2024), whereas saponins are known for their immunomodulatory roles (Shen et al., 2023). The hydroethanolic extract showed growth inhibition of *E. coli* at concentrations ≥ 50 mg/mL, with a MIC value of 100 mg/mL. Although the activity was moderate, it demonstrates the ability of *E. colona* extracts to suppress bacterial growth, suggesting possible applications in ethnoveterinary medicine. The activity may be attributed to the synergistic action of tannins and saponins, which disrupt bacterial cell membranes (Lobiuc et al., 2023). This finding supports the ethnobotanical relevance of grasses in maintaining livestock health and controlling gastrointestinal infections.

Table 1: Qualitative phytochemical analysis of *Echinochloa colona*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Present	Absent	Present
Flavonoids	Absent	Absent	Absent
Terpenoids	Absent	Absent	Absent
Phenolic compounds	Absent	Absent	Absent
Reducing sugars	Present	Present	Absent
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Absent

Carbonyl compounds	Absent	Absent	Absent
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Table 2: Estimation of Minimum Inhibition Concentration against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Echinochloa colona</i>	NG	G	G	G	100
Nutrient broth	NG	NG	NG	NG	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)

Conclusion

Echinochloa colona exhibits a moderate spectrum of bioactive phytochemicals and demonstrates inhibitory activity against *E. coli*. Its dual value as a fodder grass and a potential source of natural antimicrobials highlights its importance in sustainable livestock health management and restoration of grasslands for wildlife. Further studies involving bioassay-guided fractionation to validate its therapeutic potential and optimize its use in integrated grassland management.

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Chapter 9

Phytochemical analysis and antimicrobial activity of *Urochloa distachyos* (L.) T.Q.Nguyen

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Abstract: This study presented the availability of bioactive compounds and antimicrobial activity of *Urochloa distachyos* (whole plant). Successive solvent extraction (n-hexane, ethanol, aqueous) revealed a significant presence of tannins, saponins, phenolic compounds, reducing sugars, and alkaloids, particularly in the ethanolic and aqueous extracts. Minimum inhibitory concentration (MIC) assays demonstrated effective antibacterial potential against *Escherichia coli* of hydroethanolic extract, highlighting the species' therapeutic promise and ecological importance as a fodder grass.

Keywords: Secondary metabolites, conservation, grass

Introduction

Grasses form the structural backbone of grassland ecosystems, playing a crucial role in soil stabilization, nutrient cycling, and serving as a primary food source for both wild and domesticated herbivores (He et al., 2023; Behera et al., 2025). They have medicinal (Mishra et al., 2022; Sinha et al., 2023), ecological (Dey et al., 2024), and economic values (Sharma et al., 2025). Among the wild grass diversity, *Urochloa* species are widely distributed in India and act as an important fodder resource and contribute to ecosystem resilience (Behera et al., 2025). *Urochloa distachyos* (L.) T.Q.Nguyen (Figure 1) is an underexplored grass species of the genus *Urochloa*. Documenting its phytochemical profile is essential, as bioactive constituents in grasses often provide antimicrobial, antioxidant, and therapeutic benefits, supporting their inclusion in sustainable livestock and grassland management strategies. This chapter focuses on qualitative phytochemical screening of *U. distachyos* using different solvent extracts, followed by MIC (Minimum Inhibitory Concentration) evaluation against *E. coli*. The outcomes aim to bridge existing gaps in knowledge on its bioactive potential, thereby highlighting its dual role as a fodder species and a natural source of antimicrobial agents.



Figure 1: Collected sample of *Urochloa distachyos*

Materials and methods

Sample collection: Whole plants of *Urochloa distachyos* were collected from selected grassland patches of Cuttack, Odisha, India (Figure 1) and authenticated using a regional book on grass (Behera et al., 2025).

Phytochemical screening: Successive extraction was carried out using n-hexane, ethanol, and distilled water. Standard protocols were followed for the detection of tannins, saponins, flavonoids, terpenoids, phenolics, reducing sugars, steroids, alkaloids, and carbonyl compounds (Jena et al., 2025).

Antimicrobial assay: Hydroethanolic extract was subjected to MIC assay against *E. coli* using serial dilution techniques (Jena et al., 2025). Growth inhibition was recorded visually and compared with controls (nutrient broth and microbial broth).

Results and discussion

The results of qualitative phytochemical analysis (Table 1) indicate a rich presence of bioactive compounds. Phenolic compounds were exclusive to the ethanol extract, whereas alkaloids were detected only in the aqueous extract. The absence of flavonoids in nonpolar and ethanolic extracts but their presence in aqueous extract indicates the water-soluble nature of these metabolites. Details are listed in Table 1. MIC assay results (Table 2) revealed complete inhibition of *E. coli* growth at a 12.5 mg/mL concentration of hydroethanolic extract, whereas higher concentrations showed no visible growth (NG).

Table 1: Qualitative phytochemical analysis of *Urochloa distachyos*

Bioactive compounds	n-Hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Absent	Present	Present
Flavonoids	Absent	Absent	Present
Terpenoids	Present	Absent	Absent
Phenolic compounds	Absent	Present	Absent
Reducing sugars	Absent	Present	Present
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Absent	Present
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of MIC of hydroethanolic extract against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Urochloa distachyos</i>	NG	NG	NG	NG	12.5
Nutrient broth	NG	NG	NG	NG	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)

This suggests strong antibacterial efficacy at relatively low doses. These findings align with earlier reports on the bioactivity of Poaceae members, suggesting that *U. distachyos* could be a potential candidate for developing plant-based antibacterial agents.

Conclusion

The present investigation establishes *Urochloa distachyos* as a noteworthy fodder species exhibiting substantial antibacterial potential. Its diverse phytochemical repertoire and pronounced inhibitory effect against *E. coli* substantiate its promise as a natural source of therapeutic agents. Future research should prioritize bioassay-guided fractionation, purification, and structural elucidation of active constituents.

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Chapter 10

Phytochemical profiling and antimicrobial evaluation of *Eriochloa procera* (Poaceae)

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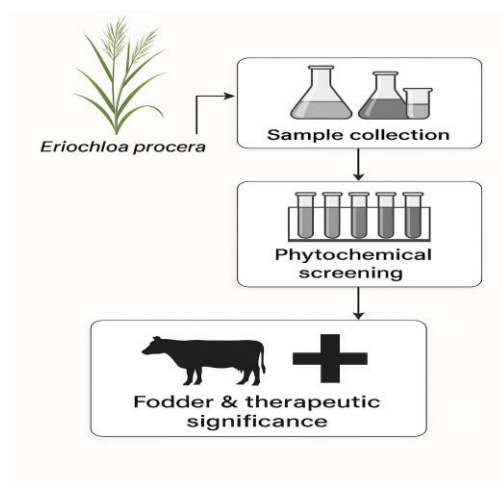
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Abstract: *Eriochloa procera*, a lesser-known wild fodder grass, was subjected to qualitative phytochemical screening and minimum inhibitory concentration (MIC) analysis against *Escherichia coli*. Both ethanolic and aqueous extracts were found to contain tannins, saponins, phenolic compounds, reducing sugars, and alkaloids, while flavonoids were detected only in aqueous extracts. MIC assay demonstrated significant inhibition at a concentration of 12.5 mg/mL, with a MIC value of 25 mg/mL. These findings suggest that *E. procera* has potential as a natural antimicrobial agent for sustainable ethnoveterinary applications.

Keywords: Phytochemicals, MIC assay, fodder grass, antimicrobial potential, ethnoveterinary medicine



Graphical abstract

Introduction

Grasses play a vital role in maintaining the health of grassland ecosystems, supporting livestock productivity, and contributing to rural livelihoods (Jiang et al., 2022; Rousset et al., 2024; Tuo et al., 2024; Behera et al., 2025). They are also a major food source for wildlife and an important component of ecological balance and wildlife management (Messmer et al., 2024). Despite their potential for nutritional and therapeutic benefits to both herbivores and human communities, wild grasses are often underutilized. One such species is *Eriochloa procera* (Retz.) C. E. Hubb., a perennial grass species commonly found in moist areas and along paddy field bunds (Behera et al., 2025). This grass is an important component of natural pastures and serves as a food source for grazing herbivores; however, its phytochemical and pharmacological properties remain poorly documented. With the rising concern over antimicrobial resistance and the need for natural alternatives, investigating the bioactive potential of wild fodder grasses has become a priority. This study aims to profile the phytochemical constituents of *E. procera* and assess its antibacterial efficacy against *E. coli*, thereby highlighting its significance for ethnoveterinary applications and grassland management.

Materials and methods

Sample collection: *Eriochloa procera* was collected from selected grassland patches in Cuttack, Odisha, India (Figure 1) and was authenticated using a regional reference book on grasses (Behera et al., 2025).

Phytochemical screening: Successive extractions were performed using n-hexane, 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).

Antimicrobial assay: The hydroethanolic extract was tested for minimum inhibitory concentration (MIC) assay against *E. coli* using serial dilution techniques (Jena et al., 2025). Growth inhibition was assessed visually and compared with control samples, which included both nutrient broth and microbial broth.

Results and discussion

Qualitative screening of bioactive compounds showed a diverse range of secondary metabolites in both ethanolic and aqueous extracts (Table 1). Tannins, saponins, phenolic compounds, and reducing sugars were consistently identified, while alkaloids were exclusively found in the ethanolic extract.



Figure 1: Collected sample of *Eriochloa procera*

The presence of flavonoids was restricted to the aqueous extract, indicating they may be key contributors to its bioactivity. These phytoconstituents are known for their antimicrobial, antioxidant, and wound-healing properties (Farahmandfar et al., 2019), which support the ethnomedicinal use of this grass by local communities. MIC results demonstrated growth inhibition of *E. coli* at 25 mg/mL (Table 2). The growth in microbial broth served as a positive control, validating the assay. This result confirmed that hydroethanolic extracts of *E. procera* possess bacteriostatic activity against gram-negative pathogens. These findings are comparable to other reported fodder grasses with antimicrobial properties, highlighting *E. procera* as a potential candidate for the development of a natural antimicrobial formulation.

Table 1: Qualitative phytochemical analysis of *Eriochloa procera*

Bioactive compounds	n-hexane	Ethanol	Aqueous
Tannin	Absent	Present	Present
Saponin	Absent	Present	Present
Flavonoids	Absent	Absent	Present
Terpenoids	Absent	Absent	Absent
Phenolic compounds	Absent	Present	Present
Reducing sugars	Absent	Present	Present
Steroids	Absent	Absent	Absent
Alkaloids	Absent	Present	Absent
Carbonyl compounds	Absent	Absent	Absent

Table 2: Estimation of MIC *Eriochloa procera* against *E. coli*

Extract	Concentration (mg/mL)				MIC (mg/mL)
	100	50	25	12.5	
<i>Eriochloa procera</i>	NG	NG	NG	G	25
Nutrient broth	NG	NG	NG	G	-
Microbial broth	G	G	G	G	-

(NG = No Growth; G = Growth observed)

Conclusion

The study presents a detailed and comprehensive report on the phytochemical and antimicrobial properties of *Eriochloa procera*, a grass species with emerging therapeutic potential. It highlights that the plant is notably rich in secondary metabolites such as tannins, saponins, phenolics, and flavonoids, as well as its ability to inhibit the growth of *E. coli*, a common pathogenic bacterium associated with gastrointestinal infections in both humans and animals. These bioactive compounds are well known for their pharmacological relevance. This underscores its potential for use in ethnoveterinary medicines and therapeutic applications, especially in rural and resource-limited settings. The application of this plant species as a plant-based therapeutic for livestock disease management will help in reducing their dependency on synthetic antibiotics. Furthermore, this study highlights the importance of future research that should emphasize bioassay-guided fractionation, isolation of bioactive compounds, and in vivo validation to support its integration into sustainable livestock healthcare and grassland conservation strategies. Moreover, promoting the conservation and cultivation of this grass species would help in maintaining ecological sustainability and grassland biodiversity. This will help in achieving broader goals of environmental conservation and sustainable agriculture. This study provides a strong foundation for further studies on *E. procera* for the development of veterinary medicine and ecosystem management.

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Chapter 11

Unexplored sedge of India: fodder, antioxidant and medicinal potential of *Cyperus iria* L. (Cyperaceae)

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Abstract: *Cyperus iria*, a widely distributed yet underexplored sedge of India. In the contemporary situation, screening of fodder plants and medicinal agents is an important task. Therefore, qualitative phytochemical screening revealed the presence of key metabolites, with tannins and reducing sugars detected in aqueous extracts and carbohydrates & starch as primary metabolites, suggesting nutritional and therapeutic value. Thin-layer chromatography (TLC)-based DPPH assay demonstrated notable antioxidant activity, particularly in aqueous fractions with distinct R_f values, indicating the presence of free radical-scavenging compounds. These findings highlight *C. iria* as a valuable natural resource with scope for further bioassay-guided studies to isolate and characterize its active phytoconstituents for sustainable ethnomedicinal and nutraceutical applications.

Keywords: Sedge, phytochemical screening, primary metabolites, secondary metabolites, TLC-DPPH assay, antioxidant activity, fodder potential, medicinal plant, nutraceuticals

Introduction

Cyperus iria L. (Cyperaceae), commonly known as rice flat sedge, is a fast-growing annual species widely distributed in India (Figure 1-2). Traditionally regarded as a weed of paddy fields, this sedge plays an important ecological role in soil stabilization and provides a readily available source of fodder for livestock in rural landscapes (Jiang et al., 2018). Despite its abundance and adaptability, *C. iria* remains largely underexplored for its biochemical and pharmacological attributes. Recent studies on members of the genus *Cyperus* have revealed the presence of diverse primary and secondary metabolites with antioxidant, antimicrobial, and medicinal properties (Motmainna et al., 2021). However, scientific information on the phytochemistry and bioactivity of *C. iria* is scarce, creating opportunities to assess its nutraceutical and therapeutic potential. The plant's adaptability to diverse habitats and its rapid biomass production further enhance its significance as a

sustainable resource for fodder and medicinal applications. In this context, the present study aims to investigate the primary and secondary metabolites of *C. iria* through qualitative phytochemical screening and thin-layer chromatography (TLC)-based DPPH antioxidant analysis. By documenting its biochemical profile and antioxidant activity, the present work seeks to highlight the species' potential for use in animal nutrition, herbal medicine, and future bioactive compounds discovery.

Materials and methods

Sample collection: *Cyperus iria* was collected from Cuttack, Odisha, India (Figure 1). A plant specimen is identified by authors followed by published literature (Saxena and Brahman, 1996).

Phytochemical screening: Successive extractions were performed using n-hexane, ethanol, and distilled water. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025).

Antioxidant activity: For the detection of antioxidant potential, the DPPH assay was carried out (Bhatnagar et al., 2013). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air dried, and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

a) Ethyl acetate: Methanol: Water (40: 5.4:4) [EMW] (Polar neutral)

b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)

c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)

Results and discussion

Qualitative phytochemical screening of *Cyperus iria* revealed a selective distribution of primary and secondary metabolites across different solvent extracts. Among the secondary metabolites, the aqueous extract exhibited the presence of tannins and reducing sugars, whereas the ethanolic extract showed only reducing sugars (Table 1). No secondary metabolites were detected in the non-polar (n-hexane) extract, indicating that the major bioactive compounds of *C. iria* are more soluble in polar solvents. Similarly, the analysis of primary metabolites demonstrated that carbohydrates were present in the ethanolic extract, while both carbohydrates and starch were detected in the aqueous extract (Table 2), suggesting the nutritional significance of this sedge as a potential fodder resource. TLC-

based DPPH antioxidant assay further confirmed the antioxidant potential of *C. iria*. Aqueous extract displayed distinct spots with measurable Rf values under different mobile phases (Table 3). The highest retention factor (Rf 0.983) was observed in the chloroform: ethyl acetate: formic acid system, accompanied by a streak ranging from 0 to 0.344, indicating the presence of compounds with strong free radical-scavenging activity. The ethyl acetate: methanol: water system also produced a significant spot with an Rf value of 0.758, while no detectable antioxidant compounds were observed in the n-hexane: petroleum ether: ethanol system. These findings suggest that antioxidant constituents are predominantly concentrated in the polar fractions of the plant.

Table 1: Qualitative phytochemical analysis of *C. iria* for detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected.
	Ethanol	Only reducing sugars
	Aqueous	Tannin and Reducing Sugars

Table 2: Qualitative phytochemical analysis of *C. iria* for detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All tested bioactive compounds were not detected.
	Ethanol	Only Carbohydrate
	Aqueous	Starch and Carbohydrate

The overall results highlight *C. iria* as a source of nutritionally relevant primary metabolites and bioactive secondary metabolites with notable antioxidant activity. The predominance of polar compounds underscores the importance of aqueous and ethanolic extractions for maximizing the recovery of active constituents. This phytochemical and antioxidant profile supports the traditional use of the plant as a fodder resource and provides a scientific basis for its potential applications in natural antioxidant development and ethnomedicinal formulations.

Table 3: TLC-based DPPH analysis of *C. iria* using different mobile phases

	Mobile Phases	Rf value of Spots			
		S1	S2	S3	Streak
Aqueous	Ethyl acetate: Methanol: Water (40:5.4:4)	0.758	~	~	~
	Chloroform: Ethyl acetate: Formic acid (5: 4: 1)	0.983			0-0.344
	n-Hexane: Petroleum ether: Ethanol (90:10:1)	~	~	~	~

(Rf: Retention factor)



Figure 1: Dried plant sample of *C.iria* for experimental purpose



Figure 2: *Cyperus iria* in its wild habitat

Conclusion

Cyperus iria L. demonstrates significant nutritional and pharmacological potential, with polar extracts rich in primary metabolites such as carbohydrates and starch, as well as secondary metabolites including tannins and reducing sugars. The TLC-DPPH analysis confirmed its antioxidant activity, particularly in aqueous and ethanolic fractions, highlighting its ability to scavenge free radicals. These findings position *C. iria* as a valuable, underutilized sedge with applications in fodder production, natural antioxidant development, and potential medicinal use. Further studies involving bioassay-guided fractionation and isolation of active compounds could pave the way for its incorporation into sustainable nutraceutical and ethnomedicinal frameworks.

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Chapter 12

Nutritional and medicinal values of *Fuirena ciliaris* Roxb.

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Abstract: *Fuirena ciliaris*, belonging to the family Cyperaceae, is an underexplored sedge with potential pharmacological properties. In the present study, qualitative phytochemical screening was carried out to detect primary and secondary metabolites in different solvent extracts of *F. ciliaris*, followed by thin-layer chromatography (TLC)-based antioxidant assays using DPPH (2,2-diphenyl-1-picrylhydrazyl). Among the secondary metabolites, tannins, saponins, phenols, flavonoids, and reducing sugars were present in polar extracts, while non-polar fractions were largely inactive. Primary metabolites such as proteins and carbohydrates were detected mainly in ethanol and aqueous extracts. TLC analysis of aqueous fractions revealed distinct antioxidant-active bands with retention factor (R_f) values ranging from 0.371 to 0.985, indicating the presence of bioactive compounds with radical-scavenging potential. These findings highlight the importance of *F. ciliaris* as a promising fodder grass for wildlife & livestock. It could also be the source of natural antioxidants and suggest its potential applications in the nutraceutical and pharmaceutical industries.

Keywords: Cyperaceae, phytochemical screening, primary metabolites, secondary metabolites

Introduction

The search for natural antioxidants has intensified due to their potential role in preventing oxidative stress-related disorders such as cardiovascular diseases, diabetes, and cancer (Mallik et al., 2024). Plants of the family Cyperaceae have long been recognized for their ecological importance (Barrett, 2013) and ethnomedicinal uses (Taheri et al., 2021). However, many species remain unexplored for their chemical constituents and biological activities. Keeping the need for screening of therapeutic agents from nature and restoration of biodiversity, particularly grasslands, an attempt has been made to document the nutritional and medicinal uses of *Fuirena ciliaris* Roxb. It is commonly distributed in wetland habitats and is a perennial sedge traditionally used as fodder and the genus *Fuirena* for phytoremediation properties (Lekeufack et al., 2017). Despite its ecological significance, there is little or no information on its phytochemical profile and antioxidant potential. The present study aims to provide a preliminary assessment of the primary and

secondary metabolites present in different solvent extracts of *F. ciliaris* and to evaluate their antioxidant properties using TLC-based DPPH assays.



Figure 1: Plant parts of *Fuirena ciliaris*

Materials and methods

F. ciliaris was collected from Cuttack, Odisha, India (Figure 1). The plant specimen is identified by authors followed by published literature (Saxena and Brahman, 1996). Successive extractions were performed using n-hexane, ethanol, and distilled water. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025). For the detection of antioxidant potential, the DPPH assay was carried out (Bhatnagar et al., 2013). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air-dried, and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

- a) Ethyl acetate: Methanol: Distilled water (40:5.4:4) [EMW] (Polar neutral)
- b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)
- c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)

Results and discussion

Phytochemical screening revealed a clear polarity-dependent distribution of metabolites (Table 1). Polar extracts (ethanol and aqueous) contained a rich array of secondary metabolites, including tannins, saponins, phenols, flavonoids, and reducing sugars. The aqueous extract was particularly rich, containing all tested metabolites except alkaloids, which were not detected. In contrast, the non-polar n-hexane extract showed only reducing sugars, suggesting that most antioxidant compounds are hydrophilic. The primary metabolite analysis (Table 2) demonstrated the presence of proteins and carbohydrates primarily in ethanol and aqueous extracts, while n-hexane contained only carbohydrates. These metabolites contribute to the nutritional value of the plant, supporting its traditional use as fodder. TLC-DPPH analysis of aqueous extract revealed distinct antioxidant-active zones in all tested solvent systems (Table 3; Figure 2). The highest activity was recorded in the ethyl acetate: methanol: distilled water mobile phase, which produced two sharp antioxidant bands (Rf: 0.371 and 0.714) and a streak extending from 0.571 to 0.985. The chloroform: ethyl acetate: formic acid system showed a single strong spot at Rf of 0.984, while n-hexane: petroleum ether: ethanol developed a single band at Rf of 0.754. The multiple active spots indicate the presence of diverse radical-scavenging compounds, likely polyphenols and flavonoids, consistent with the qualitative phytochemical results.

Table 1: Qualitative phytochemical analysis for the detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	Only reducing sugars
	Ethanol	Tannin, Saponin, Phenol, and Reducing Sugars
	Aqueous	Tannin, Saponin, Flavonoid, Phenol, and Reducing sugars

Table 2: Qualitative phytochemical analysis for the detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	Only Carbohydrate
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *F. ciliaris* using different mobile phases

	Mobile Phases	Rf value of Spots		
		S1	S2	Streak
Aqueous	Ethyl acetate: Methanol: Distilled water (40:5.4:4)	0.371	0.714	0.571-0.985
	Chloroform: Ethyl acetate: Formic acid (5:4:1)	0.984	-	0 – 0.666

	n-Hexane: Petroleum ether: Ethanol (90:10:1)	0.754	~	~
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(Rf: Retention factor)

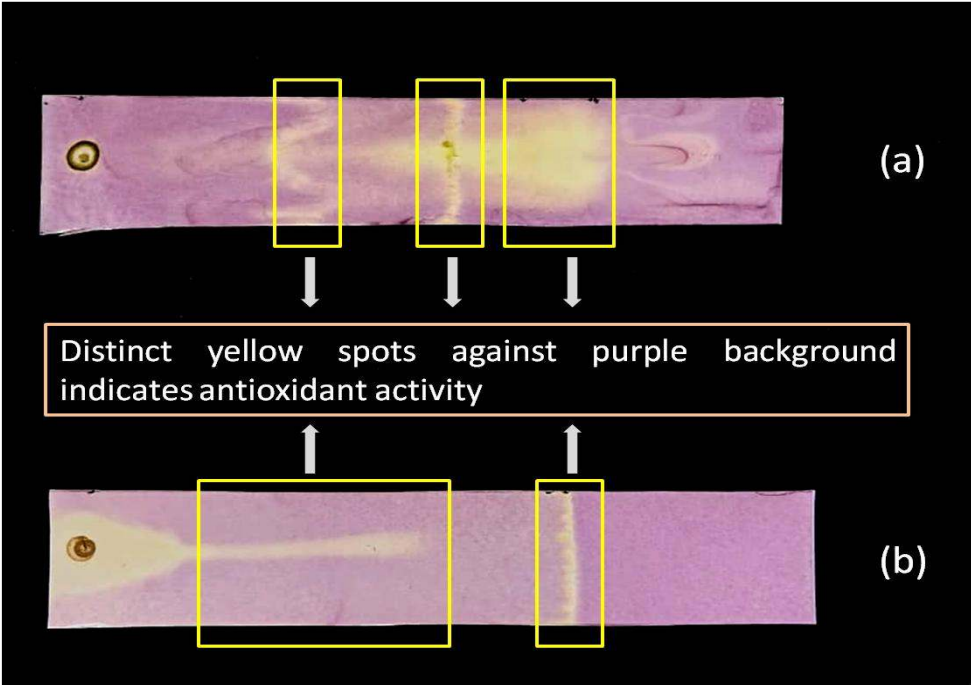


Figure 2: Antioxidant activity of *F. ciliaris* in mobile phases a) Ethyl acetate: Methanol: Distilled water and b) Chloroform: Ethyl acetate: Formic acid

Conclusion

Present study demonstrates that *Fuirena ciliaris* is a valuable fodder sedge with phytoremediation properties and a rich source of bioactive compounds, including polyphenols and flavonoids, which exhibit notable antioxidant activity. The prevalence of metabolites in polar extracts indicates that aqueous and ethanol fractions are optimal for further isolation and characterization of bioactive compounds. These findings provide a scientific foundation for the potential nutraceutical and pharmaceutical applications of *F. ciliaris*, underscoring the need for further comprehensive chemical and biological investigations. Additionally, the diversity of primary and secondary metabolites in *F. ciliaris* suggests its potential for restoring grasslands, highlighting its multifaceted utility.

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Chapter 13

Diversity of genus *Cyperus* (Cyperaceae) in Cuttack district, Odisha, India

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Abstract: The genus *Cyperus* (family Cyperaceae) represents one of the most ecologically significant groups of sedges, occupying a wide range of wetland, agricultural, and riparian habitats. The present study documented the diversity of *Cyperus* species in the Cuttack district of Odisha, India. A total of 31 species of *Cyperus* were recorded from varied habitats, including rice fields, moist areas, wetlands, gardens, and riverine zones. These species exhibit wide ecological plasticity and play an important role in soil stabilization, fodder availability, and wetland ecosystem functioning. The documentation of this diversity serves as a baseline for future ecological studies, conservation strategies, and potential utilization of *Cyperus* species in phytoremediation and ethnopharmacology.

Keywords: Business capital of Odisha, Cyperaceae, Mahanadi River

Introduction

The family Cyperaceae, commonly known as the sedge family, comprises about 5,500 species distributed worldwide (Larridon et al., 2021), with the genus *Cyperus* being one of the largest (Moraes and Sennikov, 2021) and most ecologically adaptable genera (Kúr et al., 2021). Members of *Cyperus* are well known for their ability to thrive in wetland habitats and disturbed landscapes, contributing to biodiversity, soil fertility, and wetland health (Saxena and Brahmam, 1996). Odisha, situated along the eastern coast of India, harbours rich floral diversity due to its unique geomorphological and climatic conditions (Sinha et al., 2025). Among its various districts, Cuttack presents a mosaic of habitats such as paddy fields, moist riverine belts, barren lands, and gardens, which provide ideal ecological niches for *Cyperus* species. Despite their ecological significance, *Cyperus* species are often overlooked in biodiversity assessments due to their morphological similarity and taxonomic complexity. The present study aims to document the diversity and habitat distribution of *Cyperus* species in Cuttack district, providing a comprehensive checklist that may aid in further ecological and taxonomic research.

Materials and methods

Extensive field surveys were conducted across different localities of Cuttack district in the year 2024-2025, covering rice fields, wetlands, riverbanks, gardens, and fallow lands. Species identification was carried out using regional floras and standard taxonomic keys of Cyperaceae (Saxena and Brahmam,1996). Vernacular names were recorded based on interactions with local communities and an available online database (Kumar, 2025). Habitat preferences were documented through direct observation.

Results and discussion

The study recorded a total of 31 species of *Cyperus* distributed across diverse habitats in Cuttack district (Table 1). Rice fields and moist places were the most common habitats supporting species such as *C. brevifolius*, *C. compactus*, and *C. distans*. Riverine zones along the Mahanadi River harboured species like *C. conglomeratus*, *C. esculentus*, *C. iria*, *C. kyllingia*, and *C. pangorei*. Wetlands and garden areas supported ornamental and aquatic species such as *C. flabelliformis* and *C. haspan*. The ecological amplitude of these species reflects their high adaptability to both natural and anthropogenically disturbed habitats.

Table 1: Diversity of genus *Cyperus* in Cuttack, Odisha, India

Name	Vernacular name	Habitat
<i>Cyperus articulatus</i> (Figure 1)	Guinea rush	Near water bodies
<i>Cyperus brevifolius</i> (Figure 2)	Green kyllinga	Rice fields
<i>Cyperus castaneus</i>	Chestnut flat-sedge	Moist places
<i>Cyperus cephalotes</i>	White kyllinga	Floating herb
<i>Cyperus compactus</i>	Badoli	Rice fields
<i>Cyperus compressus</i>	Chancha	Agricultural fields
<i>Cyperus conglomeratus</i>	Tight-head sedge	Near the Mahanadi River
<i>Cyperus cuspidatus</i>	Coastal plain flatsedge	Moist places
<i>Cyperus cyperoides</i> (Figure 3)	Common flat sedge	Moist places
<i>Cyperus diffusus</i>	Small flower umbrella-sedge	Near water bodies
<i>Cyperus distans</i>	Slender cyperus	Rice fields
<i>Cyperus dubius</i>	Beruan betha	Near forest
<i>Cyperus eleusinoides</i>	Flatsedge	Wet places

<i>Cyperus esculentus</i>	Tiger nut	Near the Mahanadi River
<i>Cyperus flabelliformis</i>	Umbrella papyrus	Gardens
<i>Cyperus haspan</i> (Figure 4)	Dwarf papyrus sedge	Gardens
<i>Cyperus imbricatus</i>	Shingle flatsedge	Wet areas
<i>Cyperus iria</i>	Swanti	Near the Mahanadi River
<i>Cyperus kyllingia</i>	White-flowered kyllingia	Near the Mahanadi River
<i>Cyperus pangorei</i>	Mat sedge	Near the Mahanadi River
<i>Cyperus panicus</i>	Poongorai	Barren land
<i>Cyperus pilosus</i>	Fuzzy flatsedge	Near water bodies
<i>Cyperus platystylis</i>	Tall flat sedge	Near water bodies
<i>Cyperus polystachyos</i>	Manyspike flatsedge	Near water bodies
<i>Cyperus pumilus</i>	Dwarf sedge	Moist places
<i>Cyperus puncticulatus</i>	Flat sedge	Near water bodies
<i>Cyperus rotundus</i>	Mutha	Near water bodies
<i>Cyperus sanguinolentus</i>	Purple-glume flatsedge	Near water bodies
<i>Cyperus squarrosus</i>	Bearded flatsedge	Moist places
<i>Cyperus tenuispica</i>	Slender spiked sedge	Moist places
<i>Cyperus triceps</i>	Galingales	Near roadside

The remarkable diversity of *Cyperus* species in Cuttack can be attributed to the district's extensive hydrological network, rice-based agroecosystems, and semi-tropical climate, which collectively create a conducive environment for their growth. The dominance of these species in moist and riverine habitats underscores their crucial ecological role in stabilizing soil, filtering water, and mitigating floods. Certain species hold significant economic value (Simpson and Cecilia, 2001) due to their use in traditional medicine (Babiaka et al., 2025) and as edible medicinal tubers (Pirzada et al., 2015). Meanwhile, presence of less-known species like *C. cephalotes* and *C. pangorei* emphasizes the importance of protecting their habitats and implementing continuous monitoring measures to ensure their conservation.

Conclusion

The present study documents 31 species of *Cyperus* distributed across diverse habitats of Cuttack district, Odisha, reflecting the ecological richness and adaptability of this genus. Given their ecological and economic significance, conservation of wetland and riverine habitats is essential to safeguard these species. Further studies on the phytochemical, ethnobotanical, and ecological aspects of *Cyperus* species will enhance their sustainable utilization.



Figure 1: *Cyperus articulatus* in a natural habitat



Figure 2: Vegetative parts of *Cyperus brevifolius*



Figure 3: *Cyperus cyperoides* near the moist areas of the roadside of Cuttack, Odisha, India



Figure 4: *Cyperus haspan* in its natural habitat in Cuttack, Odisha, India

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Chapter 14

Some common grass species of Cuttack district, Odisha, India

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Abstract: Grasses form a vital component of the vegetation in tropical regions, providing fodder, soil stabilization, and ecological services. A survey for grasses in Cuttack district, Odisha, India, revealed the presence of 31 common grass species belonging to 22 genera and occupying varied habitats such as roadsides, open grasslands, agricultural fields, marshy areas, and riverbanks. Species like *Cynodon dactylon*, *Imperata cylindrica*, and *Saccharum spontaneum* were observed to dominate disturbed and moist areas, while others, such as *Bothriochloa bladhii* and *Pennisetum pedicellatum* were frequent along roadsides. This documentation offers baseline data for grassland management, conservation, and sustainable utilization in the region.

Keywords: Grassland, conservation, Mahanadi areas, agricultural field, ecological services

Introduction

Grasses belonging to the family Poaceae are among the most widely distributed and ecologically significant plant groups on Earth (Saxena and Brahman, 1996; Behera et al., 2025). They serve as primary fodder resources (Sethi et al., 2024), contributing to soil binding, and play key roles in nutrient cycling. They have economic (Sharma et al., 2025), food (Dimri et al., 2024), medicinal (Mishra et al., 2022), and ornamental values (Hamar-Farkas et al., 2024). In India, grasslands and roadside vegetation harbour a rich diversity of species that sustain rural livelihoods and local ecosystems. Cuttack district, situated on the banks of the Mahanadi and Kathajodi rivers of Odisha, is characterized by fertile alluvial plains, a tropical monsoon climate, and is a mosaic of agricultural lands, wetlands, and urbanized areas. Despite the ecological and economic values, the grasses of this district remain under-documented. This chapter presents an inventory of commonly occurring grass species of Cuttack, highlighting their vernacular names and habitat preferences to facilitate further ecological studies and conservation efforts.

Materials and methods

Extensive field surveys were conducted across different habitats of Cuttack district, like roadsides, wastelands, grasslands, agricultural fields, marshy areas, and riverbanks during

2024-2025. Species were identified by the authors, followed by published literature (Behera et al., 2025). Vernacular names were recorded through interactions with local communities and the available database (Kumar, 2025).

Results and discussion

The field survey recorded 31 common grass species belonging to 22 genera across diverse habitats of Cuttack district (Table 1). Their distribution reflects remarkable ecological adaptability (Figure 1). *Alloteropsis cimicina*, *Bothriochloa pertusa*, *Chloris barbata*, and *Eragrostis tenella* dominate disturbed soils, thriving with frequent human activity and vehicular dispersal. Moisture-loving taxa, including *Echinochloa colonum*, *Eragrostis unioloides*, and *Setaria verticillata*, were concentrated near the Mahanadi River and in low-lying wetlands, where seasonal flooding provides ideal conditions. *Panicum sumatrense*, *Perotis indica*, and *Setaria flavida* were abundant in open fields and fallow lands, demonstrating resilience to nutrient-poor substrates. *Imperata cylindrica* and *Saccharum spontaneum* play a vital ecological role by stabilizing riverbanks and preventing soil erosion. Economically important species like *Cynodon dactylon* emphasize the need for conserving grass habitats to sustain biodiversity, soil health, and rural livelihoods.

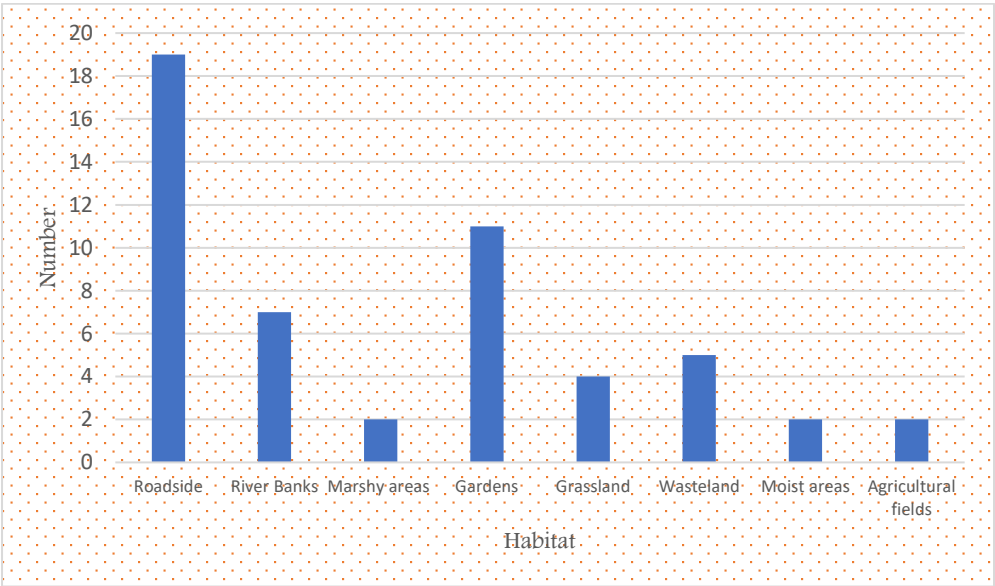


Figure 1: Diversity and habitat of grass species in Cuttack, Odisha

The bar graph illustrated that roadside habitats harbour the highest species richness, followed by riverbanks and moist areas, reflecting the adaptability of grasses to disturbed and periodically flooded environments (Figure 1).



Figure 2: Habitat of *Alloteropsis cimicina*



Figure 3: Inflorescence of *Aristida setacea*



Figure 4: Inflorescence of *Bothriochloa bladhii*



Figure 5: Inflorescence of *Bothriochloa pertusa*



Figure 6: Habitat of *Chloris barbata*



Figure 7: Inflorescence of *Chrysopogon aciculatus*



Figure 8: Inflorescence of *Chrysopogon zizanioides*

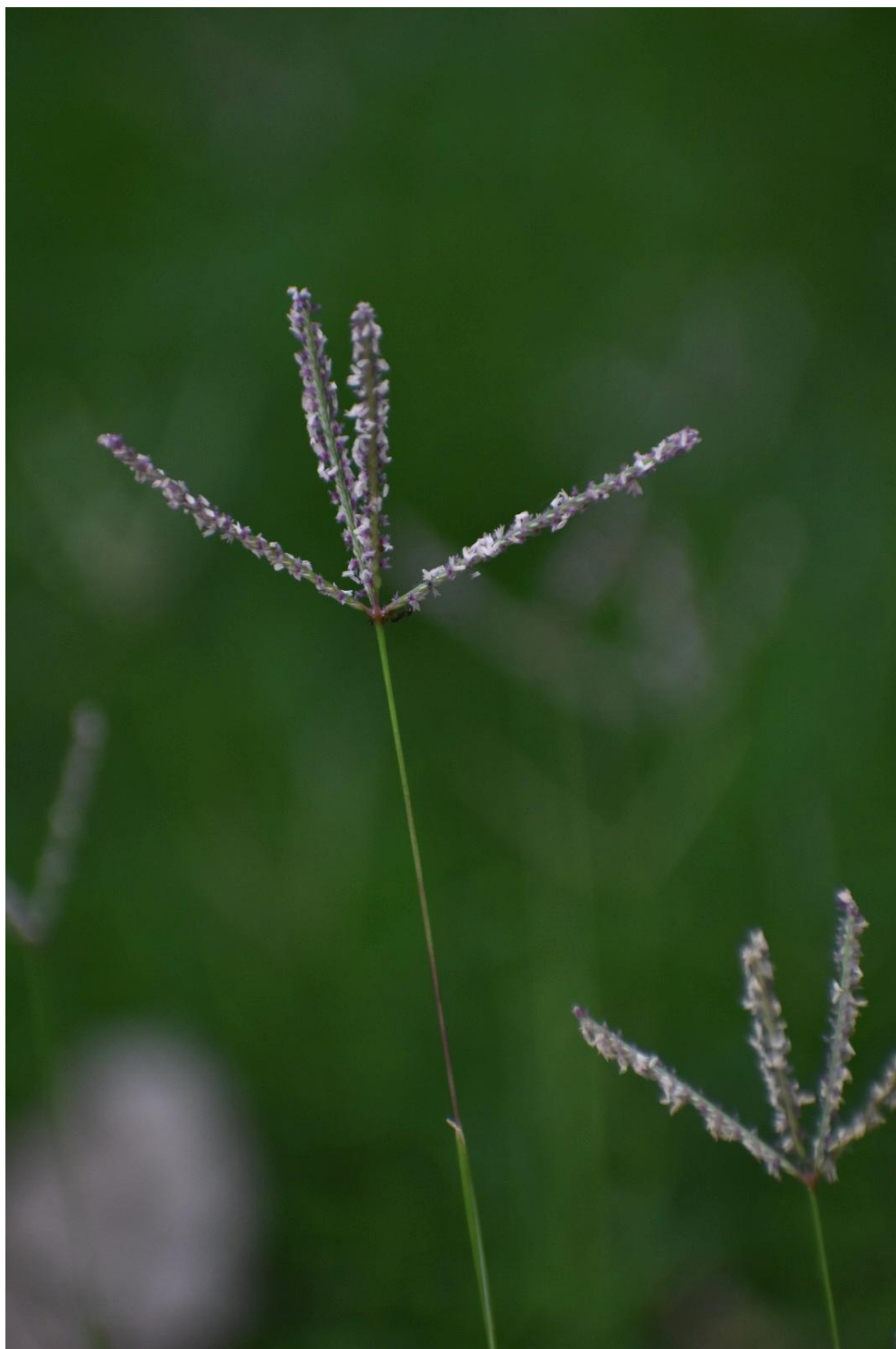


Figure 9: Inflorescence of *Cynodon dactylon*



Figure 10: Inflorescence of *Dactyloctenium aegyptium*



Figure 11: Inflorescence of *Digitaria bicornis*



Figure 12: Inflorescence of *Echinochloa colona*



Figure 13: Inflorescence of *Imperata cylindrica*

Table 1: Common grass species of Cuttack, Odisha, India

Name	Vernacular name	Habitat
<i>Alloteropsis cimicina</i> (Figure 2)	Bada Borati Ghasa	Roadside
<i>Apluda mutica</i>	Mugar Ghasa	Open grassland
<i>Aristida setacea</i> (Figure 3)	Jhadu Ghasa	Roadside and near the Mahanadi River
<i>Bothriochloa bladhii</i> (Figure 4)	Gandhabena	Roadside
<i>Bothriochloa pertusa</i> (Figure 5)	Basana	Roadside
<i>Chloris barbata</i> (Figure 6)	Gajalekha	Roadside
<i>Chrysopogon aciculatus</i> (Figure 7)	Guguchia	Roadside & wasteland
<i>Chrysopogon zizanioides</i> (Figure 8)	Bena	Roadside, near water bodies & near the Mahanadi River
<i>Cynodon dactylon</i> (Figure 9)	Duba	Roadside, grassland, agricultural fields & gardens
<i>Dactyloctenium aegyptium</i> (Figure 10)	Kukudia	Wasteland
<i>Digitaria bicornis</i> (Figure 11)	Mukurjali	Wasteland
<i>Digitaria ciliaris</i>	Chiri-Chiri	Roadside & gardens
<i>Echinochloa colona</i> (Figure 12)	Suan	Moist areas & gardens
<i>Eleusine indica</i>	Nandia	Wasteland & gardens
<i>Eragrostis ciliaris</i>	Gajalakha	Roadside
<i>Eragrostis tenella</i>	Dauria	Roadside
<i>Eragrostis unioloides</i>	Phurphuri	Moist areas
<i>Imperata cylindrica</i> (Figure 13)	Dabbu	Marshy areas, gardens & near the Mahanadi River
<i>Oplismenus burmanni</i>	Kaugodia	Roadside & gardens
<i>Oplismenus compositus</i>	Mohara	Roadside & gardens

<i>Panicum repens</i>	Reda	Roadside & near the Mahanadi River
<i>Panicum sumatrense</i>	Suan	Grassland & gardens
<i>Paspalum scrobiculatum</i>	Koda	Roadside
<i>Pennisetum pedicellatum</i>	Dinabandhu	Roadside & near the Mahanadi River
<i>Perotis indica</i>	Nakka	Grassland & wasteland
<i>Saccharum spontaneum</i>	Kasatandi	Marshy areas & near the Mahanadi River
<i>Setaria flavidia</i>	Juna	Roadside & gardens
<i>Setaria pumila</i>	Siala	Gardens & agricultural fields
<i>Setaria verticillata</i>	Baunsa ghasa	Near the Mahanadi River
<i>Sporobolus diandrus</i>	Kakarchada	Roadside
<i>Urochloa distachyos</i>	Dhanri	Roadside

Conclusion

The grasses of Cuttack district exhibit remarkable diversity and habitat adaptability, ranging from dry roadsides to marshy riverbanks. Many species hold ecological, medicinal, and economic significance, particularly for fodder and soil stabilization. Documentation of such species provides essential baseline data for conservation strategies, sustainable grazing management, and future ecological research in the dynamic landscapes of Odisha.

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Chapter 15

Common sedges of Nayagarh district, Odisha, India

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Abstract: The present study documents the diversity of sedges (family Cyperaceae) in Nayagarh district, Odisha, India, based on an extensive field survey. Sedges are ecologically significant wetland plants that contribute to soil stabilization, nutrient cycling, and fodder resources. Systematic surveys conducted from July 2025 to September 2025 recorded 30 species belonging to 10 genera, with the genus *Cyperus* being dominant. Most species were concentrated in wetlands, moist grasslands, rice fields, and lake margins, reflecting the district's hydric landscape and seasonal monsoon influence. The documentation of lesser-known species such as *Actinoscirpus grossus*, *Eleocharis dulcis*, and *Fimbristylis ferruginea* highlights the need for habitat protection to conserve wetland biodiversity.

Keywords: Cyperaceae, Nayagarh, Odisha, wetlands, sedge diversity, field survey

Introduction

Sedges (family Cyperaceae) represent an important group of monocotyledonous plants found primarily in wetlands, riverbanks, moist grasslands, and rice agro-ecosystems (Barrett, 2013). Globally, the family includes about 5,600 species distributed across diverse habitats, serving as key components in ecological processes such as water purification, erosion control, and carbon sequestration (Taheri et al., 2021). In India, Cyperaceae is represented by approximately 610 taxa (Rameshkumar et al., 2022; Rahul et al., 2025), many of which are yet to be thoroughly explored in regional floras. Odisha, with its mosaic of wetlands, forested landscapes, and agricultural fields, provides suitable habitats for sedges. Nayagarh district, located in Odisha state, is characterized by an undulating topography, tropical monsoon climate, and fertile alluvial soils, creating ideal conditions for the growth of sedges. Despite their ecological (Barrett, 2013) and economic value (Simpson and Cecilia, 2001), sedges remain an under-documented species. This study aims to systematically record the diversity, habitats, and distribution patterns of sedges in Nayagarh district to provide baseline data for future ecological monitoring and conservation planning.

Materials and methods

The field survey was carried out in Nayagarh district, Odisha, India, between July 2025 and September 2025. The district comprises forested uplands, paddy fields, seasonal wetlands, and riverine landscapes.



Figure 1: Habitat of *Eleocharis dulcis*



Figure 2: Habitat of *Cyperus distans*



Figure 3: Inflorescence of *Cyperus cyperoides*

Representative habitats included rice fields, lake margins, forest edges, moist grasslands, sandy wastelands, wastelands, and Mahanadi River banks. Plant specimens were photographed, collected, and identified using published literature (Saxena and Brahman, 1996). Vernacular names and habitat details were searched from different databases (Kumar, 2025). The field data were compiled into a checklist with botanical names, vernacular/common names, and observed habitats.

Results and discussion

A total of 30 sedge species belonging to 10 genera were documented (Table 1). The genus *Cyperus* was the most dominant, with 15 species, followed by *Fimbristylis* (7 species), *Eleocharis* (1 species), *Abildgaardia* (1 species), and others. Notable species include *Actinoscirpus grossus*, a robust wetland sedge with high fodder potential, and *Eleocharis dulcis*, which is known for its edible tubers. It was observed that wetlands and moist rice fields supported the highest species richness, hosting nearly 65% of the recorded species. Species such as *Cyperus difformis*, *Fimbristylis aestivalis*, and *Schoenoplectiella juncoides* were dominant in swampy paddy ecosystems, while *Bulbostylis barbata* and *Lipocarpha chinensis* were found in sandy wastelands. *Fuirena umbellata* and *Scleria terrestris* are observed in forest edges and near water bodies. Sedges play critical roles in soil binding, flood control, and nutrient retention. Their abundance in wetlands indicates good water retention but also reflects habitat vulnerability due to agricultural intensification, drainage, and invasive weeds.

Table 1: Common sedges of Nayagarh district, Odisha, India

Botanical Name	Vernacular Name	Habitat
<i>Abildgaardia ovata</i>	Marmari	Moist areas and wetlands
<i>Actinoscirpus grossus</i>	Santara	Rice fields and wetlands
<i>Bulbostylis barbata</i>	Bearded watergrass	Sandy disturbed areas
<i>Cyperus articulatus</i>	Guinea rush	River banks
<i>Cyperus brevifolius</i>	Green kyllinga	Moist grasslands
<i>Cyperus compactus</i>	Badoli	Water-logged areas or near wet agricultural lands
<i>Cyperus cuspidatus</i>	Coastal plain flatsedge	Sandy moist areas
<i>Cyperus cyperoides</i> (Figure 3)	Common flat sedge	Disturbed wetlands
<i>Cyperus difformis</i>	Smallflower umbrella sedge	Wetlands
<i>Cyperus diffusus</i>	Dwarf umbrella sedge	Forest edges

<i>Cyperus distans</i> (Figure 2)	Piedmont flatsedge	Moist to wet areas
<i>Cyperus esculentus</i>	Tiger nut	Wet agricultural fields
<i>Cyperus haspan</i>	Dwarf papyrus sedge	Swampy lake edges and wetlands
<i>Cyperus imbricatus</i>	Shingle flatsedge	Wetlands and Rice field edges
<i>Cyperus mindorensis</i>	White water sedge	Moist areas
<i>Cyperus neochinensis</i>	Chinese flatsedge	Forest areas near streams and wetlands
<i>Cyperus platystylis</i>	Flat-style flatsedge	Lakes and river banks
<i>Cyperus polystachyos</i>	Manyspike flatsedge	Disturbed wetlands
<i>Eleocharis dulcis</i> (Figure 1)	Chinese water chestnut	Lakes and wetlands
<i>Fimbristylis aestivalis</i>	Summer fringe-rush	Wetlands and swampy grasslands
<i>Fimbristylis complanata</i>	Puerto Rico fimbry	Wetlands
<i>Fimbristylis dipsacea</i>	Harper's fimbriatylis	Moist sandy soil
<i>Fimbristylis ferruginea</i>	Rusty sedge	Coastal wetland
<i>Fimbristylis schoenoides</i>	Ditch fimbry	Grasslands
<i>Fimbristylis tenera</i>	NIL	Wetlands
<i>Fimbristylis tetragona</i>	Angled-stem fimbry	Wetland and swampy areas
<i>Fuirena umbellata</i>	NIL	Lake edges
<i>Lipocarpus chinensis</i>	NIL	Moist wastelands
<i>Schoenoplectiella juncoides</i>	Rock bulrush	Swampy wetlands
<i>Scleria terrestris</i>	Ground nut-rush	Wet forest edges

Conclusion

This field survey presents the first comprehensive checklist of sedges from Nayagarh district, documenting 30 species across diverse wetland and grassland ecosystems. The dominance of *Cyperus* and *Fimbristylis* species highlights the ecological importance of seasonal wetlands and rice agro-ecosystems. Given the increasing threats of wetland degradation, land-use change, and climate variability, urgent conservation measures, including habitat

restoration, awareness programs, and long-term ecological monitoring, are recommended to protect the region's sedge diversity.

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Chapter 16

Nutritional, antioxidant, and pharmacological potential of *Fimbristylis sericea* R.Br. (Cyperaceae)

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Abstract: *Fimbristylis sericea* R.Br. (Cyperaceae), a coastal sedge with significant ecological importance, has been understudied for its nutritional and therapeutic benefits. The present study explored its primary and secondary metabolites and antioxidant activity using TLC-based DPPH (2,2-Diphenyl-1-picrylhydrazyl) assays. Key metabolites like tannins, saponins, phenols, proteins, and carbohydrates were detected in ethanol and aqueous extracts, whereas n-hexane extracts showed no bioactive compounds. The TLC-DPPH analysis revealed distinct antioxidant spots, indicating potent radical-scavenging properties. These results position *F. sericea* as a valuable source of natural antioxidants and a promising fodder sedge, with potential pharmaceutical applications.

Keywords: Bioactive compounds, Cyperaceae, therapeutic values

Introduction

The genus *Fimbristylis* (Cyperaceae) comprises herbaceous sedges widely distributed in tropical and subtropical regions, occupying wetlands, sand dunes, and disturbed habitats (Sunil et al., 2016). Among them, *Fimbristylis sericea* R.Br. (Figure 1) thrives along coastal ecosystems, where it plays a critical role in soil stabilization and habitat restoration. Members of Cyperaceae have been reported to contain bioactive compounds with nutritional, antioxidant, and pharmacological properties along with ecological significance (Barrett, 2013; Taheri et al., 2021). However, scientific literature on the phytochemical and medicinal attributes of *F. sericea* remains scarce. Antioxidant-rich plants are gaining attention for their ability to neutralize free radicals, thereby reducing the risk of oxidative stress-related health problems (Kumar et al., 2017; Mallik et al., 2024; Chandrashekar et al., 2025). Investigating the phytochemical parameters and antioxidant activity of *F. sericea* can provide valuable insights into its potential as a natural source of therapeutic agents and nutraceuticals.



Figure 1: *Fimbristylis sericea* in its habitat

Materials and methods

F. sericea was collected from Cuttack, Odisha, India (Figure 2). The plant specimen was identified by the authors, followed by published literature (Saxena and Brahmam, 1996). Successive extractions were performed using n-hexane, ethanol, and distilled water. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025). For the detection of antioxidant potential, the DPPH assay was carried out (Bhatnagar et al., 2013). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air dried, and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

- a) Ethyl acetate: Methanol: Distilled water (40:5.4:4) [EMW] (Polar neutral)
- b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)
- c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)



Figure 2: Plant parts of *F. sericea*

Results and discussion

The qualitative screening revealed that secondary metabolites such as tannins, saponins, phenols, and reducing sugars were abundant in ethanolic and aqueous extracts, whereas non-polar n-hexane extracts showed no detectable bioactive compounds (Table 1). Similarly, primary metabolites, including proteins and carbohydrates, were present only in ethanol and aqueous fractions (Table 2), indicating a higher polarity of nutritionally significant constituents. TLC-DPPH assays demonstrated prominent antioxidant activity in aqueous extract, with distinct purple-to-yellow spots appearing across different mobile

phases (Table 3). The mobile phase Chloroform: Ethyl acetate: Formic acid (5:4:1) exhibited the highest Rf value (0.984), suggesting the presence of highly mobile antioxidant compounds (Figure 3).

Table 1: Qualitative phytochemical analysis for the detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Tannin, Saponin, Phenol and Reducing sugars
	Aqueous	Tannin, Saponin and Reducing sugars

Table 2: Qualitative phytochemical analysis for the detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *F. sericea* using different mobile phases

	Mobile Phases	Rf value of Spots		
		S1	S2	Streak
Aqueous	Ethyl acetate: Methanol: Distilled water (40:5.4:4)	0.866	0.916	0.216 – 0.833
	Chloroform: Ethyl acetate: Formic acid (5:4:1)	0.984	-	0 – 0.333
	n-Hexane: Petroleum ether: Ethanol (90:10:1)	0.555	0.793	0.238 – 0.904

(Rf: Retention factor)

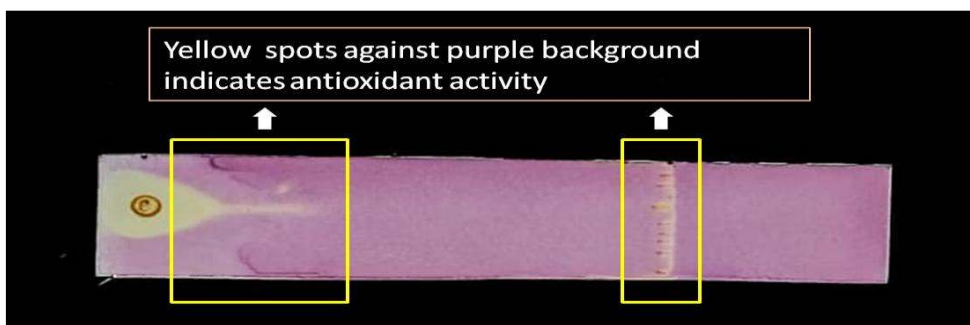


Figure 3: Antioxidant activity of *F. sericea* in Chloroform: Ethyl acetate: Formic acid system

The predominance of phenolic compounds, tannins, and saponins in ethanolic and aqueous extracts suggests that *F. sericea* contains metabolites with strong antioxidant and pharmacological potential. Phenolics and tannins are well-known for their free radical-scavenging capacity and ability to modulate oxidative stress pathways, while saponins contribute to anti-inflammatory and antimicrobial activities. The absence of metabolites in non-polar extracts indicates that the bioactive constituents of *F. sericea* are largely polar in nature, aligning with its aqueous habitat. The strong DPPH activity across multiple mobile phases further supports the presence of diverse antioxidant compounds. The high R_f value (0.984) in the chloroform-ethyl acetate-formic acid system points to the presence of low-polarity antioxidants, suggesting a complex phytochemical profile. Collectively, these findings provide the first phytochemical evidence of the antioxidant potential of *F. sericea*, supporting its use as a candidate for nutraceutical and pharmaceutical applications.

Conclusion

The present study reveals *Fimbristylis sericea* as a rich source of nutritionally significant primary metabolites and pharmacologically relevant secondary metabolites, particularly phenolics and tannins. The plant exhibits promising antioxidant activity, as evidenced by TLC-DPPH assays, indicating its potential role in preventing oxidative stress-related diseases. Further studies on compound isolation, structural characterization, and *in vivo* pharmacological validation are essential to fully exploit the therapeutic potential of this underutilized coastal sedge.

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Chapter 17

Cyperus arenarius Retz. (Cyperaceae): an understudied sedge of sand dune with fodder, antioxidant, and medicinal potential

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Abstract: *Cyperus arenarius* Retz., a sand dune-associated sedge, remains largely unexplored despite its ecological resilience. The present investigation highlights its qualitative phytochemical profile, primary & secondary metabolites, and antioxidant activity using thin-layer chromatography (TLC)-based DPPH (2,2-diphenyl-1-picrylhydrazyl) analysis. The findings revealed the presence of tannin, saponin, phenol, proteins, carbohydrates, and reducing sugars in different extracts, supporting its fodder, antioxidant, and prospective medicinal applications.

Keywords: Coastal ecosystem, DPPH assay, primary metabolites, phytochemical screening, secondary metabolites

Introduction

Sand dune ecosystems are fragile habitats characterized by harsh environmental conditions such as high salinity, low nutrient availability, and continuous sand movement (Kammann et al., 2022; Sabo et al., 2024). Plants thriving in these ecosystems develop unique morphological and biochemical adaptations (Wang et al., 2019; Cao et al., 2024; Kumar, 2025). Among the sand dune plants, sedges have attracted attention for their ecological roles (Barrett, 2013) and potential pharmacological properties (Taheri et al., 2021). *Cyperus arenarius* Retz. (Figure 1) is a perennial sedge commonly found along coastal sand dunes of India (Saxena and Brahmam, 1996). Traditionally used as fodder and for soil stabilization, this species remains understudied for its phytochemical and antioxidant properties. The present study aims to provide the first qualitative assessment of its primary and secondary metabolites and evaluate its free radical scavenging activity.



Figure 1: *Cyperus arenarius* in its natural sand dune habitat

Materials and methods

Cyperus arenarius was collected from Puri, Odisha, India (Figure 2). The plant specimen was identified by the authors, followed by published literature (Saxena and Brahmam, 1996). Successive Soxhlet extractions were performed using n-hexane, ethanol, and distilled water. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025). For the detection of antioxidant potential, the DPPH assay was carried out (Bhatnagar et al., 2013). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air-dried, and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

- a) Ethyl acetate: Methanol: Distilled water (40:5.4:4) [EMW] (Polar neutral)
- b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)
- c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)



Figure 2: Morphological features and plant parts of *C. arenarius*.

Results and discussion

The field survey in coastal areas of Puri district, Odisha, revealed that it is a fodder sedge for wildlife. Ethanolic and aqueous extracts showed the presence of tannin, saponin, phenol, and reducing sugars, while n-hexane extract was devoid of detectable secondary metabolites (Table 1).

Table 1: Qualitative phytochemical analysis for the detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Tannin, Saponin, Phenol and Reducing sugars
	Aqueous	Tannin, Saponin and Reducing sugars

The ethanolic extract exhibited a broader phytochemical spectrum compared to the aqueous extract. Proteins and carbohydrates were detected in both ethanolic and aqueous extracts, indicating significant nutritional value. No primary metabolites were found in the non-polar extract (Table 2).

Table 2: Qualitative phytochemical analysis for the detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *C. arenarius* using different mobile phases

Aqueous	Mobile Phases	Rf value of Spots	
		S1	Streak
	Ethyl acetate: Methanol: Distilled water (40:5.4:4)	0.642	0.285 – 0.928

	Chloroform: Ethyl acetate: Formic acid (5:4:1)	0.984	0 – 0.454
	n-Hexane: Petroleum ether: Ethanol (90:10:1)	-	0.49 – 0.967

(Rf: Retention factor)

TLC-based DPPH assay revealed distinct antioxidant-active spots across different solvent systems, indicating free radical scavenging potential (Table 3). The highest Rf value (0.984) was observed in the chloroform: ethyl acetate: formic acid system. The presence of tannins, phenols, and saponins suggests that *C. arenarius* harbors bioactive compounds with potential antioxidant and therapeutic properties. Phenolic compounds are well-known for their radical scavenging activity (Platzer et al., 2022), while saponins and tannins contribute to anti-inflammatory and antimicrobial effects (Hossain et al., 2025). The detection of proteins and carbohydrates further enhances its value as a nutritious fodder species for coastal livestock and wildlife. Given its natural abundance on sand dunes, this sedge may serve as an ecologically sustainable source of antioxidants and nutraceuticals. Further quantitative analyses, isolation of active compounds, and pharmacological evaluations are needed to fully exploit its medicinal potential.

Conclusion

Cyperus arenarius Retz. is a resilient sand dune sedge with promising fodder, antioxidant, and medicinal properties. The presence of diverse primary and secondary metabolites, along with detectable antioxidant activity, highlights its ecological and nutritional significance. Conservation and systematic bioprospecting of this species could unlock new avenues for sustainable coastal resource utilization.

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Chapter 18

Nutritional and medicinal potential of *Fimbristylis ferruginea* (Cyperaceae)

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Abstract: *Fimbristylis ferruginea* is an underexplored sedge species commonly occurring in wetlands, marshes, and coastal ecosystems belonging to the family Cyperaceae. Despite its ecological significance, limited information exists on its nutritional and medicinal potential. The present chapter highlights the available primary-secondary metabolites and antioxidant activity of *F. ferruginea*. Qualitative analysis revealed the presence of proteins, carbohydrates, starch, tannins, flavonoids, saponins, and reducing sugars. Antioxidant potential was demonstrated through thin-layer chromatography (TLC)-based DPPH (2,2-diphenyl-1-picrylhydrazyl) analysis, with distinct retention factors in different solvent systems. The findings highlight the importance of *F. ferruginea* as a potential source of bioactive compounds with nutraceutical and therapeutic relevance. The present study advocates further exploration and conservation of sedges as valuable non-conventional plant resources.

Keywords: Cyperaceae, primary metabolites, secondary metabolites, nutraceuticals, medicinal plants, sedges, wetland biodiversity

Introduction

Cyperaceae, the sedge family, comprises about 5,600 species distributed worldwide, with many adapted to wetland and coastal habitats (Taheri et al., 2021). Members of this family play crucial ecological roles, including soil stabilization, water retention, and as fodder for herbivores (Barrett, 2013). However, their nutritional and pharmacological values remain largely neglected compared to other angiosperm families. *Fimbristylis ferruginea* (L.) Vahl, commonly referred to as rust-colored fimbristylis, is a perennial sedge that thrives in saline soils, estuaries, and littoral zones across tropical and subtropical regions (Saxena and Brahman, 1996; Figure 1). Traditionally, species of *Fimbristylis* have been used in ethnomedicine treatments (Chauhan et al., 2024). Nevertheless, *F. ferruginea* itself has not been systematically studied for its phytochemical richness and bioactivity. This chapter provides insights into the nutritional and medicinal potential of *F. ferruginea* by presenting

results of qualitative phytochemical screenings and antioxidant activity analyses. It also places the species in the broader context of sedge utilization and its future research prospects.



Figure 1: Aerial parts of *Fimbristylis ferruginea*

Materials and methods

Fimbristylis ferruginea was collected from Nayagarh, Odisha, India (Figure 2). The plant specimen was identified by the authors, followed by published literature (Saxena and Brahmam, 1996). Soxhlet apparatus was used (n-hexane, ethanol, and distilled water) for extraction. Standard protocols were followed for detecting the primary and secondary metabolites (Jena et al., 2025). For the detection of antioxidant potential, the DPPH assay was carried out (Bhatnagar et al., 2013). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air-dried, and then the chromatograms were sprayed with 0.2 % DPPH in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

- a) Ethyl acetate: Methanol: Distilled water (40:5.4:4) [EMW] (Polar neutral)
- b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)
- c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)



Figure 2: Whole plant of *Fimbristylis ferruginea*

Results and discussion

The phytochemical profile (Table 1) revealed tannins, flavonoids, saponins, and reducing sugars in ethanol and aqueous extracts, while no secondary metabolites were detected in n-hexane extracts.

Table 1: Qualitative phytochemical analysis for the detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Tannin and Reducing sugars
	Aqueous	Tannin, Saponin, Flavonoids and Reducing sugars

Table 2: Qualitative phytochemical analysis for the detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Protein, Starch and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *F. ferruginea* using different mobile phases

Aqueous	Mobile Phases	Rf value of Spots	
		S1	Streak
	Ethyl acetate: Methanol: Water (40:5.4:4)	-	0-0.5
	Chloroform: Ethyl acetate: Formic acid (5:4:1)	0.983	-

	n-Hexane: Petroleum ether: Ethanol (90:10:1)	0.666	0.783 0.916	–
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(Rf: Retention factor)

Primary metabolites, including proteins, carbohydrates, and starch, were identified in ethanol and aqueous extracts (Table 2). Distinct antioxidant activity was recorded in TLC-based DPPH assays (Table 3; Figure 3). The aqueous extract displayed spots with retention factors ranging from 0.666 to 0.983 in different mobile phases, confirming antioxidant potential.

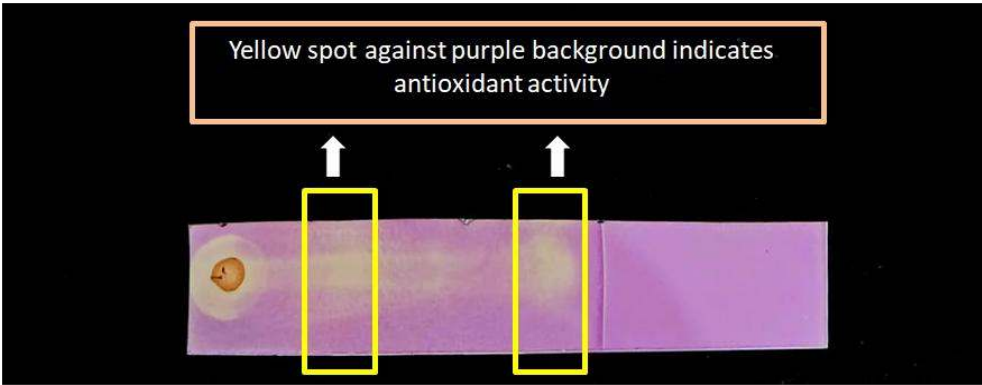


Figure 3: Antioxidant activity of *Fimbristylis ferruginea*

The results establish *F. ferruginea* as a promising sedge with both nutritional and medicinal relevance. The detection of proteins and carbohydrates suggests potential dietary benefits, particularly for communities relying on wetland resources. Secondary metabolites such as tannins and flavonoids are widely recognized for their antioxidant, anti-inflammatory, and antimicrobial activities (Platzer et al., 2022). The antioxidant profiling through DPPH-TLC highlights radical scavenging potential, aligning with earlier reports on antioxidant-rich sedges. These findings open avenues for isolation of individual bioactive compounds and exploring pharmacological activities such as antimicrobial, anti-diabetic, and hepatoprotective effects.

Conclusion

The phytochemical and antioxidant analyses of *Fimbristylis ferruginea* confirm the presence of nutritionally valuable primary metabolites and bioactive secondary metabolites. Its antioxidant activity further supports medicinal potential, making it a candidate for future nutraceutical applications. Given its abundance in wetland ecosystems, *F. ferruginea* may serve as a sustainable resource for non-conventional plant-

based health supplements. However, detailed pharmacological, toxicological, and clinical studies are essential to validate its efficacy.

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Chapter 19

Pharmacological evaluation of *Cyperus dubius* var. *dubius* (Cyperaceae): a fodder sedge of India

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Abstract: *Cyperus dubius* var. *dubius* is a lesser-known sedge of ecological and pharmacological significance. Traditionally recognized for its role in soil stabilization and wetland conservation. Therefore, as per the demand for natural sources of secondary metabolites in the contemporary global situation, with a lot of health problems on the horizon. An attempt has been made to screen the available primary and secondary metabolites, along with the evaluation of the antioxidant potential of this sedge species. Qualitative phytochemical analysis revealed the presence of tannins, saponins, reducing sugars, proteins, and carbohydrates in its extracts, while the antioxidant assay demonstrated promising antioxidant potential. The present chapter discusses a comprehensive account of its ecological role, phytochemistry, and medicinal prospects, underlining the plant's potential as both an environmental stabilizer and a reservoir of bioactive compounds.

Keywords: Antioxidant activity, phytochemical analysis, soil stabilizer

Introduction

The family Cyperaceae is a diverse group of sedges known for their ecological adaptability and wide-ranging utility (Barrett, 2013; Chauhan et al., 2024). Among them, *Cyperus dubius* var. *dubius* (Figure 1) has received relatively little attention. Ecologically, it plays an important role in soil stabilization, water retention, and wetland ecosystem functioning. The species thrives in moist and disturbed habitats, often contributing to erosion control and acting as a pioneer species in degraded landscapes (Saxena and Brahmam, 1996). With the growing need for sustainable ecosystem services and plant-derived medicines, *C. dubius* var. *dubius* deserves closer scientific investigation. Therefore, an attempt has been made to screen the available primary and secondary metabolites along with the evaluation of antioxidant potential. The findings may pave the way for developing novel drugs, grassland development, wetland restoration, and providing valuable fodder for herbivores.



Figure 1: Plant of *Cyperus dubius* var. *dubius*



Figure 2: Plant parts of *C. dubius* var. *dubius*

Materials and methods

Cyperus dubius var. *dubius* was collected from Cuttack, Odisha, India (Figure 2). The plant specimen was identified by the authors, followed by published literature (Saxena and Brahmam, 1996). Soxhlet apparatus was used (n-hexane, ethanol, and distilled water) for extraction. Standard protocols were followed for detecting the primary, secondary metabolites and antioxidant activity (Bhatnagar et al., 2013; Jena et al., 2025). Aqueous extract was run in three mobile phases given below (Eloff et al., 2008). The TLC plates were air-dried, and then the chromatograms were sprayed with 0.2 % DPPH (2,2-diphenyl-1-picrylhydrazyl) in methanol as an indicator. The presence of antioxidant compounds was detected by yellow spots against a purple background.

- a) Ethyl acetate: Methanol: Distilled water (40:5.4:4) [EMW] (Polar neutral)
- b) Chloroform: Ethyl acetate: Formic acid (5:4:1) [CEF] (Intermediate polarity/acidic)
- c) n-Hexane: Petroleum ether: Ethanol (90:10:1) [HPE] (Non-polar/Basic)

Results and discussion

Qualitative phytochemical analyses (Table 1) reveal that non-polar extracts (n-Hexane) did not show the presence of secondary metabolites. However, polar solvents demonstrated significant activity:

- 1. **Ethanol extract:** Presence of tannins and reducing sugars.
- 2. **Aqueous extract:** Tannins, saponins, and reducing sugars.

These findings suggest that the bioactive compounds are more soluble in polar solvents, highlighting their hydrophilic nature (Table 1).

Table 1: Qualitative phytochemical analysis for the detection of secondary metabolites

Polarity	Extract	Detected secondary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Tannin and Reducing sugars
	Aqueous	Tannin, Saponin and Reducing sugars

Primary metabolites (Table 2) were also absent in non-polar extracts. Ethanol and aqueous extracts revealed the presence of proteins and carbohydrates, suggesting a nutritional dimension in addition to medicinal relevance. The TLC-based DPPH analysis provides

insights into the antioxidant activity of *C. dubius* var. *dubius*. Three mobile phases revealed distinct retention factor (Rf) values, confirming the presence of antioxidant compounds with varying polarity (Table 3).

Table 2: Qualitative phytochemical analysis for the detection of primary metabolites

Polarity	Extract	Detected primary metabolites
Non-Polar  Polar	n-Hexane	All the tested bioactive compounds were not detected
	Ethanol	Protein and Carbohydrate
	Aqueous	Protein and Carbohydrate

Table 3: TLC-based DPPH analysis of *C. dubius* var. *dubius* using different mobile phases

	Mobile Phases	Rf value of Spots		
		S1	S2	Streak
Aqueous	Ethyl acetate: Methanol: Distilled water (40:5.4:4)	0.933	-	0.666 – 0.9
	Chloroform: Ethyl acetate: Formic acid (5:4:1)	0.194	0.985	-
	n-Hexane: Petroleum ether: Ethanol (90:10:1)	0.5	-	-

(Rf: Retention factor)

The present investigation on *C. dubius* var. *dubius* reveals its diverse role in ecology, nutrition, and pharmacology. The findings confirm that this sedge is not only an ecological stabilizer but also a potential source of bioactive compounds with significant medicinal value (Table 1-3). Traditionally, sedges, including *Cyperus* species, have been used as supplementary fodder in rural landscapes, particularly in waterlogged and marginal areas where conventional fodder grasses are scarce. The presence of proteins and carbohydrates in ethanol and aqueous extracts of *C. dubius* var. *dubius* (Table 2) strengthens this role by highlighting its nutritional contribution. Although the crude nutritional content may not be comparable to dedicated fodder crops, the availability of digestible carbohydrates and proteins suggests that it could serve as a resilience crop for herbivores during dry or degraded conditions. Moreover, its adaptability to wetlands ensures a sustainable supply

of biomass without the need for intensive agricultural practices. The dense and fibrous root system of *C. dubius* var. *dubius* allows it to play a crucial role in soil stabilization and erosion control. This ecological function is particularly important in riparian zones, sandy soils, and wetlands, where soil erosion threatens biodiversity and agricultural productivity. By binding soil particles and improving water retention, the species provides ecosystem services that indirectly support fodder availability. Thus, its ecological significance complements its nutritional and pharmacological roles, making it a dual-benefit species. Phytochemical analysis (Table 1) demonstrated the presence of tannins, saponins, and reducing sugars, mainly in polar extracts. These compounds are known to exhibit diverse biological activities:

1. **Tannins:** Antioxidant, antimicrobial, and anti-inflammatory properties (Chandrashekar et al., 2025).
2. **Saponins:** Antimicrobial, anti-inflammatory, and potential immunomodulatory activity (Lal et al., 2024; Marndi et al., 2024).
3. **Reducing sugars:** Serve as energy sources and may support synergistic bioactivity in plant extracts (Devi et al., 2023; Jena et al., 2024).

The TLC-based DPPH assay confirmed free radical scavenging activity, with distinct R_f values observed across different mobile phases (Table 3). The broad streaks in aqueous extracts suggest the presence of multiple antioxidant compounds. These results underscore the potential of *C. dubius* var. *dubius* as a source of natural antioxidants capable of counteracting oxidative stress, which is implicated in chronic diseases such as diabetes, cardiovascular disorders, cancer, and neurodegenerative conditions.

Future directions for drug development

The phytochemical richness of *C. dubius* var. *dubius* opens promising avenues for future drug development:

1. **Isolation and characterization of bioactive compounds:** Advanced chromatographic and spectroscopic techniques (HPLC, LC-MS, NMR) are needed to identify specific molecules responsible for antioxidant activity.
2. **In vitro and in vivo validation:** Bioassays targeting microbial pathogens, cancer cell lines, and inflammatory pathways should be undertaken to confirm pharmacological efficacy.

3. **Drug formulation and nutraceutical development:** Given its nutritional metabolites (proteins and carbohydrates), *C. dubius* extracts may be formulated as herbal supplements with combined health benefits.
4. **Bioprospecting for lead molecules:** Tannins and saponins from other sedges have shown anticancer, hepatoprotective, and immunomodulatory activities. Comparative studies may reveal whether *C. dubius* var. *dubius* can yield novel lead compounds for pharmaceutical studies.
5. **Sustainable utilization and cultivation:** Since the plant is ecologically resilient and thrives in wetlands, it can be cultivated sustainably without significant input costs, ensuring long-term availability of raw material for research and industry.

Integrating ecology and pharmacology

The significance of *C. dubius* var. *dubius* lies in its unique position at the intersection of ecology and pharmacology. As a soil stabilizer, it protects landscapes from degradation, and as a nutritional fodder plant, it supports herbivorous health. Its bioactive compounds, on the other hand, provide a biochemical foundation for future drug discovery. This ecological–pharmacological synergy makes it a promising model species for sustainable bioprospecting that benefits both ecosystems and human health.

Conclusion

The significance of *C. dubius* var. *dubius* lies in its unique position at the intersection of ecology and pharmacology. As a soil stabilizer, it protects landscapes from degradation, and as a nutritional fodder plant, it supports livestock health. Its bioactive compounds, on the other hand, provide a biochemical foundation for future drug discovery. This ecological pharmacological synergy makes it a promising model species for sustainable bioprospecting that benefits both ecosystems and human health.

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Chapter 20

Spinifex littoreus (Poaceae): ecological and protective roles in coastal sand dune ecosystems

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Abstract: *Spinifex littoreus* (Burm.f.) Merr., locally known as Gurudanka in Odisha state, India, is a perennial sand dune grass widely distributed along tropical and subtropical coasts of Asia and the Pacific. It plays a pivotal role in stabilizing coastal dunes and protecting shorelines from erosion, along with providing shelter for many reptiles and insects. It is also a fodder grass for coastal herbivores. It has several ethnomedicinal uses, and pharmacological activities are also reported. Still, it is not a well-known grass species. Keeping the importance of *S. littoreus* in mind, a note on its habit, habitat, morphology, and diverse uses was presented in this chapter, along with photographs. Authors have visited the coastal areas of Odisha to collect information on medicinal and ecological uses of the plant, which are discussed in this chapter to highlight its importance and draw attention towards its sustainable use and conservation strategy.

Keywords: Grass, coastal, sand binding, restoration

Introduction

Coastal ecosystems are increasingly threatened by climate change, rising sea levels, and anthropogenic pressures such as urbanization and sand mining (Dong et al., 2024). Among the natural bioengineering solutions for coastal stabilization, dune-forming grasses hold a central role in mitigating erosion and protecting biodiversity (Paxton et al., 2024). *Spinifex littoreus* (Burm.f.) Merr., a stoloniferous grass (Figure 1) belonging to the Poaceae family, is one of the dominant species of tropical Asian sand dunes (Divyasree and Raju, 2019). In India, it is well documented along the east coast, including Odisha, Andhra Pradesh, and Tamil Nadu, where it forms extensive mats that trap and stabilize sand (Saxena and Brahman, 1996). It is native to the sandy shores of India, Sri Lanka, Southeast Asia, and the western Pacific islands, where it thrives on primary and secondary dunes exposed to high winds and saline conditions (Saxena and Brahman, 1996). Beyond its ecological value, *S. littoreus* is traditionally used in folk medicine for ailments such as digestive disorders, joint pain, and inflammation (Vedhamani et al., 2024).



Figure 1: Habitat of *S. littoreus* in sand dune areas

Recent phytochemical investigations have revealed an array of bioactive metabolites like alkaloids, flavonoids, tannins, steroids, astragalin, and kaempferol that support its reported antimicrobial, antioxidant, anti-inflammatory, and anticancer activities (Shakila, 2020; Vedhamani et al., 2024). Keeping the importance of this coastal grass species, an attempt has been made to gather the information from field and literature survey. This review and field survey integrates scattered information on *S. littoreus* to provide a comprehensive understanding of its ecological and pharmacological significance, highlighting its

potential for both coastal ecosystem management and biomedical applications. Field surveys were carried out between January and September 2025 in the coastal areas of Puri district, Odisha. The present note will also be useful for students, researchers, and conservationists.

Morphology: It is stout, glaucous, bushy grass, 60-120 cm high (Figure 2) and broad with long underground or superficial stolons. Leaves long, very rigid, 10-15 cm long, squarrose, recurved, pungent, margins spinulose-serrulate; sheaths often imbricate, inflated, dry striate, hirsute at the mouth; ligule hirsute. Male heads up to 15 cm diam., sessile at the angles of zigzag rachis with pungent lanceolate bracts, 1.9-4 cm long; racemes 5-8 cm long with the scabrous rachis produced at the tips into pungent spines resembling those of the female but short. Spikelets 1 cm long, glabrous, scaberulous. Lower glume shorter, ca 5-6.4 mm long, 7-9 nerved; upper glume similar but a little longer. Lower lemma lanceolate, 5-nerved, rigidly acuminate or subaristate; upper lemma usually a little longer (or shorter), subaristate or cuspidately acuminate.



Figure 2: Morphological characteristics of *Spinifex littoreus*

Female heads up to 32.5 cm diam.; bracts pungent up to 20 cm long. Female spikelets 1 - 1.3 cm long, partly sunken in the base of the needle-like rachis, which is supported by distichous bracts, some of which are 7.5 -15 cm long, others short, flatter, and 2.5 cm long. Glumes and palea all lanceolate-acuminate, membranous and subequal, outer

puberulous, lower 11-nerved, upper 5-7 nerved. Lower lemma 5-nerved, upper 5-7 nerved, bisexual; palea 2-nerved. Lodicules quadrate-oblong, 2-nerved. Style with stigmas 1.8 cm long (Saxena and Brahmam, 1996; Figure 3-4).

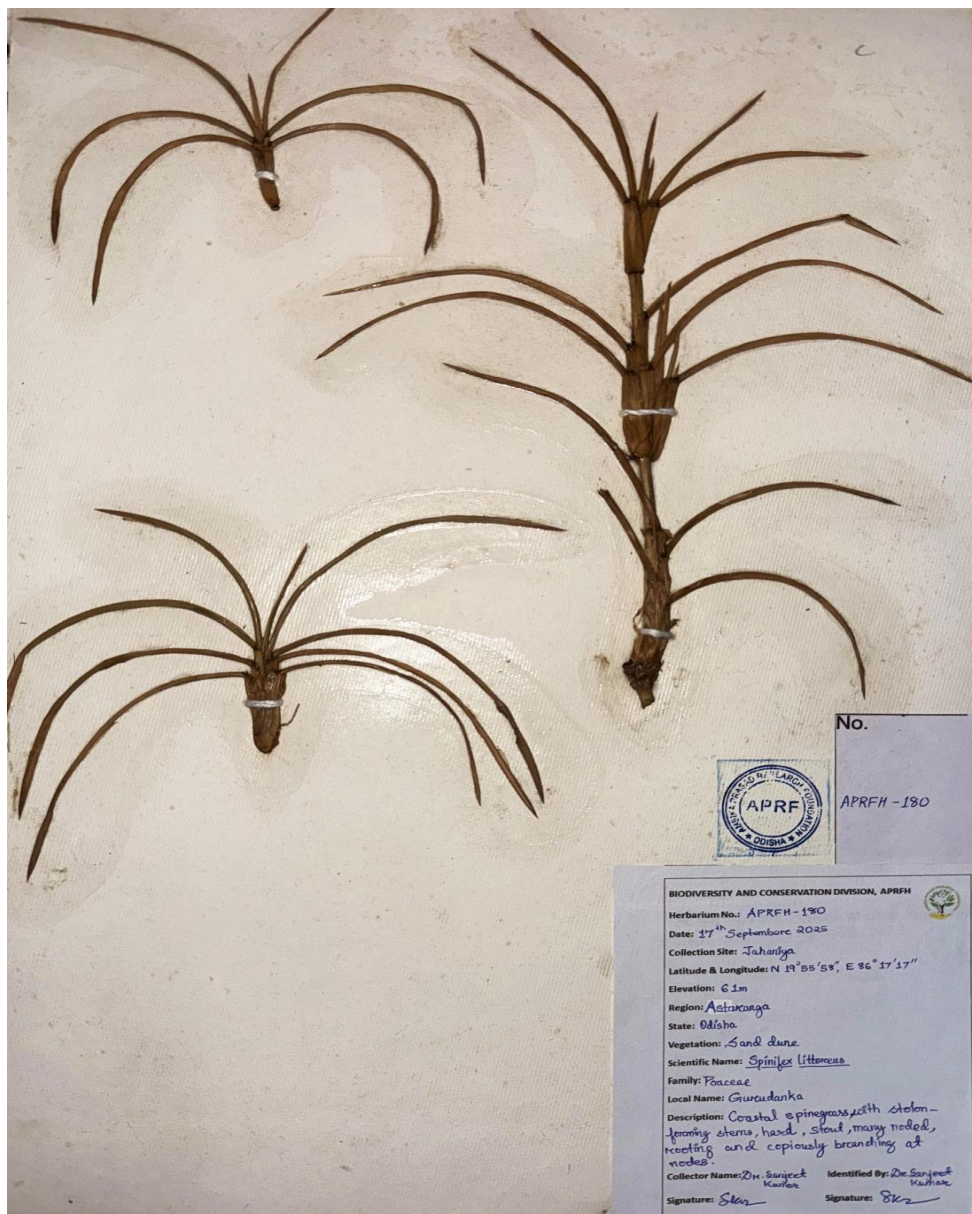


Figure 3: Herbarium specimen of *S. littoreus*

Ecological significance: The ecological significance of *S. littoreus* lies in its important role in maintaining coastal ecosystem balance and resilience. Through its extensive

stoloniferous growth, *S. littoreus* stabilizes sand dunes, mitigating coastal erosion and promoting dune formation. A herbarium specimen is prepared and submitted to the Herbarium unit, Ambika Prasad Research Foundation, Odisha, India (Figure 3).



Figure 4: Habit and natural appearance of *Spinfex littoreus*

This process not only enhances coastal protection against storms but also fosters habitat diversity for a range of organisms, including reptiles, insects, and small mammals. By supporting a complex network of dune-associated species, *S. littoreus* contributes to coastal biodiversity (Figure 5). Furthermore, its ability to trap sediments and facilitate dune accretion makes it an asset in the face of climate change, providing a natural buffer against sea-level rise and extreme weather events. As a result, *S. littoreus* has become an important

component of restoration programs aimed at promoting climate resilience through nature-based solutions.



Figure 5: Discussion with locals on sand dune flora and their ecological importance

Medicinal uses

During field survey, it was found that leaves paste is used to cure joint pain. In literature survey, diverse medicinal uses are noted and listed in Table 1 along with ecological significances (Figure 5).

Table 1: Medicinal and ecological aspects of *S. littoreus*

Medicinal uses	Sources	Ecological aspects
Root extract is used to treat digestive disorders	Vedhamani et al., (2025)	Bind the sand dune, provide shelter for reptiles and insects. Fodder grass of wildlife.
Root decoction is used to treat joint and muscle pain	Vedhamani et al., (2025)	
Leaves possess analgesic activity	Shakila, (2020)	
Leaves possess antimicrobial	Thirunavukkarasu et al., (2010)	
Leaves possess antioxidant	Vedhamani et al., (2024)	
Leaves possess anticancer	Vedhamani et al., (2024)	
Root possesses anti-inflammatory	Yogamoorthi and Priya, (2006)	
Leaves possess larvicidal efficacy	Nallaiyah and Newton, (2024)	

Pharmacological properties: Several studies have demonstrated the pharmacological activities of *S. littoreus* extracts (Table 1). Methanolic root extracts reduce inflammation and pain (Yogamoorthi and Priya, 2006). Leaf extracts inhibit the growth of pathogenic bacteria and fungi (Thirunavukkarasu et al., 2010). Methanolic leaf extracts exhibit larvicidal efficacy against mosquito larvae, suggesting potential in vector control (Nallaiyah and Newton, 2024). The above all reported pharmacological activities draw attention towards its ethno-pharmacological potential.

Conclusion

Spinifex littoreus exemplifies the intersection of ecological functionality and medicinal potential. As a natural engineer of coastal dunes, it plays a critical role in shoreline stabilization and biodiversity maintenance. Concurrently, its rich phytochemistry offers a

promising source of bioactive compounds for pharmaceutical development. Integrated approaches that combine ecological restoration with phytochemical research can unlock its dual value for climate resilience and drug discovery.

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Editor's Profile



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Grasses and sedges form the foundation of the major food webs that sustain both wildlife and human communities. The health and vitality of forests and associated ecosystems are directly linked to the abundance and diversity of fodder plants, particularly grasses and sedges, which provide essential nutrition for herbivores and, in turn, support higher trophic levels. A comprehensive understanding of native grasses and sedges is therefore crucial for protecting wildlife, as their conservation directly contributes to the preservation and restoration of grasslands.

Despite their ecological significance, many food, medicinal and cultural aspects of grasses and sedges remain underexplored and underutilized. This work seeks to document and these lesser-known attributes, with the aim of enriching fodder resources, promoting sustainable management practices and guiding future initiatives in wildlife conservation and grassland development. By integrating traditional knowledge with modern ecological perspectives, the study emphasizes the indispensable role of grasses and sedges in ensuring ecological balance, food security and biodiversity conservation.

