

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 provide a primary source of fodder for livestock and wild herbivores, 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 such as tannins, saponins, flavonoids, and phenolics

have been linked to antimicrobial, antioxidant, and anti-inflammatory activities, offering 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 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 author followed by published literature (Behera et al., 2025). 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 standard method (Jena et al., 2025). Antibacterial activity was done 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

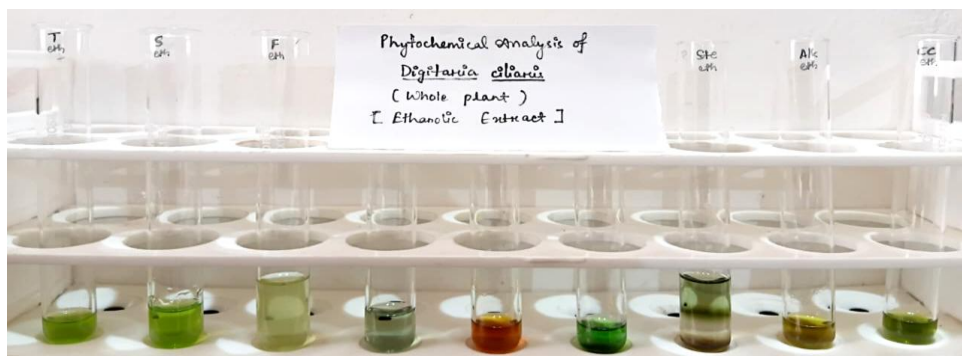


Figure 3: Phytochemical analysis using ethanolic extract



Figure 4: Phytochemical analysis using aqueous extract

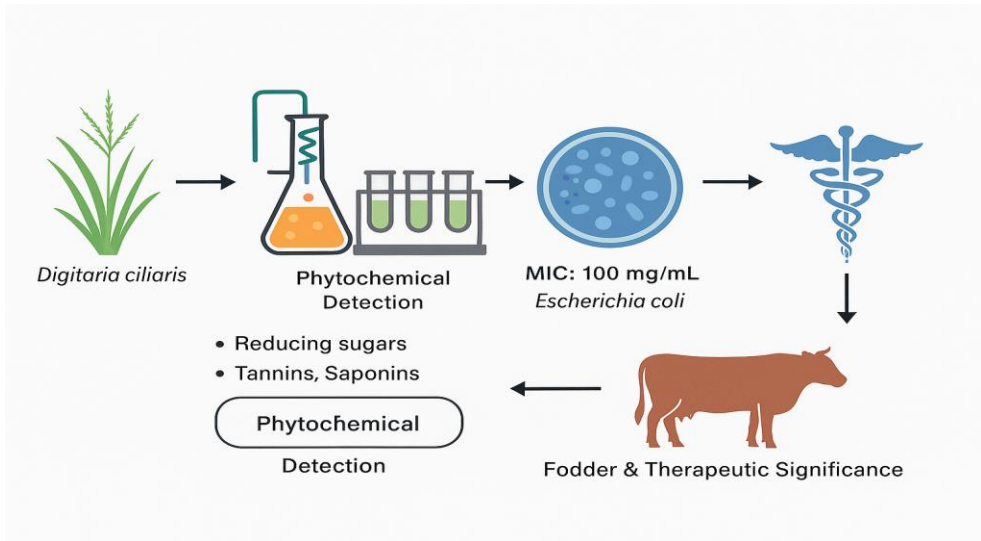


Figure 5: Significance of present study

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.

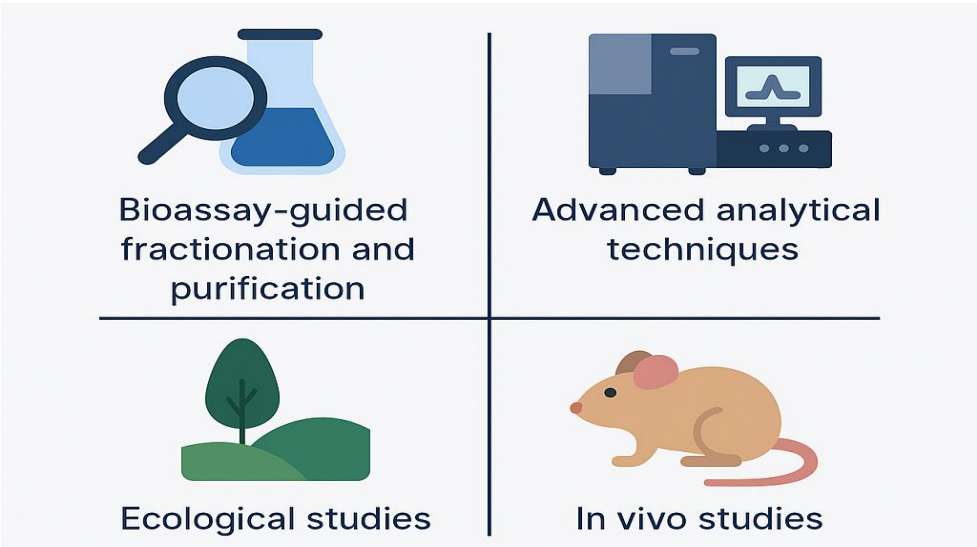


Figure 6: Future aspects of present study

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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