

## Revisiting Poaceae: antibacterial prospects in the era of antimicrobial resistance

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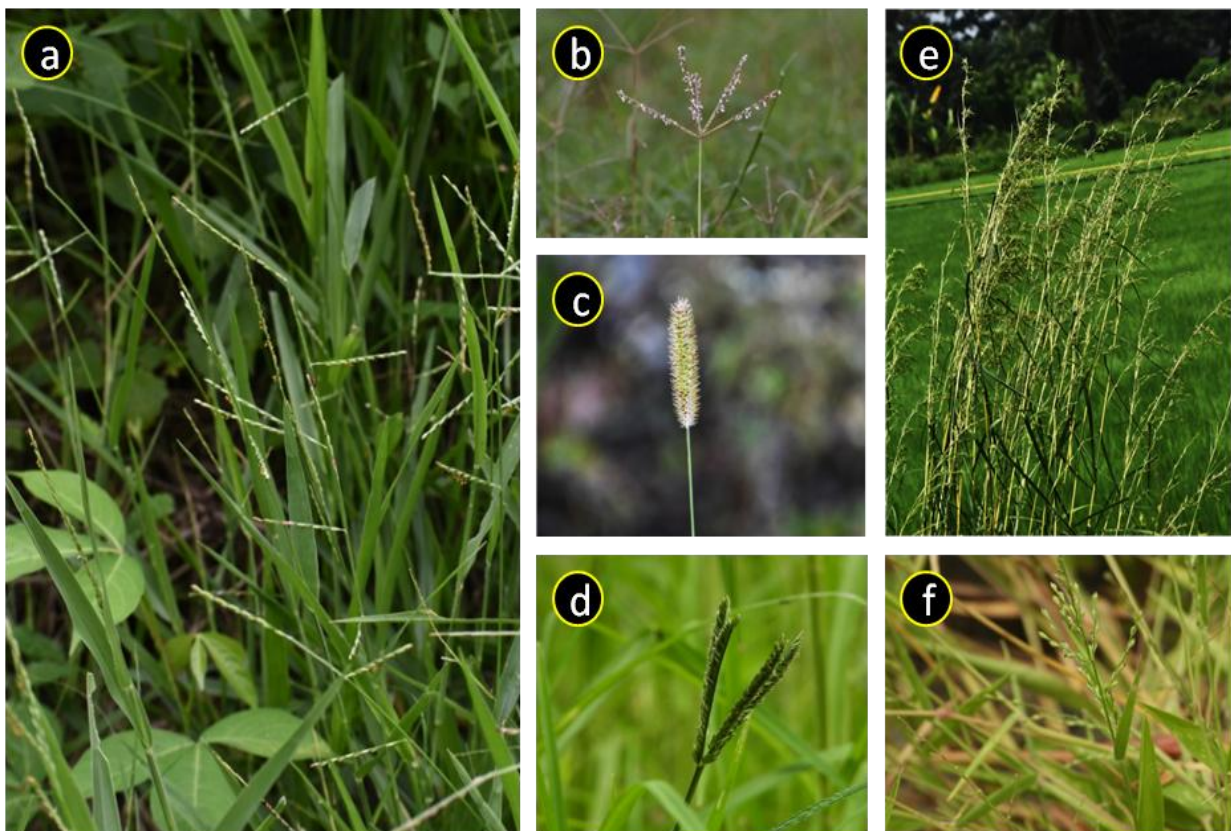
**Abstract:** The rapid rise of antimicrobial resistance necessitates the exploration of alternative sources of antibacterial agents. While medicinal plants have been extensively studied, grasses remain largely underexplored despite their global abundance and ecological significance. This review synthesizes existing knowledge on the antibacterial potential of Poaceae members, focusing on their activity against clinically relevant pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas* spp and more. Existing evidences indicate that several grasses exhibit measurable antibacterial activity, like *Eleusine indica* and *Digitaria* species. showing broad-spectrum effects. The presence of bioactive compounds such as phenolics, flavonoids, tannins and saponins significantly contribute to this activity. However, most studies remain limited to *in vitro* assessments, with considerable variability in methodologies and outcomes. This review highlights the need for systematic phytochemical investigations, mechanistic studies and *in vivo* validation to fully realize the pharmacological potential of Poaceae. Reframing grasses as sources of bioactive compounds offers new perspectives in ecological phytochemistry and antimicrobial drug discovery.

**Keywords:** Bacterial infections, grasses, pharmacology, Poaceae, secondary metabolites

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## Introduction

Worldwide, the growing concern of antibacterial resistance is unfolding alongside an increasing burden of bacterial infections and associated diseases (Salam et al., 2023). This challenge is not only driven by clinical misuse of antibiotics but is also deeply intertwined with ecological disruptions and shifting lifestyle patterns that facilitate the emergence and spread of resistant strains (Bengtsson-Palme et al., 2018). In response, medicinal plants have gained renewed attention as reservoirs of diverse bioactive compounds, offering promising avenues for the discovery of novel antimicrobial agents, capable of addressing this escalating crisis (Vaou et al., 2021). However, the notion of “medicinal plants” is often narrowly framed, frequently evoking images of trees, shrubs or well-documented herbal species. Grasses, in contrast, rarely occupy this conceptual space despite their unique presence and ecological significance (Sharma et al., 2025). Members of the family Poaceae are among the most widely distributed plant groups on earth, occurring across a spectrum of habitats ranging from biodiversity-rich landscapes to highly disturbed grasslands and even aquatic or semi-aquatic ecosystems (Behera et al., 2025). Their resilience and adaptability suggest complex interactions with surrounding microbial communities, potentially shaping unique phytochemical defenses (Sinha et al., 2023).



**Plate 1:** Members of Poaceae family (a) *Urochloa distachyos* (b) *Cynodon dactylon* (c) *Setaria pumila* (d) *Eleusine coracana* (e) *Cymbopogon citratus* and (f) *Urochloa ramosa*

Despite their abundance and central role in human life as staple foods, fodder and components of traditional ecological systems, grasses have remained relatively underexplored in pharmacological

research (Jethy et al., 2025; Kumar et al., 2025). This is particularly striking given that Poaceae (Plate 1) represents one of the largest plant families globally, yet its members are seldom investigated for antibacterial properties in comparison to other plant groups (Roy and Devi, 2025). Emerging evidence, however, indicates that several grass species possess measurable antimicrobial activity, supported by the presence of phenolics, flavonoids, tannins and other secondary metabolites (Sharma et al., 2025). In this context, revisiting the antibacterial potential of Poaceae is both timely and necessary. Understanding grasses not merely as ecological or agricultural entities but as sources of bioactive compounds opens new perspectives in phytochemistry and drug discovery. This review therefore aims to synthesize existing knowledge on the antibacterial properties of grass species, highlighting their relevance, current gaps and future prospects in addressing antimicrobial resistance.

### Methodology

The present study is based on an extensive survey of published literature related to family Poaceae. Scientific databases, including Google Scholar, Scopus, PubMed and Web of Science, were consulted to retrieve peer-reviewed research articles, review papers, ethnobotanical surveys and pharmacological studies. Keywords including “Poaceae,” “medicinal uses,” “phytochemistry,” “ethnopharmacology,” “antibacterial resistance”, “bacterial diseases” and “phytoconstituents” were used to review relevant publications. Additionally, regional floras, theses, books and reports documenting traditional knowledge and distribution patterns were examined. Only studies containing verifiable scientific or ethnomedicinal data were considered. Information obtained was critically analyzed and systematically organized under thematic sections to ensure clarity and coherence (Kumar, 2025; Sahu et al., 2026).

### Antibacterial activity

The compiled data (Table 1) indicate that grass species exhibit consistent, though moderate, antibacterial activity against a range of clinically relevant pathogens. A general trend of higher susceptibility in gram-positive bacteria such as *Staphylococcus aureus* and *Bacillus* spp. is evident. Likely due to structural differences in their cell walls (Fatima et al., 2018). Additionally, the reported anti-MRSA activity in *Digitaria sanguinalis* shows the potential of grasses in addressing antimicrobial resistance (Fatima et al., 2018). Notably, *Eleusine indica* and *Digitaria* species show broad-spectrum activity, while species like *Paspalum scrobiculatum* and *Setaria pumila* (Roy and Devi, 2025) demonstrate relatively lower MIC (Minimum Inhibitory Concentration) values, suggesting higher potency. The frequent targeting of *Escherichia coli* across multiple grass species highlights a possible ecological linkage between grasses and microbial pressures in their environment (Dash et al., 2026). While the observed activities are generally lower than standard antibiotics, these findings position grasses as promising sources of bioactive compounds rather than direct therapeutics. Overall, the results challenge the traditional neglect of Poaceae in pharmacology and emphasize their potential in antibacterial drug discovery. This can actually work as an alternative as well as a solution towards the excess extraction of medicinal plants and move slowly towards the easily available and underexplored species like grasses.

Table 1: Grass species exhibiting antibacterial activity grouped by target bacteria and associated diseases

Bacterium	Gram type	Associated diseases	Active grass species (with activity)	Source(s)
<i>Bacillus spp.</i>	Gram +ve	Food poisoning, opportunistic infections	<i>Cynodon dactylon</i> (5 and 8 mm), <i>Dactyloctenium aegyptium</i> (5 and 7 mm), <i>Setaria viridis</i> (6 and 8 mm), <i>Avena sativa</i> (5 and 7 mm), <i>Sorghum halepense</i> (7 and 9 mm), <i>Eragrostis tenella</i> (ZOI 13 mm), <i>Dinebra retroflexa</i> (ZOI 10 mm), <i>Urochloa ramosa</i> (8 and 9 mm)	Singh et al., (2022); Swami et al., (2024)
<i>Escherichia coli</i>	Gram -ve	Diarrhea, urinary tract infections (UTIs), gastroenteritis	<i>Dactyloctenium aegyptium</i> (MIC ~100 mg/mL), <i>Digitaria radicata</i> (MIC 40 µg/mL), <i>Eragrostis tenella</i> (ZOI 6 mm), <i>Dinebra retroflexa</i> (ZOI 8 mm), <i>Eleusine indica</i> (MIC 0.3 - 4.8 mg/cm <sup>3</sup> ), <i>Chloris barbata</i> (MIC 25 mg/mL), <i>Paspalum scrobiculatum</i> (MIC 12.5 mg/mL), <i>Setaria pumila</i> (MIC 12.5 mg/mL), <i>Digitaria chinensis</i> (MIC 50 mg/mL), <i>Urochloa distachyos</i> (MIC 12.5 mg/mL), <i>Eriochloa procera</i> (MIC 25 mg/mL), <i>Urochloa ramosa</i> (active at 400 µg/mL)	Shaikh et al., (2012); Roy and Devi, (2025); Dash et al., (2026)
<i>Neisseria gonorrhoeae</i>	Gram -ve	Gonorrhea (sexually transmitted infection)	<i>Digitaria abyssinica</i> (limited activity; MIC > 250 mg/mL)	Sapunyo et al., (2023)
<i>Pseudomonas spp.</i> ( <i>P. protogens</i> , <i>P. aeruginosa</i> )	Gram -ve	Respiratory infections, burn infections, hospital-acquired infections	<i>Cynodon dactylon</i> (ZOI 5 and 7 mm), <i>Dactyloctenium aegyptium</i> (ZOI 6 and 8 mm), <i>Setaria viridis</i> (ZOI 5 and 9 mm), <i>Avena sativa</i> (ZOI 7 and 9 mm), <i>Sorghum halepense</i> (ZOI up to 9 mm), <i>Urochloa ramosa</i> (6 and 8 mm), <i>Eleusine indica</i> (11 ± 0.8, 7 ± 0.4 and 12 ± 0.5 mm)	Al-Zubairi et al., (2011); Carvalho et al., (2019); Singh et al., (2022); Swami et

				al., (2024)
<i>Salmonella choleraesuis</i>	Gram -ve	Respiratory infections, blood stream infection	<i>Eleusine indica</i> (11 ± 0.7 mm)	Al-Zubairi et al., (2011)
<i>Salmonella typhi</i>	Gram -ve	Typhoid fever	<i>Eleusine indica</i> (MIC ~4.8 mg/cm <sup>3</sup> )	Dash et al., (2026)
<i>Staphylococcus aureus</i>	Gram +ve	Skin infections, wound infections, abscesses, pneumonia	<i>Digitaria radicata</i> (MIC 50 µg/mL), <i>Digitaria sanguinalis</i> (anti-MRSA compounds), <i>Urochloa ramosa</i> (5 and 7 mm), <i>Eleusine indica</i> (13 ± 0.9 and 10 ± 0.7 mm), <i>Zea mays</i> (MIC ≥1024 µg/mL).	Al-Zubairi et al., (2011); Fatima et al., (2018); Singh et al., (2022); Carvalho et al., (2019)
<i>Streptococcus</i> spp.	Gram +ve	Strep throat, pneumonia, meningitis	<i>Eragrostis tenella</i> (ZOI 13 mm), <i>Dinebra retroflexa</i> (ZOI 10 mm)	Shaikh et al., (2012)

(-ve = Negative, +ve = Positive)

### Research gaps

Despite enormous diversity of Poaceae, there are still few studies that connect phytochemical composition to antibacterial processes. Furthermore, the majority of research is limited to *in vitro* tests with little validation using *in vivo* models and bioassay-guided isolation.

### Future aspects

In order to isolate and describe active chemicals from potential grass species, future studies should concentrate on bioassay-guided fractionation. By combining molecular methods with ecological phytochemistry, mechanisms of action and adaptive importance may be clarified. To turn these discoveries into useful therapeutic uses, toxicity profiling, *in vivo* validation and synergistic research with current antibiotics are also crucial. Examining Poaceae in the context of ethnoveterinary and sustainable healthcare frameworks could increase their usefulness and could also shift the scenario against medicinal plant exploitation.

## Conclusion

Members of the Poaceae family have significant antibacterial activity against a variety of harmful pathogens, including both gram-positive and gram-negative bacteria. As this synthesis demonstrates, certain species such as, *Eleusine indica* and *Digitaria* species (*D. abyssinica*, *D. radicata*), show broad-spectrum potential despite the activity being generally mild, suggesting the existence of physiologically active phytochemicals. These results show the importance of grasses as reservoirs of antimicrobial chemicals and contest their traditional undervaluation in pharmaceutical research. Nonetheless, the variation in activity between species and extraction techniques emphasizes the need for more thorough and systematic research.

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