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Phragmites australis L.: A Systematic Review on Botanical Description Phytochemistry and Pharmacological Application

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ABSTRACT

Phragmites australis is a plant that belongs to the Poaceae family, also known as Gramineae. It is characterized by annual cane-like stems that arise from a robust and extensive rhizomatous system. P. australis is known for its pharmacological, ecological, and therapeutic properties, as it is rich in active biological substances, which endow it with antioxidant and anti-inflammatory activities. Many people from all over the world use basil in traditional medicine, including North African countries, especially Algeria, which they use to treat many organic and infectious diseases. On the other hand, according to scientific reports, the P. australis plant contains most of the major and biologically active molecules such as flavonoids, phenols, tannins, steroids, glycosides, and reduced sugars. Pharmacological studies also indicate that the plant has analgesic, antidiabetic, antihyperlipidemic, anti-inflammatory, antimicrobial, antioxidant, and hepatoprotective actions. In conclusion, P. australis may be one of the best sources of plant medicines that can be used to treat many acute and chronic diseases.

Keywords: *P. australis, Systematic review, Phytochemistry, Botany, Pharmacological activities*

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INTRODUCTION

Research on herbal medicine has grown to be one of the biggest scientific issues in the past 20 years (Pelkonen *et al*., 2014). Medicinal plants have long been used to treat or prevent a wide range of illnesses. Ethnopharmacological research indicates that over 1200 plants are utilized in traditional medicine across the globe for their biological properties (Salmerón-Manzano *et al*., 2020). The use of food and medicinal plants is a major part of the medication management of so-called chronic diseases in some traditional non-industrialized societies (China, some African, and Latin American countries) (Islam & Samir, 2021). Bioactive compounds found in medicinal plants serve a variety of purposes and are used in various domains. Of these substances, the secondary metabolites are most prominent in the field of medicine (Chetehouna *et al*., 2024). Specifically found in tropical and subtropical regions, *Phragmites Australis* is a worldwide annual herbaceous plant that is a member of the Poaceae family (Frahtia & Niemann, 2024). In addition to being used as a medicinal plant in Asian, central European, and Mediterranean nations, *Phragmites Australis* is also widely employed in Algerian traditional medicine to treat a variety of illnesses (Derouiche *et al*., 2017). *Phragmites Australis* is known to contain many active substances and is also considered a source of many dietary supplements (Sohaib *et al*., 2022). It has several pharmacological effects including; analgesic, antidiabetic, antihyperlipidemic, anti-inflammatory, antimicrobial, antioxidant, and hepatoprotective effects (Ren *et al*., 2022). This paper offers an up-to-date summary of the phytochemical, Botanical, and pharmacological properties of the *Phragmites Australis* based on the database (e.g., PubMed, Science Direct, NCBI, and Google Scholar).

MATERIALS AND METHODS

This review gathered, examined, and summarized the literature on *Phragmites Australis* botanical description, secondary metabolites, and biological features. PubMed, ScienceDirect, SpringerLink, Web of Science, Scopus, Wiley Online, Scifinder, and Google Scholar, as well as numerous patient offices, use scientific search engines such as PubMed, ScienceDirect, SpringerLink, Web of Science, Scopus, Wiley Online, Scifnder, and Google Scholar (e.g., WIPO, CIPO, USPTO) were used to collect all published articles about this species. The term '*Phragmites Australis* ' is frequently used, either alone or in combination with the terms 'chemical substances', 'botanical description', and 'pharmacological activity.' There were no language limitations. The titles, abstracts, and contents of the collected data were used to identify and manipulate them. The reference lists of the retrieved papers were also looked at to see if any other papers were relevant. Chemsketch version 12.01 was used to create the chemical structures.

Taxonomic and botanical description

Phragmites Australis is recognized by an array of designations, encompassing common reed, common cane, wild cane, reed grass, and additional appellations (Beaudette, 2020). It is a globally distributed plant species and it is recognized as one of the most invasive wetland plants (Hurley *et al*., 2024).

The botanical classification of Phragmites Australis is a subject of interest due to its widespread distribution and ecological significance. It belongs to the family Poaceae, also known as Gramineae (Watson & Clifford, 1976), and it is classified within the class Liliopsida, which is distinguished by its monocotyledonous flowering plant species. This class is encompassed within the broader taxonomic group of angiosperms, commonly referred to as flowering plants (Singh, 2003). Phragmites is the genus to which *Phragmites Australis* belongs, this genus is characterized by its widespread distribution and comprises numerous species that have evolved to thrive in wetland ecosystems (Lambertini *et al*., 2012).

P. Australis is characterized by annual cane-like stems that arise from a robust and extensive rhizomatous system. The stems are capable of attaining heights of up to 6 meters, exhibit a diameter ranging from 4 to 10 millimeters, and possess hollow internodes measuring 10 to 25 centimeters in length (Mal & Narine, 2004). Rhizomes are characterized as perennial structures that exhibit both horizontal and vertical growth orientations. The horizontal components of rhizomes facilitate the expansion of the clonal population, whereas the vertical segments are responsible for the emergence of annual erect stems. Furthermore, rhizomes are composed of extensive Aerenchyma tissue, which aids in gas exchange. Roots originate from rhizomes and various submerged portions of the shoots. The leaves exhibit a smooth texture, are alternately arranged, and possess narrow-lanceolate laminae measuring 20–70 cm in length and 1–5 cm in width, characterized by closely spaced nerves and tapering to elongated slender tips (Haslam, 1972). The inflorescence manifests as a terminal panicle, frequently measuring approximately 30 cm in length, characterized by a lax structure and exhibiting a color range from dull purple to yellow, with the principal branches supporting numerous spikelets. The branches are characterized by a smooth texture, typically adorned with sporadic clusters of elongated silky trichomes (Haslam, 1972).

Genetic and morphological diversity

Phragmites Australis displays considerable genetic variability, encompassing various subspecies and genotypes that have evolved to thrive in diverse climatic and geographical contexts. For example, within Europe, there exist pronounced genetic distinctions between Mediterranean and temperate forms of *Phragmites Australis*, which are also associated with other species such as *Phragmites Mauritianus* in Africa and *Phragmites Karka* in Asia (Lambertini *et al*., 2012).

The genetic diversity is further underscored by the existence of various ploidy levels within the species, which span from triploid to octoploid, with tetraploid and octoploid constituting the predominant forms (Gorenflot, 1976).

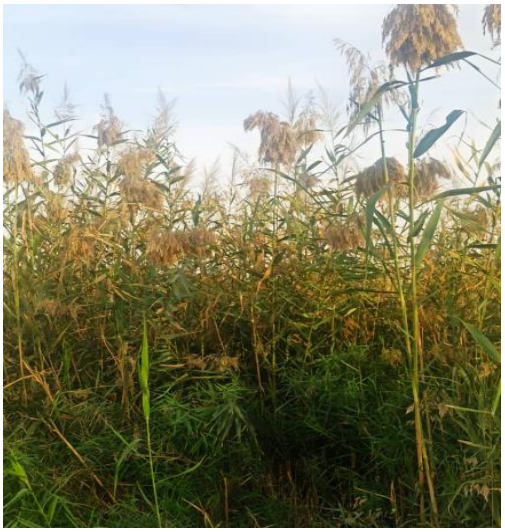

Figure 1. *Phragmites Australis* (Original photo, 2024).

Potential applications of phragmites Australis

The plant exhibits an extraordinary capacity for the uptake and sequestration of heavy metals, thereby rendering it an instrumental agent in the field of phytoremediation. It possesses the efficacy to eliminate metallic contaminants such as zinc, copper, and lead from polluted ecosystems, as substantiated by its application in engineered wetlands dedicated to the treatment of wastewater (Sellal & Belattar, 2024).

Beyond its ecological functions, *Phragmites Australis* presents promising opportunities for implementation in sustainable construction practices. The ash derived from this species, when employed as a partial substitute for cement, demonstrates pozzolanic characteristics, albeit it may lead to a diminution in the compressive strength of mortar. This application advances sustainable development by harnessing plant waste and mitigating cement consumption (Khatib *et al*., 2025).

Additionally, a recent study has explored the plant's capacity to boost immune responses and support liver health in fish indicating it could offer similar advantages in livestock, potentially promoting overall health and increasing disease resistance (Wang *et al*., 2022).

Traditional medicine applications

Plant metabolites have been used since 2600 BC, and over the following 4,000 years, secondary metabolites from plants were primarily used for food, medicine, and poison (Boulaares *et al*., 2024). A lot of these herbal products exhibit medicinal properties like antioxidant, anticancer, anti-inflammatory, antimicrobial, and antiviral effects (Chetehouna *et al*., 2024). The taxonomic group *Phragmites* has historically been employed for the management of diverse health ailments. Its derived extracts demonstrate a spectrum of pharmacological properties, encompassing analgesic, antidiabetic, antihyperlipidemic, anti-inflammatory, antimicrobial, antioxidant, and hepatoprotective actions (Farouk *et al*., 2023).

CONCLUSION

Phragmites Australis appears to include a lot of bioactive chemicals and to have a variety of important pharmacological

effects, according to the research findings. Antioxidant, anti-inflammatory, antimicrobial, and analgesic effects. The scientific evidence on this remarkable medicinal herb, however, is insufficient. As a result, we must infer that more research into this therapeutic herb is required.

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