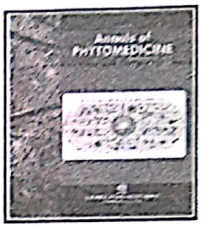
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Nutraceutical and pharmacological perspectives of Tuberose, *Agave amica* (Medik.): Insights into its bioactive phytoconstituents

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Abstract

Agave amica (Medik.) is a highly valued ornamental and aromatic plant that has gained increasing attention for its diverse phytochemical composition and emerging nutraceutical and pharmacological potential. This review comprehensively explores the botanical characteristics, phytochemical profile, biological activities and industrial applications of tuberose, with a particular focus on its bioactive constituents. The plant is rich in volatile compounds such as methyl benzoate, benzyl alcohol, eugenol and farnesol, along with non-volatile constituents including phenolics, flavonoids, terpenoids and glycosides. These compounds contribute significantly to its antioxidant, antimicrobial, anti-inflammatory, anticancer and neuroprotective activities. The review highlights the mechanisms of action of these bioactive compounds, emphasizing their role in modulating key cellular signalling pathways, reducing oxidative stress and interacting with enzymes and receptors. Advances in extraction technologies, including green extraction methods and supercritical fluid extraction, have improved the efficiency and sustainability of phytochemical recovery. Furthermore, the application of nanotechnology and encapsulation techniques has enhanced the bioavailability, stability and controlled delivery of tuberose-derived compounds, thereby expanding their therapeutic potential.

In addition to its pharmacological relevance, tuberose holds significant promise in the nutraceutical, cosmetic and wellness industries. Its essential oil is widely used in perfumery and aromatherapy, while its bioactive compounds are being explored for incorporation into functional foods and dietary supplements. Despite these promising applications, challenges such as variability in phytochemical composition, lack of standardization and limited clinical validation remain barriers to its widespread utilization. Future research should focus on comprehensive phytochemical characterization, standardization of extraction and formulation processes and clinical evaluation of its therapeutic efficacy. The integration of advanced omics technologies and computational approaches can further enhance the understanding of its biological mechanisms and facilitate drug discovery. Overall, *A. amica* represents a valuable yet underutilized bioresource with significant potential for the development of innovative nutraceutical and pharmaceutical products, contributing to sustainable healthcare and industrial advancement.

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