Flavonoids in traditional medicinal plants: A comprehensive review of biosynthesis, therapeutic applications, and cultural contexts

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DOI: https://www.doi.org/10.22271/phyto.2026.v15.i2a.15772

Abstract

This review synthesizes research on flavonoids present in medicinal plants, including traditional Chinese herbs, Ayurvedic plants, and Western medicinal herbs. It elucidates their health benefits, chemical properties, therapeutic applications, and the cultural and geographical contexts in which they are found. Additionally, it compares flavonoid content across various plant species to address gaps in understanding their biochemical diversity, biosynthesis, and ethnopharmacological significance. The review aims to assess chemical properties and biosynthetic pathways, evaluate flavonoid quantification methods, identify therapeutic applications, examine environmental influences, and compare regulatory mechanisms across taxa. Literature was selected based on integrative metabolomic, transcriptomic, phytochemical, and ethnobotanical studies from diverse geographic regions and cultural traditions, analyzed through comparative and critical frameworks. Key findings reveal extensive characterization of flavonoid biosynthesis involving MYB, bHLH, and WRKY transcription factors with tissue and specific expression patterns; significant variation in flavonoid content influenced by environmental factors such as altitude, light, and developmental stage; documented pharmacological activities including antioxidant, anti-inflammatory, anticancer, and antimicrobial effects supported by experimental evidence; and limited integration of cultural usage patterns with chemical and molecular data. These findings underscore the complexity of flavonoid metabolism shaped by genetic, environmental, and cultural factors. The review highlights the importance of establishing standardized quantification protocols and conducting functional validation to enhance translational potential. This comprehensive understanding guides future research, quality control, and the clinical use of flavonoid-rich medicinal plants worldwide.

Keywords: Flavonoids, medicinal plants, biosynthesis, therapeutic applications, cultural contexts