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Therapeutic potential of plant oleoresins: Pharmacological activities and nutraceutical applications

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Abstract

Plant oleoresins are concentrated natural extracts obtained from spices, aromatic plants, medicinal herbs and resin-producing species, containing both volatile and non-volatile bioactive constituents. Owing to their rich phytochemical composition, including phenolics, flavonoids, terpenoids, alkaloids, carotenoids, curcuminoids and piperine, oleoresins have gained considerable attention as promising therapeutic and nutraceutical agents. This review comprehensively summarizes the chemistry, extraction technologies, phytochemical composition, pharmacological activities and nutraceutical applications of commercially important plant oleoresins. Conventional and advanced extraction methods, including solvent extraction, supercritical CO_2 extraction, ultrasound-assisted extraction, microwave-assisted extraction and pressurized liquid extraction, are discussed along with modern characterization techniques. The review highlights the diverse pharmacological properties of oleoresins, including antioxidant, anti-inflammatory, antimicrobial, anticancer, antidiabetic, cardioprotective, neuroprotective, hepatoprotective, immunomodulatory and antiobesity activities, emphasizing their underlying molecular mechanisms. Furthermore, the role of oleoresins as functional food ingredients, dietary supplements, natural preservatives and components of functional beverages is explored. Emerging delivery systems such as nanoemulsions, liposomes, microencapsulation and nanoparticles are also discussed for enhancing stability and bioavailability. Despite challenges related to standardization, bioavailability and regulatory approval, advances in green extraction technologies and nanotechnology offer significant opportunities for future development. Plant oleoresins hold immense potential for applications in nutraceuticals, pharmaceuticals and functional foods, contributing to disease prevention, health promotion and sustainable healthcare solutions.

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