

From Traditional Remedy to Modern Phytomedicine: A Review of the Therapeutic Benefits of *Portulaca oleracea*

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Abstract:

Portulaca oleracea is a widely distributed edible medicinal plant that has long been used in traditional systems of medicine across Asia, the Mediterranean, and other parts of the world. This review explores the transition of *Portulaca oleracea* from a traditional folk remedy to a subject of modern phytochemical and pharmacological research. Traditionally valued for its cooling, anti-inflammatory, and wound-healing properties, the plant has been used to manage a variety of ailments including gastrointestinal disorders, skin diseases, diabetes, and infections. Contemporary phytochemical investigations have revealed that *Portulaca oleracea*

is rich in biologically active compounds such as omega-3 fatty acids, flavonoids, alkaloids, terpenoids, vitamins, and phenolic compounds, which contribute to its diverse therapeutic potential. Experimental and clinical studies have demonstrated significant antioxidant, anti-inflammatory, antimicrobial, antidiabetic, hepatoprotective, and neuroprotective activities. This review synthesizes current knowledge on the ethnomedicinal uses, phytochemical composition, and pharmacological properties of *Portulaca oleracea*, highlighting its potential role in the development of novel plant-based therapeutic agents. The study also emphasizes the need for further clinical validation and standardization to support its safe and effective integration into modern phytomedicine.

Introduction:

Portulaca oleracea L., commonly known as purslane, is a cosmopolitan succulent that has long been used as both food and medicine. Over the past decade, increasing attention has

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focused on its dense nutritional profile particularly omega-3 fatty acids and a diverse repertoire of bioactive metabolites that appear to undergird a wide spectrum of pharmacological effects (Kureshi et al., 2025; Li et al., 2024). Contemporary reviews synthesize evidence for antioxidant, anti-inflammatory, cardiometabolic, antimicrobial, neuroprotective, wound-healing and hepatoprotective activities, while also highlighting emerging applications in nanomedicine (Kureshi et al., 2025; Li et al., 2024). This review summarizes recent findings (primarily 2024–2025) and identifies key gaps to guide future research.

Phytochemical Profile and Nutritional Context

The medicinal promise of purslane is closely tied to its phytochemistry. Leaves and stems contain notable levels of omega-3 polyunsaturated fatty acids (PUFAs), especially α -linolenic acid, alongside flavonoids (e.g., kaempferol, quercetin), carotenoids, alkaloids, terpenoids, polysaccharides, vitamins (A, C, E, B-complex) and minerals (K, Mg, Ca, Zn) (Kureshi et al., 2025; Chandana et al., 2025). This matrix supports multiple molecular pathways antioxidant, anti-inflammatory and metabolic regulation that are implicated in chronic disease prevention (Banerjee et al., 2014; Li et al., 2024; Das et al., 2025; Chandana et al., 2025). Nutritionally, purslane's combination of PUFAs and antioxidants is unusual for terrestrial vegetables and provides a plausible mechanistic basis for its cardiometabolic and neuroprotective effects (Li et al., 2024; Chandana et al., 2025).

Antioxidant and Anti-inflammatory Activities

Reactive oxygen species (ROS) and chronic, low-grade inflammation drive the pathogenesis of cardiovascular disease, diabetes, neurodegeneration and cancer (Kesavan et al., 2023). Purslane extracts consistently demonstrate robust free radical scavenging and lipid peroxidation-inhibiting activity in vitro, with corroborating in vivo models indicating reduced oxidative stress markers (Rami et al., 2023; Kureshi et al., 2025; Bhosale et al., 2025). Flavonoids and carotenoids, together with vitamins C and E, likely mediate these effects, while polysaccharide fractions may contribute immunomodulatory benefits (Li et al., 2024; Bhosale et al., 2025). Anti-inflammatory properties have been linked to downregulation of pro-inflammatory mediators (e.g., TNF- α , IL-6, COX-2) and modulation of NF- κ B signaling, although the precise constituents responsible for these pathways require further isolation and standardized assays (Li et al., 2024; Kureshi et al., 2025).

Cardiometabolic Benefits

A substantive body of evidence supports cardioprotective, anti-atherosclerotic, lipid-lowering and antithrombotic actions of purslane. The omega-3 content contributes to improved lipid profiles and endothelial function, while antioxidant compounds reduce oxidative modification of LDL, a key atherogenic step (Kureshi et al., 2025; Li et al., 2024). Several preclinical studies and small human trials (as summarized in reviews) report decreases in total cholesterol, LDL-C, and triglycerides, with modest increases in HDL-C following purslane

supplementation or dietary inclusion (Li et al., 2024; Chandana et al., 2025). Moreover, anticoagulant/antiplatelet effects have been noted mechanisms may involve eicosanoid balance modulation via omega-3 metabolism suggesting potential benefits in thrombosis-prone states, though this raises safety considerations when combined with antiplatelet drugs (Kureshi et al., 2025; Li et al., 2024).

Purslane also exhibits antidiabetic and antihyperglycemic effects. Animal models and small clinical datasets indicate improved fasting glucose, insulin sensitivity, and glycemic variability, attributed to a synergy between polyphenols, polysaccharides and omega-3 fatty acids that influence insulin signaling and gut microbiota-mediated glucose homeostasis (Li et al., 2024; Sadaf et al., 2025). Nonetheless, heterogeneity in extract types, doses, and durations complicates meta-analytic conclusions; rigorous, adequately powered trials with standardized preparations remain a priority (Li et al., 2024; Kureshi et al., 2025).

Antimicrobial and Wound-Healing Properties

Traditional uses of purslane for skin ailments, infections and wound care are increasingly supported by laboratory evidence. Extracts exhibit antibacterial and antifungal activity against common pathogens, with proposed mechanisms that involve membrane disruption and inhibition of microbial enzymes by alkaloids and phenolics (Kureshi et al., 2025; Bhosale et al., 2025). In wound models, purslane's antioxidant and anti-inflammatory actions appear to accelerate re-epithelialization and collagen deposition, while its antimicrobial effects may reduce bioburden at the wound site (Sadaf et al., 2025; Chandana et al., 2025). Translation to clinical practice will require standardized topical formulations, dose-response studies and head-to-head comparisons with standard care (Chandana et al., 2025; Li et al., 2024).

Neuroprotection and Hepatoprotection

Preclinical studies suggest that purslane extracts exhibit neuroprotective effects under ischemic, excitotoxic, or neuroinflammatory conditions. Proposed mechanisms include attenuation of oxidative stress, modulation of neurotransmitter systems and anti-inflammatory signaling, potentially benefiting neurodegenerative disease pathways (Sadaf et al., 2025; Li et al., 2024). For the liver, hepatoprotective effects have been observed against toxin-induced injury, with reductions in serum transaminases and histologic evidence of decreased steatosis and oxidative damage, likely mediated by antioxidant and membrane-stabilising constituents (Sadaf et al., 2025; Bhosale et al., 2025). While these findings are promising, clinical validation is limited and warrants targeted human studies.

Antitumor Potential

In vitro assays report antiproliferative effects of purslane constituents against select cancer cell lines, coupled with pro-apoptotic signaling and inhibition of angiogenesis pathways (Chandana et al., 2025; Bhosale et al., 2025). However, current evidence remains preliminary and predominantly preclinical, standardization of extracts, identification of active molecules

and evaluation in animal models with pharmacokinetics and toxicity are prerequisites before contemplating clinical applications (Li et al., 2024; Kureshi et al., 2025).

Safety, Quality Control and Standardization

Purslane is widely consumed as a vegetable and generally regarded as safe; nonetheless, oxalate content may pose risks for individuals with calcium-oxalate nephrolithiasis or those requiring low-oxalate diets (Li et al., 2024; Chandana et al., 2025). Potential anticoagulant effects suggest caution in patients on antiplatelet or anticoagulant therapy (Kureshi et al., 2025; Li et al., 2024). A recurring theme across reviews is the lack of standardization: studies employ diverse extraction solvents (aqueous, ethanolic, methanolic), plant parts, harvest conditions, and doses, impeding cross-study comparability and dose-effect inferences (Li et al., 2024; Kureshi et al., 2025). Development of pharmacopeial monographs, validated chemical markers (e.g., specific flavonoids or omega-3 indices) and good agricultural and collection practices (GACP) will be essential for clinical translation (Kureshi et al., 2025; Chandana et al., 2025).

Emerging Directions: Functional Foods and Nanomedicine

Given its nutritional profile, purslane is a compelling candidate for functional foods and nutraceuticals targeting cardiometabolic and inflammatory conditions (Li et al., 2024; Chandana et al., 2025). Parallel work explores purslane extracts as green reductants or capping agents for biogenic metallic nanoparticles, opening avenues for antimicrobial coatings, targeted drug delivery, and photocatalytic biomedical applications (Kureshi et al., 2025; Li et al., 2024). To bridge bench to bedside, future studies should integrate standardized extract chemistry, mechanistic biomarkers (e.g., inflammatory cytokine panels, lipidomics) and clinically meaningful endpoints.

Discussion & Conclusion

Contemporary evidence portrays *Portulaca oleracea* as a nutrient-dense medicinal plant with multimodal pharmacology, notably antioxidant, anti-inflammatory, cardiometabolic, antimicrobial, neuroprotective, wound-healing, and hepatoprotective effects, supported by a diverse phytochemical reservoir (Kureshi et al., 2025; Li et al., 2024). While preclinical data are strong, clinical validation remains uneven and methodological heterogeneity limits definitive conclusions on efficacy and dosing. Advancing purslane from a promising traditional remedy to an evidence-based therapy will require standardized preparations, robust randomized controlled trials, and careful safety evaluation, especially regarding oxalate load and potential anticoagulant interactions (Li et al., 2024; Kureshi et al., 2025). Even so, the convergence of nutrition, phytochemistry, and emerging nanotechnology positions purslane as a versatile candidate in integrative strategies for chronic disease prevention and supportive care (Li et al., 2024; Chandana et al., 2025).

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