

Phytochemical characterization and biological activities of aqueous and methanolic extracts from selected medicinal plants

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Abstract

Medicinal plants are a rich source of bioactive compounds with potential therapeutic applications. This study evaluated the phytochemical composition, antioxidant, antidiabetic, and antibacterial activities of aqueous and methanolic leaf extracts of *Citrus limon* L., *Carica papaya* Linn., *Vitex negundo* L., and *Emblia officinalis* L. Physicochemical analyses confirmed the quality and purity of plant materials, while phytochemical screening revealed the presence of phenolics, flavonoids, tannins, saponins, carbohydrates, phytosterols, and fixed oils. Antidiabetic activity assessed via α -amylase inhibition showed concentration-dependent effects, with methanolic *E. officinalis* extract exhibiting the highest inhibition (85-90% at 500-600 $\mu\text{g/mL}$). Antioxidant activity, evaluated using the DPPH radical scavenging assay, demonstrated superior radical neutralization by methanolic extracts compared to aqueous extracts. Antibacterial activity against *Bacillus cereus* displayed a dose-dependent increase in inhibition zones, highlighting the extracts' antimicrobial potential. GC-MS analysis identified diverse bioactive compounds, including phenolic derivatives, fatty acids, terpenoids, and sterols, known for their antioxidant, antimicrobial, and anti-inflammatory properties. In silico toxicity prediction using ProTox-II indicated predominantly low to moderate toxicity, with key compounds such as α -amyrin, phytol, squalene, and dl- α -tocopherol being non-toxic. These findings demonstrate that the selected plant extracts, particularly their methanolic fractions, possess significant pharmacological potential and could serve as safe sources of natural antioxidants, antidiabetic agents, and antimicrobial compounds.

Keywords: *Citrus limon* L., *Carica papaya* Linn., *Vitex negundo* L., *Emblia officinalis* L., phytochemicals, antioxidant, antidiabetic, antibacterial, GC-MS, ProTox-II