



Comparative Review of Conventional and Novel Extraction Methods on the Phenolic Content of Plant Extracts: Implications for Food Applications

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Abstract

Plant-derived phenolic compounds are widely recognized for their potent antioxidant and antimicrobial properties, making them highly valuable in the food, pharmaceutical, and cosmetic industries. However, the efficiency of their extraction- and consequently their bioactivity -is critically dependent on the extraction method employed. This review provides a comparative analysis of conventional extraction techniques (maceration, Soxhlet) and novel methods, including ultrasound-assisted extraction (UAE), microwave-assisted extraction (MAE), supercritical fluid extraction (SFE), and pressurized liquid extraction (PLE), with a focus on their impact on total phenolic content (TPC) and antioxidant activity. A systematic literature search was conducted using PubMed, Scopus, and Science Direct databases for articles published between 2010 and 2025. The findings indicate that novel extraction methods significantly enhance phenolic yield (typically by 30–100%) compared to conventional approaches. MAE and UAE drastically reduce extraction time (from hours to minutes) and solvent consumption while minimizing degradation of heat-sensitive compounds. SFE is the most environmentally friendly technique but requires high-capital equipment. Key parameters influencing extraction efficiency -solvent type (particularly hydroalcoholic solvents), temperature (optimum 40–60 °C), extraction time, and solvent-to-solid ratio- are discussed. Response surface methodology (RSM) is highlighted as an effective tool for simultaneous optimization of these parameters. This review concludes that the choice of extraction method directly determines the quantity and quality of phenolic extracts. For industrial food applications requiring high yield, short processing time, and scalability, MAE and UAE are superior to conventional methods. Future research should focus on developing green solvents (e.g., natural deep eutectic solvents, NADES) and integrating novel techniques to achieve efficient, economical, and environmentally sustainable extraction processes suitable for food industry adoption.

Keywords: Phenolic compounds; Microwave-assisted extraction; Ultrasound-assisted extraction; Maceration; Green solvents; Response surface methodology; Food preservation

