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Solvent-free extraction of food and natural products

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HIGHLIGHTS

- Solvent-free extraction reduces extraction time and degradation
- Solvent-free acts extraction directly on the plant cell to release metabolites
- The combination of microwaves and "in situ" water permits direct extraction
- A pulsed electric field disrupts plant cells locally

ABSTRACT

This review presents useful and green techniques of solvent-free extraction used in ancient times, such as extraction of olive oil and citrus essential oil, and innovative techniques, such as pulsed electric field, microwave, instantaneous controlled pressure drop, and extrusion. We discuss the devices, their applications, mechanisms, and parameters influencing sample preparation prior to analysis of natural products.

Keywords:
Degradation
Extraction
Extrusion
Food
Microwave
Natural product
Plant cell
Pressing
Pulsed electric field
Solvent-free extraction

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1. Introduction

An analytical procedure for natural products comprises three steps:

- **extraction** [e.g., solvent extraction in single step or many steps, Soxhlet extraction, Kumagawa extraction, Clevenger extraction, Likens-Nickerson simultaneous distillation-extraction, and solvent extraction intensified by innovative techniques, such as microwave (MW) or ultrasound, pressure liquid solvent extraction, and supercritical solvent extraction];
- **evaporation** of the solvent by distillation for concentration or purification; and,
- **analysis** [e.g., gas chromatography (GC), GC coupled with mass spectrometry (MS), high-performance liquid chromatography (HPLC) coupled to UV or MS, nuclear magnetic resonance (NMR), X-ray diffraction (XRD) or gravimetry].

While the analysis step is complete after only seconds or minutes, extraction and