Synergistic intermittent heating and energy intensification of scale-up parameters in an optimized microwave extraction process

Olusegun AbayomiOlalere[a]*; Nour HamidAbdurahman*[a]*; Rosli bin MohdYunus*[a]*; Oluwaseun RuthAlara*[a]*; Chee-YuenGan*[b]

[a]Centre of Excellence for Advanced Research in Fluid Flow, University Malaysia Pahang, Pahang, Malaysia
[b]Analytical Biochemistry Research Centre (ABrC), Universiti Sains Malaysia, 11800 Penang, Malaysia

ABSTRACT

The most daunting challenge in microwave extraction is the variability in the output quality due to inherent uncontrollable temperature factors. This study focused on how to optimize the energy absorption and reduce the effects of temperature fluctuations on extracts quality in microwave extraction of white pepper. The Taguchi Orthogonal Optimization array was employed to simultaneously study the effects of four parameter settings on energy absorption. The result obtained from the three-level setting confirmed solvent-to-plant ratio (D) as the most significant factor in the optimization of absorbed microwave energy. This suggests that solvent-to-plant ratio provided a higher contribution to the extraction process with a decreasing significance level of D > A>B > C. The result from the microstructural analysis showed a 40.02% decline in the BET-surface area. The cumulative area decline and morphological changes indicated textural and dispersive transformation from the intermittent microwave electromagnetic heating. Moreover, The LC–MS/QToF analysis shows the presence of 25 and 186 bioactive compounds for negative (–ve) and positive (+ve) electrospray (ESI) ionization modes, respectively. These compounds are responsible for various biological activities of oleoresin oil which has a potential use in many medicinal applications.

KEYWORDS:

Microwave energy; White pepper; Taguchi optimization; Pulsed-heating; Microwave extraction