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Optimization of Plectranthus amboinicus (Lour.) Spreng Extraction Process using Microwave-Assisted Technique

Nabilah A. Samad[a], Dayang Norulfairuz Abang Zaidel[a,*], Eraricar Salleh[a], Abdul Halim Mohd Yusof[a], Daniel Joe Dailin[a], Dyg Norkhairunnisa Abang Zaidel[b]

[a]Department of Bioprocess and Polymer Engineering, School of Chemical and Energy Engineering,Universiti Teknologi Malaysia, 81310, Skudai, Johor, Malaysia
[a]Faculty of Engineering,Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia
dnorulfairuz@utm.my

Plectranthus amboinicus (Lour.) Spreng is a medicinal herb with bioactive compounds and known to have pharmacological properties. To obtain the extract of this herb, efficient extraction technique with high extraction rates is needed. Microwave-assisted extraction (MAE) is a green extraction technique with shorter irradiation time, less solvent used and lower CO_2 emission compared to other conventional extraction methods. The objective of the study was to determine the optimum operating extraction condition of *P. amboinicus* using MAE by varying the irradiation time, solvent concentration and solvent-to-solid ratio to obtain optimum yield extract and conducted using response surface methodology (RSM). The extract obtained at optimum condition was characterized for its antioxidant properties. The RSM results show that the optimum condition of *P. amboinicus* extraction was at 2 min, 30 % ethanol concentration and solvent-to-solid ratio at 30 mL/g with yield extract obtained at 39.81 wt %. The result antioxidants activity of the *P. amboinicus* extract showed IC_{50} value of 4.63 mg/mL while the inhibition of DPPH radical scavenging activity from the trolox standard was 5.48 ± 0.77 mg trolox equivalents (TEQ)/g extract. The study proved MAE is a better alternative compared to conventional extraction method with 16.8 % higher yield and the extract of *P. amboinicus* can be potentially applied in healthcare and pharmaceutical industry.

1. Introduction

Plectranthus amboinicus (Lour.) Spreng. is small flowering herbs which scattered naturally throughout the tropical countries and middle east regions like India, Asia and Australia. It is usually called as Indian borage due to its fleshy and famous succulent as it has oregano properties and refreshing odour (Arumugam et al., 2016). In Malaysia, *P. amboinicus* are known with various names such as *pokok bangun-bangun*, *bebangun, sedingin* or *hati-hati hijau* (Sabrina et al., 2014). Besides, *P. amboinicus* is among the most cited species in the family Lamiaceae mainly for its medicinal properties (Lukhoba et al., 2006) such as for digestive condition, skin condition, respiratory condition, infections and fever (Morton, 1992). This indicates that *P. amboinicus* has a pharmacological properties which is suitable for curing disease like cardiovascular, respiratory, skin, oral, digestive and urinary diseases.

Traditionally, the hydro distillation and soxhlet extraction methods are used to extract natural oils and this includes *P. amboinicus*. Soxhlet extraction requires a long 16 h of extraction time and uses more than 300 mL of solvent (Hadkar et al., 2013) with the yield ranged only between 23 wt% (Megha Rani et al., 2013) to 23.7 wt% (Megha Rani et al., 2016). To overcome this problem, microwave-assisted extraction (MAE) process was a simple and cheap equipment (Atirah et al., 2017) that has been proven to reduce extraction time, lessen solvent usage and improve the extraction yield as it uses microwave energy to heat solvents rapidly and efficiently with an ability to conduct homogeneous heating on natural product and solvent (Jain et al., 2009). MAE requires only 10 to 20 mL of solvent and 30 to 45 s of irradiation time depending on the natural product used for the extraction (Hadkar et al., 2013). Study by Wang and Weller (2006) has reported that MAE is a comparable extraction technique to other technique such as subcritical water extraction, supercritical fluid

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