UNIVERSITI TEKNOLOGI MARA

KINETIC BEHAVIOUR OF *CHRISTIA VESPERTILIONIS* OIL IN SUPERCRITICAL CARBON DIOXIDE

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ABSTRACT

Public interest in natural drugs has enormously increased in industrialized countries with expanding use of plants and herbal medicines. Recently, one of the plant herbs involves in curing cancer diseases has emerged and is recognized as *Christia vespertilionis*. Previously, *Christia vespertilionis* was extracted using solvent extraction such as hexane, methanol and dichloromethane. Unfortunately, conventional solvent was toxic, unsafe and might contaminate the extract of the product especially product that were used for medicinal purposes. Therefore, extraction of *Christia vespertilionis* plant using pure supercritical carbon dioxide (SC-CO_2) without any co-solvent was assessed for the first time. The aim of the research is to investigate kinetic behaviour of *Christia vespertilionis* oil in SC-CO_2 fluid in terms of extraction yield, oil's solubility, mass transfer and phytocompound's characterization. The effect of extraction parameter such as temperatures (40 to 85°C) and pressures (276 to 414 bar) of SC-CO_2 extraction on yield, solubility and mass transfer of *Christia vespertilionis* oil were evaluated. Extracted oil was then analysed under gas chromatography mass spectrometry according to their retention indices and mass spectra. Experimental data of solubility was correlated using four empirical of density-based models i.e. Chrastil (1982), del Valle and Aguilera (1988), Adachi and Lu (1983), and Sparks et al. (2008) models. Furthermore, behaviour of extraction yield and mass transfer of oil in solid and fluid phases was modeled using a Lack's plug flow model by Sovova (1994). Results demonstrated that the oil yield and solubility were highly dependent on the extraction pressure. The highest yield of 13.54 mg oil/g dry sample and oil's solubility of 0.167 mg oil/g CO_2 were obtained at 60°C and 414 bar. Result revealed that all empirical density based models were able to predict the solubility of *Christia vespertilionis* oil in SC-CO_2. Best fitting method showed that Adachi and Lu model gave the best correlation with the lowest % AARD value of 1.61%. A good adjustment was achieved when using Sovova (1994) model in describing the SC-CO_2 extraction process of *Christia vespertilionis* plant. Close correspondence between experimental and predicted yield confirmed the adequacy of Sovova model for predicting the output at the given extraction conditions. Furthermore, a well-defined of mass transfer phenomenon of SC-CO_2 extraction process where the highest mass transfer coefficient of solute in solid phase of 0.02441 min^{-1} and in fluid phase i.e. 22.67 min^{-1} was obtained. Component analysis result showed that the extract exhibited higher content of medicinal compounds, primarily from class of steroids, terpenoids, ester and fatty acids that comprises of cholestan-3-ol 2-methylene-(3β,5α)-, hexahydro farnesyl acetone, l-ascorbyl 2,6-dipalmitate, methyl oleate, oleic acid, palmitoleic acid, phytol and α-monoolein. Those compounds have been reported to possess various therapeutic applications such as anticancer, antimicrobial, anti-inflammatory, antibacterial, antioxidant and other pharmacological activities. The prediction of kinetic behaviour of *Christia vespertilionis* oil in SC-CO_2 obtained in this study can be used as future development mainly for equipment design process.

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