

UNIVERSITI TEKNOLOGI MARA

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

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Chemical Engineering)

Faculty of Chemical Engineering

June 2019

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-CO₂) 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-CO₂ fluid in terms of extraction yield, oil's solubility, mass transfer and phytochemical's characterization. The effect of extraction parameter such as temperatures (40 to 85°C) and pressures (276 to 414 bar) of SC-CO₂ 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 CO₂ 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-CO₂. 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-CO₂ 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-CO₂ 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, 1-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-CO₂ obtained in this study can be used as future development mainly for equipment design process.

ACKNOWLEDGEMENT

In the Name of Allah, the Most Gracious, the Most Merciful, Alhamdulillah, I am very grateful to Allah S.W.T., Originator of the heavens and the earth, for giving me the opportunity to increase knowledge in this challenging world. First and foremost, I would like to express my sincere appreciation and deeply thank to my research supervisor, Dr. Norhuda Ismail for her guidance, encouragement, valuable suggestions, moral support and patience throughout this project work. She always been there for me whenever there are difficulties arise. I really appreciate her efforts and suggestions and for giving me the opportunity to pursue this research. Furthermore, I would like to thank to my co-supervisors, Prof. Dr. Norazah Abd Rahman and Dr. Ana Najwa Mustapa for their willingness in teaching, motivating and helping me which contributes tremendously to this project.

Special thanks are extended to technicians in the Faculty of Chemical Engineering, Mr. Mohd Yazid Yusof, Mrs. Nor Suhaila Sabli and Mr. Mohd Faez Sarulan for their assistance and guidance where they were always there to help me in setting up and operate experimental equipment in the laboratory. Thank you for your time, efforts and valuable advice on certain aspect of work during my research study. I also would like to express sincere gratitude towards Kementerian Pendidikan Tinggi (KPT) for providing financial support under MyBrain15 programme which helps me in bearing the cost of expenses throughout this research works.

Finally, an honourable mention goes to all my family and friends for supporting me and encouraging me in completing this project. In addition, I wish to express my sincere appreciation and love to my beloved husband, Muhammad Afiq Rozali and my lovely daughter, Afia Alisha Muhammad Afiq. Their continuous support, love, understanding and patience have encouraged me in completing my research work. Finally, special thanks to my postgraduate friends who have encouraged me directly and indirectly throughout my research and who has been helpful in any ways towards the success of this project. Without the help from each of you, this project might not be a success. Thank you so much.

TABLE OF CONTENT

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF PLATES	xvii
LIST OF SYMBOLS	xviii
LIST OF ABBREVIATIONS	xx
LIST OF NOMENCLATURE	xxii
CHAPTER ONE: INTRODUCTION	1
1.1 Background of Study	1
1.2 Problem Statement	2
1.3 Research Objectives	4
1.4 Scopes and Limitations of Study	4
1.5 Significance of Study	5
1.6 Thesis Chapter Outline	5
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Overview of <i>Christia vespertilionis</i>	7
2.2 Medicinal Components of <i>Christia vespertilionis</i>	8
2.3 Classical Approaches for Natural Plant Extraction	8
2.3.1 Steam Distillation and Hydrodistillation Methods	9
2.3.2 Disadvantages of Steam Distillation and Hydrodistillation Methods	9
2.3.3 Solvent Extraction Method	10
2.3.4 Disadvantages of Soxhlet Extraction Method	10

2.4	Supercritical Fluid Extraction Process	15
2.5	Supercritical Carbon Dioxide Extraction	20
2.6	Properties of Supercritical Carbon Dioxide	21
2.6.1	Density of Supercritical Fluid	23
2.6.2	Viscosity of Supercritical Fluid	24
2.6.3	Diffusivity of Supercritical Fluid	25
2.7	Factors that Influence the Extraction Efficiency of Supercritical Carbon Dioxide	30
2.8	Sample Pre-treatments	41
2.8.1	Effect of Moisture Content	41
2.8.2	Effect of Sample Particle Size	43
2.8.3	Effect of Microwave Radiation	47
2.9	Mathematical Modeling of Supercritical Fluid Extraction Process	48
2.9.1	Solubility Modeling	49
2.9.1.1	<i>Previous Literatures on Application of Empirical Models for Solubility Prediction</i>	49
2.9.1.2	<i>Solubility Modeling using Empirical Models</i>	53
2.9.1.3	<i>Comparison between Empirical and Thermodynamic Models for Solubility Modeling</i>	59
2.9.2	Modeling of Extraction Oil Yield	62
2.9.2.1	<i>Previous Literatures on Modeling of Extraction Oil Yield (SFE Process)</i>	63
2.9.2.2	<i>Extraction Oil Yield Modeling using Sovova (1994) Model</i>	72
	CHAPTER THREE: RESEARCH METHODOLOGY	77
3.1	Selection of Operating Conditions for Extraction Process	79
3.2	Materials	80
3.2.1	Raw Material	80
3.2.2	Chemicals	80
3.3	Sample Pre-treatments Before Extraction Process	80
3.3.1	Moisture Content Determination	81
3.3.2	Particle Size Determination	81
3.3.3	Microwave Pre-treatment	82
3.3.4	Determination of Extraction Time	82