UNIVERSITI TEKNOLOGI MARA

MICROWAVE ASSISTED HYDRODISTILLATION OF *CLINACANTHUS NUTANS*

NUR SYUHADA BINTI MAULUD

Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons.)
(Chemical)

Faculty of Chemical Engineering

July 2019

ACKNOWLEDGEMENT

Firstly, I wish to thank Allah S.W.T for giving me the opportunity to embark on my degree and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Dr. Atikah Kadri for continuous support, motivation and immense knowledge. Her guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor for my degree study.

Besides my advisor, my sincere thanks goes to master student, Astri Fadhilah who willingly help me without fail and keep motivating me to finish this research successfully. Thank you kak As for continuous lesson and knowledge that you shared with me and keep spreading your positive vibes to other people as well. Special thanks to my close friends for helping me with this project. Thank you for lending your ears and shoulders every time I shared my problems.

This thesis is specially dedicated to the loving memory of my very dear late mak and ayah for the vision and determination to educate me. Thank you for your understanding and never bragging whenever I busy doing this project. This piece of victory is dedicated to both of you. Alhamdulillah, I am finally done with this project, mak. I miss you mak, this is for you. Not to forget, my siblings Abang, Apis and Adik who consistently support me spiritually and financially to motivate me to end this degree journey with flying colours.

ABSTRACT

Microwave Assisted Hydrodistillation (MAHD) was used to extract *Clinacanthus nutans* (*C.nutans*) in order to take advantage on this novel extraction to evaluate the potential of MAHD. Different power of microwave such as 300W, 400W and 600W were investigated on extraction yield produced and compared with conventional hydrodistillation. Also, the effect of MAHD and HD extraction on chemical components of *C.nutans* extract were evaluated using GC-MS chromatography and to evaluate the mechanism of MAHD by verifying through first order and second order kinetic model. The condition of extraction was optimized at 6 g of plant sample, ratio of plant sample to solvent was kept at 1:14 (w/v) and extraction time of 80 min for MAHD and 120 min for HD. Higher yield, 3.33% was able to obtain through MAHD method for extraction time of 80 min at power of 300 W compared to conventional hydrodistillation (HD) which only produced 1.67% of oil yield. Second order kinetic model was proven to be a suitable model to simulate on basis of MAHD and HD experiment results. High coefficients of correlation (R^2) were simulated by the second order model, which satisfactorily applied to the process. MAHD is proven to produce more quality components compared to HD when analysed by GC-MS.

TABLE OF CONTENT

PLAGIARISM DECLARATION ..... **I**
SUPERVISOR'S CERTIFICATION ..... **II**
COORDINATOR'S CERTIFICATION ..... **III**
AUTHOR'S DECLARATION ..... **IV**
ACKNOWLEDGEMENT ..... **V**
ABSTRACT ..... **VI**
LIST OF TABLES ..... **IX**
LIST OF FIGURES ..... **X**
LIST OF SYMBOLS ..... **XII**
LIST OF ABBREVIATIONS/NOMENCLATURE ..... **XIII**

CHAPTER ONE : INTRODUCTION **1**

1.1 BACKGROUND STUDY 1
1.2 OBJECTIVES OF THE STUDY CLEARLY IDENTIFIED 3
1.3 PROBLEM STATEMENT 3
1.4 SCOPE OF RESEARCH 4

CHAPTER TWO : LITERATURE REVIEW **5**

2.1 INTRODUCTION 5
2.2 CLINACANTHUS NUTANS LINDAU 5
2.2.1 Ethnomedicinal benefits and uses 8
2.2.2 Phytochemical content 11
2.2.3 Pharmacological effects 16
2.3 EXTRACTION METHOD 22
2.3.1 Conventional extraction 23
2.3.2 Advanced Technology Extraction Method 28
2.4 MICROWAVE-ASSISTED HYDRODISTILLATION 35
2.5 PARAMETER AFFECTING THE EXTRACTION PROCESS 40
2.5.1 Extraction Time 40
2.5.2 Microwave Power 42
2.5.3 Water to plant material ratio 43
2.6 KINETIC MODELLING 45
2.6.1 First-Order Model 45
2.6.2 Second-Order Model 46
2.6.3 Peleg's model 47

CHAPTER THREE : RESEARCH METHODOLOGY **50**

3.1 INTRODUCTION 50
3.2 MATERIALS 50
3.3 SAMPLE PREPARATIONS 50
3.4 MICROWAVE-ASSISTED HYDRODISTILLATION 51

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND STUDY

*Clinacanthus nutans (*Burm. f.) Lindau (*C.nutans)* is well known in Southeast Asia primarily in Malaysia, Indonesia and Thailand as a useful traditional medicinal plant. The plant belongs to the family member of Acanthaceae and genus *Clinacanthus* with the specific epithet *nutans* (Kong & Abdullah Sani, 2017). It has several name based on native languages of countries. "Belalai Gajah" or Sabah snake grass is locally named in Malaysia while in Thailand, this plant is recognized as Saled Pangpon Tua Mea (saliva of female mongoose) or Phaya Plong Thong or Phaya-Yor (Yahaya et al., 2015). Nowadays, this plant is not only can be found in Sabah but all around Malaysia since it has been widely cultivated in all states of Malaysia due to its abundance of valuable values. Public awareness in using medicinal herbs in treatment, which are found to be safe in consumption, has increased the demands for herbal remedies. At the moment, many researchers attracted to make research on this plant for its medical potency in treatment of skin rashes, wounds, burns and virus herpes simplex. Several studies such as from Pongmuangmul et al., (2016) have been done on this plant to study digalactosyl diglyceride (DGDG) and monogalactosyl diglyceride (MGDG) for their in vitro antiviral activities against herpes simplex virus type 1 (HSV-1) and type 2 (HSV-2). Furthermore, gout, uterine fibroid, diabetes, liver cancer and kidney syndrome are treated using *C.nutans* as traditional remedy in Malaysia (Sekar & Rashid, 2016). Skin-related diseases such as varicella-zoster virus (VZV) lesions and herpes infection, snake bites as well as skin rashes are treated using *C.nutans* in Thailand up until Thai Ministry of Health has shortlisted *C.nutans* as one of the medicinal plants for public healthcare (Yeo et al., 2018).

According to the previous study, this plant possesses anti-hepatitis, anti-herpes, anti-inflammatory, anti-venom, analgesic, antiviral and antioxidant properties due to its phytochemical compound content in plant. In addition, this short shrub with hairy branches and small oblong leaves contains lupeol, β-sitosterol, stigmasterol, botulin,