

**OPTIMISATION OF KAFFIR LIME LEAVES
(*Citrus hystrix*) VOLATILE OIL EXTRACTION
BY PRESSURISED LIQUID EXTRACTION (PLE)
USING RESPONSE SURFACE METHODOLOGY (RSM)**

ABDUL RAHMAN BIN ABDUL GHAFAR

**BACHELOR OF SCIENCE (Hons.)
FOOD SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCES
UNIVERSITI TEKNOLOGI MARA**

JANUARY 2013

This Final Year Project entitled “**Optimisation of Kaffir Lime Leaves (*Citrus hystrix*) Volatile Oil Extraction by Pressurised Liquid Extraction (PLE) Using Response Surface Methodology (RSM)**” was submitted by Abdul Rahman bin Abdul Ghafar, in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Food Science and Technology, in the Faculty of Applied Sciences and was approved by

Dr. Zaibunnisa bt. Abdul Haiyee
Supervisor
B.Sc. (Hons.) Food Science and Technology
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Dr. Normah bt. Ismail
Project Coordinator
B.Sc. (Hons.) Food Science and
Technology
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Assoc. Prof. Dr. Noorlaila Ahmad
Programme Coordinator
B.Sc. (Hons.) Food Science and
Technology
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam
Selangor

Date: _____

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	ix
ABSTRAK	x
CHAPTER 1 INTRODUCTION	
1.1 Background and problem statement	1
1.2 Significance of study	3
1.3 Objectives of study	4
CHAPTER 2 LITERATURE REVIEW	
2.1 Essential oils	5
2.2 Volatile compounds	5
2.2.1 Composition of volatile compounds in kaffir lime leaves	6
2.2.1.1 Citronellal	6
2.2.1.2 Sabinene	7
2.2.1.3 Myrcene	7
2.2.1.4 α -pinene	8
2.3 Citrus species	9
2.4 Kaffir lime (<i>Citrus hystrix</i>)	10
2.4.1 Uses and products	10
2.5 Extraction methods for volatile oils	11
2.5.1 Pressurised Liquid Extraction (PLE)	11
2.5.1.1 Extraction parameters	13
2.5.2 Other methods of extractions	16
2.5.2.1 Distillation	16
2.5.2.2 Soxhlet extraction	17
2.5.2.3 Solvent extraction	18
2.5.2.4 Supercritical Fluid Extraction (SFE)	19
2.6 Response Surface Methodology (RSM)	20

CHAPTER 3 METHODOLOGY

3.1	Materials	22
3.1.1	Samples	22
3.2	Chemicals	22
3.3	Methods	23
3.3.1	Moisture content	23
3.3.2	Pressurised Liquid Extraction (PLE)	23
3.3.3	Optimisation of kaffir lime leaves volatile oil using Response Surface Methodology (RSM)	24
3.3.4	Gas Chromatography/Mass Spectrometry (GC/MS)	25
3.3.5	Statistical analysis	25
3.3.6	Oil yield	25
3.3.7	Profiling of flavour compound	26

CHAPTER 4 RESULTS AND DISCUSSION

4.1	Moisture content of kaffir lime leaves	27
4.2	Optimisation of kaffir lime leaves extraction by Pressurised Liquid Extraction (PLE)	28
4.2.1	Model building and selection	31
4.2.2	Validation of selected model	33
4.2.3	Significant variables terms	34
4.2.4	Optimisation condition for kaffir lime leaves volatile oil extraction by PLE	38
4.3	Citronellal compound and yield of volatile oil from kaffir lime leaves extraction	41
4.4	Major compounds in kaffir lime leaves volatile oil	41

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1	Conclusion	45
5.2	Recommendation	45

CITED REFERENCES	46
APPENDICES	51
CURRICULUM VITAE	52

ABSTRACT

OPTIMISATION OF KAFFIR LIME LEAVES (*Citrus hystrix*) VOLATILE OIL EXTRACTION BY PRESSURISED LIQUID EXTRACTION (PLE) USING RESPONSE SURFACE METHODOLOGY (RSM)

Kaffir lime leaf (*Citrus hystrix*) is a source of natural flavouring widely used for a long term in the Asian country. The major constituent of *Citrus hystrix* has been reported is citronellal which is responsible for flavour. Usually kaffir lime leaves flavour available in the market is synthetic. Thus, this study is to introduce a natural kaffir lime leaves flavour based on extraction. Generally, conventional method has many disadvantages like production of thermally destructive compounds in the extract, time consuming and lower yield of the extract obtained. Current extraction methods like hydrodistillation and Soxhlet extraction are tedious, labour and time consuming. Thus, the major objectives of this study were to optimise more efficient and rapid Pressurised Liquid Extraction to produce quality kaffir lime leaves oleoresin. Optimised Pressurised Liquid Extraction conditions were at a temperature of 65.65 °C and a static time of 5.02 minutes. Flavour profiling of the extract obtained from this optimised condition was also been carried out using GC-MS. The compounds determined were sabinene, myrcene, α -pinene and citronellal. The concentration of the major marker compound, citronellal in the extract was 0.28 mg/100g. Moisture content in the fresh leaves was 59.22±0.39% and for dried leaves was 13.15±0.27%. The total percentage yield of the extract obtained using optimised condition was 56.16%. The volatile oil was analysed by using GC-MS to identify the major marker compound and the flavour profile of *Citrus hystrix*.