



Faculty of Engineering

GINGER ESSENTIAL OIL SYNTHESIS BETWEEN CHINA AND KUCHING LOCAL GINGER FOR INSECT REPELLENT

Wong Fong Fei

Bachelor of Engineering with Honours

(Chemical Engineering)

2022

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (✓)

Final Year Project Report

Masters

PhD

✓

DECLARATION OF ORIGINAL WORK

This declaration is made on the 28th day of June 2022.

Student's Declaration:

I WONG FONG FEI (68072) DEPARTMENT OF CHEMICAL ENGINEERING AND ENERGY SUSTAINABILITY FACULTY OF ENGINEERING hereby declare that the work entitled GINGER ESSENTIAL OIL SYNTHESIS BETWEEN CHINA AND KUCHING LOCAL GINGER FOR INSECT REPELLENT is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

3RD JULY 2022

Date submitted

WONG FONG FEI (68072)

Name of the student (Matric No.)

Supervisor's Declaration:

I MOHAMMAD OMAR ABDULLAH hereby certifies that the work entitled GINGER ESSENTIAL OIL SYNTHESIS BETWEEN CHINA AND KUCHING LOCAL GINGER FOR INSECT REPELLENT was prepared by the above named student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of BACHELOR OF CHEMICAL ENGINEERING WITH HONOURS, and the aforementioned work, to the best of my knowledge, is the said student's work.

Received for examination by: MOHAMMAD OMAR ABDULLAH
(Name of the supervisor)

Date: 3RD JULY 2022


I declare that Project/Thesis is classified as (Please tick (√)):

- ☐ **CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)*
☐ **RESTRICTED** (Contains restricted information as specified by the organisation where research was done)*
☒ **OPEN ACCESS**

Validation of Project/Thesis

I therefore duly affirm with free consent and willingly declare that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abiding interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies for the purpose of academic and research only and not for other purpose.
- The Centre for Academic Information Services has the lawful right to digitalise the content for the Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic exchange between Higher Learning Institute.
- No dispute or any claim shall arise from the student itself neither third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student except with UNIMAS permission.

Student signature 
(3RD JULY 2022)

Supervisor signature: M. O. ABDULLAH
(3RD JULY 2022)

Current Address:

DEPARTMENT OF CHEMICAL ENGINEERING AND ENERGY SUSTAINABILITY, FACULTY OF ENGINEERING, UNIMIVERSITY OF MALAYSIA, SARAWAK, 94300, KOTA SAMARAHAN, SARAWAK.

Notes: * If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the period and reasons of confidentiality and restriction.

[The instrument is duly prepared by The Centre for Academic Information Service]

APPROVAL SHEET

This final year project report, which entitled **GINGER ESSENTIAL OIL SYNTHESIS BETWEEN CHINA AND KUCHING LOCAL GINGER FOR INSECT REPELLENT** was prepared by Wong Fong Fei (68072) as a partial fulfillment for the Degree of Bachelor of Chemical Engineering is hereby read and approved by:

M. O. ABDULLAH

PROFESSOR DR MOHAMMAD OMAR ABDULLAH

(Supervisor)

3RD JULY 2022
(Date)

GINGER ESSENTIAL OIL SYNTHESIS BETWEEN CHINA AND
KUCHING LOCAL GINGER FOR INSECT REPELLENT

WONG FONG FEI

A dissertation submitted in partial fulfilment
of the requirement for the degree of
Bachelor of Engineering with Honours
(Chemical Engineering)

Faculty of Engineering
Universiti Malaysia Sarawak
2022

Dedicated to my beloved parents and supervisor who always provide me with unconditional encouragements, motivations and supports

ACKNOWLEDGEMENT

Firstly, the author would like to express gratitude to all of the individuals and organisations that have assisted and contributed to her research throughout the course of her education, particularly the Department of Chemical Engineering and Energy Sustainability in the Faculty of Engineering at University Malaysia Sarawak (UNIMAS). The author would like to extend his profound and heartfelt gratitude to her supervisor, Professor Dr. Mohmmad Omar Abdullah, for providing her with the opportunity to carry out this research and for supplying her with the invaluable guidance and information required to finish this research. It was he who gave the author the inspiration to carry out this investigation in a manner that was both more detailed and of a higher quality. The experience of working under his guidance and gaining an unfathomable amount of knowledge throughout the course has left the author feeling appreciative once more.

In addition, the author would like to express her gratitude to her parents for their unwavering support, encouragement, love, prayers, and sacrifices in order to provide author with an education and to get ready for future. It is important not to forget to express gratitude to the author's cherished friends for their assistance and unwavering support in carrying out this research. The author would like to commit this final year project to all of the people who have helped them in any way, either physically or mentally, throughout the process of completing the report.

ABSTRACT

Ginger essential oil is the volatile oil extracted from ginger rhizome itself. The present of the essential oil on a plant usually is in small amount and the quantity extracted will be varying with the essential oil extraction method. Hydro distillation, steam distillation, solvent extraction, and cold press extraction is some of the examples for essential oil extraction. Comparing to the chemical synthetic mosquito repellent, green mosquito repellent would be favour by the public recently as it is environmentally friendly and does not harm to the human's health. Some of the essential oil had been proven to have the repellent ability against the mosquito including the ginger essential oil. Hence, the focus of this study is on the comparison study between China and Kuching local ginger essential oil as the green mosquito repellent. The ginger essential oils are extracted by using hydro distillation method for 7 hours. The percentage oil yield for China and Kuching local ginger are 0.158 wt. % and 0.264 wt. % respectively. The extracted ginger essential oils are further done for Fourier Transform Infrared Spectroscopy (FTIR) and Gas Chromatography- Mass spectrometry (GC-MS) analysis. Based on the generated FTIR spectrum graph, both types of ginger essential oils have the same function groups including phenolic compounds, alcohol primer, alkene methyl group, aromatic compound, carbonyl compound, carboxylic acid, hydroxyl group. From the GC-MS results it revealed that the most abundant chemical constituents presented in the both China and Kuching local ginger essential were: α -Zingiberene (7.88% and 7.03%), α -Curcumene (6.04% and 6.49%), α -Citral or Geraniol (3.81% and 7.86%), β -Bisabolene (3.06% and 4.62%), β -Sesquiphellandrene (5.83% and 5.95%), β -Sesquisabinene (0.07% and 0.51%), β -Selinenol (3.97% and 2.26%), Zingiberenol (5.16% and 1.64%), [6]-Shogaol (0.33% and 0.23%), trans-Sesquisabinene hydrate (1.72% and 2.87%), trans-Geranylgeraniol (3.51% and 2.81%), Camphene (1.17% and 0.56%), Eucalyptol (2.68% and 1.81%), Citronellol (1.76% and 1.55%), Neral (2.82% and 6.03%), and Geraniol (1.62% and 2.29%) respectively. Kuching local ginger essential oil is chosen as the more suitable mosquito repellent due to its higher monoterpene compounds in ginger essential oil.

Keywords: *Ginger essential oil, Hydro distillation, FTIR, GC-MS, Mosquito repellent*

ABSTRAK

Minyak pati halia adalah minyak melanggar yang diekstrak daripada rizom halia itu sendiri. Kehadiran minyak pati pada tumbuhan biasanya dalam jumlah yang kecil dan kuantiti yang diekstrak akan berbeza-beza mengikut kaedah pengekstrakan minyak pati. Penyulingan hidro, penyulingan wap, pengekstrakan pelarut, dan pengekstrakan akhbar sejuk adalah beberapa contoh untuk pengekstrakan minyak pati. Berbanding dengan ubat nyamuk sintetik kimia, ubat nyamuk hijau akan digemari oleh orang ramai baru-baru ini kerana ia mesra alam dan tidak membahayakan kesihatan manusia. Beberapa minyak pati telah terbukti mempunyai keupayaan penghalau terhadap nyamuk termasuk minyak pati halia. Justeru, fokus kajian ini adalah terhadap kajian perbandingan antara minyak pati halia China dan tempatan Kuching sebagai ubat nyamuk hijau. Minyak pati halia diekstrak menggunakan kaedah penyulingan hidro selama 7 jam. Peratusan hasil minyak untuk halia China dan tempatan Kuching ialah 0.158 wt. % dan 0.264 wt. % masing-masing. Minyak pati halia yang diekstrak selanjutnya dilakukan untuk analisis Spektroskopi inframerah fourier transformasi (FTIR) dan Kromatografi Gas- Spektrometri Jisim (GC-MS). Berdasarkan graf spektrum FTIR yang dihasilkan, kedua-dua jenis minyak pati halia mempunyai kumpulan fungsi yang sama termasuk sebatian fenolik, primer alkohol, kumpulan metil alkena, sebatian aromatik, sebatian karbonil, asid karboksilik, kumpulan hidroksil. Daripada keputusan GC-MS ia mendedahkan bahawa jujuk kimia yang paling banyak terdapat dalam kedua-dua penting halia tempatan China dan Kuching ialah: α -Zingiberene (7.88% dan 7.03%), α -Curcumene (6.04% dan 6.49%), α - Citral atau Genarial (3.81% dan 7.86%), β -Bisabolene (3.06% dan 4.62%), β -Sesquiphellandrene (5.83% dan 5.95%), β -Sesquisabinene (0.07% dan 0.51%), β -Selinenol (3.97% dan 2.26%), Zingiberenol (5.16% dan 1.64%), [6]-Shogaol (0.33% dan 0.23%), hidrat trans-Sesquisabinene (1.72% dan 2.87%), trans-Geranylgeraniol (3.51% dan 2.81%) Camphene (1.17% dan 0.56%), Eucalyptol (2.68% dan 1.81%), Citronellol (1.76% dan 1.55%), Neral (2.82% dan 6.03%), dan Geraniol (1.62% dan 2.29%) masing-masing. Minyak pati halia tempatan Kuching dipilih sebagai penghalau nyamuk yang lebih sesuai kerana sebatian monoterpena yang lebih tinggi dalam minyak pati halia.

Kata kunci: Minyak pati halia, penyulingan hidro, FTIR, GC-MS, penghalau nyamuk

TABLE OF CONTENTS

	Pages
TITLE PAGE	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
ABSTRACT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	xi
ABBREVIATIONS	xiii
NONAMECLATURE	xiv
CHAPTER 1 INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	4
1.3 Research Question	5
1.4 Objectives of the Study	6
1.5 Scopes of the Study	6
1.6 Significance of Study	6
1.7 Summary	7
CHAPTER 2 LITERATURE REVIEW	
2.1 Overview of Ginger (<i>Zingiber officinale Roscoe</i>)	8
2.1.1 Zingiberaceae	8
2.1.2 <i>Zingiber officinale Roscoe</i>	8
2.1.2.1 The History and Background	8
2.1.2.2 Characteristic of Ginger	9
2.1.2.3 Application of Ginger	10
2.1.2.4 Chemical Component of Ginger	11
2.1.2.5 Bioactive Compounds of Ginger	13
2.2 Overview of Essential Oils (EOs)	19
2.2.1 Essential Oils Extraction Method	20

2.2.1.1 Hydro distillation	20
2.2.1.2 Steam distillation	23
2.2.1.3 Solvent extraction	24
2.2.1.4 Cold press extraction	26
2.2.2 Percentage Yields of Essential Oils	28
2.3 Overview of Fourier Transform Infrared Spectroscopy (FTIR)	33
2.3.1 FTIR Analysis for Ginger Essential Oil	35
2.4 Overview of Gas Chromatography-Mass Spectrometry (GC-MS)	37
2.4.1 GC-MS Analysis for Ginger Essential Oil	40
2.5 Overview on The standard Test Methods for Mosquitoes Repellent	46
2.5.1 Cage Test	47
2.5.2 Excito-Repellency (ER) Test System	49
2.5.3 Cone Test	51
2.6 Research Gap	52
2.7 Summary	53
CHAPTER 3 METHODOLOGY	
3.1 Ginger Essential Oil Extraction	54
3.1.1 Equipment, Apparatus and Materials	54
3.1.2 Experimental Procedure	54
3.1.2.1 Sample Preparation	54
3.1.2.2 Extraction of Ginger Using Hydro Distillation Extraction	55
3.1.2.3 Separation of The Condensate	56
3.2 Fourier Transform Infrared Spectroscopy (FTIR) Analysis	56
3.2.1 Equipment, Apparatus and Materials	56
3.2.2 Experimental Procedure	57
3.3 Gas Chromatography- Mass spectrometry (GC-MS) Analysis	57
3.3.1 Equipment, Apparatus and Materials	57
3.3.2 Experimental Procedure	58
3.4 Gantt Chart	59
3.5 Summary	59
CHAPTER 4 RESULTS AND DISCUSSION	
4.1 Extraction of Ginger Essential Oil	60

4.2 Fourier Transform Infrared Spectroscopy (FTIR) Analysis	64
4.3 Gas Chromatography- Mass spectrometry (GC-MS) Analysis	70
4.4 Selection of Ginger Essential Oil as Mosquito Repellent	84
4.5 Summary	86
CHAPTER 5 CONCLUSIONS	
5.1 General Conclusions	87
5.2 Recommendations	88
REFERENCES	89

LIST OF TABLES

Figure		Page
2.1	Summarization of percentage yield of ginger essential oil corresponding to the extraction method.	28
2.2	Summarization of FTIR spectrum of ginger essential oil corresponding to the extraction method.	35
2.3	Summarization of major chemical constituents in the ginger essential oil.	41
2.4	Size dimensions of the cage test for mosquito repellent.	47
3.1	List of equipment, apparatus and materials for essential oil extraction.	54
3.2	List of equipment, apparatus and materials for FTIR analysis.	56
3.3	List of equipment, apparatus and materials for GC-MS analysis.	57
3.4	Gas chromatography-Mass spectrometry (GC-MS) operation values.	58
4.1	Data collection of China ginger for ginger essential oil extraction.	61
4.2	Data collection of Kuching local ginger for ginger essential oil extraction.	62
4.3	Functional groups and compounds existed in China ginger essential oil FTIR spectrum graph.	64
4.4	Functional groups and compounds existed in Kuching local ginger essential oil FTIR spectrum graph.	67
4.5	GC-MS analysis of chemical constituents of China ginger essential oil.	70
4.6	GC-MS analysis of chemical constituents of Kuching local ginger essential oil.	77

4.7	Comparison of chemical constituents between China and Kuching local ginger essential oils.	82
-----	--	----

LIST OF FIGURES

Figure		Page
1.1	Global market value for mosquito repellent (Ridder, 2020).	1
1.2	Categorization of mosquito repellents (Lalit Jajpura et al., 2015).	3
2.1	Chemical structural of the components in ginger (<i>Zingiber officinale Roscoe</i>) (Abdullahi et al., 2010).	13
2.2	Synopsis of biological activities for ginger.	14
2.3	Set up of Clevenger apparatus system for hydro distillation (ExportersIndia, 2022).	21
2.4	Steam distillation extraction process (Boukhatem, 2020).	23
2.5	Steam distillation for essential oil extraction (Food Science, 2022).	24
2.6	Soxhlet extractor (Hesham et al., 2016).	26
2.7	Cold press extraction process (Boukhatem, 2020).	27
2.8	Wavelength range with chemical bonding (Nalla et al., 2018).	34
2.9	7000D triple quadrupole GC/MS (DKSH, 2022).	39
2.10	Gas Chromatography-Mass Spectrometry (GC-MS) for ginger essential oil (Alhassane & Zhang, 2007).	40
2.11	Human arm in the cage test for mosquito repellency experiment (Colucci & Müller, 2018).	48

2.12	Excito-repellency test chamber for the mosquito repellent experiment (Roberts et al., 1997).	49
2.13	The improve design for the excito-repellent test chamber for side view (Paeporn et al., 2007).	51
2.14	Cone test for the mosquito repellency testing against the treated fabric (Annuar & Yusof, 2016).	51
3.1	Hydro distillation extraction apparatus set up (Mehani et al., 2016).	55
3.2	FYP 1 Gantt Chart.	59
3.3	FYP 2 Gantt Chart.	59
4.1	Set up of apparatus of hydro distillation.	60
4.2	China ginger essential oil.	61
4.3	Kuching local ginger essential oil.	62
4.4	FTIR spectrum graph for China ginger essential oil.	64
4.5	FTIR spectrum graph for Kuching local ginger essential oil.	67
4.6	Gas chromatogram graph for China ginger essential oil.	70
4.7	Gas chromatogram graph for Kuching local ginger essential oil.	76
4.8	Comparison of percentage chemical constituents for China and Kuching local ginger essential oils.	83

ABBREVIATION

ACE	-	Angiotensin-1 Converting Enzyme
AD	-	Alzheimer's Disease
ADA	-	Adenosine Deaminase
ASTM	-	American Society for Testing and Materials
CHD	-	Coronary Heart Disease
CVD	-	Cerebrovascular Disease
DEET	-	N,N-Diethyl-3-Methylbenzamide
DMP	-	Dimethyl Phthalate
Eos	-	Essential Oils
ER	-	Excito-repellency
GC-MS	-	Gas Chromatography- Mass Spectrometry
LPO	-	Lipid Peroxidation
PD	-	Parkinson's Disease
RHD	-	Rheumatic Heart Disease
ROS	-	Reactive Oxygen Species
spp.	-	Species
TNF- α	-	Tumour Necrosis Factor α
WHO	-	World Health Organization

NOMENCLATURE

%	-	Percent
°C	-	Degree Celsius
°C/min	-	Degree Celsius Per Minute
Cm	-	Centimetres
g/m ²	-	Grams Per Meter Square
Mg	-	Miligrams
mL	-	Mililiters
mL/min	-	Milliliters Per Minute
Mm	-	Millimetres
μL	-	Microliters
wt. %	-	Weight Precent

CHAPTER 1

INTRODUCTION

1.1 Background

Mosquitoes are the insect that categorized like the utmost dangerous vectors that spreading pathogens and parasites which cause considerable impact on human life, and transmit fatal illnesses for instance chikungunya, filariasis, malaria, and dengue fever. There are around 2700 species of mosquitoes discovered globally with the *Culex*, *Aedes*, and *Anopheles* mosquitoes are the most common and significant of them (Lakshmi Manokaril & Charanya Meenu, 2014). Considering that mosquitoes are in charge for the transmission of several diseases that are fatal to humans, a variety of insect repellent items such as lotions, coils, and liquidators are readily accessible on the market for use as mosquito deterrents. However, their usage is restricted for a variety of reasons, including vomiting, eczema difficulties, skin and eyes irritation, choking dangers from the burning gases emitted by coils, and so on (Rajendran Ramasamy et al. 2014). According to Ridder (2020), the global share of the mosquito repellent market shows a gradually increasing of the market value and expected achieved around 4.6 billion U.S. dollars in year 2023. This indicated a huge commercial opportunity if there are the products with more environmentally friendly and convenient.

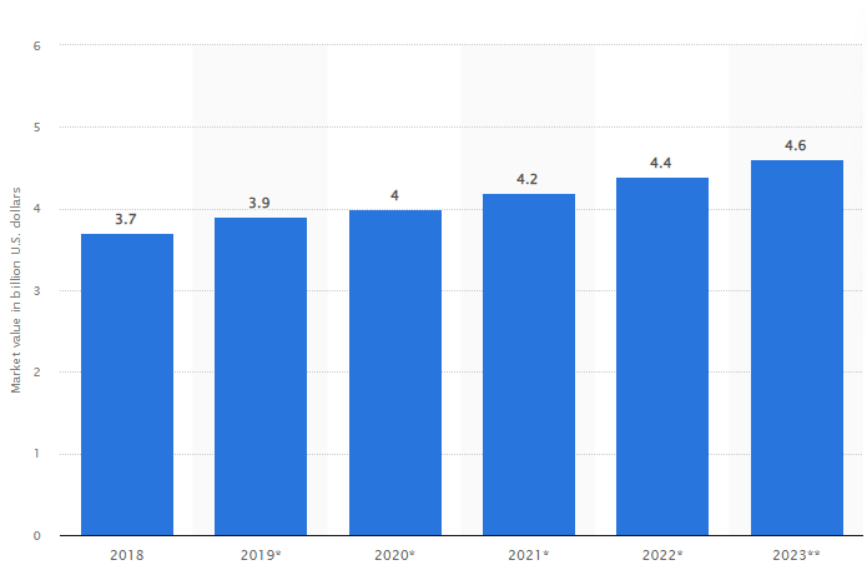


Figure 1.1: Global market value for mosquito repellent (Ridder, 2020).

Mosquito repellent chemicals have two modes of action that may be generally classified as follows: the Olfactory mode and the Tactile mode of action. When mosquitoes detect an increase in level of carbon dioxide in the atmosphere, they will employ the warm and humidity convection coming as of the human or animals' body to detect the direction of living. So, mosquitoes are unable to identify humans when vacation at Olfactory mode (transpiration repellency) because the humidity detection pores that assist them in locating live beings are congested, and further preventing them from locating humans. While tactile mode (straight-contact repellency), on the other hand, is based on the act for the mosquito repellent compounds on nervous for mosquito, result them in confusing condition as well as resist their own actions at toxic concentrations before being knocked down by direct contact to the repellent substances (Patel et al., 2012).

Mosquito repellents are categorised according to their nature and basis of action. Chemical repellents are distinguished from herbal repellents by the fact that they are derived from chemical synthetic rather than plants (Lalit Jajpura et al., 2015). In terms of action, they can be divided into two categories which are repelling insecticides and contact insecticides. When it comes to repellent action insecticides, the compounds that are primarily employed to repel insects and pests instead of causing they go dead. Contact Insecticides, on the other hand, are compounds that include neuro toxicity for mosquitoes, causing their nervous systems to be disrupted and making them unconscious when they come into contact with them. Figure 2.2 below shows the categorization of the mosquito repellents produce in all over the world.

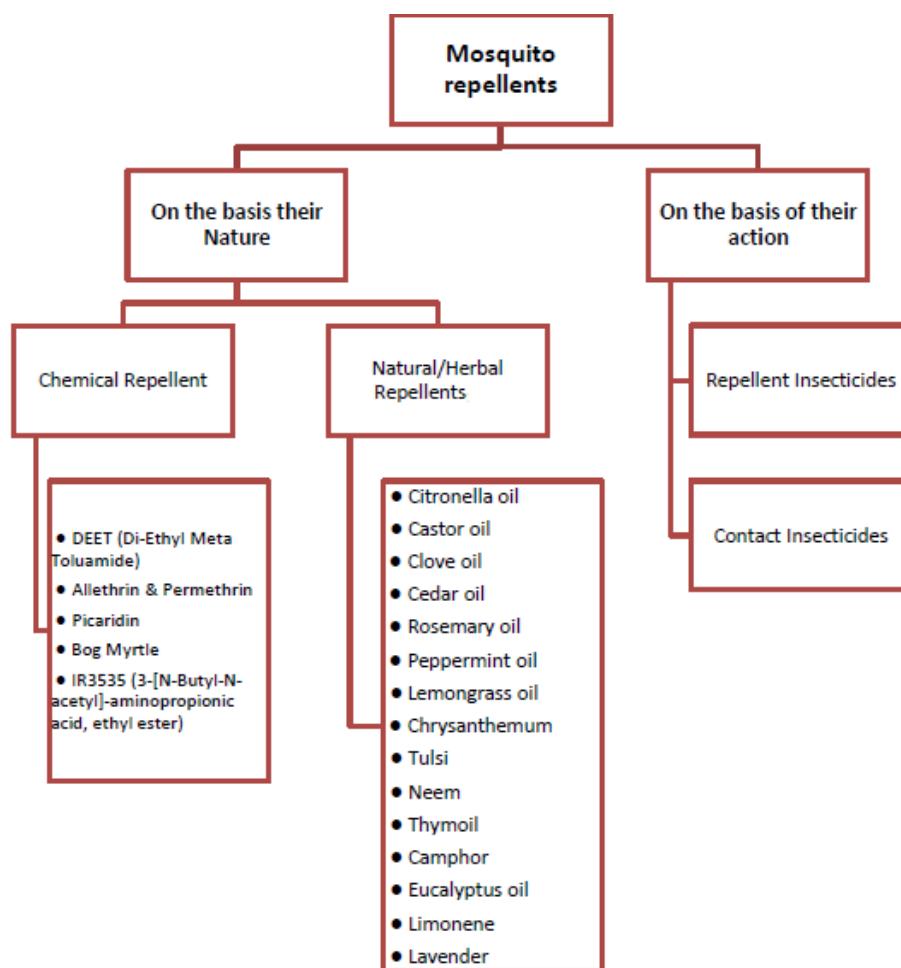


Figure 1.2: Categorization of mosquito repellents (Lalit Jajpura et al., 2015).

Based on the **Figure 1.2**, the natural repellent or the herbal repellents are the extracted oil from the plant. This extracted oil is usually called as essential oil. Essential oil can be defined as combinations of volatile organic molecules derived from plants that are complex in nature. According to research done by Sathantriphop et al. (2015), the occurrence of sesquiterpenes, alcohols and monoterpenoids in essential oils contributes to the repellent ability of the oils against mosquito. Apart from that, α -pinene, citronellal, limonene and Citronellol are all frequent components of numerous essential oils that have repelling properties. Moreover, it is worth mentioned that the low toxicity and excellent performance in mosquito repellency properties of the essential oil make it start to be considered by public as an alternate to conventional synthetic insect repellent. A total of around 10 percent of the essential oil identified so far are commercially accessible as possible insecticides and repellents, based on the analysis of more than 3,000 different plant species to date (Muturi et al, 2017).

1.2 Problem Statement

Despite the fact that Malaysia has tropical weather all year, the country's temperature is typically highly humid due to the country's proximity to water. The typically natives of warm climates in Malaysia attain a result for the numerous breeding of the mosquitoes (Environmental Science, 2021). This is because the habit of the mosquitoes which are prefer to warmer and more humid climates. The vast majority of mosquitoes can survive in temperatures ranging from 10 to 32 degrees Celsius. Mosquito eggs will begin to hatch as soon as the temperature in neighbourhood reaches this level of temperature (Terminix, 2021). Mosquitoes lay eggs at the standing water left in flowerpot trays, plants and open containers. With a short life cycle approximately 8-10 days elapse between the hatching of an egg and the development of an adult mosquito, most of the mosquitoes' eggs cannot be perished by human immediately due to carelessness of surrounding hygiene (Environmental Protection Agency, 2021).

There are 3 kind of common mosquito species in Malaysia which are Aedes Mosquitoes (Aedes Aegypti), Anopheles Mosquito (Anopheles spp.) and Culex Mosquito (Culex spp.) (Rentokil, 2021). Among these species the most dangerous is the Aedes Mosquitoes which is the primary vector of diseases such as Dengue fever and Chikungunya that can be life-threatening in the region (Fathy Khater, et al., 2019). Mosquitoes can be an annoyance if their bites are innocuous, but they can also cause allergic reactions in some people and subsequent diseases if the wounds are scratched by the victims (Environmental Science, 2021). According to the Malaysian Ministry of Health, the total amount of dengue fever cases recorded in the country had achieved 80,000 for year 2019 up to 3rd of August, with a total of 113 deaths reported (The Straits Times, 2019). Almost all the states in Malaysia except Perak, Perlis and Terengganu had the greatest rates of occurrence.

The most simple and efficient way to eliminate the mosquitoes from the residential house is using the chemical mosquito repellent. In most situations, insect repellents operate by creating a vapour barrier around the treated surface, preventing the insect or arthropod from coming into contact with the surface (Nerio et al., 2010). When making commercial mosquito repellents, non-biodegradable artificial compounds such as allethrin, N,N-diethyl-3-methylbenzamide (DEET), and dimethyl phthalate (DMP) are used. These chemicals have the potential to pollute the environment and provide unacceptable health hazards when used in large quantities (Khater, 2012). Researchers Pavela and Benelli (2016) have revealed that inhaling the chemicals included in insect repellents might cause serious respiratory problems as well as

allergic reactions in some people. These compounds can be lethal if inhaled in large quantities and may potentially cause cancer if inhaled in prolonged periods of time. Besides, based on the survey done by Rediff (2015), 11.8% of people who used chemical-based mosquito repellents reported a variety of health problems, including breathing difficulties, headaches, discomfort in the eyes, bronchial irritation, coughing, colds, running noses, and skin infections. The more serious cases whereby a few of them suffer from asthma after utilising these repellents. With growing public safety concerns, it is desirable to see a resurgence in interest in the usage of natural goods derived from plants. Natural products usually are efficient, ecologically friendly, biodegradable, affordable, as well as widely accessible.

A variety of hexapods have been found to be resistant to various essential oils, which are steam distilled concentrates of volatile aromatic compounds from various components of plants, for instance flowers, rhizomes, roots, fruit, and trees. As a result, several essential oils have been employed in environmentally friendly and commercial repellents formulations (Rajesh & Joshi, 2013). Also, according to a study published by Madreseh-Ghahfarokhi et al. (2018), *Culex theileri* Theobald, 1903 which is a species of large distinct mosquito that has been studied extensively of using ginger as a repellent to it. Based on the results, ginger essential oil was found to have 45% insecticidal activity and 61% insect repellent activity. However, different type of the ginger can have different insect repellent activity. Hence, intention of the research was to investigate the chemical compositions for two different type of ginger essential oil which extracted from China ginger and Kuching local ginger, then estimate its potential in terms of mosquito repellent activity.

1.3 Research Question

This project will be focused on the study of the extraction of ginger essential oil as the insect repellent and below are the research questions:

- i. How to extract the significant amount of essential oil from the ginger?
- ii. What is the chemical component and characteristic of ginger essential oil?
- iii. How is the difference between China ginger and local ginger based on their percentage oil yield, functional group and chemical constituents present?