ETHNOBOTANICAL AND ETHNOPHARMACOLOGICAL DOCUMENTATION OF ANTIMALARIAL PLANTS USED BY THE JAKUN COMMUNITY IN KG PETA, ENDAU-ROMPIN, JOHOR, MALAYSIA

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UNIVERSITI TUN HUSSEIN ONN MALAYSIA
ETHNOBOTANICAL AND ETHNOPHARMACOLOGICAL
DOCUMENTATION OF ANTIMALARIAL PLANTS USED BY THE JAKUN
COMMUNITY IN KG PETA, ENDAU-ROMPIN, JOHOR, MALAYSIA

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A thesis submitted in
fulfillment of the requirement for the award of the degree of
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This thesis is dedicated to my beloved mother, Rohanah Hashim
a strong and gentle soul
who is nursing me with affection and love
and her dedication to my success in life
&
to my husband, Faiz Akmal
for earning an honest living for us and
for supporting and encouraging me to believe in myself.

In memory of
my late father, Ismail Alip
without you
I would not be who I am today.
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ABSTRACT

Malaria, one of the leading infectious diseases in many tropical regions including Malaysia is caused by the parasite *Plasmodium*. An ethnobotanical survey of medicinal plants used by the indigenous people particularly the Jakun tribe from Kg. Peta, Endau-Rompin, Johor for the treatment of malaria and malaria associated symptoms was conducted using a semi-structured interview. The declining popularity of application of traditional remedies by the young generation threatens the disappearance of traditional knowledge possessed mainly by the older generation. Hence, the need for documentation of this knowledge justifies the relevance of this study. Out of 19 species (17 families) were recorded, 7 species: *Hodgsonia macrocarpa*, *Pentaphragma begoniifolium*, *Rennellia elliptica*, *Saprosma corymbosa*, *Strychnos ignatii*, *Tacca integrifolia* and *Tetracera macrophylla* were investigated for phytochemical and *in vitro* antiplasmodial activities. Twelve aqueous and 12 methanolic extracts were screened for antiplasmodial phytochemical classes i.e., alkaloids, flavonoids, terpenoids and anthraquinones using thin-layer chromatography (TLC). Results revealed the presence of at least one of the phytochemical class in each extracts. Extracts were subjected to antiplasmodial activity through histidine-rich protein II (HRP2) assay against K1 strain of *P. falciparum* chloroquine-resistant. Overall, ten methanolic extracts from *H. macrocarpa* (stem), *P. begoniifolium* (root, stem and leaves), *R. elliptica* (root, stem and leaves), *S. corymbosa* (leaves), *T. integrifolia* (root) and *T. macrophylla* (stem) have potential antiplasmodial activities against chloroquine-resistant *P. falciparum* (IC$_{50}$ < 10 µg/mL). The part of the plants species involves indicates statistically significant difference of IC$_{50}$ between the kinds of extractions (p < 0.05). The results scientifically validated the plants used in Jakun’s traditional medicine displayed promising therapeutic properties and further studies could lead to develop phytomedicines in the treatment of malaria.
ABSTRAK

Malari, salah satu penyakit berjangkit yang utama di kebanyakan kawasan tropika termasuk Malaysia yang disebabkan oleh parasit Plasmodium. Satu survei etnobotani tumbuhan ubat-ubatan yang digunakan oleh orang-orang asli terutamanya suku Jakun yang tinggal di Kg. Peta, Endau-Rompin, Johor bagi rawatan malaria dan gejala-gejalanya telah dijalankan menggunakan temu duga separa terarah. Penurunan populariti penggunaan ubat-ubatan tradisional oleh generasi muda menyebabkan kepupusan pengetahuan tradisional terutamanya yang dimiliki oleh generasi tua. Oleh itu, keperluan mendokumentasi pengetahuan ini adalah bagi menjelaskan kerelevanan kajian ini. Daripada 19 spesies (17 famili) yang direkodkan, 7 spesies: Hodgsonia macrocarpa, Pentaphragma begoniiifolium, Rennellia elliptica, Saprosma corymbosa, Strychnos ignatii, Tacca integrifolia dan Tetracera macrophylla telah dikaji bagi fitokimia dan aktiviti in vitro antiplasmodial. Dua belas akueus dan 12 ekstrak metanol telah disaring bagi kelas fitokimia antiplasmodial i.e., alkaloid, flavonoid, terpenoid dan antrakuinon dengan menggunakan kromatografi lapisan-nipis (TLC). Hasil kajian menunjukkan kehadiran sekurang-kurangnya satu kelas fitokimia dalam setiap ekstrak. Ekstrak-ekstrak ini menjalani aktiviti antiplasmodial melalui assai protein kaya-histidina II (HRP2) terhadap strain K1 P. falciparum rintang-klorokuina. Keseluruhannya, sepuluh ekstrak metanol iaitu H. macrocarpa (batang), P. begoniiifolium (akar, batang dan daun), R. elliptica (akar, batang dan daun), S. corymbosa (daun), T. integrifolia (akar) dan T. macrophylla (batang) mempunyai potensi aktiviti antiplasmodial terhadap P. falciparum rintang-klorokuina (IC₅₀ < 10 μg/mL). Bahagian spesies tumbuhan yang terlibat menunjukkan perbezaan statistik IC₅₀ yang signifikan antara jenis pengekstrakan (p < 0.05). Hasil kajian telah mengesahkan secara saintifik bahawa tumbuhan yang digunakan dalam perubatan tradisional masyarakat Jakun ini memaparkan ciri terapeutik dan kajian lanjutan mampu membawa kepada pembangunan fitokimia dalam rawatan malaria.
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LIST OF SYMBOLS AND ABBREVIATIONS

~ - Similarity
> - Greater than
< - Less than
± - Uncertainty
% - Percentage
°C - Degree Celsius
µg/mL - Microgram per milliliter
µL - Microliter
µL/well - Microliter per well
µM - Micromolar
cm - Centimeter
g - Gram
g/mL - Gram per milliliter
gsm - Grams per square meter
ha - Hectare
in - Inch
kg - Kilogram
km - Kilometer
km² - Square kilometer
m - Meter
mg - Milligram
mg/kg - Milligram per kilogram
mg/mL - Milligram per milliliter
mM - Millimolar
mm - Millimeter
mL - Milliliter
ng/mL - Nanogram per milliliter
nM - Nanomolar
nm - Nanometer
rpm - Revolutions per minute
w/w - Weight per weight
wt/vol - Weight per volume
ABS - Access and Benefit Sharing
ACT - Artemisinin based Combination Therapy
ANOVA - Analysis of Variance
Art - Artemisinin
ASMQ - Artesunate-mefloquine
B.C. - Before Christ
BSA - Bovine serum albumin
BSCII - Biosafety Cabinet Class II
C₆H₁₄ - Hexane
C₄H₈O₂ - Ethyl acetate
C₄H₁₀O - Butanol
CBD - Convention on Biological Diversity
CCM - Complete Culture Medium
CH₃COOH - Acetic acid
CO₂ - Carbon dioxide
CQ - Chloroquine
DBP - Dewan Bahasa dan Pustaka
DCM - Dichloromethane
DMSO - Dimethyl sulfoxide
E - East
ELISA - Enzyme-linked Immunosorbent Assay
EtOAc - Ethyl acetate
FAO - Food and Agriculture Organization
FRIM - Forest Research Institute Malaysia
GMT - Greenwich Mean Time
GPS - Global Positioning System
H₂O - Water
H₂SO₄ - Sulfuric acid
HEPES - 4-(2-hydroxyethyl)-1-piperazineneethanesulfonic acid
HRP2 - Histidine-rich Protein II
IC_{50} - 50% Inhibitory Concentration
IC_{90} - 90% Inhibitory Concentration
IgG - Immunoglobulin G
IgM - Immunoglobulin M
ILO - International Labour Organization
IMR - Institute for Medical Research
JAKOA - Department of Orang Asli Development
JNPC - Johor National Parks Corporation
Kg. - Kampung
M - Molar
Mef - Mefloquine
MeOH - Methanol
MOH - Ministry of Health Malaysia
N - North
NaCl - Sodium chloride
NaHCO_{3} - Sodium bicarbonate
NATO - North Atlantic Treaty Organization
OD - Optical Density
PBS - Phosphate buffer solution
PBST - PBS-Tween
pH - Power of Hydrogen
PIC - Prior Inform Consent
pLDH - Plasmodium Lactate Dehydrogenase
Q - Quinine
R&D - Research and Development
RAMSAR - The Convention on Wetlands of International Importance
RBC - Red blood cell
R_f - Relative Front
RPMI - Roswell Park Memorial Institute Medium
SDX/PYR - Sulfadoxine/pyrimethamine
SPR - Slide Positivity Rate
THM - Traditional Herbal Medicine
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CHAPTER 1

INTRODUCTION

1.1 Introduction

Ethnobotanical research involves the relationship between human and plants in many aspects of life such as food resources, portion in cosmetics, base in textiles and elements in farming. Ethnopharmacology on the other hand, emphasizes on the pharmacological treatment in general (Ríos, 2011). Such study is itemized on the bio-evaluation of the effectiveness of traditional medicines. Ethnomedicine also has close relation with ethnobotany and ethnopharmacology as it is based on written sources and verbal information such as knowledge and practices which are passed from generations to generations for centuries (Ríos, 2011).

In the modern era, some people are still practicing traditional treatment and medication in their lives. Most of the under-developed countries practically uses the plants and herbs for health and treatment which are the repetition of their ancestors’ practices for generations. In Malaysia, majority of natives from different ethnics exercise different traditions in using herbs and plants as medicinal sources. They have a close relationship with the forest since forest products have traditionally formed as the basis of their livelihood (Lin, 2005).

Medicinal plants are used by Orang Asli Jakun in Kg. Peta, Endau-Rompin to treat and cure people who were infected by certain illnesses or diseases. The location where they stay in the Johor National Park Endau-Rompin (TNJER) make it possible for them to access suitable plants and herbs in the treatment of various illnesses or used as sources of food. Most of the older generation (above 40 years old) who believed in the traditional medication based on plants. Therefore, they are
knowledgeable in many aspects of traditional medication and practices. This traditional knowledge (TK) and practices are inherited and passed on continuously to the younger generation. This traditional knowledge is essential to be preserved but the young generations now lack the urge to learn the traditional practices as they prefer the convenience provided by the use of modern medication. The consequence of the new generation being indulged in modernizations results in the erosion of traditional knowledge (Ismail et al., 2014). Hence, the ways in which the Orang Asli Jakun in Kg. Peta treats illnesses like malaria and malaria-associated symptoms should be documented promptly so that the TK on the use of medicinal plants may be preserved before they are eroded and totally forgotten.

Like any other communities, the Orang Asli of TNJER also suffer from malaria. Malaria is a very old disease and a major public health concern in many tropical and subtropical countries (Jonville et al., 2008; Adebayo & Krettli, 2011; Basir et al., 2012) including Malaysia even though malaria control and prevention activities over the last few decades have greatly reduced the incidence of malaria (Sanders et al., 2014).

Malaria is an infectious disease transmitted from one person to another via the bite of female *Anopheles* mosquito. There are four species of plasmodia causing malaria in humans, namely: *Plasmodium falciparum*, *P. vivax*, *P. malariae* and *P. ovale* (Adebayo & Krettli, 2011; WHO, 2014). Additionally, *P. knowlesi*, a simian malaria parasite is now recognized as the fifth plasmodium species that can cause malaria to humans (Singh & Daneshvar, 2010; Azidah et al., 2014).

The onsets of malaria symptoms are nonspecific. This is due to presence of one or more vague features of general body weakness. The incubation period is about 10 to 15 days after the first bite by the infected mosquito. The symptoms appear are fever, chills, shivering, headache, loss of appetite, vomiting, dizziness, muscle and joint aches, fatigue and nausea. If severe cases of malaria are not addressed properly, this can lead to complications and eventually death (WHO, 2014).
1.2 Problem statements

1.2.1 The erosion of traditional knowledge (TK)

All community of indigenous people worldwide possess their own unique traditional knowledge. Traditional knowledge is very diverse. It covers literary, artistic or scientific works, song, dance, medical treatments and practices as well as agricultural technologies and techniques. The precious medicinal values that hold by folk medicines usually belong to indigenous people as they have been using medicinal plants since myriad of time (Lim et al., 2010).

Medicinal plants have been demonstrated to be potential source in the medical field while the indigenous people keep and transfer the knowledge and practices usually through an informal system and adapting it as their way of life. This knowledge is often transmitted from one generation to another as such the traditional uses of many plants have not been documented. The lack of survey and documentation of medicinal plants that are used by indigenous people leads to knowledge erosion and lost with succeeding generations.

This phenomenon occurs in Malaysia due to less consciousness among the community of the indigenous ethnics about traditional knowledge (Kulip, 2003; Lin, 2005; Samuel et al., 2010). The documentation of traditional usage of medicinal plants to treat certain diseases is still less favorable. In contrast with others ethnics in the world such as the Chinese, the Indians, the Bhutanese and etc., keep upgrading the data into pharmacopoeia. In addition, nowadays the young generations just take a shortcut by receiving modern treatment in hospital. They are use conventional approach because of the belief to modern medicine is strongly convincing. Exposure to modern culture also a key reasons that contribute to degradation of traditional knowledge.

Hence, by conducting a proper survey and documentation be able to avoid danger of losing this precious knowledge before degradation of natural habitats and ecosystems leading to loss of plants and cultural diversity. Therefore, there is a need to document traditional knowledge especially about medicinal plant diversity and how the native communities are using them.
1.2.2 The development of resistance of *Plasmodium sp.* to popularly known medication

Nowadays, the burden of this infectious disease is getting worse. All of the *Plasmodium* species such as *P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale* and *P. knowlesi* have been identified to be responsible for human malaria infection. Among these species, *P. falciparum* is the most common cause of fatality due to malaria worldwide (WHO, 2014). The disease has become more severe as *P. falciparum* has developed resistance against conventional medicines and therefore cause decline in reducing the incidence of malaria (Noor Rain et al., 2007; Muganga et al., 2010; Stangeland et al., 2011).

According to Noor Rain et al. (2007), *P. falciparum* also plays a role in the incidence of malaria cases in Malaysia. Therefore, the disease is endemic to this country even though various control activities was carried out over the last few decades. Current available drugs have become ineffective towards these parasites. Since 1963, this species were reported to be resistant particularly to chloroquine subsequently to combination of chloroquine and pyrimethamine and also to sulfadoxine/pyrimethamine (SDX/PYR) in endemic areas of Peninsular Malaysia (Noor Rain et al., 2007).

Being one of the potential parasitic in Malaysia and developing of the resistance, it is time to explore and discover medicinal plants that can be basis platform of finding new antiplasmodial properties via effectiveness of bioassay activity. In addition, the results can be groundwork for pharmacologist to develop new novel of antimalarial drugs for treatment, prevention and management of the disease.

1.3 Aim and objectives

This research aims to perform an ethnobotanical and ethnopharmacological study of medicinal plants used by the Jakun people to treat malaria and malaria associated symptoms in Kg. Peta, Endau-Rompin, Mersing, Johor. The study has collected and documented herbal remedies traditionally used for the treatment, screening the
antiplasmodial phytochemical classes and also evaluate for antiplasmodial activity of the plants selected.

The specific objectives are:

(i) To document medicinal plants used by the Jakun people in Endau-Rompin, Johor for the treatment of malaria and malaria associated symptoms.

(ii) To screen crude extracts of selected medicinal plants in the treatment of malaria and malaria associated symptoms in Endau-Rompin, Johor for the presence and absence of antiplasmodial phytochemicals property.

(iii) To investigate crude extracts in an in vitro antiplasmodial activity in order to verify and evaluate the potential selected medicinal plants in the treatment of malaria and malaria associated symptoms as claimed by the Jakun people in Endau-Rompin, Johor.

1.4 Significance of the study

Endau-Rompin Johor rainforest is the oldest tropical rainforest in the world. It has its own attraction from its tranquillity and uniqueness. Its ecological system encircled the rich of flora and fauna in the rainforest. The plant species has its own distinctiveness (Wong, Saw & Kochummen, 1987). It relates to the use of it as an antidote and medicinal cure to specific illness. Commonly, modern pharmaceutical depends on plants as a resource in modern medical practices. It is due to the numerous active phytochemicals needed in remedial of human disease. Furthermore, it is estimated nearly one-fourth of prescription drugs made of extracts or active phytochemicals which derived from plant essence (Brahmachari, 2009). Thus, documentation of medicinal plants used by Orang Asli Jakun in Kg. Peta, Endau-Rompin for the treatment of malaria disease is vital in order to avoid erosion of traditional knowledge (TK). The tribe rich in knowledge of traditional treatment then feared of losing this precious knowledge if the young generation who do not responsible to take the task for preserving them. At the same time, the research function as preliminary tasks in the scientific approach on selected plants to treat malaria diseases as claimed by key informants in Kg. Peta. This research also functions as a medium to identify the presence and absence of major antiplasmodial phytochemical in the selected plants. The antiplasmodial phytochemical classes
which had been identified from the traditional plants can be the basis platform in the pharmacological on the deviations and modification of new antiplasmodial medication. Next, effectiveness of bioassay activity in the selected plants used in the research, the possibilities to act as the medication and resources in finding and discovering the antimalarial treatment is able to contribute in the pharmacology field. Besides that, the information about the traditional plants, usefulness, extracts preparation, dose and formula and mode of administration from traditional practitioners and users may help in the preliminary for pharmacologist. This research may contribute to Ministry of Health Malaysia (MOH) in finding the cure of malaria diseases specifically to the residence which had the obstacle to gain the modern allopathic. Other than that, this research is enabling to stand as the fundamentals in the development of the herbal and complementary medication exploration. Finally, the research may be realistic, resulting on the success of selecting the appropriate plants species. Then, it may be commercialized and contribute to the society about the healing agent and medicinal conception.

1.5 Scope and limitation of the study

The main purpose of this study is to evaluate selected ethnomedicinal plants for treating malaria and malaria associated symptoms based on the traditional practices of the Orang Asli in Johor National Park Endau-Rompin (TNJER). Based on the requirements of the objectives, the scope and limitations of this research were identified: the location of the study, ethnicity, type of traditional knowledge domain, selection of medicinal plants, screening of phytochemical classes and bioassay activity of antiplasmodial.

The location of this study area at the south state of Peninsular Malaysia with selected indigenous community namely as Jakun (or Orang Hulu) who settled down in a small village called Kg. Peta, Endau-Rompin, Mersing, Johor was chosen as key informants to provide knowledge of medicinal plants. The location of the study area is within TNJER which is an area south of the state of Pahang and northern-east part of Johor. Though they lived far inland but they are surrounded by tropical rainforest which are oldest in the world who still practice traditional medical treatments into their lives. Thus, it was limited to key informants who are knowledgeable about
medicinal plants also expert in medical practices. In traditional settings, preparation of plant extracts that involves performance of rituals such as shamanism and divination and also combination of other plant species may disregards. This study was limited on the therapeutic activity of a single plant species in the treatment of malaria and malaria associated symptoms due to the efficacy of the plant that do not related to the whole traditional healing process.

Moreover, crude extract comprises a mixture of phytochemical classes but its limited to screen four major secondary metabolites of antiplasmodial which are alkaloids, flavonoids, terpenoids and anthraquinones. Detection of major classes present in these plant extracts using thin-layer chromatography (TLC) may be difficult because of the overlapping spots making it difficult to detect the colour changes after staining by reagent.

Besides that, *P. falciparum* K1 strain was used in histidine-rich protein II (HRP2) to evaluate the *in vitro* antiplasmodial activity of the selected plants. This bioassay activity was focuses on at crude extracts level in order to verify their ethomedicinal plant property that claimed by the Jakun peoples.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews four keywords of this study. Section 2.2 elaborates on role and value of traditional knowledge (TK), importance of documentation of TK and the role and status of TK on documentation of medicinal plants in healthcare and medicine in Malaysia. Section 2.3, explains definition, origin and background of Orang Asli in Malaysia then zoom in to Jakun people in Kg. Peta, Endau-Rompin and their interactions with medicinal plants. Section 2.4 comprises of epidemiology of malaria worldwide and in Malaysia, the life cycle of *Plasmodium sp.*, symptoms of malaria and the malaria treatments in terms of practicing traditionally and using modern medication. Lastly, in Section 2.5, reviews the major antiplasmodial phytochemical classes such as alkaloids, flavonoids, terpenoids and quinones.

2.2 Traditional knowledge (TK)

Traditional knowledge (TK) denotes and distinguishes a community’s way of life or culture and the conceptualise of the indigenous and how people contextual principle applied in daily lives which depends on the traditional knowledge and the forming of a cultural and spiritual identity which being moulded and passed on verbally from generation to generation and transmitted through many form of art and communication. Other forms of traditional knowledge are expressed through different means (Lim et al., 2010).
2.2.1 Its role and value of traditional knowledge (TK)

Traditional knowledge (TK) gains its recognition to the facts that it contributes to sustainable development. Thousands years of traditional practices had proven to enhance and promote biodiversity at the local level and aid in maintaining a healthy ecosystem. The benefits of TK valued, referred to its function and tasks in the society. TK contributes in industrial growth and industries such as plant-based medicine, health products and cosmetics as well as handicraft (Lim et al., 2010).

Traditional knowledge usage and benefits in daily lives had been recognized. Many international bodies such as International Labour Organization (ILO), Food and Agriculture Organization (FAO), United Nations Educational Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP), North Atlantic Treaty Organization (NATO), the World Bank, United Nations Convention to Combat Desertification (UNCCD), the United Nations Conference on the Environment and Development (UNCED) and The Convention on Wetlands of International Importance (RAMSAR), had accepted TK in pharmaceutics’ ground (CBD, 2015). TK had international respect.

International Property Laws had been formed to preserve, protect and promote traditional knowledge. In 1992, the Convention on Biological Diversity (CBD) recognized the value of TK in protecting species, ecosystems and landscapes and incorporated language regulating access to it and its use. Three broad approaches to protect traditional knowledge have been developed. The first emphasizes on protecting of traditional knowledge as a form of cultural heritage. The second point at protection of traditional knowledge as a collective human right. The third, taken by the World Intellectual Property Organization (WIPO) to investigate the interpretation use of existing genus or species to protect the traditional knowledge (UNCCD, 2014).

The contribution of the indigenous and local communities to the conservation and sustainable use of biological diversity had gone far beyond their role as natural resource managers. Their skills and contribution techniques provide valuable information to the global community and a useful model for biodiversity policies until it is recognized internationally. Furthermore, as on-site communities with
extensive knowledge of local environments, they are most directly involved with conservation and sustainable use (Lim et al., 2010).

2.2.2 The importance of documentation of traditional knowledge (TK)

The importance of traditional knowledge (TK) is known worldwide. In 1998, Malaysia had established the National Policy on Biological Diversity. Malaysia is coined to utilise its ground biological diversity and to preserve the natural sources to reach the objectives of 1992 United Nations Convention on Biological Diversity (CBD). The government share benefits of the natural sources globally. Article 15 of CBD emphasized on the implementation of access and sharing the natural sources (Lim et al., 2010).

Malaysia targets to develop and commercialise the use of natural resources in living organisms derived from plants and herbs internationally. Products such as the Tongkat ali (Eurycoma longifolia), Kacip fatimah (Labisia pumila), Mas cotek (Ficus deltoidea), Pegaga (Centella asiatica), Misai kucing (Orthosiphon staminues) and etc. are some of the name in the pharmaceuticals and medicinal supplement which had been documented and shared by universally (Zainon, 2004).

The heredity of plants in the tropical rainforests transects the human needs and it is public’s responsibility to conserve the 30% of our green. South America, Central Africa and Southeast Asia are the tropical rainforest found in the world. Malaysia rainforest is believed to be the oldest tropical rainforest and covers 59% of the total land area. Currently, search and exploration on the genetic resources in living plant in tropical rainforest leads to the founding of its scientific and traditional pharmaceutical values. It is upsetting when deforestation threatens the environment, leaving the researchers with worries of its extinctions. About 4.9 million hectares of forests in Malaysia shown reduction within 1983-2003 (WWF, 2015). In between 2000 and 2012 Malaysia recorded the world’s highest rate of forests lost, covering 47,278 km² area of land forest (Butler, 2013). Rapid degradation of natural habitats distracts the ecosystem and brings destruction to the rainforest. Meanwhile in Africa’s inhabitants are reported to practise the utilising of its living organism in the community. The indigenous in Ogbomoso, Nigeria use plants to treat the malaria disease. The society clicks to medicinal plants treatment in curing any ailments
(Olorunnisola et al., 2013). This conduct had not been documented since, and demands to such conducts were important to treasure. Lack of pertinent documentation will cause the knowledge to disappear.

Malaria treatment is still in search. The aboriginal ways of handling the issue of malaria amongst them is seen as the phases in conserving traditional knowledge of medicinal plants. Malaysia’s young generation view the preserving of traditional issue lightly. Modernization cause these younger generations to migrate to urban area and forget the existence of traditional medicine (Ong, Faezah & Milow, 2012). Approaches should be taken to overcome such circumstances. Ninth Malaysia Plan (2006-2010) by Forest Research Institute Malaysia (FRIM) discussed the application of TK in modern era and establish the traditional medicinal in the society of the rural and urban area locally and internationally also globally (Lim et al., 2010).

Malaysia bioproducts growth had been proven to be potential due to the ample and rich sources of traditional plants to utilise in the industry of traditional pharmaceutical. Act and steps needed to ensure the traditional medicinal preserved used in future generation. Thus, government must set up a programme whereby the community in modern times valued the TK and view the issue of processing and gathering the information of TK seriously by collecting the database at the preliminary stages, screen the plants for traditional medicinal means then stress at its potential in industrial world. Malaysia authority must cooperate with the local and involvement from the private sectors is vital. All steps taken by the government is an assurance to result in the success of conserving the traditional medicinal in Malaysia and to the world to utilise it in modern pharmaceutical. The Research and Development (R&D) programme is essential to the success of authority’s programme and taken step a reality. Laws and order should be implementing in assurance to preserve the heritage and treasure of the TK.

2.2.3 The role and status of traditional knowledge (TK) on documentation of medicinal plants in healthcare and medicine in Malaysia

In life circle, it is transparent that the existence of human was not complete without ties to plants and the growing nature. Human needs plants in every aspects of life. History shown that not only humans use and utilise plants as food but in many terms
of daily use such as in construction, clothes preparation and design, and importantly in medicine and healthcare (Brahmachari, 2009). Traditional herbal medicine (THM) is the knowledge in implementing plants as main sources of important material in health care product. Its pharmaceutical value, proven and clearly be seen in the lives of the indigenous. WHO (2013) state that the use of traditional and herbal medicine influenced the society in diverse community.

WHO (2013) regards the traditional medicine (TM) as important to the society especially in the developing countries, where it may reduce the dominant facts of allopathic medicine being utilize in clinical subject. It is being urged for the developing countries to use the herbal and natural medicine in treatment of patient and consumers in the community. About 80% of the world population use TM to cure various ailments (Brahmachari, 2009; Wangchuk et al., 2011).

Malaysia shown the spiritual influence in medicinal matter, where in Malay society they is “bomoh”, in Chinese custom there is ‘sin seh’ and in Indian society there is ‘ayurvedi’. All the terms are referred to the herbalists and traditional medicine (Kui, 2007).

The history of mankind is as old as the history of traditional medicine. 5,000 years ago, the Indian society practice Ayurveda in maintaining and curing life ailments. This is the oldest form of medication practiced to mankind. Ayurveda is Sanskrit words mean ‘the science’ of life. Its healing therapy passed on generations verbally and had written record in Sanskrit (Gokani, 2014). Chinese therapy had recorded the use of herbs and plants in its traditional treatment and had more than 2,500 years of history in traditional medication which includes the practise of acupuncture, massage and mind/body and dietary therapy. Chinese medicinal procedure materia medica includes plants, minerals and animals parts. (Lao, Xu & Xu, 2012). Islamic and Christianity civilisation be seen used medicinal agents in treating various diseases and infection in lots of ailments as mentioned in Quran and Bible. Globally, there’s 35,000 green species identified as related to medical resolutions (Ibrahim, 2005). Burkill (1966) in his compilation of the Malay Peninsula economic merchandises reported 1,300 of plants in the region of traditional medicine used in the society.

Documented of the traditional medicine and heritage are treasured for generations and passed to next generation in many transportation: songs, folk stories, medica pharmacopeia and to other parts of the world in terms of publications and
Two books: ‘A Dictionary of Malayan Medicine’ (Gimlette & Thomson, 1939) and ‘A Dictionary of Economic Product of the Malay Peninsula’ (Burkill, 1966) is a documentation of Malays traditional herbs and plants in pharmaceuticals and also in economic structure. A survey conducted by Salleh and Latiff (2002), stated that approximately 48% of the whole publications of documented pieces in the form of theses, 22% are of journals meanwhile 15% and 7% of the publications are proceeding and technical reports respectively. Monograph and books fill in 8% of the survey result in published documented. There are no accesses to public references in the TK subject whereas the documented document only available in the institutions where the report submitted. Table 2.1 shows documentation of medicinal plants used by other tribes in Malaysia.

Table 2.1: Documentation of medicinal plants used by other tribes in Malaysia

<table>
<thead>
<tr>
<th>Tribes</th>
<th>Location</th>
<th>Reported no. of medicinal plants uses</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iban and Kelabit</td>
<td>Sarawak</td>
<td>1,144</td>
<td>Christensen, 2002</td>
</tr>
<tr>
<td>Murut</td>
<td>Sabah</td>
<td>68</td>
<td>Kulip, 2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,300</td>
<td>Kulip, 2009</td>
</tr>
<tr>
<td>Kadazandusun</td>
<td>Croker Range, Sabah</td>
<td>50</td>
<td>Ahmad &amp; Ismail, 2003</td>
</tr>
<tr>
<td>Dusun Tobilung</td>
<td>Kampung Toburan, Kudat, Sabah</td>
<td>49</td>
<td>Yusoff, Ahmad &amp; Pasok, 2003</td>
</tr>
<tr>
<td>All tribes</td>
<td>Peninsular Malaysia</td>
<td>19</td>
<td>Al-Adhroey et al., 2010</td>
</tr>
<tr>
<td>Temuan</td>
<td>Kampung Jeram Kedah, Negeri Sembilan</td>
<td>56</td>
<td>Ong, Chua &amp; Milow, 2011</td>
</tr>
<tr>
<td>Temiar</td>
<td>Kampung Bawong, Perak</td>
<td>62</td>
<td>Samuel et al., 2010</td>
</tr>
<tr>
<td>Jah Hut</td>
<td>Kampung Pos Penderas, Jerantut, Pahang</td>
<td>53</td>
<td>Ong, Faezah &amp; Milow, 2012</td>
</tr>
<tr>
<td>Kensiu</td>
<td>Kampung Lubuk Ulu Legong, Kedah</td>
<td>39</td>
<td>Mohammad, Milow &amp; Ong, 2012</td>
</tr>
<tr>
<td>Jakun/ Orang Hulu</td>
<td>Kampung Peta, Johor</td>
<td>52</td>
<td>Taylor &amp; Wong, 1987</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>Ismail et al., 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>23</td>
<td>Sabran, Mohamed &amp; Abu Bakar, 2015</td>
</tr>
<tr>
<td>Jakun/ Orang Hulu</td>
<td>Endau-Rompin</td>
<td>50</td>
<td>Omar et al., 2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>Omar et al., 2008</td>
</tr>
</tbody>
</table>

In Malaysia, traditional knowledge (TK) is the key player in forest management and biodiversity conservation (Lim et al., 2010). As a matter of fact, the medicinal values of folk medicines are famous to indigenous people as they have been using medicinal plants since ancient time and are still practicing it until
previous time. However, there are decreasing data in treating disease with medicinal plants. It leads to the facts that the indigenous knowledge of traditional usage of many species of plants remains unknown since the knowledge is transferred orally from generation to generation. Lacking of documented manuscript lost the valued treasure of info in traditional medication. The way information transformed support the facts because verbal communication may leads in the way, thus researchers must take fast actions in documented the sources. Next, through ethnobotanical information collection efforts, studies of herbal plants can potentially contribute to and enhance development in the field of nutraceuticals and pharmaceuticals. Herbs or medicinal plants or other natural products are now becoming one of the world’s most important commodities. They are defined as drugs that may cure ailments. The use of these drugs, moreover, is used to diagnose, treat, prevent or cure diseases.

2.3 The Orang Asli

2.3.1 Definition, origin and background of Orang Asli

Dewan Bahasa Dictionary defined “peribumi” as the ‘aborigine’ and ‘aboriginal’ Malaysian (DBP, 2014). Associates to the description of “peribumi” in Malaysia, which stated as the roots of early group in the society. Whereas, the “peribumi” is classify into “penduduk asal” that is the ancestors of the Malay Peninsular group in the society and the native Malaysian ethnic that is the “Orang Asli” (Kamarudin & Ngah, 2007).

Nor (1998) implied the issue precisely in the influence of law and order that allotted the aborigine of Malaysia to the categorization of the “bumiputera” and “Orang Asli”. Following the proclamation, he classified the “bumiputera” in Malaysia referred to the Malays in Peninsular of Malaysia, the Malays in Sarawak, Iban, Bidayuh, Kayan, Kenyah, Kelabit, Melanau, Murut including other natives in Sarawak; the Malays in Sabah, Kadazan, Dusun, Bajau and the other natives in Sabah. The “Orang Asli” classified into 3 main ethnics identified as Negrito, Senoi and Proto-Malay.

In accordance to the constitutional law under the Akta Orang Asli 1954, the definition of the word “Orang Asli” and “bumiputera” generally span to all
Malaysia’s residents, whilst under the Akta 134 in particular to the Orang Asli act in the Peninsular of Malaysia, distinct the “Orang Asli” as compliance to the circumstances of (Kamarudin & Ngah, 2007):

a) Anyone whose father’s and ancestors were from the Orang Asli root, speak the Orang Asli language, custom the way of life of the tribe in credence and tradition. This includes the Orang Asli heritance and anyone from other social stratification/tribe/aborigines adopted by the Orang Asli; defined as one of the Orang Asli.

b) Children of an association/part of the Orang Asli society/member of the tribe; requisite the male from other tribe but spoke in the Orang Asli language and practice the Orang Asli way of life is defined as the member of the Orang Asli.

c) Any Orang Asli neglected the way of life of the Orang Asli in associates of émigré to another religion remains the tribe as he/she still belief in the religion.

d) Any how to define an individual as the definite Orang Asli must be the choice of judgements from the Minister.

Orang Asli meaning the 'original people' or 'aboriginal people' or 'first people' is a Malaysian term used officially for the indigenous people in Peninsular Malaysia. The terminology introduced by the anthropologists for 18 tribes to 3 main ethnics: Negrito, Senoi and Proto-Malay. Each main ethnic divided into several small tribes which adapt the social and culture of the aboriginal and speak the language of the Orang Asli (Figure 2.1) (JAKOA, 2013).

The categorization of the 18 tribes group allied to the texture of the skin of the face, culture of the people, the language use in communication and geographical aspects of the populaces. Majority of the inhabitants live in the wilderness which influenced by nature and belief in the ancestral trust and clench to primitive way of life. Wholly, atheist and don’t practice law and order in the society and neglected modernism (Masron, Masami & Ismail, 2013).
The Orang Asli was the early settler in the Peninsular since 5,000 years ago. It was believed that the origin of these people were from China and Tibet that exile to new land across Southeast Asia before they sojourn in the Malay Peninsula and Indonesian archipelagos (Abdul Latiff, 2010).

The Negrito is assumed as the early settlers, resides in Peninsular Malaysia approximately 25,000 years ago. Famed as ‘little Negroes’, is physically short (1.5 m or less), dark skin, curly hair, wide nose, round eyes and low cheek. Majority of the ethnic lives in north of the Peninsular especially in Perak and Kelantan and small amount in Kedah and Pahang (Figure 2.2) (Kamarudin & Ngah, 2007; Masron et al., 2013).

The Senoi is believed to be the traits of the Monggol from north, migrate to the Peninsular in 2,000 B.C. They were physically different from the Negrito, taller with fairer skin, billowy hair and not curly. Most of the Senoi resides in the north and middle of Malaysia Peninsular especially in Perak, Pahang and Kelantan while some of them were found in Selangor and Terengganu (Kamarudin & Ngah, 2007; Masron et al., 2013).

The Proto-Malay had fairer skin with straight hair. Most of these people reside in the south and middle of the Peninsular. No genuine historical resources on the facts of the Proto-Malay migrate to the south of the Peninsular as Johor and Negeri Sembilan but it was believed that they were the origin of the Orang Kuala

Figure 2.1: Three main ethnics and 18 tribes of Orang Asli in Peninsular Malaysia
which immigrate from Sumatera 500 years ago (Kamarudin & Ngah, 2007; Masron et al., 2013).

Orang Asli are the indigenous communities in Peninsular Malaysia. They were the minority to the inhabitants in Peninsular (Lee, Chang & Noraswati, 2009) make up 0.5% of 150,000 native Malaysia’s populations in 2011 (Masron et al., 2013) but practice different culture and tradition similarly to different language. The society’s identity was defined by the course of nature.

2.3.2 The Jakun community in Kg. Peta, Endau-Rompin, Mersing, Johor

Omar (1983) believed that the Jakun tribe originally came from Yunnan which is the south of China, whereas Abd Rahman (2012) proclaimed that migration started 2,500 B.C. Other than that, some assumed that the Jakun tribe had blood relationship with the Mongol and Indonesian (Asmah, 1983). The Jakun was also known as the Orang Hulu (People of the Upriver) (Taylor & Wong, 1987; Abd Rahman, 2012).
Survey made by Department of Orang Asli Development (JAKOA) in 2013, stated there’s 34,722 (46.10%) of the Jakun from 75,332 total Proto-Malay ethnic. The Jakun people highly dominant tribe in the Proto-Malay ethnic compared to Temuan, Semelai, Orang Kanaq, Orang Kuala/ Orang Laut and Orang Seletar (Table 2.2). In addition, JAKOA had recorded that the Jakun tribe shown second in amount of the Orang Asli population after the Semai tribe which exist from the Senoi ethnic, populated of 51,437 people (JAKOA, 2014).

### Table 2.2: Proto-Malay ethnic group, location and estimates population in 2013 (JAKOA, 2014)

<table>
<thead>
<tr>
<th>Proto-Malay ethnic</th>
<th>Location</th>
<th>Population</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temuan</td>
<td>Selangor &amp; Negeri Sembilan</td>
<td>27,590</td>
<td>36.62</td>
</tr>
<tr>
<td>Semelai</td>
<td>Middle Pahang &amp; East Negeri Sembilan</td>
<td>7,727</td>
<td>10.26</td>
</tr>
<tr>
<td>Jakun</td>
<td>South Pahang &amp; North Johor</td>
<td>34,722</td>
<td>46.10</td>
</tr>
<tr>
<td>Orang Kanaq</td>
<td>East Johor</td>
<td>148</td>
<td>0.19</td>
</tr>
<tr>
<td>Orang Kuala</td>
<td>West &amp; South Johor shoreline</td>
<td>3,525</td>
<td>4.68</td>
</tr>
<tr>
<td>Orang Seletar</td>
<td>West &amp; South Johor shoreline</td>
<td>1,620</td>
<td>2.15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>75,332</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Johor is one of the state in Malaysia. Johor situated exactly at the south of Peninsular Malaysia. The majority of the Jakun stay in Johor and the remaining was occupant in Pahang. The Jakun residential area in Johor is known as Kg. Peta, Endau-Rompin, Mersing which is situated at the south of Pahang and northern-east of Johor also located in the eco-tourism of Johor National Park Endau-Rompin (TNJER).

Kg. Peta had its name following the incident of the Orang Asli and the British, who went to explore the Endau-Rompin rainforest, which is known as Johor National Park Endau-Rompin (TNJER) during the 2nd World War. They found a map of hidden treasure during the Japanese Colonization, thus the incidents the village is named as Kampung Peta (Kg. Peta) as in Malay language “peta” means map (Seow et al., 2013).

The Jakun people had Malay features with olive brown skin. They speak in Austronesia which has similarity with Malay Language. The language use had decreased when assimilation with the Malay Language occurred. In majority, the
Jakun people belief in supernatural power. Their religion was animism and it was the ancestors’ belief. However, exposure to education and development programme, some of them had converted to Islam (Abd Rahman, 2012).

In 1950s and 1970s, the people trade the sources from the rainforest as a life income. During that period they do not fully depend on agricultural activities because the rainforest was rich with agricultural resources for living. Nature is the sources in one’s native life. Nowadays, the communities leads a more proactive lives, where some of the people indulge in small business and being the dealer of craft and art project parallel to the other tribal indigenous activities from other ethnic in Malaysia (Sam, Seow & Mohamed, 2013).

Nowadays, most of new generations migrate to city looking for a stable job in industrial and plantation sector. The livelihoods of the Jakun people in Kg. Peta are the combination of agriculture, fishing, tapping rubber trees and hunting. The rest of the population are JNPC staff and work as a tourist guide. The community in Kg. Peta adhered modernism and advancement in the aspects of economic, education, and social growth following to the governments strategies and plan. The implementation and enforcement of all the plans and programme were through the state and federal level to assure that each and every member of the community in the country gain the benefits of such line-up (Seow et al., 2013).

Majority of the Jakun people embraces their ancestors’ belief (Jamiran, Seow & Mohamed, 2013). This ancestral knowledge especially in the element of traditional medicinal substance from plants in the rainforest is a valuable paragon for new generation. The plants and herbs in Malaysia’s rainforest contain lots of use in the world of science and medicine. Modern generation should inherit the knowledge from the natives, as the rich sources of the medicinal essential are from flora and fauna in our rainforest. The modernism in pharmaceutical education should equal the traditional curative in modern realm. The heritable knowledge from the indigenous tribal should be conserved and nurtured by the young generation for future orientation in traditional medicinal domain. The influence of modern science should not sink the traditional methods in healing and curing illness in a develop country which endow the community with modern approach of medicinal cure.
2.3.3 The Jakun people and medicinal plants

The Endau-Rompin rainforest situated border to the northern-east of Johor Darul Takzim and south to Rompin, Pahang Darul Makmur. The rainforest covers 48,905 hectare of Johor National Park Endau-Rompin (TNJER) ecotourism area. It is a nature preserve extent in Malaysia. In addition, it is renowned as world’s oldest tropical rainforest, in the region of 248 million years by the founding and observing of the rock formation which mantle the rainforest range. The name ‘Endau-Rompin’ is given after the rivers that flow through the Endau and Rompin River (Wong et al., 1987).

The rainforest are packed and rich with lots of plants species. The natives had used and consumed plants as food, traditional medicine, construction tools, clothes, hunting and fishing gadgets also as life equipment for many centuries. World Health Organization (WHO) researched, recorded 80% of the human population depend on traditional medication to cure illness (Samuel et al., 2010). Biological diversity of the rainforest benefited the society and aids them with 1000 ways of practice in life.

In addition, the Jakun tribe inhabited area is situated in Kg. Peta, TNJER which is in the ecotourism area. They depend on nature and spiritual riches such as the mountains, hills, rivers, rocks and caves. The Kg. Peta society held in ancestor’s belief and practice animism, where nature influenced their being in this world. Plants and it substance produces daily vitamins and make the package all in one where the Jakun believed that the environment gives life to the whole society (Jamiran et al., 2013).

Generally, the native attitudes towards the use of nature are based on three main concepts: (communal concept) a tribe owns a certain area and each individual in the tribe had their own ground but shared sources. Secondly, the people believed they were responsible of god’s asset and finally is they have to carry the responsibility to take care of the nature and environment for the necessities of their future generation. Lastly, the people pick up and pull together all the resources from the tropical rainforest manually in order to preserve the environment (Sam et al., 2013).

An interview with the Tok Batin son, Radu Bin Sangka who is one of Johor National Parks Corporation (JNPC) workers, stated that the Jakun practice traditional
ways in using the plants and herbs medication to cure illness influenced by three factors which strongly relates to the believed of ancestors acceptance to spiritual and natural environment’s power or strength that cure sickness is first by having faith to clinical or hospital scientific medication. Secondly based on the tribal descendants to previous generation and finally the use of the herbs and plants in medication through the indication and dream experienced (Sam et al., 2013).

Older generation believed that plants and all parts of it as the roots and herbs from the tropical forests may cure any sickness and diseases such as high blood pressure, fever, injured, diarrhoea, stomach ache and many other sicknesses. They intensely hold the principal of the ability of the plants and herbs in curing diseases. It is previously, that many of the younger generation believed in scientific means in curing illness. These young generation seek the aids of hospitals and local clinics to fight illness as they now assume that the equipment used in the clinics and hospitals are more hygienic, safe to use and are modernized to apt to the modern medicinal methods (Sam et al., 2013).

Refer to a true happening, Sam et al. (2013) which happened to a teenager who was diagnosed having bone cancer, his biological brother dreamt of their late great grandfathers informing him to take the stem barks of a plant known as Keruing air then boil the roots and finally perform a ritual bath under that particular tree with the water. Six months after the bath, the teenager condition getting better and finally cured and healthy as before. This occurrence decisively had shown the contact and influenced of nature and its cause to people in the native’s society, where their prime conceptual belief is that spiritual power may give life and strength to their people.

It is undeniable to the conceptual and functions of the medicinal plants in curing illness in the native’s society and human nature. The practice of utilizing the plants and herbs as medicinal cure had been practiced for many generations. They have built up a large ‘drugstore’ of plants which have healing values. While others consuming aids from available commercial pharmaceutical products, the relatively isolated communities still rely on plant remedies for certain ailments.
2.4 Malaria

Malaria disease - malaria (or ague, as it was called earlier) has been known from antiquity. The sign is when one’s getting intermittent fevers with chills and shivering are believed to have been malaria according to the religious and medical texts of ancient Indian, Chinese and Assyrian civilizations. Charaka and Susrata have described the disease and noted it in association with mosquitoes’ bites. In the 5th century BC in Greece, Hippocrates was the first describing in details the prevalence of the disease in certain places and seasons. The relation between the disease and places; stagnant waters, swamps and marshy lands was recognized and measures. Next, steps to control the disease applied by effective drainage system as practiced in Rome and Greece by the 6th century AD. The name malaria (mal-bad, aria-air) was given in the 18th century in Italy as it was believed to be caused by foul emanations from marshy soil. Paludism, another name for malaria (from French) means ‘marsh’. This infectious disease was present from thousands of years ago according to the demonstration of a specific parasitic antigen in Egyptian mummies. In 1880, Alphonse Laveran is a French army surgeon in Algeria was discovered the specific causative agent of malaria in the red blood cells of a patient. Then, the mode of transmission of the disease was established in 1897 when Ronald Ross in Secunderabad, India identified the developing stages of malaria parasites in mosquitoes (Paniker, 2007).

2.4.1 Epidemiology of malaria worldwide

Tropical and subtropical regions around the world face serious malaise and fatality due to the infectious disease called malaria (Jonville et al., 2008; Fotie, 2009; Adebayo & Krettli, 2011). The area most likely to be affected is usually the whole spread of the sub-Saharan Africa Region and other mildly affected areas such as Asia, Middle East and Latin America (WHO, 2016).

The World Health Organization (WHO) through its World Malaria Report 2015 had predicted that on a global scale in 2015 there were approximately 214 million cases of malaria (with a minimum cutoff rate of 149 million and a maximum of 303 million) and an estimated 438,000 deaths (with a minimum cutoff rate of
236,000 and a maximum of 635,000). About 90% these deaths represent in the African Region and 7% in the Southeast Asia Region followed by 2% in the Eastern Mediterranean Region. However, the global death rate due to malaria has declined by 60% since 2000 and by 66% in the African Region (WHO, 2015a).

The tropical and sub-tropical belt consisting of more than 95 countries and territories is naturally prone to malaria, thus affecting approximately 3.2 billion people, which means that almost half of the world’s population faces the risk of becoming victims of malaria (WHO, 2016). This disease mostly infects the sub-Saharan African population and the majority of the deaths in the African continent plague children under the age of 5 years with one dying every minute due to this disease and also pregnant women (Tabuti, 2008; Fotie, 2009; Muganga et al., 2010; Musila et al., 2013).

The WHO has adopted various approaches to control malaria including prompt and effective treatment such as by sleeping under insecticide-treated bed nets by people at risk, applying indoor residual spraying with insecticide and wearing long sleeved clothing, confirmation of malaria diagnosis for every suspected case, timely treatment with appropriate antimalarial medicines to prevent the vector mosquitoes. Furthermore, stagnant water near and around homes should be drained as this serves as a breeding ground for mosquitoes (WHO, 2006).

2.4.2 Epidemiology of malaria in Malaysia

In Malaysia, malaria is under endemic disease of public health problem. Being one of the vector-borne infection diseases in Malaysia, it affects indigenous people, traditional villagers found in hilly jungles, land scheme settlers, jungle workers, loggers as well as immigrants from endemic malaria countries (Rohani et al., 2014). Increasing figure due to rapid influx of legal and illegal workers and large number of tourist into this country becoming a new source of infection resulting increasing detection of malaria cases. Immigrants that contribute to malaria cases in Malaysia are 49.6% from Indonesians, 17.1% from Myanmarese, 11.2% Bangladeshis and 8.1% Thais and the 14% remaining reported among immigrants from Pakistan, Nepal, India, Vietnam and Kampuchea (Alias et al., 2014).
The total number of malaria cases in Malaysia is trending downward from 12,705 cases in 2000 to 4,725 cases in 2012. The incidence rate declined from 0.55 per 1,000 populations in 2000 to 0.16 per 1,000 populations in 2012 (Figure 2.3). Since then (2000-2012), a total of malaria cases are reduced from 3,918 to 1,097 cases in Peninsular Malaysia, 3,011 to 1,571 cases and 5,776 to 2,052 cases in Sarawak and Sabah respectively (MOH, 2014). While, in Johor reported depreciation total of cases based on declining of fatality rate (FR) is < 5% population within 10 years period (2000-2009) and annual parasitic index (API) values of > 0.1/1000 population to < 0.1/1000 population after the first four years (Alias et al., 2014).

Figure 2.3: Number and incidence of malaria (per 1,000 populations) in Malaysia, 2000-2012 (MOH, 2014)

The highest number of malaria deaths in Malaysia was reported to be 46 in 2001 and has been reduced to 16 deaths in 2012. The case fatality rate of malaria been around 0.3 to 0.5 per 100,000 populations since 2006 (Figure 2.4) (MOH, 2014).

There are five species of plasmodia known to infect humans namely: *P. falciparum, P. vivax, P. malariae* and *P. ovale*. *P. knowlesi* is a simian malaria parasite and now is known as the fifth plasmodium species can cause malaria to human (Singh & Daneshvar, 2010; Azidah et al., 2014). *P. knowlesi* had reported an increasing order with 41 cases in 2008 to 55 cases in 2009 (Alias et al., 2014).
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