



## **Sustainability of Orang Asli Indigenous Knowledge and Practices of Green Technology in Medicine**

**\*Regina Lambin, Norwaliza Abdul Wahab, Ramlee Mustapha, Goh Swee Choo\***  
Sultan Idris Education University, Perak, Malaysia

**Ramlee Abdullah**  
Sultan Zainal Abidin University, Terengganu, Malaysia

**Mohd Penislin Md Sharif**  
Wollywood Production Sdn Bhd, Selangor, Malaysia

*\*Corresponding author: geenalambin@gmail.com*

### **ABSTRACT**

This study was designed to determine the sustainability of Orang Asli Indigenous Knowledge and Practice of Green Technology (IKPGT) in the field of herbal therapeutic medicine at selected Orang Asli settlements in Peninsular Malaysia. A case study with multiple sites was used as the research design. Interview protocols and observations were used to obtain the qualitative data. The interview involved 13 informants from Mah Meri, Semai, Bateq dan Semaq Beri tribes. The interviews were video and audio-taped, transcribed verbatim, analyzed, and imported into Atlas.ti software for data processing. The findings showed that the Orang Asli tribes were using their indigenous knowledge to prepare traditional herbal medicine to cure certain diseases using selected herbs from the forest. This ethno-medicine especially in herbal therapeutics is pertinent in Orang Asli culture. Orang Asli tribes utilized medicinal plants to heal various health conditions in treating both children and adults. The plants were hand-picked and processed with natural “green” methods without damaging the natural habitat and without using synthetic chemicals. This explorational study found that Orang Asli’s practices of making traditional medicine from selected plants were environmentally friendly and could be sustainable if the practices were passed down to the younger generation. However, the younger generation of Orang Asli seemed to be less interested to learn and to practice the making of herbal medicine to treat common illnesses among Orang Asli community. Another major weakness of Orang Asli IKPGT in making therapeutic herbal medicine was the lack of documentation of the medicinal procedures and processes. In conclusion, the main result shows that most Orang Asli tribes still maintain and practice “green technology” based on their indigenous knowledge in their daily lives. As an implication, Orang Asli IKPGT, based on the empirical data, could be used to develop as a new “Green ethno-medicine framework” with respect to Orang Asli traditional herbal medicine preparation.

**Keywords:** Indigenous knowledge, IKPGT, green technology, Orang Asli, ethno-medicine

### **INTRODUCTION**

Even in their remote villages, Orang Asli – the indigenous community in Peninsular Malaysia, does not isolate itself completely from the mainstream culture and economy but maintains a tradition of “spiritual” connection with the nature. Orang Asli are the aborigines of the Malay peninsula (Mustapha, 2013). The Orang Asli are officially classified into three main ethno-linguistic groups, namely the Senoi, Proto-Malays, and the Negritos – each consisting of several dialectic sub-groups (Mustapha, 2013). Orang Asli communities are concentrated in selected states based on their ethnic groups, with the Senoi predominantly residing in Perak and Pahang; the Proto-Malays in Pahang, Johor, Negeri Sembilan and Selangor; and the Negritos in Kelantan, Perak and Pahang (Khor & Mohd Shariff, 2008).

Orang Asli were once thinly scattered throughout the peninsula, but most have been pushed back into the interior montane forests as the Malay population grew on the coastal plains and in the major river valleys (Mustapha, 2013).

They practice a range of native cultures, customs, taboos, beliefs, and indigenous health practices. They adopt their ancestral philosophy of unified supra belief of human-nature equilibrium that influenced their way of life and *weltanschauung* (Lambin et al., 2018; 2019). It is well known that Orang Asli are native peoples who protect and manage their natural resources and the ecosystems surrounding them to ensure their continued existence. Orang Asli also possess certain indigenous or ethno-knowledge, skills, ethics, and wisdom that they pass on to their progeny and community. Generation after generation – indigenous knowledge transmission *via* oral tradition is a common practice among the Orang Asli. In this article, indigenous knowledge is conceptualized as an ancient native repository of way of thinking and practice developed by a community which is different from other communities. In traditional medicine, for example, Ayurveda originated in India where as Acupuncture had its genesis in China.

Since the dawn of Orang Asli in the Malay peninsula, they had identified the local and native flora and fauna. While their forefathers spiritualize nature, they carefully observed and safeguarded the forest where they lived. In other words, the Orang Asli indigenous knowledge and customs existed through their predecessors' strong relationship with the environment. They also believe in the existence of spirits and that the supernatural beings co-populated the forests. That is why, based on the Orang Asli *pantang-larang* (taboo), they are not permitted to *takbur* (boast), destroy, or degrade the natural ecosystem (Yew et al., 2017). Otherwise, they might even encounter misfortunes in their daily routines as they believe the afflictions could be attributed to the wrath of supernatural beings helming the forests. According to Sam and Aminah (2015), the anger of forest spirits is believed to bring bad luck to Orang Asli in the forms of floods, draught, disease, or death. As a result, they strive to safeguard their environment to avert misfortunes and other negative consequences in their daily lives if they disturb the nature's equilibrium. Hence, their indigenous or ethno-knowledge and practice are considered “green” or environmentally friendly.

According to Lambin et al. (2019), Orang Asli indigenous knowledge can be considered local knowledge rather than scientific knowledge. Their indigenous knowledge could include superstitious and customary knowledge. The authors have coined the phrase Indigenous Knowledge and Practice of Green Technology (IKPGT) to denote the Orang Asli indigenous knowledge and practice which are environmentally friendly (Lambin et al., 2018; 2019). The phrase “green technology” in this context of this study refers to Orang Asli products or processes which have minimal negative impact on the environment. Furthermore, the use of green technology reflects the user's intention to preserve and conserve a sustainable natural environment (Ramle et al., 2014). Orang Asli Indigenous Knowledge and Practice of Green Technology (IKPGT) is naturalistically and ecologically friendly. Orang Asli IKPGT in this study refers to the natural resources, tools, processes, and products that Orang Asli used or produced which is “green” or environmentally friendly. Thus, this empirical study was designed to explore the Orang Asli IKPGT in the field of indigenous or ethno-herbal medicine in the selected Orang Asli settlements in Peninsular Malaysia.

## **PROBLEM STATEMENT**

Orang Asli treasured their indigenous knowledge due its importance in maintaining their identity and well-being. Their simple and “green” lifestyle has significantly preserved the natural ecosystem equilibrium and maintained the natural bio-diversity. Orang Asli has, since their existence in the Malay peninsula, built their own indigenous knowledge and wisdom to run their communal lives. However, their rich indigenous or ethno-knowledge and practices are scantily documented. Lack of documentation may lead to the extinction of Orang Asli indigenous knowledge if the younger generation of Orang Asli youth are not interested to learn and practice it. Modern societies are now more conscious of green lifestyle. Hence, the “Green” epistemology that has been practice by Orang Asli could be a good model for the mainstream people to emulate.

Nevertheless, the efforts to integrate indigenous knowledge and western science often encounter problems due to the different paradigm structure and underlying worldviews (Parsons et al., 2017). Indeed, in modern technological advancement, Orang Asli indigenous knowledge of “green

technology” is in mortal danger, and often forgotten or neglected. Therefore, this heritage needs to be identified, documented, and protected or it may disappear forever. Each tribe of Orang Asli has inherited rich corpus of indigenous or ethno-knowledge from their ancestors. However, most of it has never been documented. In other words, substantial of Orang Asli traditional knowledge and practices remain undocumented (Lambin et al., 2018). Indigenous knowledge often embraces cultural values or supra-meanings that appear being undermined or threatened by mainstream-style of knowledge structures, hence the indigenous knowledge possessed by Orang Asli is deemed inferior. One of the fields of Orang Asli indigenous knowledge is in the traditional herbal medicine which is on the brink of extinction. Hence, the purpose of this study was to identify Orang Asli IKPGT in field of herbal medicine.

### **PURPOSE AND OBJECTIVES OF THE STUDY**

The purpose of this study was to explore the sustainability of Orang Asli indigenous knowledge and practices of green technology (IKPGT) in herbal medicine. Specifically, the objectives of this study were to:

- (a) identify the IKPGT used by Orang Asli on traditional herbal medicine.
- (b) explore the sustainability of IKPGT on traditional herbal medicine in selected Orang Asli settlements

### **CONCEPTUAL FRAMEWORK**

The conceptual framework for this study was based on two models: (a) an integrated model of indigenous ecosystems (Sangha et al., 2015) and (b) the first nations holistic lifelong learning model (Canadian Council on Learning, 2007). Specifically, an integrated model of indigenous ecosystem is a model representing indigenous peoples relationship with their ecosystem that suggests how various elements of indigenous lives are connected to their ecosystem. Hence, the model is relevant or in line with the aim of this study that is to maintain the sustainability of the ecosystem based on the close relationship of indigenous people with nature.

The second model is the first nations holistic lifelong learning model. It focuses on sustainability of the indigenous learning mechanism. In other words, indigenous learning is a life-long process. This model has been selected in this study because it is relevant to the indigenous learning epistemology. Both models could be related to green lifestyle of the indigenous peoples. Based on these models, we developed a new concept called Indigenous Knowledge and Practice of Green Technology (IKPGT) to denote the sustainability and the “greenness” of the indigenous knowledge and practices. Figure 1 illustrated the conceptual framework of this study.

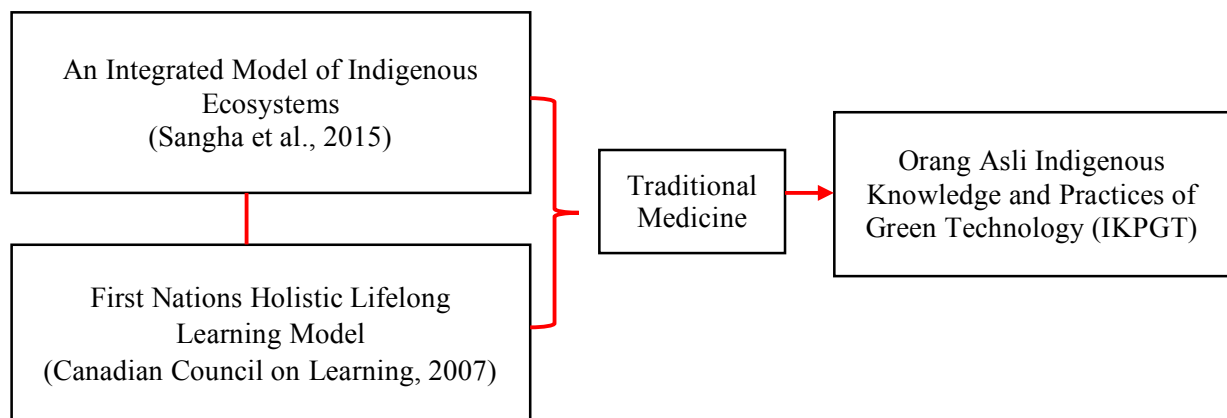


Figure 1: The conceptual framework of Orang Asli IKPGT

## LITERATURE REVIEW

### The Indigenous Peoples of Malaysia

Malaysia is a multi-cultural nation that comprised various ethnic backgrounds – Malays, Indians, Chinese and the natives of peninsular Malaysia and Sabah and Sarawak. The population of Malaysia is estimated in 2018 to be around 32 million (World Population Review, 2018) which is equivalent to 0.42% of the total world population (Worldometer, 2018). The Orang Asli is the indigenous people of the peninsular Malaysia. Orang Asli population is estimated at 217,000 (Nicholas, 2019). The term "Orang Asli" in Malay means "Original People" or the earliest inhabitants of the Malay peninsula. Most of them settled in the remote thick rain forest (Wahab & Mustapha, 2015). In general, Orang Asli is also identified as an Aslian community (Choy et al., 2010). The Orang Asli could be divided into three groups – Senoi, Proto-Malay and Negrito and eighteen sub-groups (JAKOA, 2017). Table 1 showed the three major ethnolinguistic groups of Orang Asli and their sub-groups.

Table 1. The groups and sub-groups of Orang Asli in Peninsular Malaysia

ORANG ASLI ETHNOLINGUISTIC GROUP		
SENOI (55%)	PROTO-MALAY (42%)	NEGRITO (3%)
Che Wong	Semelai	Kensiu
Mah Meri	Jakun	Kintak
Jahut	Kanaq	Jahai
Semoq Beri	Kuala	Lanoh
Semai	Seletar	Mendriq
Temiar	Temuan	Bateq

The three ethnolinguistic groups of Orang Asli namely the Senoi, the Proto-Malay (Aboriginal Malay) and the Negrito (Semang) which can be further sub-divided into 18 sub-tribes with their physical characteristics, linguistic affinities, and cultural practices (Bellwood, 1997; JHEOA, 2002; Hood, 2006; Nicholas, 2006; Ang et al., 2011) with unique features, lifestyles and languages (Azmi, 2017). Senoi is the biggest tribal group comprising about 55% of the total population of Orang Asli, followed by the Proto-Malays and the Negritos at 42% and 3 %, respectively (JAKOA, 2017).

Orang Asli has diverse cultures, traditions, and ways of living, beliefs, and languages. The term "indigenous peoples" refers to "culturally separate ethnic groups having a distinct identity from national society, who derive their existence from local resources and are politically non-dominant" (Melchias, 2001:35). The Orang Asli population in peninsular Malaysia comprised distinct ethnic groups and sub-tribes, who dwells in diverse geographical regions in the country. The Mah Meri tribe, for example, lives mainly on Pulau Carey, Selangor and they are talented in indigenous handicrafts (Lim et al., 2016). While in Terengganu, Semaq Beri lifestyle is directly associated with the forest. They possess distinctive thoughts on the forest environment and life, as noted in a study conducted by Ramle et al. (2014). Not only Orang Asli tribes in Selangor and Terengganu have their specialties, so do in Perak and Pahang. The Semai tribes who live in small settlements along the foothills of the Titiwangsa Range of Perak and Pahang (Chan & Saidon, 2017) were popular with religious rituals involving music, singing, and dancing called *Sewang*. In addition, Orang Asli has extensive indigenous knowledge of the forest flora and fauna.

### **Orang Asli IKPGT**

In general, indigenous knowledge is a body of knowledge, skills, and technology belonging to a particular native community (Ndangwa, 2007; Macherera et al., 2016) and is transmitted orally from generation to generation (Anyaku et al., 2015). Various scholars have defined indigenous knowledge differently depending on their specialties or focus of the study (Akenji, 2009). According to a definition provided by Siyanbola et al. (2012), indigenous knowledge generally alludes to the developed long-standing conventions and practices of certain territorial, indigenous, or neighbourhood groups and also the wisdom, virtues, and lessons of these communities. Siyanbola et al. (2012) asserted that indigenous knowledge is a specific commonality. Indigenous knowledge, in general, refers to the corpus of local understanding about customs, culture, virtues, and practices. In other words, indigenous knowledge is commonly understood as traditional or ethno-knowledge. However, whether indigenous knowledge should be used interchangeably with the traditional knowledge, native knowledge, or ethno-knowledge is a point of contention (Nakata et al., 2005). Indigenous knowledge is also referred to as the art of using natural resources. This knowledge has been passed down to subsequent generations and has helped indigenous people to manage their natural resources and the ecosystems of their surroundings.

Indigenous knowledge also provides problem-solving strategies for the Orang Asli communities. Despite its importance for the indigenous tribes, their native knowledge and practices are being neglected and often disregarded by the mainstream peoples on the pretext of the indigenous knowledge is not scientific. However, some studies have shown that some of the indigenous knowledge and practices are environmentally friendly. The Orang Asli “green” mindset and practices are valuable lessons for mainstream peoples in Malaysia. By sharing indigenous people traditional knowledge, the mainstream peoples could improve their cross-cultural understanding and “green” practices. More specifically, Orang Asli “green technology”, if documented properly, could be used by the non-indigenous peoples such as in preserving the environment, in using natural resources in house building, natural way of treating the water and in herbal therapeutic treatment.

The term “technology” refers to the appliance of knowledge for practical purposes. The United Nations used green technology as a wide term for ecologically friendly solutions to decrease ecological damages. In the Malaysian National Green Technology Policy (KeTTHA, 2017), green technology refers to the development and application of products, equipment, and systems that have minimal negative impact on the environment. Norizan et al. (2017) defined green technology as an application, product, or system that focuses on environmental sustainability and is environmentally friendly. Indigenous knowledge of “green technology” refers to the indigenous peoples’ arts of using natural resources to sustain lives without damaging the environment. In this study, the Orang Asli indigenous and practices of green technology abbreviated as IKPGT is used as one of the indicators of sustainability. This exploratory study was conducted in several Orang Asli settlements to gather qualitative data regarding Orang Asli IKPGT in the field of traditional herbal medicine.

### **Traditional Medicine**

Traditional medicine is a subset of indigenous knowledge. Ancient medical practices in varied cultures that had existed for centuries before the dawn of modern sciences. Traditional medicine is defined as knowledge, skills and practices derived from native cultures to treat illnesses or diseases (Kang et al., 2017). Herbal therapy is a well-known type of traditional medicine. According to Ullah et al. (2013), medicinal plants are favored as a treatment method to treat a disease in the alternative medicine. Besides indigenous communities, people in poor and rural areas are prone to use herbal medicine for their health care.

Based on the literature, the IKPGT in traditional medicine practiced by the Orang Asli tribes could contribute to their environmental sustainability. Traditional herbal medicine is prepared naturally without added chemical substances. Yew et al. (2017) found that Orang Asli in Kampung Bawong, Perak still depend on local plants as a primary medical source. The preservation of the traditional way of making herbal medicine is seen as an obligation to maintain the well-being of the indigenous communities. For Orang Asli, the traditional medicine is used in a healing process with spiritual rituals to drive away bad omen. They believed their illness was caused by the act of spiritual punishment or karma for their misbehaviors.

Nevertheless, the written records of IKPGT on medicinal plants used by native peoples were scanty. Furthermore, Wubetu et al. (2017) stated few studies had been conducted on the use and practice of traditional medicine. Therefore, in order to sustain and preserve the herbal indigenous knowledge and to protect such herbal species, the documentation is critical. Oladeji and Agbelusi (2017) suggested that database of information on traditional medicinal plant species used by indigenous peoples to treat varied illness should be created.

## **METHODOLOGY**

This research used a qualitative descriptive case study research approach. Renganathan (2011) underscored the importance of conducting qualitative research with the Orang Asli tribe in order to obtain rich description of their practices. Case study was a type of research that seek to gather data based on what was occurring in a natural setting. The aim of this study was to explore the sustainability of Orang Asli Indigenous Knowledge and Practice of Green Technology (IKPGT) in the field of herbal therapeutic medicine at the selected Orang Asli settlements in Peninsular Malaysia. Four Orang Asli tribes were studied in the four states of Peninsular Malaysia – Selangor, Perak, Terengganu, and Pahang. The tribes were Semai, Mah Meri, Semaq Beri, and Bateq. This case study delved into in-depth observation and interview with the participants regarding their IKPGT in herbal medicine.

Based on the snow-balling technique, six Orang Asli Headmen (*Tok Batin*) or tribal elders and seven women were selected as the informants for this study. The informants had to agree to participate in the research. The researchers were poised to explore, learn, and perceive – as a result – the informants were interviewed and observed to raise the credibility of the findings. A profile of each informant, which consisted of a brief description of the informant background, was recorded. The informants were drawn from Semai, Mah Meri, Semaq Beri, and Bateq tribes in Peninsular Malaysia. Six informants were males, and seven were females. The informants were knowledgeable in herbal medicine.

To maintain the confidentiality of the informants, they were not identified by the name in the findings. Rather, they were assigned based on the terms of pseudonyms (Bloomberg & Volpe 2008). In this study, we used coding such as M = Male, and F = Female i.e., MM1, MF2, etc. The ages of informants ranged between 40 and 60 years. The majority of the informants were Muslim, and only one informant was Christian. All male informants were headman while the female informants were housewives.

A semi-structured interview with key informants was used in this investigation. Besides the interview, the process of making herbal medicine were also observed, and the plants were analyzed. The interviews were conducted according to the protocol that had been devised. The primary source of this case study was the interview data. The data were analyzed using thematic analysis. The scientific names of the plants were derived from credible sources.

The data were analyzed using Atlas-ti software. The coding and categorization processes were conducted. The audiotaped interviews were transcribed, the Malay transcripts were double-checked for accuracy before the data were analyzed. A thematic coding approach was used to analyze the transcripts. According to Boyatzis (1998), thematic analysis encodes qualitative data that requires an explicit “code”. The analysis was carried out by creating medical theme clusters. After the themes had been identified, they were verified by the informants.

## **FINDINGS**

The results revealed that the informants learnt about the medicinal plants from their parents and elders in their villages. However, the informants also lamented that the younger generation of Orang Asli were not interested to learn their indigenous knowledge and practices. Orang Asli utilized selected herbs and medicinal plants to make natural remedies to treat certain ailments and diseases. The plants that the informants used for traditional medicine were mentioned in their native names. The researchers have to verify the plants to their scientific names by searching them from the credible sources. Due to the limited medicinal plants in their settlement areas, the informants only mentioned the regularly used plants for their common usage only.

### **Types of Medicinal Plants and Their Uses**

Based on their locality, the informants mentioned about the plants that were commonly used in their villages or settlements. In this study, the informants stated several plant species which have medicinal values in healing common ailments or diseases. The plants were *Daun Ketum*, *Bunga Raya*, *Tepos Tanah*, *Hempedu Bumi*, *Pegaga*, *Dukung Anak*, *Telinga Kera*, *Tongkat Ali*, and *Durian*. Some of the plants mentioned by the informants were not found in the settlements such as *Bemban*, *Pokok Milik*, *Lebap*, and *Kendur Urat* – hence, the plants were not examined in this study. The description of each kind of medicinal plant and its treatments would be discussed one by one based on the pictures taken during the observation.

#### ***Daun Ketum (Mitragnya Speciosa)***

The empirical findings showed that a woman (FL1) from the Semai tribe believed that *Daun Ketum* (Figure 2) is usually used for abdominal pain and diarrhea. The preparation method is by soaking the *Daun Ketum* and then filter it for drinking.



Figure 2: *Mitragnya Speciosa (Daun Ketum)*

*"Daun Ketum ... usually for abdominal pain and diarrhea. Soak it, keep it first, filter it, and see how many days one can drink it. But we do not drink it like usual now, and we drink a little bit by little bit to ease abdominal pain until it finished".*

**(FL1:S/F/42)**

#### ***Bunga Raya (Hibiscus Rosa-Sinensis)***

Semai community used hibiscus (Figure 3) for bathing to treat skin diseases. The hibiscus flower could be mixed with other flowers to make bathwater. One female informant (FL1) cautioned that only certain flowers are used.

*"We use the hibiscus as medicine to cure, we study the species of the hibiscus, we don't use all hibiscus, depends on the type of disease, if he suffers from acne, he could take it as a treatment. Other flowers like paper flowers are mixed to make the bath water; we don't use all flowers ..."*

**(FL1: S/F/42)**

Another lady informant from Bateq tribe (FZ9) asserted that hibiscus could be used to reduce headache, fever, and knee pain. She said:

*"Here we take hibiscus to control headache, fever ... just boil it ... cool it... then apply the liquid on the body [which in pain] ... we add water and make it in the form of mucus and lime ... if you have body heat or headaches ... use it for about three days".*

**(FZ9: B/F/50)**



Figure 3: Hibiscus Rosa-Sinensis (*Bunga Raya*)

***Tepus Tanah* (Zingiber Spectabile)**

A Tok Batin (MA4) informed that *Tepos Tanah* (Figure 4) and its red flower and leaves can be used to enhance blood circulation and reduce inflammatory. He told:

"For those who "lacked" of blood ... we use *Tepus* with red flowers and leaves for bathing ... for blood (circulation) to increase..."

(MA4:S/M/39)



Figure 4: Zingiber Spectabile (*Tepus Tanah*)

***Hempedu Bumi* (Andrographis Paniculata)**

In this study, a female informant (FM3) believed that *Andrographis Paniculata* (Figure 5) or *Hempedu Bumi* has been used by Mah Meri tribe, where the leaf decoction is taken orally for treating diabetes and hypertension.



Figure 5: *Andrographis Paniculata* (*Hempedu Bumi*)



***Pegaga (Centella Asiatica)***

This study also found that Mah Meri tribe relied on the leaves of *Centella Asiatica* (CA), commonly known as *Pegaga* (Figure 6) – which can be taken orally – to treat fever, relieve pain, headache, and dizziness.



Figure 6: *Centella Asiatica (Pegaga)*

***Dukung Anak (Phyllanthus Niruri)***

Figure 7 showed the photo of *Phyllanthus Niruri*, which is popularly known as *Dukung Anak* among the Mah Meri tribe. A female informant (FM3) claimed that they used the plants mixed with boiled water to be taken orally to treat diarrhea and stomach ache. Meanwhile, the roots are boiled, and the infusion is used to treat jaundice.



Figure 7: *Phyllanthus Niruri (Dukung Anak)*

***Telinga Kera (Tradescantia Albiflora)***

Based on the interview session with the informants, *Tradescantia Albiflora* (Figure 8) or locally known as *Telinga Kera* are often used by Mah Meri people to cure kidney diseases. The leaves are to be boiled and keep the boiled water with the leaves cooled before drinking it.



Figure 8: *Tradescantia Albiflora (Telinga Kera)*

***Tongkat Ali (Eurycoma Longifolia)***

In the Semaq Beri tribe, besides flowers and leaves, roots such as *Tongkat Ali* (Figure 9) are used by Orang Asli to provide energy and stimulant to their body. A tok Batin (MD6) from Semaq Beri tribe told that root can be used for bathing to rejuvenate the body and to treat fever as well as a male tonic:

*“... many more ... red Tongkat Ali ... also have black Tongkat Ali ...2-3 types ... can be used to bathe the child and to refresh the body ...*

(MD6: SB/M/58)



Figure 9: *Eurycoma Longifolia (Tongkat Ali)*

**Durian (Durio)**

The interview also revealed that the Semaq Beri and Bateq tribes practice the intake of durian root water (Figure 10) to refresh the body and eliminate thirst. Tok Batin (MD6) asserted:

"... water from the durian root can also eliminate thirst and refresh the body ..."

(MD6: SB/M/58)



Figure 10: Durio (*Durian*)

**DISCUSSION OF RESULTS**

Based on the empirical findings, Orang Asli tribes used medicinal plants to treat a variety of health ailments in both children and adults. Most of the medicinal plants mentioned by the informants in this study – *Daun Ketum*, *Bunga Raya*, *Tepos Tanah*, *Hempedu Bumi*, *Pegaga*, *Dukung Anak*, and *Telinga Kera* were used to treat common diseases such as headache, fever, inflammatory, diarrhea, stomach ache, diabetes, hypertension, and jaundice. A common procedure in preparing the herbal medicine is by boiling the leaves and/or flowers. These medicines can be taken orally or by bathing. Besides flowers and leaves, there were roots that were mentioned by the informants such as *Tongkat Ali* and Durian roots. These roots are used particularly as energy drinks and stimulants.

The “green” ways that these plants were gathered that they were hand-picked with minimal damages to the forest and without any added chemical substance. The indigenous ways of preparing the traditional herbal medicine to heal certain ailments are linked to their surroundings and spirituality which help them to connect to their heritage, land, custom, and ancestors' spirits – bringing true spiritual serenity during the “treatment” period. In other words, the indigenous people believe that there was a spiritual link between human beings and plants, specifically in making a remedy for treating various ailments (Oladeji & Agbelusi, 2017). According to Yew et al. (2017), the preservation of the traditional way of making herbal medicine is seen as an obligation to maintain the well-being of the indigenous communities. For Orang Asli, the traditional medicine is used in a healing process with spiritual rituals to drive away bad omen. They believed their illnesses were caused by the acts of spiritual punishment or karma for their misbehaviors. Orang Asli have unique and distinctive skills in managing the natural environment. They have learned on how to manage their resources and deal with challenging conditions.

In addition, the findings underscored the importance of ensuring the continuity for future generation and to share “green” knowledge about the Orang Asli IKPGT for sustainable development. In general, indigenous knowledge refers to the long-standing tradition and practices of indigenous or native peoples’ wisdom, knowledge, and epistemology. Due to rapid development and modernization, we have seen that the unstoppable depleting of natural resources and it is the biggest worry of the future generation. Hence, it is vital to understand how the Orang Asli IKPGT have saved the environment. Furthermore, it can improve the mainstream people’s understanding of Orang Asli conditions and to provide productive solutions designed to help these aboriginal communities. In other words, the understanding of Orang Asli indigenous knowledge could enhance the government’s responsiveness to their needs.

The Orang Asli IKPGT provides invaluable knowledge and guidance in making the best use of natural sources to conserve our natural resources. The world's remaining natural resources – forests, minerals, freshwater, fossil fuel, and other natural resources are in danger to deplete irreversibly. As a result, Orang Asli indigenous “green” knowledge and practices should be acknowledged and supported. Their indigenous knowledge represented high moral aspects of their interaction with nature to preserve their natural environment (Ramle et al., 2014). Orang Asli green lifestyle could be a model for the mainstream people in terms of preserving and conversing the mother nature. The Orang Asli IKPGT employed by Orang Asli in their daily lives from the days of their ancestors to today are still applicable but to preserve the knowledge and practices, documentation is a must. IKPGT practiced by Orang Asli tribes could contribute to the preservation of environmental sustainability. The documentation of Orang Asli IKPGT in herbal medicinal plants is a promising first step toward the preservation of Orang Asli indigenous knowledge and practice.

Orang Asli also believed that the environment should be cleaner and healthier for all forms of life and ecosystems. By using environmentally friendly “green technology” to conserve their environment and ecosystem, the Orang Asli IKPGT provides invaluable knowledge in making the “green” herbal medicine without damaging and depleting biodiversity and without using harmful substances. Finally, Orang Asli IKPGT can build a sustainable development for present and future generations.

## CONCLUSION

Based on the empirical data and the limitations of the study, several conclusions can be drawn. The informants have revealed the common herbal plants that they used to heal several types of ailments and diseases. These indigenous knowledge and practices they inherited from their ancestors. The herbal plants included *Daun Ketum*, *Bunga Raya*, *Tepos Tanah*, *Hempedu Bumi*, *Pegaga*, *Dukung Anak*, and *Telinga Kera*. The plants were found in the wild and the process of making remedies from these plants were “green” in nature. They were hand-picked and processed naturally without any added chemical. The preservation of the traditional way of making herbal medicine is seen as an obligation to maintain the well-being of the indigenous communities. For Orang Asli, the traditional medicine was used in a healing process with spiritual rituals to drive away bad omen. They believed their illnesses were caused by the acts of spiritual punishment or karma for their misbehaviors. Orang Asli tribes are afraid of the supernatural wrath especially the forest spirits that prevent them from destroying the environment.

The indigenous herbal therapy practice based on local resources to cure diseases while sustaining the environment plays a vital role in everyday life of Orang Asli in Peninsular Malaysia. The “greenness” of their practices toward maintaining an ecosystem were based on their indigenous knowledge, customs, totems, and rituals and were passed on from generation to generation. Orang Asli green lifestyle could be a model for the mainstream people in terms of preserving and conserving the mother nature.

Nevertheless, Orang Asli faced difficulties to sustain and maintain their IKPGT due to globalization and modernization. The result showed that now few Orang Asli parents have passed down their IKPGT to their children. Furthermore, the informants stated that the conservation and preservation of their indigenous knowledge and practices were challenging due to the deforestation. The plants and trees that they used for traditional medicine were now difficult to find due to forest clearance for agriculture and housing estates.

In terms of the sustainability of IKPGT on traditional medicine among Orang Asli, the findings of this study showed that there was lack of written document on Orang Asli herbal medicine and fewer younger Orang Asli were taught by their parents about their indigenous knowledge and practice on herbal therapeutic medicine. Hence, in order to sustain and preserve the herbal indigenous knowledge and to protect such herbal species, the documentation is critical. It is recommended that database of information on traditional medicinal plant species used by indigenous peoples to treat varied illnesses should be created. In the nutshell, the indigenous medicine practiced by Orang Asli tribes could contribute to environmental sustainability.

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