



Universiti Malaysia
KELANTAN

**DIVERSITY AND USAGE OF WILD EDIBLE
PLANTS SELL AT THE TRADITIONAL
MARKET IN JELI AND MACHANG,
KELANTAN**

by

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A report submitted in fulfilment of the requirements for the degree of
Bachelor of Applied Science (Natural Resources Science) with Honours

**FACULTY OF EARTH SCIENCE
UNIVERSITI MALAYSIA KELANTAN**

2019

DECLARATION

I declare that this thesis entitled “Wild Edible Plants Sell at the Traditional Market in Jeli and Machang, Kelantan” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

“I hereby declare that I have read this thesis and in my opinion, this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Applied Science (Natural Resources Science) with Honours”

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Date : 10 JANUARY 2019

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Wild Edible Plants Sell at the Traditional Market in Jeli and Machang, Kelantan

ABSTRACT

Wild edible plants is refers as plants that not cultivated and can be consumed by human. Nowadays, wild edible plants have been widely commercialized in the traditional market in Malaysia. But, the uses of wild edible plants among our young generations seem to be decrease and this issue become worried that the traditional knowledge about this wild species will become diluted in community. Thus, this study investigated on the diversity, the traditional knowledge and to prepare the checklist of the wild edible plants sell at the traditional markets in Jeli and Machang, Kelantan. Study was conducted through the visited to the traditional market around the study area as well as simple interviews of the sellers and the customers to know their basic knowledge on this topic. Study revealed that 37 species is recorded selling in the traditional market at the both study area. Part use and way of consumption of every species and also the traditional knowledge about the usage of certain species had been recorded in this study. The findings of this study will be useful as a reference for students and subsequent researchers that can be used for inducing awareness among people on the benefit taking this plant as additional food and management purposes.

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Tumbuhan Liar Boleh Dimakan yang Dijual di Pasar Tradisional di Jeli dan Machang, Kelantan

ABSTRAK

Tumbuhan liar boleh dimakan dirujuk sebagai tumbuhan yang tidak ditanam dan boleh dimakan oleh manusia. Pada masa kini, tumbuhan liar boleh dimakan telah dikomersialkan di pasar tradisional di Malaysia. Namun, penggunaan tumbuhan ini dalam kalangan generasi muda kita terlihat semakin menurun dan isu ini menjadi kebimbangan bahawa ilmu tradisional berkaitan tumbuhan liar boleh dimakan akan semakin lenyap dalam komuniti setempat. Oleh itu, kajian ini menyiasat tentang kepelbagaian, ilmu tradisional dan untuk menyediakan senarai semak tumbuhan liar boleh dimakan yang dijual di pasar tradisional di Jeli dan Machang, Kelantan. Kajian ini dibuat berdasarkan kunjungan ke pasar tradisional sekitar kawasan kajian termasuk menemuramah ringkas peniaga dan pembeli untuk mengetahui pengetahuan asas mereka berkenaan tajuk ini. Kajian menepati bahawa sebanyak 37 jenis tumbuhan direkodkan dijual di pasar tradisional di kedua-dua kawasan kajian. Bahagian yang digunakan dan cara pengambilan untuk setiap jenis tumbuhan dan juga ilmu tradisional berkenaan kegunaan beberapa tumbuhan telah direkodkan dalam tesis ini. Dapatan kajian ini akan berguna sebagai sumber rujukan untuk pelajar dan seterusnya para penyelidik yang boleh digunakan untuk menyebarkan kesedaran tentang kebaikan mengambil tumbuhan liar ini sebagai makanan tambahan dan juga untuk tujuan pengurusan.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Wild edible plants can be refers as plants that are not cultivated and can be consumed by human in their daily life (Brahma, Singh, Rethy & Gajurel, 2014). During the old days, people need to go into the forest to get the sources of wild edible plant. But, nowadays wild edible plant have already been commercialized and people easily can get it at the traditional markets. The common wild edible plants that sold in the traditional market around Malaysia is *Etilingera elatior* (torch ginger) or more popular with name *bunga kantan* (Figure 1.1) among local people. The indigenous people or also known as Orang Asli in Malaysia use wild edible plants as their daily food. The community of Orang Asli usually has deep knowledge about the usage of wild edible plants.



Figure 1.1 : *Etilingera elatior* (torch ginger)

Compared to indigenous people, local people not really consume wild edible plants as their additional dish. Usually, only the old folk generation who like to consume this wild species in their diets. The knowledge about the usage of this species was actually the information that passed from one generation to another generation. But, young generation was likely had less keen to consume this wild edible plant as their additional food in their daily diet. A study done by Cruz, Peroni & Albuquerque in 2013 prove that the reasons for people consume less wild plants nowadays because of chemical characteristics and unpleasant morphological of the plant, specifically smell and taste. The other cause mentioned by the participants regarding the uninterested in consume this edible plants is because they doesn't know that plant can be used for human consumption and they not considered that species can be taken in their diet. There are many species of wild edible plants that can be eaten and contain various nutrition that good to human. Wild vegetables also contribute to socioeconomic impact which it can be used as foods, medicines, fibers and cultural ceremonies (Ng, Chye & Mohd Ismail, 2012).

The uses of wild edible plant is an early tradition that have been increasingly abandon, especially in modern societies like industrialized communities and other communities. The increase in industrialized community can resulting the neglecting of perpetuation of this knowledge in spite of its antiquity and the fact that it fulfil one of the basic human needs (Reyes-García, Vadez, Huanca, Leonard & Wilkie, 2005). The other reason that may influence the neglecting of this tradition among communities is because the consumption of this wild plant is considered only for poor family (Grosskinsky & Gullick, 2000; Arias Toledo, Colantonio, & Galetto, 2007), while, consumption of industrialized food are distinguished as more modern and prestigious in certain country like some Latin American countries, such as

Argentina (Ladio, 2001; Arias Toledo et al., 2007), Colombia (Cruz et al., 2013) and Brasil (Nascimento, 2010), including some African countries, such as in Sudan (Grosskinsky & Gullick, 2000; Ngugi, 1999) and in Lesoto (Prasad, 1998).

In Malaysia especially in Kelantan, there is not much proper documented study that carried on about this topic and much other traditional knowledge on this wild edible plant is still remained unrecorded until now. Less interest to study about this species among young generations in our country become worried that this traditional knowledge will be lost for future generations. Traditional knowledge of this edible plant can be the initiator for further scientific study on the benefit of this plant to human health. Actually, the record of this traditional knowledge is not only important for record purpose and to conduct further studies, but also important in the conservation of species and genetic diversity of this wild edible plant before it becomes diluted or lost from community forever.

1.2 Problem Statement

Currently, there is no formal research on the diversity of wild edible plants that sell at the traditional market in Jeli and Machang, Kelantan. This data might be useful for future research for data gathering about these plants. Since there is lack of data and knowledge about these wild edible plants, people don't know the scientific name of every plant and keep calling it with their local name. Some local name actually may represent other plants and can cause confusion among people.

1.3 Objectives

- 1) To determine the diversity of wild edible plants sell at the traditional market in Jeli and Machang, Kelantan.
- 2) To prepare the checklist and the usage of wild edible plant that sell at the traditional market in Jeli and Machang, Kelantan.

1.4 Scope of Study

The scope of this study is to determine the species diversity of wild edible plants in two different places in Kelantan that is in Jeli and Machang, Kelantan. This study mainly focuses on documentation and establish the information about the usage of the wild edible plants so that the traditional knowledge about this edible plants will not lose among the community.

1.5 Significant of Study

This research focuses on the estimation of the diversity of wild edible plants sell at the traditional market in Jeli and Machang, Kelantan by using observation and survey methods. The result of this research will provide the diversity and the knowledge about the usage of all species that found at the traditional market.

The study provides baseline data of wild edible plants sell at the traditional market in Jeli and Machang, Kelantan which could be utilized comparatively by other researchers. It also will provides traditional information about the usage of every wild edible plant that sell at the traditional market that could be used as valuable references for students and subsequent researchers that can be used for inducing awareness among people on the benefit taking this plant as additional food and management purposes.

CHAPTER 2

LITERATURE REVIEW

2.1 Wild Edible Plants

The Food and Agricultural Organization or also known as FAO defined wild edible plants (WEPs) as “plants that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action” (Heywood, 1999). This organization also stated that at least 100 billion people around the world were believed using wild edible plants in their daily diet. According to Keatinge, Wang, Dinssa, Ebert, Hughes, Stoilova & Mavlyanova (2015), indigenous plants or also called traditional vegetables are best defined as species that locally important for the sustainability of economies, human health and nutrition and social structure. While, Brahma et al. (2014), refers wild edible plant that are available from their natural habitat and can be used as food sources that neither domesticated nor cultivated. So, wild edible plants indicate the species for human consumption that can be collected from the surrounding ecosystems include fields, pastures and forests but are not cultivated.

2.2 The Key Characteristics of Wild Edible Plants

Firstly, the use of wild edible plant is based on traditional ecological knowledge and they are locally available (Pardo-De-Santayana, Tardío & Morales, 2005; Jman Redzic, 2006; Arenas & Scarpa, 2007). Secondly, they are reducing the need to spend limited cash resources, low-cost option for increasing nutrition and

low-input (Shackleton & Shackleton, 2004; Jama, Mohamed, Mulatya & Njui, 2008). Next, they contribute huge benefits to vulnerable populations like children, women and poorer households (Grivetti & Ogle, 2000; Fentahun & Hager, 2009), that are often disproportionately affected by climate events (Eriksen & O'Brien, 2007). Besides, they provide to livelihoods and are always available during times of conflict-driven famine or drought (Gordon & Enfors, 2008; Muller & Almedom, 2008; Strauch, Muller & Almedom, 2008). Lastly, this wild plant can bear water stress better than their domesticated relatives (Humphry, Clegg, Keen & Grivetti, 1993; Addis, Urga & Dikasso, 2005), because they have an “innate resilience to rapid climate change, which is often lacking in exotic species” (Fentahun & Hager, 2009).

2.3 The Usage of Wild Edible Plant

Throughout history, wild edible plant have supported people to tide over times of natural calamities and wars (Redzic, Barudanovic & Pilipovic, 2010; Turner et al., 2011; Thakur, Sharma & Uniyal, 2017). Thus, uses of wild edible plant have been widely studied, both in developing and developed countries (Ju, Zhuo, Liu & Long, 2013; Kang et al., 2014; Bortolotto, de Mello Amorozo, Neto, Oldeland & Damasceno-Junior, 2015). Around 300 to 800 of different species have been reported at the different country level that this wild species to be used for several edible purposes (Maundu, 1996; Asfaw, 2008). Another study proved that humans have been used 7000 and more wild edible plant during some stage in their history and until now, one million people's diet around the world have been complemented by wild edible plant (Burlingame, 2000) and continually become a main sources of food for rural and tribal communities (Badhwar & Fernandez, 2011; Saha, Sundriyal

& Sundriyal, 2014). The importance of wild edible plant in nutrition, ensuring food security, income generation, poverty reduction and agricultural diversification has been specially highlighted (Samant & Dhar, 1997; Jana & Chauhan, 1998; Sundriyal, Sundriyal, Sharma & Purohit, 1998). It is now being debated that wild edible plant are high in source of nutrients and vitamins (Johns, Kokwaro & Kimanani, 1990; Sundriyal & Sundriyal, 2001; Pardo-de-Santayana et al., 2007; Bharucha & Pretty, 2010; Turner et al., 2011) that can significantly contribute towards alleviating malnutrition (Burlingame, 2000).

2.3.1 Wild Edible Plants and Its Medicinal Importance

Wild edible plant was believed can prevent certain disease to those who consume it regularly. As an example, Tutan (*Solanum nigrum*) which is used by indigenous people in Malaysia was believed can reduce high blood pressure and kill intestinal worms (Ng et al., 2012). Besides, the content of potassium in *Etligeria elatior* was found higher than some other leafy vegetables (Ng et al., 2012). Constantly consume this wild edible plant may aid in avert cardiovascular diseases and hypertension, which one of important cation that contain in this plant that is dietary potassium is important in reduce the platelet reactivity which become the main factor that cause vascular occlusion. Other than that, dietary potassium also can control blood pressure in human (He & MacGregor, 2008). Moreover, consumption of wild edible plant that contain high potassium can increase bone health by block the development of calciuria and enhances the bioavailability of calcium in the body (Ng et al., 2012).

Calcium which is most abundance in *Urtica urens* was very important for muscle and bone growth (Afolayan & Jimoh, 2009). Consume at least one modest

serving of *Urtica urens* that approximately to 150g per day can fulfil the daily calcium requirement of human that need about 1,200 mg of calcium per day (Council, 1989; Turan, Kordali, Zengin, Dursun & Sezen, 2003). According to a study by (Afolayan & Jimoh, 2009), the indigenous vegetables like *Chenopodium album* could fulfil the daily demand of potassium for an adult and can help to prevent cardiovascular diseases and be useful to control hypertension.

A study carry on in Bhutan indicate that various type of wild plants that contain medicinal properties and can give positive impact on human health. As an examples, leaves of *Urtica* species can alleviate tuberculosis, leaves of *Gerardiana* species and *Mentha spicata* can reduce blood pressure, while leaves of *Nasturium officinalis* used to enhance blood properties, and lastly, young shoots of *Plectocomia himalayana* also can contribute good benefits to human health (Durst & Bayasgalanbat, 2014). Next, a paper from Philippines described that wild edible plant, especially bitter gourd (*Momordica charantia*) and moringa (*Moringa oleifera*) which are eaten and used for medicinal purpose like sterility in woman, treatment of skin diseases, as a purgative, as a parasiticide, and antipyretic (Durst & Bayasgalanbat, 2014).

Bitter gourd (*Momordica charantia*) fruits are rich in β -carotene, folic acid, vitamin C, potassium, magnesium and phosphorus (Yuwai, Rao, Kaluwin, Jones & Rivett, 1991). The fruits are usually used in folk medicine to cure a rapidly spreading non-communicable disease that effects millions of people in poor countries and to treat type II diabetes in human (WHO, 2012; Federation, 2013).

2.3.2 Nutritional Composition

Many research on underutilized vegetables in different regions around the world showed that most of these wild edible plant have great antioxidant properties and high in nutritional values, which are equivalent to those commercially cultivated vegetables (Glew et al., 2005; Maisuthisakul, Suttajit & Pongsawatmanit, 2007; Afolayan & Jimoh, 2009). Leaves of some *Chenopodium* species (*C. murale* and *C. album* and *C. opulifolium*) collected from different location of southeast Spain by Guerrero & Isasa (1997) contain high nutritional composition that indicates that these species can be useful for nourishment purposes, due to high amounts of vitamin C, minerals and protein found in this three species. Besides, high fiber content in wild leafy vegetables also important because fiber prevents the absorption of excess cholesterol and cleanses the digestive tract by removing potential carcinogens from the body (Mih, Ngone & Ndam, 2017).

Amaranthus is another genus whose species are widely consumed in India that being a source of protein-rich seed and carotene-rich leafy vegetables (Prakash & Pal, 1991). A study by Hall, Nagy & Berry (1975) in U.S.A about *Tamarindus indica*, *Portulaca oleracea*, *Momordica charantia*, *Ricinus comunis*, *Hibiscus sinensis*, *Cajanus cajan* and others found that the leaves contain large quantities of essential amino acids.

2.4 Mode of Preparation and Consumption

There are many ways to prepare this wild plants that are either can be eaten raw, fermented, cooked or salted (Ong, Norliah & Sorayya, 2012). Usually, Malaysian tends to eat raw or cooked the wild vegetables to adjust according to their tastes. People in Cinque Terra (Italy) and other European countries usually eat raw in

salads, or pickled and kept like capers in vinegar (Guil-Guerrero, 2002). While, in Cantabria, Spain and India, most species are consumed raw without any kind of preparation. Green wild vegetables were also eaten raw in salads, (e.g. *Rumex acetosa*, *Rorippa nasturtium-aquaticum*) or cooked (*Silene vulgaris*) with pulses or other vegetables. Some people also prepared herb liqueurs by using *Scandix australis* or *Sideritis hyssopifolia*. This is usually made with anisette and liquor, cinnamon bark, *Prunus spinosa* fruits, sugar and a few coffee seeds. These will be macerate for three to four months but some people prefer to leave the mixture up to one year (Pardo-De-Santayana, Tardío & Morales, 2005).

2.5 Pattern in Distribution of Knowledge According to the Gender and Age

Gender of Consumers

A huge number of research on wild edible plant have been done in aim to know the style in the distribution of the knowledge related with the use of these plants according to the gender and age of the consumers. Arias-Toledo et al. (2007) differentiate the use and knowledge in the Argentinian Chaco related to food plants and medicinal that resulting there is no remarkable difference in the number of wild edible plant known by people of different gender and age. But, a different result was found among members of Mapuche communities by Ladio y Lozada (2004), who examined the differences in use and knowledge based on the environments of those plants are collected in one of the region in Argentina that is Patagonia region. Four well-differentiated collection locations was found by the researcher that show where different knowledge and usage patterns of wild edible plants were observed with the respect of the gender and age parameters, the most conserved sites being those

exhibiting less differentiation. Therefore, in this environment, all plants that known can be eaten are actually consumed.

A study done by Reyes-Garcia et al. (2005), that investigate two communities in the Bolivian Amazon, found that the community that is located far away from an urban center is better in the conservation of the knowledge and use of wild edible plant. In this community, both use and knowledge are statically corresponded except for the community that located near to the urban area. Some studies on edible plants in Brazil also have been performed. As an example, a notable study was carried out by Do Nascimento, da Silva Vasconcelos, Maciel & Albuquerque (2012), in two rural communities in northeastern Brazil who investigated both exotic and native that usually consumed and familiar edible species. The authors found that native species is the most common used by communities even that species is not various in that area. But, there is no outstanding difference in the knowledge of this native based on age. A study in Uganda conducted by Agea, Obua, Waiswa, Okia & Okullo, in 2010 found that women show a tendency to consume more wild edible plants rather than men.

2.6 *In situ* Management Practices

Many researchers have done studied on people effort that can influence the evolution of useful plants (Casas, del Carmen Vázquez, Viveros & Caballero, 1996; Avendaño, Casas, Dávila & Lira, 2006; Casas, Otero-Arnaiz, Pérez-Negrón & Valiente-Banuet, 2007; González-Insuasti & Caballero, 2007; Ekué, Sinsin, Eyog-Matig & Finkeldey, 2010) and have come out with management action that can be used to help the survival of individual plant species with desirable traits. The four types of *in situ* management practices that human can apply are include tolerance,

systematic collection, promotion of individual plant species and protection. Firstly, collecting wild edible plant can be considered as an *in situ* form of management, as long as the collected elements belong to populations presenting desirable phenotypes such that this selective leads to the differentiation of regions or groups of individual plants that are preferred for the collection of this plants (Casas et al., 1996; Casas et al., 2007; Ekué et al., 2010). Secondly, tolerance can be considered with not remove the plants that can provide useful product for human in the area that assign to cultivating, planting or other natural resources (Casas et al., 1996; González-Insuasti & Caballero, 2007; Neto, Peroni & de Albuquerque, 2010).

Next, protection such as protecting against unfavourable climatic conditions, implies regular elimination of predators and competitors of useful plants, trimming, and mineral or nutrient addition for a healthier plant growth (Casas et al., 1996; Casas et al., 2007; González-Insuasti & Caballero, 2007). Lastly, promotion consists strategies set to increase the population density of desired species through planned planting of vegetative structures or seeds of a species in wild areas (González-Insuasti & Caballero, 2007). Ekué et al. (2010) found that management actions that can expand the population of wild edible plant are also can be differentiate by gender that show that women usually in charge of this type of task.

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area

This research was conducted at the traditional market around Jeli and Machang, Kelantan, Malaysia (Figure 3.1). In Jeli, there is a total of seven traditional markets that were included in this study. The traditional market include the permanent market such as Pasar Besar Jeli (N 5°41'32.35", E 101°50'48.93") (Figure 3.2), day market in Jeli town, Kuala Balah (N 5°26'34.87", E 101°54'43.89") Batu Melintang (N 5°42'55.04", E 101°44'30.18") and Ayer Lanas (N 5°47'1.53", E 101°53'17.75") and night market in Batu Melintang, Gemang (N 5°44'49.40", E 101°51'41.90") and Kampung Sungai Satan (N 5°43'48.01", E 101°54'4.19"). Mostly, the traditional market operated in the different day except for Pasar Besar Jeli that open every day. All of the two day markets are open in different day in a week that is on Tuesday, Thursday and Saturday in Jeli town and on Friday in Ayer Lanas. For night market, there will be on Friday for Batu Melintang, Gemang on Saturday until Monday and lastly on Wednesday in Kampung Sungai Satan.

For Machang, there were five traditional markets that were included in this study. The permanent market is Pasar Besar Machang (N 5°45'53.4", E 102°13'12.7") (Figure 3.3) and Pasar Borong Wakaf Bata (N 5°46'22.7", E 102°10'39.8") (Figure 3.4), while the other three were only open once a week that is Pasar Tani that opens on Friday, Pasar Isnin and Machang Night Market that operate every Monday. Pasar Tani, Pasar Isnin and Machang Night Market (N 5°45'51.71",

E 102°13'4.88") is operated around Pasar Besar Machang except for Pasar Borong Wakaf Bata that located far away from Pasar Besar Machang.

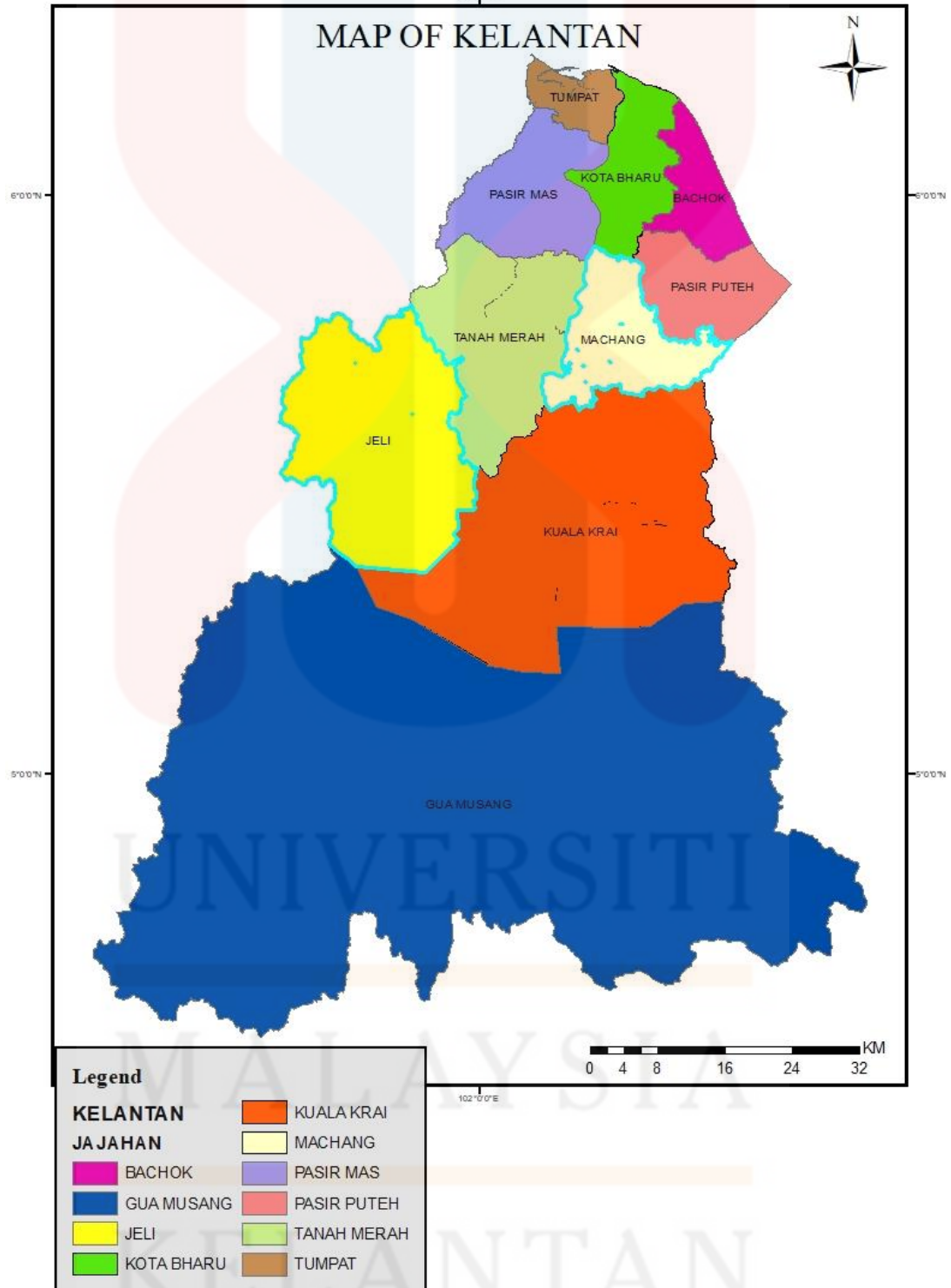


Figure 3.1 : Map of Kelantan



Figure 3.2 : Map of Pasar Besar Jeli
(Source : Google Maps, 2018)

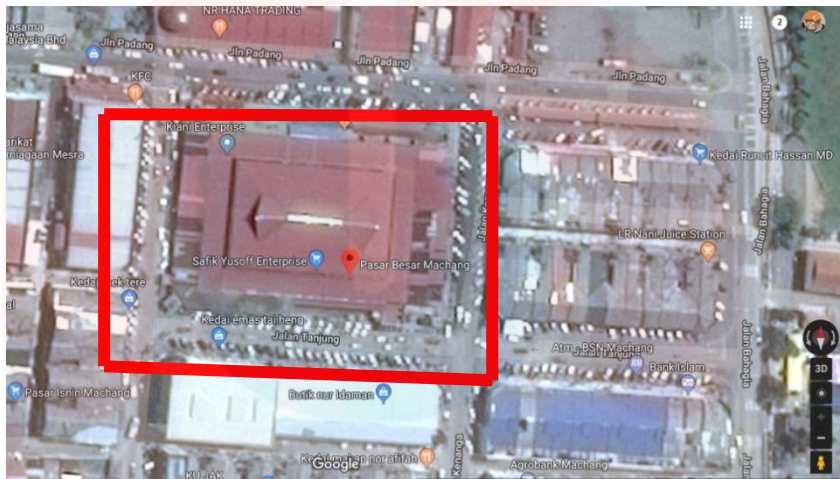


Figure 3.3 : Map of Pasar Besar Machang
(Source : Google Maps, 2018)



Figure 3.4 : Map of Pasar Borong Wakaf Bata, Machang
(Source : Google Maps, 2018)

3.2 Materials

Field notebook was used to record the data and information about the plants obtained. While, the coordinate of every traditional market in Jeli and Machang was read by using a Global Positioning System (GPS). The picture of the wild edible plants that selling in the traditional market was taken using a camera. List of the simple questions was used together during the data gathering section in traditional market as an additional data.

Besides, secateurs, tagging, newspaper, plastic, pressing wood and 70% ethanol was used during herbarium section.

3.3 Methods

3.3.1 Observation

This research was conducted at the traditional market in Jeli and Machang, Kelantan. Firstly, the coordinate of every traditional market was recorded. Secondly, observation was done to know the number of stalls that sell wild edible plants in that area. The number of every type of wild edible plants was recorded (Figure 3.5 & Figure 3.6) About one to two hour was spent in the market to observe all type of wild edible plants that sold in every stall. The picture of every species sold was taken for identification purposes. Every matured plant was collected to preserve as the herbarium specimens.

3.3.2 Simple Questioners

Several simple questions was asked to sellers and customers to know their basic knowledge on this topic that is about wild edible plants (Table 3.1 and Table 3.2). The data obtained about the knowledge of local people on this plants will be act as supportive data that was used later in the discussion.

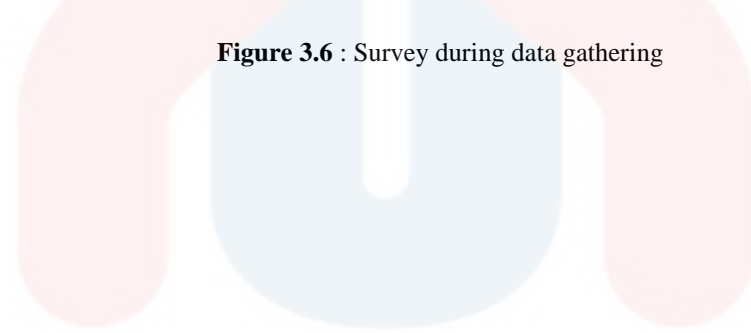


Figure 3.5 : Survey during data gathering

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Figure 3.6 : Survey during data gathering



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Table 3.1 : The question that was asked to the sellers

Questions : To the sellers

1) Gender

Male

Female

2) Age

≤ 20

21 – 30

31 – 40

41 – 50

≥ 51

3) Race

Malay

Chinese

Indian

Others ; _____

4) What is local name for every wild vegetables that he/she sold?

5) What is the usage of this vegetable to human health that he/she know?

6) How this vegetable will be prepared, either it will be eaten raw, cooked, salted or fermented?

7) Which one was the most popular vegetables among customers?

8) From where does he/she get the supply for the wild vegetables? Does the supply of the wild vegetables was influence by the season?

9) Which parts of the plants that can be eaten/usually eat by people?

Table 3.2 : The question that was asked to the customers

Questions : To the customers

1) Gender

Male

Female

2) Age

≤ 20

21 – 30

31 – 40

41 – 50

≥ 51

3) Race

Malay

Chinese

Indian

Others ; _____

4) What is local name for the vegetable that he/she purchased?

5) What is the usage of this vegetable to human health that he/she know?

6) How this vegetable will be prepared, either it will be eaten raw, cooked, salted or fermented?

7) Which part of the plants that can be eaten/usually eat by people?

8) Why he/she choose to eat wild vegetable?

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3.4 Data Analysis

a) Checklist

The information obtained like scientific name, family, local name, status, parts used and the usage was summarized in a form of table.

b) Shannon Diversity Index, H' (Spellerberg & Fedor, 2003).

$$H' = - \sum_{i=1}^s (P_i) \ln(P_i)$$

where :

H' = the Shannon diversity index

P_i = fraction of the entire population made up of species i

S = numbers of species encountered

\sum = sum from species 1 to species S

c) Evenness

$$\text{Evenness, } E = \frac{H'}{H_{\max}} = \frac{H'}{\ln S}$$

where :

E = constrained between 0 and 1.0

H' = the Shannon diversity index

H_{\max} = the maximum diversity of a species found

S = total number of species.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Floristic Composition of Wild Vegetable

Result was obtained after visited 12 traditional markets around the study area. Table 4.1 summarizes the numbers of genera and species for all wild vegetable that sell in the traditional market in Jeli and Machang. A total of 24 families, 34 genera and 37 species of edible plants were recorded. Zingiberaceae was recorded to be the most dominant family that contribute five genera of 34 genera that equivalent to 14.71% of all genera found in the study area. This is because, the species in this family is mainly become the ingredient in some of the dishes that prepared by the local people for flavouring and coloring. Asteraceae and Leguminosae become the second highest family recorded with total of three genera found that equal to 8.82% of all genera recorded followed by two others families that is Euphorbiaceae and Solanaceae that record two genera, respectively that represent 5.88% of the all genera found, while the others family show the fair number of genus recorded.

With respect to the species gathered, Zingiberaceae is the most important family in the study area. From total of 37 species recorded, this family contribute 18.92% of all species recorded that equivalent to seven species of the wild edible plants found.

Table 4.1 : Number of genera and species for all wild vegetable families in Jeli and Machang, Kelantan

No.	Family	Genus	%	Species	%
1	Anacardiaceae	1	2.94	1	2.70
2	Apiaceae	1	2.94	1	2.70
3	Apocynaceae	1	2.94	1	2.70
4	Araceae	1	2.94	1	2.70
5	Asteraceae	3	8.82	3	8.11
6	Bignoniaceae	1	2.94	1	2.70
7	Blechnaceae	1	2.94	1	2.70
8	Convolvulaceae	1	2.94	1	2.70
9	Dennstaedtiaceae	1	2.94	1	2.70
10	Euphorbiaceae	2	5.88	2	5.41
11	Gramineae	1	2.94	1	2.70
12	Labiatae	1	2.94	1	2.70
13	Lecythidaceae	1	2.94	1	2.70
14	Leguminosae	3	8.82	4	10.81
15	Moraceae	1	2.94	1	2.70
16	Myrtaceae	1	2.94	1	2.70
17	Passifloraceae	1	2.94	1	2.70
18	Piperaceae	1	2.94	1	2.70
19	Polyganaceae	1	2.94	1	2.70
20	Rutaceae	1	2.94	1	2.70
21	Schizophyllaceae	1	2.94	1	2.70
22	Solanaceae	2	5.88	2	5.41
23	Umbelliferae	1	2.94	1	2.70
24	Zingiberaceae	5	14.71	7	18.92
Total		34	100.00	37	100.00

For Jeli area, there are 20 families recorded with the dominant family is Zingiberaceae. By referring to Table 4.2, the total number of genera from this family is five (17.86%) followed by Asteraceae and Leguminosae (10.71%) that correspondent to three genera from 28 total genera recorded. There are 29 species of wild edible plants found in this area. Six species were found from a family Zingiberaceae that contribute 20.69% of all species found.

Table 4.2 : Number of genera and species for all wild vegetable families in Jeli, Kelantan

No.	Family	Genus	%	Species	%
1	Anacardiaceae	1	3.57	1	3.45
2	Apiaceae	1	3.57	1	3.45
3	Apocynaceae	1	3.57	1	3.45
4	Araceae	1	3.57	1	3.45
5	Asteraceae	3	10.71	3	10.34
6	Bignoniaceae	1	3.57	1	3.45
7	Blechnaceae	1	3.57	1	3.45
8	Convolvulaceae	1	3.57	1	3.45
9	Dennstaedtiaceae	1	3.57	1	3.45
10	Euphorbiaceae	1	3.57	1	3.45
11	Gramineae	1	3.57	1	3.45
12	Leguminosae	3	10.71	3	10.34
13	Myrtaceae	1	3.57	1	3.45
14	Passifloraceae	1	3.57	1	3.45
15	Piperaceae	1	3.57	1	3.45
16	Polyganaceae	1	3.57	1	3.45
17	Schizophyllaceae	1	3.57	1	3.45
18	Solanaceae	1	3.57	1	3.45
19	Umbelliferae	1	3.57	1	3.45
20	Zingiberaceae	5	17.86	6	20.69
Total		28	100.00	29	100.00

Besides, there are 21 families recorded for Machang area. From 30 genera found in this study area, four genera is recorded from family Zingiberaceae (13.33%), marked that this family is the dominant among other family of wild edible plants sold in Machang. This study also recorded that 32 species of edible plants sell in the traditional market around Machang area and five of it is classified under Zingiberaceae family that contribute 15.63% from the total species found (Table 4.3).

Table 4.3 : Number of genera and species for all wild vegetable families in Machang, Kelantan

No.	Family	Genus	%	Species	%
1	Anacardiaceae	1	3.33	1	3.13
2	Apiaceae	1	3.33	1	3.13
3	Apocynaceae	1	3.33	1	3.13
4	Asteraceae	3	10.00	3	9.38
5	Bignoniaceae	1	3.33	1	3.13
6	Blechnaceae	1	3.33	1	3.13
7	Convolvulaceae	1	3.33	1	3.13
8	Dennstaedtiaceae	1	3.33	1	3.13
9	Euphorbiaceae	2	6.67	2	6.25
10	Gramineae	1	3.33	1	3.13
11	Labiatae	1	3.33	1	3.13
12	Lecythidaceae	1	3.33	1	3.13
13	Leguminosae	3	10.00	4	12.50
14	Moraceae	1	3.33	1	3.13
15	Myrtaceae	1	3.33	1	3.13
16	Polygonaceae	1	3.33	1	3.13
17	Rutaceae	1	3.33	1	3.13
18	Schizophyllaceae	1	3.33	1	3.13
19	Solanaceae	2	6.67	2	6.25
20	Umbelliferae	1	3.33	1	3.13
21	Zingiberaceae	4	13.33	5	15.63
Total		30	100.00	32	100.00

Family of Zingiberaceae was the most dominant family for both study areas. But, Machang area show a little bit higher in the number of family that is 21 families for Machang, while 20 families for Jeli area. In term of total number of genera and species, Machang still a bit higher compared to Jeli with the difference of two for total number of genus and three for total number of species.

Thirty-seven species were recorded in all visited traditional market in the study areas. There are total 491 individuals of all species found sold in the traditional markets (Table 4.4). *Parkia speciosa* or more common with named *petai* among local people is the highest individual found in both district with total 41 individuals.

Barringtonia racemosa, *Ficus roxburghii*, *Ocimum sanctum*, *Piper sarmentosum* and *Pithecellobium bubalinum* is the lowest individual that can be found in both area that mark only one individual for each species (Appendix A & Appendix B). All the lowest species was only recorded at Machang district except for *Piper sarmentosum* that only recorded at Jeli district. Wild edible plants found in Machang is more higher compared to the number of individuals recorded at Jeli area. This is because the demand for wild edible plants in Machang is more compared to demand in Jeli.

Table 4.4 : Number of individuals for all wild edible plants sell at the traditional market in Jeli and Machang, Kelantan

Botanical Name	Native Name	Jeli	Machang	Sum
<i>Anacardium occidentale</i>	Tere, Keteleh, Gajus	5	5	10
<i>Alpinia galanga</i>	Lengkuas	16	15	31
<i>Archidendron jiringa</i>	Jering	19	4	23
<i>Athyrium esculentum</i>	Pucuk paku	9	17	26
<i>Barringtonia racemosa</i>	Putat	0	1	1
<i>Callerya atropurpurea</i>	Jenerih	3	2	5
<i>Capsicum frutescens</i>	Cili api	0	9	9
<i>Centella asiatica</i>	Pegaga	12	13	25
<i>Cosmos caudatus</i>	Ulam raja	2	8	10
<i>Curcuma longa</i>	Kunyit	14	14	28
<i>Curcuma mangga</i>	Ketemu	2	0	2
<i>Cymbopogon citratus</i>	Serai	14	12	26
<i>Elettariopsis curtisii</i>	Pijat	17	0	17
<i>Emilia sonchifolia</i>	Bayam praksi	2	9	11
<i>Etlingera elatior</i>	Kantan	16	18	34
<i>Euodia ridlevi</i>	Tenggek burung	0	2	2
<i>Ficus roxburghii</i>	Ara	0	1	1
<i>Gynura precumbens</i>	Sambung nyawa	0	4	4
<i>Ipomoea reptans</i>	Kangkung	9	7	16
<i>Lasia spinosa</i>	Geli / Geli-geli	2	0	2
<i>Manihot esculenta</i>	Ubi kayu	0	2	2
<i>Ocimum sanctum</i>	Temangi, Selasih	0	1	1

Table 4.4 (Continued)

<i>Oenanthe javanica</i>	Kangkung selom	4	10	14
<i>Oroxylum indicum</i>	Beko	10	10	20
<i>Parkia speciosa</i>	Petai	23	18	41
<i>Parsonsia helicandra</i>	Lemak ketam	1	2	3
<i>Passiflora foetida</i>	Ulat bulu, Letup-letup	2	0	2
<i>Phyllanthus androgynus</i>	Cekak manis, Cekur manis	2	2	4
<i>Piper sarmentosum</i>	Kadok	1	0	1
<i>Pithecellobium bubalinum</i>	Kerdas	0	1	1
<i>Polygonum minus</i>	Kesom	15	13	28
<i>Schizophyllum commune</i>	Kulat sisir	1	4	5
<i>Solanum torvum</i>	Terung pipit	4	2	6
<i>Stenochlaena palustris</i>	Midin, Pakis merah	6	5	11
<i>Syzygium polyantha</i>	Serai kayu	10	23	33
<i>Zingiber cassumunar</i>	Halia bara	0	1	1
<i>Zingiber officinale</i>	Halia	18	17	35
Total		239	252	491

Alpinia, *Curcuma*, *Elettariopsis*, *Etingera* and *Zingiber* are the five genera under the dominant family, Zingiberaceae that recorded in the both of the study areas (Table 4.5). The second highest number of genus recorded is from family Asteraceae and Leguminosae that record three genera respectively.

Table 4.5 : List of species recorded at traditional market in Jeli and Machang, Kelantan

No.	Family	Genus	Species
1	Anacardiaceae	<i>Anacardium</i>	<i>Anacardium occidentale</i>
2	Apiaceae	<i>Centella</i>	<i>Centella asiatica</i>
3	Apocynaceae	<i>Parsonsia</i>	<i>Parsonsia helicandra</i>
4	Araceae	<i>Lasia</i>	<i>Lasia spinosa</i>
5	Asteraceae	<i>Cosmos</i>	<i>Cosmos caudatus</i>
		<i>Emilia</i>	<i>Emilia sonchifolia</i>
		<i>Gynura</i>	<i>Gynura precumbens</i>
6	Bignoniaceae	<i>Oroxylum</i>	<i>Oroxylum indicum</i>
7	Blechnaceae	<i>Stenochlaena</i>	<i>Stenochlaena palustris</i>
8	Convolvulaceae	<i>Ipomoea</i>	<i>Ipomoea reptans</i>
9	Dennstaedtiaceae	<i>Diplazium</i>	<i>Athyrium esculentum</i>
10	Euphorbiaceae	<i>Manihot</i>	<i>Manihot esculenta</i>
		<i>Phyllanthus</i>	<i>Phyllanthus androgynus</i>

Table 4.5 (Continued)

11	Gramineae	<i>Cymbopogon</i>	<i>Cymbopogon citratus</i>
12	Labiatae	<i>Ocimum</i>	<i>Ocimum sanctum</i>
13	Lecythidaceae	<i>Barringtonia</i>	<i>Barringtonia racemosa</i>
14	Leguminosae	<i>Archidendron</i>	<i>Archidendron jiringa</i>
		<i>Callerya</i>	<i>Callerya atropurpurea</i>
		<i>Parkia</i>	<i>Parkia speciosa</i>
15	Moraceae	<i>Ficus</i>	<i>Ficus roxburghii</i>
16	Myrtaceae	<i>Syzygium</i>	<i>Syzygium polyantha</i>
17	Passifloraceae	<i>Passiflora</i>	<i>Passiflora foetida</i>
18	Piperaceae	<i>Piper</i>	<i>Piper sarmentosum</i>
19	Polygonaceae	<i>Persicaria</i>	<i>Polygonum minus</i>
20	Rutaceae	<i>Euodia</i>	<i>Euodia ridlevi</i>
21	Schizophyllaceae	<i>Schizophyllum</i>	<i>Schizophyllum commune</i>
22	Solanaceae	<i>Capsicum</i>	<i>Capsicum frutescens</i>
		<i>Solanum</i>	<i>Solanum torvum</i>
23	Umbelliferae	<i>Oenanthe</i>	<i>Oenanthe javanica</i>
24	Zingiberaceae	<i>Alpinia</i>	<i>Alpinia galanga</i>
		<i>Curcuma</i>	<i>Curcuma longa</i>
			<i>C. mangga</i>
		<i>Elettariopsis</i>	<i>Elettariopsis curtisii</i>
		<i>Etlingera</i>	<i>Etlingera elatior</i>
		<i>Zingiber</i>	<i>Zingiber cassumunar</i>
			<i>Z. officinale</i>

Table 4.6 show the list of species in Jeli, while Table 4.7 recorded the list species that found in Machang. All five genera that is *Alpinia*, *Curcuma*, *Elettariopsis*, *Etlingera* and *Zingiber* that classified under the dominant family that is Zingiberaceae family can be found in Jeli area. But, there is no recorded of wild edible plants from genus *Elettariopsis* that sold in traditional market around Machang area. Species recorded of Zingiberaceae family at Jeli area is more than species recorded in Machang area. *Alpinia galangal*, *Curcuma longa*, *C. mangga*, *Elettariopsis curtisii*, *Etlingera elatior*, and *Zingiber officinale* is the species that sold in Jeli while in Machang area, there is no recorded of *Elettariopsis curtisii* and

Curcuma mangga found. But, species *Zingiber cassumunar* were only recorded in Machang.

Table 4.6 : List of species recorded at traditional market in Jeli, Kelantan

No.	Family	Genus	Species
1	Anacardiaceae	<i>Anacardium</i>	<i>Anacardium occidentale</i>
2	Apiaceae	<i>Centella</i>	<i>Centella asiatica</i>
3	Apocynaceae	<i>Parsonsia</i>	<i>Parsonsia helicandra</i>
4	Araceae	<i>Lasia</i>	<i>Lasia spinosa</i>
5	Asteraceae	<i>Cosmos</i>	<i>Cosmos caudatus</i>
		<i>Emilia</i>	<i>Emilia sonchifolia</i>
		<i>Gynura</i>	<i>Gynura precumbens</i>
6	Bignoniaceae	<i>Oroxylum</i>	<i>Oroxylum indicum</i>
7	Blechnaceae	<i>Stenochlaena</i>	<i>Stenochlaena palustris</i>
8	Convolvulaceae	<i>Ipomoea</i>	<i>Ipomoea reptans</i>
9	Dennstaedtiaceae	<i>Diplazium</i>	<i>Athyrium esculentum</i>
10	Euphorbiaceae	<i>Phyllanthus</i>	<i>Phyllanthus androgynus</i>
11	Gramineae	<i>Cymbopogon</i>	<i>Cymbopogon citratus</i>
12	Labiatae	<i>Ocimum</i>	<i>Ocimum sanctum</i>
13	Leguminosae	<i>Archidendron</i>	<i>Archidendron jiringa</i>
		<i>Callerya</i>	<i>Callerya atropurpurea</i>
		<i>Parkia</i>	<i>Parkia speciosa</i>
14	Myrtaceae	<i>Syzygium</i>	<i>Syzygium polyantha</i>
15	Passifloraceae	<i>Passiflora</i>	<i>Passiflora foetida</i>
16	Piperaceae	<i>Piper</i>	<i>Piper sarmentosum</i>
17	Polygonaceae	<i>Persicaria</i>	<i>Polygonum minus</i>
18	Schizophyllaceae	<i>Schizophyllum</i>	<i>Schizophyllum commune</i>
19	Solanaceae	<i>Solanum</i>	<i>Solanum torvum</i>
20	Umbelliferae	<i>Oenanthe</i>	<i>Oenanthe javanica</i>
21	Zingiberaceae	<i>Alpinia</i>	<i>Alpinia galanga</i>
		<i>Curcuma</i>	<i>Curcuma longa</i>
			<i>C. mangga</i>
		<i>Elettariopsis</i>	<i>Elettariopsis curtisii</i>
		<i>Etingera</i>	<i>Etingera elatior</i>
		<i>Zingiber</i>	<i>Zingiber officinale</i>

Table 4.7 : List of species recorded at traditional market in Machang, Kelantan

No.	Family	Genus	Species
1	Anacardiaceae	<i>Anacardium</i>	<i>Anacardium occidentale</i>
2	Apiaceae	<i>Centella</i>	<i>Centella asiatica</i>
3	Apocynaceae	<i>Parsonsia</i>	<i>Parsonsia helicandra</i>
4	Asteraceae	<i>Cosmos</i>	<i>Cosmos caudatus</i>
		<i>Emilia</i>	<i>Emilia sonchifolia</i>
		<i>Gynura</i>	<i>Gynura precumbens</i>
5	Bignoniaceae	<i>Oroxylum</i>	<i>Oroxylum indicum</i>
6	Blechnaceae	<i>Stenochlaena</i>	<i>Stenochlaena palustris</i>
7	Convolvulaceae	<i>Ipomoea</i>	<i>Ipomoea reptans</i>
8	Dennstaedtiaceae	<i>Diplazium</i>	<i>Athyrium esculentum</i>
9	Euphorbiaceae	<i>Manihot</i>	<i>Manihot esculenta</i>
		<i>Phyllanthus</i>	<i>Phyllanthus androgynus</i>
10	Gramineae	<i>Cymbopogon</i>	<i>Cymbopogon citratus</i>
11	Labiatae	<i>Ocimum</i>	<i>Ocimum sanctum</i>
12	Lecythidaceae	<i>Barringtonia</i>	<i>Barringtonia racemosa</i>
13	Leguminosae	<i>Archidendron</i>	<i>Archidendron jiringa</i>
			<i>Pithecellobium bubalinum</i>
		<i>Callerya</i>	<i>Callerya atropurpurea</i>
		<i>Parkia</i>	<i>Parkia speciosa</i>
14	Moraceae	<i>Ficus</i>	<i>Ficus roxburghii</i>
15	Myrtaceae	<i>Syzygium</i>	<i>Syzygium polyantha</i>
16	Polygonaceae	<i>Persicaria</i>	<i>Polygonum minus</i>
17	Rutaceae	<i>Euodia</i>	<i>Euodia ridlevi</i>
18	Schizophyllaceae	<i>Schizophyllum</i>	<i>Schizophyllum commune</i>
19	Solanaceae	<i>Capsicum</i>	<i>Capsicum frutescens</i>
		<i>Solanum</i>	<i>Solanum torvum</i>
20	Umbelliferae	<i>Oenanthe</i>	<i>Oenanthe javanica</i>
21	Zingiberaceae	<i>Alpinia</i>	<i>Alpinia galanga</i>
		<i>Curcuma</i>	<i>Curcuma longa</i>
		<i>Etlingera</i>	<i>Etlingera elatior</i>
		<i>Zingiber</i>	<i>Zingiber cassumunar</i>
			<i>Z. officinale</i>

4.2 Shannon Diversity Index and Evenness

Species diversity is defined as the number of species and abundance of each species that live in a particular location. Shannon Diversity Index (H') is a commonly used to calculate diversity index that takes into account both evenness and abundance of species present in the community. A high value of H' would be a representative of a diverse and equally distributed community while lower values represent less diverse community. A value of zero would represent a community with just one species. For this study, Shannon diversity index was used to calculate and compare the diversity of wild edible plants sell at the traditional market in Jeli and Machang. The actual diversity value to the maximum possible diversity can be compare by using the measure called evenness.

Table 4.8 : The diversity and evenness of the wild edible plants in Jeli and Machang, Kelantan

Study Area	H'	H_{max}	Evenness
Overall	3.18	6.20	0.51
Jeli	3.01	5.48	0.55
Machang	3.13	5.53	0.57

Based on Table 4.8, H' for Machang calculated to be a bit high value than H' in Jeli area that would be represent the wild edible plants in Machang is more diverse than in Jeli area. As the main resources of this plants selling at both area is from Rural Transformation Centre (RTC) Tunjong, that may be an indication of the different between the diversity of wild edible plants selling at both area. Machang is located nearest with RTC Tunjong compared to Jeli that may influence the uneven distribution of the vegetable. The market demand of wild edible plants may be much higher in Machang compared to Jeli that also can contribute to the difference recorded in both areas. But, the difference of the H' between both study areas is not too wide. Overall, the Shannon diversity index for this study is 3.18. Typical,

according to values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4 (Magurran, 2004).

As the species evenness range is from 0 to 1, with zero signifying no evenness and one as a complete evenness, the evenness of the species in this study area can be concluded as fair. The evenness of the wild edible plants in both areas calculated to be almost same between each other that is 0.55 for Jeli area and 0.57 for Machang area. Overall, the evenness of the diversity in this study is 0.51.

4.3 Usage and Consumption of Wild Edible Plants

According to old generations, wild edible plants was used in traditional medicine to treat certain disease. From data gathering at the study area, there are several species that believe by the native people that contain nutrients that good to human. As an example, the most diverse plants that selling in Jeli area is *Parkia speciosa* or more familiar with named *petai* among native people (Figure 4.1D). Despite the seeds give out a strong odour, it make a favourite *ulam* dish, usually consumed raw with anchovies sauce. The seeds also can be prepared by other ways that is by boiled, steamed, pickled or sometimes are added into vegetable dishes as flavouring. The *petai* seeds are used in traditional medicine to treat diabetes and high blood pressure and believe can be more effective by consumed raw with the seedpods. Native people also believe that this wild edible plant is good for kidney but cannot be taken in large quantities at the same times.

Besides, the most diverse plants that selling in Machang area is *Syzygium polyantha* or called *serai kayu* and *samak* by native communities (Figure 4.1B). This plants is believe can stabalize high blood pressure and diabetes, reduce body temperature and treat diarrhea. The young leaves that have a unique aroma can be

eaten raw or make as *kerabu*. Old generations believe that this wild plants can slow down the aging process.

Cekur manis or scientifically called *Phyllanthus androgynus* is one of the wild edible plants that become more popular in both of this area (Figure 4.1C). Shoots and leaves is separate from the stem and can be cooked to be additional dish during lunch. The sweet tasty leaves of this plants is believe good for mother during confinement period. Cook the leaves with water and a bit of black pepper is a popular confinement meals among confinement mother.

Oroxylum indicum normally grow along the river. This plant is included in family of Bignoniaceae and popular with name *beko* or *bonglai* among native people (Figure 4.1A). Young shoots should be boiled before can be eaten as *ulam*. Young fruits should be roast first before can be mix into *kerabu* to reduce the bitter taste that come from the fruits. The fruits was said good for increase the production of breast milk for breastfeeding and to purify the blood.

Centella asiatica or *pegaga* is not a new *ulam* among Malays community. *Pegaga* is small, long stalks with creeping herb and kidney-shaped green leaves which are smooth and soft in texture (Figure 4.2A). *Pegaga* grows wild under a wide range of conditions, open sunny or light shade areas. This leaves are usually eaten raw with anchovies sauce or as *kerabu*. The leaves, if eaten raw are believed can cure indigestion and can purify the blood. The leaves are also believed to be good for mothers who have just given birth and for preserving youthfulness.

Kantan or *Etilingera elatior* is a aromatic herbal plant with long leaves and rhizomes beneath the soil (Figure 4.2B). This plant is believe contain many nutritional constituents that essential for human diet. The young flower shoots are

often used as a major ingredient in local spicy dishes, such as *tom yam*, *asam pedas* and *laksa*, to give a unique aroma and taste to the dishes.



Figure 4.1 : (A) *Oroxylum indicum* (Beko); (B) *Syzygium polyantha* (Serai kayu); (C) *Phyllanthus androgynous* (Cekur manis); (D) *Parkia speciosa* (Petai)

Anacardium occidentale is a plants from family Anacardiaceae. The plants known as *gajus* because of the nuts and also called as *ketereh* or *tere* by local people. The young leaves are aromatic and are eaten raw with rice as a flavouring or with chilli paste (Figure 4.2C). The young leaves, finely chopped, also serve as an

ingredient in *nasi ulam* and *nasi kerabu*. The nuts, being the main crop of the *gajus* plant, have high nutritional value and make as a favourite light snack and are often used in various food dishes. The young leaves are often used to treat mouth ulcers and hypertension.



Figure 4.2 : (A) *Centella asiatica* (Pegaga); (B) *Etlingera elatior* (Kantan); (C) *Anacardium occidentale* (Ketereh); (D) *Archidendron jiringa* (Jering)

KELANTAN

Archidendron jiringa or *jering* is come from same family of *petai* that is Leguminosae is known for its high protein content (Figure 4.2D). The fleshy, soft fruits are eaten fresh and raw as *ulam*. The young fruits are often eaten raw with anchovies sauce. Sometimes they are boiled thoroughly until the offensive smell has disappeared, and consumed with salt and grated coconut. The *jering* fruit is used to treat high blood pressure. However, an overdose can result in toxicity that can cause kidney hyperemia and difficulty in urinating.

Polygonum minus or more known as *kesum* among local people is a bushy, creepy herb and widely distributed in Malaysia (Figure 4.3A). Both the leaves and stem contain strong flavouring and aroma. The fresh leaves are often sliced and sprinkled on *laksa* for its strong aroma. It is also used as an ingredients for *kerabu*. A decoction of the fresh herb is taken for indigestion, constipation and after childbirth.

Pakis merah is a fern. Scientifically, its known as *Stenochlaena palustris* (Figure 4.3B). The young leaves is red and they turn green when mature. The young shoots are soft and often boiled with salted fish or black pepper will gives a sweet and fresh taste. Other traditional usage is the leaf juice is rubbed on the forehead to relieve fever. It also believed to ease delivery by grilled the young shoots and consumed by pregnant women.

Solanum torvum or more familiar with named *terung pipit* and *terung manggur* is a spreading slender shrub. The fruit is a globular berry that produced in clusters of 10 or less (Figure 4.3C). The fruit has a bitter taste and unique smell. It is used as an appetiser and sometimes eaten raw as *ulam* or cooked as vegetable dish. The fruits can be boiled or used in curries. *Terung pipit* plant is well known for its medicinal properties. The fruits was believed can treat hypertension and stomachache.

Cosmos caudatus or known as *ulam raja* among native people is an annual, perennial, short-lived and aromatic herba that classified from family of Asteraceae. Young leaves are used as an appetiser and a food flavouring due to their unique aroma and taste (Figure 4.3D). The young, soft shoots make a tasty *ulam* dish. The young leaves are often eaten raw with anchovies sauce and chilli and used in dishes such as *kerabu*. *Ulam raja* is recommended in the traditional medicine system for improving blood circulation.

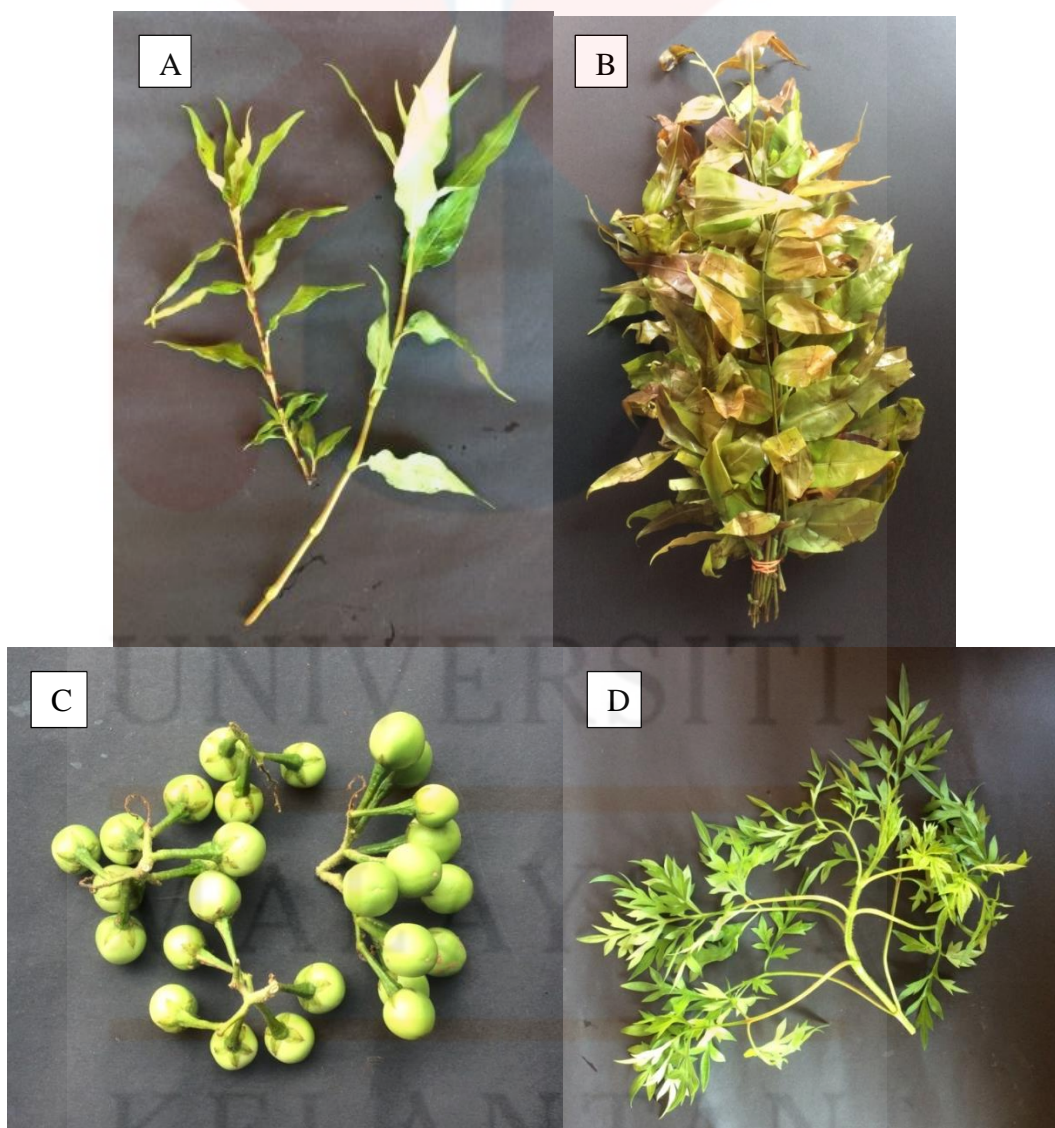


Figure 4.3 : (A) *Polygonum minus* (Kesum); (B) *Stenochlaena palustris* (Pakis merah); (C) *Solanum torvum* (Terung pipit); (D) *Cosmos caudatus* (Ulam raja)

Manihot esculenta is a dicotyledonous, perennial bushy shrub. Young *ubi kayu* leaves have a sweet-bitter taste and are used as an appetiser. The young leaves of *ubi kayu* are boiled and eaten with anchovies sauce along with rice. The tuber are peeled, boiled and eaten with sugar and coconut. The matured tubers are often sliced and fried. Sometimes they are dried to make spicy or salty chips. The tuber is also used to make porridge or fermented to produce *tapai* (a fermented dessert). The tuber also grated before squeezed repeatedly and washed to remove starch that can be made into tapioca flour.

Kadok or the scientific name, *Piper sarmentosum* as recorded in Jeli area is a creeping terrestrial herb that include in family of Piperaceae (Figure 4.4). The young leaves are consumed raw with chilli paste and are sometimes dipped in hot water. They also found as an ingredient of *kerabu* mixture. It is also used in curries and salted fish dishes. The leaves are tasty and have a unique aroma. Traditionally, the leaves are used to treat cough and cold, joint pains and toothaches. The leaves are boiled and the decoction is rubbed to cure weakness and pain on bones.



Figure 4.4 : *Piper sarmentosum* (Kadok)

The result of the study showed the most of the plant parts were consumed after cooked. The wild edible plants are consumed mainly in different ways according to their preferences. They are mainly eaten raw or cooked and thus require different preparation processes. Table 4.9 shows the ways of consumption of the plants by the local communities.



Table 4.9 : The ways of consumption of the wild edible plants by the local communities

Botanical Name	Family	Native Name	Status	Parts Used	Method of Consumption
<i>Alpinia galanga</i>	Zingiberaceae	Lengkuas	Wild, Planted	Rhizome	Rhizome used to flavouring food
<i>Anacardium occidentale</i>	Anacardiaceae	Tere, Ketereh, Gajus	Wild, Planted	Young leaves, Nuts	Young leaves eaten raw or make as <i>kerabu</i> while nuts use as a light snack
<i>Archidendron jiringa</i>	Leguminosae	Jering	Wild	Fruits	Fruit eaten raw
<i>Athyrium esculentum</i>	Dennstaedtiaceae	Pucuk paku, Paku ikan, Paku gajah	Wild	Young shoots	Young shoots eaten cooked
<i>Barringtonia racemosa</i>	Lecythidaceae	Putat	Wild	Young leaves	Young leaves eaten raw
<i>Callerya atropurpurea</i>	Leguminosae	Jenerih	Wild	Young leaves	Young leaf eaten raw
<i>Capsicum frutescens</i>	Solanaceae	Cili api	Wild, Planted	Fruits	Green or ripe fruits used to flavouring food
<i>Centella asiatica</i>	Umbelliferae	Pegaga	Wild, Planted	Leaves	Leaves eaten raw
<i>Cosmos caudatus</i>	Asteraceae	Ulam raja	Wild, Planted	Young leaves	Young leaves eaten raw
<i>Curcuma longa</i>	Zingiberaceae	Kunyit	Wild, Planted	Rhizome, Leaves, Flowers	Rhizome used to flavouring and coloring food, leaves use to flavouring food while flower eaten raw

Table 4.9 (Continued)

<i>Curcuma mangga</i>	Zingiberaceae	Ketemu, Temu pauh	Wild	Rhizome	Rhizome eaten raw or eaten as <i>kerabu</i>
<i>Cymbopogon citratus</i>	Gramineae	Serai	Wild, Planted	Leaves base	Leaf base used to flavouring food
<i>Elettariopsis curtisii</i>	Zingiberaceae	Pijat	Wild	Rhizome	Rhizome mix other ingredients to make <i>sambal</i>
<i>Emilia sonchifolia</i>	Asteraceae	Bayam praksi	Wild	Leaves	Leaf and soft stem eaten raw or cooked
41 <i>Etilingera elatior</i>	Zingiberaceae	Kantan	Wild, Planted	Young flower shoots, Half-ripe fruiting shoots	Fruits used to flavouring food and ripe seeds are eaten raw
<i>Euodia ridlevi</i>	Rutaceae	Tenggek burung	Wild	Young leaves	Young leaves eaten raw
<i>Ficus roxburghii</i>	Moraceae	Ara	Wild	Fruits	Added in dishes
<i>Gynura precumbens</i>	Asteraceae	Sambung nyawa	Wild, Planted	Leaves	Leaves eaten raw
<i>Ipomoea reptans</i>	Convolvulaceae	Kangkung	Wild, Planted	Leaves, stems	Leaf and soft stem eaten cooked
<i>Lasia spinosa</i>	Araceae	Geli, Geli-geli	Wild	Young shoots	Young shoots eaten cooked
<i>Manihot esculenta</i>	Euphorbiaceae	Ubi kayu	Wild, Planted	Young leaves, Tuber	Young leaves are boiled or cooked while the tuber boiled or fried as a snack

Table 4.9 (Continued)

<i>Ocimum sanctum</i>	Labiatae	Temangi, Kemangi, Selasih	Wild, Planted	Young leaves	Young leaves eaten raw
<i>Oenanthe javanica</i>	Umbelliferae	Kangkung selom	Wild	Shoots, Young leaves	Shoots and young leaves eaten raw
<i>Oroxylum indicum</i>	Bignoniaceae	Beko, Bonglai	Wild	Shoots, Fruits	Shoots and fruits eaten cooked, or fruits used as ingredient in <i>kerabu</i> mixture
<i>Parkia speciosa</i>	Leguminosae	Petai	Wild, Planted	Seeds	Mature seeds eaten raw or cooked
<i>Parsonia helicandra</i>	Apocynaceae	Lemak ketam	Wild, Planted	Young leaves	Young leaves eaten raw
<i>Passiflora foetida</i>	Passifloraceae	Ulat bulu, Letup- letup	Wild	Young shoots, leaves	Young shoots and leaves eaten raw
<i>Phyllanthus androgynus</i>	Euphorbiaceae	Cekak manis, Cekur manis	Wild, Planted	Leaves	Leaves eaten cooked
<i>Piper sarmentosum</i>	Piperaceae	Kadok	Wild, Planted	Young leaves	Young leaf consumed raw, dipped in hot water or ingredient in <i>kerabu</i> mixture
<i>Pithecellobium bubalinum</i>	Leguminosae	Kerdas	Wild	Seeds	Seeds eaten raw
<i>Polygonum minus</i>	Polyganaceae	Kesom	Wild, Planted	Leaves	Leaf and stem used to flavouring food
<i>Schizophyllum commune</i>	Schizophyllaceae	Kulat sisir	Wild	All parts	Cooked before eaten

Table 4.9 (Continued)

<i>Solanum torvum</i>	Solanaceae	Terung pipit	Wild	Fruits	Fruits eaten raw or boiled
<i>Stenochlaena palustris</i>	Blechnaceae	Midin, Pakis merah	Wild	Young shoots	Young shoots eaten cooked
<i>Syzygium polyantha</i>	Myrtaceae	Serai kayu, Samok	Wild	Young leaves, Soft stems	Young leaves and stems eaten raw or used to flavouring food
<i>Zingiber cassumunar</i>	Zingiberaceae	Halia bara	Wild, Planted	Rhizome	Eaten raw
<i>Zingiber officinale</i>	Zingiberaceae	Halia	Wild, Planted	Rhizome	Rhizome used to flavouring food

From the data recorded, 98% of the seller in the study area is Malay. There is only two Chinese sellers in Machang area, while in Jeli area, all the sellers is Malay. Among all the seller that have been asked about the usage of the edible plants to human health, about 65% of the sellers know a little bit of this traditional knowledge. The sellers especially the one who age more than 51 years old, know more about the usage of certain wild edible plants.

While, with the total of 75 respondents from the customers, only 16% of them know about the benefits of the vegetable they buy to their health. The others only buy to make as *ulam* and as appetizer of their meals. This may be an indication of decreasing in traditional knowledge on edible plants due to development and less interest to know the benefits of this wild plants. One day, the knowledge of edible plants may become diluted if this situation keep happen in the future. This is why, this study is important to conserve the traditional knowledge in our society not only to record this knowledge but also to take initiative to conserve the genetic and species diversity before they will be forgotten by us.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, from both district, there are total of 37 species of wild edible plants belonging to 26 families were recorded. *Parkia speciosa* is the highest number of individual sold in both area with 41 total individuals for both of the district. There are 28 species of wild vegetables in Jeli, meanwhile 32 species had been found in Machang district. From this study, traditional knowledge about several species on their usage to the human health had been recorded. It is possible if one day, the traditional knowledge on this wild plants could create new innovations in the pharmaceutical industry in our country. Hence, the communities should engage in sustainable management and preservation of traditional knowledge of these multi-valued resources for the well-being local communities.

5.2 Recommendations

Because of time constraints, the study could only be done at two districts that are in Jeli and Machang, Kelantan. In the future, if the final year project period is extended, the study area maybe can be added so that the data can be used to represent the whole data for Kelantan. Moreover, there is also difficulty occur during the drying process of the sample collected. The students should take turn to do the process because of the lacking of several materials like pressing wood and the space for the oven. GPS also need to be added because many students use this device during the data gathering and some students cannot get the device because already been booked by other student first. This problem can cause the difficulties to student during collect the data at the field. Besides, to increase dietary diversity on wild edible plants among local people, complimentary studies and further ethnobotanical studies should be conducted. A detailed evaluation of nutritional composition should be done to prove and encourage consumption of this wild species among young generation. In addition, proper value chain development for marketing and value-addition of selected species can give more income to native communities.

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APPENDIX A

The numbers of individual of the species and Shannon diversity index value according to the traditional market in Jeli, Kelantan

Botanical Name	Native Name	Pasar Jeli	Pasar Ayer Lanas	Pasar Kuala Balah	Pasar Pagi Batu Melintang	Pasar Malam Batu Melintang	Pasar Malam Sungai Satan	Pasar Malam Gemang	Sum	H'
<i>Anacardium occidentale</i>	Tere, Ketereh, Gajus	4	1	0	0	0	0	0	5	0.081
<i>Alpinia galanga</i>	Lengkuas	8	4	4	0	0	0	0	16	0.181
<i>Archidendron jiringa</i>	Jering	12	1	6	0	0	0	0	19	0.201
<i>Athyrium esculentum</i>	Pucuk paku	3	1	5	0	0	0	0	9	0.123
<i>Callerya atropurpurea</i>	Jenerih	1	2	0	0	0	0	0	3	0.055
<i>Centella asiatica</i>	Pegaga	9	1	2	0	0	0	0	12	0.150
<i>Cosmos caudatus</i>	Ulam raja	1	1	0	0	0	0	0	2	0.040
<i>Curcuma longa</i>	Kunyit	9	3	2	0	0	0	0	14	0.166
<i>Curcuma mangga</i>	Ketemu, Temu pauh	0	0	2	0	0	0	0	2	0.040

Appendix A (Continued)

<i>Cymbopogon citratus</i>	Serai	7	4	3	0	0	0	0	14	0.166
<i>Elettariopsis curtisii</i>	Pijat	12	0	5	0	0	0	0	17	0.188
<i>Emilia sonchifolia</i>	Bayam praksi	0	1	1	0	0	0	0	2	0.040
<i>Etlingera elatior</i>	Kantan	7	2	7	0	0	0	0	16	0.181
<i>Ipomoea reptans</i>	Kangkung	6	3	0	0	0	0	0	9	0.123
<i>Lasia spinosa</i>	Geli, Geli-geli	0	0	2	0	0	0	0	2	0.040
<i>Oenanthe javanica</i>	Kangkung selom	2	1	1	0	0	0	0	4	0.068
<i>Oroxylum indicum</i>	Beko	3	3	4	0	0	0	0	10	0.133
<i>Parkia speciosa</i>	Petai	15	5	3	0	0	0	0	23	0.225
<i>Parsonsia helicandra</i>	Lemak ketam	0	1	0	0	0	0	0	1	0.023
<i>Passiflora foetida</i>	Ulat bulu, Letup- letup	0	2	0	0	0	0	0	2	0.040
<i>Phyllanthus androgynus</i>	Cekak manis, Cekur manis	1	0	1	0	0	0	0	2	0.040
<i>Piper sarmentosum</i>	Kadok	1	0	0	0	0	0	0	1	0.023

Appendix A (Continued)

<i>Polygonum minus</i>	Kesom	7	3	5	0	0	0	0	15	0.174
<i>Schizophyllum commune</i>	Kulat sisir	0	0	1	0	0	0	0	1	0.023
<i>Solanum torvum</i>	Terung pipit	3	1	0	0	0	0	0	4	0.068
<i>Stenochlaena palustris</i>	Midin, Pakis merah	0	4	2	0	0	0	0	6	0.093
<i>Syzygium polyantha</i>	Serai kayu	4	2	4	0	0	0	0	10	0.133
<i>Zingiber officinale</i>	Halia	10	4	4	0	0	0	0	18	0.195
Total									239	3.014

APPENDIX B

The numbers of individual of the species and Shannon diversity index value according to the traditional market in Machang, Kelantan

Botanical Name	Native Name	Pasar Isnin	Pasar Besar	Pasar Malam	Pasar Borong	Pasar Tani	Sum	H'
<i>Anacardium occidentale</i>	Tere, Ketereh, Gajus	0	3	0	0	2	5	0.078
<i>Alpinia galanga</i>	Lengkuas	0	7	1	1	6	15	0.168
<i>Archidendron jiringa</i>	Jering	0	1	0	1	2	4	0.066
<i>Athyrium esculentum</i>	Pucuk paku	2	4	0	0	11	17	0.182
<i>Barringtonia racemosa</i>	Putat	0	1	0	0	0	1	0.022
<i>Callerya atropurpurea</i>	Jenerih	0	0	0	0	2	2	0.038
<i>Capsicum frutescens</i>	Cili api	1	2	0	0	6	9	0.119
<i>Centella asiatica</i>	Pegaga	1	3	1	3	5	13	0.153
<i>Cosmos caudatus</i>	Ulam raja	0	4	0	0	4	8	0.110
<i>Curcuma longa</i>	Kunyit	0	9	1	1	3	14	0.161

Appendix B (Continued)

<i>Cymbopogon citratus</i>	Serai	0	4	0	1	7	12	0.145
<i>Emilia sonchifolia</i>	Bayam praksi	0	1	1	2	5	9	0.119
<i>Etlingera elatior</i>	Kantan	2	5	0	5	6	18	0.189
<i>Euodia ridlevi</i>	Tenggek burung	0	0	0	0	2	2	0.038
<i>Ficus roxburghii</i>	Ara	0	0	0	0	1	1	0.022
<i>Gynura precumbens</i>	Sambung nyawa	0	2	0	0	2	4	0.066
<i>Ipomoea reptans</i>	Kangkung	0	1	0	1	5	7	0.100
<i>Manihot esculenta</i>	Ubi kayu	0	1	0	0	1	2	0.038
<i>Ocimum sanctum</i>	Temangi, Selasih	0	1	0	0	0	1	0.022
<i>Oenanthe javanica</i>	Kangkung selom	2	4	0	1	3	10	0.128
<i>Oroxylum indicum</i>	Beko	3	3	0	0	4	10	0.128
<i>Parkia speciosa</i>	Petai	3	4	0	3	8	18	0.189
<i>Parsonsia helicandra</i>	Lemak ketam	0	0	0	0	2	2	0.038
<i>Phyllanthus androgynus</i>	Cekak manis, Cekur manis	0	1	0	0	1	2	0.038

Appendix B (Continued)

<i>Pithecellobium bubalinum</i>	Kerdas	0	1	0	0	0	1	0.022
<i>Polygonum minus</i>	Kesom	0	5	0	3	5	13	0.153
<i>Schizophyllum commune</i>	Kulat sisir	0	0	0	0	4	4	0.066
<i>Solanum torvum</i>	Terung pipit	0	0	0	0	2	2	0.038
<i>Stenochlaena palustris</i>	Midin, Pakis merah	1	1	0	0	3	5	0.078
<i>Syzygium polyantha</i>	Serai kayu	2	6	0	3	12	23	0.218
<i>Zingiber cassumunar</i>	Halia bara	1	0	0	0	0	1	0.022
<i>Zingiber officinale</i>	Halia	0	9	1	1	6	17	0.182
Total							252	3.135

APPENDIX C

Final Year Project Planning (FYP1 + FYP2)

Materials	Field notebook
	Global Positioning System (GPS)
	Camera
	List of the simple questions
	Secateurs
	Tagging
	Newspaper
	Plastic
Pressing wood	
Chemical	70% ethanol
Field Work	18 times (9 July 2018 – 19 October 2018)