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DISTRIBUTION AND DIVERSITY OF FAMILY ZINGIBERACEAE AT LATA KEDING, JELI, 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 Honors

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DECLARATION

I declare that this thesis entitled “Distribution and Diversity of Family Zingiberaceae at Lata Keding, Jeli Kelantan” is the result my own research except as cited in the references. This thesis has not been accepted for any degree is not concurrently submitted in candidature of any other degree.

Signature : 

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Distribution and Diversity of Family (Zingiberaceae) in Lata Keding, Jeli Kelantan.

ABSTRACT

This study investigates the distribution and diversity of the Family Zingiberaceae in Lata Keding, Jeli, Kelantan. The objective is to determine thediversity and to assess abundance of Zingiberaceae Family species in the area. A random sampling method was used, and GPS was used for location tracking. Morphological features were analyzed to identify the species, and photographic evidence was collected. *Alpina* sp.1 appeared as the most abundant species, with 93 individuals, while *Globba* sp.1 had the lowest representation with 18 individuals. Thedistribution of other species varies moderately. Color-coded mapping facilitates visualanalysis, aiding in the creation of comprehensive diversity maps. For distribution, abundant Zingiberaceae flowers *Etlingera punicea* were observed along the route andthe position pattern for *E.punicea* was scattered along the route on the sampling day, with characteristic red flowers with yellow stripes. The study concluded that *Alpina* sp.1 dominated in Lata Keding Jeli, Kelantan with moderate overall diversity indicatedby a Shannon- Wiener Index (H') of 1.602067.Factors that affect the diversity and distribution of the Zingiberaceae family in Lata Keding Jeli Kelantan are possible because of the water source because the growth of the Zingiberaceae family depends on the presence of water, soil moisture, soil fertility, human factors as well the study area is made into an ecotourism attraction that will affect growth and reproduction. Family Zingiberaceae in Lata Keding, Jeli, Kelantan. Human activities pose a threat to habitat integrity, emphasizing the importance of conservation efforts. Although there is a diversity comparable to other tropical regions, conservation measures are essential forlong-term preservation. In achieving its objectives, this study contributes valuable insights into the ecological composition of Lata Keding, Jeli, Kelantan, enriching the understanding of the dynamics of Zingiberaceae species in this region.

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Taburan dan Kepelbagaian Famili (Zingiberaceae) di Lata Keding, Jeli Kelantan

ABSTRAK

Kajian ini menyiasat taburan dan kepelbagaian Famili Zingiberaceae di Lata Keding, Jeli, Kelantan. Objektifnya adalah untuk menentukan kepelbagaian dan menilai kelimpahan spesies Famili Zingiberaceae di kawasan tersebut. Kaedah persampelan rawak telah digunakan, dan GPS digunakan untuk pengesanan lokasi. Ciri morfologi dianalisis untuk mengenal pasti spesies, dan bukti fotografi telah dikumpulkan. *Alpina* sp.1 muncul sebagai spesies yang paling banyak, dengan 93 individu, manakala *Globba* sp.1 mempunyai perwakilan paling rendah dengan 18 individu. Taburan spesies lain berbeza-beza secara sederhana. Pemetaan berkod warna memudahkan analisis visual, membantu dalam penciptaan peta kepelbagaian yang komprehensif. Untuk pengedaran, bunga Zingiberaceae *Etlingera punicea* yang banyak diperhatikan di sepanjang laluan dan corak kedudukan untuk *E.punicea* bertaburan di sepanjang laluan pada hari persampelan, dengan ciri bunga merah dengan jalur kuning. Kajian merumuskan bahawa *Alpina* sp.1 mendominasi di Lata Keding Jeli, Kelantan dengan kepelbagaian keseluruhan yang sederhana ditunjukkan oleh Indeks Shannon- Wiener (H') 1.602067. Faktor-faktor yang mempengaruhi kepelbagaian dan taburan famili Zingiberaceae di Lata Keding Jeli Kelantan ialah mungkin kerana sumber air kerana pertumbuhan famili Zingiberaceae bergantung kepada kehadiran air, kelembapan tanah, kesuburan tanah, faktor manusia serta kawasan kajian dijadikan tarikan ekopelancongan yang akan menjejaskan pertumbuhan dan pembiakan. Famili Zingiberaceae di Lata Keding, Jeli, Kelantan. Aktiviti manusia menimbulkan ancaman kepada integriti habitat, menekankan kepentingan usaha pemuliharaan. Walaupun terdapat kepelbagaian yang setanding dengan kawasan tropika lain, langkah pemuliharaan adalah penting untuk pemeliharaan jangka panjang. Dalam mencapai objektifnya, kajian ini menyumbangkan pandangan berharga tentang komposisi ekologi Lata Keding, Jeli, Kelantan, memperkayakan pemahaman tentang dinamik spesies Zingiberaceae di rantau ini.

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LIST OF ABBREVIATIONS

GPS	Global positioning system
E. punicea	*Etlingera punicea*
E.elatior	*Etlingera elatior*
A.javanica	*Alpinia javanica*
cm	centimeters
m	metres
UMK	Univesiti Malaysia Kelantan

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LIST OF SYMBOLS

∑	Total
( )	Parentheses
%	Percentage
÷	Division
×	Multiply
+	Addition

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Lata Keding, situated on Hill Kudung in Jeli, Kelantan near Kampung Gemang and the Gemang subdistrict, is a recently developed recreational spot boasting a wealth of natural and historical wonders. Renowned for its stunning waterfalls, modern recreational facilities, and resorts, Lata Keding draws both locals and tourists alike. Moreover, Bukit Kudung, formerly a stronghold and hiding place for communists, harbors numerous mysteries. Beyond the picturesque façade of its 480-meter height lies a significant landmark known as Stone 73, marking a 2.3-kilometer border with Thailand.The Zingiberaceae family represents a fraction of the vast array of tropical plant species, comprising approximately 50 genera and over 1,300 species. Its uses span from culinary and medicinal purposes to industrial applications and ornamental cultivation. (Lianah et al., 2020) Commonly referred to as the ginger family, Zingiberaceae holds significant economic value and potential as an ornamental plant group among monocotyledons.

Zingiberaceae, renowned for its medicinal properties, is widespread across the tropics, particularly in Southeast Asia. Ginger, a crucial natural resource within this family, yields numerous beneficial products ranging from food and medicine to spices, perfumes, and dyes. As the largest family in the plant kingdom, Zingiberaceae predominantly thrives in tropical Asia. Ginger, a globally recognized herb from the Zingiberaceae family, is found in various habitats, spanning from lowland to hill

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forests, as perennial plants (Larsen et al., 1999). 1,600 species of ginger are recorded worldwide (Larsen et al. 1999; Xu & Chang 2017), withover 160 species from 18 genera documented in Peninsular Malaysia alone. Various studies have been conducted throughout Malaysia to update the species composition and distribution of Malaysian ginger plants. Among the investigations, Appalasamy et al., (2019), and Izlamira et al., (2020) recently published ginger species composition data for certain areas in Malaysia. However, many forest areas in Malaysia are still unexplored. The Zingiberaceae family consistsof more than 1,500 species distributed in atat least 53 genera (Kress et al., 2002; Lamb et al., 2013; Christenhusz & Bying, 2016). Currently there are 143 taxa known from nine genera of the Alpinieae tribe thatoccur in Borneo, namely *Etlingera* Giseke (42 spp.*)*, *Amomum* Roxb. (36 spp.), *Alpinia*Roxb. (19 spp.), *Plagiostachys* Ridl. (15 spp.), *Hornstedtia* Retz. (15 spp.), *Elettari* Maton (9 spp.), *Elettariopsis* Baker (3 spp.), *Geocharis* (K.Schum.) Ridl. (2 spp.), and *Geostachys* (Baker) Ridl. (2 spp.) (Lamb et al., 2013).

1.2 Problem statement

The problem statement of this study consists of the lack of data on the family Zingiberaceae in Lata Keding, Jeli, Kelantan. The lack of information about this family of flora causes a gap in knowledge about the species belonging to the family. This study also aims to help the knowledge gap discussed above by providing the latest data on the Zingiberaceae family, especially those found in the state of Kelantan. According to Appalasamy et al., (2022), lack of sampling of Zingiberaceae especially in Kelantan and wild ginger in some Kelantan forests has yet to be found.

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1.3 Objective

- To determine the distribution and diversity of family Zingiberaceae in Lata Keding, Jeli Kelantan.
- To assess the species abundance of Family Zingiberaceae in Lata Keding, Jeli Kelantan.

1.4 Scope of Study

The study area was conducted in Lata Keding, Jeli Kelantan. Lata Keding, located on Bukit Kudung in Jeli, Kelantan near Kampung Gemang and Gemang subdistrict and Lata Keding is a recently developed recreation area with natural wealth. The height of Lata Keding is 480 meters and the distance to the border is 2.3 kilometers from Thailand. This research was conducted to determine the diversity of Zingiberaceae in Lata Keding and evaluate the abundance of Zingiberaceae species in Lata Keding, Jeli, Kelantan. This study also includes the identification ofZingiberaceae species recorded through random sampling and observations made in line with the objectives of the study.

1.5 Significance of Study

The investigation into the distribution and diversity of the Zingiberaceae family in Lata Keding, Jeli Kelantan, holds immense value for the wider community. Through the insights gained from this research, we deepen our understanding of the local flora and the critical need to conserve plant diversity. This knowledge isn't just for scientists and local stakeholders; it resonates with anyone who admires nature's beauty. Moreover, this study significantly enriches our grasp of local plant biodiversity, particularly within the confines of Lata Keding. The mapping of diversity across various pathways provides invaluable insights into the distribution and richness of Zingiberaceae species. Furthermore, it sheds

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light on the ecological ramifications of preserving plant diversity and offers a valuable sustainability assessment for devising effective conservation strategies. By underscoring the significance and potential applications of Zingiberaceae, this research aligns with broader nature conservation endeavors and advances scientific exploration in botany and ecology. Additionally, it empowers us to safeguard endangered plant species and formulate robust conservation measures, thereby ensuring the continuity of the local ecosystem. This is pivotal in preserving nature's equilibrium and the inherent splendor of the Lata Keding region for posterity.

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CHAPTER 2

LITERATURE REVIEW

2.1 Taxonomy of Zingiberaceae

Zingiberaceae are monocot plants, the largest of the eight in the order Zingiberales. This family has about 53 genera and more than 1,200 species (Kress et al., 2002). Zingiberaceae is found mainly in tropical and subtropical regions, with Southeast Asia. Previously, Zingiberaceae plants were classified solely based on their morphology. This classification has gained wide acceptance. Kress et al., (2002) proposed a new taxonomy of Zingiberaceae based on morphological features and molecular phylogeny, consisting of four subfamilies and six tribes: *Siphonochiloideae* (Siphonochileae), *Tamijioideae* (Tamijieae), *Alpinioideae* (Alpinieae).

The Family Zingiberaceae is the largest family of the order Zingiberales and is widespread throughout the world, including America, Indonesia, Indochina, Malaysia and Thailand (Nagappan et al., 2019; Zahara, 2020). The Zingiberaceae comprises 55 genera with approximately 1,300 species (Royal Edinburgh Botanic Gardens). There are 750 species distributed in 31 genera in Malaysia (Govaerts et al., 2022). At the same time, about 200 species from 19 genera were recorded in PeninsularMalaysia (Nagappan et al., 2019).

The 20 selected Zingiberaceae species considered in this study are known for their traditional properties and medicinal value (Baruaha et al., 2019). Some of them are threatened and endangered species, *Alpinia rafflesiana, Scaphochlamys kunstleri* and *Zingiber puberulum* (International Union for Conservation of Nature [IUCN]).

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However, only a few species have been scientifically examined for their biological value and properties. In the meantime, the taxonomic information on the 20selected species included in this study needs to be updated. However, something is wrong with unclear morphological characters such as *Etlingera* and *Hornstedtia.* This makes correct classification based on morphological characters difficult, especially for those who are not taxonomists. Therefore, this study aims to construct a phylogenetic tree of 20 selected species of Zingiberaceae using molecular taxonomic methods that do not require morphological characters for phylum identification.

The previous botanical inventory update was conducted in 2009 by a research group from the Forestry Research Institute Malaysia (FRIM), which reported a total of 856 human specimens from 122 families, 312 genera and 552 species of Dewy Forest Plants Reserve (FR) (Lim et al., 2009). These data show that eight genera and 22 species of the Zingiberaceae family were found in this forest reserve. The Zingiberaceae family includes about 51 genera and 1,600 species found. Occurs abundantly in the tropical regions of Asia, Africa and America. To date, the Malaysian Floristic Zone, which includes Malaysia, Indonesia, Brunei, Singapore, the Philippines, and Papua New Guinea, has the richest diversity of Zingiberaceae in the world. In Figure 2.1 show 29 species of Zingiberaceae in Khao Nan and Khan Luang National Park, Nakhon Si Thammarat,Thailand (Kittipanangkul& Ngamriabsakul, 2011).

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Figure 2.1: 29 species of Zingiberaceae. In Khao Nan and Khan Luang National Park, Nakhon Si Thammarat,Thailand, Line 1,from top, left to right; *Alpinia mutica, Alpinia javanica, Alpinia zerumbet, Amomum aculeatum, Amomum biflorum*. Line 2, left to right; *Amomum hastilabium,Amomum uliginosum, Amomum sp., Elettariopsis curtisii, Etlingera elatior.* Line 3, left to right; *Etlingera fulgens, Etlingera littoralis, Etlingera pauciflora, Etlingera subterranea, Hornstedtia leonurus.* Line 4, left to right; *Globba pendula, Globba leucantha, Boesenbergiabasispicata, Boesenbergia plicata, Curcuma aurantiaca*. Line 5, left to right; *Curcuma longa, Curcuma rubescens, Curcuma zedoaria, Hedychium khaomaenense, Kaempferia pulchra*. Line 6, left to right; *Zingiber newmanii, Zingiber officinale, Zingiber ottensii, Zingiber zerumbet.* (Kittipanangkul & Ngamriabsakul, 2011)

2.2 Family Descriptions and Classification

This zingiberaceae is a perennial zingiberaceae with a branched rhizome, usually creeping horizontally. The stems are short and poorly developed, usually elongated by overlapping leaf midribs; usually unbranched but sometimes can be quite large.The leaves are arranged in two rows with long, open fronds; leaf blades usually narrowed at the base of the shoot, elliptic, sometimes linear or broadly elliptic, glabrous or hairy; lateral veins arranged parallel like chicken feathers; petioles of different lengths.

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Flowers appear at the tips of leafy shoots or on short, leafless shoots that arise directly from the rhizome. Flowers can be sparsely or densely arranged, cylindrical or fusiform, sometimes round, with few to many flowers; flowers arranged in the form of a cincinnus forming a thyrse or sometimes in the form of a raceme or spike. Zingiberaceae is divided into four tribes. Alpiniae: Inflorescences arise from the base. The leaves are arranged in two rows transverse to the rhizome; lateral staminodes reduced to small structures, not petaloid, swollen, or absent. The ovary is usually trilocular with axial placentation, sometimes imperfect, and very rarely unilocular with parietal placentation. Globeae: Lateral staminodes are petaloid and free from the lip; filaments are bow-like and usually long and prominent; ovary is unilocular with parietal placentation. Hedychieae: Theleaves are arranged in two rows parallel to the rhizome; lateral staminodes are petaloid and free from the lip; ovaries are trilocular with axial placement or unilocular with basal or free columnar placement. Zingibereae: The leaves are arranged in two rows parallel to the rhizome; lateral staminodes are petaloid and adnate to the lip; the ovary is trilocular with axial placement.

2.3 Distribution Zingiberaceae in Peninsular Malaysia

In the order Zingiberales, Zingiberaceae is the largest family. It is found in many tropical and subtropical regions of the world, including America, Indonesia, Indochina, Malaysia, and Thailand (Nagappan et al., 2019 & Zahara, 2020). The family Zingiberaceae comprises about 1,300 species spread across 55 genera (Royal Botanic Garden Edinburgh [RBGE], n.d.). There are thirty- one genera and seven hundred species in Malaysia (Govaerts et al., 2022). At the same time, around 200 species belonging to 19 genera have been reported in Peninsular Malaysia (Nagappan et al., 2019). Perennial plants are generally distributed from lowland to hill forests (Larsen et al., 1999). Over 160 species from 18 genera have been documented in Peninsular

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Malaysia alone, out of the approximately 1,600 species of Zingiberaceae that have been identified globally (Larsen et al., 1999; Xu & Chang 2017). To update the species composition and distribution of Malaysian Zingiberaceae plants, numerous studies have been carried out across the country. Data on the species composition of Zingiberaceae for specific areas in Malaysia was recently published by Appalasamy et al. (2019), and Izlamira et al. (2020), among other investigations. Nonetheless, a great deal of Malaysia's forest regions remain unexplored Zingiberaceae can be found in many different habitats, including areas with limestone, according to Larsen et al. (1999). Still, there aren'tenough studies on limestone Zingiberaceae, particularly in Peninsular Malaysia. 16 Zingiberaceae species were found in Peninsular Malaysia's limestone regions. Furthermore, two uncommon species of Zingiberaceae were discovered in Peninsular Malaysia in 2017 according to Kiew et al. (2017).

All species except *Globba leucantha* are found in all three forests reserve. *G. leucantha* is found near the waterfall in Sungai Pinang Forest reserve This particular speciesis found to be dominant in the downstream vicinity this waterfall and covers the rocky area in this area. Another species with wide coverage in these three forest reserves is *Amomum ochreum* and *Amomum xanthophlebium*. Except *Etlingera* sp. and *Alpinia* sp. Zingiberaceaeplant family has a wide range of habitat distribution and the species of this wild ginger in Malaysian forest is the most studied said Appalasamy et al. (2022). The diversity and distribution of Zingiberaceae species along natural trail of Lojing Highlands, Kelantan was shown in figure 2.2.

Etlingera is the most common genus along the Lojing Highlands' natural path in Kelantan; the most comparable plant seen along the path is *E. punicea. E. punicea*, referred to as Chalong by the Temiars, is a plant that grows well and is more likely to flourish in moist soil. *Etlingera triorgyalis,* also known as *Etlingera littoralis,* is located at an elevation of 893 meters above sea level. *Etlingera* sp also known as Apus

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Tapi, was discovered in the study region close to rivers and tiny waterfalls at an elevation of 893 meters above sea level. A prior investigation was conducted by a different group about the variety and dispersion of Zingiberaceae in Kelantan, encompassing limestone forests by Appalasamy et al. (2022) and the Lojing Highlands nature trail (Appalasamy et al., 2020). A cluster of *Hornstedtia* sp. One plant was discovered 843 metres above sea level. Along the study area, only individuals of the species were discovered. *Etlingera* is the most prevalent genus along the Lojing Highlands' natural route in Kelantan. The most comparable plant seen along the route is *E. punicea*, *Etlingera triorgyalis*, also known as *Etlingera littoralis*, is located at an elevation of 893 metres above sea level. *Etlingera* sp, was discovered 893 metres above sea level. Only two of the four *Globba* species that exist in Kelantan's Lojing Highlands have been identified. In the research area, this plant can be found between 850 and 1000 metres above sea level. Figure 2.2 below shows the map of diversity and distribution of Zingiberaceae species along natural trail of Lojing Highlands, Kelantan (Appalasamy, 2020).

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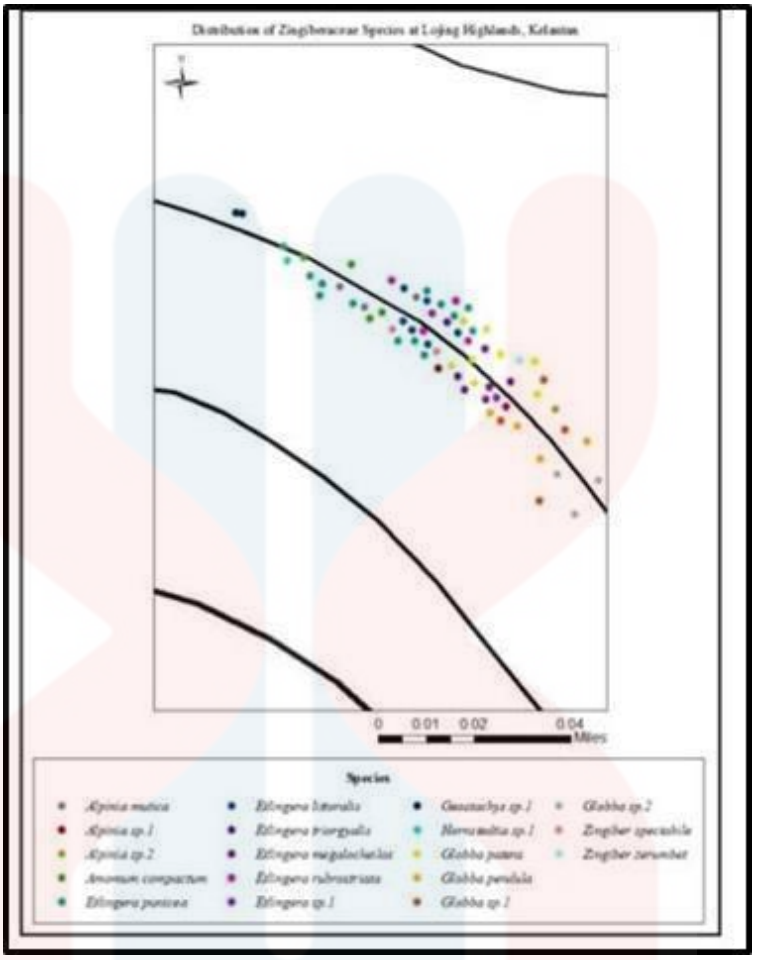

Figure 2.2 The diversity and distribution of Zingiberaceae species along natural trail ofLojing Highlands, Kelantan (Appalasamy, 2020)

A prior study on the distribution and diversity of Zingiberaceae in Kelantan was conducted by a different group and included the Lojing Highlands Natural Trail andthe limestone forest (Appalasamy et al., 2022*). Alpinia mutica, Alpinia* sp.1*, and Alpinia*sp.2 are widely distributed in the Lojing Highlands, Kelantan, between 800 and 950 metres above sea level. The Lojing Highlands in Kelantan are home to two species of Zingiberaceae which *is Zingiber spectabile* Gryphon and *Zingiber* sp.1. *Zingiber spectabile* was foundin two locations between 850 and 870 metres in altitude. At 894 metres, a young *Zingiber* sp.1 clump was discovered. Just an individual this species was detected in thestudy area in the Lojing Highlands. Figure 2.3 below show wild ginger species in limestone forest of Kelantan.

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Figure 2.3: Identified wild ginger species in limestone forest of Kelantan. (a) *Alpinia javanica*; (b) *Etlingera littoralis*; (c) *Etlingera maingayi*; (d) *Etlingera punicea*; (e) *Plagiostachys* sp.; (f) *Wurfbainia uliginosa*; (g) *Globba leucantha*; (h) *Globba patens*; (i) *Bosenbergia plicata*; (j) *Sundamomum hastilabium*; (k) *Zingiber aurantiacum*; (l) *Zingiber ottensii*; (m) *Zingiber puberulum*;(n) *Zingiber spectabile*; (o) *Zingiber wrayi*; (p) *Zingiber petiolatum* (Appalasamy et el., 2022)

2.4 Morphology of Zingiberaceae

Plants of the family Zingiberaceae are commonly known as gingers. They are perennial Zingiberaceae that are variable in height and size (Larsen et al., 1999). Species such as *Etlingera elatior* have large leafy shoots growing up to six metres in height whileothers such as *Kaempferia galanga* are almost prostrate near the ground. They produce aromatic rhizomes that are subterranean or above ground. Each rhizome can turn upwards,transforming into an erect leafy shoot. Inflorescences are terminal, either on leafy shoots or on special erect shoots near the base of the plant. Zingiberaceae is a family of aromaticperennial gingers (Christenhusz & Byng 2016). It features hairy or creeping rhizomes thatgrow horizontally in the soil, pseudostems, single leaves, and inflorescences with unique shapes and colors (Irayanti & Yadnya-Putra 2020). In taxonomy, morphological characteristics are often used to help in the description and identification of plants (Zahara,2020; Hassemer et al., 2020)

Plant taxonomy has historically divided groups of plants based on morphological characteristics, which provide information about the growth, form, and external structure of plants and are helpful in understanding plant origins and similarities (Viscosi & Cardini, 2011). Morphological traits can be quantified (leaf length) or qualitatively reported and observed (leaf shape). In order to identify, describe, classify, and solve taxonomic problems pertaining to plants, morphological characteristics of plants can be employed asprimary or diagnostic markers (Iroka et al., 2015). Plant species can differ in the shape andstructure of morphological characteristics, even amongst members of the same species (Susetyarini et al., 2020). The main areas of variation are in the leaves, stems, and flowers.

Variation in morphological characteristics can result from the effects of position, environment, and juvenile factors (Iroka et al.,2015). Often, the morphologicalcharacteristics differ because the growth and development of young plant structures are not fully formed (Susetyarini et al., 2020). In the study area, Zingiberaceae species exhibitfibrous root systems, rhizomes that grow horizontally in the soil, and roots usually emerge from the rhizome surface. They have single leaves with symmetrical blades, arranged alternately in two opposite rows, with a ligule at the junction between the leaf blade and leaf sheath or between the petiole and leaf sheath. Leaf sheaths surround the true stem, forming a pseudostem.The absence of flowers during sampling limits species identification because inflorescence and floral structure are important morphologicalfeatures of ginger that aid plant identification at the species level (Larsen et al., 1999). Themorphological features examined in the study are habits; location, thickness and color of the rhizome; the height of the petiole, its base (if it is swollen to a bulbous base); distancebetween petioles; bladeless characters such as color, indumentum, number and length; length, shape of garment and uvula; Length of

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petiole, robe, channeled or rounded cross section; number of leaves on a leaf stem; Blade color on both surfaces, size, shape, grain,texture, cap, tip and base; Length of the inflorescence and fruit stand, arrangement of the floral bracts on the leaf vein, texture of the floral bracts and floral bracts (color, ingrowth,texture, shape); Size, color and shape of petals, floral tube, petals, labellum, stamens, stamens, ovary.

2.4 Botanical Charateristics of Zingiberaceae

The Zingiberaceae family comprises a significant group of plants with substantial ecological and economic value, widely used in traditional medicine, culinary arts, and cosmetics. This study was conducted in Mijen, Central Java, Indonesia area to identify and document Zingiberaceae species found in three different locations. A total of 19 species from 9 different genera were identified. Each species has unique botanical characteristics that distinguish it from others. The following table provides detailed information on the local names, scientific names, and botanical characteristics of each species found in this study.

Table 2.1 below provides a detailed description of the botanical characteristics of various Zingiberaceae species found in the Mijen area. (Saensouk et al.,2017). Each species shows significant differences in terms of pseudostems, leaves, rhizomes, and inflorescences. Forexample, *Curcuma longa* (turmeric) has yellow to orange rhizomes with yellow flowers, while *Zingiber officinale* (ginger) has paler rhizomes with pink flowers. *Curcuma heyneana* (meet sleigh) is known for its leaves that grow from its rhizomes and its very attractive flowers with pink edges. Likewise, with *Kaempferia galanga* (kencur), which has thick and round leaves with a special aroma. All these features are important to identify species of the zingiberaceae family.

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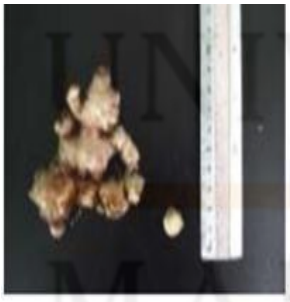
Table 2.1: Study of botanical characteristics of Zingiberaceae (Lianah et al.,2020)

Local (Scientific name)	Botanical characteristics
1.(Kunyit) *Curcuma longa* 	*Curcuma longa* or turmeric, is similar to *Curcuma xanthorriza*, except for the flowers which have yellow color. It is an herbaceous perennial with 1 to 1 m height that grow from underground rhizome. Rhizomes are branched, yellow to orange in color and have strong aroma. Turmeric leaves are alternate and arranged in two rows. Pseudo stems grow from the leaf sheaths which are oblong to elliptical with narrow tips.
2.(Lempoyang) *Zingiber zerumbet* L. 	The leaves are arranged alternately along the pseudostem which is curved and can grow from 1 to 2 m in length. Pseudo stems are 50-200 cm height. The leaves have short petioles, with lanceolate or oblong to lanceolate leaf sheaths, 15 to 20 cm long, and 3-8 cm width. Rhizomes are aromatic, have light yellow to yellow color. Inflorescence is oblong or ellipsoid, 7-15 cm long and 3-5 cm width. Flowers turn red upon maturing.
3.(Halia) *Zingiber officinale* Rosc. 	The petals are pink and attractive. The local name is ‘jahe’; it has upright stems with a height reaching up to 2 m long. Ginger rhizomes grow horizontally underground at shallow depth and irregularly branched., with pale yellowepidermis. The side rhizomes taste rather bitter. All the leaves are green. The inflorescence growsfrom rhizome, 15-35 cm in length and slender. The bracts are ovate or elliptical, 20-30 mm length and 15-20 mm width with yellow green color. The flowers are short lived, surrounded bybracteoles.

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4.(temu giring)
Curcuma heyneana Val

Curcuma heyneana is a perennial, herbaceous plant producing pseudo stems up to 75 cm height.The pseudo stems grow from branched and elongated rhizomes, have leaves with 15 to 42 cmlength and 5 – 13 cm width leaf blades. Inflorescence comes from the side of the pseudo stem the flower petals are pink on the edge and very attractive

5.(Kencur)
Kaempferia galanga L

Kaempferia galangal, or galangal is small, stemless perennial herb growing up to 40cm tall from rhizomes. The rhizomes are aromatic, vertically oriented with many small secondary tubers with camphoraceous aroma. Kencur rhizomes are relatively easy to grow. The leaves are round and thick, arranged in a rosette on the ground. Flowers are white with corolla tubes of 20-30 mm long. This species grows in lowland orfertile and mountainous areas but not flooded.

6.(Lengkuas)
Alpinia galanga

Pseudo-stems are 1.5 to 2 m high. The plants were found to grow in loose soil, exposed to sun,a little damp, but not flooded.

*7.(*Halia merah)
Zingiber officinale var. Rubrum

Pseudo-stem and leaves close to form like a stem.The flowers are 2-2.5 cm in length and 1-1.5 cm in width. The flower is 30 cm long, with yellowish white color and red purple spots; leaves grow close together. The base and tip of the leaf are tapered (acuminatus), while the leaf edges are flat. The leaf length reaches up to 15-23 cm and the leaf width is about 8-12.5 cm. The stem has 3-7 leaves per stem. Flower emerges from the rhizome with a length of about 25 cm.
The outer part of the rhizome is reddish and has scales. Rhizome are aromatic and spicy

8.Lempuyang gajah
Zingiber zerumbet (L.) Roscoe ex Sm.

Zingiber zerumbet has leafy stems that can grow up to 1.2 m. The leaves are arranged alternately with pale to dark green color. Leaf blades are petiolate with petioles or 4-5 mm, lanceolate about 14-40 long and 3-8 cm width. Pseudo stems are green in color. Flowers appear from the rhizome with pine cone shape. The main rhizome is quite large and strong and branched with yellow color.

9.(Tepus)
Etlingera foetens (Blume) R.M.Sm

Etlingera foetens are similar to kecombrang, but they are smaller in size. Pseudo stems have heightreaching 2 m. The leaves have reddish greencolor. The base of the leaf and the tip of theleaf arepointed (acutus). Inflorescence is not terminal with flower stalk of less than 100 cm. Flowers arepink. The rhizome has a very bitter taste.

10. (Kantan)
Etlingera elatior

Lengkuas-like plants, found near water sources inwild living forests and may reach up to 3-5 m in height. The leaves sit alternately and are elongated (oblongatus). Leaf tip pointed (acutus),the base of the leaf is rounded. The length of the leaves reaches 20-30 cm with the width of 5-15 cm. Leaves of the red kecombrang are reddish incolor. Inflorescence grows from side rhizomes. The length of the flower stalk can be more than 100 cm. Flowers are pale pink, pink, to dark red.The rhizome is long, soft and fleshy with white color.

11.(Wresah)
Amomum maximum Roxb.

Amomum maximum were found scattered in the forest. Plants resembles Cardamom and arranged in almost round bunches. Flowers appear from the rhizome close to the artificial stem. The crown tube is white and longer than the petals. Wresah fruits are green with a sweet and sour taste and fragrant. The seeds are small blackish brown.

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12.(Kapulaga)
Amomum compactum Soland.ex Maton

Pseudo stems are about 2.5 cm in diameter, dark green, the width of the leaves is around 3-10 cm and the length is from 7-50 cm. Leaves are elongated (oblongatus). Base and tip of the tapered leaf (acuminatus). The edges of the leaves are flat and slightly wavy. The length of the leaves reaches 30-90 cm with the width of 10-20 cm. Pseudo stems have a maximum height of 1.5 meters. The stem is usually green but near the rhizome is red. The base of the leaf is rounded (rotundatus). The tip of a pointed leaf (acutus). The edges of the leaves are slightly wavy. The length of the leaves can reach 7-50 cm, while the width of the leaves reaches 3-10 cm. Pinnate leaves. The leaf surface is slippery. Flowers grow from side rhizomes. The petals are white, and the center is yellow (yellowish white). The fruit comes out of the pseudo stem at the bottom and creeps on the ground. The fruit is grayish yellow in shape resembling eggs and is hairy. Fruit diameter ± 10 mm. Seeds are reddish color, fragrant like camphor

13.(Kunci Pepet Kunir Putih)
Kaempferia rotunda L

Kaempferia rotunda is a perennial with 30-70 cm height, with pseudo stem that consists of 2 - 4 erect leaves from an underground rhizome with small tuberous roots. Young tubers can also be used as fresh vegetables and is propagated by rhizomes. Flowering stems are produced from the rhizome when no leaves are present.

14.(Kunci)
Kaempferia pandurata Roxb.

Kaempferia pandurata Roxb. an herbaceous plant with a height of 70-110 cm. The shoots are composed of leaf stalks with sheath covers. The leaf sheaths are red, the blades are oval and the apex of leaves are pointed. The leaf is about 50 cm long and 12 cm wide. The middle of the petioles is deeply grooved. The flower appears between the leaf sheaths at the bottom of the trunk. The petals are white or light pink.

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15.(Temu putih/ temu pepet)
Curcuma zedoaria (Berg) Rosc)

Curcuma zedoaria are herbaceaous with large white and tuberous branched rhizomes. Unlike the other species, it was found grow individually, not in groups. The leaves are lancelolate, have violet color in the middle part, large, up to 1 meter height. The plants are fragrant, have yellow flowers with red and green bracts. The rhizomes also have a fragrance of mango, but not as strong as Curcuma manga, with a bitter after taste.

16.(Temu ireng)
Curcuma aeruginosa Roxb

C. aeruginosa is a perennial that has unbranchedleafy stems up to 200cm tall from large underground rhizomes. Rhizomes are usually about 16 cm in length and about 30 mm in width. Leaves are distichous, 30–80 long 10–18 cm wide; lamina is oblong-lanceolate with acute apex, acuminate base, with purple or reddishbrown patch along the sides of the distal half of the midrib on the adaxial. Inflorescence is lateral, 25–30 cm long; peduncle is 12–18 cm; spike is 12–15 × 5 cm; bracts are large, pink to violet; bracteoles 3.5 × 2.5 cm, white with amedian light green patch. Flowers are about 50 mm, equal to or slightly shorter than the bracts.

17.(Temu lawak)
Curcuma xanthorrhiza Roxb.

Curcuma xanthorrhiza is a herbaceaous perennials with a cluster of pseudostems 1 to 2 metres height that grow from underground rhizome. Each pseudostem is made up of up to 8leaves with blades that can be 40 - 90cm long and15 - 21cm wide. The rhizomes are branched and are yellow in color, they were harvested when theshoots have withered. The leaves are long up to 120 cm height, ovate to lanceolate, with parallel venation. The flowers are purple or crimson. Inflorescence was sprouting from the rhizome next to the leaf shoot, with peduncle of 10-25 cmlong; flower spikes are cylindrical, 15-25 cm long, 10-20 cm in diameter, provided with 15-35bracts arranged spirally; each bract bears a flower

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(Bengkle) *Zingiber purpureum* Roscoe		*Zingiber purpureum* is also known as *Zingiber cassumunar*. It has pseudo stems with a height of30 to 100 cm with alternating leaves. Leaves are lanceolate, 13-30 cm long, 2-5 cm width. The bangle flower is shaped like a pineapple in dark red color, with a length of 3.5 -5 cm and a widthof 1.5 - 1.75 cm.

2.5 Zingiberaceae as Medicine

The Zingiberaceae family is a versatile group of plants primarily cultivated for medicinal purposes. In Peninsular Malaysia, there are 160 species of Zingiberaceae, with 16%-20% of them being used as spices, food flavors, seasonings, medicines, andvegetables (Ibrahim et al., 2007). This family of plants is well-known in Southeast Asia, with many species traditionally used in medicine, proven effective in treating various diseases. In Malaysia, various Zingiberaceae species are commonly used in traditional treatments for ailments such as stomach problems, nausea, vomiting, epilepsy, sore throat, cough, bruises, wounds, childbirth, eye wash, eye pain, liver complaints, rheumatism, muscle pain, ringworm, asthma, fever, malignancy, swelling,and other disorders (Burkill, 1966).

Kaempferia galanga, a member of the Zingiberaceae family, is recognized asa potential medicinal plant. In the traditional medicine of Asian countries, local doctorsfrequently use this plant (Sulaiman et al., 2008). *K. galanga* is beneficial in treating conditions such as asthma, hypertension, abdominal pain, headache, rheumatism, toothache, indigestion, and bacterial infections (Kanjanapothi et al., 2004). Additionally, the dried part of this Zingiberaceae plant serves as a valuable cardiotonicand sedative agent (Amuamuta et al., 2017). The acetone extract of *K.*

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galanga has an oxidase effect that inhibits monoamines. It is also used to restore internal heat and enhance blood circulation (Vittalrao et al., 2011).

This powder has the advantage of having an expectorant effect and treating coughs with mucus and chest pain (DeFilipps et al., 2018), and the essential oil of therhizome can relieve colds and nasal congestion (Subositi et al., 2020). In addition, processed rhizome paste is often used in balms to treat rheumatism and wounds (Mans et al., 2019). The isolated chemical compounds have beneficial pharmacological properties such as: antimicrobial, anthelmintic, anti-dengue, antioxidant, anti- inflammatory, anti-diarrheal, anti-tumoral, anti- mutagenic, anti-obesity, anti-allergic, adaptogenic, analgesic, lipid-lowering, hypopigmenting, sedative, amebicidal, vasodilator and wound healing wounds (Subositi et al., 2020).Zingiberaceae is used asa medicinal plant because it contains various bioactive compounds that have pharmacological activity, such as anti-bacterial (Irayanti & Yadnya-Putra 2020), anti-hepatotoxic (Jagtap, 2015), inflammatory (Sikha et al., 2015), anti-viral (Pant et al., 2013), antidiabetic (Nwozo et al., 2014), anti-cancer (Pawar et al., 2011), hypocholestraemic (Shafreen et al., 2018), anti-rheumatic (Abdel-Lateef et al., 2016),anti- fibrotic (Jose et al., 2014), gastroprotective (Jeon et al., 2015), anti-arthritic, anti- oxidant, anti-cardio protective anti-arrhythmic, and neuroprotective (Nithya & Jayshree 2017). Table 2.2 below provides a detailed Species, local name by Kelantan people and traditional uses of ginger species found in Kelantan. (Appalasamy et al., 2022).

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Table 2.2 Species, local name by Kelantan people and traditional uses of gingerspecies found in Kelantan (Appalasamy et al., 2022).

No	Herbarium Specimen No	Scientific Name	Local name	Traditional Uses
1	NSAZ001	*Alpinia conchigera*	Lengkuas genting	Bone ache, fungal infection (panau), dysmenorrhea
2	NSAZ002	*Alpinia galanga*	Lengkuas	Spice, antiinflammatory, diarrhoea
3	NSAZ003	*Amomum kepulaga*	Buah Pelaga	Spice, prevent nausea, reduce smoking addiction
4	NSAZ004	*Curcuma longa*	Kunyit	Colouring, stomachache, postnatal treatment, anti-inflammatory
5	NSAZ005	*Curcuma xanthoriza*	Temulawak	Yellow fever, hepatitis, stomach ulcers, antiinflammatory, pimple
6	NSAZ006	*Elettariopsis curtisii*	Pepijat	Postnatal treatment
7	NSAZ007	*Kaempferia galanga*	Cekur	Postnatal treatment, swelling, Itchiness
8	NSAZ008	*Gastrochilus panduratun*	Tepus sehelai setahun	Postnatal treatment
9	NSAZ009	*Zingiber officinale*	Halia	Spice, diabetes, stomachache, fungal infection, postnatal treatment
10	NSAZ010	*Zingiber zerumbet*	Lempoyang	Postnatal treatment, anemia, joint ache, hypertension

The Zingiberaceae family is highly versatile and primarily cultivated for medicinal purposes. In Peninsular Malaysia, there are 160 species of Zingiberaceae, with 16%-20% being utilized as spices, food flavors, seasonings, medicines, and vegetables (Ibrahim et al., 2007). This plant family is well-known in Southeast Asia, and many of its species are traditionally used in medicine, proving effective in treatingvarious diseases. In Malaysia, different Zingiberaceae species are widely employed in raditional treatments for ailments such as stomach problems, nausea,

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vomiting, epilepsy, sore throat, cough, bruises, wounds, childbirth, eye wash, eye pain, liver complaints, rheumatism, muscle pain, ringworm, asthma, fever, malignancy, swelling, and other disorders (Burkill, 1966). *Kaempferia galanga* belongs to the Zingiberaceaefamily and is one of the potential medicinal plants. In the traditional medicine of the Asian country, this plant is often used by local doctors (Sulaiman et al., 2008). *K. galanga* is useful in the treatment of asthma, hypertension, abdominal pain, headache, rheumatism, toothache, indigestion and bacterial infections (Kanjanapothi et al.,2004). In addition, the dried part of the Zingiberaceae is a valuable cardiotonic and sedative agent (Amuamuta et al., 2017). The acetone extract of this plant has an oxidase effect that inhibits monoamines. *Kaempferia galanga* can be used to restore internal heat and improve blood circulation (Vittalrao et al., 2011).

This powder is beneficial due to its expectorant effects, helping treat coughs with mucus and chest pain and the essential oil from the rhizome can alleviate colds and nasal congestion (Subositi et al., 2020). Additionally, processed rhizome paste is commonly used in balms for treating rheumatism and wounds (Mans et al., 2019). The isolated chemical compounds from Zingiberaceae possess various pharmacological properties, including antimicrobial, anthelmintic, anti-dengue, antioxidant, anti-inflammatory, anti-diarrheal, antitumor, anti- mutagenic, anti-obesity, anti-allergic, adaptogenic, analgesic, lipid-lowering, hypopigmenting,sedative, amebicidal, vasodilator, and wound healing (Subositi et al., 2020). Zingiberaceae is used medicinally due to its bioactive compounds that exhibit pharmacological activities such as antibacterial (Irayanti & Yadnya-Putra 2020), anti- hepatotoxic (Jagtap, 2015), anti-inflammatory (Sikha et al., 2015), antiviral (Pant et al., 2013), antidiabetic (Nwozo et al., 2014), anticancer (Pawar et al., 2011), hypocholesterolemia (Shafreen et al., 2018), antirheumatic (Abdel-Lateef

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et al., 2016), antifibrotic (Jose et al., 2014), gastroprotective (Jeon et al., 2015), anti- arthritic,antioxidant, cardioprotective, anti-arrhythmic, and neuroprotective effects (Nithya & Jayshree 2017).

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CHAPTER 3

MATERIAL AND METHODOLOGY

3.1 Study Area

The study was conducted at Lata Keding, Jeli Kelantan. Lata Keding, also known as Lata UMK among UMK students and the Jeli community, was located approximately 87 km from Kota Bharu, Kelantan, and 257 km from Penang via the East-West Highway. Geographically situated in the Jeli District of Kelantan state, it was positioned between 5° 44' 51.396"N and 101° 50' 54.6"E, as shown in Figure 3.1.

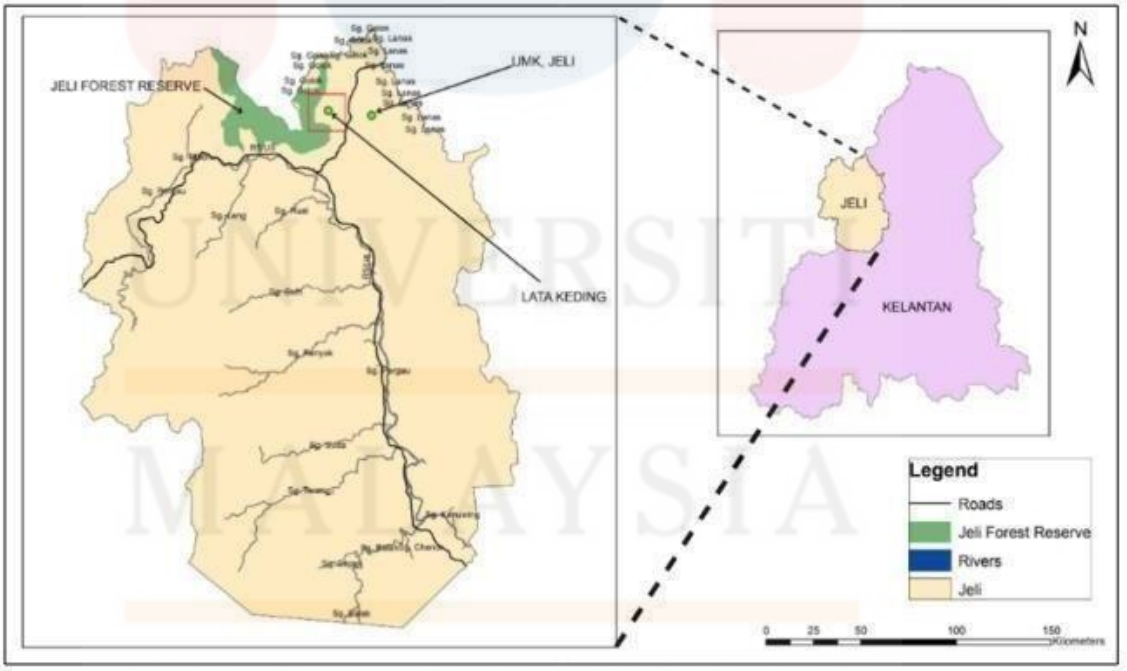

Figure 3.1 Location of the study area in Lata Keding, Jeli, Kelantan (Amaludin et al.,2021)

3.2 Materials

Global Positioning System (GPS) version 6.93.3. was used to determine the study area's coordinates. A soil digger, ruler, camera to take pictures of the Zingiberaceae species that were found, knife, and an existing field notebook were also needed. The Universiti of Malaysia Kelantan, Faculty of Earth Sciences, supplied all of them for use in field research.

3.3 Sampling and Collection Zingiberaceae

A random sampling method was used to determine the diversity of Zingiberaceae species in Lata Keding, Jeli, Kelantan. The Global Positioning System (GPS) was used with the expected coordinates of the area being 5° 44' 51.396"N and 101° 50' 54.6"E., and was conducted in February 2024. The sampling area was in the Lata Keding Forest area, Jelly. Lalang resort staff assisted in this sampling. To avoid errors such as bias in the search for Zingiberaceae species, a distance of 5 meters was maintained, and the search was carried out on both sides of the path, left and right, each day, a different trail was selected and the location was marked using a Garmin GPS 64s for 5 days in one place. Each trail has a distance of 1000 m in Lata Keding. For each trail, ginger was searched on both sides of the trail to avoid bias and to ensurethat the surrounding area was covered in the sampling.

The determination of the diversity of Zingiberaceae species was analyzed through morphological characteristics, including fruit, leaves, stem rhizome, and flower. The Zingiberaceae species were captured using a camera for the collection of evidence. GPS was used to record the coordinates of the sampling area and the locationof Zingiberaceae species.

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3.4 Identification of Zingiberaceae

The identification process of Zingiberaceae species uses references such as (Larsen et al., 1999) and online journals such as "Herbarium Kew" (Royal Botanic Gardens), a guide to gingers of Borneo (Poulsen et al., 2013) and referring to expert lecturer in identifying species of zingiberaceae.

3.5 Determination of Species Diversity and Abundance of Zingiberaceae

The index used to compare and calculate the diversity of species and habitats uses the Shannon-Weiner diversity index (Clarke and Warwick, 2001). Species diversity was calculated as follows. H' is the Shannon Wiener Diversity Index value.

For objective 1: To determine the distribution and diversity of family Zingiberaceaein Lata Keding, Jeli Kelantan

H'= The value of Shannon Wiener diversity Index

S = is the number of species in the community

pi = is the ratio of individualsof the species,
ln = is the natural logarithm

$$H = -\sum_{i=1}^{s} pi * In\, pi \qquad \text{(Equation 3.1)}$$

The number of individuals found in the area was recorded. As for the abundance of species, the formula that was used is as below

For objective 2: To assess the species abundance of Family Zingiberaceae in Lata Keding, Jeli Kelantan

$$\text{Species Abundance} = \frac{Total\ number\ of\ individual\ of\ a\ species}{total\ number\ of\ species} \times 100$$

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CHAPTER 4

RESULT AND DISCUSSION

4.1.1 Distribution of Family Zingiberaceae at Lata Keding, Jeli Kelantan

The distribution of *E. punicea* at Lata Keding, Jeli Kelantan were taken and marked for each find in one track to see the distribution of the *E.punicea* species from Zingiberaceae. For each *E. punicea* that was marked and found was shown in the map below which is figure 4.1. Each species was tagged using GPS application Garmin GPS 64s and the coordinates are shown in Appendix. The map below was generated from Geographic Information System Software (GPS 64s), ArcMap 10.3 which showsthe distribution of *E.punicea* from the Family Zingiberaceae in Lata Keding,Jeli Kelantan. Figure 4.1 below showsthe map of distribution family Zingiberaceae *(E. punicea*) in Lata Keding, Jeli,Kelantan. The Zingiberaceae family plant, *E. punicea*, is found starting at a height of 117 m and as many as 20 flowers are found in the Lata Keding Jeli Kelantan trail area.The flowers are red with a yellow stripe in the middle and the most found along the natural trail in Lata Keding Jeli Kelantan. *E.punicea* wasthe most abundant as this plant was observed along the trail and known locally by the Jeli people as Chalong, can grow up to 7 m tall and is more likely to grow in wet soil.

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Figure 4.1: Map of distribution Family Zingiberaceae (*E.punicea*) in Lata Keding, Jeli Kelantan.

4.2 Diversity of Family Zingiberaceae at Lata Keding in Jeli Kelantan

The diversity of the Zingiberaceae family in Lata Keding Kelantan was taken and marked for each discovery in four different tracks to see the diversity of the Zingiberaceae family. For each Zingiberaceae Family marked and found have been shown in the map below. The map below was generated from Geographic Information System Software, ArcMap 10.3 which shows the diversity and distribution of the Zingiberaceae Family in the Lata Keding Jeli, Kelantan.

The diversity of the Zingiberaceae family in Lata Keding, Jeli, Kelantan. The species *Alpina* sp.1 was the most common, with a total of 93 individuals recorded, making up the majority of the total count. On the other hand, *Globba* sp.1 has the lowest representation with only 18 individuals. Other species, namely *E.elatior, E.punicea, A.javanica, and Alpina* sp.2, show moderate distribution, with numbers ranging from 19 to 32 individuals. When mapping these species, different colors havebeen assigned for better differentiation and visual analysis, *E. elatior* (red), *E. punicea(*blue), *Globba* sp.1 (black), *A. javanica* (yellow), *Alpina* sp.1 (purple) and *Alpina* sp.2(green). This color coding facilitates the creation of a comprehensive diversity map for the Zingiberaceae family in the Lata Keding, Jeli, Kelantan. Table one below has become a reference to create a diversity map according to the Species, Local Name ofthe Family Zingiberaceae found along the trail of Lata Keding, Jeli, Kelantan.Figure 4.2 shows the map of diversity of Family Zingiberaceae in Lata Keding, Jeli, Kelantan

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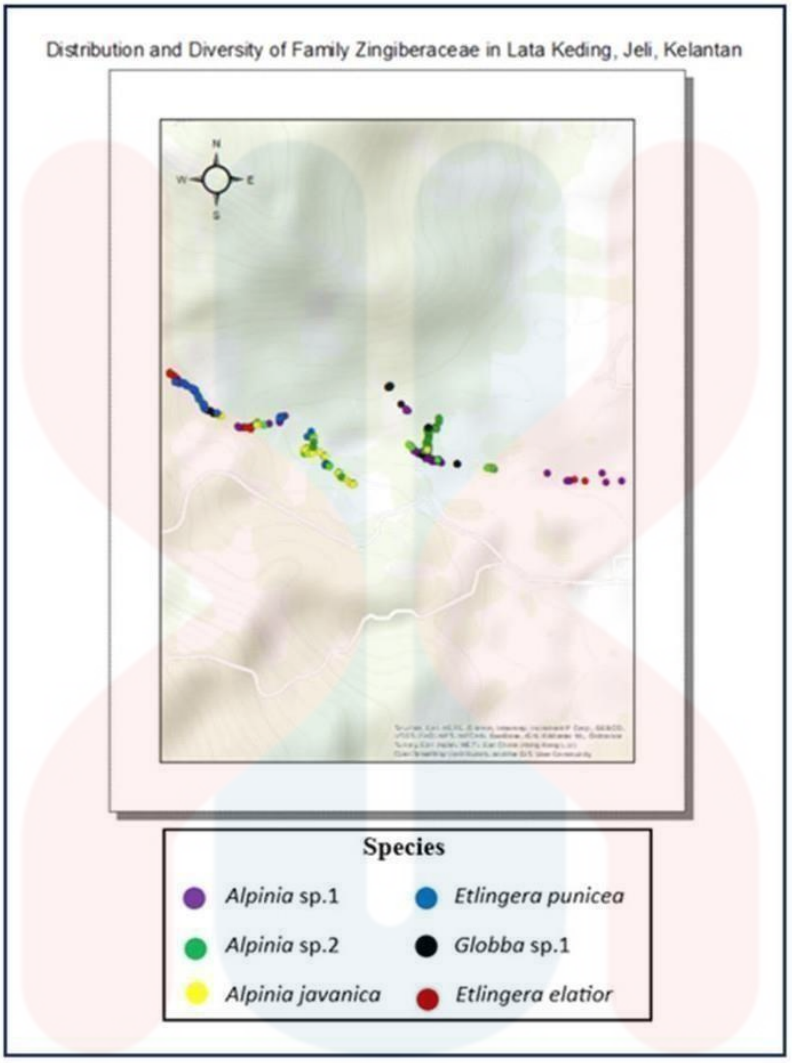

Figure 4.2 Map of diversity of Family Zingiberaceae in Lata Keding, Jeli, Kelantan

The findings show a diverse distribution of Zingiberaceae species, with certain species such as *Alpina* sp.1 growing more prominently than others. This distribution pattern can be influenced by various ecological factors, including soil type, moisture availability, light conditions and interactions between species. Understanding these factors is important for conservation efforts and for maintaining the biological diversity of the area. The diversity of species found in a forest ecosystem is related to the biotic and the environmental factors, including topography, altitude, soil, air, lightand rainfall and forest humidity Zingiberaceae can live from lowlands to altitude morethan 200 m above sea level, with high rainfall and high humidity (Randi A ,2013)

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Comparison between Studies in Lata Keding, Jeli, Kelantan with studying at Lojing Highlands Kelantan because these two journals have almost the same title, which is diversity and distribution but different places, recorded the presence of six species from the Zingiberaceae family, with the main species including *Alpina* sp.1, *E.elatior*, *E. punicea*, *Alpina javanica*, *Alpina* sp.2, and *Globba* sp.1. In contrast, a study in Lojing Highlands, Kelantan, documented a wider diversity with 18 species from seven different genera (*Alpinia, Wurfbainia, Etlingera, Hornstedtia, Geostachys, Globba, and Zingiber*). In the Lojing Highlands, *Etlingera* spp. is the most dominant with six species, followed by *Globba* spp. with four species, and *E.punicea* as the most abundant species. This comparison shows that the Lojing Highlands have more species (18 compared to six) and genera (seven compared to fewer) than the Lata Keding. In terms of species distribution, *Alpina sp*.1 dominates in Lata Keding while *E. punicea* is the most common species in the Lojing Highlands, found along the route. Studies in the Lojing Highlands also show species found at higher altitudes such as *Hornstedtia sp*.1 at 843 m a.s.l., and *Globba* spp. between 850-1000 m, which shows possible different habitat variations.

Ecological factors also play an important role in determining the distribution of species. In Lata Keding, factors such as soil type, moisture availability, light conditions, and interactions between species affect the distribution of Zingiberaceae. This is because Lata Keding is a tourism and recreation area where the area is explored a lot by humans to make roads and so on. In addition, this species can live from the lowlands to a height of more than 200 m above sea level with high rainfall and humidity. Conversely, in the Lojing Highlands, crop cultivation and anthropogenic pressures also affect the diversity and abundance of wild ginger populations, with some species only found once possibly due to the habitat being completely

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inaccessible at the time of sampling. This shows that anthropogenic pressure is more prominent in Lojing Highlands, while studies in Lata Keding focus more on natural factors.Table 3 shows the species, Local name of family Zingiberaceae found along trail of Lata Keding, Jeli, Kelantan.

Table 3: Species, Local name of family Zingiberaceae found along trail of Lata Keding,Jeli, Kelantan

Species	Collector's Number	Local name
Etlingera elatior	NA 01-02 ,08-10, 14, 19-21, 58-69	Torch Ginger
Etlingera punicea	NA01-03 ,05-07,26,30-34,31-37,38-43, 46-57	Chalong
Globba sp.1	NA 21-22,25-26,27,28-29 ,38-43 ,44-45	Dancing Ladies Ginger
Alpinia javanica	NA04, 07-08 ,10,14-15,17-19,23,25-30, 35-37,41.46-49,50-53,	Javanese alpinia
Alpina sp.1	NA01-03-07,08-11-13, -17,16-18 19,21 -27 ,20-22 ,21,24-29,32-44,46-49	Apus sungai
Alpina sp.2	NA 01,03,08-10 ,11-12,12-20, 31,37,42, 45-50,50-52	Apus darat

E.punicea has a rhizome that is about 12 cm underground with a diameter of about 1.5 cm and is green with a hint of pale red or pink. Its leafy stems can reach a height of 2 to 5 meters, with a distance between the stems of 11 to 40 cm. The leaves consist of about 10 pairs. The upper leaf surface is completely green, sometimes with brown stripes on the lower surface of young leaves, while the lower surface is hairless. These plants are between 5 and 10 cm long, horizontal then vertical, and mostly located underground. Inflorescences are also mostly underground except for bract tipsand sterile flowers. The flowers have red petals with yellow and crimson petal marginson the edges, and a pink stigma.Figure 4.2.1 and figure 4.2.2 shows the *E.punicea* (Roxb.) R.M.Sm Flowers at Lata Keding, Jeli Kelantan.

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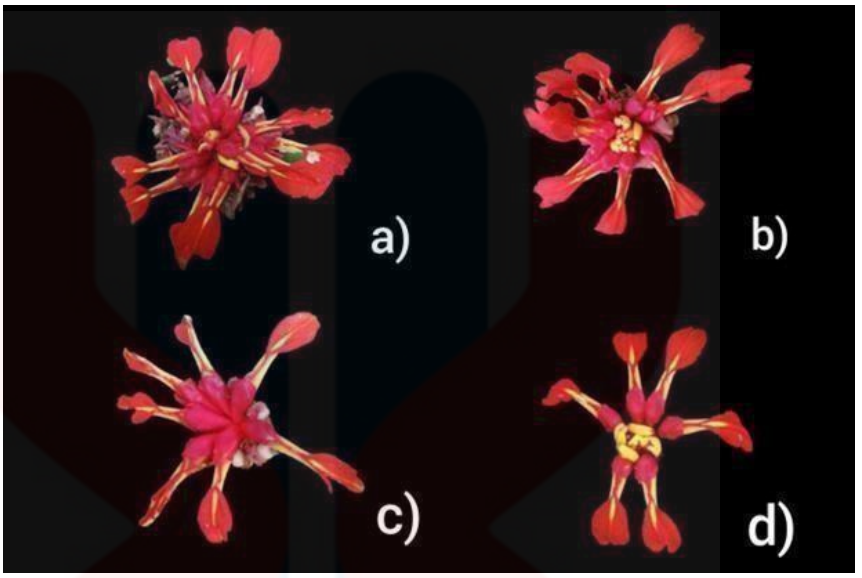

Figure 4. 2 .1: *Etlingera punicea* (Roxb.) R.M.Sm Flowersat Lata Keding, Jeli Kelantan

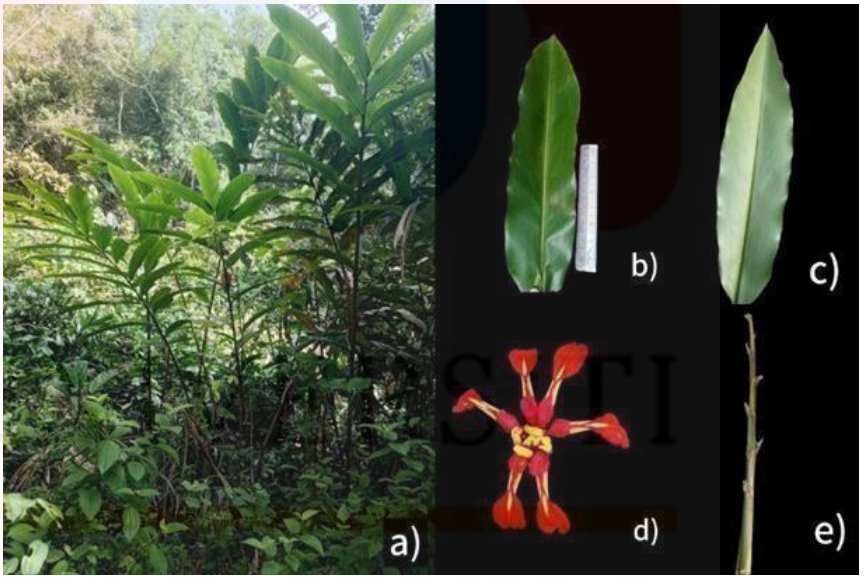

Figure 4.2.2 *E. punicea* (a)habit (b)adaxial surface of the leaf (c)abaxial surface of the leaf (d) flowers (e) pseudostem.

Alpinia javanica of the family Zingiberaceae and genus *Alpinia*, this large terrestrial ginger can grow and climb. It was first described from Java but has also been recorded from Maluku, Peninsular Malaysia and Thailand. it is widespread and

can be found throughout the Peninsular where it grows on low ground in open places in the forest, near semi-shaded streams banks and roadsides

A.javanica is a large land ginger that can grow up to 3.3 meters tall. The leaves are large, measuring 60–100 cm long and 16–21.5 cm wide, with a velvety hairy lower surface and leaf margin, while the upper leaf surface is almost hairless except for the midvein. This leaf has an uneven base and a tail-shaped tip (caudate). Bisected ligule 1–2.5 cm long, dark brown and hairy on the edge. Petiole (leaf stalk) measuring 2.5–10 cm long and short hairy. The inflorescence of this plant is 5–31 cm long, standing upright or slightly drooping with flowers facing downwards. Rachis and peduncles are red. The corolla has a broad obovate labellum (4–5 cm long), which is concave and covers the stamens with wrinkled margins. Lateral staminodes are red with a length of about 4–8 mm and are irregular in shape. The young fruit is green and round, with a diameter of about 2.5 cm, and covered with short hairs. Figure 4.2.3 above shows *Alpinia javanica* in Lata Keding Kelantan.

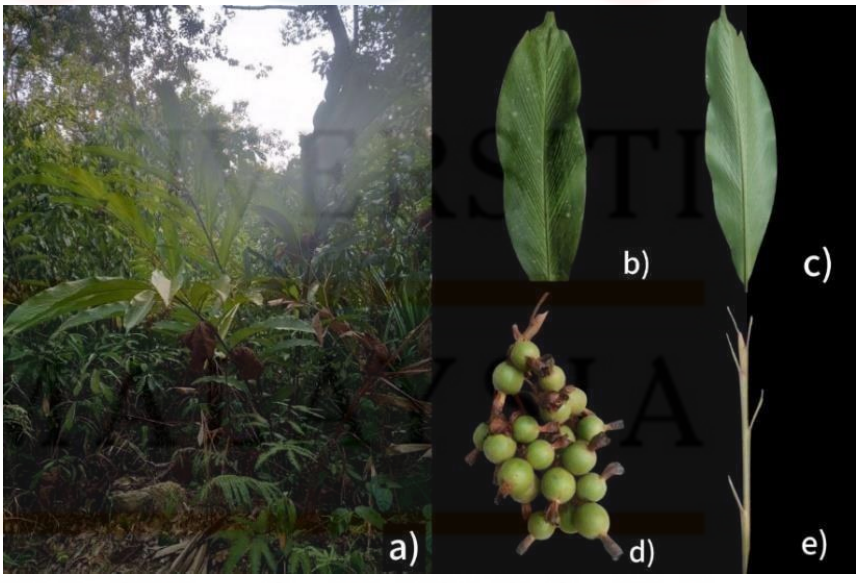

Figure 4.2.3*: Alpinia javanica* (a)habit (b)adaxial surface of the leaf (c) abaxial surface of the leaf (d) fruit (e) pseudostem

Cultivated throughout the tropics, it seems to have originated in Peninsular Malaysia. Many cultivated forms, varying in flower color, are all very attractive: large inflorescences (on scales up to 1.5 m long) and sterile bracts protruding at the base of the flowering part of the flower make this species easy to recognize. (K.Larsen et.al 1999) *E.elatior* has an underground rhizome with a diameter of about 34 cm. The leafy stems can reach a height of between 5 and 6 meters and are spaced around 10-18 cm from each other, forming a dense clump. The leaves consist of about 17 pairs of laminae, where the leaves in the upper part measure about 33 x 4.5 cm, in the middle part measure 66-81 x 15-18 cm, and in the base part measure about 36 x 14 cm. The surface of the leaf is completely green, with a hint of pink in the young leaves. The peduncle of this plant can reach a length between 100 and 200 cm, horizontal first before becoming upright. The flowers of *E. elatior* are dark red with a yellow margin on the labellum (petal), and the petals are white with a pink tip. The fruit measures about 2.5 x 3 cm and has a short hairy surface. The fruit head can extend to around 19 cm with a diameter of 10 cm. The fruit is oblong with a smooth, unstriped pericarp, pale yellow or light green when ripe.Figure 4.2.4 above show Torch Ginger, *E.elatior* in Lata Keding.

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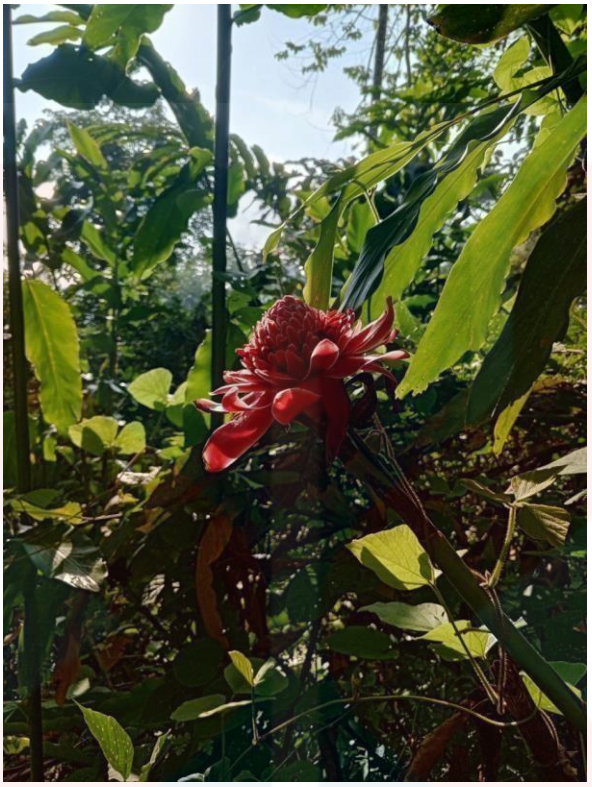

Figure 4.2.4 The torch Ginger (*Etlingera elatior)* in Lata Keding, Jeli, Kelantan**.**

Table 4 below show Relative Species Abundance of Zingiberaceae Family in Lata Keding, Jeli Kelantan. In table 2 have column scientific name. This is a column containing the scientific name of each species of Zingiberaceae ie *E.elatior, E.punicea,Globba* sp.1 *,Alpinia javanica, Alpina* sp.1 *Alpina* sp.2.Next in table have number of individuals. This is a column showing the number of individuals of each species observed or counted during the field survey in Lata Keding. This gives an idea of how common each species. For *E. elatior* as many as 19 trees, *E.punicea* 32, *Globba* sp.1 as many as 18, *A. javanica* by 30 *Alpina* sp.1 of 93 and *Alpina* sp.2 as many as 32 individuals in total are 224 trees from the Zingiberaceae family. For relative species abundance (%), this column showing the relative abundance of each species as a percentage of the total observed population. Relative abundance is obtained by dividing the number of individuals of each species by the total number of individuals

in the study, then multiplying by 100 to obtain a percentage. The table provides data on the relative abundance of species of the family Zingiberaceae in Lata Keding, Jeli, Kelantan, showing both the number of individuals observed and their percentage contribution to the total population. Among the observed species *Alpina* sp.1 exhibited the highest relative species abundance, with 93 individuals accounting for 41.52% of the total. Following that, *Alpina* sp.2 and *E. punicea* both had 32 individuals, contributing 14.29% each to the total count. *Alpina javanica* follows closely with 30 individuals, representing 13.39% of the total population. Meanwhile, *E.elatior* and *Globba* sp.1 had a lower abundance, with 19 and 18 individuals respectively, constituting 8.48% and 8.04% of the total count. Therefore, *Alpina* sp.1 stands out as the most abundant species, while *E.elatior and Globba* sp.1 exhibit lower abundance in the studied area. This species abundance distribution highlights the dominance of certain species, such as *Alpina* sp.1, and provides insight into the ecological dynamics and biodiversity of Lata Keding, Jeli, Kelantan.

Table 4: Relative Species Abundance family Zingiberaceae in Lata Keding, Jeli Kelantan.

Lata Keding		
Scientific Name	**Number of Individual**	**Relative Species Abundance (%)**
Etlingera elatior	19	8.48
Etlingera punicea	32	14.29
Globba sp.1	18	8.04
Alpina javanica	30	13.39
Alpina sp.1	93	41.52
Alpina sp.2	32	14.29
TOTAL	224	100.00

The shannon-wiener index value, H' recorded in this study is H'=1. 602066568.The H' value recorded represents the diversity of species in this study. Shannon-Wiener (H') 1.602067 indicates a moderate level of biodiversity in the community. A higher shannon-wiener Index value indicates higher biodiversity within a community. In this case, a value of 1.602067 suggests a moderate level of biodiversity in Lata Keding. This study, the analysis results show the relative abundance of species in the plant community in the study area. Relative species abundance gives an idea of how much each type of plant contributes. From the table above, it is found that some species are found more than others.

For example, *Alpina* sp.1 species accounted for 41.52% of the total plant population observed, making it the most abundant species in the study area. Meanwhile, other species such as *E.punicea* also make a significant contribution with an abundance of 14.29%. Overall, all abundances of these species, when combined, give an overall abundance index of 100%. This means that all observed plants were taken into account in the analysis. These results provide a clear and comprehensive view of the dominant plant types in the study area. In the study area in Lata Keding, Jeli Kelantan, the results of the richness analysis showed the presence of 6 different plant species. Although the number of these species may not be large, it gives an idea of the species variation in the area. This confirms the 6 species richness values recorded in the analysis, showing the number of different species in the study area. These results show that although the area may not have a wide variety of species, there are several different species that still contribute to the biological and ecological diversity of the area. Table 3 below shows the shannon-wiener index value for species Zingiberaceae in Lata Keding, Kelantan.

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In comparing the diversity of the Zingiberaceae family in Lata Keding, Kelantan, with the new orchid records on the summit of Gunung Jerai, Kedah, significant differences emerge in terms of species diversity and plant community structure at both locations. Lata Keding, despite only identifying six species, exhibits a moderate level of diversity with a shannon-wiener diversity index (H') value of 1.602067. Gunung Jerai demonstrates a higher level of diversity with the discovery of 74 species from 40 genera, yielding an H' value of 3.424. Comparing the shannon-wiener index values at both sites provides an insightful perspective on the quantity of plant species present.

Although Gunung Jerai exhibits a higher H' value, indicating greater diversity, both locations still show the presence of numerous plant species. Despite having fewer species, Lata Keding maintains essential diversity to support a varied environment. In Gunung Jerai, the higher value suggests broader life diversity, offering more significant support for natural diversity. This underscores that, despite differences in species quantity, natural diversity remains crucial. Gunung Jerai, with its greater biological diversity, may be attributed to factors such as a larger area size and higher habitat diversity. Additionally, the more balanced dominance of various species in Gunung Jerai reflects a more balanced ecological state within the plant community there. This underscores that a more diverse and complex environment in Gunung Jerai provides better support for life diversity compared to that in Lata Keding.

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CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

As a conlusion, in this study, a detailed analysis of the diversity of Zingiberaceae species in the Lata Keding area, Jeli, Kelantan, was conducted. The main findings indicate that *Alpina* sp.1 is the most abundant species in the area, with a population reaching 93 individuals, followed by *E.punicea* and *Alpina* sp.2 with 32 individuals each. The diversity analysis using the Shannon-Wiener Index showed moderate diversity, with a value of 1.602067. However, this diversity reflectsvarying distribution patterns throughout the area, with some species being more dominant than others.

Factors influencing the distribution and diversity of Zingiberaceae species in Lata Keding include the availability of water sources, soil fertility, and shade. Like many tropical forest habitats, this area may face pressure from human activities such as deforestation and development. Therefore, preserving natural habitats is crucial to ensuring the conservation of these species. In comparison, this study suggests that the diversity in Lata Keding is comparable to other tropical forest areas studied. However, this diversity may be lower compared to more pristine primary forest areas. Hence, protective and conservation measures need to be implemented to ensure the long-term preservation of Zingiberaceae species diversity in this area.

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In conclusion, the objective of the study focused on the distribution and diversity of the Zingiberaceae Family in Lata Keding, Jeli, Kelantan was successfully achieved. In addition, the research determined the abundance of ZingiberaceaeFamily species in Lata Keding, Jeli, Kelantan, providing a valuable insight into the ecological composition of the region. Using the Shannon-Wiener Diversity Index to facilitate the assessment of species abundance and density can further enrich our understanding of ecosystem dynamics and zingiberaceae species in Lata Keding, Jeli, Kelantan.

5.2 Recommendations

It is recommended to conduct a long-term study to monitor changes in the diversity and population of Zingiberaceae species in this area, as well as a more in-depth study of the genetic and reproductive aspects of this species for a more effective conservation strategy. Maintaining and protecting the natural habitat in LataKeding, including controlling human activities that can damage the habitat such as deforestation and development, is important. Efforts to restore affected areas and repair degraded habitats also need to be carried out. Increasing awareness among local communities about the importance of Zingiberaceae and the diversity of educational biology programs and voluntary activities, as well as involving local communities in conservation projects, can increase the effectiveness of the measures taken. In addition, proposals to introduce or strengthen policies and laws that protect forest areas and Zingiberaceae species are important, with support from local and national authorities to implement effective conservation strategies.

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REFERRENCE

Abdel-Lateef, Mahmoud, Hammam, El-Ahwany E, El-Wakil E, Kandil S, Taleb HA, El-Sayed, Hassenein . 2016. Bioactive chemical constituentsof *Curcuma longa L*. rhizomes extract inhibit the growth of human hepatomacell line (Hepg2). Acta Pharm66:387-398. DOI: 10.1515/acph- 2016-0028

Amuamuta, Plengsuriyakarn, Na-Bangchang. Anticholangiocarcinoma activity and toxicity of *the Kaempferia galanga* Linn. Rhizome ethanolic extract. BMC Complement Altern Med. 2017;17(1):213. doi: 10.1186/ s12906-017- 1713

Appalasamy Suganthi, Arumugam, Geng, Rak. A short note on wild gingers (Zingiberaceae) in Pulau Pangkor, Perak, Peninsular Malaysia. *The Malaysian Forester.* 2019;82(1):159–162

Appalasamy Suganthi, Arumugam, Lam, Nur Azizun. Wild gingers (Zingiberaceae) at Sungai Kangkawat, Imbak Canyon Conversation Area (ICCA), Sabah. *Journal of Tropical Biology and Conversation.* 2020; 17:97–103 Appalasamy

Appalasamy, Arumugam. Four new records of Zingiberaceae in GunungTelapak Burok, Berembun Forest Reserve (Fr), Negeri Sembilan. *IOP Conference Series: Earth and Environmental Science.* 2020; 596:012059. doi: 10.1088/1755-1315/596/1/012059. [CrossRef] [Google Scholar]

Appalasamy , Rathamanalan , Arsogah , Harni , Sam , Amaludin , Geng, Kumaran JV, Arumugam , Subramaniam . Gingers species diversity and distribution along a natural trail of Lojing Highlands, Kelantan. *IOP Conference Series: Earth and Environmental Science.* 2020; 549:012036. doi: 10.1088/1755-1315/549/1/012036.

Aweng, Karunakaran, Zakia, Sharifah Aisyah and Suganthi 2019 Diversity of Plants Species Abundantly Consumed in Traditional Practice of Siamese Community of Kelantan, Malaysia. *Proceedings of the 2nd International Conference on Advance and Scientific Innovation 18th July Banda Acheh Indonesia*

Baruaha, , Sudin, Twahira, Neelav,Manabi, & Mohan. (2019). Molecular diversity assessed amongst high dry rhizome recovery Ginger germplasm (*Zingiber officinale Roscoe*) from NE-India using RAPD and

FYP FSB

UNIVERSITI MALAYSIA KELANTAN

ISSR markers. *Industrial Crops and Products*, 129, 463-471. https://doi.org/10.1016/j. indcrop.2018.12.037

Burkill, 1966. *A Dictionary of the Economic Products* of the Malay Peninsula,2nd Ministry of Agriculture and Cooperative, Kuala Lumpur.

Christenhusz, Byng. 2016 The Number of Known Plants Species in the World and Its Annual Increase, Phytotaxa 261: 201-217.DOI 10.11646/phytotaxa 261.3.1

Dančák, Hroneš, Sochor. (2020a) Thismia minutissima (Thismiaceae), a remarkable new mycoheterotrophic species from Sarawak, Borneo. Kew Bulletin 75(2): e29. 10.1007/s12225-020-09886-4

Dančák, Hroneš , Sochor. (2020b) Thismia ornata and T. coronata (Thismiaceae), two new species from Sarawak, Borneo. Willdenowia 50(1): 65–76. 10.3372/wi.50.50106 [CrossRef] [Google Scholar] [Ref list]

Govaerts, Newman, & Lock. (2022). World checklist of Zingiberaceae. https:// checklistbuilder.science.kew.org/reportbuilder. do

Hassemer, Prado, Baldini. 2020. Diagnoses and descriptions in plant taxonomy: are we making proper use of them?.Taxon 69 (1): 1-4.

Ibrahim, Khalid and Hussin 2007 Cultivated gingers of peninsular Malaysia: ultilization profiles and micropropagation The Gardens' Bulletin Singapore 59 71-88.

Irayanti, Yadnya-Putra. 2020. A narrative review of Zingiberaceae family as antibacterial agent for traditional medication based on balinese local wisdom. J Pharm Sci 2 (2): 2301-7708.DOI: 10.24843/JPSA. 2020.v02.i02.p04

Ikora, Okeke, Izundu, Okereke, Nyanayo, Okwealor. 2015. Taxonomic significance of morphological characters in the species of *Stachytarpheta* found in Awka, Nigeria. Int J Plant Soil Sci
Ismanto, Partomihardjo T and Widjaja E A 1988 Floribunda 1 33-6.

Izlamira , Appalasamy , Nivaarani , Noor Hisham . Zingiberaceae diversity in Ulu Sat Forest Reserve, Kelantan. In: Abdullah, Abong, Jemal , Amaludin , Nordin , editors. *Hutan Ulu Sat: Nadi pemeliharaan alam semulajadi Kelantan (Ulu Sat Forest: The heart of Kelantan's nature conservation)* Kelantan, Malaysia: Department ofForestry Kelantan; 2020. pp. 72–78.

Jagtap S. 2015. Phytochemical screening, anti-oxidant activity, multielemental analysis by ICP-Spectroscopy and antimicrobial activity of rhizome extractsof *Curcuma pseudomontana J*. Graham. EuropeanJBiomedPharmSci2(4):1152-1169

Jeon, Lee, Shin, Jin. 2015. *Curcuma aromati* cawater extractattenuates ethanol-induced gastritis via enhancement of antioxidant status. EvidBasedComplementAlternatMed2015:17. DOI10.1155/2015/582496

Jose, Thomas. 2014. Comparative phytochemical and antibacterial studies oftwo

FYP FSB

indigenous medicinal plants *Curcuma caesia* Roxb. and *Curcuma aeruginosa* Roxb. IntJGreen Pharm8: 65-71.DOI: 10.22377/ijgp. v8i1.356

Kanjanapothi, Panthong, Lertprasertsuke , Taesotikul , Rujjanawate , Kaewpinit , et al. Toxicity of crude rhizome extract of Kaempferia galanga

Kiew, Rafidah, Ong, Ummul-Nazrah . Limestone treasures, rare plantsin Peninsular Malaysia-what they are, where they grow and how to conserve them. *Malaysian Naturalist*. 2017;71(1):32–41

Kittipanangkul, & Ngamriabsakul. (2011, November 1). Zingiberaceae diversity in Khao Nan and Khao Luang national Parks, Nakhon Si Thammarat, Thailand. Walailak Journal of Science and Technology. ht Schwabe, K.A., Carson, R. T., DeShazo, J.R., Potts, M.D., Reese, A.N. &

Kress, Prince and Williams 2002 The phylogeny and a new classification of the gingers (Zingiberaceae): evidence from molecular and morphological data. *America Journal Botany* 89 1682-1696

Kress, Newman, Poulsen. & Specht. (2007). An analysis of generic circumscriptions in tribe *Alpinieae* (Alpinioideae: Zingiberaceae). *Gardens' Bulletin Singapore*, 59(1-2), 113-128.
L. (Proh Hom). J Ethnopharmacol. 2004;90(2-3):359-65. doi: 10.1016/j. jep.2003.10.020.

Lamb, Gobilik , Ardiyani and Poulsen 2013 A *Guide to Gingers of Borneo* Natural History Publications (Borneo), Kota Kinabalu

Larsen, Ibrahim, Khaw, Saw 1999 Gingers *of Peninsular Malaysia and Singapore*

Larsen, Ibrahim H, Khaw, Saw. *Gingers of Peninsular Malaysia and Singapore.* Kota Kinabalu: Natural History Publications (Borneo); 1999

Larsen, (2007). The exploration of gingers in SE Asia – Some milestones and perspectives symposium. *The Gardens' Bulletin Singapore*, 59(2), 1-12.

Lim C,

Lianah, Krisantini K, Wegener M. 2020. Evaluation and identification of the native Zingiberaceae species in Mijen, Central Java, Indonesia. IOP Conf Ser: Earth Environ Sci 457

Mat Yunoh Kiew. Botany of the Berembun Forest Reserve, Lawrence G H M 1964 Taxonomy of Vascular Plants (New York :)

Merckx, Freudenstein, Kissling, Christenhusz, Stotler, Crandall-Stotler , Wickett , Rudall , Maas van de Kamer , Maas.(2013) Taxonomy and classification. In: Merckx. (Ed.) Mycoheterotrophy: the biology of plants living on fungi.Springer, New York, 19–101. 10.1007/978-1-4614-5209-6_2

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Nagappan, Tatin and Skornickova 2019 Investigation on bioactive potential of selected wild ginger, genus Etlingera from Tasik Kenyir, Terengganu *Greater Kenyir Landscapes* ed Abdullah M., Mohammad A., Nor Zalipah., Safiih Lola. (Denmark: Springer, Cham) p 75-82

National Park, Kapuas Hulu Regency (Pontianak: Universitas Tanjung Pura. Faculty Negeri Sembilan, Malaysia, Malayan Nature Journal. 2009; 61:143-189.

Nithya, Jayshree 2017 World J. Pharm. Pharmaceu. Sci. 6 635-643

Nithya, Jayshree. 2017. A review on herbs of the Zingiberaceae family with beneficial effects on cardiovascular diseases. World J Pharm Pharmaceu Sci 6 (6): 635-64

Nor Syahaiza and Appalasamy 2021 Etnobotani Keluarga Halia (Zingiberaceae) Dalam Masakan Negeri Cik Siti Wan Kembang retrieved fhttps://www.majalahsains.com/etnobotani-keluarga-halia-zingiberaceae-dalam-masakannegeri-cik-siti-wan-kembang/

NorFatin Fazlyn . (2020) Distribution and Anatomy of *Etlingera spp* in Jeli,Kelantan.Faculty of Earth Science Universiti Malaysia Kelantan.

Nuraliev, Yudina, Shepeleva, Truong, Do. (2020) Flower structure in *Thismia* (Thismiaceae, Dioscoreales): Newinsights from anatomy, vasculature and development. Botanical Journal of the Linnean Society: boaa066. 10.1093/botlinnean/boaa066 [CrossRef] [Reflist

Nwozo, Osunmadewa, Oyinloye. 2014. Anti-fatty liver effects of oils from *Zingiber officinale* and *Curcuma longa* on ethanolinduced fatty liver in rats. JIntegrMed12:59-65DOI: 10.1016/S2095-4964(14)60006- 6.

Ong and Nordiana 1999 Malay ethno-medico botany in Machang, Kelantan, Malaysia Fitoterapia 70 502–513.

Pandey 2003 Angiosperm: Taxonomy, Anatomy. Embryology (Ram Nagar: S. Chand and Pitopang R, Damry, Rusdi, Hamzah B, Zubair MS, Amar AL, Fathurahman F, Basri Z, Poulsen AD. 2019.

Randi 2013 Identification of Types of Peat Vegetation Compilers of Danau Sentarum

Suganthi, Arumugam, Geng BJ, Rak AE. A short note on wild gingers (Zingiberaceae) in Pulau Pangkor, Perak, Peninsular Malaysia. *The Malaysian Forester*. 2019;82(1):159–162

Saensouk, Pasorn and Chantaranothai 2017 Agric. and Nat. Resources 30 1-9

Schwabe, Carson, DeShazo, Potts, Reese, Vincent. (2015) Creation of Malaysia's Royal Belum State Park: A Case Study of Conservation in a Developing Country. *Journal of Environment & Developmen*t 24(1): 54–81. 10.1177/1070496514551173

Schwabe, Carson, Deshazo, Potts, Reese, and Vincent, J. R. (2014). Creation of Malaysia‟s Royal Belum State Park: A Case Study of Conservation in a Developing Country. *Journal of*

FYP FSB

environment & Development 0(0) 1-28

Setyawati, E. R., & Endrawati, S. 2019. Uji Efek Tonikum Ekstrak Etanol Rimpang Temu Kunci (*Boesenbergia pandurata* (Roxb) Schlecht) Terhadap Mencit Jantan Galur Swiss. *Indonesian Journal on Medical Science*, 6(2), 52–56.

Shafreen RB, Lubinska M, Ró˙za´ nska A, Dymerski T, Namie´snik J, Katrich E, Gorinstein S (2018). Human serum interactions with phenolic and aroma substances of Kaffir (*Citrus hystrix*) and Key lime (*Citrus aurantifolia*) juices. J. Lumin. https://doi.org/10.1016/j.jlumin.2018.04.010

Shepeleva EA, Schelkunov MI, Hroneš M, Sochor M, Dančák M, Merckx VSFT, Kikuchi IA, Chantanaorrapint S, Suetsugu K, Tsukaya H, Mar SS, Luu HT, Li H-Q, Logacheva MD, Nuraliev MS. (2020) Phylogenetics of the mycoheterotrophic genus *Thismia* (Thismiaceae: Dioscoreales) with a focus on the Old-World taxa: delineation of novel natural groups and insights into the evolution of morphological traits. *Botanical Journal of the Linnean Society* 193(3): 287–315. 10.1093/botlinnean/

Siti-Munirah. (2018) *Thismia kelantanensis* (Thismiaceae), a new species from Kelantan, Peninsular Malaysia. Kew Bulletin 73(3): e42. 10.1007/s12225-018-9767-0.

Siti-Munirah. (2020) Notes on a ten-perigoned *Rafflesia azlanii* from the Royal Belum State Park, Perak, Peninsular Malaysia. Malayan Nature Journal 72(1): 11–17. [Google Scholar] [Ref list]

Subositi, Kurnianingrum, Mujahid, Widiyastuti . *Kaempferia galanga L*. amedicinal plant used by indonesian ethnic groups: genetic diversity based oninter-simple sequence repeats (ISSR). Agrivita. 2020;42(1):45-52. doi: 10.17503/agrivita. v42i1.1850.

Suksuwan, (2016). *The Malaysia Rainforest. WWF Malaysia.* Retrieved March17, 2017, from http://www.wwf.org.my/about_wwf/what_we_do/forests_main/forest_protect/protect_projects/project_royal_belum

Sulaiman, Zakaria, Daud, Hidayat Antinociceptiveand anti-inflammatory activities of the aqueous extract of *Kaempferia galanga* leaves in animal models. J Nat Med. 2008;62(2):221-7. doi: 10.1007/s11418-007-0210-3

Susetyarini, Wahyono, Latifa, Nurrohman .2020. The identification of morphological and anatomical structures of *Pluchea indica*. The 5thHamzanwadi International Conference of Technology and Education 2019. Journal of Physics: Conference Series 1539

Sofiyanti, Mat-Salleh, Mahmud Mazlan, Hasein and Burslem 2016 *Rafflesia parvimaculata* (Rafflesiaceae), a new species of Rafflesia from Peninsular Malaysia Phytotaxa 253(3) 207-213.

Viscosi V,Cardini A. 2011. Leaf morphology, taxonomy and geometric morphometrics: a simplified protocol for beginners. Plos One 7 (3): 1-20. 10.1371/journal.pone.0025630

Vittalrao AM, Shanbhag T, Kumari M, Bairy KL, Shenoy S. Evaluation of antiinflammatory and analgesic activities of alcoholic extract *of Kaempferia*

FYP FSB

galanga in rats. Indian J Physiol Pharmacol. 2011;55(1):13-24.

Wong,ais . and Gan. 2009. *Rafflesia su-meiae* (Rafflesiaceae) A new species from from Kelantan, Peninsular Malaysia. *Folia Malaysiana* 10 (2)

World *Applied Sciences Journal* 12 (Special Issues of Tourism and Hospitality):01-09, 2011. ISSN 1818-4952. IDOSI Publications, 2011

Xu, Chang. *Identification and control of common weeds* (3) Singapore: Springer; 2017. Zingiberaceae; pp. 909–911.

Zahara. 2020. Identification of morphological and stomatal characteristics of Zingiberaceae as medicinal plants in Banda Aceh, Indonesia. The 1stInternational Conference on Agriculture and Bioindustry 2019.

Zahara. (2020). Identification of morphological and stomatal characteristics of Zingiberaceae as medicinal plants in Banda Aceh, Indonesia. In IOP Conference Series: Earth and Environmental Science (Vol. 425, No. 1, p. 012046). IOP Publishing. https://doi.org/10.1088/1755- 1315/425/1/012046

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APPENDIX A

Appendix A: Appendix A shows species name of Zingiberaceae, longitude and latitude coordinate to map the distribution and diversity of family Zingiberaceae at Lata Keding Jeli,Kelantan.

Species Name	Latitude Decimal Degree	Longitude Decimal Degree
Alpinia sp. 1	5.745892	101.8523
Alpinia sp. 1	5.745983	101.852421
Alpinia sp. 1	5.745994	101.852451
Alpinia sp. 1	5.746363	101.852499
Alpinia sp. 1	5.746438	101.852472
Alpinia sp. 1	5.747331	101.851696
Alpinia sp. 1	5.747328	101.851714
Alpinia sp. 1	5.747314	101.851723
Alpinia sp. 1	5.747302	101.851743
Alpinia sp. 1	5.747342	101.851701
Alpinia sp. 1	5.747358	101.851683
Alpinia sp. 1	5.746701	101.852735
Alpinia sp. 1	5.747118	101.847327
Alpinia sp. 1	5.747107	101.847275
Alpinia sp. 1	5.747093	101.847185
Alpinia sp. 1	5.747013	101.84714
Alpinia sp. 1	5.746967	101.84714
Alpinia sp. 1	5.746892	101.847148
Alpinia sp. 1	5.746839	101.84678
Alpinia sp. 1	5.746784	101.846294
Alpinia sp. 1	5.746766	101.846175
Alpinia sp. 1	5.746718	101.846123
Alpinia sp. 1	5.746709	101.845908
Alpinia sp. 1	5.746711	101.84586
Alpinia sp. 1	5.746722	101.845707
Alpinia sp. 1	5.746757	101.845654
Alpinia sp. 1	5.744679	101.860202

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Alpinia sp. 1	5.744686	101.860064
Alpinia sp. 1	5.744793	101.859381
Alpinia sp. 1	5.74475	101.858819
Alpinia sp. 1	5.745068	101.858669
Alpinia sp. 1	5.744793	101.857513
Alpinia sp. 1	5.744798	101.857431
Alpinia sp. 1	5.745081	101.856746
Alpinia sp. 1	5.745213	101.854827
Alpinia sp. 1	5.745396	101.853489
Alpinia sp. 1	5.74543	101.852957
Alpinia sp. 1	5.745505	101.852838
Alpinia sp. 1	5.74553	101.852833
Alpinia sp. 1	5.745509	101.852859
Alpinia sp. 1	5.745524	101.852856
Alpinia sp. 1	5.745525	101.852854
Alpinia sp. 1	5.745529	101.852815
Alpinia sp. 1	5.745535	101.852816
Alpinia sp. 1	5.745527	101.852684
Alpinia sp. 1	5.745483	101.852712
Alpinia sp. 1	5.745536	101.852676
Alpinia sp. 1	5.745531	101.852676
Alpinia sp. 1	5.745512	101.852612
Alpinia sp. 1	5.745519	101.8526
Alpinia sp. 1	5.745533	101.852566
Alpinia sp. 1	5.745572	101.852569
Alpinia sp. 1	5.74561	101.852531
Alpinia sp. 1	5.745605	101.852516
Alpinia sp. 1	5.745628	101.852511
Alpinia sp. 1	5.745619	101.852452
Alpinia sp. 1	5.745604	101.852446
Alpinia sp. 1	5.74561	101.852387

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Alpinia sp. 1	5.745595	101.852367
Alpinia sp. 1	5.745796	101.852107
Alpinia sp. 1	5.745823	101.852129
Alpinia sp. 1	5.745881	101.851985
Alpinia sp. 1	5.745935	101.851972
Alpinia sp. 2	5.745885	101.852361
Alpinia sp. 2	5.745878	101.852377
Alpinia sp. 2	5.745887	101.852474
Alpinia sp. 2	5.745925	101.852485
Alpinia sp. 2	5.746006	101.852445
Alpinia sp. 2	5.746034	101.852458
Alpinia sp. 2	5.74608	101.852459
Alpinia sp. 2	5.746093	101.852463
Alpinia sp. 2	5.746135	101.852399
Alpinia sp. 2	5.746265	101.852428
Alpinia sp. 2	5.74631	101.852469
Alpinia sp. 2	5.746314	101.852492
Alpinia sp. 2	5.74643	101.852458
Alpinia sp. 2	5.746471	101.852495
Alpinia sp. 2	5.746545	101.852472
Alpinia sp. 2	5.746563	101.85248
Alpinia sp. 2	5.746554	101.852514
Alpinia sp. 2	5.746632	101.852456
Alpinia sp. 2	5.746657	101.85245
Alpinia sp. 2	5.746681	101.85244
Alpinia sp. 2	5.746706	101.852725
Alpinia sp. 2	5.746681	101.852748
Alpinia sp. 2	5.746696	101.852739
Alpinia sp. 2	5.746699	101.852724
Alpinia sp. 2	5.74668	101.852743
Alpinia sp. 2	5.746914	101.852854

FYP FSB
UNIVERSITI
MALAYSIA
KELANTAN

Alpinia sp. 2	5.747031	101.852848
Alpinia sp. 2	5.747038	101.852852
Alpinia sp. 2	5.746197	101.848359
Alpinia sp. 2	5.746028	101.84838
Alpinia sp. 2	5.746017	101.84833
Alpinia sp. 2	5.74494	101.849372
Alpinia sp. 2	5.746383	101.848348
Alpinia sp. 2	5.746377	101.848398
Alpinia sp. 2	5.745942	101.848239
Alpinia sp. 2	5.745981	101.848146
Alpinia sp. 2	5.745986	101.848143
Alpinia sp. 2	5.745971	101.848153
Alpinia sp. 2	5.745846	101.848042
Alpinia sp. 2	5.745798	101.848056
Alpinia sp. 2	5.745772	101.848098
Alpinia sp. 2	5.745342	101.848915
Alpinia sp. 2	5.745293	101.848952
Alpinia sp. 2	5.745099	101.849247
Alpinia sp. 2	5.7451	101.849247
Alpinia sp. 2	5.745088	101.849268
Alpinia sp. 2	5.745075	101.849287
Alpinia sp. 2	5.747105	101.847243
Alpinia sp. 2	5.746818	101.846604
Alpinia sp. 2	5.746877	101.846372
Alpinia sp. 2	5.745252	101.854815
Alpinia sp. 2	5.745236	101.854782
Alpinia sp. 2	5.745247	101.854737
Alpinia sp. 2	5.745257	101.854697
Alpinia sp. 2	5.745268	101.854614
Alpinia sp. 2	5.745274	101.854593
Alpinia sp. 2	5.745534	101.852821

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Alpinia sp. 2	5.746036	101.851879
Alpinia sp. 2	5.746032	101.851852
Alpinia sp. 2	5.746091	101.851772
Globba sp. 1	5.74671	101.852467
Globba sp. 1	5.746716	101.852476
Globba sp. 1	5.747551	101.851502
Globba sp. 1	5.748184	101.851129
Globba sp. 1	5.748178	101.851086
Globba sp. 1	5.748161	101.851098
Globba sp. 1	5.748177	101.851061
Globba sp. 1	5.748176	101.851055
Globba sp. 1	5.748185	101.851071
Globba sp. 1	5.747242	101.8448
Globba sp. 1	5.747311	101.844698
Globba sp. 1	5.747339	101.844583
Globba sp. 1	5.748022	101.844124
Globba sp. 1	5.748047	101.844086
Globba sp. 1	5.745383	101.853485
Globba sp. 1	5.745386	101.853499
Globba sp. 1	5.745719	101.852249
Alpinia javanica	5.745903	101.852448
Alpinia javanica	5.746279	101.848363
Alpinia javanica	5.746187	101.848366
Alpinia javanica	5.746207	101.848365
Alpinia javanica	5.745982	101.848123
Alpinia javanica	5.745985	101.84812
Alpinia javanica	5.745904	101.84807
Alpinia javanica	5.745783	101.8482
Alpinia javanica	5.745794	101.8483
Alpinia javanica	5.74582	101.84828
Alpinia javanica	5.745806	101.848327

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Alpinia javanica	5.745788	101.848323
Alpinia javanica	5.745816	101.848618
Alpinia javanica	5.745691	101.848728
Alpinia javanica	5.745688	101.848773
Alpinia javanica	5.745084	101.849257
Alpinia javanica	5.74491	101.849444
Alpinia javanica	5.744902	101.849495
Alpinia javanica	5.744758	101.849628
Alpinia javanica	5.744719	101.849728
Alpinia javanica	5.744688	101.849804
Alpinia javanica	5.7447	101.849819
Alpinia javanica	5.74468	101.849796
Alpinia javanica	5.746854	101.846372
Alpinia javanica	5.746805	101.846356
Alpinia javanica	5.746795	101.846333
Alpinia javanica	5.747119	101.845091
Alpinia javanica	5.747154	101.845035
Alpinia javanica	5.747173	101.844903
Alpinia javanica	5.747616	101.844391
Alpinia javanica	5.74763	101.844372
Alpinia javanica	5.747688	101.844338
Alpinia javanica	5.747745	101.844322
Etlingera punicea	5.747079	101.847199
Etlingera punicea	5.747062	101.847187
Etlingera punicea	5.747033	101.847148
Etlingera punicea	5.747219	101.84493
Etlingera punicea	5.747379	101.84452
Etlingera punicea	5.747424	101.844455
Etlingera punicea	5.747548	101.844402
Etlingera punicea	5.747524	101.844458
Etlingera punicea	5.747543	101.844452

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Etlingera punicea	5.747775	101.84428
Etlingera punicea	5.747755	101.84426
Etlingera punicea	5.747868	101.844223
Etlingera punicea	5.748049	101.844146
Etlingera punicea	5.74806	101.844064
Etlingera punicea	5.748067	101.844116
Etlingera punicea	5.748109	101.844035
Etlingera punicea	5.748219	101.843838
Etlingera punicea	5.748244	101.843823
Etlingera punicea	5.748286	101.843751
Etlingera punicea	5.748311	101.843641
Etlingera punicea	5.748318	101.843564
Etlingera punicea	5.748336	101.843559
Etlingera punicea	5.748326	101.843506
Etlingera punicea	5.748335	101.843494
Etlingera punicea	5.748337	101.843491
Etlingera punicea	5.748331	101.843488
Etlingera punicea	5.748341	101.843431
Etlingera punicea	5.748356	101.843453
Etlingera punicea	5.74658	101.848282
Etlingera punicea	5.746394	101.848263
Etlingera punicea	5.746384	101.848143
Etlingera punicea	5.745669	101.848751
Etlingera punicea	5.745673	101.848748
Etlingera punicea	5.745367	101.848806
Etlingera punicea	5.74539	101.848808
Etlingera punicea	5.745387	101.848819
Etlingera punicea	5.745387	101.84883
Etlingera punicea	5.745378	101.848838
Etlingera punicea	5.745347	101.848812
Etlingera punicea	5.747079	101.847199

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Etlingera punicea	5.747062	101.847187
Etlingera punicea	5.747033	101.847148
Etlingera punicea	5.747219	101.84493
Etlingera punicea	5.747379	101.84452
Etlingera punicea	5.747424	101.844455
Etlingera punicea	5.747548	101.844402
Etlingera punicea	5.747524	101.844458
Etlingera punicea	5.747543	101.844452
Etlingera punicea	5.747775	101.84428
Etlingera punicea	5.747755	101.84426
Etlingera punicea	5.747868	101.844223
Etlingera punicea	5.748049	101.844146
Etlingera punicea	5.74806	101.844064
Etlingera punicea	5.748067	101.844116
Etlingera punicea	5.748109	101.844035
Etlingera punicea	5.748219	101.843838
Etlingera punicea	5.748244	101.843823
Etlingera punicea	5.748286	101.843751
Etlingera punicea	5.748311	101.843641
Etlingera punicea	5.748318	101.843564
Etlingera punicea	5.748336	101.843559
Etlingera punicea	5.748326	101.843506
Etlingera punicea	5.748335	101.843494
Etlingera punicea	5.748337	101.843491
Etlingera punicea	5.748331	101.843488
Etlingera punicea	5.748341	101.843431
Etlingera punicea	5.748356	101.843453
Etlingera elatior	5.746662	101.846151
Etlingera elatior	5.746703	101.846046
Etlingera elatior	5.746708	101.845931
Etlingera elatior	5.748424	101.843524

FYP FSB
UNIVERSITI MALAYSIA KELANTAN

Etlingera elatior	5.748422	101.843473
Etlingera elatior	5.748481	101.843484
Etlingera elatior	5.748443	101.843471
Etlingera elatior	5.748468	101.843483
Etlingera elatior	5.748438	101.843419
Etlingera elatior	5.748433	101.843434
Etlingera elatior	5.74845	101.843436
Etlingera elatior	5.748498	101.843414
Etlingera elatior	5.748558	101.843361
Etlingera elatior	5.748629	101.843272
Etlingera elatior	5.748635	101.843239
Etlingera elatior	5.748649	101.843261
Etlingera elatior	5.748652	101.843265
Etlingera elatior	5.744733	101.860422
Etlingera elatior	5.744735	101.860367
Etlingera elatior	5.744784	101.858084
Etlingera elatior	5.744848	101.857682
Etlingera elatior	5.744802	101.857537
Etlingera elatior	5.745232	101.854817

FYP FSB
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