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Evaluation and identification of the native Zingiberaceae specie in Mijen, Central Java, Indonesia

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Abstract. Zingiberaceae, Musaceae, and Cactaceae families are a small part of the diversity of species of tropical plants found in Indonesia. The Zingiberaceae consists of around 50 genera and more than 1,300 species. The uses of Zingiberaceae ranges from food, medicine, industry, to ornamental plants. The constraints in the commercialization of the species of this family are the lack of information on the growth characteristics and cultivation techniques to produce quality crops, and understanding on the phytochemical content of different parts of the plants. This study aims to identify the presence and diversity of Zingiberaceae species in the Central Java region, particularly in Mijen District, Gunung Prau, and Darupono Teak Forest, and to study the uses by the local community by conducting surveys and interviews. We recorded 19 species belonging to the Zingiberaceae in the study area, with a total of 293 individuals from the 10 genera, and Zingiber was the most dominant genus. Five of these species have been used by local residents as spices, 12 species as herbal medicines, and 2 species have potentials as ornamentals or cut flowers, *Etilingira foetens* and *Etilingera elatior*.

Keywords: Plant identification, Zingiberaceae, native species, central Java

1. Introduction

Traditional medicine has long been known as a cultural heritage in Indonesia [1]. In Central Java alone, 1,734 traditional plant-based formulas for healing have been documented [1]. According to the World Health Organization (WHO), about 4 billion people in the world (\pm 80%) use the plant as a raw material in the manufacture of drugs [2]. They further estimated that approximately 75-90% of people who live in the countryside still rely on medicinal plants as the main source of treatment for sickness and to maintain health [2]. More than 21,000 species of plants in the world are used in health and beauty treatments [3]. Herbal and traditional medicines derived from plants have the potential to be further developed into commercialization to increase the income of the village community [4, 5]. Herbaceous plants have a very important role in supporting forest ecosystems as they can prevent runoff on the forest floor that can cause surface erosion during the rainy season [6, 7].

The Zingiberales order has around 2,600 species, distributed in 68 genera over eight families, Marantaceae, Cannaceae, Zingiberaceae Costaceae, Heliconiaceae, Strelitziaceae, Musaceae, and



Lowiaceae, who have similar morphological characteristics. Unique characteristics among them are rhizomatous; inflorescence with bractea; stamens and filaments form the staminoid structure; and zygomorphic flower [8]. The eight families in the Zingiberales have been divided into two groups: the monophyletic family (Marantaceae, Cannaceae, Zingiberaceae, and Costaceae) and the paraphyletic (Heliconiaceae, Strelitziaceae, Musaceae, and Lowaceaceae) [8]. The monophyletic family has 1 functional stamen whereas the paraphyletic family has 5 functional stamens [8]. Costaceae is included in the Zingiberaceae family of the previous classification because Costaceae and Zingiberaceae have similar flowering and floral characteristics [8-10]. The separation between the two families is due to lack of aromatic oil, branching air stems, spiromonostichous leaves with closed and tubular sheaths in Costaceae [8]. The herbaceous Zingiberaceae (gingers) are versatile species that have been cultivated mostly as medicinal herbs. Members of this family have wild relatives that have not been identified and live in the tropical forests of Asia, including in Indonesia [4, 8].

Mijen is one of the districts in Semarang Central Java, Indonesia whose community still rely on medicinal plants as traditional medicine or herbs [5, 6]. People in this area have traditional knowledge from the older generations on the use of different plant species as traditional medicine, and the knowledge has been applied in their daily life [5, 6]. The government, in this case, the Mayor of Semarang city, and the local community, are very supportive to the efforts of conservation of medicinal crops in the village Wonolopo [6]. Wonolopo has since been called "Herbal Village" in 2016. Based on our study there are about 50 traders have formed an association of traditional medicines "Sumber Husodo" [Kuswanto, unpublished report]. The association has sales regions to avoid competition amongst traders within the association [Kuswanto, unpublished report]. Government has provided loans to help start-up capital for the community so they can get easier access to loans and venture capital [Kuswanto, unpublished report]. The cooperative is expected to grow and improve the livelihood of its members [Kuswanto, unpublished report].

It is important to increase the active role of local communities in the management and the production of medicinal plants and herbs native to Mijen area [4-6]. Most people in this area work as labors in the teak forest area; they grow herbs between the teak trees as well as in the village community gardens [6]. Zingiberaceae rhizomes has a unique smell and are very common herbs in Indonesia [11, 12]. The tropical climate is a suitable environment for Zingiberaceae, and it is widely distributed throughout the tropics, particularly in Southeast Asia [11-14]. This study aims to determine the diversity of medicinal plants in the Mijen district, to identify the morphological characteristics of the species, and to assess the level of utilization of the Zingiberaceae species by Mijen local communities.

Previous studies about Zingiberaceae in Indonesia includes the finding of two new species of *Alpinia* section *Alpinia* subsection *Cenolophon*, *Alpinia macrocrista* Ardiyani & Ardi, and *Alpinia pusilla* Ardi & Ardiyani, from Sulawesi, Indonesia [15]. A recent exploration of Sumatra resulted in the re-collection of *Curcuma sumatrana*, an endemic Zingiberaceae species that was first described 150 years ago [1]. *Curcuma sumatrana* currently qualifies under IUCN assessment as vulnerable [16]. Very limited information are available on Zingiberaceae from Sunda Kecil islands. The initial survey in Mount Rinjani National Park, Lombok, in 2011 collected five wild gingers, *Etingera rubroloba*, *E. calophrys*, *Amomum maxium*, *A. gracile*, *Alpinia* sp. dan *Globba marantina* [13]. In addition, another species of *Alpinia* was recorded, and likely has not been identified previously [15].

2. Materials and methods

The study was conducted in two periods, the first period was between January to June 2017, the second period was from July to December 2017. Descriptive analysis was based on plant morphology; direct measurements of the size (height, leaf size, and flower morphology) were conducted on the plants in the field. Three paths were made during the survey, i.e. Mijen, Bubakan and Wonoplumbon path. The plants from the species of Zingiberaceae found during the survey in Mijen were recorded, sample plants were collected and brought to the laboratory of the Department of Biology FST UIN

Walisongo, Semarang city. Specimens were then identified for confirmation of the identification at Bogor Botanical Garden. Qualitative data were analyzed using descriptive method and photographed.

Information on the ethno-medicine and ethno-economics were collected through exploratory surveys using participatory rural appraisal method [17]. Interviews were conducted to 5 respondents from each of the 7 suburbs of Wonolopo village. This village was selected as it is the only village that has an association of traditional herbals. The questions included in the interview was semi-structural in open ended questions [17], particularly on the names of the medicinal plants and herbals used by the community, their specific uses e.g. as herbal, medication, cosmetics or spices, parts of the plants used, traditional believes on the advantages of each herbal, and whether or not the community have cultivated the herbals, or collecting them from the natural habitat.

The research used shears, plant tags, identification guides, newspapers, 10 kg plastic bags, ethanol, oven, cardboard, sewing needles, and stationeries. Data were collected by means of visual observations, documentation and collection of herbarium specimens.

3. Results and discussion

The study revealed that most of the people of the Mijen sub-district rely on the native plants as sources of medicine. However, along with the development of modern medicine and the easier access of the public health facilities, the local people have started using drugs from pharmacies in the city. The results of interviews with local communities revealed that ten species of Zingiberaceae have been used by people in their everyday life. Through the surveys we learned that Zingiberaceae family were grown in 3 locations in Central Java, namely Mijen, Darupono, and Gunung Prau; the number of species in each location is listed in table 1.

Table 1. Results of the initial survey of the Zingiberaceae species found in Mijen, Darupono and Gunung Prau, Central Java.

No	Location	Number of Species	
		Period I (January – June 2017)	Period II (July - December 2017)
1	Mijen	19	16
2	Darupono	12	6
3	Gunung Prau	16	9

Based on the results of the survey (table 1) there were significant differences in the number of species found between seasons; in the first period of January or during the rainy season 12-19 species was found, whereas in the dry season of July to December only 9-16 species were found. This shows that Zingiberaceae growth is highly affected by rainfall or needs continuous water supply for their optimal growth.

Identification and inventory of morphological characteristics of the Zingiberaceae species found in the Mijen sub-district are listed in table 2.

Based on the morphological characteristics of the Zingiberaceae family found in the Mijen District of Semarang City, the Teak Darupono Kendal Forest, and the Gunung Prau Protected Forest, a total of 19 species with a total of 293 individuals and belonging to 10 genera were recorded (table 2). *Zingiber* is the most dominant genus, which comes from Mijen. A detail comparison of the genus and individual plants that were found in the study locations are described figure 1.

Genus zingiber has the most number of individuals (121) which indicate that this area is a suitable habitat for zingiber (figure 1). The genus *Costus* has the smallest number of individuals. *Costus* has not been cultivated even it is considered a weed. It is likely that there were actually many more plants growing on the area but because they are considered weeds, they are cleared or eliminated by the residents. The second most common genus is *Curcuma*, which has been widely cultivated and used by the residents as a daily medicine and as a cooking spices.

Table 2. Identification of species from Zingiberaceae from three exploration path

Genus	Species and local name	Number of plants
<i>Hedycgium</i>	<i>Hedychium coronarium</i> J.König	12
<i>Curcuma</i>	<i>Curcuma longa</i> L (Kunyit)	20
	<i>Curcuma zanthorrhiza</i> Roxb (Temu lawak)	30
	<i>Curcuma amada</i> Roxb (Temu mangga)	5
	<i>Curcuma heyneana</i> Val.& van Zijp (Temu giring)	5
<i>Zingiber</i>	<i>Zingiber officinale</i> Roxb.(jahe)	23
	<i>Zingiber officinale</i> var. <i>rubrum</i> (jahe merah)	15
	<i>Zingiber zerumbet</i> subsp. <i>zerumbet</i> (<i>Zingiber aromaticum</i>)	21
	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm (Lempuyang gajah)	22
	<i>Zingiber montanum</i> (J.König) Link ex A.Dietr. (Bengle)	40
<i>Kaempferia</i>	<i>Kaempferia galanga</i> L. (Kencur/ Temu putri)	8
	<i>Kaempferia rotunda</i> (Kunci Pepet/ Kunyit putih)	12
<i>Amomum</i>	<i>Amomum compactum</i> Soland.ex Maton (Kapulaga)	17
<i>Wresah</i>	<i>Amomum maximum</i> Roxb.	17
<i>Costus</i>	<i>Costus specios (koenig) J.E.Smith (Pacing)</i>	8
<i>Etilingera</i>	<i>Etilingera foetens</i> (Blume) R.M.Sm (Tepus)	2
	<i>Etilingera elatior</i> (Jack) R.M. Sm (Kecombrang)	10
<i>Boesenbergia</i>	<i>Boesenbergia rotunda</i> (L.) Mansfeld (Temu Kunci)	12
<i>Alpinia</i>	<i>Alpinia galanga</i> (L.) Willd (Lengkuas / Laos)	10
	<i>Alpinia purpurea</i> (L.) Willd	4
10 genus	19 Species	293

The diversity of species found in a forest ecosystem is related to the biotic and the environmental factors, including topography, altitude, soil, air, light and rainfall and forest humidity [17, 18]. Teak in Mijen forest area is a lowland forest type with an altitude of 200-500 meters above sea level with high enough rainfall, resulting in high diversity of flora species. Zingiberaceae can survive from lowlands to high altitude of more than 200 m above sea level, with high rainfall and high humidity [18]. In the study area some species were observed to be growing in the open riverbank forests and swamps, e.g. kecombrang or *Etilingera*, and Tepus. In the Mijen route, kecombrang was found and in Wonoplumbon, whereas Tepus was found in the Bubakan and Mijen pathways, but were not found in other pathways. Tepus usually grow in the primary forests [19, 20].

Kecombrang and Tepus inflorescences are attractive and colourful and can last more than 2 weeks. Wresah fruits have a sweet and unique sour taste and is edible, but has not yet been utilized by local

residents. The current uses of Zingiberaceae as traditional medicine and whether or not they have been traded by the local community are described in table 3.

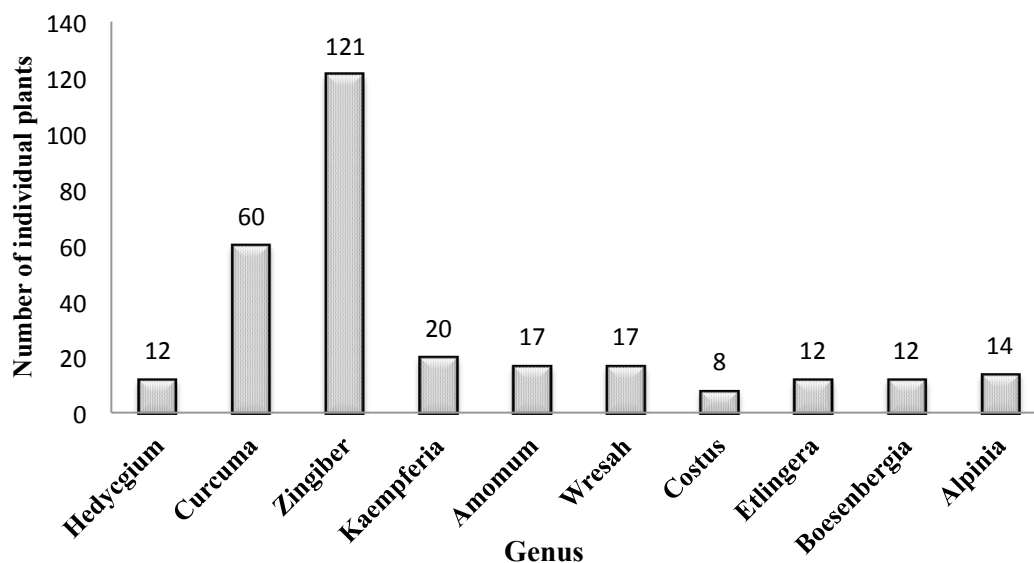


Figure 1. Chart of number of individuals species and genus

Based on the results of ethno-medicine and ethno-economic study (table 3) 19 species of the Zingiberaceae have already been used by the community as medicinal herbs, five for spices, and one species for cosmetics. The rest have been used as traditional herbs to maintain fitness and health. The uses of Zingiberaceae species as sources of traditional medicine have been reported in Lampung [21], Banjarbaru [21], and also in Thailand [22]. Apart from its uses as herbs and spices, some species have potentials to be developed as cut flowers or ornamental plants.

Botanical characteristics of the Zingiberaceae species found in Mijen are described in table 4. Description of the plant morphology referred to [23-26].

A total of 19 species of Zingiberaceae have been found in 3 survey locations. Zingiberaceae from Mijen can be separated into 19 families and 9 genus (*Zingiber*, *Curcuma*, *Kaempferia*, *Alpinia*, *Hedychium*, *Boesenbergia*, *Amomum*, *Etlingera*, *Wresah*). *Zingiberaceae*, genus *zingiber*: 5 (*Zingiber officinale* Roxb, *Zingiber montanum* (J.König) Link ex A.Dietr, *Zingiber officinale*, var *Rubrum*, *Zingiber zerumbet* subsp *Zerumbet*, *Zingiber zerumbet* (L.) Roscoe ex Sm Genus *Kaempferia*: 2 (*Kaempferia galanga* L., *Kaempferia rotunda*,) Genus: *Curcuma*: 4 (*Curcuma heyneana* Val. & Van Zijp, *Curcuma*, *zanthorrhiza* Roxb . *Curcuma longa* L., *Curcuma amada* Roxb., Genus: *Boesenbergia*: 1 (*Boesenbergia rotunda* L.) Mansfeld, Genus: *Alpinia*: 1 (*Alpinia galanga* (L.) Willd) Genus: *Hedychium*: 2 (*Hedychium coronarium* J.König, *Curcuma aeruginosa* Roxb.) *Etlingera* genus: 2 (*Etlingera foetens* (Blume) RMSm, *Etlingera elatior* (Jack) RM Sm), Genus: *Amomum*: 1 (*Amomum compactum* Soland.ex Maton), Genus: *Wresah*: 1 (*Amomum maximum* Roxb.)

From the 19 species identified, one species does not belong to the Zingiberaceae family. From this study we recorded 16 species that have been already utilized as herbal medicines, 5 species of spice and one species for cosmetics (*Curcuma heyneana* Val. & Van Zijp / Giring Giring), 2 species for food ingredients (*Curcuma aeruginosa* Roxb. & *Amomum maximum* Roxb./wresah). We also found 2 species which are previously unknown to exist in the area and under-utilized, i.e. *Etlingera elatior* and *Etlingera foetens* (Blume). Both *Etlingera* species have very beautiful and long lasting flowers [27, 28].

Table 3. Ethnobotany, ethno-medicine and ethno-economy of the Zingiberaceae species in Mijen, Central Java

Local name (Scientific name)	Ethno-medicine	Ethno-economy / Traded
Temu ireng (<i>Curcuma aeruginosa</i> Roxb.)	Malaria medicine, ringworm scabies, reduce menstrual pain, worms, hemorrhoids, skin treatment.	Yes
Temu lawak (<i>Curcuma xanthorrhiza</i> Roxb.)	Arthritis, increase appetite	Yes
Kunyit, (<i>Curcuma longa</i>)	Joint inflammation, abdominal pain, diarrhea, colds	Yes, as spices
Lempuyang (<i>Zingiber zerumbet</i> (L.)	Increase appetite, cold, swollen feet	Yes
Bengkle (<i>Zingiber purpureum</i> Roscoe)	Diet, medication for fever, rheumatism, coughing up phlegm, launching a bowel movement, ulcer medication, source of vitamins for baby and small children	Yes
Jahe (<i>Zingiber officinale</i> Rosc.)	Medication for coughing, warmers	Yes; as spices
Temu giring (<i>Curcuma heyneana</i> Val),	Cosmetic powder, anti worm, diarrhea, dysentery and chickenpox	Yes
Temu mangga (<i>Curcuma mangga</i> Valetton & Zijp)	Weight control, anti cancer, and increase appetite	Yes
Temu putih (<i>Curcuma zedoaria</i> (Berg) Rosc)	Anti cancer	Yes
Kencur (<i>Kaempferia galanga</i> L),	Cough medicine	Yes, as spices
Temu Kunci (<i>Boesenbergia pandurata</i> Roxb.)	Sputum diarrhea medication or for cough medicine, laxative, increase appetite and breast milk enhancer	Yes, as spices
Kunci Pepet/ Kunir putih, (<i>Kaempferia rotunda</i> L)	Indigestion, abdominal pain, heart burn, and swelling due to bruising or sprains	Yes
Lengkuas / laos (<i>Alpinia galanga</i>)	Medicine for phlegm	Yes, as spices
Lempuyang gajah (<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm	Ambaeien, anemia, rash, whooping cough, Allergy	Yes
Kapulaga (<i>Amomum compactum</i> Soland.ex Maton)	Cold medicine	Yes
Jahe merah (<i>Zingiber officinale</i> var. <i>rubrum</i>)	Cough medicine, warmers	Yes
Lempuyang wangi (<i>Zingiber aromaticum</i>)	Increase appetite, relieve fatigue	Yes
Kecombrang (<i>Etilingera elatior</i> (Jack) R.M. Sm	No	No
Wresah (<i>Amomum maximum</i> Roxb.	No	No

Table 4. Study of botanical characteristics of Zingiberaceae.




Local (Scientific name)	Botanical characteristics
Temu ireng (<i>Curcuma aeruginosa</i> Roxb)	<p><i>C. aeruginosa</i> is a perennial that has unbranched leafy 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 reddish-brown 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 a median light green patch. Flowers are about 50 mm, equal to or slightly shorter than the bracts.</p>
	
Temu lawak (<i>Curcuma xanthorrhiza</i> Roxb.)	<p><i>Curcuma xanthorrhiza</i> is a herbaceous perennials with a cluster of pseudostems 1 to 2 metres height that grow from underground rhizome. Each pseudostem is made up of up to 8 leaves with blades that can be 40 - 90cm long and 15 - 21cm wide. The rhizomes are branched and are yellow in color, they were harvested when the shoots 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 cm long; flower spikes are cylindrical, 15-25 cm long, 10-20 cm in diameter, provided with 15-35 bracts arranged spirally, each bract bears a flower.</p>
	
Kunyit (<i>Curcuma longa</i>)	<p><i>Curcuma longa</i> or turmeric, is similar to <i>Curcuma xanthorrhiza</i>, except for the flowers which have yellow color. It is a herbaceous perennials with 1 to 1m 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.</p>
	
Lempuyang (<i>Zingiber zerumbet</i> (L.)	<p>The leaves are arranged alternately along the pseudo-stem which is curved and can grow from 1 to 2m 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.</p>
	

Table 4. Continued



Local (Scientific name)	Botanical characteristics
<p>Bengkle (<i>Zingiber purpureum</i> Roscoe)</p> 	<p><i>Zingiber purpureum</i> is also known as <i>Zingiber cassumunar</i>. It has pseudo stems with a height of 30 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 width of 1.5 - 1.75 cm. When young, flower bangle has a green tip. The rhizomes are reddish and has a pungent odor.</p>
<p>Jahe (<i>Zingiber officinale</i> Rosc.)</p> 	<p>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 yellow epidermis. The side rhizomes taste rather bitter. All the leaves are green. The inflorescence grows from 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 by bracteoles.</p>
<p>Temu giring (<i>Curcuma heyneana</i> Val)</p> 	<p><i>Curcuma heyneana</i> 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 cm length 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.</p>
<p>Temu mangga (<i>Curcuma mangga</i> Valetton & Zijp)</p> 	<p><i>Curcuma mangga</i> is herbaceous, perennial plant with pseudo stems 30 – 110 cm long growing from rhizomes. Each pseudo stem have 5 - 7 leaves with leaf blades of 16 – 60 cm long and 7 – 15 cm width. Fruits are round, yellowish green with brown seeds. The unique characteristic of this plant is its tuber which is pale yellow on the inside with lighter color outside and speckled like ginger, has a distinctive smell like the smell of fresh mango.</p>

Table 4. Continued






Local (Scientific name)	Botanical characteristics
<p>Temu putih/ temu pepet (<i>Curcuma zedoaria</i> (Berg) Rosc)</p> 	<p><i>Curcuma zedoaria</i> are herbaceous with large white and tuberous branched rhizomes. Unlike the other species, it was found grow individually, not in groups. The leaves are lanceolate, 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 <i>Curcuma manga</i>, with a bitter after taste.</p>
<p>Kencur / Temu Putri (<i>Kaempferia galanga</i> L)</p> 	<p><i>Kaempferia galanga</i>, or <i>galangal</i> 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 grow in lowland or fertile and mountainous areas but not flooded.</p>
<p>Kunci (<i>Kaempferia pandurata</i> Roxb.)</p> 	<p><i>Kaempferia pandurata</i> Roxb. a 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 are deeply grooved. The flower appears between the leaf sheaths at the bottom of the trunk. The petals are white or light pink. Flowers bloom one at a time. The rhizomes has a range of colors and aromas depending on the variety.</p>
<p>Kunci Pepet Kunir Putih (<i>Kaempferia rotunda</i> L)</p> 	<p><i>Kaempferia rotunda</i> 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.</p>
<p>Lengkuas (<i>Alpinia galanga</i>)</p> 	<p>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.</p>

Table 4. Continued






Local (Scientific name)	Botanical characteristics
<p data-bbox="178 414 638 481">Jahe merah (<i>Zingiber officinale</i> var. Rubrum)</p> 	<p data-bbox="657 414 1343 772">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.</p>
<p data-bbox="178 784 638 851">Lempuyang gajah (<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.)</p> 	<p data-bbox="657 784 1343 1120"><i>Zingiber zerumbet</i> 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.</p>
<p data-bbox="178 1153 638 1220">Kapulaga (<i>Amomum compactum</i> Soland.ex Maton)</p> 	<p data-bbox="657 1153 1343 1518">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.</p>

Table 4. Continued

Local (Scientific name)	Botanical characteristics
<p>Wresah (<i>Amomum maximum</i> Roxb.)</p> 	<p><i>Amomum maximum</i> 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.</p>
<p>Tepus (<i>Etilingera foetens</i> (Blume) R.M.Sm)</p> 	<p><i>Etilingera foetens</i> are similar to kecombrang, but they are smaller in size. Pseudo stems have height reaching 2 m. The leaves have reddish green color. The base of the leaf and the tip of the leaf are pointed (acutus). Inflorescence is not terminal with flower stalk of less than 100 cm. Flowers are pink. The rhizome has a very bitter taste.</p>
<p>Kecombrang (<i>Etilingera elatior</i>)</p> 	<p>Lengkuas-like plants, found near water sources in wild 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 in color. 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.</p>

4. Conclusion

This study has identified 19 species of Zingiberacea in Mijen that have potentials to be developed as medicinal plants. *Etilingera* was previously known to exist in this area and its potential has not been explored by the local people. Two *Etilingera* species which are native to Mijen have been recorded ie *Etilingera elatior* (kecombrang) with pink flower, and tepus / *Etilingera foetens* (Blume) with orange flower from Mount Prau. These species have beautiful flowers and have potentials to be developed into cut flowers in addition to their current uses as traditional medicines.

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