

**TAXONOMIC STUDIES AND ETHNOMEDICINAL USES OF
ZINGIBERACEAE AMONG THE BIDAYUH COMMUNITY IN SINGAI
AND JAGOI BAU, SARAWAK**

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ABSTRACT

The Zingiberaceae is a ginger family, consists of perennial herbs with creeping horizontal or tuberous rhizomes. It is comprised of about 53 genera and more than 1500 species that are distributed throughout Asia and more than 1200 species mostly growing in tropical forests. Borneo itself have more than 250 species of gingers in 19 genera. Sarawak has 141 species in 18 genera. However, these are only the named species as many species are yet to be described or determined. Many species are economically important as spices, ornamental plants and medicinal purposes. Very few studies of the Zingiberaceae had been done. The only study that been done is on the inventory and taxonomy study of the species. The first study was done by Axel Dalberg Poulsen in 2006 to describe 64 species in 18 genera of Zingiberaceae found in Sarawak. The second study was done by Meekiong et.all in 2010 to record 70 species in 15 genera of gingers found n Lanjak Entimau Wildlife Sanctuary. In his study, he had discovered 5 new species of the wild gingers. However, the study of useful gingers are very limited and many more useful species may still discovered in the forests of Sarawak. This study will document the traditional knowledge of gingers species used by Bidayuh community in Jagoi and Singai Bau District. It is also reports on a pattern of use for the ginger species by Bidayuh in Singai and Jagoi, Bau and provides the information on the microscopic identification of useful Zingiberaceae among the Bidayuh community in Mount Sejinjang Singai and Mount Jagoi Bau, Sarawak

Keywords: Bau, Bidayuh, Sarawak, Species and, Zingiberaceae

1.0 INTRODUCTION

1.1 Ethobotany study on Ginger species among the Bidayuh Singai and Jagoi

For generations, knowledge of use of plants in healing was passed down by oral tradition. Traditional livelihood centered on forest foraging and subsistence farming had kept native communities attached to the skills and knowledge of this gift of nature. Prior to the Malaysian

Independence era, there were hardly any serious efforts to documentations the use of wild plants, especially for food and medicinal purposes among the native communities. As such, it was only during the two last decades or so that there were growing interests in use of plants in scientific research, and for the search chemical constituents for use in modern medicine.

Traditional medicine continues to play a major role among the people in Sarawak and it is expected to play important roles in the future. The importance of ethno botanical resources to the native communities of Sarawak is one of the driving forces behind the current trend of community-based resource management. For Bidayuh community, medicinal plants are used, as a direct therapeutic agent because it is easy to get and cheap compared with modern medicine that are often expensive. The utilization of Zingiberaceae as food, traditional medicine, spice, condiment, dye and flavour had been practiced by Bidayuh Singai and Jagoi in generation. However, many species of gingers not been reported for their traditional used by the Bidayuh. The common useful ginger for Bidayuh is *Zingiber officinale*. Rhizomes of this ginger have been widely used as spices or condiments. Rhizomes are eaten raw or cooked as vegetables and used for flavoring food. As traditional medicine, rhizomes of this species are consumed by women during ailment, illness and confinement. Rhizomes are also taken as carminatives for relieving flatulence.

1.2 Objective of Study

The objectives of the proposed study are to, and to estimate the economic contribution these resources provide to the welfare of the community. The specific objectives proposed, among others, may include the followings:

- To document the traditional knowledge of gingers species used by Bidayuh community in Jagoi and Singai Bau District
- To provide the information on the significant of Zingiberaceae for medicinal purposes among these 2 Bidayuh communities
- To provide the information on the microscopic identification of useful Zingiberaceae among the Bidayuh community in Mount Sejinjang Singai and Mount Jagoi Bau, Sarawak

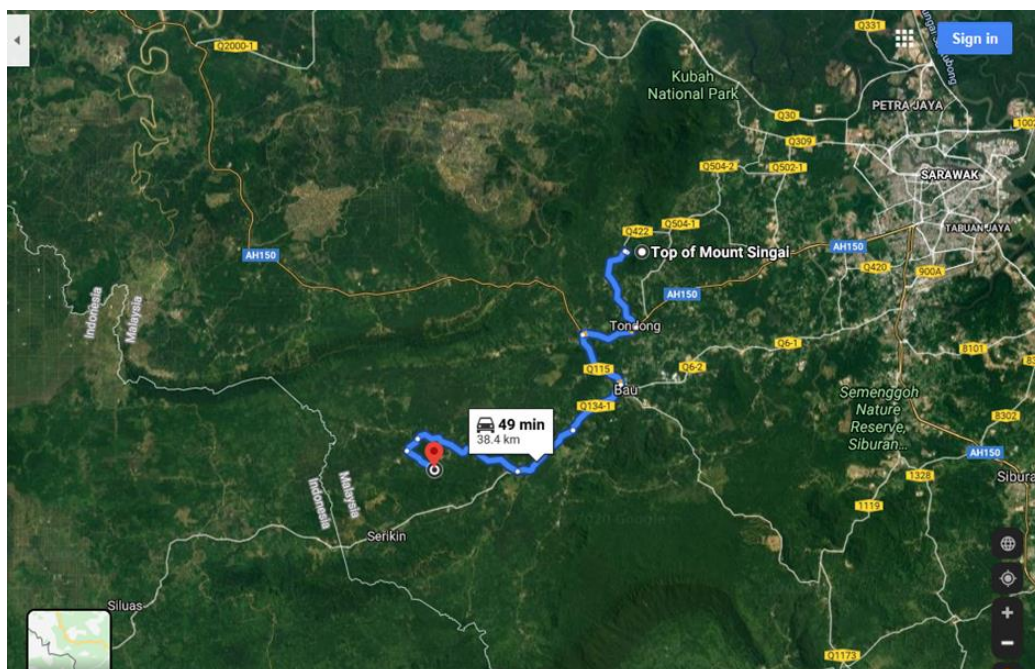
2.0 METHODOLOGY

2.1 Study Site

The study involved with 2 areas of Bidayuh communities in Sarawak namely Mount Singai and Mount Jagoi. These area are being selected for the study due to the earlier established of Bidayuh settlements. Nowadays, ethnic communities of these area are still practicing traditional medicine, of which Zingiberaceae plants are of paramount importance (Sayok et al., 2014). Singai is located about 40km from Kuching city and Jagoi is located 60km from Kuching. Both of these areas are still having a few hectare nearby forest that surrounding land along the mountain slope are the last bastion of green virgin tropical rainforest in the area housing rich biodiversity apart from supplying clean water to the villages. The locals from the immediate villages collect natural resources from these areas for their own uses and to sell to tourists at their respective stalls along the roadside and Bau local market.



Source: <http://www.malaysia-maps.com>



Source: <http://www.Google Earth Image 2020>: Singai/Jagoi Bau Sarawak

2.2 Data collection

Before conducting the study, obtaining prior informed consent from the local community in Singai and Jagoi area is an essential part in the documentation of the traditional knowledge on useful plant in accordance with Part V of the Sarawak Biodiversity Regulation 2016. It is then followed by the research regulation procedure for apply the permit to conduct research in the state of Sarawak.

There are three phases involved in collection of data. The first phase of data collection is on ethnobotanical information, the second phase of data collection on socio-economic data and the third phase is data analysis

2.3 Prior Informed Consent (PIC)

Under Part V of the Sarawak Biodiversity Regulation 2016, the researcher shall obtain the prior informed consent from the natives before the commencement of any activity. The letter obtaining the prior informed consent of the community was provided to both headman of the area on 1 September 2020. The letters were prepared in Malay language pertaining to the proposed application that is accurate, objective, clear and sufficient to allow the communities in both areas to arrive at an informed decision, included the details of the proposed project which includes the methodology, the type of biological resources sought, the quantity required, frequency, purpose of the project, starting date and duration of the activity and geographic prospecting area.

The meeting was then conducted between headman and all the community members at both areas to deliberate and decide on the matter of research conducted in their area. The prior informed consent from both communities were obtained on 11 October 2020 with the reference number of UNIMAS/PHD/PIC.

2.4 Research Regulation Procedure

The research permit application was made online via Sarawak Online Research Application System (SORAS). The permit to conduct research was obtained on 12 October 2021 with the reference number of SBC-2021-RDP-35-JER.

2.5 Plant Collection, Documentation and Specimen Identification

The local community leaders will be approached to help identify informants who are knowledgeable on Zingiberaceae as medicinal plants. These informants comprised of individuals knowledgeable in the use of Zingiberaceae. They are incorporated in the study as field guides. For this study, plant collections will be carried out with the same informants to allow consistency and to avoid conflicting species identifications and unreliable information. In the study, field parameters will be recorded include the details of taxonomy, ecology, soil types and all related information concerning the use of the plant. The specimens of each species will be taken and bring to Sarawak Herbarium (SAR) for identification. The herbarium specimens will be deposited at UNIMAS herbarium for references. The new species will be described.

2.6 Household Interviews

Data required in estimating the economic value of ginger were collected from a survey conducted with Singai and Jagoi residents. The respondents were selected using a random sampling technique whereby samples will be taken randomly from each of the villagers. Interviews were conducted through direct interviews with the direct households in Bidayuh language. Section one cover background of the respondents, medicinal consumption, the

safety and efficacy of the traditional medicinal of ginger as well as their satisfaction in using the product compared to modern medicine.

2.7 Morphology, taxonomic treatment and microscopic

The species were randomly selected for the experiment. Fresh samples of *Boesenbergia pulchella* (Ridl.) Merr., *Curcuma domestica* (Christm.) Roscoe, *Globba astrosanguinea* Teijsm. & Binn and *Globba rubra* Ridl that commonly used by Bidayuh community of Singai and Jagoi were randomly selected for comparative leaf anatomy. Fresh samples of *Alpinia* sp no, *Amomum* sp. nov, *Globba astrosanguinea* Teijsm. & Binn and *Sulettaria* sp. nov that commonly used by Bidayuh community of Singai and Jagoi were randomly selected for the identification of trichome micromorphology of the abaxial leaves. The propose of study is to obtain the leaf anatomical and micromorphology evidence that can support the taxonomic conclusions drawn using other characters for the species identification. There are 2 types of taxonomy treatment were conducted to identify the cell of leaf sample for each species.

I. Microscope digital camera

Sample Preparation using Rotary Microtome

The leaf samples for each species were cut into 3 main parts, apex, middle and base. The samples were prepared by sliding microtome (Rotary Microtome LEICA SM2000R) at the 1mm width. The aim is to identify differences of phynchemma spongy, mesophyll cell, vascular bundle and trichome vessel for each species.

The fresh samples were fixed 3:1 AA solution (70% alcohol: 30% acedic acid, sectioned used a sliding microtone (Leica SM2000r) and stained in Safranin and Alcian blue. Subsequent by dehydration in a series of ethanol solutions (50%, 70%, 80%, 90% and 100%, the section was mounted in Canada balsam and left for 2 weeks. The samples were then observed under the Olympus DP72 microscope digital camera.

II. Scanning Electron Microscopy (SEM) imaging

The leaf samples for both abaxial and adaxial part for each species were cut into a small piece. Leaf samples were immersed in FAA fixative (3.7% v/v formaldehyde, 50% ethanol, 5% acetic acid) and subjected to a light vacuum until the samples sank. Samples were then fixed overnight (approximately 18 h) at 4°C. Samples were rinsed 3 times in 25 mM sodium phosphate buffer (pH 7) before dehydrating in an ethanol series (30%, 50%, 70%, 95% and 100% dry, 30 min each step). 100% dry ethanol was changed twice, and the tissue was stored overnight at 4°C before Critical Point Drier (CPD) the next day.

Sample Preparation using Critical Point Drier (CPD K850)

The blue valve turned to clock wise to pre-cool the chamber to 5°C. The specimens were load and the chamber insert ensure thumb-screw correctly tightened. The green valve turn to clock wise to fill in the chamber with CO2 liquid. The specimens were soak and stirred for 3 minutes while maintaining the temperature below 10°C. The process were repeated for 3 times. The specimens were then heated for 35 minutes to reach the 35°C and 1250psi

pressure. The samples were de-pressurise for 20 minutes. The dried specimens were then stick on the aluminium stub attached with carbon tape for coating process. Samples were applied with platinum-coated before SEM imaging. The aim is to identify differences of trichome of the abaxial leaves

3.0 RESULTS AND DISCUSSION

3.1 Documentation, plant collection and specimen's identification

There are 47 species belonging to 21 genera of useful gingers had been documented for the Bidayuh of Singai and Jagoi. The usage of all useful gingers were documented and the status of the plants were identified. Out of these plants some are herbs, some are herbaceous type and some are gigantic plant type. The species that are endemic and listed under IUCN red list were recorded.). The local names are included based on the names commonly used by the Bidayuh of Jagoi and Singai area. The method of preparations, part used and usage of each species are included. Some of these plants were cultivated and sold in the local market and digital online selling platform, Timogah.com. such as *Zingiber officinale*, *Etlingera elatior*, *Kaempferia galanga* and *Curcuma longa*. Table 1 (List of documented useful Zingiberaceae among the Bidayuh community of Singai and Jagoi, Bau)

Table 1: List of documented useful Zingiberaceae among the Bidayuh community of Singai and Jagoi, Bau

No	Prefix (MK)	Genera	Species	Local Name	Part of used	Usage	Method of Preparation	Plant Description	Location 1
1	MK 1 (B)	<i>Geocharis</i>	<i>rubra Ridl</i>	Bunga birieh	Whole plant	Ornamental	Plant as ornamental	Wild ginger about 1 meter tall. The erect red inflorescence above the ground. Flowers are red, labellum yellow with reddish stripes	Mount Singai
2	MK 2 (B)	<i>Alpinia</i>	sp. Nov 1	Bua songet	Rhizome	The pounded rhizome is applied on skin diseases	The pounded rhizome is applied on skin diseases	Wild ginger about 1 meter tall. Green to black fruit	Mount Singai
3	MK 3 (B)	<i>Boeserbergia</i>	<i>pulchella</i> (Ridl.) Merr	Roi torun	Whole plant	To treat conjunctivitis	The whole plant pounded to extract the sap. The sap drops into the eyes	Wild ginger about 30-60cm tall. The erect red inflorescence is spindle-shaped bearing many flowers that opening 1-3 at a time. Flowers are white and red,	Mount Singa
4	MK 4 (B)	<i>Hornstedtia</i>	<i>reticulata</i> (K. Schum.) K. Schum	Topu torun	Stem	Handicraft	The sheaths of the leafy shoot are split into strips used for weaving mats, basket and tray.	Wild ginger about 3 meter tall. The red inflorescence above the ground. Flowers are red with reticulate bract.	Mount Singai
5	MK 5 (B)	<i>Sulettaria</i>	<i>longituba</i>	Bunga batuh	Whole plant	Ritual	Ritual	Wild ginger about 30cm tall. White flower	Mount Singai
6	MK 6 (B)	<i>Globba</i>	<i>astrosanguinea</i> Teijsm. &	Likuyang	Whole plant	To mitigate body pain	The pounded rhizome is use for	Wild ginger about 30cm tall. Red flower	Mount Singai & Jagoi

			Binn			after childbirth	massage the body of mother after childbirth		
7	MK 7 (B)	<i>Globba</i>	<i>brachyanthera</i> K . Schun	Bunga torun	<i>Whole plant</i>	To treat smallpox	The leaves and the young shoots are pounded into a fine paste and apply on the skin.	Wild ginger about 70cm tall. White flower	Mount Singai
8	MK 8 (B)	<i>Globba</i>	<i>pumila</i> Ridl.	Bunga torun	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 30cm tall. White flower	Mount Singai
9	MK 9 (B)	<i>Globba</i>	<i>francisci</i> Ridl	Bunga torun	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 30cm tall. Yellow flower	Mount Singai
10	MK 10 (B)	<i>Etingera</i>	<i>brevilabrum</i>	Bunga britik	<i>Rhizome</i>	The pounded rhizome is applied ton skin diseases	The pounded rhizome is applied ton skin diseases	Red flower. Has more or less patches of purple on the leaves, and very clear in young leaves	Mount Singai
11	MK 11 (B)	<i>Plagiostachys</i>	<i>crocydocalyx</i>	Bua manuk	<i>Whole plant</i>	Edible fruit	Edible fruit	Giant gingers about 3-4m tall, clump-forming plant has an enormous, slimy inflorescence and the flowers are yellow.	Mount Singai
12	MK 12 (B)	<i>Scaphochlamys</i>	<i>polyphylla</i> (K. Schum) B.L. Burt & R.M.Sm	Bunga dorod	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 30-40cm tall. White flower	Mount Singai
13	MK 13 (B)	<i>Amomum</i>	<i>longipedunculatum</i> R.M.Sm	Topu torun	<i>Whole plant</i>	Edible fruit	Edible fruit	Wild gingers about 1 m tall. Long erect peducles and cone	Mount Singai

								shape inflorescence. Green fruit	
14	MK 14 (B)	<i>Etilingera</i>	sp.	Topu torun	<i>Rhizome</i>	To treat skin diseases	The pounded rhizome is applied ton skin diseases	Wild gingers about 1.5m tall	Mount Singai
15	MK 15 (B)	<i>Zingiber</i>	sp.	Roi torun	<i>Whole plant</i>	To treat headache	The pounded rhizome produces flesh smell	Wild gingers about 70 m tall.	Mount Singai
16	MK 16 (B)	<i>Hornstedtia</i>	<i>conica</i> Ridl.	Topu torun	<i>Whole plant</i>	Edible fruit and young shoot	Edible fruit and young shoot	Wild gingers about 1.5m tall, inflorescence with white bracts and red margins. The flowers are with pink lip and a white centre	Mount Singai
17	MK 17 (B)	<i>Sundamomum</i>	<i>borealibornee nse</i> (I.M. Turner) A.D Poulsen & M.F Newman	Bunga sija	<i>Whole plant</i>	Edible fruit	Edible fruit	Wild gingers about 1 m tall, flower with white open labellum, yellow lip and red vein on the throat	Mount Singai
18	MK 18 (B)	<i>Sundamomum</i>	<i>laxesquamosu m</i> (S.Sakai & nagam.) A.D. Poulsen &M.F Newman	Bunga sija	<i>Whole plant</i>	Edible fruit	Edible fruit	Wild gingers about 1 m tall	Mount Singai
19	MK 19 (B)	<i>Alpinia</i>	<i>glabra</i> Ridl.	Sibodug	<i>Whole plant</i>	Edible fruit and young shoot	Edible fruit and young shoot	Wild gingers about 1 m tall, inflorescence terminal and the flowers are red. Green fruit.	Mount Singai

20	MK 20 (B)	<i>Alpinia</i>	<i>ligulata</i> K. Schum	Sibodug	Whole plant	Edible fruit and the leaves are for wrapping food	Edible fruit and the leaves are for wrapping food	Wild gingers about 1 m tall, inflorescence terminal and the flowers are yellowish Yellow fruit.	Mount Singai
21	MK 21 (B)	<i>Alpinia</i>	<i>havidandii</i> K. Schum	Topu tegak	Whole plant	To treat gastric	The rhizome is pounded and boil with water. The warm water taken as tea.	Wild gingers about 2 m tall, inflorescence terminal and the flowers are red. Green fruit.	Mount Singai
22	MK 22 (B)	<i>Alpinia</i>	<i>beamanii</i> R.M.Sm	Bua manuk	Whole plant	Edible fruit	Edible fruit	Wild gingers about 1 m tall, inflorescence terminal and the flowers are light green or creamy green. Green fruit.	Mount Singai
23	MK 23 (B)	<i>Meistera</i>	<i>gyrolophos</i> (R.M. Sm) Skornick & M.F. Newman	Bunga sija	Whole plant	Edible fruit	Edible fruit	Wild gingers about 1 m tall, inflorescence prostrates on the forest floor with numerous red bracts and bright orange labellum. Spiny green fruit.	Mount Singai
24	MK 24 (B)	<i>Etilingera</i>	<i>coccinea</i>	Topu	Stem	Food flavouring	The stem is cook with soup for food flavouring	Wild gingers about 2 m tall, inflorescence at ground level with numerous red flowers and long yellow lip with an enrolled and red margin. The stem produces aromatic smell.	Mount Singai

25	MK 25 (B)	<i>Alpinia</i>	<i>galanga</i> (L.) Willd.	Rikug	Rhizome	<ol style="list-style-type: none"> 1. To treat skin diseases 2. Food flavouring for sweet taste 3. To relief fever 	<ol style="list-style-type: none"> 1. The rhizome pounded and apply on the skin 2. The rhizome are pounded and cook with duck (talo) for food flavouring and give sweet taste 3. The rhizome pounded and used for massage 	Planted gingers about 2 m tall, inflorescence terminal. Rhizome taste sweet	Mount Jagoi
26	MK 26 (B)	<i>Etingera</i>	<i>elatiar</i> (Jack) R.M. Sm	Kantan	Inflorescence	Food flavouring	The stem is cook with soup for food flavouring	Cultivated gingers about 2 m tall, inflorescence is erect to 2m with pinkish bracts and recurved. Numerous red flower and long yellow lip with an inrilled and red margin.	Mount Jagoi
27	MK 27 (B)	<i>Curcuma</i>	<i>longa</i> Val.	Umi'et	Leaf and rhizome	<ol style="list-style-type: none"> 1. To treat diarrhoea 2. To treat wound 3. Food flavouring 	<ol style="list-style-type: none"> 1. The rhizome pounded to extract the juice. Drink the juice. 2. The rhizome pounded and rubbed onto the affected area. 3. he leaves are used in cooking for flavouring 	Planted gingers about 30 tall and fragrance smell of leaf. Rhizome with yellow colour	Mount Jagoi

28	MK 28 (B)	<i>Curcuma</i>	<i>zaedoria</i> Val.	Ta'mu budak	Rhizome	1. To lighten the skin 2. To treat white vaginal discharge 3. For Covid-19 prevention	1,2 & 3. The rhizome pounded and boiled in water for 30 minutes. Drink the water.	Planted gingers about 60 tall and fragrance smell of leaf with purple band along upper midribs. Rhizome with yellow colour	Mount Singai & Jagoi
29	MK 29 (B)	<i>Curcuma</i>	<i>domestica</i> Val.	Umi'et mopuk	Rhizome	1. To lighten the skin 2. To treat white vaginal discharge 3. For Covid-19 prevention	1,2 & 3. The rhizome pounded and boiled in water for 30 minutes. Drink the water.	Planted gingers about 60 tall and fragrance smell of leaf. Rhizome with yellow colour	Mount Jagoi
30	MK 29 (B)	<i>Zingiber</i>	<i>cassumunar</i> Roxb.	Ngolai	Rhizome	1. Used for massage mother after childbirth to improve blood circulation 2. For Covid-19 prevention	1. The rhizome pounded and poultice the abdomen of the mother and bandage 2. The rhizome sliced and boiled in water for 30 minutes. Drink the water.	Planted gingers about 40 tall and fragrance smell of leaf. Rhizome with yellow orange	Mount Jagoi
31	MK 30 (B)	<i>Zingiber</i>	<i>officinale</i> Roscoe	Ro'ie	Rhizome	To remove wind from the body	The rhizome pounded and boiled in water for 2-3 hours. Drink the water.	Planted gingers about 30m tall. Rhizome with spicy taste	Mount Jagoi

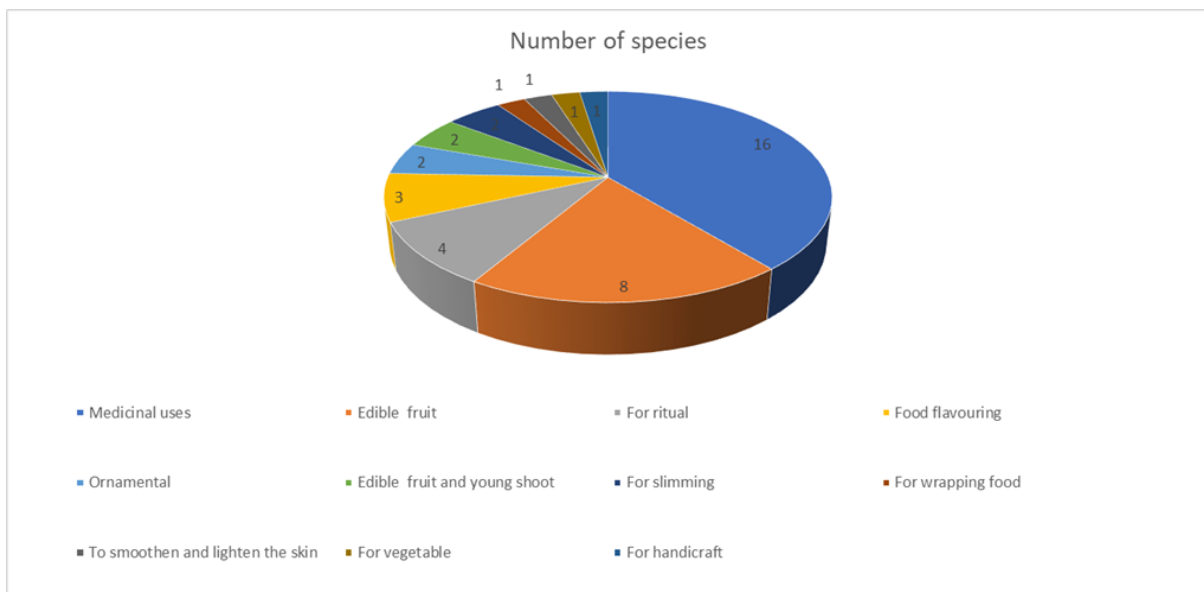
32	MK 31 (B)	<i>Amomum</i>	<i>oliganthum</i> K.Schum	Bua roja	Fruit	Edible fruit	Edible fruit	Wild gingers about 1 m tall, inflorescence on the ground and with cream to orange color of flower. Spiny green fruit.	Mount Jagoi
33	MK 32 (B)	<i>Zingiber</i>	<i>officinale</i> var <i>rubrum</i>	Ro'ie birieh	Rhizome	For slimming	The rhizome pounded and applied on the stomach	Planted gingers about 30m tall. Rhizome with spicy taste and red color	Mount Jagoi
34	MK 33 (B)	<i>Kaempferia</i>	<i>galanga</i>	Sokul	Rhizome	To remove wind from the body	The rhizome pounded and boiled in water for 2-3 hours. Drink the water.	Planted gingers about 20m tall. Rhizome with aromatic smell and cream color	Mount Jagoi
35	MK 34 (B)	<i>Plagiostachys</i>	<i>albiflora</i>	Bua manuk	Whole plant	To lower fever in baby	Mash the leaves and gengly rub on the forehead	Giant gingers about 3-4m tall, clump-forming plant has an enormous, slimy inflorescence and the flowers are yellow. Very stong sour smell of the fruit.	Mount Jagoi
36	MK 35 (B)	<i>Hedychium</i>	<i>coronarium</i>	Bunga stuli	Flower	To treat headache	The flowers are boil. The water is for bath	Wild ginger about 1m tall. Scented white flowers with yellow bases.	Mount Jagoi
37	MK 36 (B)	<i>Costus</i>	<i>speciosus</i>	Bunga buda	Rhizome	To treat diabetic and to lower the blood sugar level	The rhizome boiled in water for 30 minutes. Drink the water.	Wild ginger about 1m tall. Leaves spirally arranged on the stem. Rhizome tuberous, 1-2 cm thick, highly branched, yellowish green inside. Flower white, numerous, in dense spike and bracts ovate, acute, with	Mount Jagoi

								bright-red color.	
38	MK 37 (B)	<i>Curcuma</i>	<i>caesia</i> Roxb.	Miet songet	Rhizome	For skin care and slimming	The rhizome pounded and boiled in water for 30 minutes. Drink the water.	Wild ginger about 20cm tall. Black rhizome	Mount Jagoi
39	MK 38 (B)	<i>Ellatriopsis</i>	sp.	Dowen pangu	Leaf and rhizome	For vegetable	The leaves are cooked as vegetable	Planted gingers about 30 tall and fragrance (pangu) smell of leaf	Mount Jagoi
40	MK 39 (B)	<i>Amomum</i>	<i>cerasinum</i>	Bua torun	Fruit	Edible fruit	Edible fruit	The leafy shoot is about 3m tall, the corolla is cherry-red and the lip is white with red bands.	Mount Singai
41	MK 40 (B)	<i>Amomum</i>	<i>macroglossa</i> K. Schum	Bua torun	Fruit	Edible fruit	Edible fruit	A clump of leafy stem raised up on stilt roots. The inflorescence on a short peduncle end in a round flowering head with golden-brown bracts. Flowers have a large rounded white lip with a yellow centre.	Mount Singai
42	MK 41 (B)	<i>Amomum</i>	sp. nov	Dowen pangu	Leaf	To remove the bad smell on the hand or any part of the body	The leaves are rub on the hand	Wild gingers about 70cm tall and fragrance (pangu) smell of leaf	Mount Singai

43	MK 42 (B)	<i>Boeserbergia</i>	<i>grandis</i>	Jrangau	Root	To reduce the pain of toothache (numb agent)	The root are chew and put near to the tooth	Wild gingers about 25cm tall. White flower with yellow and red stripe	Mount Singai
44	MK 43 (B)	<i>Etilingera</i>	sp. nov	Topu torun	<i>Stem</i>	Food flavouring	The stem is cook with soup for food flavouring	Wild gingers about 2 m tall, inflorescence at ground level with numerous red flowers with long lip. The stem produces aromatic smell.	Mount Singai
45	MK 44 (B)	<i>Sulettaria</i>	<i>suculosa</i> (K.Schum.) A.D. Poulsen	Bua manuk	<i>Whole plant</i>	Ornamental	Plant as ornamental	A wild ginger forms clump of leafy shoots from spreading rhizomes, 2-3 m tall with 18-25 pairs of leaves. The inflorescence very long trailing on the soil surface or leaf litter. The flower are white.	Mount Singai
46	MK 45 (B)	<i>Zingiber</i>	sp. nov	Bunga pink	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 70cm tall. The leaves are broad 4-6 pairs. The bracts are pink color, erect and peduncle about 10-15cm.	Mount Singai
47	MK 46 (B)	<i>Zingiber</i>	sp. nov	Bunga birieh	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 70cm tall. The leaves are broad 4-6 pairs. The bracts are pink red, not so erect and peduncle about 10-15cm.	Mount Singai
48	MK 47 (B)	<i>Globba</i>	<i>rubra</i> Ridl	Bunga buda	<i>Whole plant</i>	Ornamental	Plant as ornamental	Wild ginger about 30cm tall. White flower	Mount Singai & Jagoi

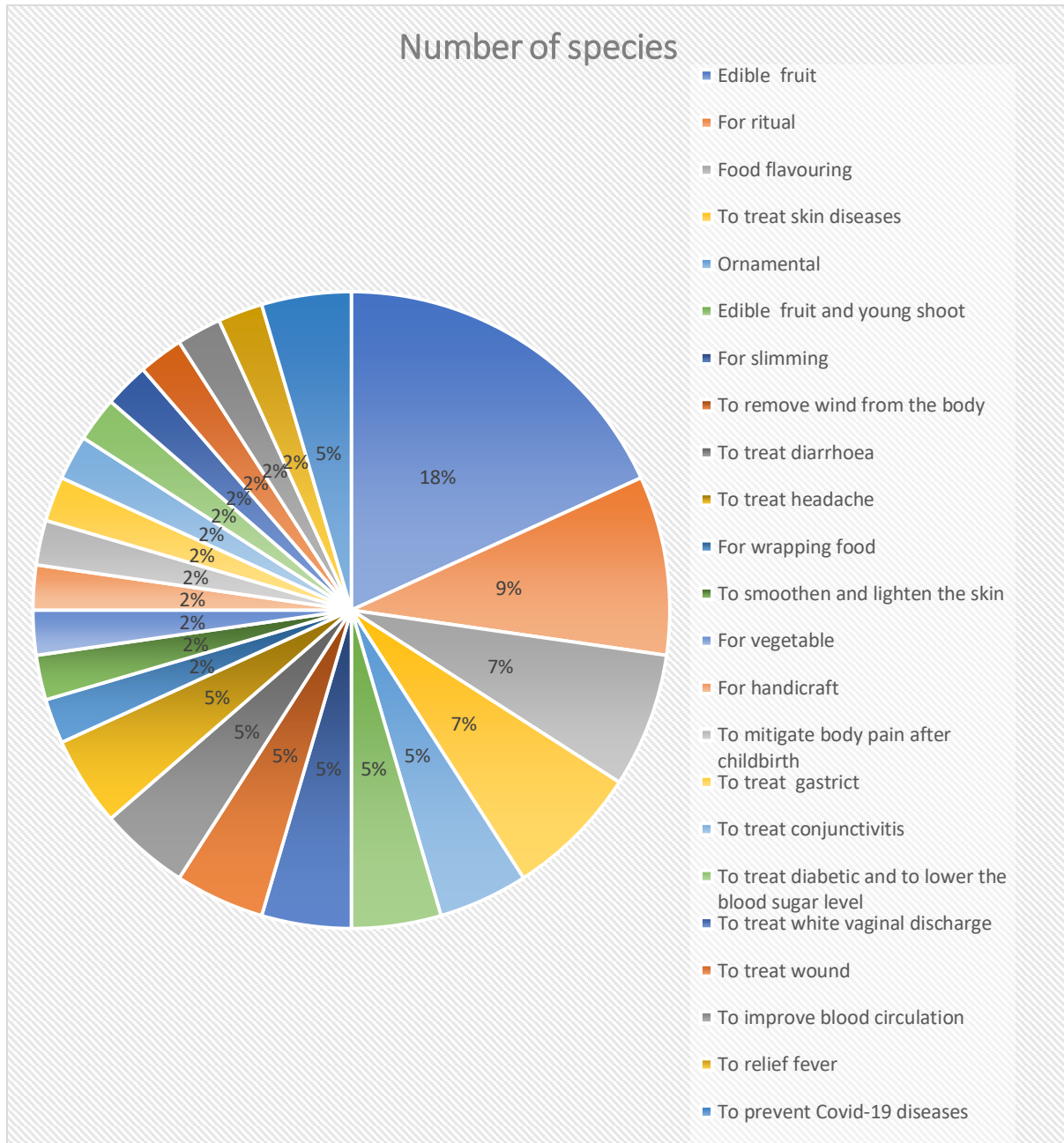
3.2 Pattern of utilization

Bidayuh community in both areas, Jagoi and Singai are use single plant or mix different plants as a medicine in a single disease. It is also found that a single plant is used in different diseases. Of these, 16 species are indicated by informants as medicinal plant, 8 species are indicated by informants as edible fruit, 4 species for ritual, 3 species for food flavouring, 2 for ornamental and 1 species each are for slimming, wrapping food, skin care, vegetable and handicraft. (Appendix 1).



3.3 Documentation of useful Zingiberaceae for medicinal purposes

All these plants have been recorded to treat 12 human diseases. Out of these plants some are herbs, some are herbaceous type and some are gigantic plant type. Bidayuh community in both areas, Jagoi and Singai are use single plant or mix different plants as a medicine in a single disease. It is also found that a single plant is used in different diseases. Most of the plants used for the treatment of skin diseases, diarrhoea, headache, gastric, conjunctivitis, white vaginal discharge, diabetic, wound to lower the blood sugar level, to remove wind from the body, to mitigate body pain after childbirth, to improve blood circulation and to prevent Covid-19 diseases.

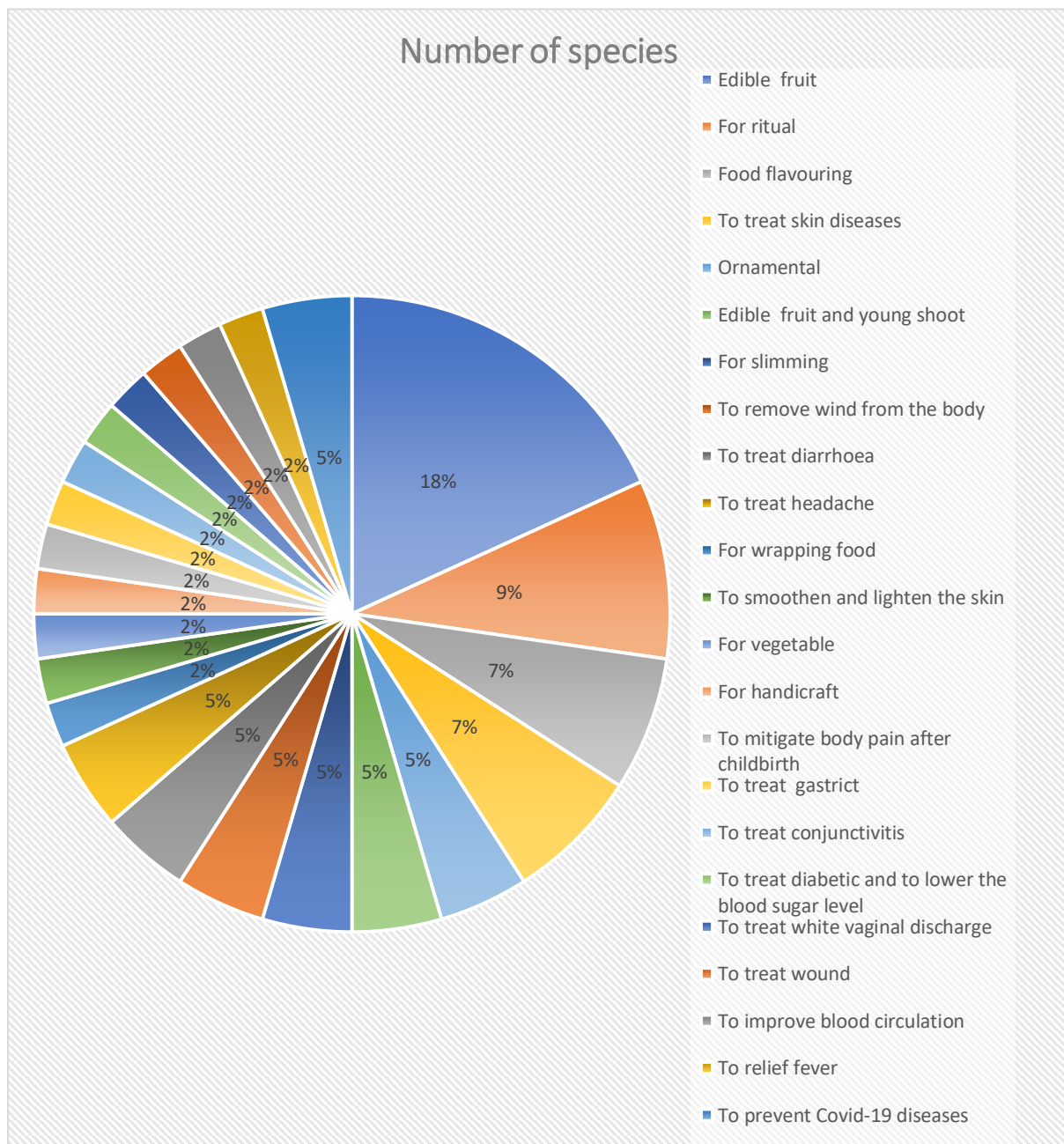


Appendix 2: Pattern of Utilization of Zingiberaceae for medicinal purposes

3.4 Documentation of useful Zingiberaceae for medicinal purposes

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Appendix 2: Pattern of Utilization of Zingiberaceae for medicinal purposes

3.5 Comparative leaf anatomy and micromorphological of useful Zingiberaceae by Bidayuh community in Jagoi and Singai Bau

Members of the family Zingiberaceae have been used for centuries in traditional medicine. Some of the wild species in the forest had been used in generation for medicinal, however, the species of this useful ginger is unknown. The population of this species become decrease

and the traditional knowledge of this species become faded. The taxonomic problems that cannot be solved completely via the classification based only on classical morphology have been solved recently via the use of modern taxonomic parameters. Of these parameters, the anatomic and micromorphological characteristics are frequently used. The use of anatomic and micro morphological characteristics for certain groups of plants is of importance to eliminate the uncertainties regarding the classification (İçeli, 2011).

3.6 Identification of anatomic characteristics for useful Zingiberaceae using Microscope digital camera

During the field work, the sample of the useful Zingiberaceae was selected randomly. The leaf anatomy of this useful Zingiberaceae was identified. Results show that there is interspecific variation in the structure of the leaf midrib and petiole which can be used for species identification. It is also part of a study to investigate the possibility of using leaf anatomy for possible identification of the species in Zingiberaceae, a difficult task due to similarities in leaf morphology and plant habit as well as infrequency in flowering.

3.7 Generic anatomical descriptions

Lamina

I. Epidermal Cells

In species with no hypodermis, adaxial cells wide and tall (Figs 1-9)

II. Hypodermis

Present adaxially (Figs 1-9)

III. Chlorenchyma

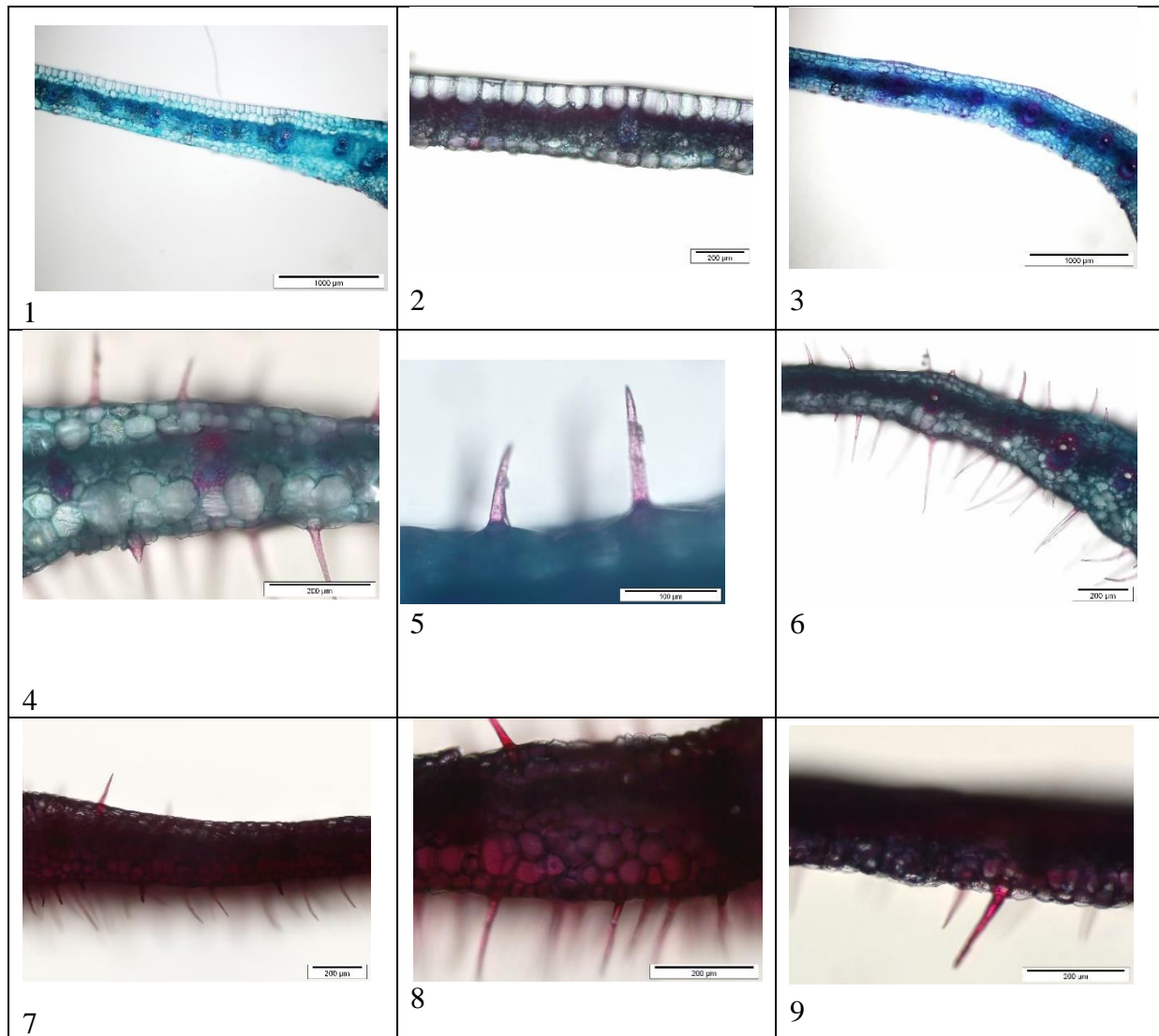
Palisade cells in 1-2 layers in certain species, the second layer smaller and wider and resembling mesophyll cells, sometimes making it indistinguishable; spongy cells in 2-6 layers.

IV. Vascular Bundles

Collateral bundles with tracheary elements consisting of 1-2 metaxylem elements and few protoxylem cells flanked by colourless parenchyma laterally. Fibre cells usually form abaxial and adaxial caps, extending to abaxial epidermal cells in all species except *Boesernbergia* (Figs 1,2,3). In large bundles, fibres extend as girders to the adaxial epidermis or hypodermis in all species; in smaller bundles fibres form adaxial caps only.

V. Crystals

Solitary crystals present in mesophyll cells of all species observed; silica bodies occur in adaxial and abaxial epidermal cells above and below veins, one silica body per cell.



Figures 1- 3. Transverse sections of leaf lamina of *Boesenbergia pulchella* (Ridl.) Merr. Fig 1: Middle part of lamina of *Boesenbergia pulchella* (Ridl.) Merr. Scale bars = 1000 μm . Fig 2: Apex part of lamina of *Boesenbergia pulchella* (Ridl.) Merr. Scale bars = 200 μm . and Fig 3: Base part of lamina of *Boesenbergia pulchella* (Ridl.) Merr. Scale bars = 1000 μm .

Figures 4- 6. Transverse sections of leaf lamina of *Globba rubra* Ridl. Fig. 4: Middle part of lamina of *Globba rubra*. Fig 5: Simple and unicellular trichome of *Globba rubra* at base part of lamina. Scale bars = 200 μm . Fig 6: Base part of lamina of *Globba rubra*. Scale bars = 200 μm .

Figures 7-9. Transverse sections of leaf lamina of *Globba astrosanguinea* Teijsm. & Binn. Fig. 7: Middle part of lamina of *Globba astrosanguinea* Teijsm. & Binn Fig 8: Simple and unicellular trichome of *Globba astrosanguinea* Teijsm. & Binn at base part of lamina. Scale bars = 200 μm . Fig 9: Apex part of lamina of *Globba astrosanguinea* Teijsm. & Binn Scale bars = 200 μm .

i. Midrib

I. Outline

Adaxial surface flat to curved, abaxial surface arced to V-shaped for *Boesenbergia pulchella* (Ridl.) Merr. *Globba astrosanguinea* Teijsm. & Binn and *Globba rubra* Ridl (fig 10-18)

II. Trichomes

Simple, unicellular in some species (fig 13-18).

III. Collenchyma

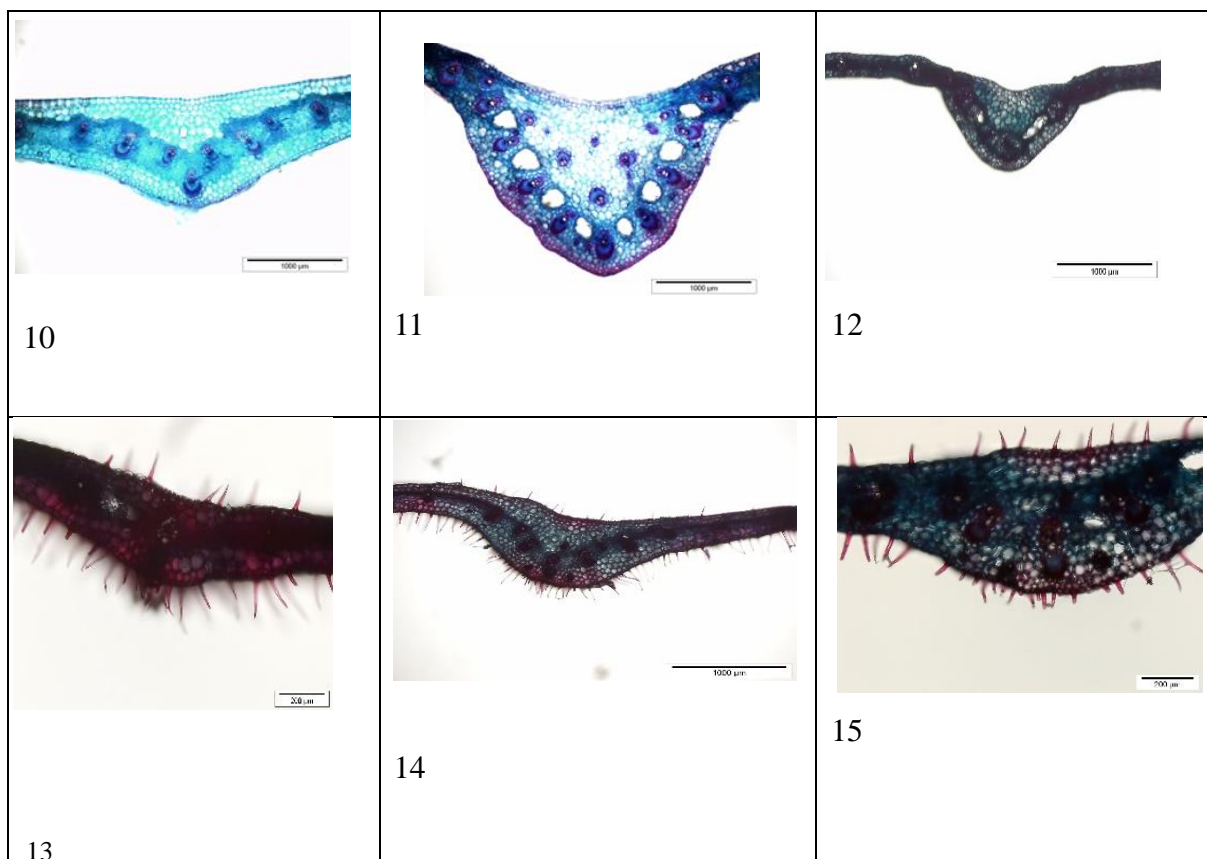
Annular and thick-walled cells present as fibre-like cells below adaxial epidermis (Fig. 11,15, 16,17 & 18).

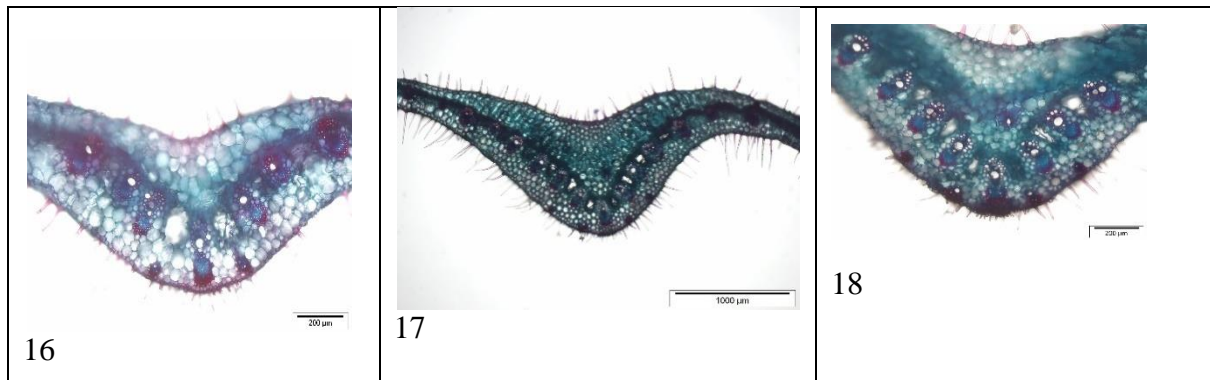
IV. Vascular Tissue

Scattered vascular bundles are distributed among the parenchyma cells close to the adaxial epidermis (Figs 10-18).

V. Crystals

Solitary in parenchyma cells in all species.



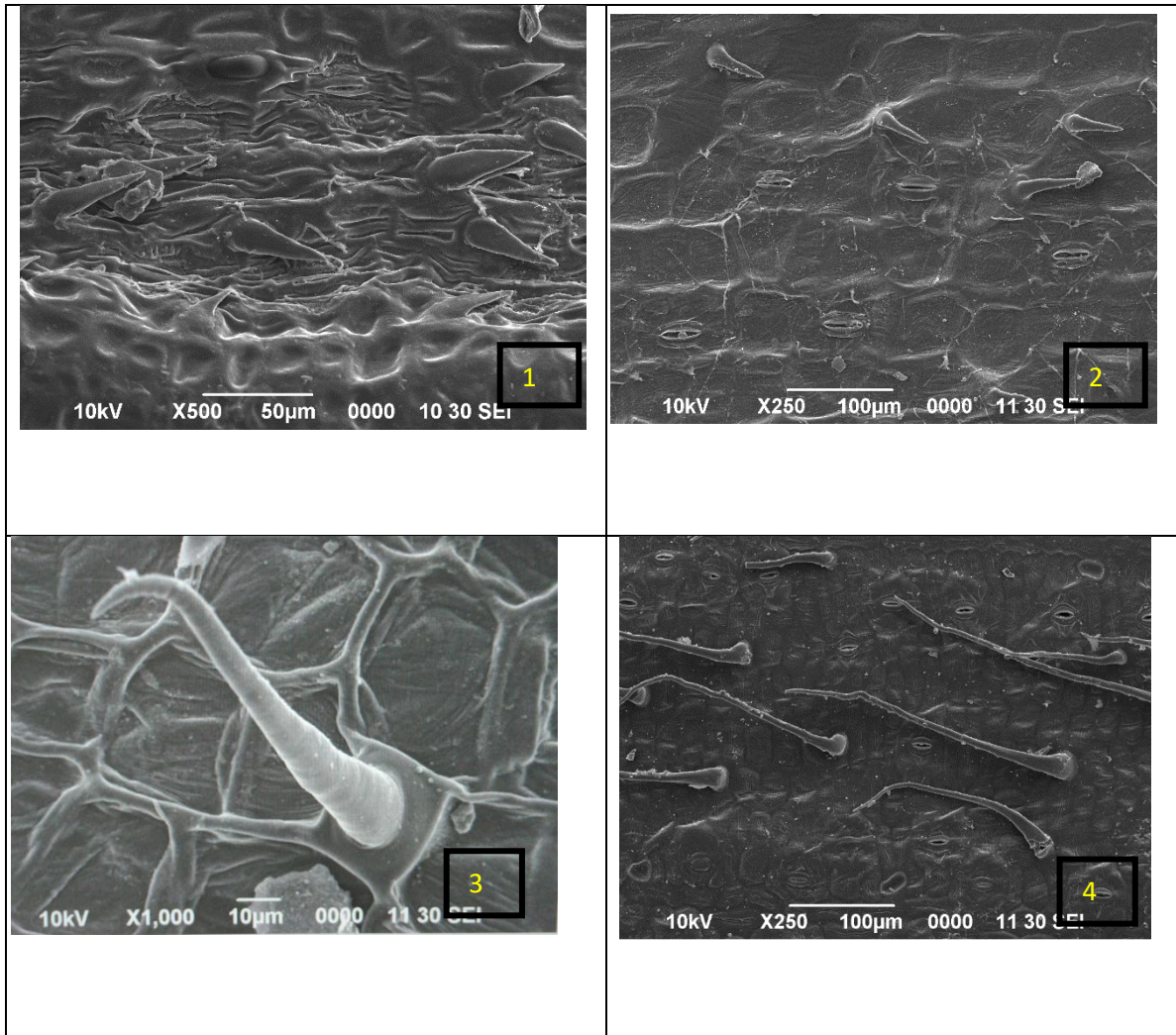


Figures 10-11. Transverse sections of leaf midribs of *Boesenbergia pulchella* (Ridl.) Merr.
Fig 12: Middle part of leaf midrib of *Curcuma zaedoria*. Scale bars = 1000 µm.
Figures 13-15. Transverse sections of leaf midribs of *Globba astrosanguinea* Teijsm. & Binn
Fig 13. Middle part of midrib of *Globba astrosanguinea* Teijsm. & Binn. Scale bars = 200 µm.
Fig 14: Base part of midrib of *Globba astrosanguinea* Teijsm. & Binn. Scale bars = 1000 µm.
Fig 15. Simple, unicellular trichome of *Globba astrosanguinea* Teijsm. & Binn
Figures 16-18. Transverse sections of leaf midribs of *Globba rubra* Ridl. Fig. 16: Middle part of midrib of *Globba rubra*. Fig 17: Apex part of midrib of *Globba rubra*. Scale bars = 200 µm.
Fig 18: Base part of midrib of *Globba rubra*. Scale bars = 200 µm.

3.8 Identification of micro morphological characteristic using Scanning Electron Microscopy (SEM)

The science of morphology is important for the definition and classification of taxa and their relation to certain groups. Micro morphological studies on plants enable micro-level analysis of pollens, leaves, tissues, seeds etc. of plants via scanning electron microscope (SEM). Scanning electron microscope provides high zoom via high resolution imaging techniques. Therefore, it is possible to obtain morphological, structural, and elemental information from the plants at high zoom levels. The micromorphology characteristics of the plant part can be useful in distinguishing the species. It is clear that many structures or characteristics of plants that look the same or similar when analyzed morphologically indeed differ from one another when micromorphological analysis is conducted via scanning electron microscope. In this sense, micromorphological analyses are useful to distinguish and identify the current species while detecting the new species and taxa. During the field work, the complete sample of this species was collected. The leaf micromorphological of this useful Zingiberaceae was identified. Results show that there are difference micromorphology characteristics among the species.

3.9 Taxonomic significance of trichome micromorphology in useful Zingiberaceae



Scanning electron micrographs of Zingiberaceae. 1 – *Alpinia* sp. nov 2- *Amomum* sp. nov Abaxial surface showing short, simple, non -glandular trichomes, pyramidal, thick-walled and unicellular trichome, 3- *Globba astrosanguinea* Teijsm. & Binn. 4- *Sulettaria* sp. nov. Abaxial surface showing long, simple, non -glandular trichomes, pyramidal, and smooth walled

4.0 CONCLUSION

The Bidayuh community still depends on the natural resources of Singai and Jagoi forest for medicine, vegetable, fruits and handicrafts making. Many species of gingers were recorded to be used traditionally as herbal medicines and general wellness. Some of the species are sold as herbal tea and are commonly used to remove excess wing from body. *Zingiber officinale* or the local ginger is one of the traditional folk medicinal plants that have been used for generation for treating diabetes, high blood pressure, cancer, fitness and many other illnesses. It is anticipated that in the future, the ginger species will continue to become the treasure trove of useful photochemical and extracts for use in the cosmetics and pharmaceutical industry. Innovation in the area of gingers for use in cosmetic products is

largely consumer-driven. Today's consumer demands products that are safe, natural, and sustainable but still effective and economical

The information on microscopy of leaf anatomy and micromorphological characteristic can be used for species identification of the useful Zingiberaceae especially when it is difficult to identify due to similarities in leaf morphology and plant habit as well as infrequency in flowering. The common characteristics in found in useful Zingiberaceae show as following:

- They are found singular without a glandular tip.
- They are highly variable in shape varying from small protuberances of epidermal cells to very complex.
- Huge number of non-glandular trichomes is present on abaxial surface.

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