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ZINGIBER MACRADENIUM K. SCHUM, AN ENDEMIC GINGER FROM SUMATERA: TRADITIONAL USE AND ANTIMICROBE POTENTIAL

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ABSTRACT

The Zingiber genus has 84 species and varieties in the Malesia region, one of which is Zingiber macradenium K. Schum. This species is endemic to Sumatra. Zingiber macradenium K. Schum with the local name Lampuriang has been used as a toothache medicine by local people in several locations in West Sumatra. This study conducted in-depth interviews with 8 (eight) key informants who were guided by a questionnaire and the data were analyzed qualitatively and quantitatively using the ICS (Index of Cultural Significance) and UV (Use Value) formulas, antibacterial test using the paper disc diffusion method. The results of the study show that the rhizome of Z. macradenium is used in addition to treating itching, lumbago and other uses by means of research. Antibacterial test showed potential as an antibacterial with a strong inhibitory diameter.

KEYWORDS

Zingiber macradenium, Zingiberaceae, Endemic, Ethnobotany, Antibacterial

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INTRODUCTION

Zingiber is a genus with high species diversity in the Zingiberaceae family. Eighty-four (84) species and varieties of Zingiber have been identified from the Malesia region (Newman et al, 2004) and at least 18 species of them have been found in Sumatra (Ardiyani, 2015; Nurainas and Arbain, 2017). One type of this family is Zingiber macradenium K. Schum. This species was described by Karl Schumman in 1878 based on type specimens collected at Sunge Bulu, Padang, West Sumatra (IPNI, 2020). The rarity status recorded on the IUCN Red List Zingiber macradenium is VU (vulnerable; vulnerable). This is thought to be due to the declining population due to habitat degradation (Orlander, 2020).

Zingiber macradenium, known locally as Lampuriang, has been used by local people as a mouthwash for toothaches. However, this use has not been scientifically proven. Although scientific information is still very limited, the use of this plant is still used as an alternative solution to public health problems.

Previously, studies on the utilization and chemical activity of the Zingiberaceae family with materials originating from Sumatra have been actively carried out by several researchers. The results found that local communities in using Zingiberaceae not only cultivated species, but also used wild species both in medicine and for various other purposes (Jalius and Muswita, 2013; Auliani, et al., 2014; Hartanto et al., 2014). The results also reveal that several Zingiberaceae species originating from West Sumatra have the potential to be developed for various purposes. Praptiwi et al (2015) found 18 species from West Sumatra which showed antioxidant activity capable of binding free radicals. The wild type Elettariopsis slahmong has the potential to be used as a biopesticide for diseases in cocoa plants (Nasir, 2017). Other data from ethnobotanical research on medicinal plants in the Mentawai noted that about 75% of the 32 species from the Zingiberaceae family have been used by sikerei in traditional medicine (Nurainas et al., 2021).

The purpose of this study was to reveal the use of Zingiber macradenium through an ethnobotanical approach. The actibacterial test was carried out to obtain preliminary scientific data that supports the use of this species in the future. The results of this study can be used as scientific data for the use of plants as herbal medicines which are alternative solutions for health problems.

RESEARCH METHOD

This study was conducted in two locations in the province of West Sumatra, namely Rantih Village, Sawahlunto City and Nagari Sungai Buluh Timur, Padang Pariama Regency (Figure 1). Study materials are in the form of self-collected samples and materials that have been stored at the Andalas University Herbarium (ANDA). Utilization data was obtained through depth interviews in the field to 8 (eight) key informants (herbalists, community leaders, and people who know and use these plants). Interviews were conducted directly with guided questionnaires. The questionnaire refers to RISTOJA (2017) with some modifications.

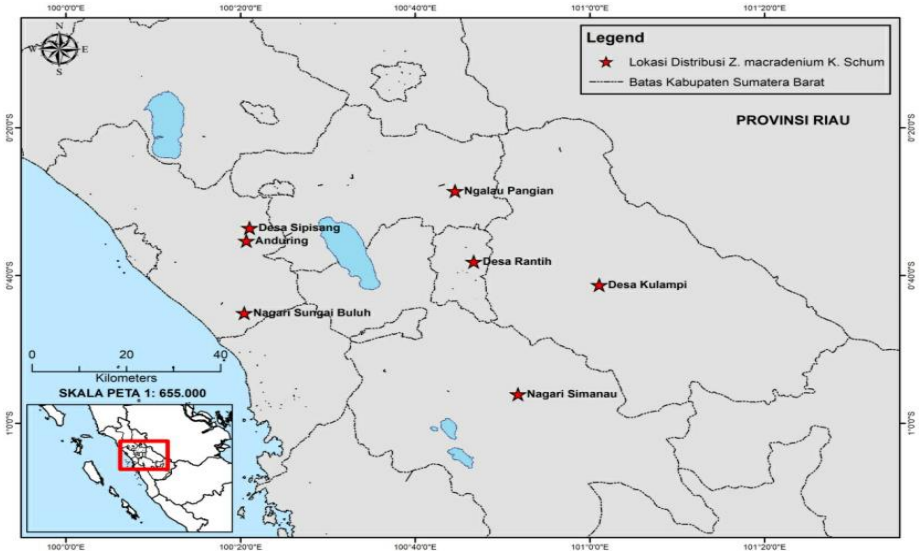

Figure 1. Distribution Map of Zingiber macradenium K. Schum in West Sumatra (Source: ArcGIS 10.4)

The antibacterial test was carried out at the Biotechnology laboratory, Sumatra Biota Laboratory, Andalas University, Padang. The method used is Kirby-Bauer diffusion or paper disc diffusion to determine the inhibition zone formed on the media in millimeter units (Bonang and Koeswardono, 1979). The material used was the brewed extract of Z. macradenium rhizome from each research location. The medium used is Sodium Agar (NA). The test bacteria used was Streptococcus mutans from the Biotechnology Laboratory, Sumatra Biota Laboratory, Andalas University, Padang. Phytochemical qualitative analysis was carried out at the Central Laboratory of Chemical Analysis, LIPI, Serpong using the screening method (Harborne, 1987).

RESULT AND DISCUSSION

A. Traditional Uses of Zingiber Macradenium K. Schum

Zingiber Macradenium is a herbaceous plant that is found growing on the banks of rivers or damp places on the edge of the forest. This species is a wild plant that is not planted intentionally. Based on data from specimens at the Andalas University Herbarium (ANDA), administratively this species was found in seven locations in 5 districts/cities. Altitudinally, this species is found in the plains to the lower mountains (Table 1 and Figure 1).

Table 1. Distribution of Lampuriang in West Sumatra Province

No	Location	Regency/City	Altitude (m dpl)
1	Sungai buluh	Padang Pariaman	80-100
2	Sipisang	Padang Pariaman	150-250
3	Kampung Tangah	Padang Pariaman	80-210
4	Tigo Lurah	Solok	800-1000
5	Lintau Buo	Tanah Datar	270-300
6	Rantih	Sawahlunto	200-300
7	Kulampi	Sijunjung	200-300

Zingiber macradenium is a herbaceous, terrestrial plant, 2.5–3 m tall, 20 leaves on the stem; rhizome below the soil surface, the outer surface is rough and hairy, the flesh of the rhizome is yellow-pink, aromatic. Leaves: midrib green, glabrous; ligules 0.2–0.5 cm short, rounded tips, glabrous, green color; petiole short, green; leaf blade glabrous, oblong, 22–58 cm x 2.5–8 cm, flat edge, acuminatus tip. Compound flowers 60–80 cm long, 3-4 flowers bloom together. Tubular flowers, 7–8 cm long; bract enclosing single flower, spathulate, 2.5–3 x 6–7 cm, apex rounded, green, glabrous; bracteola lanceolate, 5.5–6 x 0.5–1 cm, apex acuminatus, beige, glabrous; tubular calyx, 1.5–2.5 x 0.5–1.5 cm, white, glabrous; floral tube 5-6 cm long, cream color, glabrous; dorsal corolla lobe triangular-ovatus, 0.3–0.4 x 0.5–-1 cm, beige, glabrous; lateral corolla lobes ovatus, 0.2–0.3 x 0.5–1 cm, beige, glabrous; labellum subtrilobed, 4–4.5 x 2.5–3 cm, dark purple with yellow spots, tip split. Laminar stamens 5–6 cm long, cream-yellow, glabrous; anther 4–5 x 0.3–0.5 cm, yellow with appendage appendages 1.5–1.7 cm long, purple with black tips, glabrous. filiform style; stigma white color, 5-7 cm; epigenous glands 2, subulata, cream-yellow color, glabrous. Ovaries 0.2–0.3 x 0.1–0.2 cm silent, white, glabrous.

Figure 2. Zingiber macradenium K. Schum. A: The plant habit. B: Details of ligules. C: Inflorescence. D: A Flower. E: Details of stamen and ovary with epigenous glands. F: Dissection of flower (from left): bract, bracteole, calyx, dorsal and lateral corolla lobes, labellum, ovary with style, stigma and epigenous glands, floral tube with stamen attach. (A-F: Linda Agustin, 0044782, fl) Photos by Linda Agustin (Scale bar: E=5 cm; F= 3 cm)

Based on interviews that have been conducted with key informants in Rantih Village, Sawahlunto City, it was found that the form of utilization of Zingiber macradenium K. Schum is for mouthwash, itching medicine, back pain medicine, and other uses here which are meant for herbal medicin use (Table 2). The main form of utilization used by the community is for mouthwash. There are no values of local wisdom in the taking of materials and processing of Z. macradenium plants. This plant is still classified as a wild plant and there has been no conservation effort by the community in

the form of cultivation.

Table 2. Utilization of Zingiber macradenium by the people of Rantih Village, Sawahlunto City

Form of Utilization	Part of Utilization	Processing Method
Mouthwash	rhizome	The rhizome of Z. macradenium is taken to taste, washed, crushed or roughly sliced, boiled into one glass of water, then the boiled water was gargled
Back pain medicine	rhizome	almost the same as mouthwash, but the water is drunk
Itching medicine	rhizome	A little more rhizome is used, and the cooking water was used for bathing and splashed on the itchy body part
Other Uses	rhizome	The dried rhizome of Z. macradenium is used as a mixture with pepper and other ingredients, chewed by traditional healers and sprayed on patients with witchcraft

The Index of Cultural Significance (ICS) value is a quantitative analysis to measure the level of cultural significance of a plant species for a community group. The results showed that the ICS value for Z. macradenium was 9.5 which was categorized as very low (Turner, 1988). This ICS value compared to close relatives is also very low (Table 3). This is because the cultural use of Z. macradenium by people in West Sumatra is still low because this plant is still little known, its use is only for toothache medicine and is also an endemic plant when compared to species found in the literature that have been commonly used and widely cultivated. . The low value of ICS is also due to the fact that people are more likely to use common drugs on the market to treat a disease.

Table 3. Comparison of ICS values of Zingiber macradenium K. Schum. with close relatives from various locations

Species Name	Research Location	Score ICS	Category	Source
Z. *macradenium* K. Schum	Sumatera Barat	9,5	Very Low	Current Research

				Results
Zingiber officinale Rosc.	Pasuruan, Jawa Timur	48	Enough	Oktavianti, 2013
Hornstedtia scottiana (F. Muell.) K. Schum.	Manokwari, Papua	80	High	Sutarno, 2010
Alpinia oseanica Burkill	Manokwari, Papua	56	High	Sutarno, 2010
Curcuma domestica Val.	Manokwari, Papua	30	Enough	Sutarno, 2010

UV value (Use Value) is a quantitative analysis to determine the value of the use of a species by a community. The results showed that the UV value for Z. macradenium was 0.5. This UV value compared to Z. officinale and C. longa was low (Table 4). This is because people still rarely use these plants, only limited to treatment. In addition, this plant still grows wild and is rarely recognized. Z. macradenium plants are also classified as endemic plants, so the use of this species is not like the literature comparison species that have been known and used in general and cultivation efforts have been made.

Table 4. Comparison of UV values of Zingiber macradenium K. Schum with its close relatives from various locations

Species Name	Research Location	Score UV	Category	Source
Z. *macradenium*	Sumatera Barat	0,50	Low	Current Research Results
Z. *officinale*	Bali	1,00	High	Oktavia, I Dewa dan Wawan, 2017
Alpinia galanga	Bali	0,22	Low	Sujarwo *et al.*, 2018
A. *galanga*	Bali	0,80	Low	Oktavia *et al.*, 2017
C. *viridiflora*	Bali	0,22	Low	Sujarwo *et al.*, 2018
C. *longa*	Bali	1,00	High	Oktavia *et al*, 2017

Antibacterial Test

Based on the research that has been carried out regarding the antibacterial test against Streptococcus mutans using the extract of the Zingiber macradenium K. Schum rhizome brewed extract, it was shown that there was an inhibition zone for the growth of these bacteria (Table 5).

Table 5. The results of the average inhibition of the extract of Zingiber macradenium K. Schum rhizome brewed extract against the growth of Streptococcus mutans

No	Treatment	Average diameter of inhibition zone (mm)		Category	
		Sample A	Sample B	Sample A	Sample B
1	Control + (Amoxycillin)	48,12	44,78	SK	SK
2	Control – (Aquades steril)	-	-	-	-
3	Extract Concentration100%	12,35	-	K	-
4	Extract Concentration 50%	22,76	-	SK	-
5	Extract Concentration 25%	28,44	12,07	SK	K

Note: (-) not formed; (SK) is very strong; (K) strong;

Based on Table 5. it is known that the extract of Zingiber macradenium rhizome brewed had the highest inhibition zone in Sample A (Sungai Buluh, Padang Pariaman Regency) at a concentration of 25% at 28.44 mm. As for Sample B (Rantih Village, Sawahlunto City) the inhibition zone was only formed at a concentration of 25% with an inhibition zone diameter of 12.07 mm. This means that the effective concentration in inhibiting Streptococcus mutans bacteria is at a concentration of 25%. As for the concentration of 50% and 100% in Sample B, no inhibition zone was formed. This is thought to be caused by the concentration of secondary metabolites contained in each extract is too high, thus inhibiting the formation of inhibition zones. The secondary metabolite content through phytochemical screening contains saponins, alkaloids, and terpenoids/steroids.

B. Discussion

1) Uses of Zingiber macradenium

The Zingiberaceae family is known by the Indonesian people as the ginger group. This plant is widely used by the community as cooking spices, medicines, spices, ornamental plants, cosmetic ingredients, beverage ingredients, hair tonic ingredients, supporting traditional ceremonies, and so on (Auliani et al., 2014). This is because Zingiber contains bioactive compounds including gingerols, shogaols, diarylheptanoids, phenylbutenoids, flavonoids, diterpenoids, and sesquiterpenoids which have been widely studied from the aspect of their activity as antibacterial, antitussive, and antioxidant (Sivasothy et al., 2011; Tejasari et al., 2002; Tajkarimi et al., 2010; Shafri-rad et al., 2017).

The plant part of Zingiber macradenium used for all types of the most widely used plant parts as medicine by the community are roots (56.75%), stems (10.81%), bark or trees (10.81%), seeds (2.7%). , latex (2.7%), and fruit (2.7%).

Processing methods for all forms of use are generally boiled, but utilization is fresh rhizome, except for witchcraft treatment using dry rhizome. According to Husain (2015) in other uses (drug treatment) the rhizome is chewed with other ingredients and sprayed on to the patient. Other ethnobotanical studies of plants from the Zingiberaceae family include Z. ottensii, Z. zerumbet, Hornstedtia scottina, and Z. officinale. The ethnobotanical value of this species is as a medicinal plant, to treat postpartum diseases, to facilitate breastfeeding, to cure itching, fever, joint pain, fatigue and cough (Marliani et al., 2018; Devi et al., 2017; Silalahi et al. ., 2018; Tapundu et al., 2015). The method of processing is by washing the rhizome, grated, then drinking the boiled water (Arum, 2012). In addition, the methanol extract of Z. ottensii has anti-cancer properties which are

indicated by the presence of cell antiproliferation and stimulates apoptosis in breast cancer cells (Sinaga, 2014). Another ethnobotanical value of Z. zerumbet is for its traditional magical rituals. The way of processing the rhizome is mixed with red ginger and garlic, grated, the water is squeezed then mixed with lemongrass oil and then used as a basting oil (Handayani, 2015).

Based on the ethnobotanical study of Z. macradenium, it is known that the ICS value and UV value are relatively low due to the lack of knowledge of this species by the community so that this species has the potential to be domesticated. According to the Big Indonesian Dictionary (KBBI), domestication is the taming of wild animals or wild animals and so on. Meanwhile, according to PP No. 48 of 2011 concerning Animal Genetic Resources and Livestock Breeding in article 16 paragraph 4 states that domestication is a "taming" process carried out on wild animals. The difference is, if taming is more on individuals, domestication involves populations, such as selection (improvement of offspring), as well as changes in the behavior/nature of the wildlife that is the object. Domestication is also carried out on plants in cultivation efforts. Ethnobotany is closely related to domestication because it is related to the use of a plant and also ecological science to determine biotic and abiotic conditions in the domestication process (Walujo, 2011). Z. macradenium is one of the plants that has the potential to be domesticated because of the potential use of useful spices and other uses.

2) Antibacterial Test

The diameter of the inhibition zone formed at concentrations of 50% and 100% in each sample is also due to the extract used in the form of brewed extract so that the bioactive compounds contained will synergize with each other to influence and form an inhibition zone. The results will be different if a pure extract from a plant part is used, the greater the concentration, the greater the diameter of the inhibition zone formed. This is in accordance with the research of Angelika et al. (2014) that pure methanolic extract of E. hirta was able to form the largest inhibition zone on the test bacteria S. aureus, E. coli, and R. solanaceaerum at a concentration of 100%. This is also in accordance with Andries et al. (2014) regarding clove flower extract against S. mutans in vitro. Sriwidasari's research (2010) using ginger extract (Z. officinale Roscoe) against S. mutans showed antibacterial properties in the presence of an inhibitory zone at a concentration of 6.25 mg/ml. Then the research of Alibasyah, Ridha and Ana (2016) using ginger extract (Z.officinale Roscoe) on Porphyromona ggivalis bacteria has antibacterial potential at a concentration of 6.25% with an average inhibition zone diameter of 10.6 mm although it is included in the weak category.

The secondary metabolite content of several other Zingiberaceae family species including Z. zerumbet has the sesquiterpene zerumbone, 1,8-cineole and -humulene. Z. graffitbii has cathecol and phyrogallol, flavonoids and terpenoids. Z. cassumunar has flavonoids, terpenoids, alkaloids, steroids, and benzene (Singh et al., 2015). Z. officinale has ar-curcumene, geranial, camphene, eucalyptol, isobornyl formate, -zingiberene (Rad et al., 2017).

CONCLUSION

Based on the results of research and discussion, it can be concluded that Zingiber macradenium is still used by some people in West Sumatra until now as a mouthwash, itching, backache. The community's traditional knowledge of plants seems to be decreasing, this can be seen from the low UV and ICS values of plants. Zingiber macradenium has potential as an antimicrobial which can be seen from the diameter of its strong inhibitory power.

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