

The application of medicinal plants in the local community of Gantara Forest, Southeast Sulawesi, Indonesia

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Abstract. Hamzah N, Husna, Ruslin, Arba M. 2022. *The application of medicinal plants in the local community of Gantara Forest, Southeast Sulawesi, Indonesia. Biodiversitas 23: 6557-6563.* The local community around Forest Management Unit (FMU) Gantara (Gantara Forest) has traditionally utilized medicinal plants, especially people in Liwu Metingki Village of Muna District, Southeast Sulawesi Province, Indonesia, yet the least information on its application has been recorded. This study investigated the traditional application of medicinal plants by the local community nearby Gantara Forest, specifically Liwu Metingki Village. Exploratory research was implemented using the multi-method approach of field observation and a semi-structured interview with 17 traditional practitioners living around Gantara Forest. The study successfully collected and identified 34 potential medicinal plants in 20 families to treat 21 diseases. Most plants have a habitus of the tree (39%), which 67% of the local community apply as traditional herbs. Boiling has become the most popular practice in using medicinal plants of the local community (45%) to obtain benefits from the plants against internal diseases (37%). This finding demonstrates the vital role of sustainable management of Gantara Forest for human health. With this finding, the community is strongly expected to understand the significant role of medicinal plants, so they can attempt to protect the plants by, for example, planting them in their yards.

Keywords: Euphorbiaceae, Wallacea, internal diseases, leaf

INTRODUCTION

Medicinal plants include all plant species proven to have medicinal properties (Setiawan and Qiptiyah 2014). Bana et al. (2016) stated that at least 40,000 species of medicinal plants have been used by people around the world, of which 30,000 species are in Indonesia and 1,260 species are found in forests. This finding indicates abundant biodiversity of medicinal plants as a part of forest resources that must be preserved.

Medicinal plants have long been used in various parts of the world and have even become a culture for local communities (Son et al. 2019; Nugroho et al. 2022; Zaki et al. 2019; Thompson et al. 2019). Among what has been published on the use of medicinal plants in Uganda (Gumisiriza et al. 2019), found 302 species of medicinal plants consisting of 211 species, 65 families, and 165 genera, and 91 species were not detected. In Turkey, Karakose (2022) identified 128 species of medicinal plants, classified into 54 families and 106 genera. In Ethiopia (Getachew et al. 2022), 50 medicinal plants were identified. In India, 128 plant species were identified and classified into 111 genera and 56 families (Radha et al. 2022). In East China, 121 species of medicinal plants from 54 families were identified (Xiong 2020). Finally, in Argentina, 204 species of medicinal plants were identified that are used by the community as medicinal plants (Kujawska and Schmeda-Hirschmann 2022).

In Indonesia, various studies have reported the use of

medicinal plants by local communities to treat diseases, including malaria, fever, diarrhea, skin pain, ulcers, jaundice, and abdominal pain (Wibisono and Azham 2017; Yusro et al. 2019; Nugroho et al. 2022). For example, in their research, Afifah et al. (2022) revealed that as many as 229 medicinal plants in Indonesia from 70 families were used to treat diabetes mellitus.

A literature review has identified more than 940 medicinal plant species utilized throughout Indonesia (Yasir and Asnah 2018). The people of Sumatra use 114 species of medicinal plants from 51 families (Lubis et al. 2022). Two hundred four of these have been used by the local people of Southeast Sulawesi (Afifah et al. 2021). Many local communities in Southeast Sulawesi have applied medicinal plants as an alternative treatment against diseases, including 126 plant species utilized by the Wolio ethnic group in Baubau (Slamet and Andrias 2018), 20 species in Poleang, Bombana District (Saranani et al. 2021), 21 species in Abelisawah Village of Konawe District (Raodah 2019), and 61 species in Muna District (Albasri et al. 2018).

Studies on medicinal plant utilization in Muna District have yet to be completely distributed, although reports in several sites are available. Some published papers have recorded medicinal plants in the Nature Reserve Forest of Napabalano (Ernikawati et al. 2017), Kabangka (Kasmawati et al. 2019), Jompi Forest of Katobu (Ernikawati et al. 2020), Wuna City Settlement (Jumiarni and Komalasari 2017), and Wantiworo Village of Kabawo

(Bana et al. 2016). In addition to the listed sites, many other sites pose medicinal plants and have been utilized by the local community, one of which is the Forest Management Unit (FMU) Gantara (Gantara Forest).

Gantara Forest occupies an area of 18,587 Ha. Based on the block division, Production Forest-Utilization of Environmental Service Areas and Non-Timber Forest Products (HHBK) is the largest one with 4,759 Ha or 26% of the total managed forest area (RPHJP KPHP Gantara 2019). Non-timber products of the forest include fruits from candlenut (*Aleurites moluccanus*), leaves from melinjo (*Gnetum gnemon*), barks from cullilawan (*Cinnamomum culilaban*), and other medicinal plants. The area of Gantara Forest covers six districts and 22 villages, including Liwu Metingki Village.

For the people of Liwu Metingki Village, Gantara Forest has become a place to live and most of their needs are there. Forests have provided hundreds of plants used for water, medicinal, health care, culinary purposes, and even construction needs. The people of Liwu Metingki use plants around them for health care and medicinal purposes. They utilize fruit, leaves, bark, and roots in traditional medicine. This community experience needs to be developed and preserved so that it is scientifically tested for the development of modern medicine. Therefore, this study examines the application of medicinal plants by the Liwu Metingki community who reside around Gantara Forest, Muna District, Southeast Sulawesi.

MATERIALS AND METHODS

Study area

This study was conducted in Forest Management Unit (FMU/KPH) Gantara (Gantara Forest) of Liwu Metingki

Village, Muna District, Southeast Sulawesi Province, Indonesia (Figure 1). The location is directly adjacent to Gantara Forest, geographically located at 04°43'58.52" S-05°07'30.06" S and 122°46'09.08" E-122°56'44.85" E. Based on the preliminary survey, there are traditional practitioners such as shamans (*sando*), masseurs, and people who understand and implement the traditional use of medicinal plants.

Data collection

Data collection was carried out in March-July 2021. Information on medicinal plants was obtained through semi-structured interviews and direct observations of people's lives. Before conducting the interviews, we provided an overview of the research to be carried out to the informants, including the benefits to be obtained and the risks that were likely to occur for individuals and the community. Informants have the right to refuse to participate in research. Only informants who have obtained a description of the research and are willing to provide their information will be interviewed.

Interviews were conducted with 17 respondents selected by snowball sampling based on the initial informant. The determined respondents consisted of shamans (*sando*), traditional birth attendants, traditional healers who apply a decoction of medicinal plants (*lansau*), masseurs, and village elders (10 men and 7 women in total). Medicinal plants are applied in various ways by them, namely boiling, soaking, attaching directly to the treated area, or drying. In addition field observation was carried out by observing the environmental situation at the site, such as forests, settlements, and house yards.

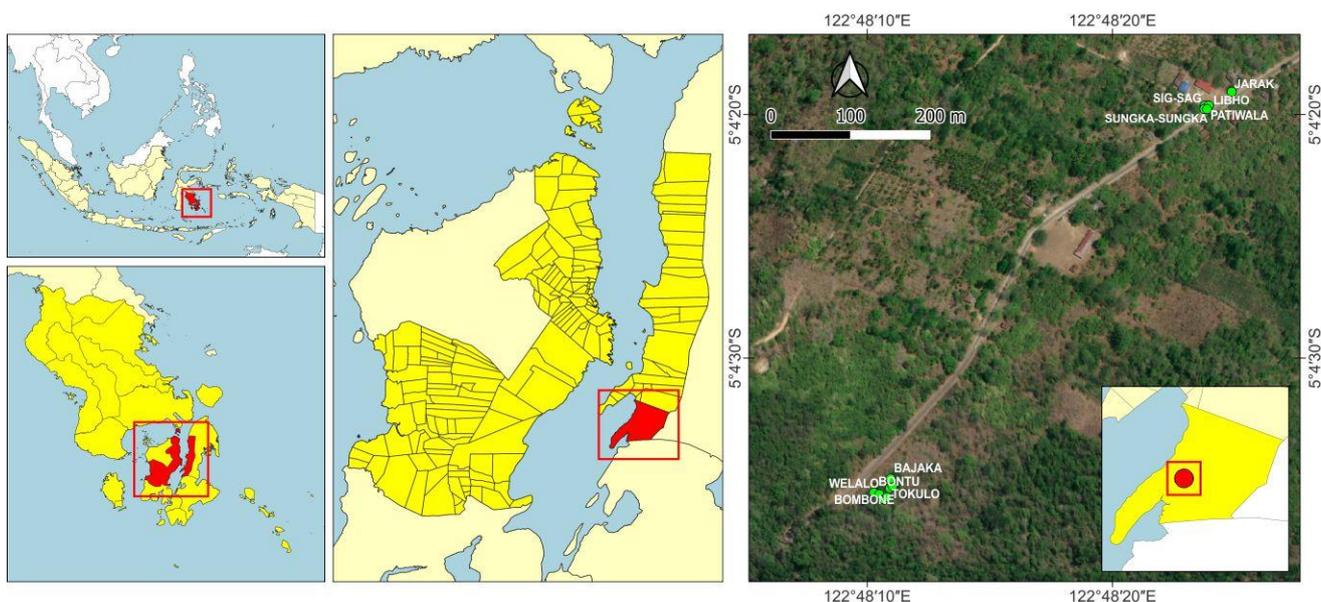


Figure 1. Study site in Gantara Forest of Liwu Metingki Village, Muna District, Southeast Sulawesi Province, Indonesia

Data analysis

Descriptive analysis was performed to present the finding by tabulating the information into tables. The available information includes family names, scientific names and local names of plants, plant habitus, plant parts applied for medication, diseases being cured, and methods of processing plant parts.

RESULTS AND DISCUSSION

The medicinal plant has been used to maintain health by preventing and treating diseases, for chronic diseases (Getachew 2022). Traditional medicine is increasingly popular nowadays, and people have a pattern of living back to nature. The study identified 34 plant species from 20 families as potential medicinal plants to cure 21 diseases

(Table 1). The high number of plant species shows that the research area has a rich diversity of flora used to treat various diseases and traditional knowledge about medicinal plants in the community (Gumisiriza 2019).

Among 20 families, *Euphorbiaceae* is the most common family at the site. This finding is in line with previous research in Muna District, Ermikawati et al. (2020) in Jompi Forest and Jumiarni and Oom Komalasari (2017) in Wuna City Settlement, where the domination of medicinal plants are from *Euphorbiaceae*. The Turkish community also uses the *Euphorbiaceae* family (Karakose 2022) and is part of the Ethiopian community (Getechew 2022). Differences in the family and species of medicinal plants used may be due to plant availability and socio-cultural differences in the community.

Table 1. Medicinal plants in Gantara Forest and the utilization by Liwu Metingki Village community

Family, species, and local name	Habitus	Used part	Target diseases and processing method
Asteraceae			
<i>Chromolaena odorata</i> L.;	Shrub	Leaf, stem	Internal disease: Leaf and stem are taken sufficiently and put into two cups of water, boiled until it becomes one glass, then drunk.
Sungka-sungka/ Komba-komba			
<i>Blumea balsamifera</i> (L.) DC;	Herb	Leaf	Internal disease: ± 7 leaves are grounded, then drunk.
Kaambu-embu/ Sambong			
<i>Lantana camara</i> L.;	Shrub	Leaf	Wound treatment: ± 15 leaves are crushed to release water, then dripped on the wound (especially for new wounds).
Patiwala/ Tembelekan			
Apocynaceae			
<i>Alstonia scholaris</i> L.;	Tree	Leaf	Internal disease: Leaves are taken sufficiently and boiled in the water, then drunk.
Gompanga/ Pulai			
Annonaceae			
<i>Annona muricata</i> L.;	Tree	Leaf	Internal disease: Leaves are taken sufficiently and boiled in the water, then drunk.
Sirkaya/ Sirsak			Fever treatment. Leaf attached to the forehead of a sufferer.
Acanthaceae			
<i>Andrographis paniculata</i>	Herb	Leaf	Swelling: Leaves are brewed with hot water, then drunk
(Burm.f.) Nees;			
Sambiloto			
Dioscoreaceae			
<i>Dioscorea hispida</i> Dennst.;	Forb	Tuber	Wounds from breast cancer. Tubers are mashed, then attached to the injured part.
Kolope/ Gadung			
Euphorbiaceae			
<i>Euphorbia hirta</i> L.;	Herb	Leaf	Internal disease: Leaves are taken sufficiently and boiled in the water, then drunk.
Patikan kebo/ Kapati-pati			
		Leaf, stem, root	Gastric pain: 6-10 plants are boiled in the water using a clay-made pot until getting 2 cups of water, then drunk.
		Leaf	Swelling. Leaves are brewed with hot water, then drunk.
<i>Aleurites moluccana</i> (L.) Wild.;	Tree	Bark	Internal disease: Leaves are taken sufficiently and boiled in the water, then drunk.
Beau/ Kemiri			
<i>Jatropha curcas</i> L.;	Forb	Leaf	Internal disease: ± 7 leaves are taken sufficiently and put into two cups of water, boiled until it becomes one glass, then drunk.
Jarak			
<i>Phyllanthus niruri</i> L.;	Shrub	Leaf, Root	Internal disease: Leaf and root are boiled, then drunk.
Kaghai-ghaino wulawo/			
Meniran			
<i>Euphorbia tithymaloides</i> L.;	Forb	Sap	Wound treatment: Stem or leaf is cut down to release sap, then dripped onto the wound.
Sig-sag			Toothache: The sap is applied to the aching tooth.
<i>Codiaeum variegatum</i> (L.) Rumph. Ex	Forb	Root	Syphilis: Roots are cut into pieces, boiled in water, then drunk.
A.Juss.;			
Puring			

Fabaceae				
<i>Spatholobus littoralis</i> Hassk; Lui feti/Bajaka	Climber	Stem		Internal disease: The wood stem is cut, and the water that comes out is drunk. Wood stems are cut into small pieces, dried, boiled to get water color changes to reddish, then drunk.
<i>Cassia alata</i> L.; Saubandara/ Ketepeng cina	Shrub	Leaf		Skin diseases (phlegm, scabies, ringworm): The leaves are grounded, smeared/pasted on the skin affected by ringworm/phlegm
Lamiaceae				
<i>Vitex cofassus</i> Reinw.ex Blume; Bitti	Tree	Leaf		Fever treatment. Leaves are attached to the forehead of a sufferer. Wound treatment: ± 15 leaves are crushed to release water, then dripped on the wound.
<i>Coleus atropurpureus</i> Benth.;	Shrub	Leaf		Feverish. Leaves are soaked in drinking water for + 15 minutes, and then drunk.
Miana/ Myana				
<i>Ocimum sanctum</i> L.;	Shrub	Leaf		Asthma: Leaves are squeezed, filtered to get extracted water, and then drunk.
Tulasi/ Kemangi hutan				Deworming treatment: Leaf and salt are squeezed together, filtered to get extracted water, then drunk.
Lauraceae				
<i>Persea Americana</i> Mill.;	Tree	Leaf		Kidney stone: ± 9 leaves boiled with 2 cups of water to get 1 cup of water, then drunk.
Alpukat				Appendicitis: ± 7 leaves are brewed with a half cup of hot water, then drunk. Cyst: ± 9 leaves are boiled with 2 cups of water to get 1 cup of water, then drunk.
Malvaceae				
<i>Ceiba pentandra</i> (L.) Gaertn.;	Tree	Leaf		Fever treatment: Young leaves are soaked in water, then drunk.
Kapuk randu				
<i>Hibiscus tiliaceus</i> L.;	Tree	Leaf		Fever treatment: Leaves are brewed with hot water, then drunk.
Bontu/ Waru				Dandruff treatment: Leaves are crushed and then rubbed on the scalp.
Moraceae				
<i>Ficus septica</i> Burm.f.;	Tree	Root		Internal disease: Roots are boiled, and then drunk.
Libho/ Awar-awar		Leaf		Red eye: The leave are attached on the part near the red eye.
Menispermaceae				
<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thompson;	Shrub	Stem		Internal disease: The stem is boiled, then drunk.
Maradhawali/ brotowali				
Musaceae				
<i>Musa paradisiaca</i> L	Herb	Hump		Breast cancer. Newly grown bananas have no leaves yet, are grated, and attached to the wounds of people with breast cancer.
Banana				
Myrtaceae				
<i>Psidium Guajava</i> L.;	Tree	Leaf		Diarrhea: 7 young leaves are boiled, Then drunk.
Jambu batu/ Jambu biji				Cough: Top leaves are chewed and swallowed for the juice.
Rutaceae				
<i>Aegle marmelos</i> (L.) Correa;	Tree	Fruit		Diabetes. The inside of the fruit is removed, the skin of the fruit is dried under the sunlight, and applied as a dinner plate and drinking glass.
Kolobe/ Maja				
Poaceae				
<i>Imperata cylindrica</i> L./	Shrub	Root		Internal disease: Cut into smaller pieces, boil with 3 cups to become 1 cup, and drink.
Reeds grass				
Sapindaceae				
<i>Erioglossum rubiginosum</i> (Roxb.) Blume;	Tree	Bark		Internal disease: The wood is peeled for the skin, brewed with warm water, then drunk.
bombone/ Katilayu				
Solanaceae				
<i>Solanum torvum</i> Sw;	Shrub	Fruit		Internal disease: Fruit is boiled or cooked as a vegetable, then eaten.
kabangkara/ terong hutan				
<i>Brugmansia candida</i> Pers.;	Herb	Leaf		Cough. 7 leaves boiled to get a glass of water, then drunk.
Kecubung				
Tiliaceae				
<i>Tilia platyphyllos</i> Scop	Tree	Leaf		Jaundice. Boiled and then drink the water.
Thymelaeaceae				
<i>Phaleria macrocarpa</i> (Scheff.) Boerl.;	Tree	Fruit		Internal disease: Fruit is peeled and then dried. Dried fruit is boiled, then drunk.
Mahkota dewa		Leaf		Itchy rash. Leaves are crushed and then used for bathing in the affected child.
Zingiberaceae				
<i>Curcuma domestica</i> Valetton;	Shrub	Rhizome		Wound treatment: The rhizome is pounded and then attached to the wound.
Kunyit				Gastric pain: The rhizome is peeled, grated, filtered to get extracted water, mixed with honey and free-range chicken egg yolk, then drunk

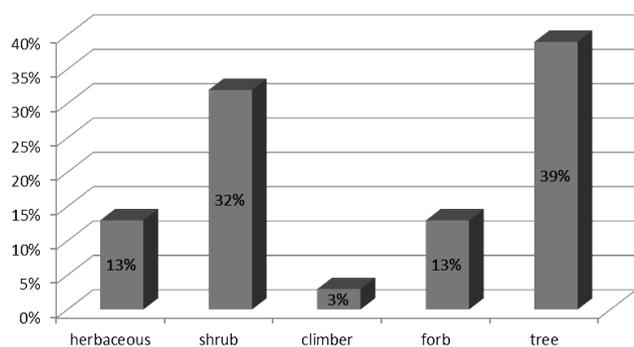


Figure 2. Distribution of medicinal plant habitus used by the local community around Gantara Forest, Liwu Metingki Village

Habitus-based medicinal plant classification

The most frequent habitus of medicinal plants applied for traditional medication is a tree (39%), followed by shrub (32%), herbaceous (13%), forb (13%), and climber (3%) (see Figure 2). Plants with tree habitus are widely used as a source of medicine by the local community around the Lambung Mangkurat Educational Forest, South Kalimantan (Nugroho et al. 2022), local community of Lambitu Sub-district, Bima District (Azmin et al. 2019), and Manobo Tribe of the Philippines (Dapar et al. 2020). Some other countries also use trees as a source of natural medicinal ingredients (Karakose 2022; Radha et al. 2022). The more common use of the tree is led by a belief that all parts of the tree, specifically in leaves, roots, and barks, contain beneficial compounds. However, trees are less effective for long-term use because they require a long time to cultivate.

The use of medicinal plants based on habitus depends on the region and the habits of the people in the area where they live. For example, in contrast to this study, a study in Uganda (Gumisiriza et al. 2019) showed that the most dominant habitus used as medicinal ingredients was herbal. Likewise, in Ethiopia (Getachew et al. 2022), herbs are most widely used as medicine compared to other habitus.

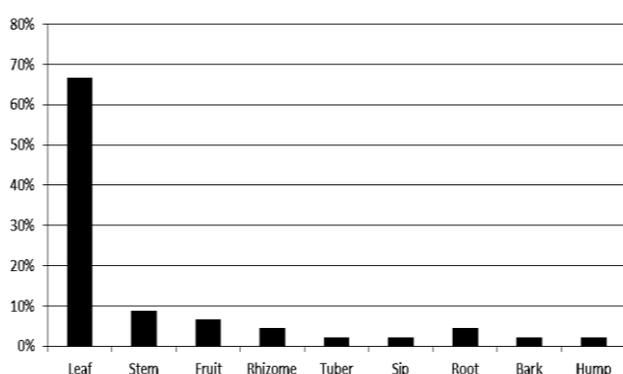


Figure 3. Distribution of medicinal plant parts used by the local community around Gantara Forest, Liwu Metingki Village

Medicinal plant parts for treatment

The frequent use of certain plant parts can demonstrate their high therapeutic potential. The potency of plant parts can be increased through engineering to produce more of the required compounds through agronomic biofortification. For some plants, more than one part is used to make herbal medicine for the same or different diseases. In addition, the same part of the plant can be used to treat different ailments depending on the method of preparation used. Most of the medicinal plants are wild and abundant plants (41%), followed by wild and rare plants (21%), so paying attention to the parts used is an important thing to do (Gumisiriza et al. 2019).

The leaf is the medication's most frequently used plant part (67%). Meanwhile, other parts applied for the medication (consecutively from the most to the least) are stem (9%), fruit (7%), rhizome (4%), root (4%), tuber (2%), sap (2%), root (2%), bark (2%), and hump (see Figure 3). Other reports also highlighted the highest utilization of leaves in medicinal plants (Kumalasari 2017; Ernikwati et al. 2017; Dapar et al. 2020).

The leaf is part of a plant that is often reported as a medicinal ingredient throughout the world, including Pakistan (Umair et al. 2017), Italy (Leto et al. 2013), Indonesia (Ramadhani et al. 2021; Az-Zahrah et al. 2021), and Malaysia (Ramli et al. 2021). Uganda (Gumisiriza et al. 2019), Turkey (Karakose 2022), Ethiopia (Getachew et al. 2022), and China (Xiong 2020). Ethnobotanical research in different parts of Ethiopia revealed that the leaf is the most often used plant for herbal remedy formulation.

The leaf is commonly used as its diverse content of secondary metabolites (Assi et al. 2017; Simanjuntak 2018; Jain et al. 2019; Fatmawati et al. 2020; Gurning and Sinaga 2020), strong or highly active compounds (Malini et al. 2017; Simanjuntak 2018), abundant availability (Mustofa et al. 2020), easy to harvest (Malini et al. 2017; Mustofa et al. 2020), and easy to process (Ramadhani et al. 2021). Most leaves are applied simply by boiling or soaking in warm water. In addition, harvesting leaves does not lead to lethal effects (Qamariah et al. 2020), promotes high regeneration (Susanti et al. 2018), and makes it easy to grow back after harvesting (Qamariah et al. 2020).

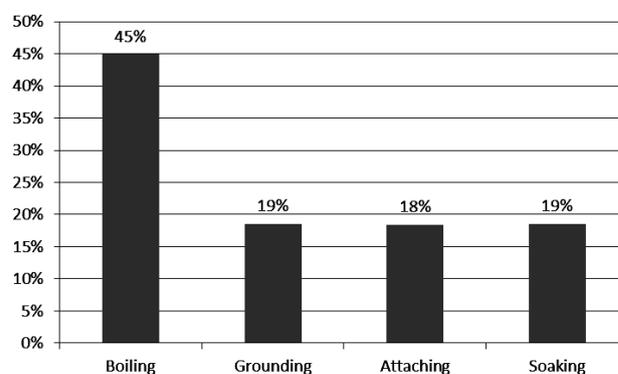


Figure 4. Distribution of methods applied for medicinal plant utilization used by the local community around Gantara Forest, Liwu Metingki Village

The use of leaves for medication in Indonesia has been reported to be practiced by the Kaili tribe in Central Sulawesi (Ifandi et al. 2016), the community of Mamuju, West Sulawesi (Syamsiah et al. 2016), the Tengger tribe in East Java (Jadid et al. 2020), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), Karo tribe in North Sumatra (Affandi and Batubara 2019), Banjar, Bugis, and Dayak tribes in South Kalimantan (Radam et al. 2016), and four sub-ethnics of Dayak in West Kalimantan (Yusro et al. 2014).

Utilization of leaves for medicinal purposes can be considered a good practice because they are easily renewed and harvested without harm to plants (Teklay et al. 2013). However, the fact that some plants shed their leaves during the dry season can create difficulties in harvesting, especially if the fresh parts will be used for preparation (Getechew 2022). In addition, leaf harvesting threatens medicinal plants because its transfer inhibits the development of flowers and fruit/seeds from the vegetative form (Abera et al. 2014; Chen et al. 2016).

Processing and utilization of medicinal plants

Interviews with the people of Liwu Metingki Village revealed the long-standing practice of using medicinal plants. This knowledge is generally passed down from generation to generation, as reported by Az-Zahrah et al. (2021) and Simanjuntak (2018) in Indonesia, Ramli et al. (2021) in Malaysia, Sulaiman et al. (2022) in Nigeria, and Milo and Sibanda (2022) in Zimbabwe.

General methods of using medicinal plants by a community of Liwu Metingki Village are boiling, brewing, grounding, or attaching to the affected part. The most applied processing method is boiling, which reaches 45%. This method is also reported to be applied by the Kanayatn Dayak tribe in West Kalimantan, who consider its effectiveness in healing (Sari et al. 2021). In some countries, the boiling method is also the most widely used, including China (Xiong 2020).

Boiling is believed to be more effective in macerating bioactive compounds into boiling water (Gumisiriza et al. 2019; Xiong 2020; Ramli et al. 2021; Luardini et al. 2021). In addition, most medicinal plants use water as a solvent, probably because water is easier to obtain and can dissolve many active components, which are believed to be able to cure diseases more effectively (Gumisiriza et al. 2019).

Target diseases of medicinal plants

Based on the results, 34 medicinal plants have been used to treat 21 diseases. The internal disease is the most targeted disease, with a percentage of 37%. Internal disease is a complex disease, often suffered by most people, and has various types and symptoms (Ahlulquist et al. 2022). Krajczyk et al. (2020) recorded 91 internal diseases, including chest tightness, cold sweat, fatigue, and fever.

Overall, this study recorded 34 medicinal plants from 20 families spread across all habitus (herbaceous, shrub, climber, forb, and tree) available in Gantara Forest and utilized by the people of Liwu Metingki Village. The identified plants have been applied to treat 21 diseases. The leaf is part of the plant widely used for treatment, mostly

applied by boiling. Further tests in phytochemical and pharmacology studies are needed to test medicinal plants used by the community. Furthermore, given the large community's need for medicinal plants, the protection of medicinal plants needs to be done by maintaining their habitat and encouraging local communities to plant them in their gardens/yards (in situ conservation) and cultivation areas (ex situ conservation).

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REFERENCES

- Abera B. 2014. Medicinal plants used in traditional medicine by Oromo people, Ghimbi District, Southwest Ethiopia. *J Ethnobiol Ethnomed* 10 (1): 115. DOI: 10.1186/1746-4269-10-40.
- Affandi O, Batubara R. 2019. Study of medicinal plant used by the Ethnic Community of Karo around Lau Debuk-Debuk Tourism Park, Indonesia. *IOP Conf Ser Earth Environ Sci* 374: 1-8. DOI: 10.1088/1755-1315/374/1/012055.
- Afifah FH, Nugroho AE, Rohman A, Sujarwo W. 2022. A review of medicinal plants for the treatment of diabetes mellitus: The case of Indonesia. *South Afr J Bot* 149: 537-558. DOI: 10.1016/j.sajb.2022.06.042.
- Ahlulquist S, Hsiue PP, Chen CJ, Shi B, Upfill-Brown A, Stavrakis AI. 2022. Renal disease is a risk factor for complications and mortality after open reduction internal fixation of proximal humerus fractures. *JSES Intl* 6 (5): 736-742. DOI: 10.1016/j.jseint.2022.05.015.
- Assi RA, Darwis Y, Abdulbaqi IM, Khan AA, Vuanghao L, Laghari MH. 2017. *Morinda citrifolia* (Noni): A comprehensive review on its industrial uses, pharmacological activities, and clinical trials. *Arab J Chem* 10 (5): 691-707. DOI: 10.1016/j.arabjc.2015.06.018.
- Azmin N, Rahmawati A, Hidayatullah E. 2019. Uji kandungan fitokimia dan etnobotani tumbuhan obat tradisional berbasis pengetahuan lokal di Kecamatan Lambitu, Kabupaten Bima. *Florea: Jurnal Biologi dan Pembelajarannya* 6 (2): 101-113. DOI: 10.25273/florea.v6i2.4678. [Indonesian]
- Az-Zahrah FR, Sari NLW, Saputry R, Nugroho GD, Sunarto, Pribadi T, and Setyawan AD. 2021. Review: Traditional knowledge of the Dayak Tribe (Borneo) in the use of medicinal plants. *Biodiversitas* 22 (10): 4633-4647. DOI: 10.13057/biodiv/d221057.
- Bana SWA, Khumaidi A, Pitopang R. 2016. Studi etnobotani tumbuhan obat pada masyarakat Kaili Rai di Desa Taripa Kecamatan Sindue Kabupaten Donggala Sulawesi Tengah. *Biocelebes* 10 (2): 68-81. [Indonesian]
- Chen S, Yu H, Luo HM, Wu Q, Li CF, Steinmetz A. 2016. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chin Med* 11 (1): 1-10. DOI: 10.4236/cm.2013.41001.
- Dapar MLG, Meve U, Liede-Schumann S, Alejandro GJD. 2020. Ethnomedicinal appraisal and conservation status of medicinal plants among the Manobo Tribe of Bayugan City, Philippines. *Biodiversitas* 21 (8): 3843-3855. DOI: 10.13057/biodiv/d210854.
- Ernikawati, Zuhud EAM, Santosa Y. 2017. Pendugaan potensi tumbuhan obat di Hutan Lindung Jompi Kabupaten Muna, Provinsi Sulawesi Tenggara. *Media Konservasi* 22 (1): 42-48. [Indonesian]
- Ernikawati, Zuhud EAM, Santosa Y. 2020. Karakteristik pengguna tumbuhan obat di Hutan Lindung Jompi Kabupaten Muna Sulawesi Tenggara. *Jurnal Penelitian Kehutanan Bonita* 2 (1): 11-19. DOI: 10.55285/bonita.v2i1.430. [Indonesian]
- Fatmawati S, Yuliana, Purnomo AS, Bakar MFA. 2020. Chemical constituents, usage and pharmacological activity of *Cassia alata*. *Heliyon* 6: 1-11. DOI: 10.1016/j.heliyon.2020.e04396.

- Getachew M, Anteneh B, Bekalu K, Yigardush A, Yalemgeta B, Abtie A, Dehnet A. 2022. Medicinal plants used for management of hemorrhoids in Ethiopia: A systematic review. *Heliyon* 8 (2022) e10211. DOI: 10.1016/j.heliyon.2022.e10211.
- Gumisiriza H, Grace B, Eunice AO, Crispin DS. 2019. Medicinal plant species used by local communities around Queen Elizabeth National Park, Maramagambo Central Forest Reserve and Ihimbo Central Forest Reserve, South western Uganda. *J Ethnopharmacol* 239 (111926). DOI: 10.1016/j.jep.2019.111926.
- Gurning K, Sinaga H. 2020. In vitro anti-diabetic potential extract test of seri (*Muntingia calabura*, L.) leaves. *Asian J Pharm Res Dev* 8 (6): 39-41.
- Ifandi S, Jumari, Suedy SWA. 2016. Knowledge understanding and utilization of medicinal plants by local community Tompu District of Kaili, Sigi Biromaru, Central Sulawesi. *Biosaintifika* 8 (1): 1-11. DOI 10.15294/biosaintifika.v8i1.4529.
- Jadid N, Kurniawan E, Himayani CES, Andriyani, Prasetyowati I, Purwani KI, Muslihatin W, Hidayati D, Tjahjaningrum ITD. 2020. An ethnobotanical study of medicinal plants used by the Tengger Tribe in Ngadisari Village, Indonesia. *PLoS ONE* 15 (7): 1-16. DOI: 10.1371/journal.pone.0235886.
- Jain C, Khatana S, Vijayvergia R. 2019. Bioactivity of secondary metabolites of various plants: A review. *Intl J Pharm Sci Res* 10 (2): 494-504. DOI: 10.13040/IJPSR.0975-8232.10(2).494-04.
- Jumiarni WD, Komalasari O. 2017. Eksplorasi jenis dan pemanfaatan tumbuhan obat pada Masyarakat Suku Muna di Pemukiman Kota Wuna. *Traditional Medicine Journal* 22 (1): 45-56. DOI: 10.22146/tradmedj.24314. [Indonesian]
- Karakose, Mustafa. 2022. An ethnobotanical study of medicinal plants in Gücece district, north-eastern Turkey. *Plant Divers* 44 (6): 577-597. DOI: 10.1016/j.pld.2022.03.005.
- Kasmawati H, Ihsan S, Suprianti R. 2019. Kajian etnomedisin tumbuhan obat tradisional Suku Muna Desa Oe Nsuli Kecamatan Kabangka Kabupaten Muna Sulawesi Tenggara. *Jurnal Farmasi, Sains, dan Kesehatan* 5 (1): 21-24. DOI: 10.33772/pharmauho.v5i1.8997. [Indonesian]
- Krajczyk M, Krajczyk E, Bogacz K, Luniewski J, Lietz-Kijak D, Szczegielniak J. 2020. The possibility of the use of Kinesio Taping in internal, oncologic, and neurologic diseases: A systematic review and meta-analysis. *Explore* 16 (1): 44-49. DOI: 10.1016/j.explore.2019.07.017.
- Kujawska M, Schmeda-Hirschmann G. 2022. The use of medicinal plants by Paraguayan migrants in the Atlantic Forest of Misiones, Argentina, is based on Guarani tradition, colonial and current plant knowledge. *J Ethnopharmacol* 283: 114702. DOI: 10.1016/j.jep.2021.114702.
- Leto C, Tuttolomondo T, La Bella S, Licata M. 2013. Ethnobotanical study in the Madonie Regional Park (Central Sicily, Italy)-Medicinal use of wild shrub and herbaceous plant species. *J Ethnopharmacol* 146 (1): 90-112. DOI: 10.1016/j.jep.2012.11.042.
- Luardini MA, Asi N, Garner M. 2019. Ecolinguistics of ethno-medicinal plants of the Dayak Ngaju Community. *Lang Sci* 74: 77-84. DOI: 10.1016/j.langsci.2019.04.003.
- Lubis MF, Hasibuan PAZ, Syahputra H, Surbakti C, Astyka R. 2022. *Saurauia vulcani* (Korth.) as herbal medicine potential from North Sumatera, Indonesia: A literature review. *Heliyon* 8: e09249. DOI: 10.1016/j.heliyon.2022.e09249.
- Malini DM, Madihah, Kusmoro J, Kamilawati F, Iskandar J. 2017. Ethnobotanical study of medicinal plants in Karangwangi, District of Cianjur, West Java. *Biosaintifika* 9 (2): 345-356. DOI: 10.15294/biosaintifika.v9i2.5756.
- Milo S, Sibanda S. 2022. An ethnobotanical survey of the medicinal plants used in the treatment of cancer in some parts of Matebeleland, Zimbabwe. *South Afr J Bot* 146: 401-408. DOI: 10.1016/j.sajb.2021.11.022.
- Nugroho Y, Soendjoto MA, Suyanto, Matatula J, Alam S, Wirabuana PYAP. 2022. Traditional medicinal plants and their utilization by local communities. *Biodiversitas* 23 (1): 306-314. DOI: 10.13057/biodiv/d230137.
- Qamariah N, Mulia DS, Fakhri D. 2020. Indigenous knowledge of medicinal plants by Dayak community in Mandomai Village, Central Kalimantan, Indonesia. *Pharmacog J* 12 (2): 386-390. DOI: 10.5530/pj.2020.12.60.
- Radam R, Soendjoto MA, Prihatiningtyas E. 2016. Utilization of medicinal plants by community in Tanah Bumbu Regency, Kalimantan Selatan. *Prosiding Seminar Nasional Lahan Basah Tahun 2016 Jilid 2*. [Indonesian]
- Radha P, Udhayavani C, Nagaraj R, Sivaranjani K. 2022. Documentation and quantitative analysis of the traditional knowledge on medicinal plants in Udumalpet Block, Tiruppur District, Tamil Nadu, India. *Acta Ecol Sin* 42 (2): 122-142. DOI: 10.1016/j.chnaes.2021.10.009.
- Ramadhani S, Iskandar J, Partasasmita R. 2021. Local knowledge of Sundanese Village people on traditional medicine: A case study in Cibeurih Hamlet, Nagarawang Village, Sumedang District, Indonesia. *Biodiversitas* 22 (5): 2891-2898. DOI: 10.13057/biodiv/d220554.
- Ramli MR, Milow P, Malek S. 2021. Diversity and traditional knowledge of medicinal plants in home gardens of Kampung Masjid Ijok, Perak, Malaysia. *Biodiversitas* 22 (5): 2458-2465. DOI: 10.13057/biodiv/d220502.
- Raodah 2019. Pengetahuan lokal tentang pemanfaatan tanaman obat pada masyarakat Tolaki di Kabupaten Konawe Sulawesi Tenggara. *Pangadereng* 5 (1): 46-63. DOI: 10.36869/v5i1.25. [Indonesian]
- Saranani S, Himaniarwati, Yuliarti W, Isrul M, Agusmin A. 2021. Studi etnomedisin tanaman berkhasiat obat hipertensi di Kecamatan Poleang Tenggara Kabupaten Bombana Sulawesi Tenggara. *Jurnal Mandala Pharmacol Indonesia* 7 (1): 60-82. DOI: 10.35311/jmpi.v7i1.72. [Indonesian]
- Sari RP, Yusro F, Mariani Y. 2021. Medicinal plants used by Dayak Kanayatan traditional healers in Tonang Village Sengah Temila District Landak Regency. *Jurnal Biologi Tropis* 21 (2): 324-335. DOI: 10.29303/jbt.v21i2.2557. [Indonesian]
- Setiawan H, Qiptyyah M. 2014. Kajian etnobotani masyarakat adat Suku Moronene di Taman Nasional Rawa Aopa Watumohai. *Jurnal Penelitian Kehutanan Wallacea* 3 (2): 107-111. DOI: 10.18330/jwallacea.2014.vol3iss2pp107-117. [Indonesian]
- Simanjuntak HA. 2018. Pemanfaatan tumbuhan obat diabetes mellitus di masyarakat Etnis Simalungun Kabupaten Simalungun Provinsi Sumatera Utara. *BioLink: Jurnal Biologi Lingkungan, Industri, Kesehatan* 5 (1): 59-71. DOI: 10.31289/biolink.v5i1.1663. [Indonesian]
- Slamet A, Andrias SH. 2018. Studi etnobotani dan identifikasi tumbuhan berkhasiat obat masyarakat Sub Etnis Wolio, Kota Baubau, Sulawesi Tenggara. *Proceeding Biology Education Conference* 15 (1) : 721-732. [Indonesian]
- Son HN, Chi DTL, Kingsbury A. 2019. Indigenous knowledge and climate change adaptation of ethnic minorities in the mountainous regions of Vietnam: A case study of the Yao people in Bac Kan Province. *Agric Sys* 176: 1-9. DOI: 10.1016/j.agsy.2019.102683.
- Sulaiman AN, Arzai AH, Taura DW. 2022. Ethnobotanical survey: A comprehensive review of medicinal plants used in treatment of gastro intestinal diseases in Kano state, Nigeria. *Phytomed Plus* 2 (1): 100180. DOI: 10.1016/j.phyplu.2021.100180.
- Susanti AD, Wijayanto N, Hikmat A. 2018. Keanekaragaman jenis tumbuhan obat di agroforestri Repong Damar Krui, Provinsi Lampung. *Media Konservasi* 23 (2): 162-168. [Indonesian]
- Syamsiah, Hiola SF, Mu'nisa A, Jumadi O. 2016. Study on medicinal plants used by the Ethnic Mamuju in West Sulawesi, Indonesia. *J Trop Crop Sci* 3 (2): 42-48. DOI: 10.29244/jtcs.3.2.43-48.
- Teklay A, Abera B, Giday M. 2013. An ethnobotanical study of medicinal plants used in Kilte Awulaelo District, Tigray Region of Ethiopia. *J Ethnobiol Ethnomed* 9 (1): 1-23. DOI: 10.1186/1746-4269-9-65.
- Thompson A, Munkara G, Kantilla M, Tipungwuti J. 2019. Medicinal plant use in two Tiwi Island communities: A qualitative research study. *J Ethnobiol Ethnomed* 15: 1-11. DOI: 10.1186/s13002-0190315-2.
- Umair M, Altaf M, Abbasi AM. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. *PLoS One* 12 (6): e0177912. DOI: 10.1371/journal.pone.0177912.
- Wibisono Y, Azham Z. 2017. Inventory of medicinal plant species in the medicinal plant conservation plot at KHDTK Samboja, Samboja District, Kutai Kartanegara Regency. *J Agrifor* 16 (1): 125-140. [Indonesian]
- Xiong Y, Sui X, Ahmed S, Whang Z, Long C. 2020. Ethnobotany and diversity of medicinal plants used by the Buyi in eastern Yunnan, China. *Plant Divers* 42 (6): 401-414. DOI: 10.1016/j.pld.2020.09.004.
- Yasir M, Asnah. 2018. Pemanfaatan jenis tumbuhan obat tradisional di Desa Batu Hamparan, Kabupaten Aceh Tenggara. *Jurnal Biotik* 6 (1): 17-34. DOI: 10.22373/biotik.v6i1.4039. [Indonesian]
- Yusro F, Mariani Y, Diba F, Ohtani K. 2014. Inventory of medicinal plants for fever used by four Dayak Sub Ethnic in West Kalimantan, Indonesia. *Kuroshio Sci* 8 (1): 33-38.
- Yusro F, Mariani Y, Wardenar E. 2019. Pemanfaatan tumbuhan obat untuk mengatasi gangguan sistem pencernaan oleh Suku Dayak Iban: Studi Kasus di Kepulauan Kapuas Hulu, Kalimantan Barat. *Jurnal Borneo Akcaya* 5 (1): 1-11. DOI: 10.51266/borneoakcaya.v5i1.120. [Indonesian]
- Zaki PH, Gandaseca S, Rashidi NM, Ismail MH. 2019. Traditional usage of medicinal plants by Temiar ribes in the State of Kelantan, Peninsular Malaysia. *For Soc* 3 (2): 227-234. DOI: 10.24259/fs.v3i2.6424.