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## **Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia.**

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### **Abstract.**

The forest area in Sigi Regency, Central Sulawesi, is a Biosphere Reserve, a habitat for various medicinal plant species. Forest areas must be managed appropriately for the welfare of the local community and society and their sustainable use. One of the local people living around the forest is the Kaili tribe. The local wisdom of the Kaili tribe, who inhabit forest areas in Central Sulawesi, in managing forests and forest products, especially using plants as medicine, must be documented in research. This study aimed to identify the species, habitat, habitus, and ways of using the plant as medicine by the Kaili people in the Sigi Regency.

Before the data collection method, there were literature study activities like interviews and field surveys. The literature study was conducted to get a start regarding the condition of the research location around the forest area and the ethnic/ethnic groups that live permanently around and within the forest area. The interviews in this study were conducted by combining purposive sampling and snowball methods.

The results showed the high potential of medicinal plants around forest areas used by the Kaili tribe, with the discovery of 113 species in 56 families. Herbs are the most common habitus of medicinal plants. The habitat of medicinal plants most commonly found in the yard of the most helpful organ is the leaves, which can be boiled in water and drunk directly.

Keywords: Species diversity, medicinal plants, Kaili tribe, local knowledge.

### **INTRODUCTION**

Indonesia, located on the equator, is a mega biodiversity country. It has a unique tropical rain area in which various plants have the potential as raw materials for medicine <sup>1,2</sup>. Indonesia's forests are one of the centres of biodiversity in the world, and Indonesia is the third place out of seven countries called the Megadiversity Country <sup>3-5</sup>. Indonesian forests are home to thousands of species of flora and fauna, many of which are endemic to Indonesia <sup>6</sup>. Forests have direct and indirect benefits that are widely recognized <sup>7</sup>. The immediate benefits of forests are the production of wood and non-timber, while the indirect benefits are as regulators of microclimates, water management and soil fertility, and sources of germplasm which are very important for human life now and in the future <sup>2</sup>. Forests also play an essential role in climate change <sup>8</sup>. In the context of climate change, forests can play a role as carbon sinks and emitters <sup>9</sup>.

Forests are also inhabited by various species of animals and plants that provide food and medicine for those in the vicinity <sup>10</sup>. Indonesia's tropical forests, which consist of multiple ecosystems, are a storehouse of biodiversity, having more than 239 species of food plants and more than 2,039 species of medicinal plants <sup>11</sup>. Every tropical forest ecosystem in Indonesia is a factory for the diversity of medicinal plants, formed by evolution over a very long time, including interacting with the socio-culture of the surrounding local community <sup>2</sup>. Each individual from a population of medicinal plants that grow naturally in each type of forest ecosystem is the smallest unit of a genuine factory that carries out secondary metabolic processes that produce a variety of unique bioactive ingredients, most of which are not accessible and inexpensive for humans to imitate <sup>12,13</sup>.

Indonesia's natural forests and culture, traditional knowledge or local wisdom of indigenous tribes living around forests and forest ecosystems are national assets of invaluable value for forest conservation and the development of the nation's health <sup>11</sup>. Traditional knowledge that grows and is well managed from generation to generation by indigenous tribes living in and around forests in the archipelago's forest is a unified whole and complements each other with biological resources that absolutely must be preserved <sup>13</sup>. Various ethnophytomedical and ethnobotanical studies conducted by Indonesian researchers have identified that there are at least 78 species of medicinal plants used by 34 ethnic groups to treat malaria, 133 species of medicinal plants to treat fever by 30 ethnic groups, 110 species of medicinal plants to treat disorders digestion by 30 ethnic groups and 98 species of medicinal plants used to treat skin diseases by 27 ethnic groups <sup>13,14</sup>.

One of the areas in Indonesia has a large forest area, and many traditional communities live in Central Sulawesi. Central Sulawesi is a vast region in Indonesia because, biogeographically, it is the heart of the island of Sulawesi and is included in the Wallacea region. Hence, this region has high biodiversity and species endemism <sup>2,15</sup>.

Central Sulawesi is also inhabited by various local communities who live around and even in forest areas. The potential of Central Sulawesi, where most of its territory is included in the forest area, which has an excellent opportunity to be developed, is the high biodiversity of medicinal plants and the local wisdom of the people living around the forest area <sup>4,16,17</sup>. Local people who live around and in forest areas have local wisdom in utilizing plants, especially the use as ingredients for medicine. Knowledge about this, starting from the habitat, habitus, identification of plant species, parts used, and how to use it as medicine to its medicinal properties, is knowledge of high value passed down from generation to generation by the people who live around and in the forest. The current problem is that most traditional knowledge needs to be well documented <sup>2,18,19</sup>.

The local wisdom of the people who live around forest areas in Central Sulawesi in managing forests and forest products, especially the use of plants as medicine, needs to be documented in the form of research because it is feared that the loss of this knowledge will also be followed by the loss of several types of plants due to the ignorance of the community about the benefits and role in human life <sup>2</sup>.

This knowledge needs to be preserved because it is an excellent opportunity for the utilization of biological natural resources, specifically non-timber forest products, sustainably and requires support from various parties, especially universities, in terms of research in the field of medicinal plants, both the types of plants and the content of active compounds contained in them. In these plants. This is important to do to scientifically reveal the use of these plants as traditional medicines that have been used for generations. Because many people think that the use of medicinal plants or traditional medicine is relatively safer than synthetic drugs. The objectives to be achieved in this research are to reveal, analyze and synthesize local knowledge of the local community around and in the forest in utilizing medicinal plants. To obtain data on the diversity of medicinal plant types used by locals in Central Sulawesi.

### **MATERIALS AND RESEARCH METHODS**

A forest area in Sigi Regency, Central Sulawesi, became the location of this research and researchers identified plants at Tadulako University Celebence Herbarium. Data collection was carried out through an exploratory survey preceded by literature study activities, namely interviews and field surveys <sup>2</sup>.

The literature study was carried out to get a start regarding the conditions of the research location, especially information about the villages around the forest area and ethnic groups/tribes who live around and in the forest area. This information will determine the villages used as research locations <sup>12</sup>.

The interviews in this study were conducted by combining purposive sampling and snowball methods. The first interview was conducted by determining the key respondent (key person) with specific criteria following the research objectives. According to the required respondent criteria, key respondents were obtained based on recommendations from the forestry service and traditional leaders. The determination of respondents was then carried out using the snowball method. The interview was stopped when the data and information obtained had no additional information <sup>2</sup>.

The purpose of field observation is to evaluate and validate the categories of medicinal plants identified through interviews. Observations were conducted by walking without using plot boundaries and conducting direct observations in the field with respondents or guides <sup>2,20</sup>. The Celebence Herbarium at Tadulako University was created to identify the medicinal plants the local community uses in the surrounding forest area.

### **RESULTS AND DISCUSSION**

The variety of medicinal plant species and the local wisdom of the Kaili tribe in their use who live around the forest. The interview results with research respondents include the community knowing medicinal plants, shamans (Sando), community leaders, and traditional leaders. According to the information, the Kaili tribe frequently uses about 113 different types of medicinal plants. Apart from medicinal properties, some plants are used for other purposes, such as bamboo production, natural pesticides, and aromatics. A list of species, including local names, scientific names, families, and uses, is presented in Table 1.

Table 1. Diversity of medicinal plant species and local wisdom of the Kaili tribe in their use

Nu.	Lokal Name	Species	Family	Use/Benefit
1	Kapasan	<i>Abelmoschus moschatus</i> [L.] Medic	Malvaceae	Maternity process
2	Uru	<i>Elmerrillia ovalis</i> (Miq) Dandy	Maqnoliaceae	Cosmetics, Fever
3	Ambarogo	<i>Cordia corymbosa</i> Miq.	Boraginaceae	Stomachache
4	Balacai	<i>Jatropha curcas</i> L.	Euphorbiaceae	Stomatitis, Cuts
5	Bambu batu	<i>Dendrocalamus strictus</i> (Roxb)	Poaceae	Jaundice
6	Bayam duri	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Constipation
7	Benalu	<i>Scurrula artopurpurea</i>	Loranthaceae	Tumor, Vomiting blood/Hematemesis
8	Bila	<i>Crecentia cujete</i> L.	Bignoniaceae	Hernia
9	Bolu bua	<i>Piper betle</i> L.	Piperaceae	Body odor, Halitosis, Leukorea
10	Bolu karuke	<i>Piper retrofractum</i> Vahl.	Piperaceae	Toothache
11	Bolu Lasu	<i>Piper majusculum</i> Blume.	Piperaceae	Viagra
12	Bolu Tana	<i>Piper</i> sp.	Piperaceae	Body odor, Halitosis
13	Bunga pagoda	<i>Clerodendron japonicum</i>	Lamiaceae	Abscesses
14	Cakar Ayam	<i>Selaginella</i> sp.	Selaginellaceae	Fever, Anti cancer
15	Daun rusuk	<i>Amydrium Zippelianum</i>	Araceae	Sore ribs
16	Daun sendok	<i>Plantago asiatica</i>	Plantaginaceae	Prostate, Appendix, Hernia
17	Gamal	<i>Gliricidia sepium</i> (jacq) Kunth	Fabaceae	Minor cuts, Headache
18	Gedi	<i>Abelmoschus manihot</i> (L.) Medicus	Malvaceae	Kidney, Maternity process
19	Gonato	<i>Clerodendrum</i> sp.	Lamiaceae	Worm infection
20	Pomempe	<i>Imperata cylindrica</i>	Poaceae	Supplement
21	Hipodo Walo	<i>Curanga fel-ferrae</i> (Lour.) Merr.	Linderniaceae	Internal disease
22	Jambu batu	<i>Psidium guajava</i> Linn.	Myrtaceae	Diarrhea
23	Jeruk bali	<i>Citrus maxima</i> Merr.	Rutaceae	Diabetes

24	Kalebou	<i>Hibiscus tiliaceus</i> L.	Malvaceae	Bronchitis
25	Kanuna	<i>Cordia myxa</i> L.	Boraginaceae	Cuts
26	Kaporontomate	<i>Apium graveolens</i> L.	Apiaceae	Pertussis
27	Kapumpu	<i>Ocimum basilicum</i> L.	Lamiaceae	Headache, Wound
28	Kayu Manuru	<i>Senna alatta</i> L.	Fabaceae	Skin fungus diseases
29	Keladi bunga	<i>Syngonium podophyllum</i>	Araceae	Centipede and Snake bite antidote
30	Kelor	<i>Moringa oleifera</i> Lamk.	Moringaceae	High fever, Diabetes
31	Kondouwe	<i>Spilanthes paniculata</i> Wall. b DC	Asteraceae	Toothache
32	Kopi arabika	<i>Coffea canephora</i> Pierre	Rubiaceae	Hypertension
33	Kujadi	<i>Kalanchoe pinnata</i> Pers.	Crassulaceae	Abscesses
34	Kumis Kucing	<i>Orthosiphon aristatus</i> (Bl.) Miq.	Lamiaceae	Urolithiasis
35	Kurondo	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm	Zingiberaceae	Filariasis
36	Labu kuning	<i>Cucurbita moschata</i> D.	Cucurbitaceae	Eye disease
37	Lamba	<i>Nicotiana tabacum</i> L.	Solanaceae	Halitosis
38	Lambantomate	<i>Elephantopus mollis</i> Kunt.	Asteraceae	Stroke
39	Langalo	<i>Glinus oppositifolia</i> (L.) DC	Molluginaceae	Urolithiasis
40	Languntule	<i>Drymaria cordata</i> (L.) Willd ex Schult	Caryophyllaceae	Diabetes
41	Lasuani	<i>Amaranthus lividus</i> L.	Amaranthaceae	Headache, <i>Possessed</i>
42	Lekosa	<i>Pollia secundiflora</i> (Bl.) Back	Commelinaceae	Swollen foot
43	Lelompeba	<i>Dysophylla auricularia</i> (L) Blume	Lamiaceae	Pertussis
44	Lengaru	<i>Alstonia scholaris</i> R.Br.	Apocynaceae	Malaria, Internal injures
45	Levonu	<i>Ficus septica</i> Burm. F.	Moraceae	Eye infection
46	Mapo	<i>Maccaranga hispida</i> (Blume) Muell.	Euphorbiaceae	Papilloma
47	Matesambula	<i>Cassia</i> sp.	Fabaceae	Epilepsy
48	Mayana	<i>Coleus scutellarioides</i> Bth.	Lamiaceae	Cough, Internal diseases
49	Mpo Mata	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Abscesses

50	Legetan	<i>Synadrella nodiflora</i> (L.) Gaertn	Asteraceae	Rabies
51	Bendot	<i>Dichrocephala integrifolia</i> (L.f)	Asteraceae	Possessed, Worm treatment
52	Ruku-ruku	<i>Hyptis suaveolens</i> (L.) Poir.	Lamiaceae	Tinea pedis
53	Sangitan	<i>Sambucus javanica</i> Reinw	Adoxaceae	Acne treatment
54	Pepaya	<i>Carica papaya</i> L	Caricaceae.	Hypertension, Worm treatment
55	Nura	<i>Begonia aptera</i> Blume	Begoniaceae	Worm treatment
56	Pada	<i>Eleusine indica</i> (L.) Gaertn	Poaceae	Uterus strengthening
57	Palola Bua	<i>Luffa cylindrical</i> Roem	Cucurbitaceae	Swollen stomach
58	Pancihinana	<i>Scindapsus pictus</i> Hassk	Araceae	Skin fungus
59	Pancsilana lida	<i>Sporobulus diandrus</i> (Retz) P.Beauv.	Poaceae	Cosmetics
60	Pancsilana lore	<i>Merremia umbellata</i> (L.) Hallier f.	Euphorbiaceae	Cosmetics (mole in face)
61	Pancongkolangi	<i>Centella asiatica</i> L. (Urb.)	Fabaceae	Tuberculosis
62	Panuntu	<i>Phyllanthus urinaria</i> L.	Lamiaceae	Kidney, Urolithiasis
63	Paparisipa	<i>Cyperus killingia</i> Endl.	Crassulaceae	Possessed
64	Paralente	<i>Ageratum conyzoides</i> L.	Asteraceae	Cuts, step
65	Parancina	<i>Solanum lycopersicum</i> L.	Asteraceae	Fever, Burns
66	Paria	<i>Momordica charantia</i> L.	Lamiaceae	Cough, Fever, Ulcer
67	Pasolonteneru	<i>Equisetum debile</i> Roxb.Ex Vaucher	Equisetaceae	Broken ribs, Muscle strain
68	Penesilin	<i>Jatropha mutifida</i> L.	Euphorbiaceae	Cuts, Stomatitis
69	Pia topoule	<i>Eleutherina bulbosa</i> (Mill.) Urb.	Iridaceae	Heart disease, Hemorrhoid
70	Pinahong	<i>Anredera cordifolia</i> (Ten.) Steenis	Basellaceae	Tumor, Hypertension
71	Posuntikala	<i>Etlingera elatior</i> (Jack) R.M. Sm.	Zingiberaceae	Gout
72	Puroo	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	Umbilical treatment
73	Putri Malu	<i>Mimosa pudica</i> L.	Leguminosae	Heatiness, Insomnia
74	Sakimalei	<i>Amphineuron</i> sp.	Thelypteridaceae	Fever and Rashes
75	Sampularo	<i>Murdannia blumei</i> (Hassk.)	Commelinaceae	Face's mole

76	Sarang Semut	<i>Myrmecodia</i> sp.	Rubiaceae	Ulcer, Hypertension
77	Silaguri	<i>Sida rhombifolia</i> L.	Malvaceae	Infection, Teeth treatment
78	Simulasi	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Appendix
79	Sinduru	<i>Melastoma candidum</i> D.Don	Melastomataceae	Abscesses, Nosebleed
80	Sirsak	<i>Annona reticulata</i> L.	Annonaceae	Kidney, Hypertension
81	Susupi	<i>Bidens pilosa</i> L.	Asteraceae	Post-maternity treatment, Cough
82	Taba	<i>Cordylin fructifera</i> A.Chev.	Asparagaceae	TBC
83	Tambajara bunga	<i>Hyptis capitata</i> Jack.	Lamiaceae	Kidney, Liver
84	Kau Jawa	<i>Lannea coromandelica</i> Merr.	Anacardiaceae	Hepatitis and Diabetes
85	Tambuang kebe	<i>Senna tora</i> L. (Roxb)	Fabaceae	Melena
86	Tampe	<i>Physalis angulata</i> L.	Solanaceae	Hypertension
87	Tatari	<i>Scleria purpurelens</i> Steud.	Cyperaceae	Kidney
88	Tavalevo	<i>Piper umbellatum</i> L.	Piperaceae	Erectile dysfunction
89	Tave Lehoka	<i>Comelina diffusa</i> Burm. f.	Commelinaceae	Gout
90	Tave hikonco	<i>Ficus stipulare</i> L.	Moroaceae	Jaundice
91	Tavovi	<i>Ipomoea batatas</i> (L.) Poir	Convolvulaceae	Skin diseases
92	Tintiase	<i>Cheilocostus speciosus</i>	Marattiaceae	Fever
93	Tombila	<i>Angiopteris evecta</i> (G Forst) Hoffm	Urticaceae	Rabies
94	Tombu	<i>Poikilospermum suaviolen</i> (Bl.) Merr	Rubiaceae	Breast cancer
95	Towote	<i>Anthocephalus chinensis</i> (Lam.) C.	Cyperaceae	Malaria, Internal injuries
96	Voluntile	<i>Eleocharis artopurpurea</i> Retz. Presl.	Asteraceae	Postpartum treatment
97	Wavaro	<i>Crassocephalum crepidioides</i> (Benth)	Asteraceae	Cuts
98	Wingkotu	<i>Erigeron sumatraensis</i> Retz.	Marattiaceae	Leprosy
99	Manggarada	<i>Acmella ciliate</i> (Kunth) Cass	Asteraceae	Toothache
100	Roviga	<i>Calotropis gigantea</i>	Apocynaceae	Stomatitis, Measles
101	Varo-Varo	<i>Cyantjilium cinereum</i> (L) H.Rob.	Asteraceae.	Cough



102	Kayu Hitam	<i>Dyospyros celebica</i> Bakh	(Ebenaceae	Internal diseases
103	Kamboja Putih	<i>Plumeria alba.</i>	Apocynaceae	Breast cancer
104	Una-Una	<i>Piper aduncum</i> L	Piperaceae	Skin diseases (Itching)
105	Titilu	<i>Tacca palmate</i> Blume	Taccaceae	Acne and Ulcer
106	Parada	<i>Chromolaena odorata</i> (L.)	Asteraceae	Minor cuts
107	Palio	<i>Cinnamomum parthenoxylon</i>	Lauraceae	Malaria
108	Wintonu	<i>Melochia umbellate</i>	Sterculiaceae	Bronchitis
109	Jati	<i>Tectona grandis</i>	Lamiaceae.	Skin diseases (Itching)
110	Samundu	<i>Polyscias nodosa</i> (Bl.) Seem	Araliaceae	Cancer
111	Tintiahe	<i>Elephantopus scaber</i> L	Asteraceae	Nail diseases
112	Siguntu lele	<i>Synedrella nodiflora</i> (L) Gaertn	Asteraceae	Arthritis, Gout
113	Marangkapi	<i>Oreocnide rubescens</i> (Blume) Miq	Urticaceae	Breast tumor

## Habitus of Medicinal Plants Utilized by the Kaili Tribe Around Forest Areas

The Habitus of medicinal plants is the general form of these medicinal plants. The habitus of medicinal plants in and around forest areas consists of plants, trees, shrubs, lianas, epiphytes, parasites and bamboo. Herbaceous habitus had the highest percentage of 54.87%, or 62 species of medicinal plants. It was followed by trees, shrubs, bushes, lianas, epiphytes, parasites, and bamboo with percentages, respectively of 21.24% (14 species), 9.73% (11 species), 6.19% (7 species), 5.31% (6 species), 0.88% (1 species), 0.88% (1 species), and 0.88% (1 species). The diagram of the habitus of medicinal plants used by the Kaili tribe is presented in Figure 1.

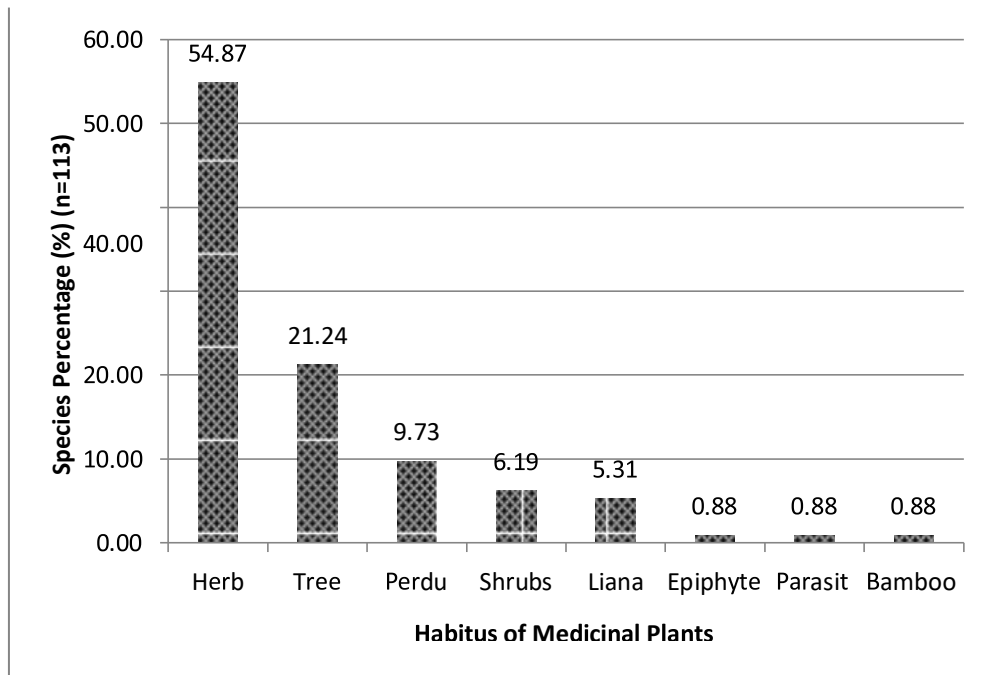


Figure 1. Diagram of the Percentage of Medicinal Plants based on their Habitus.

## The Organs of Medicinal Plants Used by the Kaili Tribe Around Forest Areas

The plant organs used as traditional medicine by the Kaili tribe around the forest area are very diverse. Based on the interview, 11 parts were frequently employed: the leaves, bark, stems, fruits, buds, the tender core of the plant's trunk (*umbut*), tuberous roots, and shoots, and several plants were used entirely as medicine. Organ with the highest frequency of use was the leaves (60.18%), followed up by all parts (17.7%), bark (4.42%), stems (4.42%), fruits (3.54%), and others (flowers, roots, buds, *but*, and tuberous roots), each of them was below 3%, as presented in Figure 2.

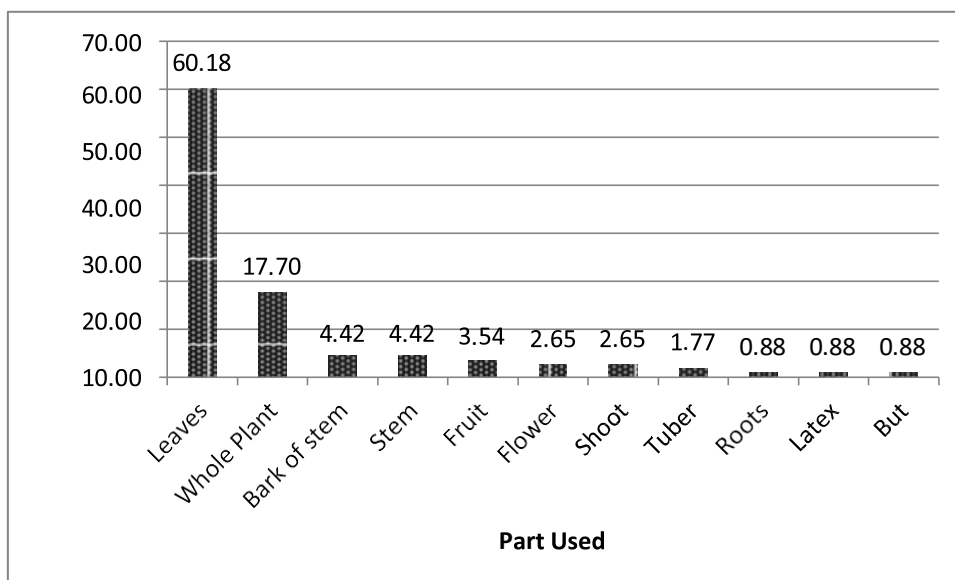


Figure 2.

Diagram of the Percentage of Medicinal Plants based on Utilized Organ.

Figure 2 demonstrated that more than 50% (60.18) of a plant's organ widely used in traditional medicine were the leaves. The percentage of the leaves was relatively high compared with other parts of the plant due to several causes. According to 11, the leaves are utilized frequently since they are quickly processed and obtained and have optimal benefit in compared to other organs. In addition, the collection of leaves also prevents the disruption of other parts since they can re-grow and to be continuously utilized.

Several former studies also indicated similar findings as reaffirmed by Kassam (2010), who conducted a study in Afghanistan, that the most common parts of plants used for remedies were the leaves, stems, flowers, roots, seeds, bark, and tubers<sup>21</sup>. Furthermore, 15 (fifteen) parts of plants were utilized for traditional medicine including the leaves, roots, bark, fruits, all parts, stems/wood, seeds, flowers, sap, buds, leaves/shoots, rhizomes, tuber, branches/twigs, water in banana stem fiber, and the tender core of the plant's trunk (*umbut*), the leaves were the most commonly used (which was 749 species (33.50%)) and *umbut* was the least part of the plant used as traditional medicine<sup>22</sup>.

### Techniques for using Medicinal Plants by the Kaili Tribe Around Forest Areas.

Local communities' use of specific plants as a medicine around forest areas varies. The most widely used technique for using medicinal plants is boiling them in boiling water and drinking them directly because they are cheap and simple, namely 54.87%, or around 64 species. The following method is straightforward because it does not require any technique, namely by applying it directly and applying it to the injured part of the body (21.24% and 15.93%). A rarely technique is gargling, which is only applied to one type of plant or 0.88%. The techniques for using plants by the Kaili Tribe around forest areas are presented in the following diagram.

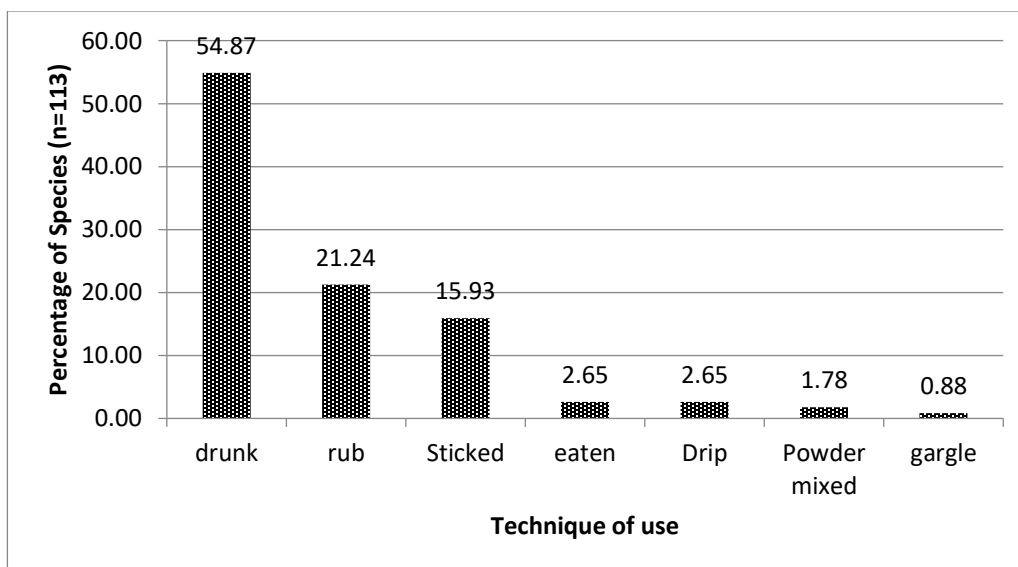


Figure 3. Percentage diagram of medicinal plants based on the technique used by the Kaili tribe.

Figure 3. Shows that the Kaili people who live around forest areas process medicinal plants by drinking, processing, sticking, eating, and eating mixed with powder and gargling. The study results showed that the method of drinking was the most preferred method for the Kaili Tribe. Boiling and drinking water were used to process more than 50% (62 species) of medicinal plants. The other research were also found in several regions in Indonesia 23–25

### CONCLUSIONS

The potential for medicinal plants utilized by the Kaili Tribe, who live around forest areas, is as high as endemic plants, as indicated by the discovery of 113 species. These types are also often found in the yard with the most heightened plant habitus. The part of the plant that is most used is the leaves, which are boiled in water and drunk.

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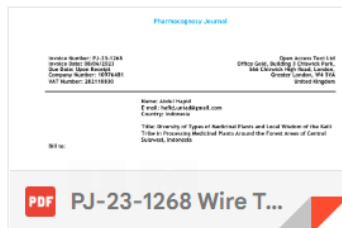
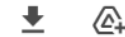
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# Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia

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## ABSTRACT

The forest area in Sigi Regency, Central Sulawesi, is a habitat for various medicinal plant species. Forest areas must be managed appropriately for the local community and society's welfare and sustainable use. One of the local people living around the forest is the Kaili tribe. The local wisdom of the Kaili tribe, who inhabit forest areas in Central Sulawesi, in managing forests and forest products, especially using plants as medicine, must be documented in research. This study aimed to identify the species, habitat, habitus, and ways of using the plant as medicine by the Kaili people in the Sigi Regency.

Prior to data collection, a literature study was conducted to obtain information regarding the condition of the research location around the forest area and the ethnic/ethnic groups who live permanently around and within the forest area. This stage was then followed by interviews and field surveys. The interviews were conducted by combining purposive sampling and snowball methods.

The results showed the high potency of medicinal plants around forest areas used by the Kaili tribe, with the discovery of 113 species in 51 families. Herbs are the most common habitus of medicinal plants. The habitat of medicinal plants is mainly found in the yard. The most used plant part is the leaves, which can be boiled in water and drunk directly.

**Key words:** Kaili tribe, Local knowledge, Medicinal plants, Species diversity.

## INTRODUCTION

Indonesia, located on the equator, is a mega biodiversity country. It has a unique tropical rain area in which various plants have the potential as raw materials for medicine.<sup>1,2</sup> Indonesia's forest is one of the biodiversity centers in the world, and Indonesia is the third place out of seventeen countries called the Megadiversity Country.<sup>3-5</sup> Indonesia's forest is home to thousands of flora and fauna species, many of which are endemic to Indonesia.<sup>6</sup> The forest has direct and indirect benefits that are widely recognized.<sup>7</sup> The immediate benefits of forests are the production of wood and non-timber. In contrast, the indirect benefits include regulators of microclimates, water management, soil fertility, and sources of germplasm which are very important for human life.<sup>2</sup> The forest also plays an essential role, as carbon sinks and emitters, in the context of climate change.<sup>8</sup>

Forests are also inhabited by various species of animals and plants that provide food and medicine for those nearby.<sup>9</sup> Indonesia's tropical forest consists of multiple ecosystems, having more than 239 species of food plants and more than 2,039 species of medicinal plants.<sup>10</sup> Every tropical forest ecosystem in Indonesia is a factory for the diversity of medicinal plants, formed by evolution over a very long time, including interacting with the socio-culture of the surrounding local community.<sup>2</sup> Each individual from a population of medicinal plants that grow naturally in each type of forest ecosystem

is the most minor and original factory producing various unique bioactive ingredients, most of which are not accessible and expensive for humans to imitate.<sup>11,12</sup>

Indonesia's natural forests and culture, traditional knowledge, and local wisdom of indigenous tribes surrounding the forest ecosystems are precious national's treasures for forest conservation and the development of the nation's health.<sup>10</sup> Traditional knowledge that grows in and is well managed between generations of the indigenous tribes living in and around forests is a unified whole that complements the biological resources and, therefore, must be preserved.<sup>12</sup> Previous ethnophytomedical and ethnobotanical studies conducted by Indonesian researchers have identified that there are at least 78 species of medicinal plants used by 34 ethnic groups to treat malaria, 133 species of medicinal plants to treat fever by 30 ethnic groups, 110 species of medicinal plants to treat disorders digestion by 30 ethnic groups and 98 species of medicinal plants used to treat skin diseases by 27 ethnic groups.<sup>12,13</sup>

One of the areas in Indonesia, which has a large forest area, and many traditional communities, is Central Sulawesi. This region is a vast one in Indonesia because, biogeographically, it is the heart of Sulawesi Island and is included in the Wallacea region. Hence, this region has high biodiversity and species endemism.<sup>2,14</sup>

Central Sulawesi is also inhabited by various local communities who live around and even in forest

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areas. The potential of Central Sulawesi, where most of its territory is included in the forest area and has an excellent opportunity to be developed, is its high biodiversity of medicinal plants and the local wisdom of the people living around the forest area.<sup>4,15,16</sup> People living around and in forest areas have local wisdom in utilizing plants, particularly medicinal ingredients. Local wisdom knowledge on the use of medicinal plants, which includes the habitat, habitus, identification of plant species, parts used, and how to use it as medicine to its medicinal properties, is a high-value knowledge passed down from one generation to the next. The current problem is that most traditional knowledge is not well documented yet.<sup>2,17,18</sup>

The loss of local wisdom knowledge could potentially lead to the loss of several plant species due to the community's unawareness of the benefits and role of those plant species in human life.<sup>2</sup> Therefore, the local wisdom of the people living around Central Sulawesi's forest areas in managing forests and forest products, especially using plants as medicine, must be investigated and well documented. Another reason to preserve the knowledge is to support the sustainable use of biological natural resources, particularly non-timber forest products. Many think medicinal plants or traditional medicine are safer than synthetic drugs. Therefore, support from various parties is required to scientifically reveal the use of several plants as medicinal ingredients, the types of medicinal plant species, and the active compounds in the plants. Thus, the study objectives were to: (i) reveal, analyze and synthesize local knowledge of the local community around and in the forest in utilizing medicinal plants; and (ii) obtain data on the diversity of medicinal plant types used by locals in Central Sulawesi.<sup>2</sup>

## MATERIALS AND RESEARCH METHODS

This research was conducted in a Sigi Regency, Central Sulawesi forest area. The plant samples collected from the forest were identified at Tadulako University Celebence Herbarium. Data was collected through an exploratory survey, followed by a literature study activity, interviews, and field surveys.<sup>2</sup>

The literature study was carried out to obtain early information regarding the conditions of the research location, mainly the villages around the forest area and ethnic groups/tribes living around and in the forest area. Based on this information, the villages used as research location was then determined.<sup>11</sup>

The interviews in this study were conducted by combining purposive sampling and snowball methods. The first interview was conducted to determine the key respondent (key person) with specific criteria following the research objectives. The key respondents, who met the required criteria, were obtained based on the recommendations from the local service office of forestry and traditional leaders. Respondents were determined using the snowball method, in which the interview was stopped when the collected data and information showed no additional information.<sup>2</sup>

Field observation aimed to evaluate and validate the categories of medicinal plants identified through interviews. Observations were conducted by walking without plot boundaries and conducting direct observations in the field with respondents or guides.<sup>2,19</sup> The Celenbence Herbarium at Tadulako University was created to identify the medicinal plants the local community uses in the surrounding forest area.

## RESULTS AND DISCUSSION

### Medicinal plants species and local's wisdom utilization

The information on the variety of medicinal plant species and the Kaili tribe's local wisdom in plant utilization was extracted from interviews with research respondents (the community who know about the medicinal plants, shamans (Sando), community leaders, and traditional leaders). The list of species, including local names, scientific names, families, and uses, is presented in Table 1. The results showed that the Kaili tribe frequently uses about 113 species of medicinal plants from approximately 51 families (Table 1). Besides medicinal purposes, some plants are also used for other purposes, such as bamboo production, natural pesticides, and aromatics.

### The diversity of medicinal plants utilized by the Kaili tribe based on habitus

The habitus of medicinal plants is the general form of these medicinal plants. The habitus of medicinal plants in and around forest areas consists of plants, trees, shrubs, lianas, epiphytes, parasites, and bamboo. Herbaceous habitus had the highest percentage of 54.87% or 62 species of medicinal plants. It was followed by trees, shrubs, bushes, lianas, epiphytes, parasites, and bamboo with percentages, respectively, of 21.24% (14 species), 9.73% (11 species), 6.19% (6 species), 5.31% (6 species), 0.88% (1 species), 0.88% (1 species), 0.88% (1 species).

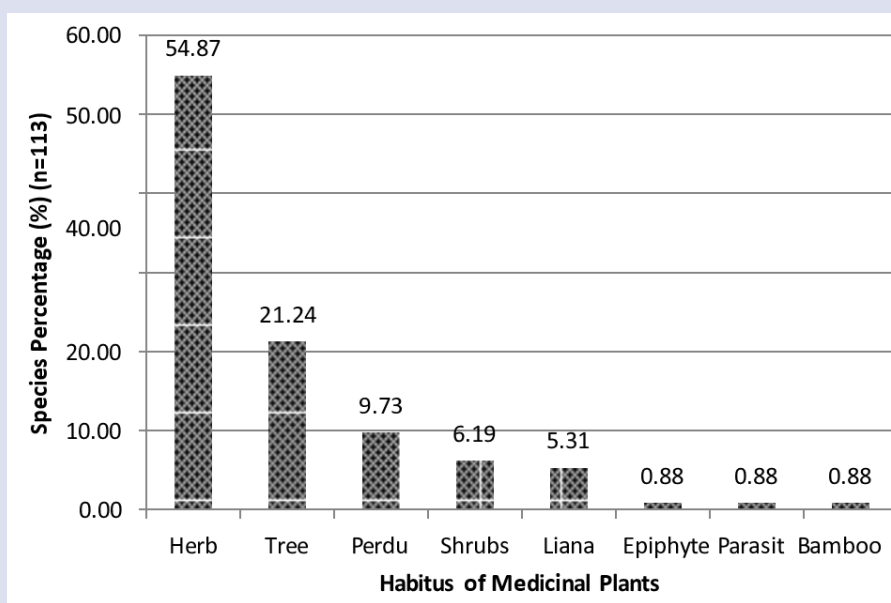


Figure 1: The percentage of medicinal plants based on their habitus

**Table 1: Diversity of medicinal plant species and local wisdom of the Kaili tribe in their use.**

Nu.	Lokal Name	Species	Family	Use/Benefit
1	Kapasan	<i>Abelmoschus moschatus</i> [L.] Medic	Malvaceae	Maternity process
2	Uru	<i>Elmerrillia ovalis</i> (Miq) Dandy	Maqnoiaceae	Cosmetics, Fever
3	Ambarogo	<i>Cordia corymbosa</i> Miq.	Boraginaceae	Stomachache
4	Balacai	<i>Jatropha curcas</i> L.	Euphorbiaceae	Stomatitis, Cuts
5	Bambu batu	<i>Dendrocalamus strictus</i> (Roxb)	Poaceae	Jaundice
6	Bayam duri	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Constipation
7	Benalu	<i>Scurrula artopurpurea</i>	Loranthaceae	Tumor, Vomiting blood/Hematemesis
8	Bila	<i>Crecentia cujete</i> L.	Bignoniaceae	Hernia
9	Bolu bua	<i>Piper betle</i> L.	Piperaceae	Body odor, Halitosis, Leukorea
10	Bolu karuke	<i>Piper retrofractum</i> Vahl.	Piperaceae	Toothache
11	Bolu Lasu	<i>Piper majusculum</i> Blume.	Piperaceae	Viagra
12	Bolu Tana	<i>Piper sp.</i>	Piperaceae	Body odor, Halitosis
13	Bunga pagoda	<i>Clerodendron japonicum</i>	Lamiaceae	Abscesses
14	Cakar Ayam	<i>Selaginella sp.</i>	Selaginellaceae	Fever, Anti-cancer
15	Daun rusuk	<i>Amydrium Zippelianum</i>	Araceae	Sore ribs
16	Daun sendok	<i>Plantago asiatica</i>	Plantaginaceae	Prostate, Appendix, Hernia
17	Gamal	<i>Gliricidia sepium</i> (jacq) Kunth	Fabaceae	Minor cuts, Headache
18	Gedi	<i>Abelmoschus manihot</i> (L.) Medicus	Malvaceae	Kidney, Maternity process
19	Gonato	<i>Clerodendrum sp.</i>	Lamiaceae	Worm infection
20	Pomempe	<i>Imperata cylindrica</i>	Poaceae	Supplement
21	Hipodo Walo	<i>Curanga fel-ferrae</i> (Lour.) Merr.	Linderniaceae	Internal disease
22	Jambu batu	<i>Psidium guajava</i> Linn.	Myrtaceae	Diarrhea
23	Jeruk Bali	<i>Citrus maxima</i> Merr.	Rutaceae	Diabetes
24	Kalebou	<i>Hibiscus tiliaceus</i> L.	Malvaceae	Bronchitis
25	Kanuna	<i>Cordia myxa</i> L.	Boraginaceae	Cuts
26	Kaporontomat	<i>Apium graveolens</i> L.	Apiaceae	Pertussis
27	Kapumpu	<i>Ocimum basilicum</i> L.	Lamiaceae	Headache, Wound
28	Kayu Manuru	<i>Senna alatta</i> L.	Fabaceae	Skin fungus diseases
29	Keladi bunga	<i>Syngonium podophyllum</i>	Araceae	Centipede and Snakebite antidote
30	Kelor	<i>Moringa oleifera</i> Lamk.	Moringaceae	High fever, Diabetes
31	Kondouwe	<i>Spilanthes paniculata</i> Wall. b DC	Asteraceae	Toothache
32	Kopi arabika	<i>Coffea canephora</i> Pierre	Rubiaceae	Hypertension
33	Kujadi	<i>Kalanchoe pinnata</i> Pers.	Crassulaceae	Abscesses
34	Kumis Kucing	<i>Orthosiphon aristatus</i> (Bl.) Miq.	Lamiaceae	Urolithiasis
35	Kurondo	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm	Zingiberaceae	Filariasis
36	Labu kuning	<i>Cucurbita moschata</i> D.	Cucurbitaceae	Eye disease
37	Lamba	<i>Nicotiana tabacum</i> L.	Solanaceae	Halitosis
38	Lambantomate	<i>Elephantopus mollis</i> Kunt.	Asteraceae	Stroke
39	Langalo	<i>Glinus oppositifolia</i> (L.) DC	Molluginaceae	Urolithiasis
40	Languntule	<i>Drymaria cordata</i> (L.) Willd ex Schult	Caryophyllaceae	Diabetes
41	Lasuani	<i>Amaranthus lividus</i> L.	Amaranthaceae	Headache, <i>Possessed</i>
42	Lekosa	<i>Pollia secundiflora</i> (Bl.) Back	Commelinaceae	Swollen foot
43	Lelompeba	<i>Dysophylla auricularia</i> (L) Blume	Lamiaceae	Pertussis
44	Lengaru	<i>Alstonia scholaris</i> R.Br.	Apocynaceae	Malaria, Internal injures
45	Levonu	<i>Ficus septica</i> Burm. F.	Moraceae	Eye infection
46	Mapo	<i>Maccaranga hispida</i> (Blume) Muell.	Euphorbiaceae	Papilloma
47	Matesambula	<i>Cassia sp.</i>	Fabaceae	Epilepsy
48	Mayana	<i>Coleus scutellarioides</i> Bth.	Lamiaceae	Cough, Internal diseases
49	Mpo Mata	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Abscesses
50	Legetan	<i>Synadrella nodiflora</i> (L.) Gaertn	Asteraceae	Rabies
51	Bendot	<i>Dichrocephala integrifolia</i> (L.f)	Asteraceae	<i>Possessed</i> , Worm treatment
52	Ruku-ruku	<i>Hyptis suaveolens</i> (L.) Poir.	Lamiaceae	Tinea pedis
53	Sangitan	<i>Sambucus javanica</i> Reinw	Adoxaceae	Acne treatment
54	Papaya	<i>Carica papaya</i> L	Caricaceae	Hypertension, Worm treatment
55	Nura	<i>Begonia aptera</i> Blume	Begoniaceae	Worm treatment
56	Pada	<i>Eleusine indica</i> (L.) Gaertn	Poaceae	Uterus strengthening
57	Palola Bua	<i>Luffa cylindrical</i> Roem	Cucurbitaceae	Swollen stomach
58	Pancihinana	<i>Scindapsus pictus</i> Hassk	Araceae	Skin fungus

Nu.	Lokal Name	Species	Family	Use/Benefit
59	Pancsilana lida	<i>Sporobulus diandrus</i> (Retz) P.Beauv.	Poaceae	Cosmetics
60	Pancsilana lore	<i>Merremia umbellata</i> (L.) Hallier f.	Euphorbiaceae	Cosmetics (mole on the face)
61	Pancongkolangi	<i>Centella asiatica</i> L. (Urb.)	Fabaceae	Tuberculosis
62	Panuntu	<i>Phyllanthus urinaria</i> L.	Lamiaceae	Kidney, Urolithiasis
63	Paparisipa	<i>Cyperus killingia</i> Endl.	Crassulaceae	<i>Possessed</i>
64	Paralente	<i>Ageratum conyzoides</i> L.	Asteraceae	Cuts, step
65	Parancina	<i>Solanum lycopersicum</i> L.	Asteraceae	Fever, Burns
66	Paria	<i>Momordica charantia</i> L.	Lamiaceae	Cough, Fever, Ulcer
67	Pasolonteneru	<i>Equisetum debile</i> Roxb.Ex Vaucher	Equisetaceae	Broken ribs, Muscle strain
68	Penesilin	<i>Jatropha mutifida</i> L.	Euphorbiaceae	Cuts, Stomatitis
69	Pia topoule	<i>Eleutherina bulbosa</i> (Mill.) Urb.	Iridaceae	Heart disease, Hemorrhoid
70	Pinahong	<i>Anredera cordifolia</i> (Ten.) Steenis	Basellaceae	Tumor, Hypertension
71	Posuntikala	<i>Elingera elatior</i> (Jack) R.M. Sm.	Zingiberaceae	Gout
72	Puroo	<i>Eclipta prostata</i> (L.) L.	Asteraceae	Umbilical treatment
73	Putri Malu	<i>Mimosa pudica</i> L.	Leguminosae	Heatiness, Insomnia
74	Sakimalei	<i>Amphineuron</i> sp.	Thelypteridaceae	Fever and Rashes
75	Sampularo	<i>Murdannia blumei</i> (Hassk.)	Commelinaceae	Face's mole
76	Sarang Semut	<i>Myrmecodia</i> sp.	Rubiaceae	Ulcer, Hypertension
77	Silaguri	<i>Sida rhombifolia</i> L.	Malvaceae	Infection, Teeth treatment
78	Simulasi	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Appendix
79	Sinduru	<i>Melastoma candidum</i> D.Don	Melastomataceae	Abscesses, Nosebleed
80	Sirsak	<i>Annona reticulata</i> L.	Annonaceae	Kidney, Hypertension
81	Susupi	<i>Bidens pilosa</i> L.	Asteraceae	Post-maternity treatment, Cough
82	Taba	<i>Cordylin fructifosa</i> A.Chev.	Asparagaceae	TBC
83	Tambajarabung	<i>Hyptis capitata</i> Jack.	Lamiaceae	Kidney, Liver
84	Kau Jawa	<i>Lannea coromandelica</i> Merr.	Anacardiaceae	Hepatitis and Diabetes
85	Tambuang kebe	<i>Senna tora</i> L. (Roxb)	Fabaceae	Melena
86	Tampe	<i>Physalis angulata</i> L.	Solanaceae	Hypertension
87	Tatari	<i>Scleria purpurelens</i> Steud.	Cyperaceae	Kidney
88	Tavalevo	<i>Piper umbellatum</i> L.	Piperaceae	Erectile dysfunction
89	Tave Lehoka	<i>Comelina diffusa</i> Burm. f.	Commelinaceae	Gout
90	Tave hikonco	<i>Ficus stipulare</i> L.	Moraceae	Jaundice
91	Tavovi	<i>Ipomoea batatas</i> (L.) Poir	Convolvulaceae	Skin diseases
92	Tintiase	<i>Cheilocostus speciosus</i>	Marattiaceae	Fever
93	Tombila	<i>Angiopteris evecta</i> (G Forst) Hoffm	Urticaceae	Rabies
94	Tombu	<i>Poikilospermum suaviolen</i> (Bl.) Merr	Rubiaceae	Breast cancer
95	Towote	<i>Anthocephalus chinensis</i> (Lam.) C.	Cyperaceae	Malaria, Internal injuries
96	Voluntile	<i>Eleocharis artopurpurea</i> Retz. Presl.	Asteraceae	Postpartum treatment
97	Wavaro	<i>Crassocephalum crepidioides</i> (Benth)	Asteraceae	Cuts
98	Wingkotu	<i>Erigeron sumatraensis</i> Retz.	Marattiaceae	Leprosy
99	Manggarada	<i>Acmeila ciliate</i> (Kunth) Cass	Asteraceae	Toothache
100	Roviga	<i>Calotropis gigantea</i>	Apocynaceae	Stomatitis, Measles
101	Varo-Varo	<i>Cyantjilium cinereum</i> (L) H.Rob.	Asteraceae.	Cough
102	Kayu Hitam	<i>Dyospyros celebica</i> Bakh	Ebenaceae	Internal diseases
103	Kamboja Putih	<i>Plumeria alba</i> .	Apocynaceae	Breast cancer
104	Una-Una	<i>Piper aduncum</i> L	Piperaceae	Skin diseases (Itching)
105	Titilu	<i>Tacca palmate</i> Blume	Taccaceae	Acne and Ulcer
106	Parada	<i>Chromolaena odorata</i> (L.)	Asteraceae	Minor cuts
107	Palio	<i>Cinnamomum parthenoxylon</i>	Lauraceae	Malaria
108	Wintonu	<i>Melochia umbellate</i>	Sterculiaceae	Bronchitis
109	Jati	<i>Tectona grandis</i>	Lamiaceae	Skin diseases (Itching)
110	Samundu	<i>Polyscias nodosa</i> (Bl.) Seem	Araliaceae	Cancer
111	Tintiaye	<i>Elephantopus scaber</i> L	Asteraceae	Nail diseases
112	Siguntu lele	<i>Synedrella nodiflora</i> (L) Gaertn	Asteraceae	Arthritis, Gout
113	Marangkapi	<i>Oreocnide rubescens</i> (Blume) Miq	Urticaceae	Breast tumor

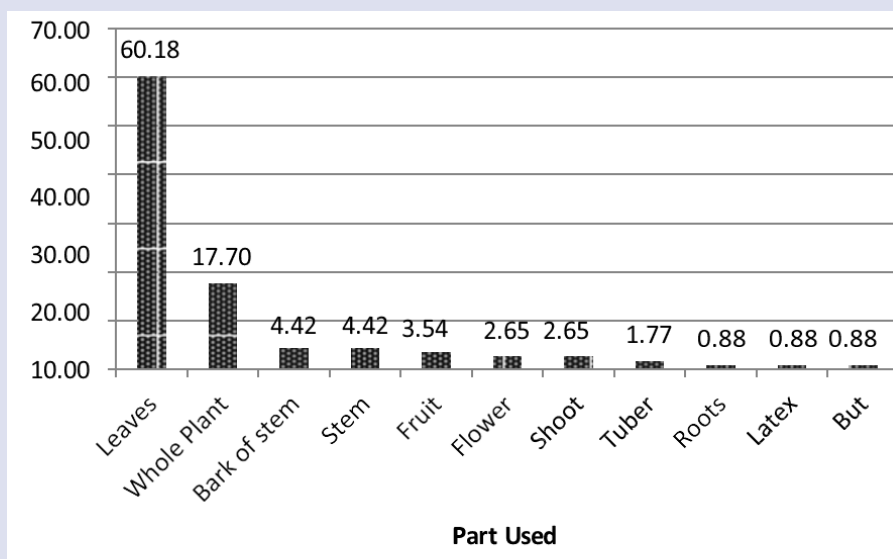


Figure 2: Diagram of the percentage of medicinal plants based on utilized organ

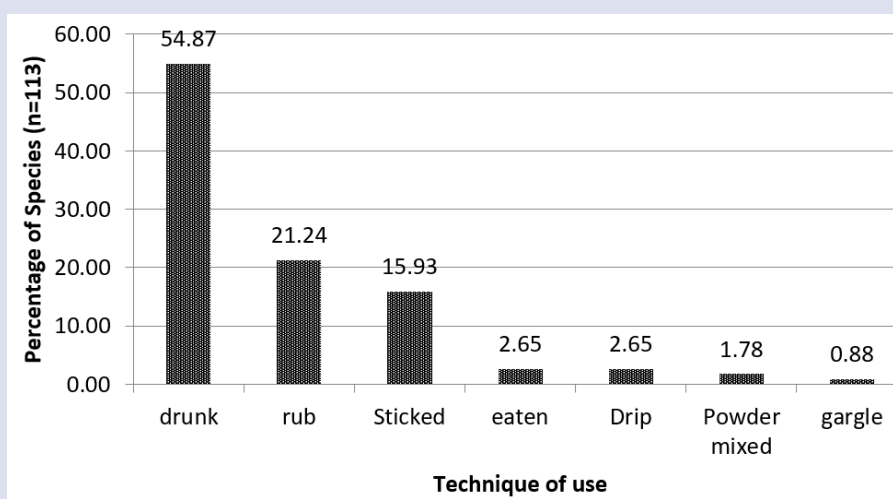


Figure 3: Different utilization modes of medicinal plants by the Kaili tribe

species), 0.88% (1 species), 0.88% (1 species), and 0.88% (1 species) (Figure 1).

### Medicinal plants based on the plant parts used by the Kaili tribe-

The plant parts used as traditional medicine by the Kaili tribe around the forest area are very diverse. Based on the interview, 11 parts were frequently employed: the leaves, bark, stems, fruits, buds, the tender core of the plant's trunk (*umbut*), tuberous roots, and shoots, and several plants were used entirely as medicine. The plant part with the highest use frequency was the leaves (60.18%), followed by all parts (17.7%), bark (4.42%), stems (4.42%), fruits (3.54%), and others (flowers, roots, buds, *but*, and tuberous roots) with each of them was below 3% (Figure 2).

The high usage of leaves as medicinal material, compared to other plant parts, is due to several reasons. The leaves are utilized frequently since they can be processed and collected faster and more optimally than other parts.<sup>11</sup> The leaf collection also prevents the disruption of other parts since they can re-grow and be continuously utilized.

Several former studies also indicated similar findings. The most common parts of medicinal plants used in Afghanistan were the leaves, stems, flowers, roots, seeds, bark, and tubers.<sup>20</sup> In Uganda, 15 (fifteenth) plant parts were utilized for traditional medicine, such as the leaves, roots, bark, fruits, all parts, stems/wood, seeds, flowers, sap, buds, leaves/shoots, rhizomes, tuber, branches/twigs, water in banana stem fiber, and the tender core of the plant's trunk (*umbut*). Of those 15 parts, the leaves were the most used (749 species (33.50%)), and *umbut* was the least part of the plant used as traditional medicine.<sup>21</sup> Recent studies on medicinal plants from the heath forest in Belitung also showed leaves as the dominant plant parts used for medicinal purposes.<sup>23</sup>

### Utilisation modes of medicinal plants by the Kaili tribe

Local communities use the specific plants as a medicine around forest areas in various ways, such as drinking, rubbing, sticking, fresh eating, dripping, mixing powder, and gargling (Figure 3). The most widely used mode in medicinal plants is boiling the plants in water and drinking the solution directly. This mode is affordable, simple, and utilized for approximately 54.87%, or 64 species. Direct rubbing and application/



sticking on the injured body part are used for 21.24% and 15.93% of medicinal plants, respectively. A rare technique, gargling, is used for one plant species (or 0.88%) which is *Acmella ciliata* (Kunth) Cass. Similar findings were observed in several other regions in Indonesia.<sup>22-25</sup>

## CONCLUSIONS

The potential medicinal plants utilized by the Kaili Tribe, who live around forest areas, is high, indicated by the discovery of 113 species. These species are also found in the yard with the most heightened plant habitus. The leaves are the most used plant part, generally boiled in water and consumed.

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kepada Pharmacognosy ▾

Kam, 29 Jun, 16.48



Dear Emily Flora,

This is our latest change. We have yellow highlights and give a note

Regards,  
Abdul Hapid



Satu lampiran • Dipindai dengan Gmail ⓘ



# Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia

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## ABSTRACT

The forest area in Sigi Regency, Central Sulawesi, is a habitat for various medicinal plant species. Forest areas must be managed appropriately for the local community and society's welfare and sustainable use. One of the local people living around the forest is the Kaili tribe. The local wisdom of the Kaili tribe, who inhabit forest areas in Central Sulawesi, in managing forests and forest products, especially using plants as medicine, must be documented in research. This study aimed to identify the species, habitat, habitus, and ways of using the plant as medicine by the Kaili people in the Sigi Regency.

Prior to data collection, a literature study was conducted to obtain information regarding the condition of the research location around the forest area and the ethnic/ethnic groups who live permanently around and within the forest area. This stage was then followed by interviews and field surveys. The interviews were conducted by combining purposive sampling and snowball methods.

The results showed the high potency of medicinal plants around forest areas used by the Kaili tribe, with the discovery of 113 species in 51 families. Herbs are the most common habitus of medicinal plants. The habitat of medicinal plants is mainly found in the yard. The most used plant part is the leaves, which can be boiled in water and drunk directly.

**Key words:** Kaili tribe, Local knowledge, Medicinal plants, Species diversity.

## INTRODUCTION

Indonesia, located on the equator, is a mega biodiversity country. It has a unique tropical rain area in which various plants have the potential as raw materials for medicine.<sup>1,2</sup> Indonesia's forest is one of the biodiversity centers in the world, and Indonesia is the third place out of seventeen countries called the Megadiversity Country.<sup>3-5</sup> Indonesia's forest is home to thousands of flora and fauna species, many of which are endemic to Indonesia.<sup>6</sup> The forest has direct and indirect benefits that are widely recognized.<sup>7</sup> The immediate benefits of forests are the production of wood and non-timber. In contrast, the indirect benefits include regulators of microclimates, water management, soil fertility, and sources of germplasm which are very important for human life.<sup>2</sup> The forest also plays an essential role, as carbon sinks and emitters, in the context of climate change.<sup>8</sup>

Forests are also inhabited by various species of animals and plants that provide food and medicine for those nearby.<sup>9</sup> Indonesia's tropical forest consists of multiple ecosystems, having more than 239 species of food plants and more than 2,039 species of medicinal plants.<sup>10</sup> Every tropical forest ecosystem in Indonesia is a factory for the diversity of medicinal plants, formed by evolution over a very long time, including interacting with the socio-culture of the surrounding local community.<sup>2</sup> Each individual from a population of medicinal plants that grow naturally in each type of forest ecosystem

is the most minor and original factory producing various unique bioactive ingredients, most of which are not accessible and expensive for humans to imitate.<sup>11,12</sup>

Indonesia's natural forests and culture, traditional knowledge, and local wisdom of indigenous tribes surrounding the forest ecosystems are precious national's treasures for forest conservation and the development of the nation's health.<sup>10</sup> Traditional knowledge that grows in and is well managed between generations of the indigenous tribes living in and around forests is a unified whole that complements the biological resources and, therefore, must be preserved.<sup>12</sup> Previous ethnophytomedicine and ethnobotanical studies conducted by Indonesian researchers have identified that there are at least 78 species of medicinal plants used by 34 ethnic groups to treat malaria, 133 species of medicinal plants to treat fever by 30 ethnic groups, 110 species of medicinal plants to treat disorders digestion by 30 ethnic groups and 98 species of medicinal plants used to treat skin diseases by 27 ethnic groups.<sup>12,13</sup>

One of the areas in Indonesia, which has a large forest area, and many traditional communities, is Central Sulawesi. This region is a vast one in Indonesia because, biogeographically, it is the heart of Sulawesi Island and is included in the Wallacea region. Hence, this region has high biodiversity and species endemism.<sup>2,14</sup>

Central Sulawesi is also inhabited by various local communities who live around and even in forest

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areas. The potential of Central Sulawesi, where most of its territory is included in the forest area and has an excellent opportunity to be developed, is its high biodiversity of medicinal plants and the local wisdom of the people living around the forest area.<sup>4,15,16</sup> People living around and in forest areas have local wisdom in utilizing plants, particularly medicinal ingredients. Local wisdom knowledge on the use of medicinal plants, which includes the habitat, habitus, identification of plant species, parts used, and how to use it as medicine to its medicinal properties, is a high-value knowledge passed down from one generation to the next. The current problem is that most traditional knowledge is not well documented yet.<sup>2,17,18</sup>

The loss of local wisdom knowledge could potentially lead to the loss of several plant species due to the community's unawareness of the benefits and role of those plant species in human life.<sup>2</sup> Therefore, the local wisdom of the people living around Central Sulawesi's forest areas in managing forests and forest products, especially using plants as medicine, must be investigated and well documented. Another reason to preserve the knowledge is to support the sustainable use of biological natural resources, particularly non-timber forest products. Many think medicinal plants or traditional medicine are safer than synthetic drugs. Therefore, support from various parties is required to scientifically reveal the use of several plants as medicinal ingredients, the types of medicinal plant species, and the active compounds in the plants. Thus, the study objectives were to: (i) reveal, analyze and synthesize local knowledge of the local community around and in the forest in utilizing medicinal plants; and (ii) obtain data on the diversity of medicinal plant types used by locals in Central Sulawesi.<sup>2</sup>

## MATERIALS AND RESEARCH METHODS

This research was conducted in a Sigi Regency, Central Sulawesi forest area. The plant samples collected from the forest were identified at Tadulako University Celebence Herbarium. Data was collected through an exploratory survey, followed by a literature study activity, interviews, and field surveys.<sup>2</sup>

The literature study was carried out to obtain early information regarding the conditions of the research location, mainly the villages around the forest area and ethnic groups/tribes living around and in the forest area. Based on this information, the villages used as research location was then determined.<sup>11</sup>

The interviews in this study were conducted by combining purposive sampling and snowball methods. The first interview was conducted to determine the key respondent (key person) with specific criteria following the research objectives. The key respondents, who met the required criteria, were obtained based on the recommendations from the local service office of forestry and traditional leaders. Respondents were determined using the snowball method, in which the interview was stopped when the collected data and information showed no additional information.<sup>2</sup>

Field observation aimed to evaluate and validate the categories of medicinal plants identified through interviews. Observations were conducted by walking without plot boundaries and conducting direct observations in the field with respondents or guides.<sup>2,19</sup> The Celenbence Herbarium at Tadulako University was created to identify the medicinal plants the local community uses in the surrounding forest area.

## RESULTS AND DISCUSSION

### Medicinal plants species and local's wisdom utilization

The information on the variety of medicinal plant species and the Kaili tribe's local wisdom in plant utilization was extracted from interviews with research respondents (the community who know about the medicinal plants, shamans (Sando), community leaders, and traditional leaders). The list of species, including local names, scientific names, families, and uses, is presented in Table 1. The results showed that the Kaili tribe frequently uses about 113 species of medicinal plants from approximately 51 families (Table 1). Besides medicinal purposes, some plants are also used for other purposes, such as bamboo production, natural pesticides, and aromatics.

### The diversity of medicinal plants utilized by the Kaili tribe based on habitus

The habitus of medicinal plants is the general form of these medicinal plants. The habitus of medicinal plants in and around forest areas consists of plants, trees, shrubs, lianas, epiphytes, parasites, and bamboo. Herbaceous habitus had the highest percentage of 54.87% or 62 species of medicinal plants. It was followed by trees, shrubs, bushes, lianas, epiphytes, parasites, and bamboo with percentages, respectively, of 21.24% (14 species), 9.73% (11 species), 6.19% (6 species), 5.31% (6 species), 0.88% (1 species), 0.88% (1 species), 0.88% (1 species).

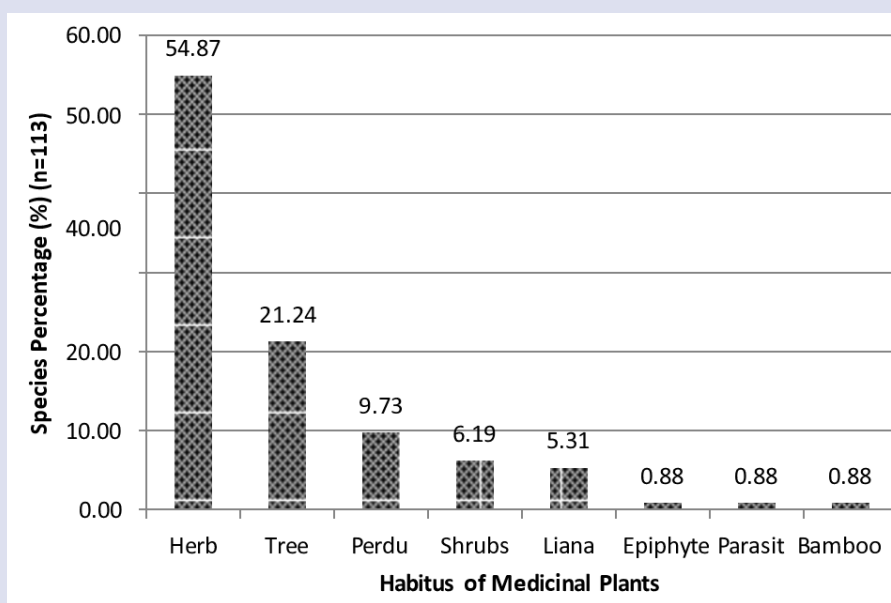


Figure 1: The percentage of medicinal plants based on their habitus

**Table 1: Diversity of medicinal plant species and local wisdom of the Kaili tribe in their use.**

Nu.	Lokal Name	Species	Family	Use/Benefit
1	Kapasan	<i>Abelmoschus moschatus</i> [L.] Medic	Malvaceae	Maternity process
2	Uru	<i>Elmerrillia ovalis</i> (Miq) Dandy	Maqnoiaceae	Cosmetics, Fever
3	Ambarogo	<i>Cordia corymbosa</i> Miq.	Boraginaceae	Stomachache
4	Balacai	<i>Jatropha curcas</i> L.	Euphorbiaceae	Stomatitis, Cuts
5	Bambu batu	<i>Dendrocalamus strictus</i> (Roxb)	Poaceae	Jaundice
6	Bayam duri	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Constipation
7	Benalu	<i>Scurrula artopurpurea</i>	Loranthaceae	Tumor, Vomiting blood/Hematemesis
8	Bila	<i>Crecentia cujete</i> L.	Bignoniaceae	Hernia
9	Bolu bua	<i>Piper betle</i> L.	Piperaceae	Body odor, Halitosis, Leukorea
10	Bolu karuke	<i>Piper retrofractum</i> Vahl.	Piperaceae	Toothache
11	Bolu Lasu	<i>Piper majusculum</i> Blume.	Piperaceae	Viagra
12	Bolu Tana	<i>Piper</i> sp.	Piperaceae	Body odor, Halitosis
13	Bunga pagoda	<i>Clerodendron japonicum</i>	Lamiaceae	Abscesses
14	Cakar Ayam	<i>Selaginella</i> sp.	Selaginellaceae	Fever, Anti-cancer
15	Daun rusuk	<i>Amydrium Zippelianum</i>	Araceae	Sore ribs
16	Daun sendok	<i>Plantago asiatica</i>	Plantaginaceae	Prostate, Appendix, Hernia
17	Gamal	<i>Gliricidia sepium</i> (jacq) Kunth	Fabaceae	Minor cuts, Headache
18	Gedi	<i>Abelmoschus manihot</i> (L.) Medicus	Malvaceae	Kidney, Maternity process
19	Gonato	<i>Clerodendrum</i> sp.	Lamiaceae	Worm infection
20	Pomempe	<i>Imperata cylindrica</i>	Poaceae	Supplement
21	Hipodo Walo	<i>Curanga fel-ferrae</i> (Lour.) Merr.	Linderniaceae	Internal disease
22	Jambu batu	<i>Psidium guajava</i> Linn.	Myrtaceae	Diarrhea
23	Jeruk Bali	<i>Citrus maxima</i> Merr.	Rutaceae	Diabetes
24	Kalebou	<i>Hibiscus tiliaceus</i> L.	Malvaceae	Bronchitis
25	Kanuna	<i>Cordia myxa</i> L.	Boraginaceae	Cuts
26	Kaporontomat	<i>Apium graveolens</i> L.	Apiaceae	Pertussis
27	Kapumpu	<i>Ocimum basilicum</i> L.	Lamiaceae	Headache, Wound
28	Kayu Manuru	<i>Senna alatta</i> L.	Fabaceae	Skin fungus diseases
29	Keladi bunga	<i>Syngonium podophyllum</i>	Araceae	Centipede and Snakebite antidote
30	Kelor	<i>Moringa oleifera</i> Lamk.	Moringaceae	High fever, Diabetes
31	Kondouwe	<i>Spilanthes paniculata</i> Wall. b DC	Asteraceae	Toothache
32	Kopi arabika	<i>Coffea canephora</i> Pierre	Rubiaceae	Hypertension
33	Kujadi	<i>Kalanchoe pinnata</i> Pers.	Crassulaceae	Abscesses
34	Kumis Kucing	<i>Orthosiphon aristatus</i> (Bl.) Miq.	Lamiaceae	Urolithiasis
35	Kurondo	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm	Zingiberaceae	Filariasis
36	Labu kuning	<i>Cucurbita moschata</i> D.	Cucurbitaceae	Eye disease
37	Lamba	<i>Nicotiana tabacum</i> L.	Solanaceae	Halitosis
38	Lambantomate	<i>Elephantopus mollis</i> Kunt.	Asteraceae	Stroke
39	Langalo	<i>Glinus oppositifolia</i> (L.) DC	Molluginaceae	Urolithiasis
40	Languntule	<i>Drymaria cordata</i> (L.) Willd ex Schult	Caryophyllaceae	Diabetes
41	Lasuani	<i>Amaranthus lividus</i> L.	Amaranthaceae	Headache, <i>Possessed</i>
42	Lekosa	<i>Pollia secundiflora</i> (Bl.) Back	Commelinaceae	Swollen foot
43	Lelompeba	<i>Dysophylla auricularia</i> (L) Blume	Lamiaceae	Pertussis
44	Lengaru	<i>Alstonia scholaris</i> R.Br.	Apocynaceae	Malaria, Internal injures
45	Levonu	<i>Ficus septica</i> Burm. F.	Moraceae	Eye infection
46	Mapo	<i>Maccaranga hispida</i> (Blume) Muell.	Euphorbiaceae	Papilloma
47	Matesambula	<i>Cassia</i> sp.	Fabaceae	Epilepsy
48	Mayana	<i>Coleus scutellarioides</i> Bth.	Lamiaceae	Cough, Internal diseases
49	Mpo Mata	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Abscesses
50	Legetan	<i>Synadrella nodiflora</i> (L.) Gaertn	Asteraceae	Rabies
51	Bendot	<i>Dichrocephala integrifolia</i> (L.f)	Asteraceae	<i>Possessed</i> , Worm treatment
52	Ruku-ruku	<i>Hyptis suaveolens</i> (L.) Poir.	Lamiaceae	Tinea pedis
53	Sangitan	<i>Sambucus javanica</i> Reinw	Adoxaceae	Acne treatment
54	Papaya	<i>Carica papaya</i> L	Caricaceae	Hypertension, Worm treatment
55	Nura	<i>Begonia aptera</i> Blume	Begoniaceae	Worm treatment
56	Pada	<i>Eleusine indica</i> (L.) Gaertn	Poaceae	Uterus strengthening
57	Palola Bua	<i>Luffa cylindrical</i> Roem	Cucurbitaceae	Swollen stomach
58	Pancihinana	<i>Scindapsus pictus</i> Hassk	Araceae	Skin fungus

Nu.	Lokal Name	Species	Family	Use/Benefit
59	Pancsilana lida	<i>Sporobulus diandrus</i> (Retz) P.Beauv.	Poaceae	Cosmetics
60	Pancsilana lore	<i>Merremia umbellata</i> (L.) Hallier f.	Euphorbiaceae	Cosmetics (mole on the face)
61	Pancongkolangi	<i>Centella asiatica</i> L. (Urb.)	Fabaceae	Tuberculosis
62	Panuntu	<i>Phyllanthus urinaria</i> L.	Lamiaceae	Kidney, Urolithiasis
63	Paparisipa	<i>Cyperus killingia</i> Endl.	Crassulaceae	Possessed
64	Paralente	<i>Ageratum conyzoides</i> L.	Asteraceae	Cuts, step
65	Parancina	<i>Solanum lycopersicum</i> L.	Asteraceae	Fever, Burns
66	Paria	<i>Momordica charantia</i> L.	Lamiaceae	Cough, Fever, Ulcer
67	Pasolonteneru	<i>Equisetum debile</i> Roxb.Ex Vaucher	Equisetaceae	Broken ribs, Muscle strain
68	Penesilin	<i>Jatropha mutifida</i> L.	Euphorbiaceae	Cuts, Stomatitis
69	Pia topoule	<i>Eleutherina bulbosa</i> (Mill.) Urb.	Iridaceae	Heart disease, Hemorrhoid
70	Pinahong	<i>Anredera cordifolia</i> (Ten.) Steenis	Basellaceae	Tumor, Hypertension
71	Posuntikala	<i>Elingera elatior</i> (Jack) R.M. Sm.	Zingiberaceae	Gout
72	Puroo	<i>Eclipta prostata</i> (L.) L.	Asteraceae	Umbilical treatment
73	Putri Malu	<i>Mimosa pudica</i> L.	Leguminosae	Heatiness, Insomnia
74	Sakimalei	<i>Amphineuron</i> sp.	Thelypteridaceae	Fever and Rashes
75	Sampularo	<i>Murdannia blumei</i> (Hassk.)	Commelinaceae	Face's mole
76	Sarang Semut	<i>Myrmecodia</i> sp.	Rubiaceae	Ulcer, Hypertension
77	Silaguri	<i>Sida rhombifolia</i> L.	Malvaceae	Infection, Teeth treatment
78	Simulasi	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Appendix
79	Sinduru	<i>Melastoma candidum</i> D.Don	Melastomataceae	Abscesses, Nosebleed
80	Sirsak	<i>Annona reticulata</i> L.	Annonaceae	Kidney, Hypertension
81	Susupi	<i>Bidens pilosa</i> L.	Asteraceae	Post-maternity treatment, Cough
82	Taba	<i>Cordylin fructifosa</i> A.Chev.	Asparagaceae	TBC
83	Tambajarabung	<i>Hyptis capitata</i> Jack.	Lamiaceae	Kidney, Liver
84	Kau Jawa	<i>Lannea coromandelica</i> Merr.	Anacardiaceae	Hepatitis and Diabetes
85	Tambuang kebe	<i>Senna tora</i> L. (Roxb)	Fabaceae	Melena
86	Tampe	<i>Physalis angulata</i> L.	Solanaceae	Hypertension
87	Tatari	<i>Scleria purpurelens</i> Steud.	Cyperaceae	Kidney
88	Tavalevo	<i>Piper umbellatum</i> L.	Piperaceae	Erectile dysfunction
89	Tave Lehoka	<i>Comelina diffusa</i> Burm. f.	Commelinaceae	Gout
90	Tave hikonco	<i>Ficus stipulare</i> L.	Moraceae	Jaundice
91	Tavovi	<i>Ipomoea batatas</i> (L.) Poir	Convolvulaceae	Skin diseases
92	Tintiase	<i>Cheilocostus speciosus</i>	Marattiaceae	Fever
93	Tombila	<i>Angiopteris evecta</i> (G Forst) Hoffm	Urticaceae	Rabies
94	Tombu	<i>Poikilospermum suaviolen</i> (Bl.) Merr	Rubiaceae	Breast cancer
95	Towote	<i>Anthocephalus chinensis</i> (Lam.) C.	Cyperaceae	Malaria, Internal injuries
96	Voluntile	<i>Eleocharis artopurpurea</i> Retz. Presl.	Asteraceae	Postpartum treatment
97	Wavaro	<i>Crassocephalum crepidioides</i> (Benth)	Asteraceae	Cuts
98	Wingkotu	<i>Erigeron sumatraensis</i> Retz.	Marattiaceae	Leprosy
99	Manggarada	<i>Acmella ciliate</i> (Kunth) Cass	Asteraceae	Toothache
100	Roviga	<i>Calotropis gigantea</i>	Apocynaceae	Stomatitis, Measles
101	Varo-Varo	<i>Cyantjilium cinereum</i> (L) H.Rob.	Asteraceae.	Cough
102	Kayu Hitam	<i>Dyospyros celebica</i> Bakh	Ebenaceae	Internal diseases
103	Kamboja Putih	<i>Plumeria alba</i> .	Apocynaceae	Breast cancer
104	Una-Una	<i>Piper aduncum</i> L	Piperaceae	Skin diseases (Itching)
105	Titilu	<i>Tacca palmate</i> Blume	Taccaceae	Acne and Ulcer
106	Parada	<i>Chromolaena odorata</i> (L.)	Asteraceae	Minor cuts
107	Palio	<i>Cinnamomum parthenoxylon</i>	Lauraceae	Malaria
108	Wintonu	<i>Melochia umbellate</i>	Sterculiaceae	Bronchitis
109	Jati	<i>Tectona grandis</i>	Lamiaceae	Skin diseases (Itching)
110	Samundu	<i>Polyscias nodosa</i> (Bl.) Seem	Araliaceae	Cancer
111	Tintiaye	<i>Elephantopus scaber</i> L	Asteraceae	Nail diseases
112	Siguntu lele	<i>Synedrella nodiflora</i> (L) Gaertn	Asteraceae	Arthritis, Gout
113	Marangkapi	<i>Oreocnide rubescens</i> (Blume) Miq	Urticaceae	Breast tumor

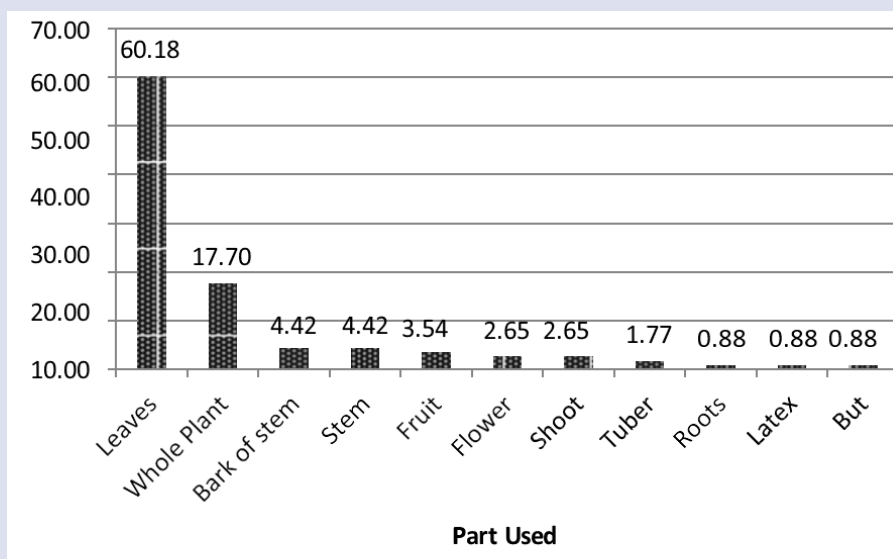


Figure 2: Diagram of the percentage of medicinal plants based on utilized organ

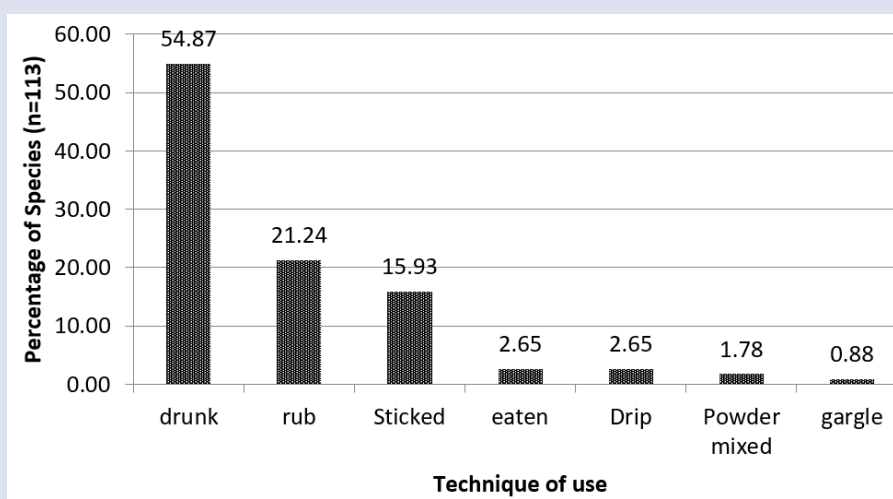


Figure 3: Different utilization modes of medicinal plants by the Kaili tribe

species), 0.88% (1 species), 0.88% (1 species), and 0.88% (1 species) (Figure 1).

### Medicinal plants based on the plant parts used by the Kaili tribe

The plant parts used as traditional medicine by the Kaili tribe around the forest area are very diverse. Based on the interview, 11 parts were frequently employed: the leaves, bark, stems, fruits, buds, the tender core of the plant's trunk (*umbut*), tuberous roots, and shoots, and several plants were used entirely as medicine. The plant part with the highest use frequency was the leaves (60.18%), followed by all parts (17.7%), bark (4.42%), stems (4.42%), fruits (3.54%), and others (flowers, roots, buds, *but*, and tuberous roots) with each of them was below 3% (Figure 2).

The high usage of leaves as medicinal material, compared to other plant parts, is due to several reasons. The leaves are utilized frequently since they can be processed and collected faster and more optimally than other parts.<sup>11</sup> The leaf collection also prevents the disruption of other parts since they can re-grow and be continuously utilized.

Several former studies also indicated similar findings. The most common parts of medicinal plants used in Afghanistan were the leaves, stems, flowers, roots, seeds, bark, and tubers.<sup>20</sup> In Uganda, 15 (fifth teen) plant parts were utilized for traditional medicine, such as the leaves, roots, bark, fruits, all parts, stems/wood, seeds, flowers, sap, buds, leaves/shoots, rhizomes, tuber, branches/twigs, water in banana stem fiber, and the tender core of the plant's trunk (*umbut*). Of those 15 parts, the leaves were the most used (749 species (33.50%)), and *umbut* was the least part of the plant used as traditional medicine.<sup>21</sup> Recent studies on medicinal plants from the heath forest in Belitung also showed leaves as the dominant plant parts used for medicinal purposes.<sup>23</sup>

### Utilisation modes of medicinal plants by the Kaili tribe

Local communities use the specific plants as a medicine around forest areas in various ways, such as drinking, rubbing, sticking, fresh eating, dripping, mixing powder, and gargling (Figure 3). The most widely used mode in medicinal plants is boiling the plants in water and drinking the solution directly. This mode is affordable, simple, and utilized for approximately 54.87%, or 64 species. Direct rubbing and application/

sticking on the injured body part are used for 21.24% and 15.93% of medicinal plants, respectively. A rare technique, gargling, is used for one plant species (or 0.88%) which is *Acmella ciliata* (Kunth) Cass. Similar findings were observed in several other regions in Indonesia.<sup>22-25</sup>

## CONCLUSIONS

The potential medicinal plants utilized by the Kaili Tribe, who live around forest areas, is high, indicated by the discovery of 113 species. These species are also found in the yard with the most heightened plant habitus. The leaves are the most used plant part, generally boiled in water and consumed.

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**Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia**

**Abdul Hapidul<sup>1\*</sup>, Anjarsari Anjarsari<sup>1</sup>, Gunawan Gunawan<sup>1</sup>, Ni Nisda Okarna Shantira Casari<sup>1</sup>, Herat Apri Adi Astora<sup>1</sup>, Sunardi Sunardi<sup>1</sup>, Elizabeth Elizabeth<sup>1</sup>**

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**Abstract:** This study aims to explore the diversity of medicinal plants and local wisdom in processing medicinal plants around the forest areas of Central Sulawesi, Indonesia. The study was conducted through a qualitative approach using focus group discussions, interviews, and observations. The study area is located in the forest areas of Central Sulawesi, Indonesia. The results of the study show that there is a high diversity of medicinal plants and local wisdom in processing medicinal plants around the forest areas of Central Sulawesi, Indonesia. The study also found that there is a need for conservation of medicinal plants and local wisdom in processing medicinal plants around the forest areas of Central Sulawesi, Indonesia.

**Keywords:** medicinal plants, local wisdom, forest areas, Central Sulawesi, Indonesia.

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# Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia

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## ABSTRACT

The forest area in Sigi Regency, Central Sulawesi, is a habitat for various medicinal plant species. Forest areas must be managed appropriately for the local community and society's welfare and sustainable use. One of the local people living around the forest is the Kaili tribe. The local wisdom of the Kaili tribe, who inhabit forest areas in Central Sulawesi, in managing forests and forest products, especially using plants as medicine, must be documented in research. This study aimed to identify the species, habitat, habitus, and ways of using the plant as medicine by the Kaili people in the Sigi Regency.

Prior to data collection, a literature study was conducted to obtain information regarding the condition of the research location around the forest area and the ethnic/ethnic groups who live permanently around and within the forest area. This stage was then followed by interviews and field surveys. The interviews were conducted by combining purposive sampling and snowball methods.

The results showed the high potency of medicinal plants around forest areas used by the Kaili tribe, with the discovery of 113 species in 51 families. Herbs are the most common habitus of medicinal plants. The habitat of medicinal plants is mainly found in the yard. The most used plant part is the leaves, which can be boiled in water and drunk directly.

**Key words:** Kaili tribe, Local knowledge, Medicinal plants, Species diversity.

## INTRODUCTION

Indonesia, located on the equator, is a mega biodiversity country. It has a unique tropical rain area in which various plants have the potential as raw materials for medicine.<sup>1,2</sup> Indonesia's forest is one of the biodiversity centers in the world, and Indonesia is the third place out of seventeen countries called the Megadiversity Country.<sup>3-5</sup> Indonesia's forest is home to thousands of flora and fauna species, many of which are endemic to Indonesia.<sup>6</sup> The forest has direct and indirect benefits that are widely recognized.<sup>7</sup> The immediate benefits of forests are the production of wood and non-timber. In contrast, the indirect benefits include regulators of microclimates, water management, soil fertility, and sources of germplasm which are very important for human life.<sup>2</sup> The forest also plays an essential role, as carbon sinks and emitters, in the context of climate change.<sup>8</sup>

Forests are also inhabited by various species of animals and plants that provide food and medicine for those nearby.<sup>9</sup> Indonesia's tropical forest consists of multiple ecosystems, having more than 239 species of food plants and more than 2,039 species of medicinal plants.<sup>10</sup> Every tropical forest ecosystem in Indonesia is a factory for the diversity of medicinal plants, formed by evolution over a very long time, including interacting with the socio-culture of the surrounding local community.<sup>2</sup> Each individual from a population of medicinal plants that grow naturally in each type of forest ecosystem

is the most minor and original factory producing various unique bioactive ingredients, most of which are not accessible and expensive for humans to imitate.<sup>11,12</sup>

Indonesia's natural forests and culture, traditional knowledge, and local wisdom of indigenous tribes surrounding the forest ecosystems are precious national's treasures for forest conservation and the development of the nation's health.<sup>10</sup> Traditional knowledge that grows in and is well managed between generations of the indigenous tribes living in and around forests is an unified whole that complements the biological resources and, therefore, must be preserved.<sup>12</sup> Previous ethnophytomedical and ethnobotanical studies conducted by Indonesian researchers have identified that there are at least 78 species of medicinal plants used by 34 ethnic groups to treat malaria, 133 species of medicinal plants to treat fever by 30 ethnic groups, 110 species of medicinal plants to treat disorders digestion by 30 ethnic groups and 98 species of medicinal plants used to treat skin diseases by 27 ethnic groups.<sup>12,13</sup>

One of the areas in Indonesia, which has a large forest area, and many traditional communities, is Central Sulawesi. This region is a vast one in Indonesia because, biogeographically, it is the heart of Sulawesi Island and is included in the Wallacea region. Hence, this region has high biodiversity and species endemism.<sup>2,14</sup>

Central Sulawesi is also inhabited by various local communities who live around and even in forest

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areas. The potential of Central Sulawesi, where most of its territory is included in the forest area and has an excellent opportunity to be developed, is its high biodiversity of medicinal plants and the local wisdom of the people living around the forest area.<sup>4,15,16</sup> People living around and in forest areas have local wisdom in utilizing plants, particularly medicinal ingredients. Local wisdom knowledge on the use of medicinal plants, which includes the habitat, habitus, identification of plant species, parts used, and how to use it as medicine to its medicinal properties, is a high-value knowledge passed down from one generation to the next. The current problem is that most traditional knowledge is not well documented yet.<sup>2,17,18</sup>

The loss of local wisdom knowledge could potentially lead to the loss of several plant species due to the community's unawareness of the benefits and role of those plant species in human life.<sup>2</sup> Therefore, the local wisdom of the people living around Central Sulawesi's forest areas in managing forests and forest products, especially using plants as medicine, must be investigated and well documented. Another reason to preserve the knowledge is to support the sustainable use of biological natural resources, particularly non-timber forest products. Many think medicinal plants or traditional medicine are safer than synthetic drugs. Therefore, support from various parties is required to scientifically reveal the use of several plants as medicinal ingredients, the types of medicinal plant species, and the active compounds in the plants. Thus, the study objectives were to: (i) reveal, analyze and synthesize local knowledge of the local community around and in the forest in utilizing medicinal plants; and (ii) obtain data on the diversity of medicinal plant types used by locals in Central Sulawesi.<sup>2</sup>

## MATERIALS AND RESEARCH METHODS

This research was conducted in the Sigi Regency, Central Sulawesi forest area. The plant samples collected from the forest were identified at Tadulako University Celebence Herbarium. Data was collected through an exploratory survey, followed by a literature study activity, interviews, and field surveys.<sup>2</sup>

The literature study was carried out to obtain early information regarding the conditions of the research location, mainly the villages around the forest area and ethnic groups/tribes living around and in the forest area. Based on this information, the villages used as research location was then determined.<sup>11</sup>

The interviews in this study were conducted by combining purposive sampling and snowball methods. The first interview was conducted to determine the key respondent (key person) with specific criteria following the research objectives. The key respondents, who met the required criteria, were obtained based on the recommendations from the local service office of forestry and traditional leaders. Respondents were determined using the snowball method, in which the interview was stopped when the collected data and information showed no additional information.<sup>2</sup>

Field observation aimed to evaluate and validate the categories of medicinal plants identified through interviews. Observations were conducted by walking without plot boundaries and conducting direct observations in the field with respondents or guides.<sup>2,19</sup> The Celenbence Herbarium at Tadulako University was created to identify the medicinal plants the local community uses in the surrounding forest area.

## RESULTS AND DISCUSSION

### Medicinal plants species and local's wisdom utilization

The information on the variety of medicinal plant species and the Kaili tribe's local wisdom in plant utilization was extracted from interviews with research respondents (the community who know about the medicinal plants, shamans (Sando), community leaders, and traditional leaders). The list of species, including local names, scientific names, families, and uses, is presented in Table 1. The results showed that the Kaili tribe frequently uses about 113 species of medicinal plants from approximately 51 families (Table 1). Besides medicinal purposes, some plants are also used for other purposes, such as bamboo production, natural pesticides, and aromatics.

### The diversity of medicinal plants utilized by the Kaili tribe based on habitus

The habitus of medicinal plants is the general form of these medicinal plants. The habitus of medicinal plants in and around forest areas consists of plants, trees, shrubs, lianas, epiphytes, parasites, and bamboo. Herbaceous habitus had the highest percentage of 54.87% or 62 species of medicinal plants. It was followed by trees, shrubs, bushes, lianas, epiphytes, parasites, and bamboo with percentages, respectively, of 21.24% (14 species), 9.73% (11 species), 6.19% (6 species), 5.31% (6 species), 0.88% (1 species), 0.88% (1 species), 0.88% (1 species).

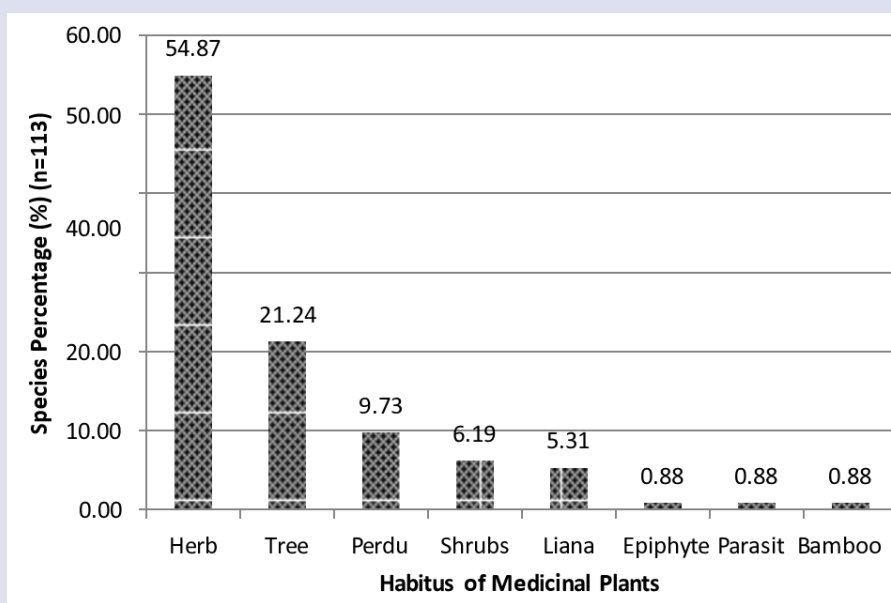


Figure 1: The percentage of medicinal plants based on their habitus

**Table 1: Diversity of medicinal plant species and local wisdom of the Kaili tribe in their use.**

Nu.	Local Name	Species	Family	Use/Benefit
1	Kapasan	<i>Abelmoschus moschatus</i> [L.] Medic	Malvaceae	Maternity process
2	Uru	<i>Elmerrillia ovalis</i> (Miq) Dandy	Maqnoiaceae	Cosmetics, Fever
3	Ambarogo	<i>Cordia corymbosa</i> Miq.	Boraginaceae	Stomachache
4	Balacai	<i>Jatropha curcas</i> L.	Euphorbiaceae	Stomatitis, Cuts
5	Bambu batu	<i>Dendrocalamus strictus</i> (Roxb)	Poaceae	Jaundice
6	Bayam duri	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Constipation
7	Benalu	<i>Scurrula artopurpurea</i>	Loranthaceae	Tumor, Vomiting blood/Hematemesis
8	Bila	<i>Crecentia cujete</i> L.	Bignoniaceae	Hernia
9	Bolu bua	<i>Piper betle</i> L.	Piperaceae	Body odor, Halitosis, Leukorea
10	Bolu karuke	<i>Piper retrofractum</i> Vahl.	Piperaceae	Toothache
11	Bolu Lasu	<i>Piper majusculum</i> Blume.	Piperaceae	Viagra
12	Bolu Tana	<i>Piper</i> sp.	Piperaceae	Body odor, Halitosis
13	Bunga pagoda	<i>Clerodendron japonicum</i>	Lamiaceae	Abscesses
14	Cakar Ayam	<i>Selaginella</i> sp.	Selaginellaceae	Fever, Anti-cancer
15	Daun rusuk	<i>Amydrium Zippelianum</i>	Araceae	Sore ribs
16	Daun sendok	<i>Plantago asiatica</i>	Plantaginaceae	Prostate, Appendix, Hernia
17	Gamal	<i>Gliricidia sepium</i> (jacq) Kunth	Fabaceae	Minor cuts, Headache
18	Gedi	<i>Abelmoschus manihot</i> (L.) Medicus	Malvaceae	Kidney, Maternity process
19	Gonato	<i>Clerodendrum</i> sp.	Lamiaceae	Worm infection
20	Pomempe	<i>Imperata cylindrica</i>	Poaceae	Supplement
21	Hipodo Walo	<i>Curanga fel-ferrae</i> (Lour.) Merr.	Linderniaceae	Internal disease
22	Jambu batu	<i>Psidium guajava</i> Linn.	Myrtaceae	Diarrhea
23	Jeruk Bali	<i>Citrus maxima</i> Merr.	Rutaceae	Diabetes
24	Kalebou	<i>Hibiscus tiliaceus</i> L.	Malvaceae	Bronchitis
25	Kanuna	<i>Cordia myxa</i> L.	Boraginaceae	Cuts
26	Kaporontomat	<i>Apium graveolens</i> L.	Apiaceae	Pertussis
27	Kapumpu	<i>Ocimum basilicum</i> L.	Lamiaceae	Headache, Wound
28	Kayu Manuru	<i>Senna alatta</i> L.	Fabaceae	Skin fungus diseases
29	Keladi bunga	<i>Syngonium podophyllum</i>	Araceae	Centipede and Snakebite antidote
30	Kelor	<i>Moringa oleifera</i> Lamk.	Moringaceae	High fever, Diabetes
31	Kondouwe	<i>Spilanthes paniculata</i> Wall. b DC	Asteraceae	Toothache
32	Kopi arabika	<i>Coffea canephora</i> Pierre	Rubiaceae	Hypertension
33	Kujadi	<i>Kalanchoe pinnata</i> Pers.	Crassulaceae	Abscesses
34	Kumis Kucing	<i>Orthosiphon aristatus</i> (Bl.) Miq.	Lamiaceae	Urolithiasis
35	Kurondo	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm	Zingiberaceae	Filariasis
36	Labu kuning	<i>Cucurbita moschata</i> D.	Cucurbitaceae	Eye disease
37	Lamba	<i>Nicotiana tabacum</i> L.	Solanaceae	Halitosis
38	Lambantomate	<i>Elephantopus mollis</i> Kunt.	Asteraceae	Stroke
39	Langalo	<i>Glinus oppositifolia</i> (L.) DC	Molluginaceae	Urolithiasis
40	Languntule	<i>Drymaria cordata</i> (L.) Willd ex Schult	Caryophyllaceae	Diabetes
41	Lasuani	<i>Amaranthus lividus</i> L.	Amaranthaceae	Headache, <i>Possessed</i>
42	Lekosa	<i>Pollia secundiflora</i> (Bl.) Back	Commelinaceae	Swollen foot
43	Lelompeba	<i>Dysophylla auricularia</i> (L) Blume	Lamiaceae	Pertussis
44	Lengaru	<i>Alstonia scholaris</i> R.Br.	Apocynaceae	Malaria, Internal injures
45	Levonu	<i>Ficus septica</i> Burm. F.	Moraceae	Eye infection
46	Mapo	<i>Maccaranga hispida</i> (Blume) Muell.	Euphorbiaceae	Papilloma
47	Matesambula	<i>Cassia</i> sp.	Fabaceae	Epilepsy
48	Mayana	<i>Coleus scutellarioides</i> Bth.	Lamiaceae	Cough, Internal diseases
49	Mpo Mata	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Abscesses
50	Legetan	<i>Synadrella nodiflora</i> (L.) Gaertn	Asteraceae	Rabies
51	Bendot	<i>Dichrocephala integrifolia</i> (L.f)	Asteraceae	<i>Possessed</i> , Worm treatment
52	Ruku-ruku	<i>Hyptis suaveolens</i> (L.) Poir.	Lamiaceae	Tinea pedis
53	Sangitan	<i>Sambucus javanica</i> Reinw	Adoxaceae	Acne treatment
54	Papaya	<i>Carica papaya</i> L	Caricaceae	Hypertension, Worm treatment
55	Nura	<i>Begonia aptera</i> Blume	Begoniaceae	Worm treatment
56	Pada	<i>Eleusine indica</i> (L.) Gaertn	Poaceae	Uterus strengthening
57	Palola Bua	<i>Luffa cylindrical</i> Roem	Cucurbitaceae	Swollen stomach
58	Pancihinana	<i>Scindapsus pictus</i> Hassk	Araceae	Skin fungus

Nu.	Local Name	Species	Family	Use/Benefit
59	Pancsilana lida	<i>Sporobulus diandrus</i> (Retz) P.Beauv.	Poaceae	Cosmetics
60	Pancsilana lore	<i>Merremia umbellata</i> (L.) Hallier f.	Euphorbiaceae	Cosmetics (mole on the face)
61	Pancongkolangi	<i>Centella asiatica</i> L. (Urb.)	Fabaceae	Tuberculosis
62	Panuntu	<i>Phyllanthus urinaria</i> L.	Lamiaceae	Kidney, Urolithiasis
63	Paparisipa	<i>Cyperus killingia</i> Endl.	Crassulaceae	<i>Possessed</i>
64	Paralente	<i>Ageratum conyzoides</i> L.	Asteraceae	Cuts, step
65	Parancina	<i>Solanum lycopersicum</i> L.	Asteraceae	Fever, Burns
66	Paria	<i>Momordica charantia</i> L.	Lamiaceae	Cough, Fever, Ulcer
67	Pasolonteneru	<i>Equisetum debile</i> Roxb.Ex Vaucher	Equisetaceae	Broken ribs, Muscle strain
68	Penesilin	<i>Jatropha mutifida</i> L.	Euphorbiaceae	Cuts, Stomatitis
69	Pia topoule	<i>Eleutherina bulbosa</i> (Mill.) Urb.	Iridaceae	Heart disease, Hemorrhoid
70	Pinahong	<i>Anredera cordifolia</i> (Ten.) Steenis	Basellaceae	Tumor, Hypertension
71	Posuntikala	<i>Elingera elatior</i> (Jack) R.M. Sm.	Zingiberaceae	Gout
72	Puroo	<i>Eclipta prostata</i> (L.) L.	Asteraceae	Umbilical treatment
73	Putri Malu	<i>Mimosa pudica</i> L.	Leguminosae	Heatiness, Insomnia
74	Sakimalei	<i>Amphineuron</i> sp.	Thelypteridaceae	Fever and Rashes
75	Sampularo	<i>Murdannia blumei</i> (Hassk.)	Commelinaceae	Face's mole
76	Sarang Semut	<i>Myrmecodia</i> sp.	Rubiaceae	Ulcer, Hypertension
77	Silaguri	<i>Sida rhombifolia</i> L.	Malvaceae	Infection, Teeth treatment
78	Simulasi	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Appendix
79	Sinduru	<i>Melastoma candidum</i> D.Don	Melastomataceae	Abscesses, Nosebleed
80	Sirsak	<i>Annona reticulata</i> L.	Annonaceae	Kidney, Hypertension
81	Susupi	<i>Bidens pilosa</i> L.	Asteraceae	Post-maternity treatment, Cough
82	Taba	<i>Cordylin fructifosa</i> A.Chev.	Asparagaceae	TBC
83	Tambajarabung	<i>Hyptis capitata</i> Jack.	Lamiaceae	Kidney, Liver
84	Kau Jawa	<i>Lannea coromandelica</i> Merr.	Anacardiaceae	Hepatitis and Diabetes
85	Tambuange kebe	<i>Senna tora</i> L. (Roxb)	Fabaceae	Melena
86	Tampe	<i>Physalis angulata</i> L.	Solanaceae	Hypertension
87	Tatari	<i>Scleria purpurelens</i> Steud.	Cyperaceae	Kidney
88	Tavalevo	<i>Piper umbellatum</i> L.	Piperaceae	Erectile dysfunction
89	Tave Lehoka	<i>Comelina diffusa</i> Burm. f.	Commelinaceae	Gout
90	Tave hikonco	<i>Ficus stipulare</i> L.	Moraceae	Jaundice
91	Tavovi	<i>Ipomoea batatas</i> (L.) Poir	Convolvulaceae	Skin diseases
92	Tintiase	<i>Cheilocostus speciosus</i>	Marattiaceae	Fever
93	Tombila	<i>Angiopteris evecta</i> (G Forst) Hoffm	Urticaceae	Rabies
94	Tombu	<i>Poikilospermum suaviolen</i> (Bl.) Merr	Rubiaceae	Breast cancer
95	Towote	<i>Anthocephalus chinensis</i> (Lam.) C.	Cyperaceae	Malaria, Internal injuries
96	Voluntile	<i>Eleocharis artopurpurea</i> Retz. Presl.	Asteraceae	Postpartum treatment
97	Wavaro	<i>Crassocephalum crepidioides</i> (Benth)	Asteraceae	Cuts
98	Wingkotu	<i>Erigeron sumatraensis</i> Retz.	Marattiaceae	Leprosy
99	Manggarada	<i>Acmella ciliate</i> (Kunth) Cass	Asteraceae	Toothache
100	Roviga	<i>Calotropis gigantea</i>	Apocynaceae	Stomatitis, Measles
101	Varo-Varo	<i>Cyantjilium cinereum</i> (L) H.Rob.	Asteraceae.	Cough
102	Kayu Hitam	<i>Dyospyros celebica</i> Bakh	Ebenaceae	Internal diseases
103	Kamboja Putih	<i>Plumeria alba</i> .	Apocynaceae	Breast cancer
104	Una-Una	<i>Piper aduncum</i> L	Piperaceae	Skin diseases (Itching)
105	Titilu	<i>Tacca palmate</i> Blume	Taccaceae	Acne and Ulcer
106	Parada	<i>Chromolaena odorata</i> (L.)	Asteraceae	Minor cuts
107	Palio	<i>Cinnamomum parthenoxylon</i>	Lauraceae	Malaria
108	Wintonu	<i>Melochia umbellate</i>	Sterculiaceae	Bronchitis
109	Jati	<i>Tectona grandis</i>	Lamiaceae	Skin diseases (Itching)
110	Samundu	<i>Polyscias nodosa</i> (Bl.) Seem	Araliaceae	Cancer
111	Tintiaye	<i>Elephantopus scaber</i> L	Asteraceae	Nail diseases
112	Siguntu lele	<i>Synedrella nodiflora</i> (L) Gaertn	Asteraceae	Arthritis, Gout
113	Marangkapi	<i>Oreocnide rubescens</i> (Blume) Miq	Urticaceae	Breast tumor

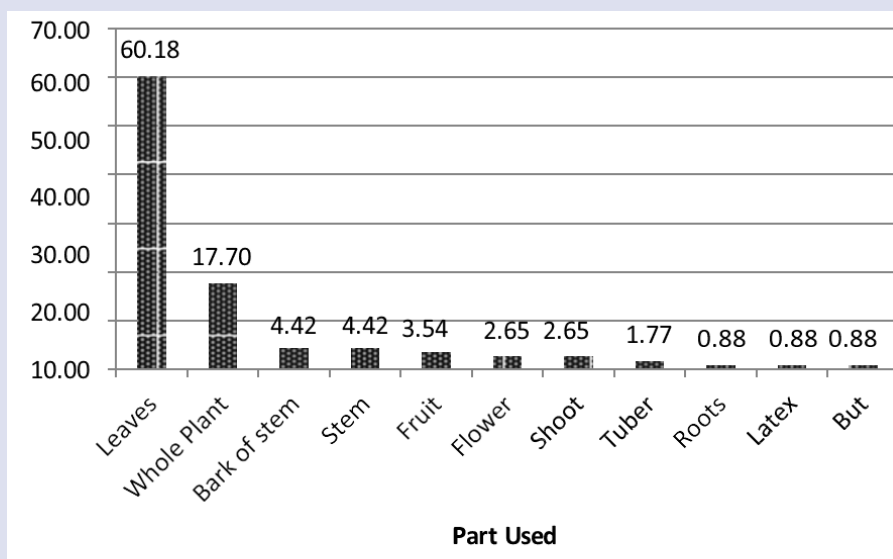


Figure 2: Diagram of the percentage of medicinal plants based on utilized organ

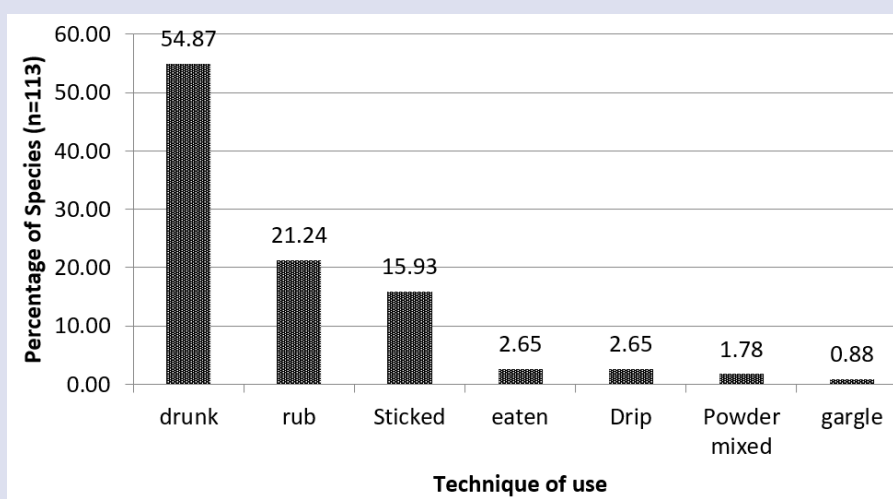


Figure 3: Different utilization modes of medicinal plants by the Kaili tribe

species), 0.88% (1 species), 0.88% (1 species), and 0.88% (1 species) (Figure 1).

### Medicinal plants based on the plant parts used by the Kaili tribe

The plant parts used as traditional medicine by the Kaili tribe around the forest area are very diverse. Based on the interview, 11 parts were frequently employed: the leaves, bark, stems, fruits, buds, the tender core of the plant's trunk (*umbut*), tuberous roots, and shoots, and several plants were used entirely as medicine. The plant part with the highest use frequency was the leaves (60.18%), followed by all parts (17.7%), bark (4.42%), stems (4.42%), fruits (3.54%), and others (flowers, roots, buds, *but*, and tuberous roots) with each of them was below 3% (Figure 2).

The high usage of leaves as medicinal material, compared to other plant parts, is due to several reasons. The leaves are utilized frequently since they can be processed and collected faster and more optimally than other parts.<sup>11</sup> The leaf collection also prevents the disruption of other parts since they can re-grow and be continuously utilized.

Several former studies also indicated similar findings. The most common parts of medicinal plants used in Afghanistan were the leaves, stems, flowers, roots, seeds, bark, and tubers.<sup>20</sup> In Uganda, 15 (fifteen) plant parts were utilized for traditional medicine, such as the leaves, roots, bark, fruits, all parts, stems/wood, seeds, flowers, sap, buds, leaves/shoots, rhizomes, tuber, branches/twigs, water in banana stem fiber, and the tender core of the plant's trunk (*umbut*). Of those 15 parts, the leaves were the most used (749 species (33.50%)), and *umbut* was the least part of the plant used as traditional medicine.<sup>21</sup> Recent studies on medicinal plants from the heath forest in Belitung also showed leaves as the dominant plant parts used for medicinal purposes.<sup>25</sup>

### Utilisation modes of medicinal plants by the Kaili tribe

Local communities use the specific plants as a medicine around forest areas in various ways, such as drinking, rubbing, sticking, fresh eating, dripping, mixing powder, and gargling (Figure 3). The most widely used mode in medicinal plants is boiling the plants in water and drinking the solution directly. This mode is affordable, simple, and utilized for approximately 54.87% of 113 species is 62 species, not 64.

Direct rubbing and application/sticking on the injured body part are used for 21.24% and 15.93% of medicinal plants, respectively. A rare technique, gargling, is used for one plant species (or 0.88%) which is *Acmella ciliata* (Kunth) Cass. Similar findings were observed in several other regions in Indonesia.<sup>22-25</sup>

## CONCLUSIONS

The potential medicinal plants utilized by the Kaili Tribe, who live around forest areas, is high, indicated by the discovery of 113 species. These species are also found in the yard with the most heightened plant habitus. The leaves are the most used plant part, generally boiled in water and consumed.

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**Abdul Hapid**

Dear Emily Flora, Already good. we have no corrections. Thank you very much Regards, Abdul Hapid

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Noted with thanks.





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## ACCEPTANCE OF MANUSCRIPT

**Title: Diversity of Types of Medicinal Plants and Local Wisdom of the Kaili Tribe in Processing Medicinal Plants Around the Forest Areas of Central Sulawesi, Indonesia**

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Dear Respected Author,

I am pleased to inform you that Editors and Reviewer have given valuable time for your article a, recommended your manuscript PJ-23-1268 as **“Accepted” for publication** in the Volume 15 Pharmacognosy Journal ISSN: 0975-3575. Thank you for your valuable contribution with us. We hope to have your next quality publication(s) with us.

Yours sincerely,

Managing Editor

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You are welcome.



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