

Traditional medicinal plants used by To Bungku Ethnic in Morowali District, Central Sulawesi, Indonesia

RAMADANIL PITOPANG^{1,*}, ASRUN¹, PUTI ANDALUSIA SARIGANDO BANILAI²,
MUHD. NUR SANGADJI³, SUDARKAM MERTOSONO⁴

¹Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Tadulako. Jl. Sukarno Hatta KM 9, Tondo, Mantikulore, Palu 94148, Central Sulawesi, Indonesia. Tel.: +62-451-422611, 422355, Fax.: +62-451-422844, *email: pitopang_64@yahoo.com

²Department of Public Health, Faculty of Public Health, Universitas Tadulako. Jl. Sukarno Hatta KM 9, Tondo, Mantikulore, Palu 94148, Central Sulawesi, Indonesia

³Department of Agronomy, Faculty of Agriculture, Universitas Tadulako. Jl. Sukarno Hatta KM 9, Tondo, Mantikulore, Palu 94148, Central Sulawesi, Indonesia

⁴Faculty of Teacher Training and Education, Universitas Tadulako. Jl. Sukarno Hatta KM 9, Tondo, Mantikulore, Palu 94148, Central Sulawesi, Indonesia

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Abstract. Pitopang R, Asrun, Banilai PAS, Sangadji MN, Mertosono S. 2025. Traditional medicinal plants used by To Bungku Ethnic in Morowali District, Central Sulawesi, Indonesia. *Asian J For* 9: 45-52. Plants play an imperative role in the well-being of human being as they deliver the fundamental needs of mankind, that is, food, shelter, clothing, and medicines. They also provide the basis for centuries-old traditional medicinal systems. The objective was to explore species of medicinal plants used in Sakita Village, Bungku Tengah, Central Sulawesi including information about the parts used, method of use, and habitus. Data were collected through direct observation, participatory observation, interview, and literature review. A snowball method was used to obtain appropriate respondents, including village, custom (*adat*), traditional (*sando*), and religious leaders, rattan and dammar collectors, as well as farmers. The collection and photography of all samples of medicinal plants were conducted, followed by their identification at the Laboratory of Plant Biosystematics, Department of Biology, Faculty of Mathematics and Natural Sciences, and the Herbarium Celebense (CEB), Tadulako University. The results showed that there were 37 species of plants, consisting of 26 families used as traditional medicine by To Bungku ethnic. The family widely used is Zingiberaceae (4 species) then followed by Euphorbiaceae (3 species), Fabaceae, Arecaceae, Asteraceae, and Myrtaceae with 2 species. Furthermore, methods of use included boiling, pounding, consuming directly, squeezing, spreading, and chewing. The organs mostly used were leaves, stems, bark, fruit, and rhizomes, with the highest percentage being leaves at 51%. The percentage of plants with the highest use was *tofu-tofu* (*Cheilocostus speciosus* (J.Koenig) C.D. Specht) at 100% and the lowest was *benalu* (*Macrosolen cochinchinensis* (Lour) Van Tieng) at only 16%.

Keywords: *Cheilocostus speciosus*, ethnobotany, medicinal plants, Morowali

INTRODUCTION

Plants are important resources of conventional medicines used against different diseases (Tariq et al. 2015). Amongst the 374,000 plant species on the earth (Christenhusz and Byng 2016), about 28,187 species are currently used for medicinal purposes (Alkin 2017). Furthermore, over 70% of the developing world population still depends on complementary or alternative systems known as traditional medicine, including about 80% of the population in Africa, 71% in Chile, 40% in Colombia (Syaiikh and Hatcher 2005), and in Indonesia about 44.2% of households utilize traditional healthcare (Rahayu et al. 2020).

Medicinal plants are widely used on every continent, for example, in Asia, the practice is well-established and documented (Ali et al. 2020). Consequently, most of the medicinal plants that have international recognition originate from this area, particularly China (Liu 2021; Liu et al. 2023), India (Shi et al. 2021), Indonesia (Elfahmi et al. 2014; Sholikhah 2016; Rahayu et al. 2020; Cahyaningsih et al. 2021) and other developing countries

(Magersa et al. 2019; Khesht et al. 2021; Nafeeza et al. 2022). In Europe, there are more than 30,000 vascular plant taxa, however, only a small proportion of these have an identified medicinal use, however the use of herbal medicine is increasing rapidly, specifically to correct metabolic disorders caused by modern diets and lifestyles (Allen et al. 2014).

Indigenous knowledge systems of medicinal plants are beneficial not only for the conservation of cultural traditions and biodiversity but also for the development of health care and treatment for the poor community (Gijan and Dalle 2019). It has been the only option available for health care before the induction of modern medicine for the prevention, diagnosis, treatment of social, mental, and physical illness (Salmeron-Manzano et al. 2020).

In Indonesia, the practice of traditional medicinal plants is an important component of the healing process (Purwanto 2021). As a large archipelago country in the world (Cleary and De Vantier 2011), Indonesia is a populous country with abundant medicinal plant resources (Liu 2021). It is also occupied by 1,340 ethnic groups with varied cultures, languages, and local wisdom in using

biological resources such as plants to meet primary healthcare needs (Elfahmi et al. 2014; Sumarni et al. 2019).

The people of Central Sulawesi constitute the plural society in Indonesia. This is reflected in the socio-cultural condition of this area inhabited by different indigenous ethnics (Andriansyah and Wekke 2018). The ethnic groups occupy different areas, and each of whom has individual culture and traditions in utilizing plants for daily purposes such as for household appliances, pharmaceuticals, and medicine (Fathurrahman et al. 2016; Pitopang and Ramawangsa 2016).

Many studies on ethnopharmaceuticals, especially concerning local wisdom in using natural plant resources as traditional medicines, have been conducted in Central Sulawesi. Some of them include the indigenous people of the Kaili Ledo (Pitopang et al. 2024), Kaili Rai ethnic group (Bana et al. 2016; Agung et al. 2018), Kaili Tara (Zubair et al. 2019), Seko (Tapundu et al. 2015), Taa Wana (Akhsa et al. 2015; Pitopang et al. 2021), Tajio (Yuliarsih et al. 2013), Tialo (Anggareni et al. 2016) Toli-toli (Nulfitriani et al. 2013), and Topo Uma Kulawi (Yulia et al. 2017).

To Bungku Ethnic is one of the indigenous people who settled in Morowali District, Central Sulawesi. This particular community has used various plant species as medicine for healing several diseases although the knowledge system is not documented. As one of the indigenous communities living in an area with very high Nickel mining activities in Central Sulawesi, it is feared that it will be able to reduce their local knowledge system and the diversity of plant species around them, it is therefore necessary to conduct research on traditional medicinal plant that aim to identify the species of

medicinal plants and the part used, the preparation methods, life forms, and the types of diseases.

MATERIALS AND METHODS

Study area

The study was conducted at Sakita Village (formerly known as *pekampua*), with an area of 1.835 square kilometers, in Central Bungku Sub-district, Morowali, Central Sulawesi, Indonesia (Figure 1). It is inhabited by 1,676 residents consisting of 482 households (833 male, 843 female). The indigenous people are referred to as To Bungku Ethnic, with strong customary characteristics, specifically in maintaining cultural values and kinship relations. The people use To Bungku language in daily life but use Indonesian (Bahasa Indonesia) outside of the community. The main livelihood of the community is working in the agricultural services, and craftsmen. The demographic structure of To Bungku Ethnic is presented in Table 1.

This study was conducted at one of the areas with high development dynamics in Central Sulawesi (Zuada et al. 2023). The area is among the main sources of nickel in Indonesia (26%) together with Southeast Sulawesi (32%) and North Maluku (27%) (Arif 2018; Rushdi et al. 2020). Nickel content in Central Sulawesi makes it one of the development areas for mining Special Economic Zones and industrialization centers. This is a derivative policy from the Master Plan for Acceleration and Expansion of Indonesia Economic Development (MP3EI) launched in 2011. Massive mining activities in the study area can reduce biodiversity and eliminate local knowledge systems related to the use of medicinal plants.

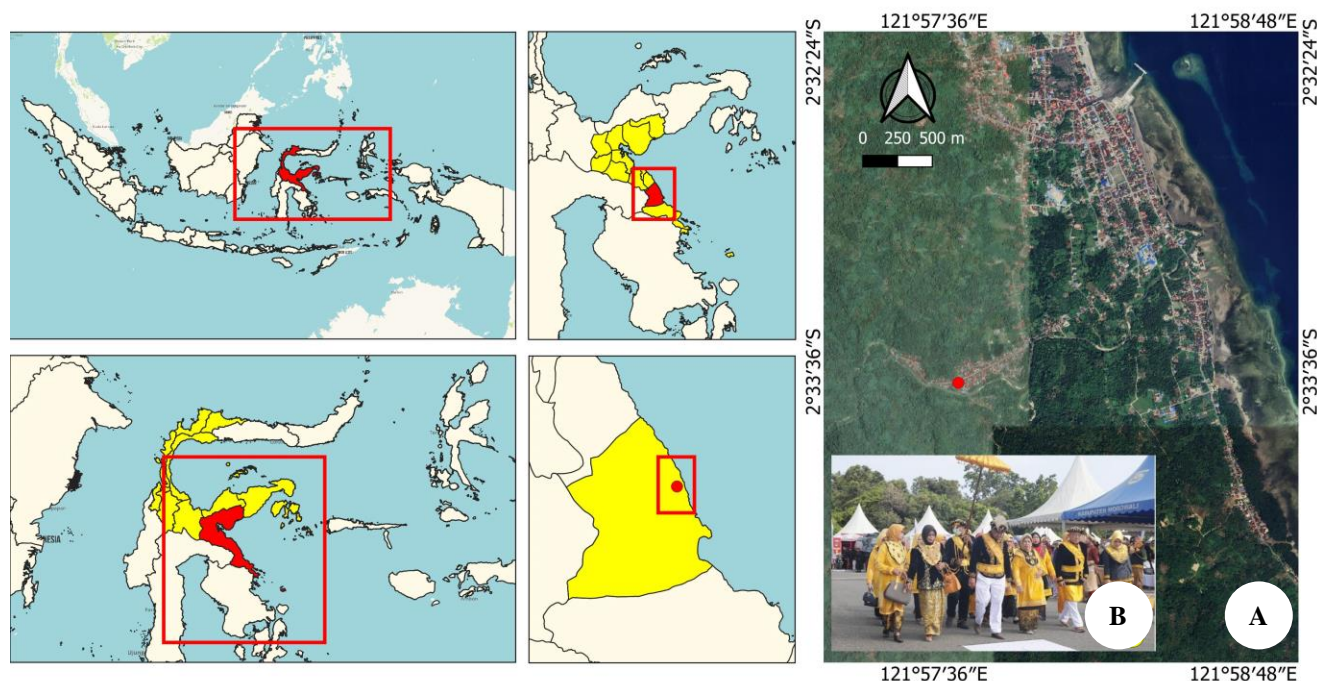


Figure 1. A. Study area Sakita Village, Bungku Sub-district, Morowali District, Central Sulawesi Indonesia; B. Adat leaders with traditional custom of To Bungku Ethnic (kindly provided by Zakia Sukma Ranti)

Table 1. Demographics structure, age composition, educational background, and religion of To Bungku Ethnic in Sakita Village, Morowali, Indonesia

Demographics structure	Individual number	Percentage (%)
Age groups (years)		
0-5	320	19.09
15-60	1288	76.85
>60	68	4.06
Total	1676	100
Education background		
Not yet attended education	57	9.38
Elementary school	17	2.80
Junior high school	77	12.66
Senior high school	340	55.92
Diploma	35	5.76
Graduate (Bachelor)	76	12.50
Magister (Program)	6	0.99
Total	608	100
Livelihood		
Farmer	832	74.82
Animal husbandry	106	9.53
Fisherman	8	0.72
Handicraft	10	0.89
Civil servant	71	6.38
Local government employee	10	0.89
Police and military	3	0.27
Teachers	38	3.42
Nurses	17	1.53
Medical doctor	2	0.18
Private employee	12	1.08
Financial institution service	3	0.27
Total	1112	100

Source: Local Government of Sakita Village (2022)

Data collection

The field study was conducted with a purposive sampling method (Tongco 2007). Data were obtained through direct observation, participatory observation, interview, and literature review (Cotton 1996; Martin 2007). A snowball method was used to obtain appropriate respondents (Bernard 2002) including village, custom (*adat*), traditional (*sando*), and religious leaders, rattan and dammar collectors, as well as farmers. The interviews were performed using semi-structured and open-ended methods related to the perceptions of the traditional use of medicinal plants. These interviews were recorded using audio recorders and notebooks. Photographs were also taken to record information (Turner 1988).

All medicinal plants used by local people were collected for herbarium collection and then identified at Herbarium Celebense (CEB), Tadulako University, Palu. The identification process involved comparing the sample with reference specimens and utilizing relevant literature (<http://floramalesiana.org/>) with the assistance of experts. Supplementary information, such as the local name, botanical name, family, and plant habitus (life form), were documented. The species were named according to the International Plant Names Index (IPNI) and their

distribution was determined using the Plants of the World Online (POWO) database from the Royal Botanic Gardens, Kew. Ornamental plants that are considered invasive alien species are evaluated using the criteria outlined in Setyawati et al. (2015). The initial assessment of the conservation status was conducted following the guidelines of the IUCN Red List, available at the website <https://www.iucnredlist.org/en>, while specimens with labels were deposited at CEB, Tadulako University, Palu, Indonesia.

Data analysis

A descriptive statistical method was used to analyze and summarize the ethnobotanical data on the reported medicinal plants and associated knowledge that focus on knowledge documentation to facilitate its circulation in the communities form of databases (Łuczaj 2023).

RESULTS AND DISCUSSION

Traditional healers in Bungku use the plant resources available in nature for various disease treatments. This study found that there were 37 species of medicinal plants belonging to 26 families used by To Bungku Ethnic (Table 2). The family widely used by the people of Sakita Village is Zingiberaceae (4 species) then followed by Euphorbiaceae (3 species), Fabaceae, Arecaceae, Asteraceae, and Myrtaceae with 2 species, respectively. The families less used are Anacardiaceae, Annonaceae, Apocynaceae, Caricaceae, Costaceae, Lamiaceae, Leguminosae, Loranthaceae, Lythraceae, Malvaceae, Manispermaceae, Meliaceae, Menispermaceae, Moraceae, Muntingiaceae, Oxalidaceae, Phyllanthaceae, Rubiaceae, Rutaceae, Solanaceae, and Verbenaceae (1 species each). Medicinal plants are obtained by the community from different habitats that grow naturally around the environment of the village, including forests or agroforests, gardens, as well as cultivation. To Bungku people use various plant species as medicine based on organ parts such as bark, sap, rhizome, fruit, leave, root, and stem. The percentage of organ parts used is presented in Figure 2.

Leaves are the most preferred plant part used in herbal formulation (48%), followed by fruits (16.22%), stem (13.51%), rhizome (8.11%), roots (2.7%), seeds (0%), sap (2.7%) as well as bark and mix with percentage of 5%. A total of 18 plant leaves are used as medicine by the local community in the studied area. Based on the information gathered from respondents, there are five types of life forms in the studied area including trees (18 species), herbs (10 species), shrubs (5 species), climbers (3 species), and epiphytes (1 species). The life form of each medicinal plant species is provided in Figure 3.

Based on the interview results, there were seven methods of concocting medicinal plants practiced by local people in the studied area namely, boiling, pounding, burning, consuming directly, squeezing, spreading, and chewing. The number of traditional medicinal plants used for each method is presented in Figure 4.

Table 2. Medicinal plants used by To Bungku Ethnic in the Morowali District, Central Sulawesi, Indonesia

Family	Botanical name	Local name (To Bungku Language)	Habitus	Part of Organ	Disease	Mode of preparation	Conserv. status
Anacardiaceae	<i>Mangifera indica</i> L.	<i>La'a Moolo</i>	Tree	Bark	Dental care/toothache	The bark is boiled and the water is gargled	DD
Annonaceae	<i>Annona muricata</i> L.	<i>Nangka falanda</i>	Tree	Leaves	High blood pressure/ hypertension	The leaves are boiled and then the water is drunk	LC
Apocynaceae	<i>Alstonia scholaris</i> (L.) R.Br	<i>Kompanga</i>	Tree	Bark of stem	Dental care/toothache	Boil the bark and drink the water	LC
Arecaceae	<i>Areca catechu</i> Burm.f	<i>Fua</i>	Tree	Nut	Dental care	The nut is chewed	LC
Arecaceae	<i>Cocos nucifera</i> L.	<i>Nimokohoni</i>	Tree	Fruit	Food poisoning	The water is drunk	NE
Asteraceae	<i>Blumea balsamifera</i> (L.) DC.	<i>Lefe ombu</i>	Shrub	Leaves	Gout urinary stones, kidney failure	The leaves are boiled and the water is drunk	LC
Asteraceae	<i>Elephantopus scaber</i> L.	<i>Patua Bumbu</i>	Herb	Leaves	Headache	The leaves are soaked in hot water, then the water is drunk	NE
Caricaceae	<i>Carica papaya</i> L.	<i>Pepaea</i>	Tree	Leaves	Indigestion	The leaves are boiled and then the water is drunk	DD
Costaceae	<i>Cheilocostus speciosus</i> (J.Koenig) C.D.Specht	<i>Tofu-Tofu</i>	Herb	Stem	Fever	The stem is grated, filtered, then drunk and applied all over the body	LC
Euphorbiaceae	<i>Aleurites moluccanus</i> (L.) Wild	<i>Beau</i>	Tree	Fruit	Tumor	Fruit endosperm is crushed and pasted over the tumor	LC
Euphorbiaceae	<i>Euphorbia hirta</i> L.	<i>Panga Bali</i>	Herb	Stem and leaves	Appendicitis	The stem and leaves are boiled and then the water is drunk	NE
Euphorbiaceae	<i>Jatropha curcas</i> L.	<i>Kalikiliki</i>	Shrub	Leaves	Rheumatism	The leaves are boiled and then the water is drunk	LC
Fabaceae	<i>Crotalaria spectabilis</i> Rotb.	<i>Kofi-kofi</i>	Shrub	Leaves	Eye care	The leaves are boiled and the water is drunk	NE
Fabaceae	<i>Senna alata</i> (L.) Roxb.	<i>Panda Kori</i>	Tree	Leaves	Dermato disease (ringworm)	The leaves are crushed until smooth and, rubbed on the skin	LC
Fabaceae	<i>Sesbania grandiflora</i> (L) Poir.	<i>Kandadafa</i>	Tree	Leaves	Indigestion	The leaves are boiled and the water is drunk	DD
Fabaceae	<i>Spatholobus littoralis</i> Hassk.	<i>Bajaka</i>	Climber	Root	Cancer/tumor	The roots are cut into small pieces and swallowed	NE
Lamiaceae	<i>Orthosiphon aristatus</i> (Blume) Miq.	<i>Kumis Kucing</i>	Herb	Leaves	Appendix kidney stones	The leaves are boiled and the water is drunk	NE
Loranthaceae	<i>Macrosolen cochinchinensis</i> (Lour.) Tiegh	<i>Benalu</i>	Epiphyte	Leaves	Cancer/tumor	The leaves are boiled and the water is drunk	NE
Lythraceae	<i>Lawsonia inermis</i> L.	<i>Petaha keu</i>	Shrub	Leaves	Indigestion	The leaves are boiled and the water is drunk	LC
Malvaceae	<i>Theobroma cacao</i> L	<i>Fuano Sakulati</i>	Tree	Fruit	Tumor	The fruit is mashed until smooth and then pasted	NE
Meliaceae	<i>Lansium domesticum</i> Correa	<i>La Bubuno</i>	Tree	Stem bark	Vomiting blood	Boil the bark and drink the water	NE
Menispermaceae	<i>Arcangelisia flava</i> (L.) Merr.	<i>Akar kuning</i>	Climber	Stem	Hepatitis/Jaundice and diabetes	The roots are cut into small pieces and then boiled, the water is drunk	NE
Menispermaceae	<i>Tinospora crispa</i> (L.) Hook.f.& Thomson	<i>Oweo mpai</i>	Climber	Stem	Hepatitis, diabetes	The roots are cut into small pieces and boiled, the water is drunk	NE
Moraceae	<i>Artocarpus altilis</i> (Parkinson) Fosberg	<i>Lefe Bokulu</i>	Tree	Leaves	Hepatitis, jaundice	The leaves are boiled and the water is drunk	NE
Muntingiaceae	<i>Muntingia calabura</i> L.	<i>Gersen</i>	Tree	Leaves	Gout	The leaves are boiled and the water is drunk	LC
Myrtaceae	<i>Psidium guajava</i> L.	<i>Jampu</i>	Tree	Leaves	Diarrhea/digestive disorders	The leaves are boiled and the water is drunk	LC

Myrtaceae	<i>Syzygium malaccense</i> (L). Merr. & L. M. Perry	<i>Oa</i>	Tree	Leaves	Appendix disease	The leaves are boiled and then the water is drunk	LC
Oxalidaceae	<i>Averrhoa bilimbi</i> L.	<i>Lefe Takule</i>	Tree	Leaves	Hepatitis	The leaves are boiled and the water is drunk	LC
Phyllanthaceae	<i>Phyllanthus urinaria</i> L.	<i>Ido-ido</i>	Herb	Whole plant	Appendix	Boil all parts of plant and then drink the water	NE
Rubiaceae	<i>Morinda citrifolia</i> L	<i>Bangkudu</i>	Tree	Fruit	Diarrhea/digestive disorders	The fruit is cut into pieces roasted and pounded, brewed with hot water, and drunk	LC
Rutaceae	<i>Citrus aurantiifolia</i> (Christm.) Swingle	<i>Lemo bio</i>	Tree	Fruit	Tetanus, infection wound	The fruit is burned and squeezed	NE
Solanaceae	<i>Physalis angulata</i> L.	<i>Botu-Botu</i>	Herb	Leaves	Indigestion	The leaves are boiled and the water is drunk	LC
Verbenaceae	<i>Clerodendrum paniculatum</i> L.	<i>Langara</i>	Shrub	Leaves	Diarrhea/digestive disorders	The leaves are boiled and the water is drunk	NE
Zingiberaceae	<i>Curcuma longa</i> L.	<i>Kuni Pae</i>	Herb	Rhizome	Stomach ulcers	Rhizome is ground until smooth then filtered and drunk	DD
Zingiberaceae	<i>Etlingera calophrys</i> (K.Schum) A.D. Poulsen	<i>La mpana</i>	Herb	Stem	Wound	The stems are burned, squeezed and then dropped on the wound	LC
Zingiberaceae	<i>Etlingera tubilabrum</i> A.D. Poulsen	<i>Panasimpo</i>	Herb	Rhizome	Internal wounds, bloody stools	Rhizome is ground until smooth, filtered, and drunk	VU
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	<i>Loiya</i>	Herb	Rhizome	Diarrhea/digestive disorders	Rhizome is ground until smooth, filtered, and drunk	DD

Note: NE: Not evaluated, DD: Data deficient, LC: Least concern, NT: Near threatened, VU: Vulnerable, EN: Endangered, CR: Critically endangered, EW: Extinct in the wild, EX: Extinct

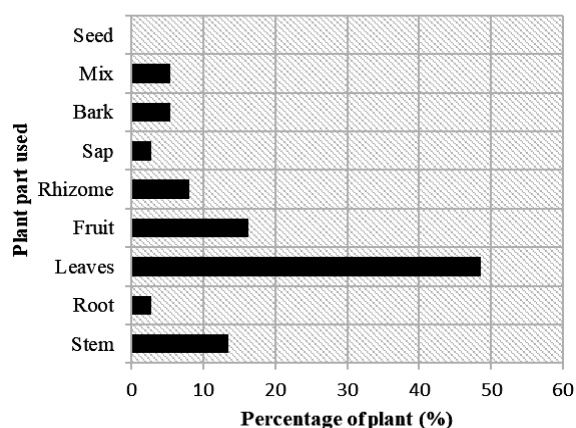


Figure 2. Plant parts used for medicine by To Bungku Ethnic in the study area

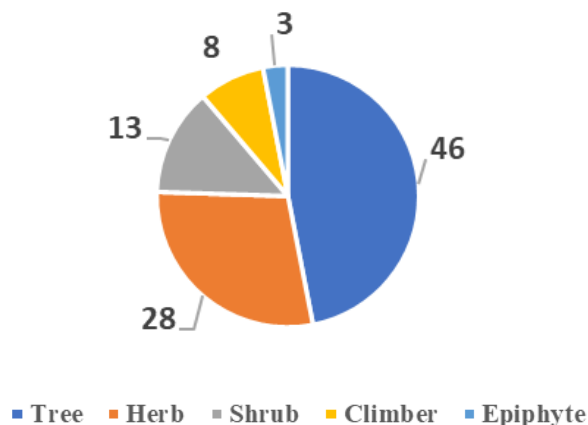


Figure 3. Percentage (%) of life forms of medicinal plants used by To Bungku Ethnic in the study area

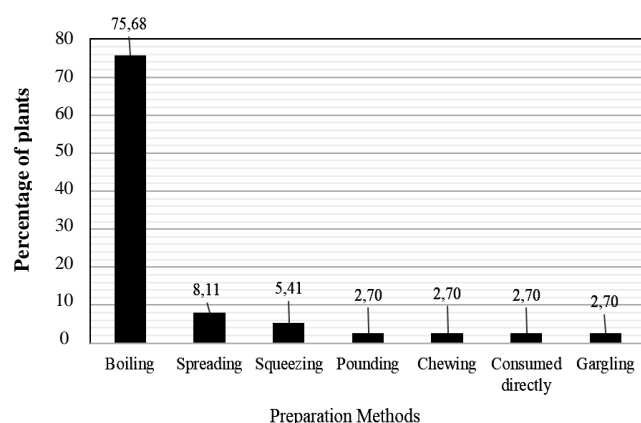


Figure 4. Preparation method of medicinal plants

Discussion

To Bungku Ethnic at Sakita Village uses medicinal plants for several purposes. Some species can be used for treatment of both single and different kinds of diseases including appendicitis, cancer, diabetes, diarrhea, gout, high blood pressure, jaundices, and urinary stones. Based on a field guide for local knowledge of ethnomedicine and medicinal plant studies in Indonesia published by the Ministry of Health of Republic Indonesia (2017), there are 74 common terms for local public health, some of which are tonsils, anti-mosquito, cough, swelling, diarrhea, overweight, chicken pox and measles.

In daily life, To Bungku Ethnic still relies on using traditional medicinal plants to maintain and care for health. Treatment using plants from the village leader is carried out by shamans or people considered to have more knowledge such as customary leaders, and village midwives. This tribe believes in the use of traditional medicinal plants that have been passed down from one generation to another from the parents. According to Zaki et al. (2019), the indigenous knowledge of preparing medicine was passed down to indigenous from the older generation by orally without any documentation. Most of the respondents claim they only identify the type of

medicinal plants used when they are involved with old people or traditional healers during the preparation of the plants and remedies. They also have poor knowledge of dosage while preparing the remedies for their patients.

A total of 37 medicinal plant species belonging to 26 families are used. The most widely used family is Zingiberaceae (4 species) followed by Euphorbiaceae (3 species), Fabaceae, Arecaceae, Asteraceae, and Myrtaceae with 2 species respectively. The Zingiberaceae species, including *kuni pae* (*Curcuma longa*), *loiya* (*Zingiber officinale*), *panasimpo* (*Etlingera tubilabrum*), and *la mpana* (*Etlingera calophrys*) are used as herbal medicine against various diseases including bloody stools, diarrhea/digestive disorders, internal wounds, and maag. *Etlingera tubilabrum* (Zingiberaceae) is among the 37 species recorded as being in the category of vulnerable to extinction based on the IUCN Red List of Threatened Species (<https://www.iucnredlist.org/species/126984481/126984759>).

Zingiberaceae (ginger group) is the largest family of the order Zingiberales, containing more than 52 genera and 1600 species (Kress et al. 2005). These aromatic herbs with horizontally creeping or tuberous rhizomes are widely used by humans, specifically as condiments, cut flowers, dyes, perfumes, spices, and traditional medicine (Pitopang et al. 2019, 2020). The rhizomes can be consumed raw or cooked as vegetables and used to make food flavoring ingredients (Larsen et al. 1999). Furthermore, Zingiberaceae contains essential oils and resins (Pitopang et al. 2022). Pitopang et al. (2019) reported 24 species, some of which are endemic to Sulawesi, and used traditionally by three different local ethnics in Lore Lindu National Park.

To Bungku ethnic uses various plant species as herbal medicine including bark, fruit, leave, rhizome, root, and stem, with the most commonly used being leaves. Knowledge about the uses of part of the plant as traditional medicine varies among local communities. Suharjito et al. (2014) reported that plant parts most frequently used were roots and leaves among the local people of Long Nah Village, East Kalimantan, while the native people of Donglai Baru, Hulu Langat, Malaysia predominantly used leaves (Ramli et al. 2021).

The life form of medicinal plants consists of trees, shrubs, herbs, lianas, epiphytes, and parasites. In this study, tree was found to be more widely used by To Bungku people as traditional medicine compared to other life forms of plants. Oktavia et al. (2022) showed that the life form of medicinal plants was dominated by trees (45%), woody lianas (21%), small trees (13%), herbs (13%), and lianas (8%) in Kelubi Village, Belitung Island, Indonesia.

According to Moges and Moges (2019), there are different types of medicinal plant species with parts, life forms, and disease types in the world. In Ethiopia, for example, approximately 800 species of medicinal plants are used to treat about 300 medical conditions. The life forms of medicinal plants include climbers, herbs, shrubs, and trees. Among all these life forms, herbs are majorly used by the community for human treatment followed by shrubs and trees.

Medicinal plants have been discovered and used in traditional medicine practices since prehistoric times. The use is due to phytochemical constituents (Awuchi 2019) synthesized in specific parts (Jantan et al. 2019). Plants synthesize hundreds of chemical and biochemical compounds for varied functions including defense against insects, herbivorous mammals, fungi, and diseases (Ahn 2017). Numerous phytochemicals with potential biological activity have been identified. Additionally, about 4000 phytochemicals have been identified (Jantan et al. 2019).

In conclusion, there are 37 species of medicinal plants used by To Bungku Ethnic. The predominant methods of use include boiling, chewing, consuming directly, pounding, spreading and squeezing, the parts commonly used are leaves, stems, bark, fruit, and rhizomes, with leaves having the highest percentage. The most common medicinal plant used by To Bungku Ethnic is *tofu-tofu* (*Cheilocostus speciosus* (J.Koenig) C.D. Specht) and the least is *benalu* (*Macrosolen cochinchinensis* (Lour) Van Tiegh).

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REFERENCES

- Ahn K. 2017. The worldwide trend of using botanical drugs and strategies for developing global drugs. *BMB Rep* 50 (3): 111-116. DOI: 10.5483/BMBRep.2017.50.3.221.
- Agung, Sulaiman SM, Pitopang R. 2018. Studi etnobotani tumbuhan obat pada masyarakat suku Kaili Rai di Dusun Sisere, Desa Labuan Toposo, Kecamatan Labuan, Kabupaten Donggala, Sulawesi Tengah. *J Biocelbes* 12 (3): 1-13. [Indonesian]
- Akhsa M, Pitopang R, Anam S. 2015. Studi etnobiologi bahan obat-obatan pada masyarakat suku Taa Wana di Desa Mire Kecamatan Ulubongka Kabupaten Tojo Una Una Sulawesi Tengah. *J Biocelbes* 9 (1): 58- 72. [Indonesian]
- Ali S, Ullah S, Paudyal V, Ali M, Tipu MK, Ur-rehman T. 2020. Complementary and alternative medicines for the treatment of Hepatitis C: Perspectives of users and CAM practitioners. *Evid-Based Complement Altern Med* 2020: 3932690. DOI: 10.1155/2020/3932690.
- Alkin B. 2017. State of the world plants 2017. Useful plants-Medicines. National Center of Biotechnology Information. <https://www.ncbi.nlm.nih.gov/books/NBK464488/>.
- Allen D, Bilz M, Leaman DJ, Miller RM, Timoshyna A, Window J. 2014. European Red List of Medicinal Plants. Publications Office of the European Union, Luxembourg.
- Andriansyah SM, Wekke IS. 2018. Gather the scattered in Kaili Land. Pluralism, Religiosity, and Integration of Central Sulawesi Society. *Miqot* 27 (1): 171-188. DOI: 10.30821/miqot.v42i1.523.
- Anggareni S, Miswan, Pitopang R. 2016. Kajian etnobotani tumbuhan berkhasiat obat suku Tialo di Desa Taopa Kecamatan Taopa Kabupaten Parigi Moutong. *J Biocelbes* 10 (1): 45-55. [Indonesian]
- Arif I. 2018. *Nikel Indonesia*. Gramedia Pustaka Utama, Jakarta. [Indonesian]
- Awuchi CG. 2019. Medicinal plants: The medical, food, and nutritional biochemistry and uses. *Intl J Adv Acad Res Sci Technol Eng* 5 (11): 220-241.
- Bana SWA, Khumaedi A, Pitopang R. 2016. Studi etnobotani tumbuhan obat pada masyarakat Kaili Rai di Desa Taripa Kecamatan Sindue Kabupaten Donggala Sulawesi Tengah. *J Biocelbes* 10 (2): 68-81. [Indonesian]
- Bernard HR. 2002. *Research Methods in Anthropology: Qualitative and quantitative methods*. Third edition. Walnut Creek, California
- Cahyaningsih R, Brehm JM, Maxte N. 2021. Setting the priority medicinal plants for conservation in Indonesia. *Genet Resour Crop Evol* 68: 2019-2050. DOI: 10.1007/s10722-021-01115-6.
- Christenhusz MJM, Byng JW. 2016. The number of known plants species in the world and its annual increase. *Phytotaxa* 261 (3): 201-217. DOI: 10.11646/phytotaxa.261.3.1.
- Cleary DFR, De Vantier L. 2011. Indonesia: Threat to the country's biodiversity. *Encyclopedia Environ Health* 2011: 187-197. DOI: 10.1016/B978-0-444-52272-6.00504-3.
- Cotton CM. 1996. *Ethnobotany: Principles and Applications*. John Wiley & Sons, Hoboken, New Jersey.
- Elfahmi, Woerdenbag HJ, Kayser O. 2014. *Jamu*: Indonesian traditional herbal medicine towards rational phytopharmacological use. *J Herb Med* 4 (2): 51-73. DOI: 10.1016/j.hermed.2014.01.002.
- Fathurrahman J, Nursanto J, Majid A, Ramadanil R. 2016. Ethnobotanical study of Kaili Inde Tribe in Central Sulawesi Indonesia. *Emir J Food Agric* 28 (5): 337-347. DOI: 10.9755/ejfa.2015-06-463.
- Gijan M, Dalle G. 2021. Ethnobotanical study of medicinal plants in Nagelle Arsi District, West Arsi Zone of Oromia, Ethiopia. *J Nat Sci Res* 9 (13): 1-19.
- IPNI. International plant names index. <http://www.ipni.org>.
- IUCN Standards and Petitions Subcommittee. <https://www.iucnredlist.org/en>.
- Jantan I, Haque MA, Ilankovan M, Arshad L. 2019. An insight into the modulatory effects and mechanisms of action of *Phyllanthus* species and their bioactive metabolites on the immune system. *Front Pharmacol* 10: 878. DOI: 10.3389/fphar.2019.00878.
- Khesht MA, Jafari HAK. 2021. The impact of cultivation of medicinal plants on the economic income of rural settlements case study of Kalat city villages. *Propósitos y Representaciones* 9 (2) : e957. DOI: 10.20511/pyr2021.v9nSPE2.957.
- Kress W J, Liu AZ, Newman M, Li QJ. 2005. The molecular phylogeny of *Alpinia* (Zingiberaceae): a complex and polyphyletic genus of ginger. *Am J Bot* 92: 167-178. DOI: 10.3732/ajb.92.1.167.
- Larsen K. 1999. *Gingers of Peninsular Malaysia and Singapore*. Natural History Publications (Borneo), Kinabalu.
- Local Government of Sakita Village. 2022. Profile of desa Sakita, baseline data, 2022. Bungku Tengah district, Morowali regency, Central Sulawesi province. [Indonesian]
- Liu CX. 2021. Overview on development of ASEAN traditional and herbal medicines. *Chin Herb Med* 13: 441-450. DOI: 10.1016/j.chmed.2021.09.002.
- Liu S, Liu S, Zhang B, Lei Q, Zhou J, Ali M, Long C. 2023. Diversity and traditional knowledge of medicinal plants used by Shui people in Southwest China. *J Ethnobiol Ethnomed* 19: 20. DOI: 10.1186/s13002-023-00594-4.
- Martin GJ. 2007. *Ethnobotany: A methods manual*. Springer New York, NY.

- Moges A, Moges Y. 2019. Ethiopian Common Medicinal Plants: Their Parts and Uses in Traditional Medicine - Ecology and Quality Control. In: Gonzalez A, Rodriguez M, Sağlam NG (eds.). Plant Science - Structure, Anatomy and Physiology in Plants Cultured in Vivo and in Vitro. InTechOpen, London. DOI: 10.5772/intechopen.86202.
- Nafeeza S, Pushpakumari B, Reddet VJS. 2022. Phyto-pharmacological potential of *Buchanania arborescens* (Anacardiaceae) on wound healing and CNS depressant activities in albino wistar rats. World J Pharm Life Sci 8 (2): 94-102.
- Nulfitrani, Pitopang R, Yuniati E. 2013. Pemanfaatan tumbuhan sebagai obat tradisional pada suku Tolitoli di Desa Pinjan Sulawesi Tengah. J Biocelebes 7 (2): 1-8. [Indonesian]
- Oktavia D, Pratiwi SD, Munawaroh S, Hikmat A, Hilwan I. 2022. The potential of medicinal plants from heath forest: Local knowledge from Kelubi Village, Belitung Island, Indonesia. Biodiversitas 23 (7): 3553-3560. DOI: 10.13057/biodiv/d230731.
- Pitopang R, Ramawangsa PA. 2016. Potential of ethnobotanical studies in Central Sulawesi Indonesia. Open J Nat Sci 5 (2): 111-131.
- Pitopang R, Damry, Rusdi, Hamzah B, Zubair MS, Amar AL, Fathurahman F, Basri Z, Poulsten AD. 2019. Diversity of Zingiberaceae and traditional uses by three indigenous groups at Lore Lindu National Park, Central Sulawesi, Indonesia. IOP Conf Ser: J Phys 1242 (1): 012039. DOI: 10.1088/1742-6596/1242/1/012039.
- Pitopang R, Umrah, Harso W, Nurainas, Zubair MS. 2020. Some botanical aspects and antifungal activity of *Etilingera flexuosa* (Zingiberaceae) from Central Sulawesi, Indonesia. Biodiversitas 21 (8): 3547-3553. DOI: 10.13057/biodiv/d21081
- Pitopang R, Atmoko AT, Yusran Y, Wardah W, Mertosono SR, Ramawang PA. 2021. Plant diversity in agroforestry system and its traditional use by three different ethnics in Central Sulawesi Indonesia. IOP Conf. Ser: Earth Environ Sci 886 (1): 012058. DOI: 10.1088/1755-1315/886/1/012058.
- Pitopang R, Ihwan, Zubair MS, Nurhaeni. 2022. The essential oils constituent of *Etilingera flexuosa* (Zingiberaceae), an endemic plant from Central Sulawesi. Pharmacogn J 14 (6): 842-846. DOI: 10.5530/pj.2022.14.177.
- Pitopang R, Pratama Y, Yusran, Banilal PAS, Mertosono SR. 2022. An ethnomedicinal research of medicinal plants used against gastrointestinal complaints by "Kaili Ledo Ethnic" in Central Sulawesi, Indonesia. AIP Conf Proc 3001: 080059. DOI: 10.1063/5.0197937.
- Plant of the World Online. 2022. <https://powo.science.kew.org/>.
- Rahayu YYS, Araki T, Rosleine D. 2020. Factors affecting the use of herbal medicines in the universal health coverage system in Indonesia. J Ethnopharmacol 260: 112974. DOI: 10.1016/j.jep.2020.112974.
- Malek S, Milow P, Aziz NJ. 2021. Traditional knowledge of medicinal plants in the Kampung Orang Asli Donglai Baru, Hulu Langat, Malaysia. Biodiversitas 22 (3): 1304-1309. DOI: 10.13057/biodiv/d22032.
- Pitopang R, Pratama Y, Yusran Y, Banilal PA, Mertosono SR. 2024. An ethnomedicinal research of medicinal plants used against gastrointestinal complaints by "Kaili Ledo ethnic" in Central Sulawesi, Indonesia. In AIP Conf Proc 3001 (1): 080059. DOI: 10.1063/5.0197937.
- Purwanto Y. 2021. Applying ethnobiology in sustainable management and utilization of biological resources in Indonesia. EPIC Ser Biol Sci 1: 8-23.
- Rushdi M, Sutomo A, Ginting P, Risdianto, Anwar M. 2020. Rangkaian Pasok Nikel Baterai dari Indonesia dan Persoalan Sosial Ekologi. Perkumpulan Aksi untuk Ekologi dan Emansipasi Rakyat (AEER), Jakarta. [Indonesian]
- Salmeron-Manzano E, Garrido-Cardenas JA, Manzano-Agugliaro F. 2020. Worldwide research trend on medicinal plants. Intl J Environ Res Public Health 17 (10): 3376. DOI: 10.3390/ijerph17103376.
- Setyawati T, Narulita S, Bahri IP, Raharjo GT. 2015. A Guide Book to Invasive Plant Species in Indonesia. Research, Development and Innovation Agency Ministry of Environment and Forestry Republic of Indonesia, Jakarta. [Indonesian]
- Shi Y, Zhang C, Li X. 2021. Traditional medicine in India. J Tradit Chin Med Sci 8 (Supplement 1): S51-S55. DOI: 10.1016/j.jtcms.2020.06.007.
- Sholikah EN. 2016. Indonesian medicinal plants as sources of secondary metabolites for pharmaceutical industry. J Med Sci 48 (4): 226-239. DOI: 10.19106/JMedSci004804201606.
- Suharjito D, Darusman LK, Darusman D, Suwarno E. 2014. Comparing medicinal plants use for traditional and modern herbal medicine in Long Nah Village, East Kalimantan. Bionatura-Jurnal Ilmu-ilmu Hayati dan Fisik 16 (2): 95-102
- Sumarni W, Sudarmin S, Sumarti SS. 2019. The scientification of *jamu*: a study of Indonesian's traditional medicine. J Phys: Conf Ser 1321 (3): 032057. DOI: 10.1088/1742-6596/1321/3/032057.
- Syaikh BT, Hatcher J. 2005. Complementary and alternative medicine in Pakistan: prospects and limitations. Evid Based Complement Altern Med 2 (2): 139-142. DOI: 10.1093/ecam/neh088.
- Tariq A, Mussarat S, Adnan M, Allah EFA, Hashem A, Alqarawi AA, Ullah R. 2015. Ethnomedicinal evaluation of medicinal plants used against gastrointestinal complaints. Biomed Res Intl 2015: 892947. DOI: 10.1155/2015/892947.
- Tapundu AS, Anam S, Pitopang R. 2015. Studi etnobotani tumbuhan obat pada suku Seko di Desa Tanah Harapan, Kabupaten Sigi, Sulawesi Tengah. J Biocelebes 9 (2): 66-86. [Indonesian]
- The International Union Conservation of Nature Redlist of Threatened Species (IUCN). 2024. <https://www.iucnredlist.org/>.
- The Ministry of Health Republic Indonesia. 2017. Field Guide of Data Collection of Ethnomedicinal and Medicine Plant Research Community based in Indonesia. Research and Development of Health Agency, Jakarta. [Indonesian]
- Tongco MDC. 2007. Purposive sampling as a tool for informant selection. Ethnobot Res Appl 5: 147-158.
- Łuczaj Ł. 2023. Descriptive ethnobotanical studies are needed for the rescue operation of documenting traditional knowledge. J Ethnobiol Ethnomed 19: 37. DOI: 10.1186/s13002-023-00604-5.
- Turner NJ. 1988. The importance of a rose: Evaluating the culture significance of plants in Thompson and lilloet interior salish. Am Anthropol 90: 272-290. DOI: 10.1525/aa.1988.90.2.02a00020.
- Yulia C, Fahri F, Pitopang R. 2017. Studi etnobotani tumbuhan obat suku "Topo Uma" di Desa Oo Parese Kecamatan Kulawi Selatan Kabupaten Sigi Sulawesi Tengah. J Biocelebes 12 (2): 1-22. [Indonesian]
- Yuliarsih, Yuniati E, Pitopang R. 2013. Studi etnobotani suku Tajio di Desa Sienjo Kecamatan Toribulu Kabupaten Parigi Moutong Sulawesi Tengah. J Biocelebes 7 (2): 49-56. [Indonesian]
- Zaki PH, Gandaseca S, Rashidi NM, Ismail MH. 2019. Traditional usage of medicinal plants by Temiar tribes in the State of Kelantan, Peninsular Malaysia. For Soc 3 (2): 227-234.
- Zuada LH, Afdalia N, Katirawi M, Nurfa M. 2023. The modus operandi of corruption during the growing period of nickel mining in Central Sulawesi: An 'elite capture' perspective. Integritas: Jurnal Antikorupsi 9 (1): 55-70.
- Zubair, Sulaiman SM, Pitopang R. 2019. Studi etnobotani tumbuhan obat pada masyarakat Kaili Rai di Desa Wombo Kecamatan Tanantovea Kabupaten Donggala Sulawesi Tengah. J Biocelebes 13 (2): 182-194. [Indonesian]