Study of the Utilization of Medicinal Plants by Traditional Healer of the Tolaki Ethnic Tribe, Southeast Sulawesi, Indonesia

Sarmadhan Saputra Tahoangako, Djoko Santosa and Nanang Fakhrudin

Correspondence

Sarmadhan Saputra Tahoangako[1], Djoko Santosa[2,3] * andNanang Fakhrudin[2,3]

[1]Master in Pharmaceutical Sciences, Faculty of Pharmacy, Universitas Gadjah Mada, Jl. Sekip Utara Sleman, Yogyakarta, 55281, Indonesia.
[2]Department of Pharmaceutical Biology, Faculty of Pharmacy, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia.
[3]Research Center for Medicinal Plants and Natural Materials, Universitas Gadjah Mada, Sekip Utara, Yogyakarta, 55281, Indonesia.

*Corresponding Author: djoko5346@ugm.ac.id

Ethnobotany Research and Applications 28:39 (2024) - http://dx.doi.org/10.32859/era.28.39.1-17
Manuscript received: 19/09/2023 - Revised manuscript received: 29/02/2024 - Published: 01/03/2024

Research

Abstract

Background: Plants are potential sources for drug discovery from natural resources. Indonesia, with its thousands of islands, harbors vast plant biodiversity. To identify promising plants for medication, an ethnomedicine study of medicinal plants was conducted in the Southeast Sulawesi Province of Indonesia. This study aimed to collect information on traditional medicinal plant usage.

Methods: The identity of plants, parts of plants used for medication, preparation methods, and dosages were systematically documented through snowball sampling, involving interviews with traditional local healers (mbu'uwai) utilizing a comprehensive questionnaire covering disease types, plant species, preparation techniques, and dosing regimens. Data were analyzed both qualitatively and quantitatively, employing the Informant Consensus Factor (ICF) and Fidelity Level (FL) values.

Results: The study revealed that 91 plant species from 44 families were utilized by healers. The most common diseases treated with medicinal plants are related to the eyes (0.97), osteoarticular system (0.96), digestive system (0.95), metabolic system (0.95), and cardiovascular system (0.95). Prominent medicinal plants include *Andrographis paniculata* (Burm.f.) Nees (100%), *Chromolaena odorata* L. (100%), *Curcuma longa* L. (100%), *Orthosiphon aristatus* Blume (100%), and *Phaleria macrocarpa* (Scheff.) Boerl. (100%). Leaves are the most commonly used plant part in traditional preparations, with boiling with water being the preferred method.

Conclusions: This study demonstrates the persistent utilization of plants for medicinal purposes within the Tolaki ethnic tribe, highlighting several species with potential as prospective drug candidates. Notably, 91 species of medicinal plants are harnessed through boiling to address prevalent ailments.

Keywords: Ethnopharmacology; Drug discovery; Informant Consensus Factor; Fidelity Level

Background

Ethnomedicine is an activity carried out by finding, selecting, and determining then developing it into new drug discoveries derived from plants (Ningsih 2017). The study of ethnomedicine serves as a crucial source of information in discovering new compounds that may lead to drug discoveries (Umair *et al*. 2017). Ethnomedicine also refers to the study of traditional medical practices (Bhasin 2007). Systematic documentation of traditional knowledge on plant utilization has contributed to several drug discoveries (Umair *et al*. 2017).

The popularity of its medicinal use has attracted the attention of scientists worldwide. Drug discovery from medicinal plants has expanded to encompass a wide range of investigation areas and a variety of analytical methods. The process typically begins with an ethnobotanist, ethnopharmacologist, or plant ecologist collecting and identifying plants of interest. Eng-Chong *et al*. (2012) developed synthetic drugs from metabolites of B. rotunda, an herb from the Zingiberaceae family commonly found in Asia and used in both food and traditional medicine. Additionally, the ethnobotanical approach, conducted as a study of traditional medicine in China and Himalayan countries, has aided in the production and development of new medicines (Sheng-Ji 2001).

Ethnomedicine exploration proves to be an effective method for recording and preserving the biodiversity of medicinal plants in Indonesia, as demonstrated by Rahmadini *et al*. (2022) in their identification of plants used to treat diarrhea and wounds in Cihanjuang Village, Indonesia. This study recommends further research on the Areuy tulungpung species to gain a deeper understanding of its benefits in treating digestive disorders. Furthermore, ethnomedicine studies have been conducted in various regions of Indonesia (Ibo & Arifa 2021, Kasmawati *et al*. 2018, Taek *et al*. 2019).

The use of plants in Indonesia has been carried out from generation to generation which later became a tradition for each region in their use to meet daily needs for food, clothing, shelter, medicine, art, and others. Utilization of the plant itself as medicine is still widely used because of the low cost, safety, and easy processing. In general, traditional medicine in the community is carried out by people who are known by the local community and who have knowledge in terms of finding, and concocting medicinal plants known as traditional healers or commonly called shamans, Batra, or traditional healers. The existence of shamans in society has an important role. In the culture of the Tolaki people, they have long-known knowledge related to the use of medicinal plants to cure various diseases. They know that there are community leaders who are considered to know terms of controlling and curing various types of diseases.

Traditional healers in the Tolaki community are called mbu'uwai. It is generally known that the traditional healers of the Tolaki ethnic group in Southeast Sulawesi Province are not willing to pass on knowledge about the use of traditional medicinal plants to those closest to them, so it becomes a serious problem. Therefore, this research was conducted to document the local knowledge possessed by traditional healers of the Tolaki ethnic group.

Materials and Methods

Study area

Southeast Sulawesi is a province in Indonesia located in the southeastern part of Sulawesi Island, with Kendari as its capital city. Geographically, Southeast Sulawesi Province is situated on the southeastern peninsula of Sulawesi Island, positioned between 02°45'-06°15' South Latitude and 120°45'-124°30' East Longitude. It covers a land area of 38,140 km² (3,814,000 ha) and is surrounded by 110,000 km² (11,000,000 ha) of water (sea). The map of Southeast Sulawesi can be seen in Figure 1.

The Tolaki tribe is a community in Southeast Sulawesi Province which inhabits several rural areas (Alang *et al*. 2021). The distribution of the Tolaki tribe in Southeast Sulawesi based on 2010 BPS data was 289,220 million people (16.28%) (Pitoyo & Hari 2017). On the mainland of Southeast Sulawesi, the majority of the Tolaki ethnic distribution covers several districts and cities, namely Konawe, South Konawe, North Konawe, Kendari City, Kolaka, North Kolaka, and East Kolaka (Melamba 2014).

Concise steps for preparing plants in this ethnomedicine research

Firstly, identify the plants that will be the focus of the study, considering their traditional medicinal uses and relevance to the research objectives. Next, gather the selected plants from their natural habitats, ensuring ethical and sustainable collection practices. Subsequently, accurately identify and verify the scientific names of the plants with the assistance of botanical experts or reliable botanical literature. Then, meticulously prepare the plant samples, removing any unwanted parts and ensuring sample integrity for subsequent analysis. Additionally, record detailed information about each sample,

including its local name, habitat, plant part used, preparation method, and any other pertinent details. Finally, appropriately store and label the samples to prevent mix-ups and maintain sample integrity throughout the research process.

Ethnomedicine Survey

The ethnomedicine study was carried out using interviews and field observations in Southeast Sulawesi, especially in the districts of Konawe, South Konawe, North Konawe, East Kolaka, and Kendari City. This study was conducted for 124 days (November 2022 to March 2023) and only focused on mbu'uwai. Data collection was carried out using snowball sampling, where data was obtained from interviews with informants (Parker *et al*. 2019). The interview technique used was an interview using an open-ended questioner.

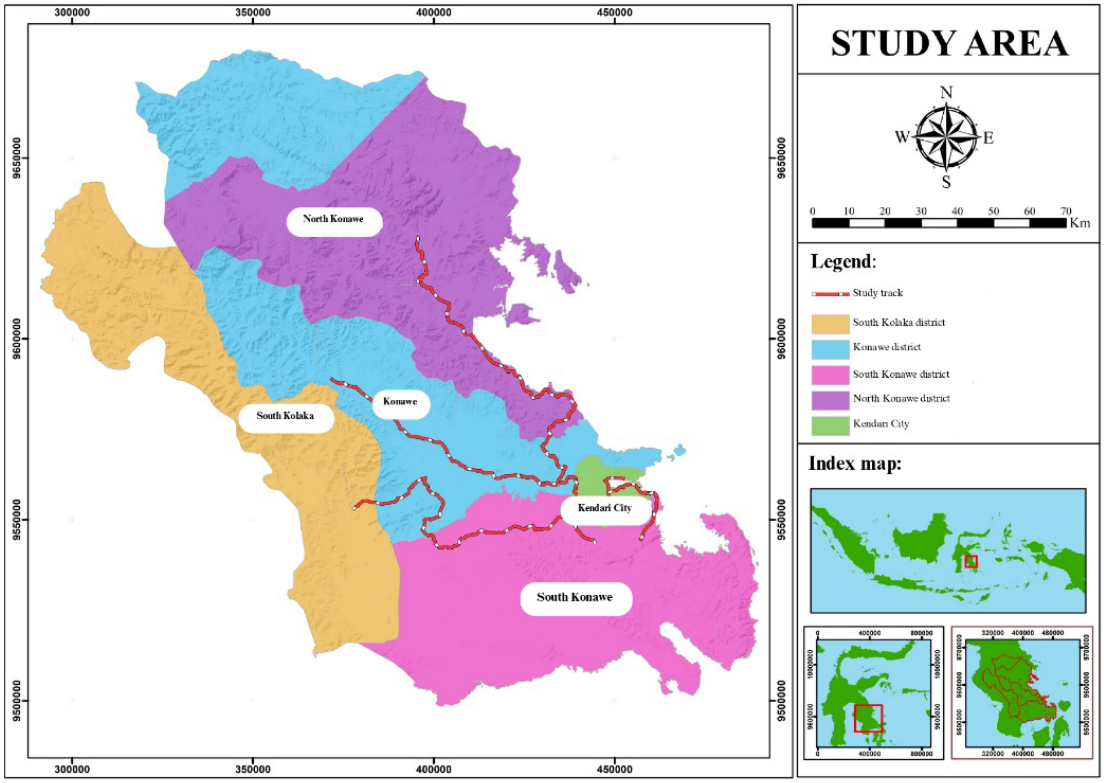

Figure 1. Map of Southeast Sulawesi, the area of the ethnobotanical study

Plant Materials

A total of 91 plant species were collected throughout the study area, the local name for this species was given by mbu'uwai, and the scientific name was given by a botanist through identification carried out at the Department of Pharmaceutical Biology, Faculty of Pharmacy, Universitas Gadjah Mada.

Data Analysis

Data were analyzed qualitatively and quantitatively using index values:

Informant consensus factor (ICF)

The ICF formula is as follows:

$$ICF = \frac{(Nur - Nt)}{(Nur - 1)},$$

The Nur is the number of informants who know and or use plants to treat diseases and Nt is the number of plants used to treat diseases (Senouci *et al*. 2019).

Fidelity Level (FL)

The FL is calculated using the following formula:

$$FL\ (\%) = N_P/N\ x\ 100,$$

The N_p refers to the number of informants who mention the use of a plant species for certain disease categories and N is the total number of informants who mention plants for all disease categories (Senouci *et al*. 2019).

Results and Discussion

Demographic Characteristics of Mbu'uwai

There were 35 mbu'uwai, originating from several areas in Southeast Sulawesi, of which 14 were from Kendari, 11 were from Konawe, 7 were from South Konawe, 2 were from North Konawe and 1 was from East Kolaka. It is also seen that both male and female mbu'uwai are involved in traditional medicine, female mbu'uwai are more knowledgeable about medicinal plant species than male Batra i.e., 24:11 (Figure 2). This happens because women are responsible as mothers who are very close to family health problems (Alaoui & Laaribya 2017).

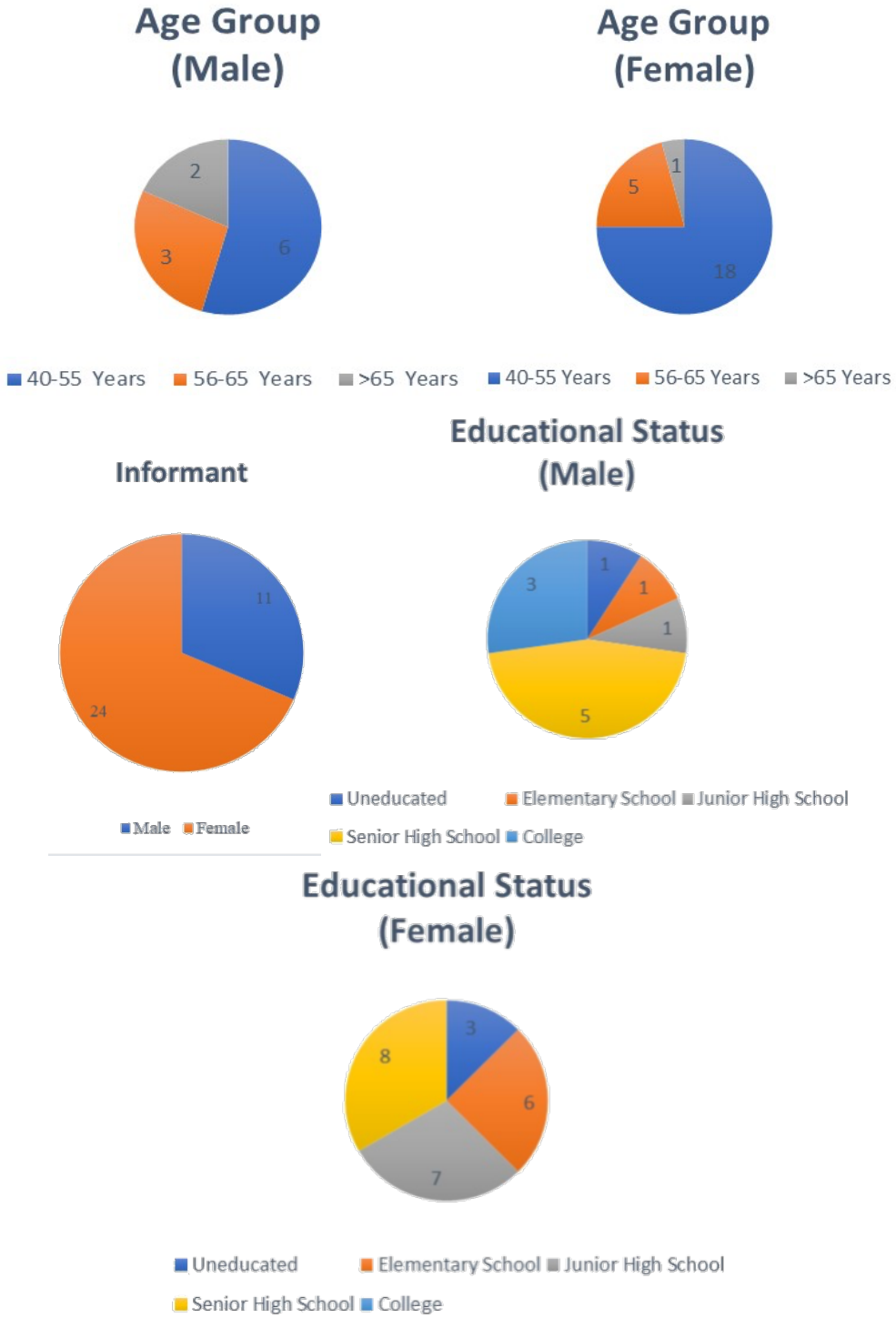

Figure 2. Demographic data of Batra (traditional healers)

Mbu'uwai, who are >40 years old tend to provide reliable information because this age category retains a lot of ancestral knowledge, which was obtained orally (Senouci *et al*. 2019). Previous research also explained that parents have more knowledge than young people about medicinal plants (Magar *et al*. 2022). Mbu'uwai, there are more men in the 40-55 years age group than the >56 years age group. Likewise, with mbu'uwai, there are more women in the age group of 40-55 years compared to the age group >56 years. Generally, mbu'uwai, have high school educational background.

Types of medicinal plants used

In total, 75 monoherbal or polyherbal preparations, containing 91 medicinal plants, were collected (see Table 3). These preparations are commonly utilized by the Batra ethnic Tolaki tribe. Based on the ethnomedicine study conducted, a total of 91 species of medicinal plants from 44 families of medicinal plants were inventoried by the researchers. The medicinal plant families with the most frequently used percentages were Asteraceae (11.00%), Euphorbiaceae, Poaceae, and Zingiberaceae each at 7.70%. Meanwhile, for other families of medicinal plants, the percentage of their use is less than 6% (Fabaceae, Myrtaceae, Lamiaceae, Morigacea, Passifloraceae, Rutaceae, and Sterculiaceae), see Figure 3. This is similar to a study conducted by Güzel *et al*. (2015) reported that the popularity of the Asteraceae family is high because the Asteraceae species have a high adaptability to various kinds of ecosystems, so they have a wide geographical distribution. In addition, the types of Asteraceae have aromatic characteristics, especially the leaves.

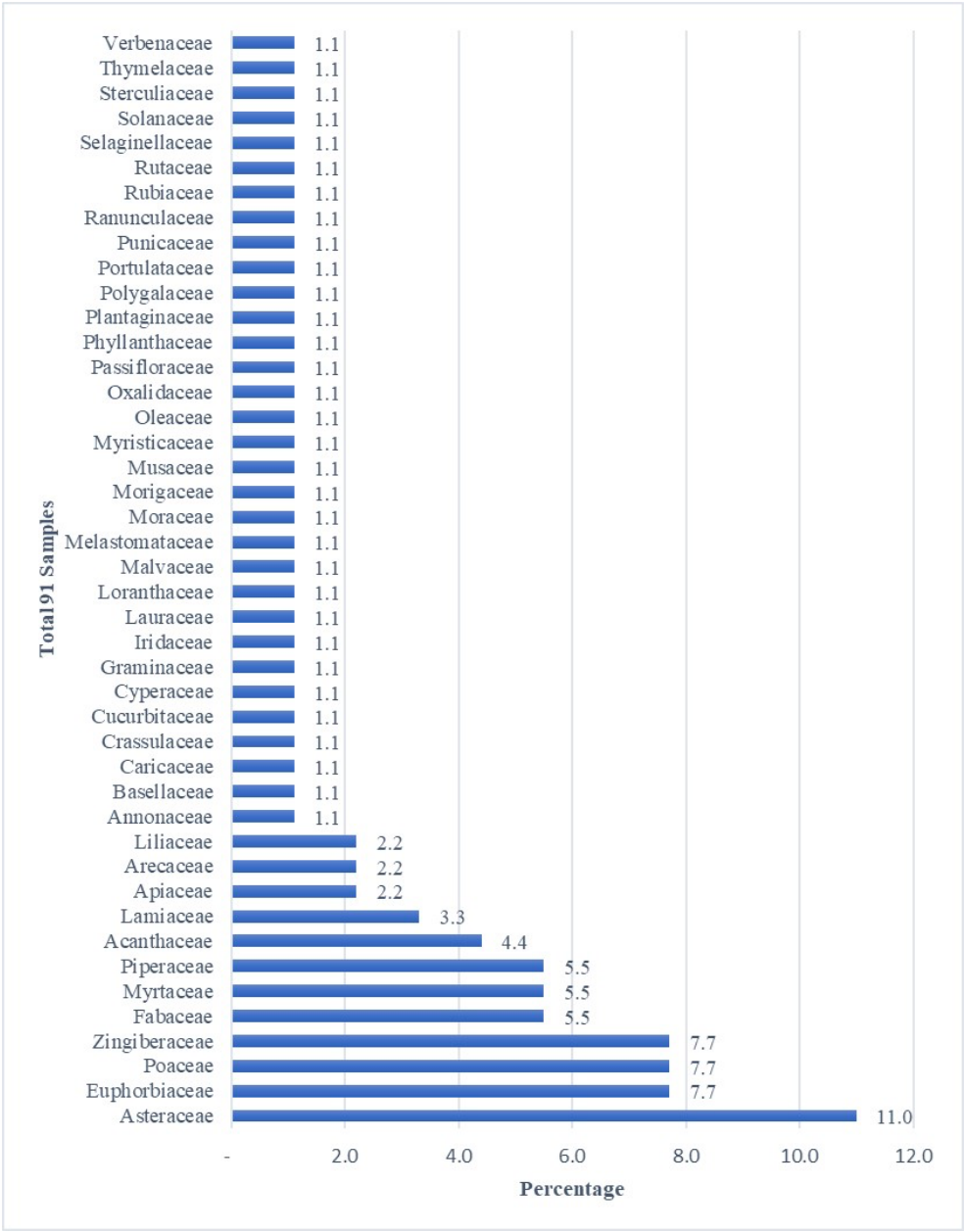

Figure 3. Plant families reported in this study

Maulidiani *et al*. (2014) reported that the Asteraceae family is often used because of its high phenolic and flavonoid content, both of which have antioxidant activity. Lulekal *et al*. (2013) showed that plants belonging to the Asteraceae family contributed to a much higher number of medicinal plant species due to their wider distribution and abundance in the flora area as well as their high bioactive content.

Parts of Medicinal Plants Used

A total of 11 parts of plants are used as traditional medicine by mbu'uwai in traditional medicine practices and the results of the percentage of plant parts that are most often used are leaves (46.80%), herbs (10.64%), then seeds (9.57%) as well as other plant parts such as roots, stems, fruit, flowers, skins, midribs and tubers less than 8% (Figure 4). Similar results have also been reported by Chaudhary *et al*. (2020), leaves are used mostly among plant parts.

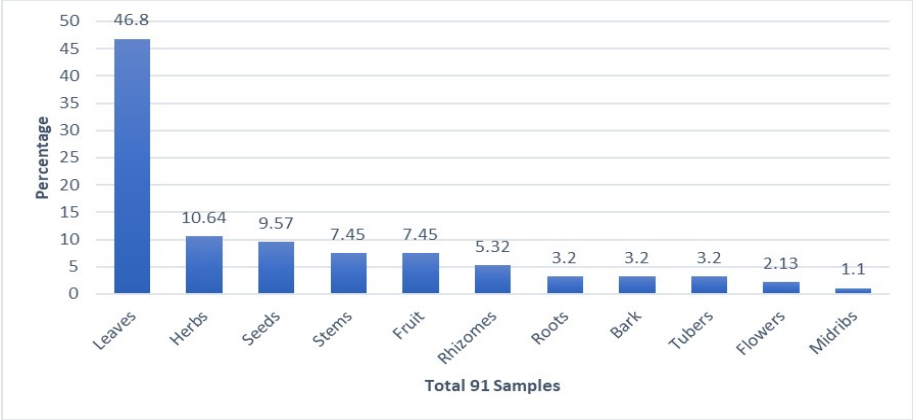

Figure 4. Part of plants used in this study

The preference for leaf parts is higher for most medicinal plant preparations compared to other plant parts because they are easy to obtain, easy to prepare, and have the best concentration of active ingredients in the leaves. Compared to taking other plant parts such as roots, tubers, and stems and taking all parts of plant leaves for use in traditional medicine, it has a minimal effect on long-term plant survival and reduces the risk of threats to traditional medicinal plants (Weldearegay & Awas 2021).

How to prepare and use medicinal plants

The results of an ethnomedicine study of 91 species of medicinal plants showed that boiling was the most common method (52.78%), while the results of other medicinal plant preparations yielded less than 14% (Figure 5). The boiling method used by mbu'uwai begins with putting the medicinal plants into a pot, then adding sufficient water and heating it to a boil for about 10-15 minutes, then the boiled water is cooled. The decoction is the most commonly used method for preparing medicinal plants because of the ease of preparation and the organoleptic results of the decoction are easily adjusted with the preferred solvent or additives such as water, honey, or milk (Nankaya *et al*. 2019). According to Elfrida *et al*. (2021) reported that treatment by drinking after boiling is known to have better efficacy compared to treatment by drinking without boiling.

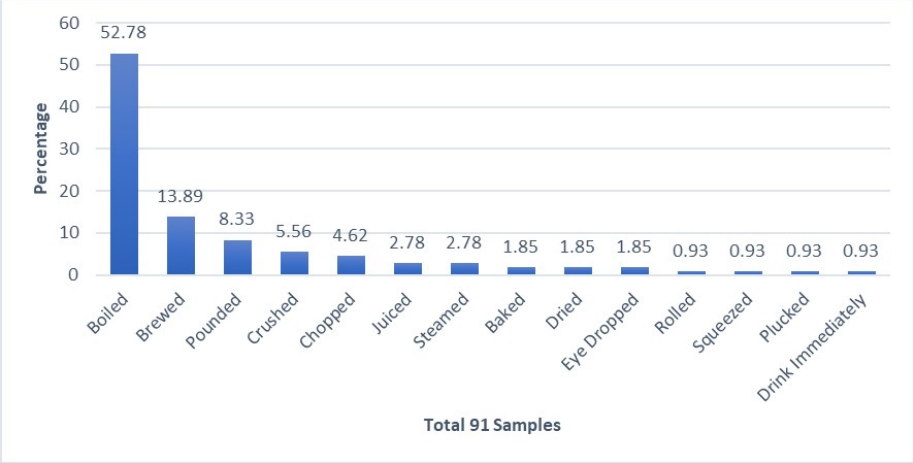

Figure 5. Plant preparation

As for how to use medicinal plants from 91 plant species that are often used by mbu'uwai, namely the use by drinking which has a percentage of 67.92% while other methods of use are less than 8%, see Figure 6. The process of boiling and drinking has the highest percentage because people believe that in the process of boiling essence can be produced and of course it is easily absorbed by the body and drunk for internal medicine (Supiandi *et al*. 2019).

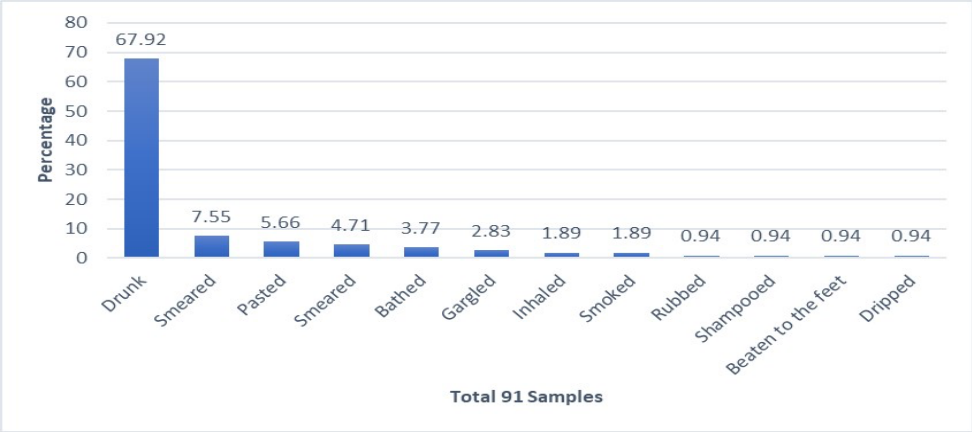

Figure 6. The data of how the plant preparation was taken by traditional community

Tolaki Ethnic Medicinal Plants

Based on the results of interviews and direct observations on mbu'uwai, 75 ingredients from 91 species of medicinal plants were obtained and used for therapeutic indications for various diseases that occur among the Tolaki ethnic community, in Southeast Sulawesi. Mbu'uwai has a different number of herbs and the number of patients based on three age groups, i.e., the age category 40-55 years has 52 medicinal herbs for 189 patients, the 56-65 years age category has 14 medicinal herbs for 91 patients, and the age category >65 years had 9 medicinal plant ingredients with 61 patients (Table 1).

Table 1. The age data and its correlation with the number of ingredients and the number of patient

Age Group	Number of Ingredients	Number of Patients
40-55 Years	52	189
56-65 Years	14	91
>65 Years	9	61

This shows that the mbu'uwai in the 40-55 years age group has a lot of medicinal plant ingredients, thus triggering more patients to seek treatment compared to other mbu'uwai age groups.

The ICF and FL Values of Medicinal Plants

The ICF analysis results of the data obtained were classified into 12 different disease categories (Table 2). The highest ICF values were associated with eye disease (0.97), osteoarticular disease (0.96), digestive system disease (0.95), metabolic system disease (0.95), cardiovascular system disease (0.95), diseases of the respiratory system & ENT (Ear, Nose, and Throat) (0.95), diseases of the teeth & mouth (0.95), diseases of the genitourinary system (0.94), skin diseases (0.94), cancer (0.94), as well as multivitamins (0.93) and nervous system diseases (0.92). These results indicate that knowledge about the therapeutic use of medicinal plants is well spread among the Tolaki ethnic community. Dulal *et al*. (2022) reported that high ICF values were due to the presence of all plants in the same community and geographical area.

The FL analysis results from the data obtained (Table 3) are calculated by the most widely used medicinal plant species. The highest FL values (100%) were shown in plants, namely *Andrographis paniculata* (Burm.F.), *Chromolaena odorata* L., *Curcuma longa*, *Orthosiphon aristatus* Blume, *Phaleria macrocarpa* (Scheff.) Boerl., *Piper betle* L., and *Zingiber officinale* Ros. The higher the FL value, the higher the informant's preference for certain species compared to other species (Senouci *et al*. 2019). *Andrographis paniculata* (Burm.F.) is employed in the treatment of diabetes and breast tumors due to the presence of Andrographolide compounds, which are among the active secondary metabolites exhibiting anticancer properties found in the Sambiloto plant (*Andrographis Paniculata* (Burm.F.) Nees), including the lactone division (Li *et al*. 2017). *Chromolaena odorata* L. is utilized to treat cough and stomach ulcers. Prior studies have concentrated on the identification of additional active favanone compounds exhibiting antioxidant and alpha-glucosidase inhibitory activities from the ethyl acetate extract of *Chromolaena odorata* L. leaves (Putri & Sri 2019).

Table 2. Informant Consensus Factor Analysis

Category Disorders/symptoms of disease	Nur	Nt	ICF	Species
Indigestion	460	20	0.95	*Adenanthera pavonina* L., *Synedrella nodiflora* (L.) Gaertn., *Areca catechu* L., *Blumea balsamifera* DC., *Chromolaena odorata* L., *Cucumis sativus* L., *Curcuma heyneana* L., *Curcuma longa* L., *Curcuma zanthorrhiza* Roxb., *Curcuma zedoaria* (Christm.) Roscoe, *Graptophyllum pictum* (L.) Griff., *Hedyotis corymbosa* L., *Lantana camara* L., *Orthosiphon aristatus* Blume, *Oryza sativa L., Punica granatum* L., *Selaginella doederleinii* Hieron, *Sesbania grandiflora* (L.) Poir., *Psidium guajava* L., *Sauropus androgynus* (L.) Merr.
Genitourinary Disorders	448	24	0.94	*Acalypha indica* L., *Aleurites moluccana* L., *Allium cepa* L., *Areca catechu* L., *Blumea balsamifera* DC., *Carica papaya* L., *Coriandrum sativum* L., *Crassocephalum crepidioides* (Benth.) S.Moore, *Cymbopogon nardus* L., *Eleutherine palmifolia* Merr., *Euphorbia hirta* L., *Ficus septica* Burm.F, *Imperata cylindrica* L., *Musa acuminata* Colla, *Nigella sativa* L., *Orthosiphon aristatus* Blume, *Phyllanthus niruri* L., *Piper betle* L., *Piper crocatum* Ruiz & Pav, *Polygala paniculata* L., *Zingiber officinale* Ros., Curcuma zedoaria (Christm.) Roscoe, *Gynura pseudochina* (L.) DC., *Syzygium aromaticum* L.
Metabolic Disorders	366	17	0.95	*Allium cepa* L., *Allium sativum* L., *Annona muricata* L., *Averrhoa bilimbi* L., *Bambusa vulgaris* Schard., *Cenchus echinatus* L., *Curcuma longa* L., *Curcuma zedoaria* (Christm.) Roscoe, *Kleinhovia hospita* L., *Lantana camara* L., *Passiflora foetida* L., *Peperomia pellucida* L., *Talinum triagulare* (Jacq.) Willd, *Vernonia amygdalina* Del., *Andrographis paniculata* (Burm.f.) Nees, Coriandrum sativum L., *Piper crocatum* Ruiz & Pav.
Cardiovascular Disorders	197	11	0.95	*Allium cepa* L., *Allium sativum* L., *Apium graveolens* L., *Musa acuminata* Colla, *Plantago major* L., *Vernonia amygdalina* Del, *Zingiber officinale* Ros., *Cucumis sativus* L., *Gynura pseudochina* (L.) DC., *Piper ningrum* L., *Wurfbainia compacta* (Sol. Ex Maton).
Respiratory Disorders, Disorders of Ears, nose and throat (ENT)	306	16	0.95	*Allium cepa* L., *Asystasia gangetica* (L.) T.Anders, *Chromolaena odorata* L., *Cinnamomum zeylanicum* Garcin ex Blume, *Citrus hystrix* DC., *Curcuma longa* L., *Eleutherine palmifolia* Merr., *Euphorbia heterophylla* L., *Kalanchoe pinnata* L., *Melaleuca leucadendra* L., *Piper betle* L., *Piper ningrum* L., *Plectranthus scutellarioides* (L.) R.Br, *Syzygium aromaticum* L., *Wurfbainia compacta* (Sol. Ex Maton), *Sesbania grandiflora* (L.) Poir.
Skin Disorders	222	13	0.94	*Allium sativum* L., *Areca catechu* L., *Senna alata* (L.) Roxb., *Ceiba pentandra* L., *Cocos nucifera* L., *Coleus scutellarioides* (L.) Benth., *Curcuma longa* L., *Mikania micrantha* Kunth, *Pedilanthus tithymaloides* (L.) Poit., *Piper betle* L., *Ruellia simplex* C. Wright, *Sesbania grandiflora* (L.) Poir., *Zingiber officinale* Ros.
Fitness Disorders	101	8	0.93	*Allium sativum* L., *Cyperus rotundus* L., *Eleusine indica* (L.) Gaertn, *Melastoma malabathricum* L., *Sauropus androgynus* (L.) Merr., *Talinum triagulare* (Jacq.) Willd, *Zingiber cassumunar* Roxb., *Curcuma zanthorrhiza* Roxb.
Cancer	141	10	0.94	*Andrographis paniculata* (Burm.f.) Nees, *Caesalpinia sappan* L., *Cosmos caudatus* Kunt., *Gynura pseudochina* (L.) DC., *Scurrula artopurpurea* (BL.) Dans, *Syzygium polycephalum* (Miq.), *Tagetes erecta* L., *Curcuma heyneana* L., *Euphorbia heterophylla* L., *Hedyotis corymbosa* L.
Osteoarticular Disorders	252	10	0.96	*Basella rubra* L., *Cymbopogon citratus* L., *Cymbopogon nardus* L., *Eleutherine palmifolia* Merr., *Myristica fragrans* Houtt., *Oleo europaea* L., *Orthosiphon aristatus* Blume, *Peperomia pellucida* L., *Phaleria macrocarpa* (Scheff.) Boerl., *Zingiber officinale* Ros.
Nervous Disorder	87	8	0.92	*Caesalpinia pulcherrima* L., *Gynura procumbens* (Blume) Miq., *Moringa oleifera* L., *Nicotiana tabacum* L., *Piper retrofractum* Vahl *Syzygium polyanthum* (Wight) Walp., *Zea mays* Certania, *Zingiber officinale* Ros.
Dental and Mouth Disorders	87	5	0.95	*Euphorbia tirucalli* L., *Psidium guajava* L., *Melastoma malabathricum* L., *Piper betle* L., *Syzygium aromaticum* L.
Eye Disorder	45	2	0.97	*Moringa oleifera* L., *Piper crocatum* Ruiz & Pav.

Table 3. Fidelity Level Analysis of Ethnomedicin Studies on Medical Plants

Botanical Name	Familiy	Common Name	Local Name	Habitus	Habitat	Part Used	FL (%)	Form of Use	How to Use
Acalypha indica L.	Euphorbiaceae	Cat's Claw	Anting-Anting	Terna	Cultivation	Leaf	8.57	Decoction/Oral	The leaves are used for cysts
Adenanthera pavonina L.	Fabaceae	Saga Tree	Tanggalasi	Tree	Wild	Leaf	77.14	Decoction/Oral	The leaves for gallstones, stomach ulcers
Aleurites moluccana L.	Euphorbiaceae	Candlenut	Kemiri	Tree	Cultivation	Sead	11.42	Decoction/Oral	The seeds for premature ejaculation
Allium cepa L.	Liliaceae	Shallot	Lasuna Momea	Herbs	Cultivation	Tubers	94.28	Decoction/Oral, Aromatherapy, Topical	The tubers for diabetes, urinary tract infections, hypertension, flu, coughs, goiter
Allium sativum L.	Liliaceae	Garlic	Lasuna mowila	Herbs	Cultivation	Tubers	85.71	Decoction/Oral, Powder/Topical	The tubers are used for body odor in children, cholesterol, hypertension, supplements, anemia
Andrographis paniculata (Burm.f.) Nees	Acanthaceae	Sambiloto	Sambiloto	Terna	Cultivation	Leaf	100	Decoction/Oral	The leaves are used for diabetes, breast tumors
Annona muricata L.	Annonaceae	Soursop	Sirisak	Tree	Cultivation	Leaf	74.28	Decoction/Oral	The leaves for cholesterol
Apium graveolens L.	Apiaceae	Celery	Saladri	Terna	Farm	Leaf	28.57	Juice/Oral	The leaves are used for hypertension
Areca catechu L.	Arecaceae	Betel nut	Inea	Tree	Farm	Fruit, Leaf	34.28	Decoction/Oral, Topical	Fruit for dysentery, blood urine, urinary tract infection
Asystasia gangetica (L.) T.Anders	Acanthaceae	Coromandel	Rembu	Terna	Wild	Leaf	22.85	Decoction/Oral	Leaves for coughs without phlegm
Averrhoa bilimbi L.	Oxalidaceae	Starfruit	Takule	Tree	Wild	Fruit	65.71	Topical	Fruit for goiter
Bambusa vulgaris Schard.	Poaceae	Yellow Bamboo	Kowuna mokuni	Tree	Wild	Stem	8.57	Decoction/Oral	Stems for hepatitis
Basella rubra L.	Basellaceae	Red Binahong	Binahong momea	Shrub	Farm	Leaf	34.28	Decoction/Oral	Leaves for gout
Blumea balsamifera DC.	Asteraceae	Sembung	Taumo	Terna	Wild	Leaf	91.42	Decoction/Oral, Topical	Leaves for stomach ulcers, postpartum
Caesalpinia pulcherrima L.	Fabaceae	Peacock Flower	Kambang	Shrub	Cultivation	Leaf	8.57	Decoction/Oral	Leaves for seizures or epilepsy in children
Caesalpinia sappan L.	Fabaceae	Sappan wood	Kasu	Tree	Cultivation	Stem	5.71	Decoction/Oral	Stems are used for breast tumors

Carica papaya L.	Caricaceae	Papaya	Kapaya	Tree	Cultivation	Akar	42.85	Decoction/Oral	Papaya root for kidney stones
Ceiba pentandra L.	Malvaceae	Kapok	Ngapu	Tree	Wild	Leaf	13.33	Gelss/Topical	Leaves for boils and acne
Cenchus echinatus L.	Poaceae	Grass	Reembu	Terna	Wild	Herbs	42.85	Decoction/Oral	Herbs for goiter
Chromolaena odorata L.	Asteraceae	Kirinyuh	Komba-komba	Bushes	Wild	Leaf	100	Decoction/Oral	Leaves for coughs, stomach ulcers
Cinnamomum zeylanicum Garcin ex Blume	Lauraceae	Cinnamon	Kasu momami	Tree	Cultivation	Stem	5.71	Juice/Oral	Stems for TB
Citrus hystrix DC.	Rutaceae	Lime	Munde iwoinahu	Shrub	Cultivation	Fruit, Peel	71.42	Aromatherapy/ Topical	Fruit for colds, tonsils, coughs
Cocos nucifera L.	Arecaceae	Coconut	Kaluku	Tree	Cultivation	Fruit	48.57	Juice/Oral, Powder/Topical	Coconut fruit for body odor, chickenpox
Coleus scutellarioides (L.) Benth.	Lamiaceae	Iler	Iler	Terna	Cultivation	Leaf	34.28	Gels/Topical	Leaves for boils
Coriandrum sativum L.	Apiaceae	Coriander	Ketumbar	Terna	Cultivation	Sead	80.00	Stew/Oral	Seeds for diabetes, premature ejaculation
Cosmos caudatus Kunt.	Asteraceae	Kenikir	Kenikir	Shrub	Cultivation	Leaf	14.28	Decoction/Oral	Leaves for cancer, tumors
Crassocephalum crepidioides (Benth.) S.Moore	Asteraceae	Sintrong	Tanggidaso	Shrub	Wild	Leaf	25.71	Decoction/Oral	Leaves for cysts, kidney failure
Cucumis sativus L.	Cucurbitaceae	Cucumber	Suai	Herbs	Farm	Fruit	68.57	Juice/Oral	Fruit for hypertension, diarrhea
Curcuma heyneana L.	Zingiberaceae	Temu Giring	Temu giring	Bushes	Cultivation	Rhizome	51.42	Stew/Oral	Rhizomes are used for intestinal worms, cancer
Curcuma longa L.	Zingiberaceae	Turmeric	Okuni	Bushes	Cultivation	Rhizome	100	Decoction/Oral, Powder, Pasta/Topical	The rhizome is used for coughs, hepatitis, stomach ulcers, body odor
Curcuma zanthorrhiza Roxb.	Zingiberaceae	Curcuma	Loiyo	Terna	Cultivation	Rhizome	57.14	Decoction/Oral	Rhizome for peptic ulcer, supplement
Curcuma zedoaria (Berg.) Roscoe	Zingiberaceae	Temu putih	Kuni mowila	Bushes	Cultivation	Rhizome	74.28	Stew/Oral	Rhizomes for stomach ulcers, kidney failure, and diabetes
Cymbopogon citratus L.	Poaceae	White Lemongrass	Padamalala mowila	Terna	Cultivation	Stem	60	Decoction/Oral, Topical	Stem for joint pain

Cymbopogon nardus L.	Poaceae	Red Lemongrass	Padamalala momea	Terna	Cultivation	Stem	80	Decoction/Oral	Stem for joint pain, gout, prostate
Cyperus rotundus L.	Cyperaceae	Nut Grass	Orembu	Gulma	Wild	Herbs	11.42	Decoction/Oral	Herbs for postmenstrual supplements
Eleusine indica (L.) Gaertn	Poaceae	Rumput Belulang	Pata	Gulma	Wild	Herbs	8.57	Topical	Herbs for hair growth supplements
Eleutherine palmifolia Merr.	Iridaceae	Bawang dayak	Bawang Dayak	Shrub	Cultivation	Tubers	74.28	Decoction/Oral	Tubers are used for coughs, gout, prostate, tonsils
Euphorbia heterophylla L.	Euphorbiaceae	Kate Mas	Katea	Terna	Wild	Leaf	51.42	Decoction/Oral	Leaves for influenza, acute respiratory infections, asthma, cancer
Euphorbia hirta L.	Euphorbiaceae	Patikan kebo	Kura	Terna	Wild	Herbs	42.85	Decoction/Oral	Herbs for kidney failure, kidney stones
Euphorbia tirucalli L.	Euphorbiaceae	Patah Tulang	Patah tulang	Shrub	Cultivation	Stem	5.71	Getah/Oral	Stem sap for gum pain
Ficus septica Burm.F	Moraceae	Awar-Awar	Libonu	Tree	Wild	Leaf	5.71	Topical	Leaves for postpartum
Graptophyllum pictum (L.) Griff.	Acanthaceae	Wungu	Tawa Moungu	Shrub	Cultivation	Leaf	48.57	Decoction/Oral	Leaves for hemorrhoids
Gynura pseudochina (L.) DC.	Asteraceae	Dewa	Ombu	Terna	Cultivation	Leaf	22.85	Decoction/Oral	Leaves for breast tumors, hypertension, kidney disorders
Gynura procumbens (Blume) Miq.	Asteraceae	Sambung Nyawa	Sambung	Shrub	Wild	Leaf	17.14	Decoction/Oral	Leaves for strokes
Hedyotis corymbosa L.	Rubiaceae	Rumput Mutiara	Rembu	Herbs	Wild	Herbs	91.42	Decoction/Oral	Herbs for appendicitis, tumors
Imperata cylindrica L.	Poaceae	Alang-Alang	Ilalang	Bushes	Wild	Roots	28.57	Decoction/Oral	Root for kidney stones
Kalanchoe pinnata L.	Crassulaceae	Cocor Bebek	Sosor bebek	Terna	Cultivation	Leaf	11.42	Topical	Leaves for fever, tonsils
Kleinhovia hospita L.	Sterculiaceae	Paliasa	Ndokulo	Tree	Wild	Leaf	5.71	Decoction/Oral	Leaves for hepatitis, liver disorders
Lantana camara L.	Verbenaceae	Patiwala	Melo	Shrub	Cultivation	Leaf	94.28	Juice/Oral, stew	Leaves for diabetes, stomach ulcers, coughs
Melaleuca leucadendra L.	Myrtaceae	Eucalyptus	Kayu mowila	Tree	Cultivation	Stem	5.71	Decoction/Oral	Stem for asthma
Melastoma malabathricum L.	Melastomataceae	Senduduk	Sengani	Shrub	Wild	Leaf	22.85	Decoction/Oral	Leaves for supplements, gum pain

Mikania micrantha Kunth	Asteraceae	Sembung Rambat	Sembung	Liana	Wild	Leaf	14.28	Topical	The leaves are used for open wounds
Moringa oleifera L.	Morigaceae	Moringa	Kelor	Tree	Cultivation	Leaf	51.42	Topical	Leaf water for Gurah eyes, migraines
Musa acuminata Colla	Musaceae	Banana	Pundi	Terna	Cultivation	Leaf, Peel	17.14	Oral, Topical	Leaves for postpartum, Skin for heart failure
Myristica fragrans Houtt.	Myristicaceae	Nutmeg	Opala	Tree	Cultivation	Sead	54.28	Minyak/Topical	Seed oil for fractures, swelling and joint pain
Nicotiana tabacum L.	Solanaceae	Tobacco	Tabako	Shrub	Cultivation	Leaf	5.71	Topical	Leaves for migraines
NiGelsla sativa L.	Ranunculaceae	Black cumin	Jintan meeto	Terna	Cultivation	Sead	8.57	Decoction/Oral	Seeds for urinary tract infections
Oleo europaea L.	Oleaceae	Olive	Zaitun	Tree	Cultivation	Sead	45.71	Minyak/Topical	Seed oil for fractures, swelling and joint pain
Orthosiphon aristatus Blume.	Lamiaceae	Cat whiskers	Kumis kucing	Terna	Cultivation	Leaf	100	Juice, Decoction/Oral, Topical	Leaves for joint pain, appendicitis, kidney stones, gout, prostate
Oryza sativa L.	Graminaceae	Rice plants	Opue	Terna	Cultivation	Sead	14.28	Bubuk/Topical	seeds are used for malnutrition
Passiflora foetida L.	Passifloraceae	Rambusa	Gola-gola	Herbs	Wild	Leaf	17.14	Decoction/Oral	The leaves are used for diabetes
Pedilanthus tithymaloides (L.) Poit.	Euphorbiaceae	Zigzag Tree	Tawa kariti	Terna	Cultivation	Leaf	11.42	Topical	Leaves for reddish skin, punctured fish bones
Peperomia pellucida L.	Piperaceae	Chinese betel leaf	Ewomongura	Terna	Wild	Herbs	71.42	Decoction/Oral	Herbal Decoction for Cholesterol, Gout
Phaleria macrocarpa (Scheff.) Boerl.	Thymelaceae	God's Crown Plant	Makota Dewa	Tree	Cultivation	Fruit	100	Juice/Oral	Fruit for gout
Phyllanthus niruri L.	Euphorbiaceae	Meniran	Okura	Terna	Wild	Herbs	85.71	Decoction/Oral	Herbs for kidney failure, kidney stones
Piper betle L.	Piperaceae	Betel leaf	Osiri	Herbs	Cultivation	Leaf	100	Decoction/Oral, Topical	Leaves for body odor, vaginal discharge, asthma, whiten teeth
Piper nigrum L.	Piperaceae	Pepper	Marisa	Herbs	Cultivation	Sead	42.85	Decoction/Oral	Seeds for asthma, hypertension
Piper crocatum Ruiz & Pav.	Piperaceae	Red betel leaf	Osiri momea	Herbs	Cultivation	Leaf	77.14	Decoction/Oral, Juice	Leaves for urinary tract infections, cholesterol, diabetes, eye inflammation

Piper retrofractum Vahl	Piperaceae	Javanese Chili	Saha	Shrub	Cultivation	Fruit	17.14	Juice/Oral	Fruits for strokes
Plantago major L.	Plantaginaceae	Sendok Leaf	Tawa sendo	Shrub	Wild	Leaf	37.14	Decoction/Oral	Leaves for coronary heart, heart failure
Plectranthus scutellarioides (L.) RBr	Lamiaceae	Miana	Miana	Terna	Farm	Leaf	34.28	Stew/Oral	The leaves are used for coughing
Polygala paniculata L.	Polygalaceae	Balm plant	Balasem	Terna	Wild	Herbs	20	Decoction/Oral	Herbs for kidney failure
Psidium guajava L.	Myrtaceae	Guava	Dambu watu	Tree	Wild	Leaf	65.71	Decoction/Oral	The leaves are used for gum pain, diarrhea
Punica granatum L.	Punicaceae	Pomegranate	Delima	Tree	Cultivation	Roots	31.42	Decoction/Oral	The roots are used for worms
Ruellia simplex C. Wright	Acanthaceae	Mexican petunia	Tawa ungu	Terna	Cultivation	Flower	8.57	Topical	Flowers for hives
Sauropus androgynus (L.) Merr.	Phyllanthaceae	Katuk	Tawakatu	Terna	Cultivation	Leaf	71.42	Decoction/Oral	The leaves are used for supplements, constipation
Scurrula artopurpurea (BL.) Dans	Loranthaceae	Benalu	Banalu	Terna	Wild	Herbs	11.42	Decoction/Oral	Herbs are used for breast tumors
Selaginella doederleinii Hieron	Selaginellaceae	Chicken Claw Plants	Cakar manu	Terna	Cultivation	Herbs	20	Decoction/Oral	Herbs for appendicitis
Senna alata (L.) Roxb.	Fabaceae	Chinese ketepeng	Sabandara	Tree	Wild	Leaf	11.42	Pasta/Topical	Leaves for skin diseases, tinea versicolor, ringworm, ringworm
Sesbania grandiflora (L.) Poir.	Fabaceae	Turi	Kambadawa	Tree	Cultivation	Leaf	6.,57	Oral,Powder/Topical	The leaves are used for hunger and body odor in children, coughs
Synedrella nodiflora (L.) Gaertn.	Asteraceae	Jotang Horse	Komba-komba mokuni	Terna	Wild	Leaf	54.28	Decoction/Oral	Leaves for stomach ulcers
Syzygium aromaticum L.	Myrtaceae	Clove	Cengkeh	Tree	Cultivation	Sead	54.28	Stew, Juice/Oral	Seeds are used for tuberculosis, gum pain, premature ejaculation
Syzygium polyanthum (Wight) Walp.	Myrtaceae	Bay leaf	Tawa salam	Tree	Cultivation	Leaf	37.14	Stew, Juice/Oral	Leaves for strokes
Syzygium polycephalum (Miq.)	Myrtaceae	Ruruhi	Ruruhi	Tree	Wild	Leaf	14.28	Stew/Oral	The leaves are used for stomach tumors

Tagetes erecta L.	Asteraceae	Marigold	Bunga Tae manu	Terna	Cultivation	Leaf	40	Decoction/Oral	Leaves for breast tumors
Talinum triagulare (Jacq.) Willd	Portulataceae	Ginseng	Tawa mokora	Shrub	Cultivation	Leaf	25.71	Decoction/Oral	Leaves for supplements, anemia
Vernonia amygdalina Del.	Asteraceae	Bitter *leaf plant*	Klorofil	Terna	Cultivation	Leaf	28.57	Juice, Decoction/Oral	Leaves for cholesterol and hypertension
Wurfbainia compacta (Sol. Ex Maton).	Zingiberaceae	Cardamom	Kapulaga	Terna	Cultivation	Sead	37.14	Stew, Juice/Oral	Seeds for tuberculosis, hypertension
Zea mays Certania	Poaceae	waxy *corn*	Gandu mowila	Terna	Cultivation	Corn husks	11.42	Topical	Corn husks for migraines
Zingiber cassumunar Roxb.	Zingiberaceae	Bangle	Bangle	Terna	Wild	Flower	57.1	Topical	Flowers for supplements in children
Zingiber officinale Ros.	Zingiberaceae	Ginger	Loio	Herbs	Cultivation	Rhizome	100	Stew/Oral, Topical	Rhizome for body odor, vaginal discharge, heart failure, migraines, joint pain

Moreover, *Curcuma longa* is employed in the treatment of cough, hepatitis, stomach ulcers, and body odor. Prior research has validated that phenolic compound, particularly curcuminoids, sourced from *Curcuma longa* L., demonstrate significant antioxidant properties, suggesting their potential effectiveness in the management or prevention of various diseases (Lukitaningsih *et al*. 2019). *Orthosiphon aristatus* Blume is employed in the treatment of joint pain, appendicitis, kidney stones, gout, and prostate issue. Typically, *Orthosiphon aristatus* Blume biosynthesizes a variety of compounds, including terpenoids, phenolics (such as isopimaric acid, flavonoids, and benzochromen), and organic acid derivatives (Silalahi 2019). Numerous medicinal plants containing flavonoids have been documented to possess a spectrum of pharmacological activities, encompassing antioxidant, antibacterial, antiviral, anti-inflammatory, anti-allergic, and anti-cancer properties (Almatar *et al*. 2013). Next, *Phaleria macrocarpa* (Scheff.) Boerl. is utilized to treat gout. The research findings indicate that secondary metabolites derived from *Phaleria macrocarpa* (Scheff.) Boerl., including tannins, saponins, phenolic compounds, flavonoids, terpenoids, and alkaloids, exert significant roles as antioxidants, anti-inflammatory agents, antimicrobial agents, and exhibit cytotoxic activity (Altaf *et al*. 2013).

Then, *Piper betle* L. is utilized for the treatment of body odor, vaginal discharge, asthma, and tooth whitening. The ethanol extract of *Piper betle* L. demonstrates antimicrobial activity, potentially due to the presence of phenolic compounds (Azahar *et al*. 2020). Furthermore, *Zingiber officinale* Ros. is employed to alleviate body odor, vaginal discharge, heart failure, migraine, and joint pain. Ginger, or *Zingiber officinale* Ros., exhibits remarkable antioxidant properties against reactive oxygen species (ROS), free radicals, peroxides, and various other harmful oxidants. Active ingredients such as gingerol, shogaol, zingerone, among others, found in ginger demonstrate antioxidant activity. These compounds inhibit the enzyme xanthine oxidase. Additionally, zingerone and essential oil derived from ginger display antimicrobial activity. Gingerol exerts an inhibitory effect on prostaglandin and leukotriene biosynthesis by suppressing prostaglandin synthase or 5-lipoxygenase (Dhanik *et al*. 2017). The heightened preference for the seven species outlined may stem from their multifarious uses, straightforward preparation methods, and proven efficacy validated through diverse experimental processes. Consequently, local inhabitants exhibit greater confidence in utilizing medicines derived from these species (Karki *et al*. 2023).

Herbarium of Medicinal Plants

A total of 51 of the 91 medicinal plants collected were made into dry herbariums. As many as 40 species in the form of photo documentation, this is because the mbu'uwai did not allow plant samples to be taken as herbariums. According to Murni *et al*. (2015), a herbarium has several functions, including as a valid basic material for flora and vegetation studies, as concrete evidence that the plant has existed at the location or place where the intended plant collection was carried out, as an important means of identifying plants, as a repository for materials reference, and as a data bank for policy making for government institutions in research locations.

The research on ethnomedicine studies that has been carried out has not yet covered remote areas in Southeast Sulawesi as a whole considering the many obstacles encountered during the ethnomedicine studies.

Conclusion

There are 91 species of plants that are efficacious as medicine in overcoming various diseases experienced by the traditional Tolaki ethnic community in Southeast Sulawesi Province. The plants most frequently used were *Andrographis paniculata* (Burm.f.) Nees, *Chromolaena odorata* L., *Curcuma longa* L., *Orthosiphon aristatus* Blume and *Phaleria macrocarpa* (Scheff.) Boerl. Based on this study, 11 plant parts were also used as traditional medicine by mbu'uwai who live in Southeast Sulawesi. Leaves are the part of the plant most often used as a traditional herb at 46.80%. The traditional community of the Tolaki ethnic group in Southeast Sulawesi Province more often uses plants that have medicinal properties by boiling them (52.78%) and then drinking the concoctions of these medicinal plants (67.92%).

Declarations

List of abbreviations: ICF - Informant Consensus Factor**;** FL - Fidelity Level

Ethics approval and consent to participate: This research was approved by the Medical and health research ethics committee (MHREC) Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, Ref. No.: KE/FK/1524/EC/2022 stated that this study complied with the ethical principles outlined in international and national guidelines on ethical standards and procedures for research with humans. All participants provided prior informed consent.

Consent for publication: Not applicable.

Competing interests: Authors have no conflict of interest.

Funding: Authors have not received any funding during this research.

Author contributions: All authors declare to have contributed intellectually and have approved the current work for publications in this journal.

Acknowledgements

We are thankful to all parties involved in this research, especially the traditional community leaders of the Tolaki ethnic group in Southeast Sulawesi Province.

Literature cited

Alang, H, Yusal MS, Hastuti. 2021. Inventarytation of medicinal plants as a self-medication by the Tolaki, Puundoho village, North Kolaka regency, Southeast Sulawesi. Jurnal Ilmiah Farmasi (Scientific Journal of Pharmacy) 17(1): 19-33.

Alaoui A, Laaribya S. 2017. Etude ethnobotanique et floristique dans les communes rurales Sehoul et Sidi-Abderrazak (cas de la Maamora-Maroc Septentrional). Nature & Technology: 15-24.

Almatar M, Rahmat Z, Salleh FM. 2013. Preliminary morphological and anatomical study of *Orthosiphon stamineus*. Indian Journal of Pharmaceutical and Biological research 1(4): 1-6.

Altaf R, Asmawi MZ, Dewa A, Sadikun A, Umar MI. 2013. Phytochemistry and medicinal properties of *Phaleria macrocarpa* (Scheff.) Boerl. extracts. Pharmacognosy reviews 7(13): 73-80.

Azahar NI, Mokhtar NM, Arifin MA. 2020. *Piper betle*: a review on its bioactive compounds, pharmacological properties, and extraction process. IOP Publishing 12(44): 1-17.

Bhasin V. 2007. Medical Anthropology: A Review. Studies on Ethno-Medicine 1(1): 1-20.

Chaudhary S, Magar GT, Sah SN, Parajuli S. 2020. Ethnic Plants of Tharu Community of Eastern Nepal. International Journal of Applied Sciences and Biotechnology 8(2): 223-230.

Dhanik J, Arya N, Nand V. 2017. A Review on *Zingiber officinale*. Journal of Pharmacognosy and Phytochemistry 6(3): 174-184.

Dulal K, Chaudhary S, Uprety Y, Shrestha N, Shakya S, Munankarmi N. 2022. Ethnomedicinal plants used by the local people of Changunarayan Municipality, Bhaktapur, Nepal. Ethnobotany Research and Applications 23(37): 1-27.

Elfrida, Tarigan, NS, Suwardi, AB. 2021. Ethnobotanical study of medicinal plants used by community in Jambur Labu village, East Aceh, Indonesia. Biodiversitas 22: 2893-2900.

Eng-Chong T, Yean-Kee L., Chin-Fei C, Choon-Han H, Sher-Ming W, Li-Ping CT, Gen-Teck F, Khalid N, Abd Rahman N, Karsani SA, Othman S, Othman R, Yusof R. 2012. *Boesenbergia rotunda*: From Ethnomedicine to Drug Discovery. Evidence-based complementary and alternative medicine: eCAM 2012: 1-25.

Güzel Y, Güzelşemme M, Miski M. 2015. Ethnobotany of medicinal plants used in Antakya: A multicultural district in Hatay Province of Turkey. Journal of Ethnopharmacology 174: 118-152.

Ibo LK, Arifa N. 2021. Etnomedisin Tumbuhan Obat Masyarakat di Kampung. Kaliki,Merauke Papua. AL-KAUNIYAH: Jurnal Biologi 14(1):90-100.

Karki S, Dhital AP, Uprety Y. (2023). Medicinal plants and their use by an ethnic minority Jirel in Dolakha district, Central Nepal. Ethnobotany Research and Applications, 25: 1-29.

Kasmawati H, Ruslin, Ihsan A, yamin, Munasari D, Elafita WO. 2018. Ethnomedicine Studies of Traditional Medicinal Plants of the Muna Tribe in the Village of Bungi Southeast Sulawesi Province of Indonesia. International Journal of Science and Research (IJSR) 8(11): 1882-1887.

Li L, Yue GG-L, Lee JK-M, Wong EC-W, Fung K-P, Yu J, Lau CB-S, Chiu PW-Y. 2017. The adjuvant value of *Andrographis paniculata* in metastatic esophageal cancer treatment - From preclinical perspectives. Scientific Reports 7(1): 1-14.

Lukitaningsih E, Abdul R, Mohamad R, Nurrulhidayah AF. 2019. In vivo antioxidant activities of Curcuma longa *and Curcuma xanthorrhiza*: a review. Food Research 4(February): 13-19.

Lulekal E, Asfaw Z, Kelbessa E, Van Damme P. 2013. Ethnomedicinal study of plants used for human ailments in Ankober District, North Shewa Zone, Amhara Region, Ethiopia. Journal Of Ethnobiology And Ethnomedicine 9(63): 1-13.

Magar RA., Mallik AR, Chaudhary S, Parajuli S. 2022Ethno-medicinal plants used by the people of Dharan, Eastern Nepal. Indian Journal of Traditional Knowledge 21(1): 72-80.

Maulidiani, Abas F, Khatib A, Shaari K, Lajis NH. 2014. Chemical characterization and antioxidant activity of three medicinal Apiaceae species. Industrial Crops and Products 55: 238-247.

Melamba B. 2014. Sejarah Persebaran, Dan Klasifikasi Bahasa Tolaki Di Sulawesi Tenggara. Etnoreflika 3(1): 1-23.

Murni P, Muswita, Harlis, Yelianti U, Kartika WD. 2015. Lokakarya Pembuatan Herbarium Untuk Pengembangan Media Pembelajaran Biologi di MAN Cendikia Muaro Jambi. Jurnal Pengabdian Pada Masyarakat 30(2): 1-6.

Nankaya J, Gichuki N, Lukhoba C, Balslev H. 2019. Medicinal plants of the Maasai of Kenya: A review. Plants 9(1): 1-17.

Ningsih IY. 2017. Pencarian Tumbuhan Obat Yang Berpotensi Sebagai Antimalaria Berdasarkan Pengetahuan Etnomedisin. Pharmacy 14(1): 41-50.

Pitoyo AJ, Hari T. 2017. Dinamika Perkembangan Etnis Di Indonesia Dalam Konteks Persatuan Negara. Populasi 25(1): 64-81.

Parker C, Scott S, Geddes A. 2019. Snowball Sampling. SAGE Research Methods Foundations.

Putri DA, Sri F. 2019. A New Flavanone as a Potent Antioxidant Isolated from *Chromolaena odorata* L. Leaves. Evidence-Based Complementary and Alternative Medicine 2019:1-12.

Rahmadini N, Rindita, Prakasa AP, Nugroho A. 2022. Ethnomedicinal Exploration of Medicinal Plant in Cihanjuang Village, Pandeglang-Banten for Curing Stomacache. Media Konservasi 27(3): 140-146.

Senouci F, Ababou A, Chouieb M. 2019. Ethnobotanical Survey of the Medicinal Plants used in the Southern Mediterranean. Case study: The region of Bissa (northeastern Dahra Mountains, Algeria). Pharmacognosy Journal 11(4): 647-659.

Sheng-Ji P. 2001. Ethnobotanical approaches of traditional medicine studies: some experiences from Asia. Pharmaceutical Biology, 39 Suppl 1: 74-79.

Silalahi M. 2019. *Orthosiphon stamineus* Benth (Uses and Bioactivities). Indonesian Journal of Science and Education 3(1): 26-33.

Supiandi MI, Mahanal S, Zubaidah S, Julung H, Ege B. 2019. Ethnobotany of traditional medicinal plants used by dayak desa community in sintang, West Kalimantan, Indonesia. Biodiversitas 20(5): 1264-1270.

Taek MM, Banilodu L, Neonbasu G, Watu YV, BP EW, Agil M. 2019. Ethnomedicine of Tetun ethnic people in West Timor Indonesia; philosophy and practice in the treatment of malaria. Integrative medicine research, 8(3), 139-144.

Umair M, Altaf M, Abbasi AM. 2017. An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan. PLoS ONE 12(6): 1-22.

Weldearegay EM, Awas T. 2021. Ethnobotanical Study in and around Sirso Natural Forest of Melokoza District, Gamo Goffa Zone, Southern Ethiopia. Ethnobotany Research and Applications 22: 1-24.