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Research Article

Medicinal Plants Diversity Used by Balinese in Buleleng Regency, Bali

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ABSTRACT
The Lontar Usada Bali is a collection of the science of traditional medicine recorded in the lontar leaves. It contains information about the diversity of medicinal plants and treatment procedures used by Balinese for generations. However, most of the information stored in the lontars is only known by the Balians (Traditional Healers). The aim of the study was to investigate and document the diversity of medicinal plants known by Balians in Buleleng Regency, Bali Province, Indonesia. Direct interview with Balians, combined with purposive sampling (for the usada plants), was used in this study and conducted in August-September 2022. The data obtained comprised plant species, habitat, habitus, local names, plant parts used, and how they were used. The data were analysed qualitatively and quantitatively using diagrams, graphs, and tables and measured by the use-value index. Sixty-five species and 37 families of plants were recorded as a medicinal plant. The most widely used plant families by Balians were Zingiberaceae, Poaceae, Rutaceae, Euphorbiaceae, Lamiaceae, Lauraceae, and Malvaceae. In most cases, leaves were used, followed by tubers, fruits, and other parts. Maceration and powder or mushy were the primary modes of making herbal medicine, and external application was the most common method of drug administration. Most medicinal plants were obtained from the home garden, taken from nature, or bought in the market. Several diseases often treated by Balians were convulsions, itching, cramps, headache, black magic, stroke, herpes and tumor/cancer. This research is important to complete the ethnobotanical data on the diversity of medicinal plants in Bali. This data is important information for the development of new drugs and must be maintained for sustainability.

INTRODUCTION
In recent years, modern society's attention and interest in "back to natural products" has increased along with awareness of the side effects of using chemical-based drugs (Rahayu & Rosleine 2020). In addition, the results of modern research also support that herbal medicinal products are generally sourced from the ethnobotanical knowledge of the local community. Furthermore, this herbal product has been proven to have various unique biochemical components and potential as a drug source (Hiben et al. 2019; Belgica et al. 2021). Therefore, knowledge about the ethnobotany of medicinal plants in a traditional society is an essential source of information for developing and discovering new compounds in

the pharmacology industry.

Until recently, alternative medicine using traditional medicines sourced from ethnobotanical studies passed down from generation to generation is still developing and used by traditional communities in various ethnic groups in Indonesia. So ethnobotanical information is an essential source of information that must be continuously recorded and developed (Nguyen et al. 2019; Kachmar et al. 2021).

Indonesia has high ethnic diversity and biodiversity, including the diversity of medicinal plants used by these ethnic communities. They have used various compositions of medicinal plants to treat various diseases in humans from generation to generation (Pandiangan et al. 2019). However, in the last few decades, traditional communities living in rural areas in Indonesia, especially in Bali, continue to face increasing cultural erosion due to interactions with foreign cultures over a long period, along with ecotourism activities. Evidence of this cultural erosion is marked by the decreasing knowledge of the ethnobotany of the local community, especially about the use of plants for traditional medicine, whereas knowledge about traditional medicinal plants is an essential asset for Indonesia (Oktavia et al. 2017).

The Balinese tribe has a source of information about the diversity of medicinal plant species and their treatment procedures, known as Lontar Usada Bali. Based on the legacy of the inscription, Lontar Usada Bali is estimated to have originated from medical knowledge in India and developed along with the development of Hinduism on the island of Bali. *Lontar Usada* is an ancient manuscript that contains information about traditional medicine systems passed down from generation to generation. This information is generally written in palm or siwalan leaves (*Borassus flabellifer* plant). It is estimated that 55,000 lontars are stored by the Balinese themselves, Pedanda, Balian, and several local institutions in Bali (Oktavia et al. 2017). Some ethnobotanical information on the Usada Bali lontar has been recorded by Tengah (Tengah 1995), but most of it is still stored in the lontar records or in the knowledge of the Balians found in Bali. This study aims to explore information on the diversity of medicinal plants stored or known by balians (traditional healers) in Buleleng Regency, Bali Province.

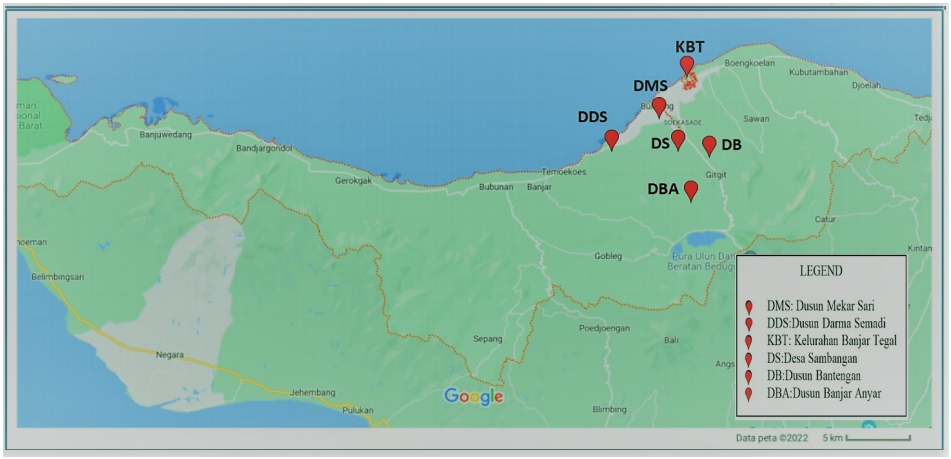
Buleleng Regency is an area on the north coast of the island of Bali with the capital city Singaraja. This area has an area of about 1,365. 88 km2 or 24.25% of the total area of Bali Province. The Balinese people in Buleleng Regency still carry out their traditional life, including in traditional medicine. They have many Balian's (traditional healers) who pass on knowledge about the diversity of medicinal plants used in the Buleleng area from generation to generation. Although some of this information has been documented in *Lontar Usada*, in fact there is still much information about the diversity of these medicinal plants that are only known by Balian and has not been well documented. This makes the topic of Balian's knowledge about the diversity of medicinal plants in Buleleng district very interesting to study.

STUDY AREA AND METHODS

Study Area

The research was located in the villages in Buleleng Regency, Bali Province (Figure 1). The selected locations were based on the presence of Balians (traditional healers) as an informant to be interviewed in this study. They were Kelurahan Banjar Tegal, Buleleng subdistrict (KBT); Dusun Bantengan, Ambengan village, Sukasada subdistrict (DB); Dusun Mekar Sari, Panji Village, Sukasada subdistrict (DMS); Dusun Darma

Semadi, Desa Tukad Mungga, Bulleleng Subdistrict (DDS), Desa Sambangan, Sukasada subdistrict (DS), and Dusun Banjar Anyar, Sambangan village, Sukasada subdistrict (DBA).



KBT: 8° 12' 25" S, 115° 08' 73" E DB : 8° 16' 66" S, 115° 12' 04" E
DMS: 8° 18' 35" S,115° 10' 13" E DDS: 8° 14' 36" S,115° 05' 86" E
DS : 8° 14' 86" S,115° 09' 82" E DBA: 8° 15' 21" S,115° 09' 96" E

Note: The research location: Kelurahan Banjar Tegal, Buleleng District (KBT); Dusun Bantengan, Ambengan Village, Sukasada District (DB); Dusun Mekar Sari, Panji Village, Sukasada District (DMS); Dusun Darma Semadi, Tukad Mungga Village, Bulleleng District (DDS), Desa Sambangan, Sukasada District (DS), and Dusun Banjar Anyar, Desa Sambangan, Sambangan Village, Sukasada District (DBA).

Figure 1. The study area of Medicinal Plants Diversity Used by Balinese In Buleleng Regency, Bali, Indonesia.

Ethnobotanical Data Collection

This research aims to record the diversity of medicinal plant species used by traditional healers (Balian) in Buleleng Regency, Bali Province. This research was conducted with an interview method with purposive sampling and using a semi-open questionnaire (Yudiyanto et al. 2022). Nine Balians from 6 villages in Buleleng Regency were interviewed as informants. Some non-numeric data on ethnobotany of medicinal plants were collected include the diversity of medicinal plant species, local names, scientific names, families, habitat, habitus, including data on plant parts used, processing methods, usage methods, types of diseases that can be treated, and the origin of obtaining medicinal plants (Budiarti et al. 2020). Photos and vouchers for medicinal plants were recorded and collected, then sent to the Bali "Eka Karya" Botanical Gardens to be identified by taxonomists. Species identification is made by comparing the morphological characteristics of medicinal plant vouchers with herbarium collections and live plant collections at the Eka Karya Bali Botanical Gardens, as well as comparisons with several literatures in the form of books Flora of Java (Backer & Bakhuizen van den Brink Jr. 1965); Flora Pegunungan Jawa (Steenis 2010) or online taxonomy sites. The scientific name was determined and verified using online database of scientific plant names The Plant List, 2018 and The International Plant Names Index, 2018 (Andila et al. 2021). In addition, some critical information was also collected, including socio-economic conditions, community culture, education level, income sources, livelihoods, informants' views on forests, and threats related to diversity (Mwangi et al. 2021).

Data Analysis

The interview data were analysed qualitatively and quantitatively. Dia-

grams, graphs, and tables were utilized to depict qualitative analysis. During the quantitative analysis, the use-value index (UV) of a species, Family Use Value (FUV) and Plant Part Value (PPV) were calculated. Some descriptions of efficacy and how to mix medicine are also explained.

a) The Use Value index (UV)

The Use Value index (UV) of a species aims to measure the relative usefulness of a medicinal plant species quantitatively (Zenderland et al. 2019; Jadid et al. 2020; Damayanti et al. 2021; Merouane et al. 2022). the UV was measured using the following formula:

$$UV = \sum Ui / N$$

UV: use value index, Ui: number of uses by informants, N: Number of respondents.

b) Family Use Value (FUV)

Family Use Value (FUV) was calculated as described by Jadid et al. (2020) and Merouane et al. (2022). FUV is defined as the use value of a plant family as an ingredient of traditional medicine by an ethnic group.

$$FUV = \Sigma UV / n$$

ΣUV is the UV sum of all species belonging to the same plant family. n: is the number of species belonging to the same plant family.

c) Plant Part Value (PPV) (%)

Plant part value (PPV) is the percentage of plant parts (stems, leaves, roots, fruit, bark, and flowers) used by traditional healers as a source of traditional medicine. PPV is calculated by the formula according to Chaachouay et al. (2019), Jadid et al. (2020) and Najem et al. (2020) as follows:

$$PPV = (\sum RU\ (plant\ part) / \sum RU) \times 100$$

Where $\sum RU\ (plant\ part)$ is the number of uses per plant part and $\sum RU$ represents the sum of uses reported for all plant parts.

RESULTS AND DISCUSSION

This study documented the diversity of medicinal plants used by Balians in Buleleng Regency, Bali Province. All informants in this study work as experts in traditional medicine in Buleleng Regency. All informants (100%) answered all the questions in the questionnaire list using the semi-interview method. Socio-demographic information of the informants (traditional healers or Balians) was shown in table 1. Overall, 87.5% of informants were male and 12.5% female, with a female/male sex ratio of 0.14. A survey of traditional healers based on gender shows that men are more dominant than women. These results are the same as those reported by the same study in other areas (Bachiri et al. 2015; Harouak et al. 2018; Najem et al. 2020). Traditional medicine practitioners in Buleleng Regency, Bali, Indonesia, have a range of age groups that vary, with the most dominant age range being 61-70 years (37.5%), then followed by an age range of 51-60 years (25%), and 31-40 years old and 71-80 years old with a percentage of 12.5% each. Based on the age range, traditional healers in Buleleng Regency, Bali, are dominant between the age range of 51-70 years, indicating that knowledge of traditional medicine and the diversity of medicinal plants requires years of experience (Najem et al. 2020). Analysis of the data based on the formal educational background of the informants showed that the most dominant formal education of the informants was a primary school (37.5%) and senior high school (37.5%), followed by informants with non-formal education (12.5%) and informants with high education in university (12.5%). Transmission of medical

knowledge by traditional healers in Buleleng Bali from generation to generation is carried out through various methods, including orally from the older generation to the younger generation and in writing through traditional medical records in *Lontar Usada*. Inheritance of medical knowledge through oral was what needs to be appropriately recorded scientifically because treatment information passed down orally is easier to experience a reduction in information (Najem et al. 2020).

Based on the results of this study (shown in table 3), it was recorded 66 species and 37 families of plants used as medicinal plants, including their scientific name, local name, family, the origin of the plant, the parts plant used, the type of disease that can be treated, location of the informant, the method of concocting the drug, the method of application of the drug, and the Useful Value index. The list of the most important plant families in terms of species used as medicinal plants by Balians in the Buleleng Regency, Bali, Indonesia was calculated following the method reported by Luziatelli et al. (2010) and shown in Figure 2. From the highest to the lowest percentage, it consisted of Zingiberaceae (18.97%), Poaceae (8.62%), Rutaceae (6.90%), Euphorbiaceae, Lamiaceae, Lauraceae, Malvaceae (5.17% each), Amaryllidaceae, Apocynaceae, Leguminosae, Loranthaceae, Magnoliaceae, Myristicaceae, Oxalidaceae (3.45% each). While the Family Use Value (FUV) is shown in Table 2. This study revealed that the plant families with high FUV were Zingiberaceae (1.71), Euphorbiaceae (1.89), Arecaceae (1.5), and Amaryllidaceae (1.5), Piperaceae (1.2), Poaceae (1.1). However, the magnitude of the FUV value is not represented by the more significant number of species members. This means that the use value of a plant family ethnobotanically does not depend on the richness and diversity of species but rather on the use value and importance of the species (Najem et al. 2019). The high value of FUV can also be caused by the high content of active compounds in those plant family groups that play a role in various biological activities such as antibacterial, anti-inflammatory, antiviral and antioxidant (Najem et al. 2020). This study showed that Zingiberaceae had the highest FUV, meaning that members of the Zigiberaceae family were most widely used

Table 1. Socio-demographic information of the informants (traditional healers or Balians).

Variables	Category	Percentage (%)	Respondent's location (number of respondents)
Age	31-40 years	12.5	DMS (1)
	41-50 years	0	-
	51-60 years	25	DS (2)
	61-70 years	37.5	KBT (1), DMS (2)
	71-80 years	12.5	DDS (1)
	81-91 years	12.5	DBA (1)
Sex	Male	87.5	DMS (3), DS (1), KBT (1), DDS (1), DBA (1)
	Female	12.5	DS (1)
Education level	no formal education	12.5	DBA (1)
	Primary School	37.5	DMS (1), DS (1), DDS (1)
	Junior high school	0	-
	Senior high school	37.5	DS (1), KBT (1), DMS (1)
	university	12.5	DMS (1)

Note: The research location: Kelurahan Banjar Tegal, Buleleng District (KBT); Dusun Bantengan, Ambengan Village, Sukasada District (DB); Dusun Mekar Sari, Panji Village, Sukasada District (DMS); Dusun Darma Semadi, Tukad Mungga Village, Bulleleng District (DDS), Desa Sambangan, Sukasada District (DS), and Dusun Banjar Anyar, Desa Sambangan, Sambangan Village, Sukasada District (DBA).

as medicinal plants. Zingiberaceae, also known as the ginger family, is a group of flowering plants and herbs that contain aromatic compounds in all parts of the plant. This plant contains a variety of secondary metabolites that exhibit a variety of significant biological and pharmacological activities. For example, Zingiber officinale species that are widely used as traditional medicine for various treatments illness include as analgesics, sedatives, antioxidants, antipyretics, antimicrobials, anticancer, anti-inflammatory and anticonvulsant drugs (Tamokou et al. 2017).

Grass et al. (2021) suggested that botanical studies have a close relationship with the selection of plant families that play a role in determining the medicinal plants used in ethnobotany. This comparative study revealed that ethnobotany's most widely used medicinal plant families were Lamiaceae, Asteraceae, Rosaceae, Malvaceae, Adoxaceae, Apiaceae, Amaryllidaceae, Oleaceae, Pinaceae, and Rutaceae. Four families, including Apiaceae, Oleaceae, Pinaceae, and Rutaceae, were grouped as important plant taxa groups. Based on the study results on the diversity of

Table 2. Family Use Value of medicinal plant families in Buleleng Regency, Bali, Indonesia.

NO.	Family	ΣUV	Number of Species n	FUV
1	Acanthaceae	1	1	1
2	Amaryllidaceae	3	2	1.5
3	Annonceae	1	1	1
4	Apiaceae	1	1	1
5	Apocynaceae	2	2	1
6	Araceae	1	1	1
7	Arecaceae	1.5	1	1.5
8	Casuarinaceae	1	1	1
9	Clusiaceae	1	1	1
10	Compositae	2	2	1
11	Crassulaceae	1	1	1
12	Cucurbitaceae	1	1	1
13	Euphorbiaceae	5.67	3	1.89
14	Lamiaceae	3	3	1
15	Lauraceae	1	1	1
16	Leguminosae	2	2	1
17	Loranthaceae	2	2	1
18	Lythraceae	3	1	3
19	Magnoliaceae	2	2	1
20	Malvaceae	3	3	1
21	Menispermaceae	1	1	1
22	Moraceae	1	1	1
23	Moringaceae	1	1	1
24	Myristicaceae	2	2	1
25	Myrtaceae	1	1	1
26	Nymphaeaceae	1	1	1
27	Oxalidaceae	2	2	1
28	Pandanaceae	1	1	1
29	Phyllanthaceae	1	1	1
30	Piperaceae	1.2	1	1.2
31	Poaceae	5.49	5	1.1
32	Polypodiaceae	1	1	1
33	Rosaceae	1	1	1
34	Rutaceae	4	4	1
35	Santalaceae	1	1	1
36	Talinaceae	1	1	1
37	Zingiberaceae	18.84	11	1.71

medicinal plants in Buleleng Regency, Bali, the most widely plant families used by Balians were Zingiberaceae (18.97%), Poaceae (8.62%), Rutaceae (6.90%), Euphorbiaceae, Lamiaceae, Lauraceae, Malvaceae (5.17 each). Therefore, three families of them (Rutaceae, Lamiaceae, and Malvaceae) were included in the theory proposed by Grass et al. (2021).

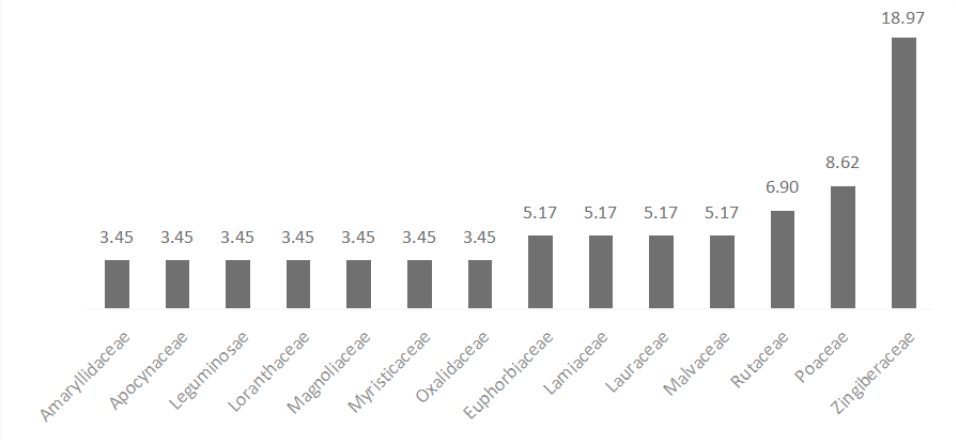


Figure 2. The list of the most important plant families in terms of species used as medicinal plants by Balians in the Buleleng Regency, Bali, Indonesia (% used).

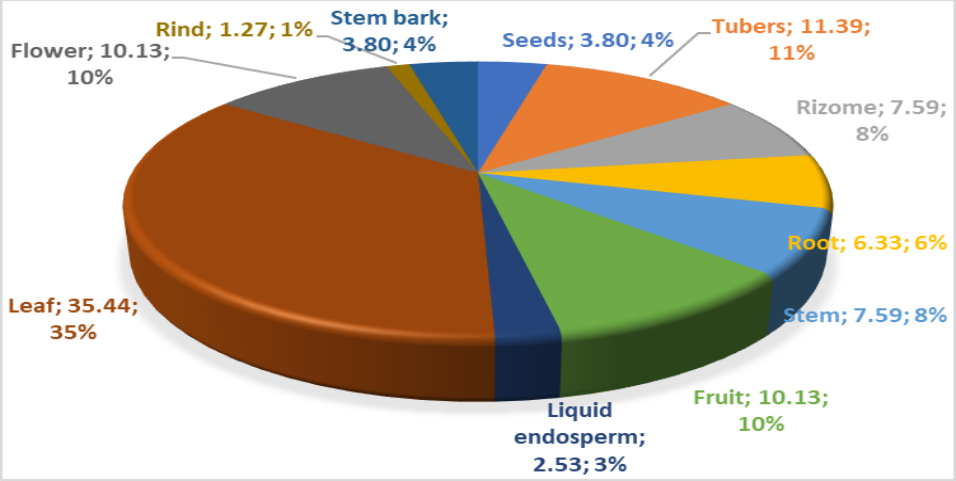


Figure 3. Percentage use of plant parts used as medicinal plants by Balians in the Buleleng Regency, Bali Province, Indonesia.

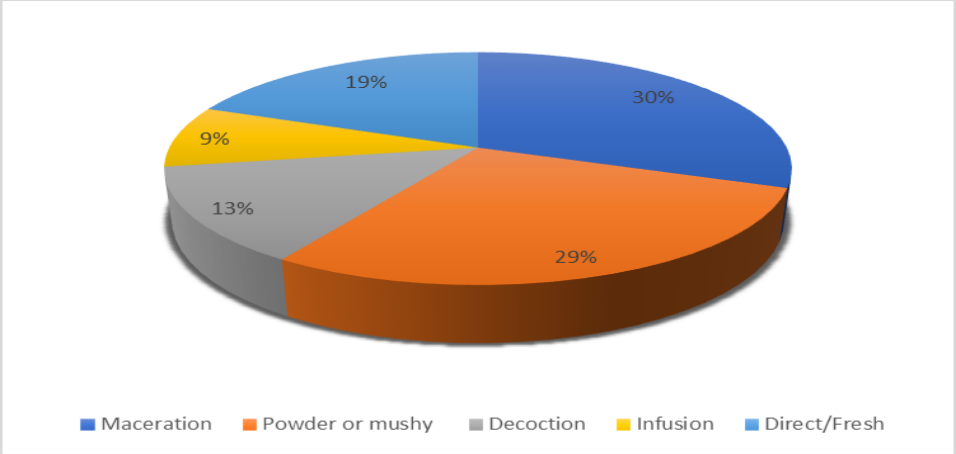


Figure 4. Method of preparing recipes as medicinal plants by Balians in the Buleleng Regency, Bali Province, Indonesia.

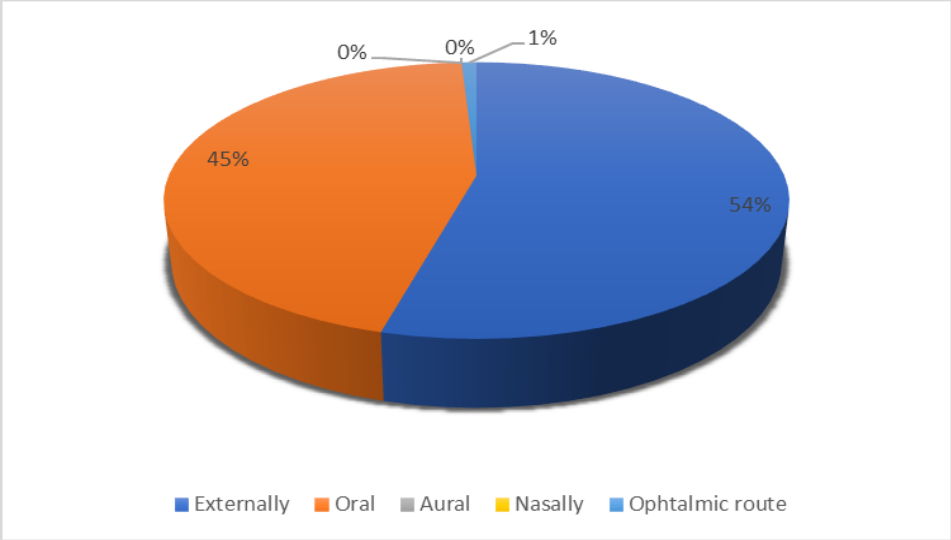


Figure 5. Modes of administration as medicinal plants by Balians in the Buleleng Regency, Bali Province, Indonesia.

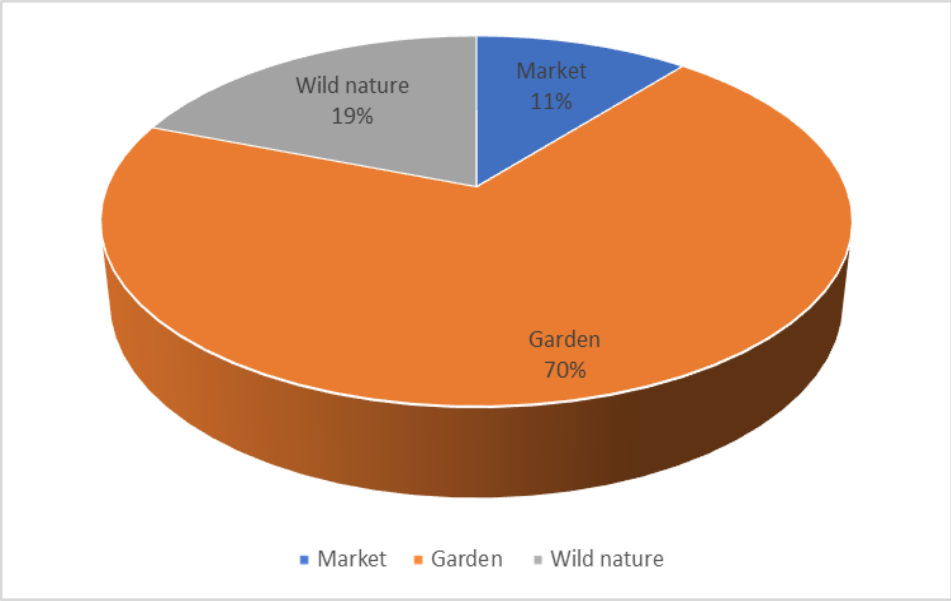


Figure 6. The origin of the medicinal plants used by Balians in the Buleleng Regency, Bali Province.

In Figure 3 was recorded that some parts of the plant were used as ingredients for traditional medicine by Balians in Buleleng Regency, Bali. In most cases, leaves were used (35.44 %) followed by tubers (11.39%), fruits (10.13 %), flowers (10.13 %), rhizomes (7.59 %), stems (7.59 %), roots (6.33 %), seeds (3.80%), stem barks (3.80%), liquid endosperm (2.53%) and rinds (1.27%). The percentage of use of each plant part as herbal medicine by traditional ethnicities varies in various places. However, generally, the leaves are the most widely used part. Elfrida et al. (2021) reported that local communities in Jambur Labu Village, East Aceh, Indonesia, mostly used leaves in herbal medicine ingredients (38%), then followed by fruit (22%), rhizome (8%), roots (7%), sap (3%), stem and tuber (2% each), and seeds (1%). A similar study was reported by Damayanti et al. (2021) on the study of the diversity of medicinal plants on the island of Lombok, which explains that the leaf is the organ that is most widely used compared to other parts such as roots, stems, flowers, fruit or seeds. Leaves are plant organs that are easily obtained and contain many secondary metabolites that are useful for health treatment,

such as flavonoids, phenols, terpenoids, and alkaloids (Tungmunnithum et al. 2018).

Meanwhile the diagram in figure 4 explained about methods of making herbal medicine by Balinese people in Buleleng Regency. According to this study, maceration (30%) and powder or mushy (29%) are the most widely used method. Other preparation methods, such as Direct/ Fresh (20%), Decoction (13%), and Infusion (9%), were also used successively. According to Arsana (2019), in traditional Balinese medicine there are 6 ways of processing drugs, namely; loloh, boreh, sembar or simbuh, tutuh or pepeh, tampel or tempel and Ses. Traditional medicine processing by maceration has a definition similar to "Loloh" which is in the form of concentrated starch liquid obtained by squeezing or grinding and adding a predetermined liquid and its use is drunk. Powder or mushy can be defined as making "boreh" and "tampel". Boreh is a concoction obtained by mashing a mixture of ingredients and in use mixed with liquids such as water, vinegar, or wine. While tampel is a concoction obtained by mashing a mixture of ingredients and in use is attached to the treated part, usually in the centre of the pulse.

Comparative studies on traditional medicinal processing methods that have been carried out by other researchers have shown varying results. Husaain et al. (2018) reported that communities residing in Koh-e-Safaid Range, northern Pakistani-Afghan borders used Decoction as the powerful method of drug preparation, followed by vegetable, powder, infusion, ash, and roast. While people in Lombok Island used Decoction (47%) as the primary mode of herbal medicine preparation (68%). It was followed by other preparation methods such as mashed (20%), chewed (15%), direct application (8%), and etch (Damayanti et al. 2021). A similar study reported by Kachmar et al. (2021) revealed local community in the Northeastern Part of Morocco used Decoction (29.11% and infusion (27.84%) as the most used methods of sample preparation, followed by fresh material (20.25%), powder (17.72%) and etc.

Interestingly, the results of this study revealed that the most common method of drug administration by Balians in Buleleng Regency, Bali Province was the external application (54%), followed by the oral mode (45%) (Figure 5). External application of treatment was carried out by various methods, such as sprayed onto certain parts of the body, applied to the affected area, used as a scrub and applied to the affected part, bathed all over the body or attached to certain body parts. While the application of the drug orally is by drinking it regularly. Higher frequency of traditional medicine external application than orally is not common. Hussain et al. (2018) reported that The administration of traditional medicine that is most often used is the oral intake method.

Curcuma viridiflora (Zingiberaceae) had the highest usability index (UV=4). Then followed by *Z. officinale* (Zingiberaceae), Jatropha gossypiifolia (Euphorbiaceae), Punica granatum (Lythraceae) (each UV= 3), *C. massoy* (Lauraceae) (UV= 2.5), Aleurites moluccanus (Euphorbiaceae), Z. montanum (Zingibercaeae), Michelia alba DC (Magnoliaceae) and A. cepa (Amaryllidaceae) (each UV= 2) (Showed in table 3). Value in use (UV) is an index or measurement widely used in ethnobotany to measure a plant species' relative importance or usefulness. UV is often used to mark the most widely used or most useful plant species. The higher the UV value of a species, it will usually tend to be cultivated more often than wild plants (Assefa et al. 2019).

The interview results revealed that most of the medicinal plants used by Balian in Buleleng Regency (Bali) came from medicinal plants planted in the home garden (70%). While some were taken directly from

nature (wild) (19%), and some were bought in the market (11%) (as shown in Figure 6). Sujarwo & Caneva (2015) reported that tropical home gardens were important sites and had a long tradition for Balinese ethnicity to maintain plant diversity. It had been recorded that more than 20 families and 29 genera were planted in Balinese home gardens. The Zingiberaceae family was the most widely planted, followed by *Poaceae*, *Fabaceae*, *Anacardiaceae*, *Cucurbitaceae*, *Asteraceae*, and *Euphorbiaceae*. The most commonly used were leaves, fruits, tuberous roots, young leaves, and young shoots.

The tradition of planting valuable plants in the home garden from generation to generation is a plant conservation effort that needs to be preserved. The conservation and sustainability of medicinal plants have been studied extensively for decades. However, the use of medicinal plants massively to produce herbal products globally has caused the availability of medicinal plants in nature to decrease significantly from time to time (Hilongan et al. 2018; Posthouwer et al. 2018). Studies reveal that currently the world is losing 100 to 1000 times more plant species than naturally occurring extinctions. This causes the earth to lose at least one crucial medicinal plant every two years (Chen et al. 2016). Therefore, it is highly recommended to carry out plant conservation efforts in-situ (Sun et al. 2022), ex-situ (Kovács et al. 2021), or in cultivation gardens so that the availability of plants in a sustainable manner can be obtained (Shao et al. 2021).

Some of the human diseases and medicinal ingredients used by Balian in Buleleng Regency Bali were described as follows:

a) Convulsions
Formula: Lulur (loloh) is made from *Centella asiatica* (L.) Urb. and *Moringa oleifera* Lam. leaves, chopped and mashed, and rubbed on the patient's feet. If the patient is not conscious, then the patient's lips are rubbed with saliva mixed with *Kaempferia galanga* L. and the front head is sprayed with *Cryptocarya massoy* (Oken) Kosterm. Usually, 1-2 times, the sickness is healed.

b) Itching
Formula: Three pieces of *Piper betle* L. leaves are rolled up and added with coconut oil, salt, "Kesuna Tunggal" (*Allium sativum* L.) and insect house called by local name "Kalisasoan". All ingredients are kneaded and crushed, then applied to the itchy part. During illness, you should not eat eggs and salted fish. Healing happens usually after three days of use.

c) Cramps or tingling
Formula: Lulur (boreh) is made of isen (*Alpinia galangal* (L.) Willd., mesuwi (*Cryptocarya massoy* (Oken) Kosterm), jebug arum (*Myristica fragrans* Houtt.), vinegar or arak, brown rice and singrong. All ingredients are mashed and rubbed on the affected area. Usually, after two days of use, it is healed.

d) Headache
Formula: sprayed water made of mesuwi (*C. massoy*), bangle (*Zingiber purpureum* Roscoe) burned, added with salt, charcoal and water. Use by spraying on the forehead and nape of the patient. Usually, once use the headache is healed. There is a ritual of praying to God (Hyang Widhi) using Banten worship facilities.

e) Black magic (Mental Disorder)
Formula: Three leaves of *Ocimum tenuiflorum* L. mixed with water, allowed standing for 8 minutes and then drunk. There is a ritual by saying 9x Om Nama Ciwaya.

f) Stroke

Formula 1: Lulur (boreh) was made of three-piece *Piper betle* leaves, added a little table salt and lengkuas (*A. galanga*). All these ingredients are mashed and applied all over the patient's body, from the neck to the feet. Most patients recover after 1-3 times of treatment.

Formula 2: Jamu (loloh) is made of ginger (*Z. officinale*), cekuh (*K. galanga*), salam leaves (*Syzygium polyanthum*) and soaked rice. All ingredients are mashed Herbal medicine is drunk in the morning and afternoon as much as half a glass.

Formula 3: Spray water consists of mesuwi (*C. massoy*), isen (*A. galanga*), Ginger (*Z. officinale*), 5 bunga jepun (*Plumeria rubra*) and soaked rice. These materials are crushed (chewed) and then sprayed on the patient's neck. Usually, 3-5 times treatments needed to be healed.

g) Herpes

Formula: Spray water is made from banyan leaves (*Ficus benjamina* L.) and 1 tablespoon of injin (rice naturally black glutinous rice). All the ingredients are mashed or chewed and then sprayed on the affected part of herpes.

h) Tumor/cancer

Formula 1: Herbal medicine (loloh) is made of Belimbing wuluh besi leaves (*Averrhoa carambola* L.), katuk leaves (*Sauropus androgynous* (L.) Merr.), red union (*A. cepa*) and added a little salt. All ingredients are mashed and the herbal medicine is drunk in the morning and afternoon as much as half a glass.

Formula 2: herbal medicine (loloh) made from kepasilan (Lorantaceae), and jeruk kinkit (*Triphasia trifolia* (Burm.f.) P. Wilson, taken 2 times a day until healed.

i) Diabetes

Formula 1: herbal medicine (loloh) is made of Talas Gajah (*Anthurium crystallinum* Linden & Andre) mashed and then filtered. Herbal medicine is taken once a day until healed.

Formula 2: Jamu (loloh) is made of 9 fruitss of *Averrhoa bilimbi* L. and 1 bulb of red onion (*A. cepa*). These materials are boiled in 3 cups of water to 1 cup. Half a glass of herbal medicine is drunk in the morning and evening and continues to be drunk until it heals.

j) Nephropathy

Formula: herbal medicine (loloh) is made from Kecibeling (*Strobilanthes crispa*) leaves (3,7,11). Herbal medicine is drunk once a day until healed.

k) Toothache

Formula 1: three peaces of leaves add a little table salt and pangolin (klesih) oil. All materials were given warm water and used for mouthwash. Most patients recover once get the treatment.

Formula 2: For cavities, put the oil into the cavities using a cotton swab. Usually, twice of use will heal.

l) Broken bones or swollen bones

Formula: herbal medicine (loloh) is made from a mixture of mesuwi (*C. massoy*), turmeric (*Curcuma viridiflora*), onion bulbs (*A. cepa*) and rice that has been soaked in water. This material is mashed and added with the water continues to be filtered. Previously, the patient was massaged using coconut oil.

m) Vomiting blood or bleeding

Formula: Jamu (loloh) is made from a mixture of undis leaves (*Cajanus cajan*), ginger (*Z. officinale*), Cekuh (*K. galanga*) and soaked rice. All ingredients are mashed, continue to be filtered. The fil-

tered results are used as herbal medicine and drunk by the patient. While the dregs are used as a scrub. The scrub is rubbed on the patient's chest and abdomen.

n) Asthma

Formula 1: Jamu (loloh) is made of roasted coconut (*Cocos nucifera*) Ginger (*Z. officinale*), Cekuh (*K. galanga*) roasted, Salam leaves (*Syzygium polyanthum*) 5 pieces and soaked rice. All ingredients are mashed. Herbal medicine is drunk in the morning and afternoon as much as half a glass.

Formula 2: Spraying Water: Isen (*A. galanga*), Ginger (*Z. officinale*), 3 Japanese flowers (*Plumeria rubra*) and soaked rice. All materials were crushed (chewed) and then sprayed on the patient's chest. Usually three times of use the diseases is healed.

o) White vaginal discharge

Formula: Jamu (loloh) consists of Isep nanah/ meniran putih (*Euphorbia thymifolia*) and Isep getih/ meniran merah *(Euphorbia thymifolia*) and red onion (*A. cepa*). These materials are boiled from 3 cups of water to 1 cup. Drank half a glass of herbal medicine in the morning and evening. Usually, 1-3 times of treatment would heal.

Table 3. Medicinal plant species used among the local community of Buleleng Regency, Bali, Indonesia.

No	Scientific name	Origin of Plants	Local name	Part of plant used	usefulness	Location	UV
1	*Aleurites moluccanus* (L.) Willd. (Euphorbiaceae)	garden	Kenari	seed	Tumor, cancer, liver	KBT	2.00
2	*Allium cepa* L. (Amaryllidaceae)	market	Bawang Merah	tubers	Swollen genitals; broken bones or swelling, low appetite, vaginal discharge, diabetes, cancer and tumor	KBT, DSM, DBA	2.00
3	Allium sativum L. (Amaryllidaceae)	garden	Kesuma Tunggal	tubers	Itching / Boils	DMS	1.00
4	*Alpinia galanga* (L.) Willd. (Zingiberaceae)	garden	Isen	rhizome	shortness of breath (asthma), stroke, pinched nerve, vertigo, liver disease, jaundice, poisoning, eye pain, cramps, stroke	KBT, DDS, DMS	1.67
5	*Anthurium Crystallinum (Araceae)*	garden	Keladi Gajah	tubers	Diabetes	DS	1.00
6	*Arcangelisia flava* (L.) Merr. (Menispermaceae)	wild nature	Kayu Kuning	root and stem	hepatitis	DMS	1.00
7	*Areca catechu* L. (Arecaceae)	wild nature	Pinang	fruits	Wound, vertigo	DMS	1.50
8	*Averrhoa bilimbi L. (Oxalidaceae)*	garden	Belimbing Buluh	fruits	diabetes	KBT	1.00
9	Averrhoa carambola L. (Oxalidaceae)	garden	Belimbing Besi	leaves	Tumor and cancer	KBT	1.00
10	*Blumea balsamifera* (L.) DC. (Compositae)	garden	Daun sembung	leaves	Liver	KBT	1.00
11	*Bryophyllum pinnatum* (Lam.) Oken (Crassulaceae)	garden	Cocor Bebek	leaves	Diabetes	DDS	1.00

Table 3. Contd.

No	Scientific name	Origin of Plants	Local name	Part of plant used	usefulness	Location	UV
12	*Cajanus cajan* (L.) Millsp. (Leguminosae)	garden	Daun Undis	leaves	Blooding	KBT	1.00
13	*Calotropis gigantea* (L.) Dryand. *(Apocynaceae)*	market	Bunga Meruri Putih	seed	Mental disorder and stroke	DDS	0.50
14	*Cananga odorata* (Lam.) Hook.f. & Thomson (*Annonceae*)	garden	Sandat Bali	flower	Breast cancer	DB, DDS	1.00
15	*Casuarina junghuhniana* Miq. (Casuarinaceae)	garden	Cemara Angin	leaves	Mental disorder		1.00
16	*Centella asiatica (L.) Urb. (Apiaceae)*	Wild nature	Pegagan	leaves	bladder disorders and convulsions	DMA, DBA	1.00
17	*Citrus aurantiifolia* (Christm.) Swingle (Rutaceae)	garden	Jeruk Nipis	fruits	Kidney stones	DDS	1.00
18	*Citrus medica* L. (Rutaceae)	garden	Jeruk Lengis	fruits	Stroke	DDS	1.00
19	*Cocos nucifera* L. (Poaceae)	garden and market	Kuud	fruits	Shortness of breath (asthma), teeth, haemorrhoids, mental disorder, diabetes, itching, ulcers, breast cancer, broken bones, swelling, bladder disorder	KBT, DMS, DDS,DS, DB,DBA	1.09
20	*Cryptocarya massoy (Oken) Kosterm. (Lauraceae)*	garden	Mesuwi	stem and leaves	fractures or swelling, cramping and headache	DBA	2.50
21	*Curcuma aeruginosa* Roxb. (Zingiberaceae)	garden	Temu Ireng	rhizome	Stroke	DDS	1.00
22	*Curcuma longa* L. (Zingiberaceae)	garden	Warangan	rhizome	Stroke	DDS	1.00
23	*Curcuma purpurascens* Blume (Zingiberaceae)	garden	Temu Tis	rhizome	Liver disease, hepatitis, poisoning	DDS	3.00
24	*Curcuma viridiflora* Roxb. (Zingibercaeae)	garden	Kunyit	rhizome	Swollen genitals; broken bones or swelling, pain in the navel or black magic	KBT, DBA	4.00
25	*Curcuma zedoaria* (Christm.) Roscoe (Zingiberaceae)	garden	Temu Putih	rhizome	Stroke	DDS	1.00
26	*Cymbopogon citratus* (DC.) Stapf (Poaceae)	garden	Sereh	stem	Diabetes	DDS	1.00
27	*Drymoglossum piloselloides* (L.) M.G. Price. *(Polypodiaceae)*	wild nature	Paku Naga	leaves	Herpes	DBA	1.00
28	*Erythrina variegata* L. (Luguminocae)	garden	Daun Dadap Sakti	leaves	stroke	DDS	1.00
29	*Euphorbia thymifolia* L. *(Euphorbiaceae)*	garden	Isep Getih	leaves	Fluor albus/ white discharge	KBT, DMS	0.67

Table 3. Contd.

No	Scientific name	Origin of Plants	Local name	Part of plant used	usefulness	Location	UV
30	*Ficus benjamina L. (Moraceae)*	garden	Beringin	leaves	itchy	DS	1.00
31	*Garcinia × mangostana* L. (Clusiaceae)	garden and market	Manggis	rind	haemorrhoid	DMS	1.00
32	*Imperata cylindrica* (L.) Raeusch. (Poaceae)	wild nature	Pucuk Ilalang	leaves	Swollen genitals	DBA	1.00
33	Jatropha gossypiifolia L. (Euphorbiaceae)	wild nature	Jarak keliki	leaves	Liver disease, hepatitis, poisoning	DDS	3.00
34	Kaempferia galanga L. (Zingibercaeae)	garden	Cekuh	rhizome	vomiting blood, asthma, stroke, pinched nerves and convulsions	DMS	1.67
35	*Kleinhovia hospita* L. (Malvaceae)	garden	Ketiman	leaves	Mental disorder	DDS	1.00
36	Knema cinerea Warb. (Myristicaceae)	wild nature	Jelema	stem bark	stroke	DDS	1.00
37	*Kaempferia galanga* L. (Zingibercaeae)	garden	Cekuh	rhizome	vomiting blood, asthma, stroke, pinched nerves and convulsions	DMS	1.67
38	*Magnolia champaca* (L.) Baill. ex *(Magnoliaceae)*	garden	Bunga Cempaka Merah	flower	Breast cancer	DB	1.00
39	*Michelia alba* DC (Magnoliaceae)	garden	Cempaka Putih	flower	Breast cancer	DB, DDS	2.00
40	*Momordica balsamina* L. (Cucurbitaceae)	garden	Paye Puuh	leaves	Mental disorder	DMS, DDS	1.00
41	*Moringa oleifera* Lam. (Moringaceae)	garden	Daun Kelor	leaves	Mental disorder, convulsions	DMS	1.00
42	*Murraya paniculata* (L.) Jack (Rutaceae)	Wild nature	Kemuning	leaves	Impotent	DDS	1.00
43	*Myristica fragrans Houtt. (Myristicaceae*	market	Jebug Arum	fruits	cramps and tingling	DMS	1.00
44	*Nymphaea alba* L. (Nymphaeaceae)	garden	Bunga Tunjung Putih	flower	Mental disorder	DDS	1.00
45	*Ocimum tenuiflorum L. (Lamiaceae)*	garden	Daun Tulasi	leaves	Black magic	DMS	1.00
46	*Oryza sativa* L. (Poaceae)	market	Padi	seed	Mental disorder, Vomiting blood or bleeding, Asthma, Cramping/tingling, Breast cancer, fractures or swelling	DBA	1.40
47	*Pandanus amaryllifolius* Roxb. (Pandanaceae)	garden	Pandan harum	leaves	Liver disease	KBT	1.00
48	*Piper betle* L. (Piperaceae)	garden	Sirih	leaves	insomnia, sores, itching, boils, stroke and herpes, toothache	DSM, DS, DBA	1.20
49	Plectranthus amboinicus (Lour.) Spreng. (Lamiaceae)	wild nature	Don ginten	leaves	Heat or fever, backache	DBA	1.00

Table 3. Contd.

No	Scientific name	Origin of Plants	Local name	Part of plant used	usefulness	Location	UV
50	*Plumeria rubra L. (Apocynaceae)*	garden	Bunga Jepun	flower	shortness of breath (asthma), stroke, pinched nerve	KBT	1.50
51	*Punica granatum* L. (Lythraceae)	garden	Dalima Wanta	leaves	Liver disease, hepatitis, poisoning	DDS	3.00
52	*Rosa chinensis* Jacq. (Rosaceae)	garden	Mawar Merah	flower	Mental disorder	DDS	1.00
53	*Saccharum spontaneum* L. (Poaceae)	Wild nature	Agar Gelagah	root	Diabetes	DDS	1.00
54	*Bombax ceiba* L. (Malvaceae)	Wild nature	Randu Alas	stem bark	Stroke	DDS	1.00
55	*Santalum album* L. (Santalaceae)	garden	Asaban Cendana	fruits	Mental disorder	DDS	1.00
56	*Sauropus androgynus* (L.) Merr. (Phyllanthaceae)	garden	Daun Katuk	leaves	Tumor and cancer	KBT	1.00
57	*Sterculia foetida* L. (Malvaceae)	garden	Kayu Kepuh	stem bark	Stroke	DDS	1.00
58	*Strobilanthes crispa* Blume (Acanthaceae)	garden	Kecibeling	leaves	Kidney stones	DS	1.00
59	*Syzygium polyanthum* (Wight) Walp. (Myrtaceae)	garden	Daun Salam	leaves	shortness of breath (asthma)	KBT	1.00
60	*Talinum paniculatum* (Jacq.) Gaertn. (Talinaceae).)	garden	Temu Ginseng	tubers	Stroke	DDS	1.00
61	*Tagetes erecta* L. (Compositae)	garden	Bunga Mitir	flower	Tumor or cancer	KBT	1.00
62	*Triphasia trifolia (Burm.f.) P.Wilson (Rutaceae)*	garden	Jeruk Kinkit	fruits	Cancer	DS	1.00
63	*Vitex trifolia L. (Lamiaceae)*	wild nature	Liligundi	root, stem, leaves,fruits, flower	Impotent	DDS	1.00
64	*Zingiber montanum (J.Koenig) Link ex A.Dietr (Zingibercaeae)*	garden	Bangle	rhizome	Headache and chills	DMS	2.00
65	Zingiber officinale Roscoe (Zingiberaceae)	garden	Jahe	rhizome	Vomiting blood, asthma, stroke or pinched nerves	KBT	3.00
66	Zingiber purpureum Roscoe *(Zingiberaceae*)	garden	Gamongan	rhizome	Tumor, cancer, breast cancer	KBT, DB	1.50

Note: Kelurahan Banjar Tegal, Buleleng subdistrict (KBT); Dusun Bantengan, Ambengan village, Sukasada subdistrict (DB); Dusun Mekar Sari, Panji Village, Sukasada subdistrict (DMS); Dusun Darma Semadi, Desa Tukad Mungga, Bulleleng Subdistrict (DDS), Desa Sambangan, Sukasada subdistrict (DS), Dusun Banjar Anyar, Sambangan village, Sukasada subdistrict (DBA).

CONCLUSIONS

Zingiberaceae, Poaceae, Rutaceae, Euphorbiaceae, Lamiaceae, Lauraceae, Malvaceae are the most widely used plant families by the Balinese as traditional medicinal ingredients. The leaves were the most widely used, followed by tubers, fruits and other parts. While maceration and powder or mushy were the main ways of making herbal medicine and external application is the most common way of administering drugs. Various types of diseases could be treated, including: convulsions, itching, cramps, headaches, black magic, stroke, herpes, tumours/cancer, etc. Thus, ethnobotanical data on medicinal plants is important information for the development of new drugs and needs to be preserved. Balinese people have had conservation awareness from generation to generation where most of these medicinal plants are planted in the home gardens.

AUTHOR CONTRIBUTION

P.S.A.: Research designing, writing the first draft of the manuscript, data analysis, conceiving and supervising the research. I.G.T.: Interviewing informants, plant collection. T.W.: Voucher species preparation, literature research. S.: data analysis, literature research. All authors approved the final version of the manuscript.

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CONFLICT OF INTEREST

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