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Ethnobotanical study of *Loloh*: Traditional herbal drinks from Bali (Indonesia)

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ABSTRACT

Ethnopharmacological relevance: Loloh are herbal drinks produced and consumed exclusively in Bali (Indonesia) to prevent and treat different ailments. This is the first study to document plants species used as *Loloh*, reporting the phytochemical components and pharmacological properties of the most cited plants. Documenting the plants used in herbal drinks in Bali by local communities to treat various ailments (providing some information on phytochemistry and pharmacology of the most interesting plants).

Materials and methods: Ethnobotanical data were obtained through semi-structured interviews (individual and group discussions) and questionnaires. Plant specimens were collected, identified and made into herbarium vouchers.

Results: A total of 51 plants species (belonging to 32 families) have been documented for their use in the various preparation of *Loloh*. Different plants and plant parts are used to prepare *Loloh* to treat heartburn, fever, diarrhea, hypertension, aphthous stomatitis (canker sores), and other minor health problems. These plants are mainly prepared as decoctions, are juiced or simply added to the preparation. The most cited plants (> 30 informants) are *Alstonia scholaris* (L.) R. Br., *Blumea balsamifera* (L.) DC., *Cinnamomum burmanni* Nees ex Bl., and *Piper betle* L. These plants are well studied with multiple demonstrated pharmacological activities (e.g., antimicrobial, anticancer, antidiabetic).

Conclusion: The Balinese communities still preserve a rich ethnobotanical knowledge. Several species are well known for their pharmacological properties, but some [such as *Pneumatopteris callosa* (Blume) Nakai and *Dendrocnide stimulans* (L. f.) Chew] are understudied and could be promising candidates for further research.

1. Introduction

Herbal beverages, such as herbal teas, juices and decoctions are consumed either for recreational or curative purposes (Volpato and Godínez, 2004; Joubert et al., 2008; Sõukand et al., 2013). Most of the research on herbal beverages is focused on herbal teas, and specifically on issues of contamination (e.g., Naithani and Kakkar, 2005; Romagnoli et al., 2007), but also on their phytochemical profile or pharmacological activities (e.g., Atoui et al., 2005; Apak et al., 2006; Büyükbalci and El, 2008). Ethnobotanical research focused on herbal medicinal beverages and drinks other than teas is surprisingly limited (e.g., Rana et al., 2004; Volpato and Godínez, 2004; Pardo de Santayana et al., 2006; Gogoi et al., 2013).

Indigenous medicinal knowledge in Indonesia is quite extensive, due to the considerable diversity of local cultures (Whitten et al., 1996; Leurs, 2010; Sujarwo et al., 2014). The rich culture and ethnobotanical knowledge of the Bali *aga* ethnic group, the indigenous people that live on the island of Bali (Astuti et al., 2000; Sujarwo et al., 2014), represents an example of this diverse cultural heritage. According to a study carried out about twenty years ago, the Balinese have been using more than 490 plant species for medicinal purposes (Tengah et al., 1995), and this number is

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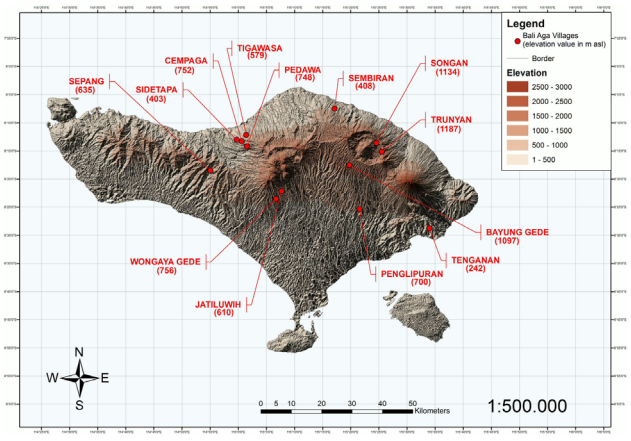

Fig. 1. Map of Bali showing the location of the surveyed villages. Villages are located on the coast and inland, at different altitudes.

Fig. 2. The ancient village of Penglipuran (Bangli regency).

particularly high considering that the flora of Bali consists of 1768 species of vascular plants (Girmansyah et al., 2013).

The utilization of plants for preparing herbal drinks in Bali is an old local tradition. One of the most common herbal drinks is *Loloh*, which are generally prepared as decoctions of plants and are commonly used to treat a variety of ailments (Liu et al., 2013). Plant material may consist of leaves, fruits, sap, rhizomes, bark, stem, flowers, and seeds from a single species or multiple species, collected from the surrounding forests.

Bali started its transformation from a predominantly rural area with lush lowland tropical rainforests to an area with densely-crowded tourist facilities in the 1960s (Pringle, 2004). The island is still covered by relatively large areas of tropical rainforests, particularly in the western part. These forests constitute the sources for the Balinese herbal preparations and allow for the continuation of local traditions.

Balinese people believe that all diseases can be cured with the help of nature, and this way of thinking is based on the interpretation and understanding of natural phenomena. In the same manner as Javanese people, and other cultures, the Balinese also believe that God has provided medicines for all diseases. Therefore, it is part of the Balinese culture to look for medicinal plants to relieve health problems (Riswan and Sangat-Roemantyo, 2002).

In Bali, as in many other regions of the world, herbal remedies remain the cornerstone of treatment of the majority of diseases (Neame and Pillay, 1964; Rates, 2001; Liu et al., 2013). Despite the fact that synthetic medical products have become common since the beginning of the 20th century (Manteiga et al., 1997; Liu et al., 2013), the use of folk remedies is still high in Indonesia, and especially in Java and Bali (Tengah et al., 1995; Astuti et al., 2000; Roosita et al., 2008; Sujarwo et al., 2014).

In the last few decades, there has been an increased interest in natural products that have medicinal properties, mainly those of plant origin (e.g., Rates, 2001; Schippmann et al., 2002; Poonam and Singh, 2009; Liu et al., 2013). This is especially true for tropical plants, such as those growing in forests located within the Pacific Rim. Only recently, researchers have started to investigate the pharmacological properties of these tropical plants (Wiart, 2006a, 2006b).

The aims of this study are to document, for the first time, the uses of plant species for preparing the well-known traditional herbal drinks named *Loloh*, and contribute to a better understanding of the Balinese folk medicine and traditional knowledge of plants. A further aim of this paper is to provide information on the pharmacological properties of the most commonly used plants in the preparation of *Loloh* and to highlight those for which information is poor or lacking.

2. Materials and methods

2.1. Study area and climate

A total of 13 *Bali Aga* villages in Bali were surveyed (S 07°54′–08°50′ and E 114°26′–115°43′; elevation 242-1187 a.s.l.) (Fig. 1). These villages were Cempaga, Pedawa, Sembiran, Sepang, Sidetapa, Tigawasa, Jatiluwih, Wongaya Gede, Bayung Gede, Penglipuran, Songan, Trunyan, and Tenganan located in different regencies (Buleleng, Tabanan, Bangli and Karangasem) (Fig. 2). People living in these villages generally maintain a traditional lifestyle and have access to forests or natural areas (about the 18% of the island is still covered by forests; Badan Pusat Statistik, 2013). Bali has a tropical climate with a bimodal seasonality (dry season from May to October and rainy season from November to April). The total annual rainfall can vary across the island spanning from around 1200 to around 3700 mm. The average annual temperature can also vary throughout the year, and ranges from 23 to 33 °C.

2.2. Interviews and data collection

Information on the use of *Loloh* was obtained through interviews. These interviews were carried out with 50 informants between May and July 2013. Different kinds of interviews were used, including personal interviews, group discussions, with selected strata of informants, and structured questionnaires (Alexiades and Sheldon, 1996; Poonam and Singh, 2009). Before each interview, Prior Informed Consent was requested and throughout the study international codes of ethics were respected. After obtaining consent, various strata of participants (farmers, village leaders, religious leaders, and traditional healers) were interviewed. The age of the selected informants ranged between 14 and 78 years (for underage informants, prior permission was obtained from parents). A detailed analysis of the factors (e.g., age, gender, education level) affecting differences in traditional knowledge of plant uses in the surveyed villages is provided in Sujarwo et al. (2014). Even though male informants were far more numerous than female informants, *Loloh* is generally prepared by women. The low number of women in our sample size is a reflection of the predominant role of men in Bali's traditional culture, especially in rural areas. Because men tend to dominate all aspects of daily life, women tend to be less confident in providing information.

At least four informants per village were interviewed. Informants were asked to provide a list of plants (wild or cultivated) used to prepare traditional herbal drinks in their village. Informants were also asked to provide information on the medicinal uses of those plants (vernacular name, plant parts used, ailments, and mode of preparation). The plants were collected with the informants and then identified by the first author and professional

experts of the Bali Botanical Garden. Scientific names of the plant species were verified using online sources (e.g., The Plantlist, 2014). Voucher specimens were deposited at the *Herbarium Hortus Botanicus Baliense* in the Bali Botanical Gardens (Indonesian Institute of Sciences). For each species, the authors reviewed available literature for phytochemical profile and pharmacological properties using scientific databases (such as ScienceDirect, Google Scholar).

3. Results

3.1. Plant species used in traditional Balinese herbal drinks

The ethnobotanical surveys led to the identification of 51 plant species used for the preparation of *Loloh*. These plants belong to 32 families (the Zingiberaceae being the most represented family) and 48 genera (Table 1). Thirty types of ailments are treated using the species of plants recorded in this current study; the most cited ailment is heartburn (Table 1 and Fig. 3). In a few cases, informants indicated different uses of these plants (e.g., food uses), and these are also provided in Table 1.

The plant parts, which are harvested to prepare the traditional herbal drinks, are listed in Fig. 4, with leaves being the most frequently used. The result of this study suggests that aerial plant parts (87%) are preferred to underground parts (13%); this may be due to the easier accessibility in harvesting the plant sources (Cunningham, 2001).

3.2. Preparations and prescriptions

Herbal drinks are generally prepared using simple procedures. The principal modes of preparation are decoction (70%) or juice (21%), while in some cases, liquids contained in the plants are consumed directly (5%). In some cases, the plants have additional uses, for example, external use as a paste (4%) (Table 1). The juice is extracted from plant parts using traditional simple techniques which involve grinding with a flat stone or pestle; the juice is then filtered by twisting the plant materials in a clean cloth. Decoctions are prepared by simply boiling the mixture of plant parts and cold water on a traditional stove. Plants are often used fresh. In case they need to be dried, our informants reported that drying the plant materials in direct sunlight may damage the “good ingredients” (the medicinal properties), thus it is generally avoided.

Although most preparations were obtained from a single plant species, in some cases mixtures with secondary species were also mentioned. Some of these secondary species are not reported in Table 1, others are listed as they constitute the main ingredient of another preparation. As an example, a decoction of leaves of *Piper betle* and rhizomes of *Zingiber montanum* (J. Koenig) Link ex A. Dietr. is prepared for sore throat; a decoction of the bark of *Alstonia scholaris* and bark of *Erythrina hypaphorus* is used for diarrhea, heartburn, and for stimulating appetite; a decoction of the leaves of *Spondias pinnata* and *Alpinia galanga* (L.) Willd. is used for heartburn. In some cases, the Balinese people add palm sugar, coconut water, or salt to improve the acceptability of *Loloh* drinks.

3.3. Phytochemical profile

All the most cited plants have many documented pharmacological activities and are well studied for their chemical profiles (Table 2). For example, in *A. scholaris* more than 400 different compounds have been isolated and the plant is very rich in alkaloids, and contains also steroids, flavanoids and triterpenoids (Baliga, 2012). *Blumea balsamifera* contains more than 100 known compounds (Pang et al., 2014). *A. scholaris*, *B. balsamifera*, *Cinnamomum burmanni*, and *Piper betle* all have many ethnobotanical uses in several folk pharmacopeias (e.g., Meena et al., 2011; Al-Dhubiab, 2012; Pang et al., 2014).

Some plants have documented ethnomedicinal uses in several tropical regions but are understudied for their potential pharmacological activity (Table 3). For example, *Lygodium circinatum* is used to neutralize snake venom, for insect bites, eye infections and wounds (Puri, 1970; Baltrushes, 2006; Samuel et al., 2010), and has only been studied for a moderate antioxidant activity (Lai and Lim, 2011) and an α-glucosidase inhibitory activity (oleanolic acid) (Van Kiem et al., 2013). *Pneumatopteris callosa* has never been studied for pharmacological activities or its phytochemistry.

4. Discussion

Living in the center of one of the most diverse tropical rainforest regions (i.e., the Flora Malesiana), the Balinese people have a deep knowledge and respect for their environment. They are superb in identification, harvesting, processing, and using the sources of plant materials for their traditional herbal drinks. The results of this current study contribute to increasing the knowledge on plants used for preparing herbal drinks and support previous studies documenting a general rich ethno-medicinal knowledge (Tengah et al., 1995; Astuti et al., 2000; Leurs, 2010). This knowledge, through continuous practice, has been carefully preserved through generations by Balinese shamans or *balian usada* and religious leaders (Hobart, 1990). Unfortunately, the young generations of Balinese (particularly those who live in the cities and have a higher education) nowadays prefer modern western medicine. Nevertheless, the people (including younger generations) that live in villages or rural areas still prefer herbal medicines, including *Loloh*, as they are relatively cheaper, easily available, and can be used directly (i.e., self-treatment). Young informants learn how to prepare *Loloh* from family members, even though their mothers are generally the ones who prepare *Loloh* for them. In some of the investigated villages (e.g., Sembiran and Songan) the migration of younger generations in search of jobs, the increased globalization and industrialization of agriculture potentially affected the persistence of traditional knowledge of plants. On the other hand, in the villages of Panglipuran and Bayung Gede, traditional knowledge of plants provides for some family income being *Loloh* of significant commercial value.

In *Loloh*, leaves constitute the most important ingredient. Leaves are easily accessible and there is a belief that leaves may possess a strong medicinal value (Singh and Lal, 2008; Poonam and Singh, 2009); this belief is recorded in ancient medicinal scripts such as *Ayurveda* in India (Sharma, 2008) and *Taru Pramana* in Bali (Worsley, 1972; Hobart, 1990). With some preparations (such as decoctions or juices) people also mix palm sugar (obtained from cooked sap harvested from the inflorescences of *Arenga pinnata* or *Cocos nucifera* L.), salt, and coconut water in order to enhance their acceptability but also the properties of the herbal drinks. The *Aren* (*Arenga pinnata*) and coconut (*Cocos nucifera*) are two species of palms that are both abundant in Bali and play important roles in the Balinese culture. Besides the use of *Aren* as a source of sugar (known in Balinese as *gula aren* or *gula Jawa*), the plant is also used to produce a liquor (obtained from the fermentation of sap) known in Balinese as *tuak* (which is also consumed by the Javanese, Sundanese, and various other tribes in Indonesia, including the Malay and Batak). *Aren* are also harvested for their stems as an important source of starch (the Balinese, Javanese, and Sundanese *sago*; the eastern Indonesians *sago* is mainly harvested from a different plant species, *Metroxylon sagu* Rottb.). Moreover, the *sada*, which is the main mid-rib of the leaves of *Aren*, is used for making brooms with claimed magical powers for use in demoniac expulsion (Belo, 1949; Koentjaraningrat, 1985).

Table 1
Plant species used for preparing Loloh. The life form, vernacular names, plant parts, description of the use, number of informants and the village are also provided. Plants might have other uses besides the preparation of *Loloh* (e.g., food uses); when provided by the informants, these uses are also listed.

Plant families & species (life form), [voucher specimen code]	Vernacular names	Parts used & medicinal use	Number of informants	Villages
Acanthaceae				
Andrographis paniculata (Burm. f.) Nees (**Shrub**) [WS03]	Sambiroto	Decoction of leaves for fever, hypertension, urolithiasis, diarrhea, malaria, diabetes	20	Pd, Sd, Sm, Sp, Tg, Tw, Wg
Graptophyllum pictum (L.) Griff. (**Shrub**) [WS23]	Temen	Decoction of leaves for fever, cough	3	Tr
Strobilanthes crispa Blume (**Shrub**) [WS45]	Pecah beling, keji beling	Decoction of leaves for curing kidney stones	2	Wg
Anacardiaceae				
Spondias pinnata (L. f.) Kurz (**Tree**) [WS44]	Kecemcem, cemceman	Juice of leaves for heartburn, urolithiasis, diabetes	7	Pg, Tg
Apocynaceae				
Alstonia scholaris (L.) R. Br. (**Tree**) [WS01]	Pule	Raw sap used for treating malaria; decoction of leaves used for diarrhea, fever, heartburn, and for stimulating the appetite; decoction of bark used as a diuretic, for treating infections, heartburn, diarrhea, rheumatic pain, cough, malaria, and for stimulating the appetite	33	Cm, Jt, Pd, Sd, Sg, Sm, Sp, Bg, Tr, Tw
Araliaceae				
Trevesia sundaica Miq. (**Tree**) [WS47]	Daun pelindo	Decoction of leaves for heartburn	1	Pd
Hydrocotyle sibthorpioides Lam (**Herb**) [WS26]	Semanggi	Decoction of leaves for stimulating the appetite	3	Cm, Tw
Arecaceae				
Arenga pinnata (Wurmb) Merr. (**Tree**) [WS05]	Jaka, aren, buah beluluk	Decoction of roots for urolithiasis	6	Sd, Sp
		The fruit is boiled and eaten	36	Bg, Cm Jt, Pd, Pg, Sd, Sp, Wg, Tg, Tw
		The inner stems are eaten as staple food	36	Bg, Cm Jt, Pd, Pg, Sd, Sp, Wg, Tg, Tw
Asteraceae				
Blumea balsamifera (L.) DC. (**Shrub**) [WS08]	Daun sembung/ berere	Decoction of leaves for diarrhea, fever, heartburn, constipation	44	Bg, Cm, Pd, Pg, Sd, Sg, Sm, Sp, Tg, Tr, Tw, Wg
Cyanthillium cinereum (L.) H. Rob. (**Shrub**) [WS48]	Sembung sotong	Decoction of leaves for heartburn, and for stimulating the appetite	2	Sp
Casuarinaceae				
Casuarina junghuhniana Miq. (**Tree**) [WS09]	Cemara geseng	Decoction of sap for diarrhea	8	Jt, Tr
Cucurbitaceae				
Momordica charantia L. (**Climber**) [WS30]	Paya puuh, paya tanduk	Decoction of leaves for heartburn	2	Wg
		The cooked fruit is added to vegetable soups	2	
Euphorbiaceae				
Antidesma bunius (L.) Spreng. (**Tree**) [WS04]	Buni	Decoction of leaves for fever and diarrhea	5	Pg, Wg
		Ripen fruit is eaten fresh	19	Cm, Pg, Sd, Sm, Sp, Tw, Wg
Jatropha curcas L. (**Shrub**) [WS27]	Jarak	Decoction of leaves for diarrhea, and as a diuretic; a paste is made with the sap and is used for aphthous stomatitis	9	Pg, Pw, Sp, Sg, Tg
Fabaceae				
Lablab purpureus (L.) Sweet (**Climber**) [WS19]	Komak, kancing landa	Decoction of leaves for fever, cough, and diarrhea	9	Pg, Tr, Sm
		Cooked leaves and seeds are added to vegetable soups	19	Cm, Pg, Sd, Sg, Sm, Tr
		Boiled seeds are eaten	19	Cm, Pg, Sd, Sg, Sm, Tr
Erythrina hypaphorus Boerl. ex Koord. (**Tree**) [WS20]	Dadap tis	Decoction of leaves for heartburn, a paste is made with the sap and is used for aphthous stomatitis	1	Sp
		Cooked young leaves are added to vegetable soups	1	Sp
Lamiaceae				
Orthosiphon aristatus (Blume) Miq. (**Shrub**) [WS32]	Kumis kucing	Decoction of leaves and flowers used as a diuretic, and for treating hypertension, and urolithiasis	13	Cm, Pg, Sd, Sp, Tw, Wg
Vitex trifolia L. (**Shrub**) [WS49]	Lili gundi	Decoction of leaves for skin allergies	2	Tr
Lauraceae				
Cinnamomum burmanni (Nees & T.Nees) Blume (**Tree**) [WS11]	Kayu manis	Decoction of leaves for heartburn, fever, cough, sore throat, hypertension, and for stimulating the appetite	33	Bg, Cm, Sd, Sg, Sm, Sp, Tw, Tg, Tr, Wg
		The bark is used as spice	33	Bg, Cm, Sd, Sg, Sm, Sp, Tw, Tg, Tr, Wg
Lygodiaceae				
Lygodium circinatum (Burm. f.) Sw. (**Climber**) [WS29]	Paku ata	Decoction of leaves is used as a preventive medicine after labor	2	Pd
Lythraceae				

Table 1 (*continued*)

Plant families & species (life form), [voucher specimen code]	Vernacular names	Parts used & medicinal use	Number of informants	Villages
Punica granatum L. (**Shrub**) [WS40]	Delima	The juice obtained from roots, fruits, and leaves is used for dysentery	1	Sg
		Ripen fruit is eaten fresh	3	Sg, Sm
Mackinlayaceae				
Centella asiatica (L.) Urb. (**Herb**) [WS10]	Paiduh	Decoction of leaves for cough, fever, heartburn, diarrhea, aphthous stomatitis, sore throat, dysentery	26	Bg, Cm, Jt, Pg, Sd, Sp, Tg, Wg
Malvaceae				
Hibiscus rosa-sinensis L. (**Shrub**) [WS24]	Daun pucuk	Juice of leaves is used to facilitate labor	14	Cm, Sd, Sp, Tr, Tw
Hibiscus tilliaceus L. (**Tree**) [WS25]	Waru	Juice of leaves is used for dysentery, fever, and for facilitating labor	8	Cm, Jt, Sg, Sp, Tw
Sida rhombifolia L. (**Shrub**) [WS43]	Selegui	Decoction of roots is used for beriberi, and cough with phlegm	2	Sp
Meliaceae				
Azadirachta indica A. Juss. (**Tree**) [WS07]	Intaran, mimba, mimbo	Decoction of leaves, barks, and fruits is used as a diuretic and for heartburn, diabetes, headache, and for stimulating the appetite	7	Sm, Tg, Tw
Menispermaceae				
Anamirta cocculus (L.) Wight & Arn. (**Climber**) [WS02]	Kantawali	Decoction of the stem for diarrhea	2	Sm
Cyclea barbata Miers (**Climber**) [WS16]	Daluman kebo, sidaluman	Decoction of leaves for fever, nausea, heartburn, headache	5	Jt, Sd
Moraceae				
Artocarpus heterophyllus Lam (**Tree**) [WS06]	Nangka	Decoction of leaves for diarrhea	1	Jt
		Cooked young fruits and seeds are added to vegetable soups	46	Bg, Cm, Jt, Pd, Pg, Sd, Sm, Sp, Tg, Tr, Tw, Wg
Ficus drupacea Thunb. (**Tree**) [WS21]	Bunut	Decoction of the bark is used for rheumatic pain and heartburn	3	Tr
Morus alba L. (**Tree**) [WS31]	Kayu besar, ononam	Decoction of leaves for hypertension	1	Wg
		Cooked leaves are added to vegetable soups	7	Tg, Wg
Myrtaceae				
Syzygium samarangense (Blume) Merr. & L. M. Perry (**Tree**) [WS46]	Jambu merah	Decoction of leaf tips for diarrhea	3	Tr
		Ripen fruits are eaten fresh	3	Tr
Pandanaceae				
Pandanus amaryllifolius Roxb. (**Shrub**) [WS34]	Pandan harum	Decoction of leaves for rheumatic pain and as a sedative (relaxing the nerves)	4	Tr
Phyllanthaceae				
Phyllanthus niruri L. (**Herb**) [WS35]	kemeniran, menirang	Decoction of leaves for fever, and for treating kidney stones	6	Jt, Tr
Sauropus androgynus (L.) Merr. (**Shrub**) [WS42]	Kayu manis, daun katup, katuk	Decoction of leaves used for heartburn, and for cleaning the blood	7	Pg, Sp
		Cooked leaves are added to vegetable soups	7	Pg, Sp
Piperaceae				
Piper betle L. (**Climber**) [WS37]	Base, sirih	Decoction of leaves for preventing body odor, and for treating diarrhea, sore throat, skin allergies, fluor albus	31	Cm, Jt, Pg, Sd, Sp, Tg, Tr, Tw, Wg
		Cooked leaves are added to vegetable soups	31	Cm, Jt, Pg, Sd, Sp, Tg, Tr, Tw, Wg
Poaceae				
Saccharum officinarum L. (**Shrub**) [WS41]	Tebu	Juice of the stem for cough	1	Bg
Podocarpaceae				
Dacrycarpus imbricatus (Blume) de Laub. (**Tree**) [WS39]	Cemara pandak	Decoction of sap for diarrhea	2	Jt
Rubiaceae				
Gardenia jasminoides J. Ellis (**Shrub**) [WS22]	Jempiring	Juice of leaves for facilitating labor	1	Pd
Paederia foetida L. (**Climber**) [WS33]	Kesimbukan, simbukan, daun kentut	Decoction of leaves for fever, and for stimulating the appetite	12	Pg, Sg, Sp, Tr
		The water collected inside the stem is used for treating aphthous stomatitis	12	Pg, Sg, Sp, Tr
		Cooked leaves are added to vegetable soups	12	Pg, Sg, Sp, Tr
Rutaceae				
Citrus aurantiifolia (Christm) Swingle (**Shrub**) [WS12]	Juruk lengis, jeruk nipis	Fruit juice for cough	3	Bg
Simaroubaceae				
Picrasma javanica Blume (**Tree**) [WS36]	Melela	Decoction of bark for heartburn	1	Sm
Solanaceae				

Table 1 (*continued*)

Plant families & species (life form), [voucher specimen code]	Vernacular names	Parts used & medicinal use	Number of informants	Villages
Cyphomandra betacea (Cav.) Sendtn. (**Shrub**) [WS17]	Tuung belanda, terong belanda	Fruit juice for aphthous stomatitis and hypertension	2	Bg
		Ripen fruit is eaten fresh	2	Bg
Thelypteridaceae				
Pneumatopteris callosa (Blume) Nakai (**Shrub**) [WS38]	Paku lindung	Decoction of leaves for fever and hypertension	3	Jt, Wg
		Cooked leaves are added to vegetable soups	3	Jt, Wg
Urticaceae				
Dendrocnide stimulans (L. f.) Chew (**Tree**) [WS18]	Lateng kidang	The water contained inside the root is used for treating aphthous stomatitis	2	Jt
		Ripen fruits are eaten fresh	2	Jt
Zingiberaceae				
Cheilocostus speciosus (J. Koenig) C. D. Specht (**Herb**) [WS13]	Ubi kayu tawa	Decoction of leaves for fever	2	Sp
Curcuma purpurascens Blume (**Herb**) [WS14]	Temu tis	Juice of rhizomes is used for cleaning the blood after labor	4	Pd, Tr
Curcuma zanthorrhiza Roxb. (**Herb**) [WS15]	Temu lawak	Juice of rhizomes is used for heartburn	2	Bg
Kaempferia rotunda L. (**Herb**) [WS28]	Temu kunci, mekunci	Decoction of leaves for rheumatic pain, and for raising body temperature	3	Pg
		Cooked rhizomes and young leaves are added to vegetable soups	3	Pg
Zingiber officinale Roscoe (**Herb**) [WS50]	Jahe	Juice of rhizomes is used for cough, rheumatic pain, headache, and for raising body temperature	5	Sg, Tr
		Rhizomes are used as spice	5	Sg, Tr
Zingiber zerumbet (L.) Roscoe ex Smith (**Herb**) [WS51]	Bangle, banglai	Juice of rhizomes is used for constipation and abscesses	4	Pd, Sm

Abbreviations. Villages: Bg=Bayung Gede; Cm=Cempaga; Jt=Jatiluwih; Pd=Pedawa; Pg=Penglipuran; Sd=Sidatapa; Sg=Songan; Sm=Sembiran; Sp=Sepang; Tg=Tenganan; Tr =Trunyan; Tw=Tigawasa; Wg=Wongaya Gede.

The role of Zingiberaceae as the most represented family in the ingredients of Balinese herbal drinks (Table 1) is not surprising since the family is well known as the most important source of spices in South and Southeast Asia (Seidemann, 2005; Xizhen et al., 2005; Khare, 2007; Remadevi et al., 2007). The medicinal uses of various species of this family in traditional Balinese herbal drinks are also mentioned and described in full detail in Balinese ancient scriptures of medicine like the *Lontar Usada Bali* and *Taru Pramana* (Worsley, 1972; Hobart, 1990; Tengah et al., 1995).

The Acanthaceae and Moraceae are also well represented. A large number of informants cited *Artocarpus heterophyllus* (even though the highest number of citations is for its food use), whereas *Morus alba* is less commonly mentioned. *M. alba* is an exotic species native to China and was probably introduced to Bali by the Dutch during the colonial time, potentially explaining the reason why the Balinese are less familiar with this species. *A. heterophyllus* (both roots and leaves), as other *Artocarpus* species, is known to have medicinal uses in treating diarrhea (Jagtap and Bapat, 2010). This species has been extensively studied and has several demonstrated pharmacological activities (e.g., antimicrobial, antidiabetic, anti-inflammatory) (Jagtap and Bapat, 2010).

The Apocynaceae is an important family of flowering plants among the medicinal species used in Asia and the Pacific (Wiart, 2006a, 2006b). In this family, the genus *Alstonia* is especially important for medicinal purposes (Wiart, 2006a). *Alstonia scholaris* is an evergreen tree with a widespread distribution from India, Sri Lanka, mainland South East Asia through the Pacific region including Australia (Baliga, 2012). The plant has various ethnobotanical uses (Meena et al., 2011). The species has a validated activity against *Plasmodium berghei* (see Table 2) supporting its use to treat malaria (Table 1). All the other uses of *A. scholaris* that have been cited by our informants also have been validated by pharmacological studies.

Blumea balsamifera (*Asteraceae*) is also cited by a large number of informants (Table 1). This shrub has a large distribution from India to Papua New Guinea (Pornpongrungrueng et al., 2007). The species has many activities, including antimicrobial, anti-inflammatory, hepatoprotective, and others (Table 2). These activities do not explain all the current uses for *Loloh*, so probably this species could have other pharmacological activities that are still unknown.

The medicinal uses of *Kayu manis* (*Cinnamomum burmanni*) in Indonesia is legendary. This plant is widely commercialized and is known as 'Indonesian Cassia' or 'Batavia Cassia' (Hasanah et al., 2004; Al-Dhubiab, 2012). This species is distributed in Southeast Asia and is cultivated in Indonesia (Al-Dhubiab, 2012). The Balinese use this species for various purposes from cooking to medicine, as part of a traditional knowledge that they share with numerous tribes in Indonesia, from Sumatra to New Guinea. However, the use of *K. manis* is apparently of Austronesian origin and was spread to the realm of the Melanesia through contact in ancient times during the Austronesian epical sails to the Pacific and Madagascar, presumably between 1000 BC and 400 BC (Pearce and Pearce, 2010).

The Piperaceae is a family consisting of 10 genera with about 2000 species of which 30 species in Asia and the Pacific are used medicinally (Wiart, 2006a). *P. betle* is a vine widely used throughout South Asia and Indonesia (Kumar et al., 2010). The plant has many pharmacological activities (Table 2) which support the result of this current study (Table 1). *P. betle* resides in the heart of the Balinese culture, and it is incorporated in various practices and uses from wedding ceremonies to medicine. Combined with the areca nut (*Areca catechu* L.) and other ingredients, *P. betle* is used in one of the most important practices that characterize the Austronesian civilization (especially the West Central Austronesia) known as the tradition of *makan pinang sirih*.

Several plants cited in this study are poorly investigated for their pharmacological activity or chemical profiles (Table 3). Considering that many other plants instead have already been tested and proved to be useful for many diseases and health problems, we believe that also these understudied plants could have interesting applications in pharmacology.

Table 2
The most cited species (> 30 informants) to prepare *Loloh* with their phytochemical profile and pharmacological activities.

Plant species	Phytochemical profile	Pharmacological activities
Alstonia scholaris	1-hydoxy-3,5dimethoxyxanthone[2] (leaves); 2-phenylethyl acetate[2] (flowers); 3,5,7,4′-tetrahydoxyl-flavone-3-O-β-dglucoside[2] (leaves); 3,28-β-diacetoxy-5-olea-triterpene[2,24] (flowers); 3β-acetate-24-nor-urs-4,12-diene ester triterpene[2,24] (flowers); 3β-hydroxy-24-nor-urs-4,12,28-triene triterpene[2,24] (flowers); 3-O-β-d-xylopyranosyl (1″→2″)-β-d-galactopyranoside[2] (leaves); 5β-methoxyaspidophylline[2] (leaves); 5-epi-nareline ethyl ether[1,2,7] (leaves); 5-methoxyaspidophylline[10] (leaves); 5-methoxystrictamine [2,10,13] (leaves); 6,7 seco angustilobine B[1,2,3,4,8] (bark, leaves); 6,7 seco-19,20-epoxy angustilobine B[1] (leaves); 7-megastigmene-3,6,9-triol[2,20] (leaves); 7,3′,4′-trimethoxyl-5-hydoxylflavone[2] (leaves); 17-*O*-Acetylechitamine[1,2,8] (bark); 19-epischolaricine[1,2,5] (leaves); 19,20-dihydrocondylocarpine[1,2] (leaves); 19,20-E-alstoscholarine[6] (leaves); 19,20 Z-alstoscholarine[6] (leaves); 19,20-Z-Vallesamine[1,2] (leaves); 19,20-E Vallesamine[1,2,3,4] (leaves); 19-E-picrinine[2] (fruit); 19-E-akuammidine[2] (fruit); 19-E-vallesamine[2] (fruit); 19-S-scholaricine[2] (fruit); (1″- > 2″)-β-D-galactopyranoside[12] (leaves); (-)-lyoniresinol 3-O-β-D-glucopyranoside[2,12] (leaves); (S)-tubotaiwine[2] (leaves); α-amyrin[18] (bark); α-amyrin acetate[2,24] (bark, flowers, leaves); α-terpineol[1,2] (bark, flowers); α-tocopherol[2] (leaves); α -tocopherolquinone[2] (leaves); Agunamine (19-hydroxytubotaiwine) [8] (leaves); Akuammicine[2] (root); Akuammicine-N-methiodide[2] (root); Akuammicine N-oxide[2,23] (bark, leaves, root); Akuammidine[1,2] (bark, leaves); Akuammiginone[1,2,23] (bark); Alschomine[1] (leaves); Alstonamine[1,2,16] (leaves); Alstonic acid A[2,17] (leaves); Alstonic acid B[2,17] (leaves); Alstonoside[2,19] (stem); Alstovenine[3] (seeds); Alyxialactone[2,22] (bark); Amyrin[1] (flowers); Angustilobine B[1,3,4] (leaves); Angustilobine B acid[1,2,8] (leaves); Angustilobine B N4 oxide[2] (leaves); Areline[1] (leaves); β-amyrin[2,18] (bark, flowers); β-amyrin-3-palmitate[2] (leaves); β-sitosterol[2] (bark, leaves); β-D-glucopyranoside[19] (stem); Biochanin A 7-O-β-D-apiofuranosyl-(1→6)-bis(2-ethylhexyl) phthalate[2] (leaves,stem); Botulin[1] (bark);	α-Glucosidase inhibitor (antidiabetic)[1,2,3,12,38] (leaves);
	Caoutchouc[1] (bark); Chlorogenic acid[3] (seeds); Chlorogenine[3] (seeds); Cycloeucalenol[2] (leaves); Demethyl echitmaine[1] (bark); Dibutyl phthalate[2] (leaves); Ditain[1] (bark); Ditamine[1,3] (bark, seeds); E-alstoscholarine[2] (leaves); Echicaoutchin[1] (bark); Echicerin[1] (bark); Echiretin[1] (bark); Echitamidine-N-oxide19-O-b-D-glucopyranoside[2,23] (bark); Echitamidine N-oxide[2,23] (bark); Echitamine [2,3,8] (bark, leaves, seeds); Echitaminic acid[2,23] (bark); Echitein[1] (bark); Echitenine[1,3] (bark); Echitin[1] (bark); Formononetin 7-O-β-D-apiofuranosyl-(1→6)-β-D-Glucopyranoside[2,19] (stem); Galactopyranoside[2,25] (leaves); Icrarinal[1] (leaves); Isoalschomine[1,3] (leaves); Isoboonein[2,22] (bark); Isorhamnetin[2,25] (leaves); Isorhamnetin-3 O-β-D-galactopyranoside[2,25] (leaves); Kaempferol[2,25] (leaves); Kaempferol-3-O-β-D-galactopyranoside[2,25] (leaves); Kaempferol-3- O-β-D-xylopyranosyl-(2-1)-O-β-D-Kuammidine[1] (leaves); Lagunamine[1,2] (leaves); Linalool[1,2] (bark, flowers); Linoleic acid[2] (seed); Loganin[2,22] (bark); Losbanine[1,2,8] (bark, leaves); Lupeol[1,2] (bark, flowers); Lupen-3-ol[2] (leaves); Lupen-3-palmitate[2] (leaves); Lupiol acetate[18] (bark);	Antiarthritic activity[39];
	Manilamine[1,2,3,4] (leaves); Megastigmane-3β, 4α, 9-triol[2,20] (leaves); Methyl (2b,16R,19E)-4,5-didehydro-1,2-dihydro-2-hydroxy-16-(hydroxymethyl)akuammilan-4-ium-17-oate chloride[13] (leaves); Methyl (16R,19E)-1,2-dihydro-16-(hydroxymethyl)-5-oxoakuammilan-17-oate[13] (leaves); Methyl burnamine[1] (leaves); Methyl scholaricine[1] (leaves); N-demethylechitamin[2] (root); N-formylscholarine[2,21] (fruit); N-hexacosane[1,2] (flowers); N4-methyl angustilobine B[2,3,4] (leaves); N4-oxide, 20(S)-tubotaiwine[4] (leaves); N^1-methoxymethyl picrinine[2,17] (leaves); N^a-methylburnamine [1,2,5] (leaves);	Anticancer activity (different efficacy dependent on the gathering season)[1,2,3,28,29,30,31];
	N^b-demethylalstogustine[2,23] (bark); N^b-demethylalstogustine N-oxide[2,23] (bark); N^b-methylscholaricine[1,2,5] (leaves); Nareline[1,2,21] (bark, leaves, fruit); Nareline ethyl ether[1,2,7] (leaves); Nareline methyl ether[1,2,7] (leaves); Oleic acid[2] (seed); Palmitic acid[1,2] (flowers, seeds); Picraline diacetyl[1] (bark, root); Picraline[1] (leaves); Picralinal[1,2,10] (bark, leaves); Picrinine[1,2,7,10,15,21] (bark, leaves, fruit, flowers); Pseudoakkuammigine oxide[1] (leaves); Quercetin[2,25] (leaves); Quercetin 3-O-β-D-xylopyranosyl[12] (leaves); Quercetin-3-O-β-D-xylopyranosyl-(2-1)- O-β-D-galactopyranoside[2,25] (leaves); Quercetin-3-O-β-D-galactopyranoside[2,25] (leaves); Reserpine[3] (seeds); Rhazimanine[1,2,16] (leaves); Rhazine[18] (bark); Scholarein A[2,3,22] (bark); Scholarein B[2,3,22] (bark); Scholarein C[2,22] (bark); Scholarein D[2,22] (bark); Scholaricine[1,2,7,9,15] (leaves); Scholarine[1,2,14] (bark, leaves); Scholarine-N4-oxide[1,2,7] (leaves); Scholarisine A[2,11] (leaves); Scholarisine B[2] (bark); Scholarisine C[2] (bark); Scholarisine D[2] (bark); Scholarisine E[2] (bark); Scholarisine F[2] (bark); Scholarisine G[2] (bark); Sitosterol[1] (bark); Squalene[2] (leaves); Stearic acid[2] (seeds); Strictamine[1,2,21] (fruit, flowers); Terpinen-4-ol[1,2] (bark, flowers); Tetrahydroalstonine[1] (flowers);	Antidiarrheal activity (spasmolytic activity)[2,3,41] (aerial parts, bark);
	Tubotaiwine[1,2,8] (leaves, root); Ursolic acid[1,2,24] (bark, flowers, leaves); Vallesamine[1] (leaves); Vallesamine oxide[1] (leaves); Vallesamine N^b-oxide[1,2,5] (leaves); Venenatine[3,18] (bark, seeds); Yohimbine[18] (bark); Z-alstoscholarine[2] (leaves)	Antifertility effect and Spermicidal activity[1,2,18,48] (bark); Antihelminthic activity[1] (leaves); Antihyperlipidemic activities[2,38] (leaves); Antihypertension[2] (bark); Antimalarial activity[1,2,32] (bark); Antimicrobial activity (leaves, stem and root barks)[1,2,3,27,33,34,35,48]; Antioxidant activity[1,2,3,26,38,42] (leaves, bark); Anti-inflammatory effect[1,2,37] and Analgesic effect[1,2,3,37] (leaves); Anti-proliferative activity[1,40,45]; Anti-stress (adaptogenic) and nootropic activity[1,2,3,42] (bark)

Table 2 (*continued*)

Plant species	Phytochemical profile	Pharmacological activities
		Anti-tussive, anti-asthmatic and expectorant activities[2,3,15] (leaves); Anti-ulcer activity[1] (leaves); Broncho-vasodilatory activity[1,3,43] (leaves); Chemopreventive activity[1,2,3,44,45] (bark); Hepatoprotective effect[1,2,3,46]; Immunostimulating effect[1,2,3,47] (bark); Radioprotective activity (protection against radiation-induced hematological and biochemical alterations) (bark)[1,2,38]; Wound healing activities[1,2] (leaves)

Notes. [1] Baliga, 2012; [2] Kaushik, et al., 2011; [3] Meena et al., 2011; [4] Macabeo et al., 2005; [5] Yamauchi et al., 1990a; [6] Cai et al., 2007; [7] Toh-Seok et al., 1997; [8] Yamauchi et al., 1990b; [9] Atta-ur-Rahman et al., 1985; [10] Cai et al., 2008a; [11] Cai et al., 2008b; [12] Jong-Anurakkun et al., 2007; [13] Zhou et al., 2005; [14] Banerji and Siddhanta, 1981; [15] Shang et al., 2010b; [16] Atta-ur-Rahman and Alvi, 1987; [17] Wang et al., 2009a, 2009b; [18] Gupta et al., 2002; [19] Thomas et al., 2008; [20] Xu et al., 2009; [21] Jain et al., 2009; [22] Feng et al., 2008; [23] Salim et al., 2004; [24] Sultana and Saleem, 2009; [25] Hui et al., 2009; [26] Arulmozhi et al., 2007; [27] Khan et al., 2003; [28] Kamarajan et al., 1991; [29] Jagetia and Baliga, 2004; [30] Jagetia and Baliga, 2005; [31] Jagetia and Baliga, 2006; [32] Gandhi and Vinayak, 1990; [33] Khyade and Vaikos, 2009; [34] Misra et al., 2011; [35] Mukherjee et al., 2012; [36] Gupta et al., 2008; [37] Shang et al., 2010a; [38] Arulmozhi et al., 2010; [39] Arulmozhi et al., 2011; [40] Jagetia and Baliga, 2003; [41] Shah et al., 2010; [42] Kulkarni and Juvekar, 2009; [43] Channa et al., 2005; [44] Jahan et al., 2009; [45] Jagetia et al., 2003; [46] Lin et al., 1996; [47] Iwo et al., 2000; [48] Madan et al., 2011.

Blumea balsamifera	1,1-Dimethyl adamantine[1] (leaves); 1,3,4,5,6,7-hexahydro-2,5,5-trimete-hyl-2H-2,4A-ethanonaphthalene[24]; 1,8 Cineole[24]; 1-Ang-4,7-dihydroxyeudesmane[24]; 1-octen-3-ol[24]; 2(1H)-naphthalene, octahydro-4-5amethyl-7-(1-methylethyl)[1] (leaves); 2-Hydroxy-4,6-dimethoxyacetophenone[24]; 2-Methylbut-2-enoic acid (3aR,4S,5R,7R,8aS) decahydro-3α,4-dihydroxy-4-methyl-7-(1-methylethyl)1-methylidene-8-oxoazulen-5-yl Ester[23]; 2′,3,5-Trihydroxy-5′,7-dimethoxyflavanone[23]; 2,3-Dimethyloxiranecarboxylic acid (1R,3R,5E,10S)10-hydroxy-6,10-dimethyl-3-(1-methylethyl)-4,9dioxocyclodec-5-en-1-ester[23]; 2,4-Dicumylphenol[21] (aerial parts); 3- Carotol[1,24] (leaves); 3-Fluoro-5-amino-pyridine[24]; 3-Nitrophthalic acid[24]; 3-Octanol[24]; 3-Octanone[24]; 3-Propyl benzaldehyde[24]; 3,3′,4′,5-tetrahydroxy-7-methoxyflavanone[15,24] (aerial parts); 3,3′,5-trihydroxy-4′,7-dimethoxyflavanone[15,23,24] (aerial parts); 3,3′,5,5′,7-pentahydroxyflavanone[15,24] (aerial parts); 3,3′,5,7-tetrahydroxy-4′-methoxyflavanone[15,17,23,24] (aerial parts, leaves); 3′,4′,5-trihydroxy-3,7-dimethoxyflavone[2,15,23] (aerial parts, leaves); 3′,4′,5-Trihydroxy-7-metoxyflavanone[24]; 3,4′5-Trihydroxy-3′7-dimethoxyflavanone[24]; 3,5-dihydroxy-3′,4′,7-trimethoxyflavone[15,24] (aerial parts); 3,5,3-trihydroxy-7,4-dimethoxy-flavone[14,16,24] (aerial parts); 3,5,3,4-tetrahydroxy-7- methoxyflavone[14,16,24] (aerial parts); 3′,5,5′,7-tetrahydroxyflavanone[15,23] (aerial parts); 3,5,7-Trihydroxy-3′4′-dimethoxyflavone[24]; 3,13-Clerodadiene-6,15-diol[24]; 3-O-7″-biluteolin[2,23] (leaves); 4-Isopropylbenzaldehyde[24]; 4,4-Demethyladamanlaer-2-ol[1] (leaves); 4′,5,7-Trihydroxy-3,3′-dimethoxyflavone[24]; 5,3′,4′-trihydroxy-3,6,7-trimethoxy flavone[22]; 5,4′-dihydroxy-7-methoxyflavone[20,24]; 5,4′-dihydroxy-3,3′,7-trimethoxy flavanone[20,24]; 5,7-dihydroxy-3,3′,4′-trimethoxy flavone[16,24] (aerial parts); 5,7-Dihydroxychromone[24]; 5,7,3',5'-metrahydroxyflavanone[4,5,7,8] (leaves); 5,7,3′,5′-tetrahydroxy flavanone[10,16,24] (aerial parts); 5α,8α-Epidioxyergosta-6,22-dien-3β-ol[24]; 6-undecanol[1] (leaves); 7,4′,4″-Tri-O-methylamentoflavone[21] (aerial parts); 9-Hexadecenoic acid[24]; 10-Epi- γ-Eudesmol[24]; 16-Kaurene[24]; (+)-γ-Gurjunene[24]; (−)-β-Elemene[24]; (−)-γ-Cadinene[24]; (−)-δ-Cadinene[24]; (2R,3S)-(-)-4′-O-methyldihydroquercetin[10] (aerial parts); (2R,3R)-(+)-4′-O-methyldihydroquercetin[10] (aerial parts); (2R,3R)-(+)-4′,7-di-O-methyldihydroquercetin[10] (aerial parts); (2R,3R)-(+)-7-O-methyldihydroquercetin[10,24] (aerial parts); (2*R*,3*R*)-7,5′-dimethoxy-3,5,2′-trihydroxyflavanone[12] (aerial parts); (2R,3R)-Dihydroquercetin-4′-Methyl Ether[13] (leaves); (2R,3R)-Dihydroquercetin-4′,7-Dimethyl Ether[13] (leaves); (11Z)-11-hexadecenoic acid[24]; (E) Ocimene[1,24] (leaves); α-Butenoic acid, 3-methoxy-4-nitro[24]; α-Caryophyllene[1] (leaves); α-Eudesmol[24]; α-Gurjunene[24]; α-pinene[1,24] (leaves); α-Selinene[1] (leaves); α-Thujene[24]; α-Terpineol[24]; Acetic acid[1] (leaves); Adamantane [1] (leaves); Adamantanecarboxylic acid, phenylester[1] (leaves); Alloaromadendrene[24]; Aromadendrene[1,24] (leaves); Aromadendrene dehydro[1,24] (leaves); Aromadendrene oxide[1,24] (leaves); Austroinulin[17,24] (leaves); Ayanin[16,24] (aerial parts); β-carotene[6] (leaves); β-Daucosterol [21] (aerial parts); β-Elemene[1,24] (leaves); β-Eudesmol[24]; β-Gurjunene[24]; β-myrcene[1,24] (leaves); β-pinene[1,24] (leaves); β-Selinene[24]; β-Sitosterol[21,23,24] (aerial parts); Balsamiferine A[9] (leaves); Balsamiferine B[9] (leaves); Balsamiferine C[9] (leaves); Balsamiferine D[9] (leaves); Balsamiferine E[9] (leaves); Balsamiferine F[9] (leaves); Balsamiferine G[9] (leaves); Balsamiferine H[9] (leaves); Balsamiferine I[9] (leaves); Balsamiferine J[9] (leaves); Blumeaene A[24]; Blumeaene B[24]; Blumeaene C[24]; Blumeaene D[24]; Blumeaene E1[17,24] (leaves); Blumeaene E2[17] (leaves); Blumeaene F[24]; Blumeaene G[24]; Blumeaene H[24]; Blumeaene I[24]; Blumeaene J[24]; Blumeaene K[17] (leaves); Blumeaene L[17] (leaves); Blumeaene M[17] (leaves); Blumealactone A[23,24]; Blumealactone B[23,24]; Blumealactone C[23,24]; Blumeatin[4,5,7,8,11,15,16,18,23,24] (aerial parts, leaves); Bornil Acetate[24]; Borneol[1,19,23,24] (leaves); γ-Cadinene[24]; γ-Eudesmol[24]; γ-Muurolene[1,24] (leaves); Camphene[1,24] (leaves); Camphor[1,19,24] (leaves); Capric acid[24]; Carboxaldehyde[19]; Caryophyllene[1,19,24] (leaves); Caryophyllene oxide[1,24] (leaves); Catechin[16,24] (aerial parts); Chrysanthenone[24]; Chrysoeriol[15,24] (aerial parts); Chrysosplenol C[15,24] (aerial parts); Cubenol[19,24]; Cuminal[1] (leaves); Cuminalaldehyde[24]; Cycloisolongifolene, 8,9-dehydro[1] (leaves); Cyclobexene,1-(2-methyl-2-cyclopentenyl)-1[1] (leaves);	Anticancer activity [3,5,23,24,27,28,29] (leaves);

Table 2 (*continued*)

Plant species	Phytochemical profile	Pharmacological activities
	Cyclopropyledene[1] (leaves); Cryptomeridiol[6,17,22,24] (leaves); Daucosterol[24]; Davidigenin[16,24] (aerial parts); Davidioside[16,24] (aerial parts); Dihydroflavonol BB-1[3]; Dihydroquercetin-4'-methyl ether[4,5,7,8,16,20,24] (aerial parts, leaves); Dihydroquercetin-7,4'-dimethyl ether[4,5,7,8,16,24] (aerial parts, leaves); δ-Cadinene[1,24] (leaves); Dimethoxydurene[1,24] (leaves); Diosmetin[15,24] (aerial parts); Elemol[24]; Epicedrol[1] (leaves); Eranthin[22]; Eriodictyol[20,24]; Eugenol[19,24]; Furan,4,5-diethy-2,3-dihydro-2,3-dimethyl[24]; Gentisic acid[21] (aerial parts); Geranyl iso-valerate[1] (leaves); Germacrene -D-4-ol[1] (leaves); Globulol[1,24] (leaves); Guaina-3,9-diene[1,24] (leaves); Guaiol[1,19,24] (leaves); Hydranngetin[24]; Hyperoside[24]; Icthyothereol acetate[6] (leaves); Isoborneol[19,24]; Isopatchoulane[1] (leaves); Isoquercitrin[24]; Ledol[1,24] (leaves); Limonene[1,24] (leaves); Linalool[1] (leaves); Linalool oxide[24]; Longifolene[24]; Lutein[6] (leaves); Luteolin[4,5,7,8,16,20,24] (aerial parts, leaves); Luteolin-7-methyl ether[4,5,7,8,20,23,24] (leaves); Mentholete[19]; Myrtenal[24]; Neoclovene dihydro[1] (leaves); Neryl acetate[1] (leaves); Ombuine[24]; O-acetyl-1-serine[24]; p-Hydroxybenzoic acid[21] (aerial parts); Palmitic acid[24];	
	Paracymene[24]; Patchoulene[1] (leaves); Perillaldehyde[1,24] (leaves); Perillol[1] (leaves); Perillyl alchohol [24]; Phytol[1,24] (leaves); Quercetin[4,5,7,8,10,16,24] (aerial parts, leaves); Quercetin-3,3′,4′-trimethyl ether [10] (aerial parts); Quercetin-3,7,3′-trimethyl ether[10] (aerial parts); Rhamnetin[4,5,7,8,20,23,24] (leaves); Sabinene[24]; Samboginonel[17] (leaves); Selinene[1] (leaves); Stigmasterol[23]; Syringaresinol[24]; Tamarixetin[4,5,7,8,23,24] (leaves); Tetracyclo [6,3,2,0,(2.5)0.0(1,8)tridecan-9-ol, 4,4-dimethyl] [1] (leaves); Terpineol[19,24]; Thujopsene[24]; Thymohydroquinone dimethyl ether[24]; Trans-2-undecenoic acid[24]; Trans-Linalool oxide[24]; Trans-Phytol[21] (aerial parts); Umberlliferone[24]; Velutin[23]; Xanthoxylin[22,24]	Antifungal activity[6] (leaves); Antimicrobial activity[24,30] (leaves); Antioxidant activity[4,7,8,23,24,25,26] (leaves); Antiplasmodial activity[24,31] (root, stem); Anti-inflammatory activity[9,24] (aerial parts); Anti-tyrosinase activity[5,24] (leaves); Enhanced Percutaneous Penetration activity[23,24]; Hepatoprotective[18,24]; Partially blocking adipogenesis[24,32]; Plasmin-inhibitory activity[33] (leaves); Wound Healing activity[24] Xanthine oxidase inhibitor (anti-hyperuricemia)[10,34,35] (aerial parts)

Notes. [1] Bhuiyan et al., 2009; [2] Ali et al., 2005; [3] Hasegawa et al., 2006; [4] Fazilatun et al., 2005; [5] Saewan et al., 2011; [6] Ragasa et al., 2005; [7] Nessa et al., 2004; [8] Nessa et al., 2010; [9] Xu et al., 2012; [10] Nguyen and Nguyen, 2012; [11] Kanghou, 1988; [12] Barua and Sharma, 1992; [13] Ruangrungsi et al., 1981; [14] Qinying et al., 1996; [15] Qi-xin et al., 2012; [16] Chen et al., 2010; [17] Shirota et al., 2011; [18] Xu et al., 1993; [19] Ping et al., 2009; [20] Huang et al., 2010; [21] Tan et al., 2013; [22] Ruangungsi et al., 1985; [23] Chen et al., 2009; [24] Pang et al., 2014; [25] Shyur et al., 2005; [26] Zhao and Xu, 1997; [27] Fujimoto et al., 1988; [28] Norikura et al., 2008a; [29] Norikura et al., 2008b; [30] Sakee et al., 2011; [31] Noor-Rain et al., 2007; [32] Kubota et al., 2009; [33] Osaki et al., 2005; [34] Nguyen et al., 2004; [35] Apaya and Chichioco-Hernandez, 2011.

Cinnamomum burmanni	1,8-cineole[1,13] (leaves, bark, branches); 4-Terpineol[2] (leaves); 5′-hydroxy-5-hydroxymethyl-4″,5″-methylenedioxy-1,2,3,4-dibenzo-1,3,5-cycloheptatriene[13]; (+)-ledene[2,13] (leaves);	Antibacterial properties[6,9,13] (bark);
	(-)-β-pinene[2,13] (leaves); (-)-terpinen-4-ol[2,13] (leaves); (1S)-α-pinene[2,13] (leaves); (E)-cinnamaldehyde[6] (bark); (Z)-nerolidol[2,13] (leaves); α-Amorphene[8] (bark); α-Calacorene[8] (bark); α-caryophyllene[2,13] (leaves); α-Cubebene[8] (bark); α-Humulene[8] (bark); α-Muurolene[8] (bark); α-pinene[13] (bark, leaves); α-terpineol[1,2,3,13] (bark, leaves); α–Ylangene[8] (bark); β-Guaiene[8] (bark); Aromadendrene[8] (bark); Benzylidenemalonaldehyde[3] (leaves); Borneol[1,3,5,13] (leaves, bark, branches); Bornyl acetate[13]; Bulnesol[2,13] (leaves); γ-eudesmol[2,13] (leaves); γ-terpinen[2,13] (leaves); Calarene[8] (bark); Camphene[5,13]; Camphor[1,2,13] (leaves, bark, branches); Caryophyllene[2,5,8,13] (bark, leaves); Caryophyllene oxide[2,13] (leaves); Caryophyllenyl alcohol[8] (bark); Cinnabutamine[7] (stem); Cinnamaldehyde[8,13] (bark, leaves); Cinnamic aldehyde cyclic syringyl glycerol 1,3-acetal[13] Cinnaretamine[7] (stem); Citral[5,13]; Coumarin[3,13] (leaves); Cyclopentadecane[8] (bark); δ-Cadinene[8] (bark); δ-Elemene[8] (bark); δ-limonene[13] (leaves); Elemol[2,13] (leaves); Eucalyptol[2,13] (leaves); Elemene[5,13]; Eugenol[3,13] (leaves); Epi-Bicyclosesquiphellandrene[8] (bark); Fenchol[5,13]; g-Cadinene[8] (bark); Glyceryl trilaurate[13] (seeds); Guaiene[5,13]; Guaiol[2,13] (leaves); Kaempferol[4,13] (leaves); Linalool[5,13]; Myrcene[5,13]; N-cis-feruloyl-5-methoxytyramine[7] (stem); N-trans-caffeoyl-5-hydroxytyramine[7] (stem); N-trans-feruloyltyramine[7] (stem); N-trans-feruloyl-5-methoxytyramine[7] (stem); Nerolidol[5,13]; p-cymene[13] (bark); Patchoulene[8] (bark); Pinene[5,13]; Quercetin[4,13] (leaves); Quercetrin[4,13] (leaves); Santalene[8] (bark); Sylvestrene[5,13]; Terpinen-4-ol[1,5,13] (leaves, bark, branches); Trans-Cinnamaldehyde[3] (leaves); Valencene[8] (bark)	Antioxidant activity[4,10,13] (leaves, fruits); Anti-inflammatory activity[13] (bark); Immuno-modulatory[13]; Insulin-enhancing biological activity[11,13] Protein tyrosine phosphatase 1B (PTP1B) inhibitory activity[12] (antidiabetic, anti-obesity) (bark)

Notes. [1] Ji et al., 1991; [2] Deng et al., 2010; [3] Wang et al., 2009a, 2009b; [4] Prasad et al., 2009; [5] Liu et al., 2007; [6] Shan et al., 2007a; [7] Hong et al., 2011; [8] Thantsin et al., 2008; [9] Shan et al., 2007b; [10] Huang et al., 2011; [11] Anderson et al., 2004; [12] Saifudin et al., 2013; [13] Al-Dhubiab, 2012.

Piper betle	1,8-cineole[1,2,13,20] (leaves, rhizome, root); 1-methyl-4-(1-methyl ethyl)benzene[17] (leaves); 1-methyl-4-(1-methylethyl)-1,4cyclohexadiene[17] (leaves); 1-methyl-5-(1-metheyletenyl) cyclohexene[17] (leaves); 2-carene[17] (leaves); 2-methyl-5(1-methylethyl)-bicyclo[3.1.0]hex-2-ene[17] (leaves); 2-methyl undecanol[18] (leaves); 2-Monopalmitin[3] (leaves); 3,7-dimethyl-1,6-octadien-3-ol[17] (leaves); 3-carene[17] (leaves); 4-(2-propenyl)phenol 5-(2-propenyl)-1,3-benzodioxole[17] (leaves); 4-allyl resorcinol[8] (root); 4-allylphenol[12]; 4-allylphenyl acetate[12];	Anticancer activity[9,21,44] (leaves);
	4-ethyl benzaldehyde[18] (leaves); 4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol[17] (leaves);	Antidiabetic activity[29] (leaves);
	4-methyl cetane[18] (leaves); 4-Propenylguaiacol[18] (leaves); 4-terpineol[20] (fruit, leaves, stalk, stem); 6β-hydroxystigmast-4-en-3-one[15] (stem); 9-Heneicosanone[18] (leaves); 9-Heptadecanone[18] (leaves); 10-Nonadecanone[18] (leaves); 23-hydroxyursan-12-en-28-oic acid[15] (stem); (+) T-muurolol[1] (rhizome);	Antifertility activity and antiestrogenic effects[22,23,28,39] (leaves, stalk);
	(2S) -4′-hydroxy- 2,3-dihydroflavonone-7-O-beta-D-glucoside[15] (stem); (E)-nerolidol[1] (rhizome); α-cadinene[1] (rhizome); α-cadinol[1] (rhizome); α-caryophyllene[17] (leaves);	Antifungal activity[4,12,17,20,21,37,40,41] (leaves);

Table 2 (*continued*)

Plant species	Phytochemical profile	Pharmacological activities
	α-copaene[1] (rhizome); α-cubebene[1] (rhizome); α-Elemene (root, stalk, stem); α-ethyl glucoside[15] (stem); α-hydroxyphenyl[3] (leaves); α-muurolene[1] (rhizome); α-humulene[1,20] (fruit, leaves, rhizome, stalk, stem); α-Phellandrene[17] (leaves); α-pinene[1,13,17,20] (fruit, leaves, rhizome, root, stem); α-terpinene[1] (rhizome); α-terpineol[1,20] (rhizome, root); Aflylpyrocatechol[13] (leaves); Allo-aromadendrene[1] (rhizome); Allylguaiacol[18] (leaves); Allylpyrocatechol[2,11,21] (leaves); Allylpyrocatechol acetate[2,13,20] (fruit, leaves, root, stem); Allylpyrocatechol diacetate[2,13,20] (leaves); Aristololactam A-II[8] (root); β-bourbonene[1] (rhizome);β-Cadinene[20] (fruit, leaves, root, stalk, stem); β-Caryophyllene[1,20] (fruit, leaves, rhizome, root, stalk, stem); β-daucosterol[15] (stem); β-elemene[1] (rhizome); β-myrcene[17] (leaves); β-phellandrene[17,20] (fruit, leaves, root); β-pinene[1] (rhizome); β-sitosterol[15] (stem); β-sitosterol-3-O-beta-D-glucoside-6′-O-palmitate[15] (stem); Benzeneacetic acid[3] (leaves); Benzeneacetic acid, alpha-hydroxy[3] (leaves); Borneol[1] (rhizome); Bornyl acetate[1] (rhizome); γ-cadinene[1] (rhizome); γ-muurolene[1,20] (fruit, leaves, rhizome, stalk, stem); γ-Selinene[20] (fruit, root, stalk, stem); γ-terpinene[1] (rhizome); Cadalene[1] (rhizome); Cadinene[2] (leaves); Camphene[1,2,13,17,20] (fruit, leaves, rhizome, root, stem); Camphene hydrate[1] (rhizome); Caprylic acid, 3-methyl butyl ester[18] (leaves); Carvacrol[2] (leaves); Caryophyllene[2,13,17] (leaves); Catechin[14] (leaves); Cetane[18] (leaves);	
	Chavibetol[2,11,13,21] (leaves); Chavibetol acetate[2,12,13,20] (fruit, leaves, root, stalk, stem); Chavibetol methyl ether[13] (leaves); Chavicol[2] (leaves); Chavicol acetate[2] (leaves); cis-calamenene[1] (rhizome); Copaene[17] (leaves); Cubenene[1] (rhizome); δ-cadinene[1] (rhizome); δ-cadinol[1] (rhizome); δ-elemene[1] (rhizome); Eugenol[2,6,7,10,12,13,17,20] (fruit, inflorescence, leaves, root, stalk, stem); Epicubenol[1] (rhizome); Germacrene D[1] (rhizome); Hexadecanamide[3] (leaves); Hydroxychavicol[3,4,5,6,9,16,21] (leaves); Isoamyl laurate[18] (leaves); Lauric acid, ethyl ester[18] (leaves); Lauric acid, methyl ester[18] (leaves); Lauryl alcohol[18] (leaves); Ledol[1] (rhizome); Limonene[1,2,13,20] (fruit, leaves, rhizome, root); Linalool[1] (rhizome); Methyl laurate[18] (leaves); Methyl piperbetol[19,21]; Methyl undecanote[18] (leaves); Morin[14] (leaves); Myrcene[1] (rhizome); Myristic acid[18] (leaves); Myristic acid,2,3-bis(hydroxy)propylester[3] (leaves); Myristic acid, methyl ester[18] (leaves); Myristic acid, ethyl ester[18] (leaves); o-eugenol[1] (rhizome); Oleanolic acid[15] (stem); p-cymene[1,20] (fruit, leaves, rhizome); p-eugenol[1] (rhizome); p-Methylanisole[18] (leaves); Palmitic acid[3] (leaves);	Antihyperglycemic activity[46,47,57] (leaves);
	Palmitic acid,2,3-bis(hydroxy)propyl ester[3] (leaves); Palmitic acid methyl ester[18] (leaves); Palmitic acid ethyl ester[18] (leaves); Ppinene[2] (leaves); Piperbetol[19,21]; Piperol A[19,21]; Piperol B[19,21]; Quercetin[14] (leaves); Safrole[1,2,7,13,20] (fruit, inflorescence, leaves, rhizome, root, stalk, stem); Sabinene[1] (rhizome); Stearic acid[3] (leaves); Stearic acid,2,3-bis(hydroxy)propyl ester[3] (leaves); Stearic acid methyl ester[18] (leaves); Stigmast-4-en-3,6-dione[8] (root); Stigmasterol[15] (stem); T-cadinol[1] (rhizome); Terpinen-4-ol[1] (rhizome); Terpinolene[1] (rhizome)	Antileishmanial activity[10,21,38] (leaves); Antimicrobial activity (also anti-dental plaque) [3,17,20,21,32,33,34,35,36,52] (leaves); Antinociceptive activity[21,30,47] (leaves); Antioxidant activity[6,12,14,21,24,25,26,27,42,43,56,57,58,60,65] (inflorescence, leaves); Antiplasmodial activity[48] (leaves); Antiulcer activity[21,42,43] (leaves); Anti-allergic activity[21,45] (leaves); Anti-amoebic activity[49] (leaves); Anti-cutaneous myiasis[55] (leaves); Anti-giardial activity[50] (leaves); Anti-giardial activity[50] (leaves); Anti-platelet aggregation[19,56] (inflorescence); Anti-proliferative[11,14,51] (leaves); Anti-tyrosinase activity[12]; Cardioprotective activity[21,66] (leaves); Hepatoprotective activity[21,58,59,60] (leaves); Hypotensive effect[7] (inflorescence); Immunomodulatory activity[5,21,54] (aerial parts); Neuroprotective effect[61]; Prevention of halitosis[62] (leaves); Radioprotective activity[11,65] (leaves); Stimulatory influence on pancreatic lipase activity and on intestinal digestive enzymes[21,64]; Vascular relaxing properties[63] (leaves); Xanthine oxidase inhibitory activity[5] (leaves)

Notes. [1] Thanh et al., 1997; [2] Bajpai et al., 2010; [3] Nalina and Rahim, 2007; [4] Ali et al., 2010; [5] Murata et al., 2009; [6] Pin et al., 2010; [7] Chen et al., 1995; [8] Ghosh and Bhattacharya, 2005; [9] Chakraborty et al., 2012; [10] Misra et al., 2009; [11] Bhattacharya et al., 2005; [12] Row and Ho, 2009; [13] Rimando et al., 1986; [14] Abrahim et al., 2012; [15] Yin et al., 2009; [16] Pisar et al., 1970; [17] Caburian and Osi, 2010; [18] Dwivedi et al., 2010; [19] Zeng et al., 1997; [20] Arambewela et al., 2005c; [21] Kumar et al., 2010; [22] Ratnasooriya and Premakumara, 1998; [23] Sarkar et al., 2000; [24] Choudhary and Kale, 2002; [25] Santhakumari et al., 2003; [26] Dasgupta and De, 2004; [27] Arambewela et al., 2006; [28] Adhikary et al., 1989; [29] Arambewela et al., 2005a; [30] Arambewela et al., 2005b; [31] Shitut et al., 1999; [32] Razak and Rahim, 2003; [33] Razak et al., 2006; [34] Nalina and Rahim, 2006; [35] Gururaj et al., 2007; [36] Fathilah et al., 2009; [37] Garg and Jain, 1992; [38] Sarkar et al., 2008; [39] Sharma et al., 2007; [40] Phongpaichit et al., 2005; [41] Himratul-Aznita et al., 2011; [42] Majumdar et al., 2002; [43] Majumdar et al., 2003; [44] Fathilah et al., 2010; [45] Wirotesangthong et al., 2008; [46] Santhakumari et al., 2006; [47] Al-Arefin et al., 2012; [48] Al-Adhroey et al., 2010; [49] Sawangjaroen et al., 2006; [50] Sawangjaroen et al., 2005; [51] Rao et al.,1985; [52] Vaghasiya et al., 2007; [53] Ganguly et al., 2007; [54] Singh et al., 2009; [55] Kumarasinghe et al., 2002; [56] Lei et al., 2003; [57] Pushpavalli et al., 2009; [58] Pushpavalli et al., 2008; [59] Milton Prabu et al., 2012; [60] Saravanan et al., 2002; [61] Saravanan et al., 2003; [62] Ramji et al., 2002; [63] Runnie et al., 2004; [64] Prabhu et al., 1995; [65] Verma et al., 2010; [66] Arya et al., 2010.

As for any medicinal plants, people should take care while consuming plants cited in Table 1 due to potential adverse effects. For example, *A. pinnata* unripen fruits are considered toxic due to a high content of calcium oxalate in the fruit peel (Lim, 2012). The ethanolic extract of *Azadirachta indica* stem bark may be not completely safe for internal use [see Ashafa et al. (2012) for more details]. *Lablab purpureus* seeds are edible if boiled and processed, otherwise they are toxic (NC State University, 2014). Some toxic

Table 3
Plants used to prepare *Loloh* that are less studied for their phytochemistry or pharmacological activities.

Plant species	Phytochemical profile (plant part)	Pharmacological activities
Casuarina junghuhniana	Alnusdiol[6] (root); (±)-lyoniresinol 2α-*O*-rhamnoside[6] (root); Casuarinondiol[6] (root); Diarylheptanoid[6] (root);	Not available
Curcuma purpurascens	A total of 34 compounds (higher contents: ar-Turmerone; Turmerone; Germacrone; Curlone; Germacrene-B; Curzerene; Camphor)[18]	Antiproliferative effects (human colon carcinoma cells)[18] (rhizome); Gastroprotective effect[19] (rhizome)
Dacrycarpus imbricatus	2-O-rhamnosylvitexin[13]; 10-nonacosanone[14]; Amentoflavone-7,7-dimethyl ether[12] (bark, leaves); β-sitosterol[12] (bark, leaves); β-sitosteryl heptadecoate[13]; *cis*-communic acid[12] (bark, leaves); Daucosterol[12] (bark, leaves); Ecdysterone[13]; Heveaflavone[12] (bark, leaves); Hinokiflavone[13]; Imbricataflavone A[12] (bark, leaves); Imbricataflavone B[12] (bark, leaves); Podocarpusflavone A[14]; p-hydroxybenzoic acid[14]; Podoimbricatin A[15] (twigs and leaves); Podoimbricatin B[15] (twigs and leaves); Robustaflavone[14]; Robustaflavone-7″-methyl ether[14]; Sequoyitol[12] (bark, leaves); Sandaracopimaric acid[12] (bark, leaves); *trans*-communic acid[12] (bark, leaves)	Antibacterial activity[16]; Anticonvulsant activity[16] Antifungal activity[16]; Anxiolytic activity[16]; Inhibitor of nucleotide phosphodiesterase and a cyclooxygenase inhibitor[16]
Dendrocnide stimulans	Not available	Antimicrobial activity[17]
Erythrina hypaphorus	Hypaphorine[7,8] (seeds)	Not available
Lygodium circinatum	1,4-di-O-β-glucopyranosyl-2-(1,1-dimethylpropenyl) benzene[11] (leaves); 4′-dihydrophaseate sodium[11] (leaves); 5-O-methyllatifolin[11] (leaves); Benzyl-O-β-D-glucopyranoside[11] (leaves); Caffeic acid[10] (leaves); Epifriedelanol[11] (leaves); Epilupeol acetate[11] (leaves); Ferulic acid[10] (leaves); Friedelin[11] (leaves); Oleanolic acid[11] (leaves); p-coumaric acid[10] (leaves); p-hydroxy benzoic acid[10] (leaves); Phaseic acid[11] (leaves); Phenolics[9] (leaves); Sinapic acid[10] (leaves); Syringic acid[10] (leaves); Xanthophyll[11] (leaves)	α-glucosidase inhibitor (oleanolic acid)[11]; Antioxidant[9] (leaves)
Pneumatopteris callosa	Not available	Not available
Strobilanthes crispa	Caffeoylquinic derivatives[1] (leaves)	Antibacterial activity[2] (leaves); Anti-diabetic agent (promoter of insulin production)[3] (leaves); Antifungal activity[1] (leaves)
Trevesia sundaica	Bisdesmosidic saponins[4] (flowers and leaves); Oleanane saponins[5]; Triterpenoid saponins[4] (flowers and leaves)	Not available

Notes. [1] Cavin et al., 1999; [2] Muskhazli et al., 2009; [3] Hasmah et al., 2010; [4] De Tommasi et al., 1997; [5] Connolly and Hill, 2000; [6] Kaneda et al., 1990; [7] Romburgh and Barger, 1911; [8] Folkers and Unna, 1938; [9] Lai and Lim, 2011; [10] Bohm and Tryon, 1967; [11] Van Kiem et al., 2013; [12] Gu et al., 1990; [13] Gu et al., 1997; [14] Gu et al., 1995; [15] Han et al., 2014; [16] Abdillahi et al., 2010; [17] Mariani et al., 2014; [18] Hong et al., 2014; [19] Rouhollahi et al., 2014.

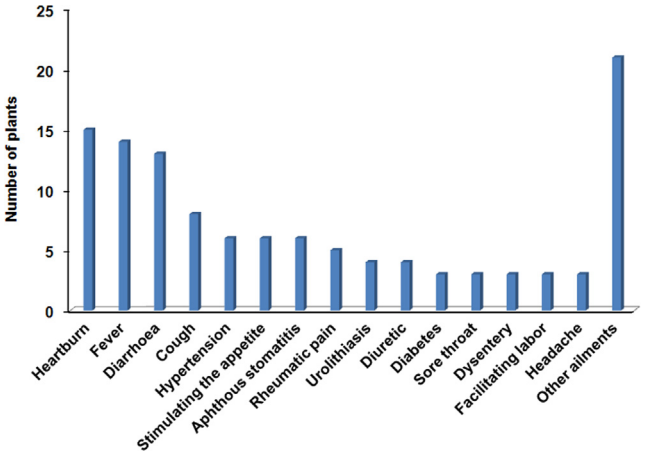

Fig. 3. Number of plant species for each category of use (various problems and ailments). External medicinal uses are also included.

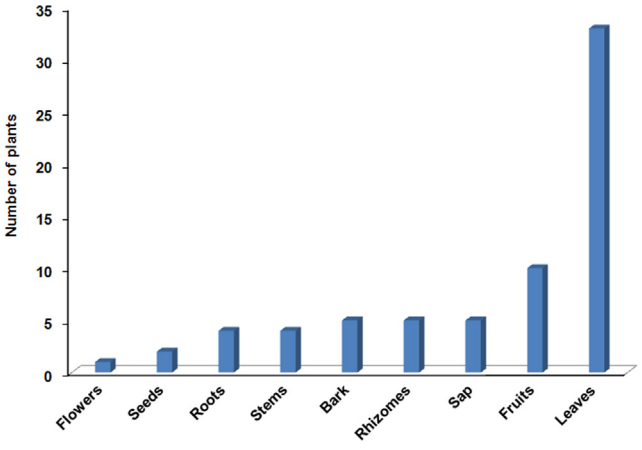

Fig. 4. Number of species and relative plant parts used for preparing *Loloh*.

effects were described also for *Sauropus androgynus* and *Sida rhombifolia* (Yu et al., 2007; Ouédraogo et al., 2013).

Several plants are gathered preferably during the rainy season from November to April. This suggests that Balinese are aware of the best timing for collecting plant parts, and this is supported by several studies that have demonstrated differences in the concentration of active phytochemical constituents over the seasons. The Balinese are very respectful with regard to sustainable use of natural resources and they generally leave some parts for future re-growth and sprouting. Many species (such as *A. scholaris*, *Andrographis paniculata*, *A. indica*, *B. balsamifera*, *C. burmanni*, *Cyclea barbata*, *Hibiscus tilliaceus*, *Orthosiphon aristatus*, *P. betle*, *Spondias pinnata*), are conserved by *Balian usada*, religious leaders, and farmers because these species are largely consumed. Other conservation strategies should be fostered for some species, at larger scale, to maintain their sustainable use.

5. Conclusion

This study showed that the Balinese community still preserves a rich ethnobotanical knowledge. The study provided a detailed description of 51 plant species used to prepare herbal drinks known as *Loloh*. Some of the species (e.g., *Pneumatopteris callosa*) would be interesting to study for their phytochemistry and pharmacological properties. Many plants have been well studied

for their pharmacological properties, demonstrating the efficacy of *Loloh* for curing various ailments and the sound ethnobiological knowledge of the indigenous people of Bali.

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