

# ETHNOBOTANICAL STUDY OF DIGESTIVE SYSTEMS DISORDERS IN BADUY ETHNIC, INDONESIA

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## ABSTRACT

Digestive disorders rank among the most commonly faced problems in Indonesia, particularly for the Baduy people in Banten Province. The Baduy population lives along water-rich areas, yet their lack of sanitation facilities and unawareness of disease prevention methods have resulted in high morbidity and mortality rates in their communities, largely due to digestive system disorders that they continue to treat with medicinal plants. Using quantitative ethnobotanical approaches this survey was undertaken to document the use of indigenous medicinal plants to treat and prevent different types of digestive system disorders among the Baduy communities. Ethnic knowledge on their medicinal plants were collected from 30 informants from the Baduy people. Quantitative approaches were used to determine the use value and informant consensus factor values of the collected data. The Baduy population currently uses 54 medicinal plant species belonging to 30 families, in treating digestive system disorders. Additional research is, however required, to validate the function of the medicinal plants and identity of their active compounds.

**Keywords:** Baduy people, digestive disorders, medicinal plants

## INTRODUCTION

Indonesia is a mega-diverse country with its flora composition particularly important in traditional medicine and agriculture and whose identity is deeply rooted among the indigenous groups throughout the Indonesian archipelago. More than 1,800 plant species inhabit several forest formations across Indonesia, 940 of which are used in herbal medicine by indigenous communities, yet only 300 species are used by the Indonesian pharmaceutical industry (LIPI 2014).

Indigenous knowledge is a product of generations upon generations of experience and constitutes a connection between indigenous communities and local natural resources (Davies & Kassler 2015). Among these resources are plants that indigenous community members gather for food, medicines, religious rituals, and

other cultural activities. The indigenous Baduy communities in Banten Province, Indonesia, form part of the immense cultural diversity of humanity, and their collective knowledge, passed down from generation to generation, constitutes a source of immeasurable cultural wealth.

The Baduy people have traditionally used medicinal plants in the treatment of various diseases. The communities continued use of ethno medicine stems from its cost-effectiveness, social acceptability, minimal side effects, and accessibility (Chawla *et al.* 2013). Since the Baduy typically reside in mountainous areas where access to public healthcare systems remains limited, they have accumulated profound experience with treating and preventing diseases with medicinal plants, whose diversity in their environment is exceptionally high.

Digestive system disorders have recently gained considerable attention among scholars in ethno medicine. Such disorders are a major

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cause of morbidity both in Indonesia and around the world, particularly among indigenous people, including the Baduy, whose inadequate access to hygienic levels of sanitation exacerbates the transmission and prevalence of various digestive diseases. Only 34% of people in low-income countries have access to adequate sanitation, and that figure is roughly 2.6 billion people worldwide (Mara *et al.* 2010).

Researches on local knowledge about medicinal plants is becoming increasingly important in defining strategies for the conservation management of biological resources (Jeruto *et al.* 2008). Fortunately, through extension activities, these ethnobotanical studies have become increasingly useful in developing healthcare and conservation programs (Vandebroek *et al.* 2010). Given those trends, valuable information about the importance of medicinal plants and indigenous knowledge disseminated orally warrants its collection, documentation and quantitative evaluation in order to guide future researches and prevent knowledge loss and erosion during its transmission from generation to generation.

Although some ethnobotanical surveys have been conducted among the Baduy (Iskandar & Iskandar 2017), there was no comprehensive report on the use of medicinal plants to specifically treat digestive system disorders. Hence, this paper aims to assess the traditional uses of medicinal plants among the Baduy and to compile profiles of the plants by applying quantitative methods. The information that would be generated could not only expand ethno medicinal knowledge but also support

general awareness on conserving indigenous medicinal plants in Indonesia.

## MATERIALS AND METHODS

The workflow contained the following specific steps: data collection and data processing analysis (Fig. 1).

### Study Site

The study was conducted at Inner Baduy, Cibeo hamlets, Kanekes village, and Leuwidamar sub district, in Lebak, Banten Province, Indonesia (Figure 2). Geographically, the village is located at longitude 6°27'27" - 6°30'0" S and latitude 108°3'9" - 106°4'5" E at an altitude of 300 - 600 m asl. The region is located roughly at 172 km west of Jakarta, Indonesia. The region experiences an average temperature of 20 °C, and the average rainfall is 4,000 mm/year. Generally, three types of soil are available in the region: dark latosol, brown alluvial, and andosol. Ethnographically, the Baduy community inhabits 5,101.85 ha, of which 2,101.85 ha constitutes the residential area and roughly 3,000 ha of which are protected forest areas. The Baduy speak their ethnic language Sunda, and as indigenous people, they depend on immediate natural resources in their vicinity for their livelihood, which they supplement with production from the primary sectors such as agriculture, horticulture, and livestock.

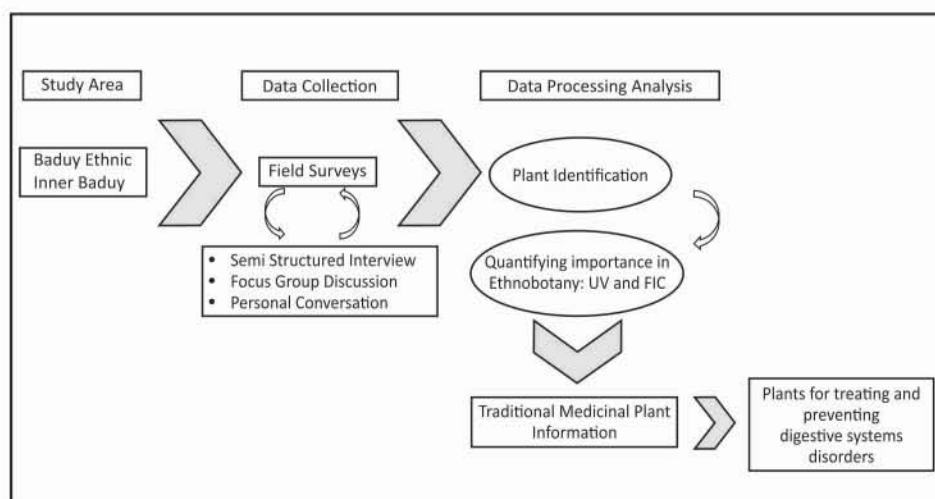


Figure 1 Flow chart of Ethnobotanical Study in the Baduy Ethnic Community

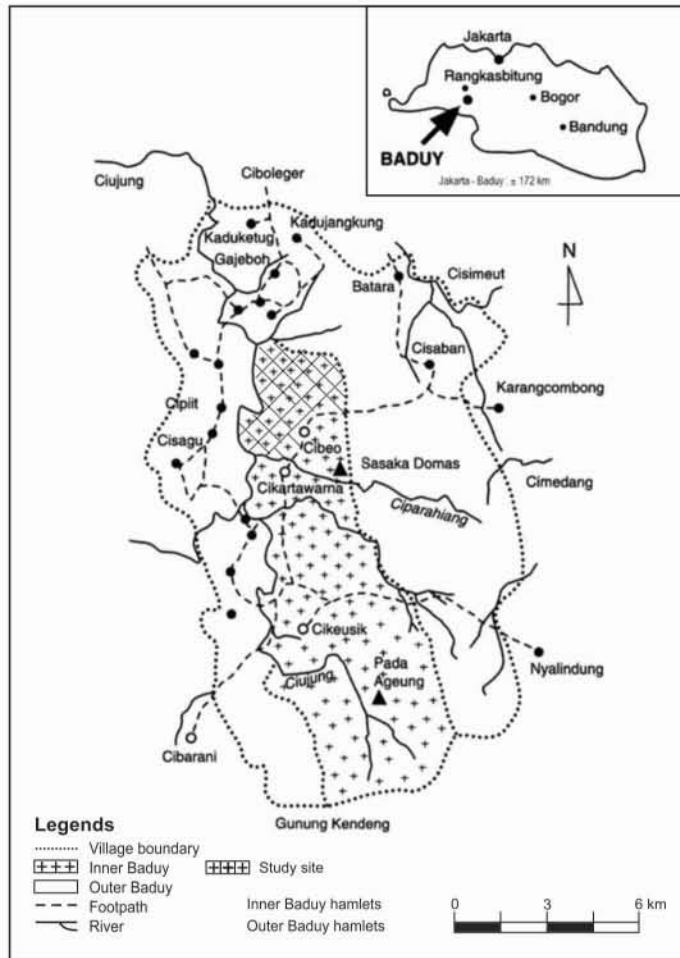


Figure 2 Map of the study site. Baduy area of the Kanekes Village, Leuwidamar Subdistrict, Lebak, Banten Province (Iskandar & Iskandar, 2017)

**Data Collection**

Prior to documenting ethno pharmacological data, semi-structured interviews and focus group discussions, personal conversations with locals, and field surveys (Martin 1995) were conducted in September 2016 until July 2017. A total of 30 household heads from the Cibeo hamlet with age ranging from 20 to 40 years with an average age of 35 years, participated in the study as informants. All informants were ethnic Baduy and were born and raised in their respective villages. The names and ages of the informants, the local names of plants and plant parts used, the method of preparation, and the medicinal uses, were recorded. Prior to the field survey, several textbooks of plant diversity were consulted for identification purposes including the Flora Malesiana series (van Steenis 1972) and Flora of Java (Backer & van den Brink 1965). Medicinal plants were photographed and made into herbarium specimen for complete identification by the botanist at the Laboratory

of Biology Education, Faculty of Teacher Training and Education, University of Sultan Ageng Tirtayasa, Indonesia. The observed plant morphology included the characters of the roots, stems, leaves, flowers, seeds and fruit.

**Analysis**

The use values (UV) of the medicinal plant species were analyzed based on Galeano *et al.* (2000) and according to the equation  $UV = U / V$ , in which  $U$  is the number of mentions per species, and  $N$  is the number of informants. UV is a quantitative parameter that indicates the relative importance of species known by the locals.

The Informant Consensus Factor (ICF), initially developed by Trotter and Logan (1986), was used to identify the relative importance of medicinal plants in ailment categories in a particular culture. ICF was calculated according to the equation  $ICF = Nur - Nt / Nur - 1$ , in which  $Nur$  is the number of uses mentioned in

each category, and  $Nt$  is the number of species indicated in each category. ICF values range from 0 to 1; values closer to 1 indicate a higher proportion of informant consensus on plant species used against a disease category, whereas values closer to 0 indicate the opposite, a lower informant consensus on plant species used as a cure.

## RESULTS AND DISCUSSION

A total of 54 species belonging to 47 genera and 30 families were recorded for the treatment of digestive system disorders (Table 1). For each species, the scientific name with voucher number, family, vernacular name in Sundanese, ailments treated, parts used, forms of

preparation, and uses were documented. The reported plant families included Arecaceae, Fabaceae, Zingiberaceae (four species each), Acanthaceae, Euphorbiaceae, Moraceae, Piperaceae (three species each), Apocynaceae, Convolvulaceae, Melastomataceae, Menispermaceae, Poaceae, Rubiaceae, Solanaceae (two species each), Amaranthaceae, Begoniaceae, Compositae, Dilleniaceae, Gnetaceae, Lamiaceae, Liliaceae, Magnoliophyta, Malvaceae, Meliaceae, Mimosaceae, Myristicaceae, Myrtaceae, Palmae, Phyllanthaceae, and Verbenaceae (one species each). All the reported plants were commonly used in treating digestive system disorders by the Baduy community because they are readily cultivated or grow as wild plants that can be harvested from the nearby forest where the Baduy live.

Table 1 Medicinal Plants Used to Treat Digestive System Disorders in Baduy Communities

Family	Species	Local name (Sundanese)	Wild/Cultivated	Ailments treated or plant uses	Parts used	Forms of preparation and use	Use value (UV)
Acanthaceae	<i>Strobilanthes crispus</i> Bl.	Pecah beling	C	Hemorrhoids	Leaf	Decoction	0.50
	<i>Staurogyne elongata</i> (Bl.) O.K	Reundeu	W	Stomach ache	Leaf	Edible	0.47
	<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Samiloto	W	Diarrhea	Leaf	Decoction	0.83
Amaranthaceae	<i>Celosia argentea</i> L.	Gamet	W	Appetite stimulant	Leaf	Crushed	0.43
Apocynaceae	<i>Tylophora cissoides</i> Bl.	Areuy peujit Kotok	W	Stomach ache	Latex	Infusion	0.23
	<i>Alstonia scholaris</i> R. Br.	Lame	W	Intestinal worm infection	Latex	Infusion	0.17
Arecaceae	<i>Areca catechu</i> L.	Jebug	W	Toothache	Root	Crushed	0.60
	<i>Ageratum conyzoides</i> L.	Babadotan	W	Flatulence	Leaf	Decoction	0.53
	<i>Blumea balsamifera</i> (L.) DC.	Capeu	W	Appetite stimulant	Leaf	Decoction	0.33
	<i>Cocos nucifera</i> L. var. <i>viridis</i>	Kalapa hejo	C	Flatulence	Bark Peel	Decoction	0.87
Begoniaceae	<i>Begonia isoptera</i> Dryand	Areuy bingbirangan	W	Stomach ache	Leaf	Decoction	0.20
Compositae	<i>Mikania cordata</i> (Burm.f.) B.L. Rob.	Areuy caputuher	W	Jaundice, Stomach ache	Whole plant	Decoction	0.27
Convolvulaceae	<i>Lepistemon binectariferum</i> (Wall.) Kuntze	Areuy plumpung	W	Stomach ache	Leaf, resin	Decoction	0.40
	<i>Merremia peltata</i> (L.) Merr.	Areuy palungpung	W	Flatulence	Leaf	Decoction	0.17
Dilleniaceae	<i>Tetracera indica</i> Merr.	Areuy asahan	W	Stomach ache	Bark juice	Drink	0.10
Euphorbiaceae	<i>Acalypha caturus</i> Bl.	Ki lauk	W	Appetite stimulant	Juvenile leaf	Edible	0.53
	<i>Macaranga tanarius</i> (L.) Muell.Arg.	Mara	W	Gastric ulcer	Leaf	Decoction	0.13
	<i>Euphorbia hirta</i> L.	Patikan kebo, Nanangkaan	W	Mouth ulcer	Latex	Rubbed	0.60
Fabaceae	<i>Erythrina litbosperma</i> Miq.	Dadap	W	Stomach ache	Leaf	Crushed	0.47
	<i>Abrus precatorius</i> L.	Saga	W	Mouth ulcer	Leaf, root	Crushed	0.60
	<i>Pterocarpus indicus</i> Willd.	Angsana	W	Toothache	Resin	Crushed	0.77
	<i>Mimosa pudica</i> Duchass. & Walp	Gehgeran, Putri malu	W	Mouth ulcer	Leaf	Crushed	0.70
Gnetaceae	<i>Gnetum neglectum</i> Bl.	Kasungka	C	Intestinal worm infection	Stem juice	Decoction	0.67
Lamiaceae	<i>Orthosiphon stamineus</i> (Blume) Miq.	Kumis ucing	C	Flatulence	Leaf	Decoction	0.80
Liliaceae	<i>Cordiline frusticosa</i> (L.) A.Chev.	Hanjuang	C	Hemorrhoids	Rhizome, leaf	Decoction	0.53

Table 1 (continued)

Family	Species	Local name (Sundanese)	Wild/Cultivated	Ailments treated or plant uses	Parts used	Forms of preparation and use	Use value (UV)
Magnoliophyta	<i>Villebrunea rubescens</i> (Bl.) Bl	Nangsi	W	Toothache	Stem juice	Edible	0.63
Malvaceae	<i>Durio zibethinus</i> Murr.	Kadu	C	Toothache	Nectar	Edible	0.43
Melastomataceae	<i>Melastoma malabathricum</i> Auct.	Harendong	W	Diarrhea, toothache, mouth ulcer	Leaf	Crushed	0.60
	<i>Bellucia axinanthera</i> Triana	Harendong leuweung	W	Stomach ache	Fruit	Edible	0.43
Meliaceae	<i>Sandoricum koetjape</i> (Burm.f.) Merr.	Kecapi	C	Diarrhea	Leaf, bark	Edible	0.43
Menispermaceae	<i>Arcangelisia flava</i> Merr.	Areuy ki koneng	W	Diarrhea, jaundice	Root, bark	Decoction	0.20
	<i>Tinospora crispa</i> (L.) Diels.	Martawali	W	Jaundice, intestinal worm infection	Bark, leaf	Decoction	0.57
Mimosaceae	<i>Pithecolobium lobatum</i> Benth.	Jengkol	C	Appetite stimulant	Juvenile leaf	Edible	0.77
Moraceae	<i>Ficus hispida</i> L.f.	Bisoro	W	Diarrhea, stomach ache, jaundice	Juvenile leaf, fruit	Edible	0.27
	<i>Ficus sagittata</i> Vahl.	Areuy ki baik	W	Mouth ulcer, stomach ache, jaundice	Latex	Decoction	0.27
	<i>Ficus racemosa</i> Roxb.	Walén	W	Stomach ache	Juvenile leaf	Edible	0.63
Myristicaceae	<i>Horsfieldia glabra</i> Warb.	Ki beo, Kalapa ciung	C	Toothache	Fruit, leaf	Edible	0.77
Myrtaceae	<i>Psidium guajava</i> L.	Jambu batu	C	Diarrhea	Fruit, leaf	Edible	0.27
Palmae	<i>Arenga pinnata</i> (Wurmb) Merr.	Kaung	W	Constipation	Root	Decoction	0.83
Phyllanthaceae	<i>Phyllanthus acidus</i> Skeels.	Cereme	W	Appetite stimulant	Fruit	Edible	0.87
Piperaceae	<i>Piper betle</i> L.	Sereh	C	Toothache, mouth ulcer	Leaf	Crushed	0.83
	<i>Piper sulcatum</i> Bl.	Areuy rinu	W	Flatulence	Fruit	Edible	0.27
	<i>Piper aduncum</i> L.	Gedebong	W	Nausea	Seed	Crushed	0.63
Poaceae	<i>Imperata cylindrical</i> (L.) P.Beauv.	Eurih	W	Mouth ulcer, Pharyngitis	Root	Decoction	0.50
	<i>Andropogon nardus</i> L.	Sereh	C	Appetite stimulant	Leaf	Decoction	0.57
Rubiaceae	<i>Morinda citrifolia</i> L.	Mengkudu	C	Jaundice	Fruit	Edible	0.67
	<i>Nauclea orientalis</i> L.	Gempol	W	Nausea	Root	Decoction	0.67
Solanaceae	<i>Physalis minima</i> L.	Cecenet	W	Intestinal worm infection	Root	Decoction	0.80
	<i>Physalis angulata</i> L.	Cecendet	W	mouth ulcer, gastric ulcer, stomach ache	Fruit	Edible	0.67
Verbenaceae	<i>Clerodendrum serratum</i> (L.) Moon	Singugu	W	Intestinal worm infection	Leaf	Decoction	0.67
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Jahe	C	Flatulence	Root	Decoction	0.93
	<i>Zingiber zerumbet</i> (L.) Roscoe ex Sm.	Lempuyang	C	Appetite stimulant	Root	Decoction	0.67
	<i>Zingiber amaricans</i> Bl.	Lampuyang	C	Stomach ache	Leaf	Decoction	0.67
	<i>Costus speciosus</i> Smith	Pacing	C	Jaundice	Stem juice	Decoction	0.83

Different plant parts were used for the treatment of various digestive system disorders (Fig. 3). The leaves were the most commonly used (43%), followed by the root (15%), fruit (13%), resin (10%), bark (8%), stem substance (5%), whole plant (2%), nectar (2%), and seed (2%). In most cases, the medicinal plants were prepared in the forms of juice, decoction, infusion, paste, and powder.

The UVs of the plants ranged from 0.1 to 0.933. The interview results revealed that the three most selected species were *Zingiber officinale* (0.93) that had the greatest UV among all plants, followed by *Cocos nucifera* L. var *viridis* and *Phyllanthus acidus* Skeels (Table 1). A high UV value for a particular plant indicated a high number of uses reported by informants.

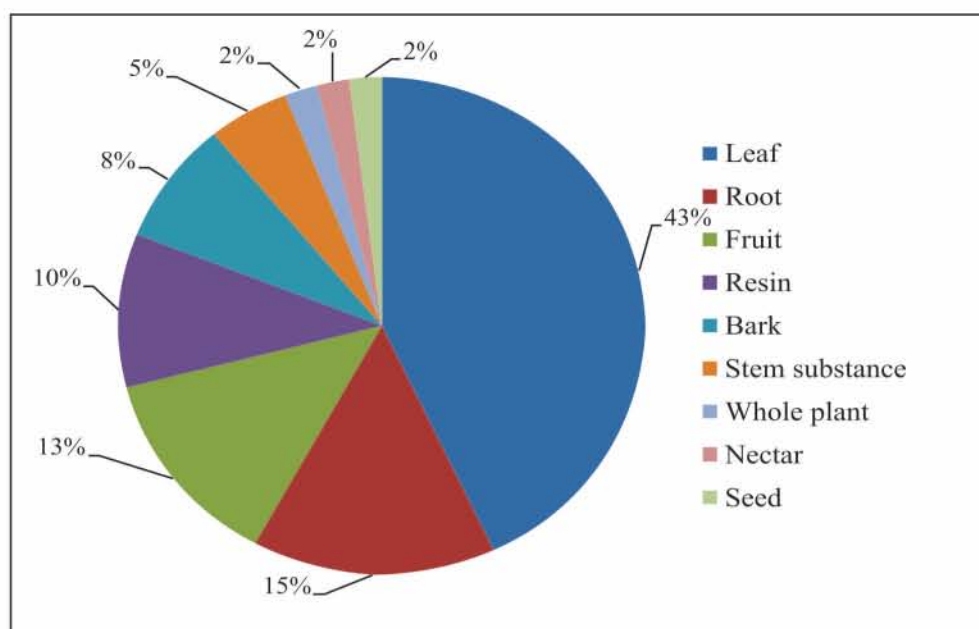


Figure 3 Use patterns of the documented medicinal plant parts

Table 2 Category of Ailment Treated and Informant Consensus Factor (ICF)

Ailments treated or plant uses	Number of taxa	Number of use report	ICF
Constipation	2	26	0.96
Gastric ulcer	2	12	0.91
Nausea	2	11	0.90
Hemorrhoid	2	8	0.86
Diarrhea	6	28	0.81
Intestinal worm infection	5	21	0.80
Flatulence	6	25	0.79
Appetite stimulant	7	25	0.75
Mouth ulcer	6	18	0.71
Toothache	6	16	0.67
Pharyngitis	2	4	0.67
Stomach ache	13	20	0.37
Jaundice	7	10	0.33

ICF was determined for 13 ailments or plant uses: appetite stimulant, constipation, diarrhea, flatulence, gastric ulcer, hemorrhoids, intestinal worm infection, jaundice, mouth ulcer, stomach ache, toothache, pharyngitis, and nausea. ICFs ranged from 0.33 to 0.96, with a mean value of 0.733 (Table 2). The ailment treated with the most use reports was constipation (0.96). The ICF values for disease treatment depended upon the availability of the medicinal plant species in the area of the studied Baduy community.

Increasing access to medicinal plants in Indonesia, a country with one of the world's most highly diversified plant species, has greatly benefited the locals, especially members of Indonesia's indigenous communities. Many studies conducted among indigenous

communities elsewhere in Indonesia. For instance, among the Dayak communities in West Kalimantan (Diba *et al.* 2013) and Sundanese communities in West Java (Roosita 2008), have documented not only the plant parts used (e.g., leaves, wood, fruits, roots, and flowers) and their processing techniques but also their beneficial effects. This current study documented that information on the uses of 54 plant species in treating 13 different ailments among the Baduy people were collected from reliable informants and were based on their personal experience. The commonly used plants that the Baduy have administered to treat and prevent digestive disorders were readily available and had healing properties.

To obtain extracts used for medicine, the informants collected the fresh or dried plant materials from the entire plants or their parts. Of all the plant parts used, the leaves were the most commonly prepared part as medicines (43%). Leaves contain a myriad of secondary metabolites or phytochemicals that play a vital role in the treatment and prevention of various digestive disorders (Kumar *et al.* 2009). The Baduy typically use fresh leaves by boiling these in water for decoctions, as they also did with other plant parts used for medicinal materials. Such preparation usually involved reducing the water volume by a third. Studies conducted in other indigenous communities around the world have shown that leaves were also the most used plant part for medicine at rates of 51.39 % in the Turgo hamlet of Yogyakarta, Indonesia (Nahdi *et al.* 2016), 47.65% in Argentina (Teves *et al.* 2015), and 34% in the Limpopo district of South Africa (Semenya & Maroni 2012). The current results also supported the findings of Handayani (2015), that leaves were the most frequently used parts in plant-based medicines. Leaves and other plant materials, including rhizomes, were also prepared for medicines by pounding and squeezing. According to the informants, the Baduy also mixed some plants with other plants depending on their intended uses. Single and mixed medicinal plant preparations may have different effects, for a mixed-medicinal plant formula may contain several hundred times the natural constituents that numerous single-medicinal plants contained.

Quantitative analysis was performed to authenticate and project the relative importance of medicinal plant species in their traditional use. Plants with high UV were also used among other indigenous communities throughout Indonesia (Nulfitriani *et al.* 2013). The plants with the first three largest UV among the medicinal plants documented in Baduy area were; Ginger (*Zingiber officinale* Roscoe), Coconut (*Cocos nucifera* L.), and *Phyllanthus acidus* Skeels.

Ginger has the greatest UV; its rhizomes are used not only as a component in medical treatments but also as an additive in numerous foods and daily beverages (e.g., *bandrek* and *bajigur*) of the Baduy people (Figure 4). Due to its aromatic compounds, Ginger is a valuable rhizome that releases a spicy, pungent, pleasant smell. The effectiveness of using ginger in the preparation of remedies against various digestive problems, including loss of appetite, flatulence, indigestion, diarrhea, and dysentery, was also reported by Sidhu & Pannu (2010).

Coconut (*Cocos nucifera* L.) registered the second-greatest UV among the Baduy who cultivate the plant and use all of its parts in one way or another for diverse purposes in their daily lives. The parts of the fruit, including the coconut kernel and tender coconut water, have numerous medicinal properties, including antibacterial, antifungal, antiviral, antiparasitic, and immunostimulant properties, that are effective against digestive system disorders (DebMandal & Mandal, 2011). The medicinal properties of coconut emanating from its constituents, include vitamin B, nicotinic acid (B3, 0.64 µg/mL), pantothenic acid (B5, 0.52 µg/mL), biotin (0.02 µg/mL), riboflavin (B2, <0.01 ng/mL), folic acid (0.003 µg/mL), and trace quantities of vitamins B1, B6, and C, as well as pyridoxine, thiamine, amino acids, L-arginine, plant hormones (auxin, 1,3-diphenylurea, and cytokinin), enzymes (acid phosphatase, catalase, dehydrogenase, diastase, peroxidase, and RNA polymerases), and other growth-promoting factors (Solangih & Iqbal, 2011). Other studies conducted in several countries have also reported the use of coconut in treating digestive system disorders. People in Brazil have used the extract from the husk fiber of *C. nucifera* to treat diarrhea (Akinyele *et al.* 2011), which people in Ghana have treated with coconut milk (Lima *et al.* 2015).



Figure 4 The third largest UV medicinal plants used by Baduy Ethnic. a. *Zingiber officinale* Roscoe. b. *Cocos nucifera* L. var. *viridis*. c. *Phyllanthus acidus* Skeels.

*Phyllanthus acidus* Skeels has the third largest UV in this study. This species is not only functioned as edible fruit, but also is known to cure wide spectrum of diseases in Asia, the Caribbean region, as well as Central and South America (Tan *et al.* 2020). Several studies showed that this plant is abundant in a number of phytochemicals, such as flavonoids, alkaloids, lignans, terpenes, steroids, and essential oil (Chakraborty *et al.* 2012; Nisar *et al.* 2018), which have remarkable health benefits.

Among the study plants, *Tetracera indica*, has the lowest UV. Most informants were unfamiliar with the medicinal plant species and had little knowledge about its ethnobotanical uses. Species in the genus *Tetracera* have also been used as medicinal plants by the Ehotile people near Aby Lagoon in Côte d'Ivoire, Africa. However, these plants containing the sought-after exudate are found only in old marshlands that are scarce and difficult to access (Malan *et al.* 2015).

According to one key informant, most of the raw materials of these medicinal plants were difficult to find along the village periphery, as the original habitats of the cultivated plants were in the wild and were located in the forest. Based on vegetation structure, the Baduy forest lands can be divided into two categories—*reuma* which is developed from fields that have long been abandoned, and are covered with dominant plants growing on the land, and *leuweung kolot* as protected areas, forbidden from entry or use as a field. Both of these contain a high diversity of plant sources for medicinal purposes. However,

some areas in the forest are considered to be sacred, and entry is forbidden.

Forests and other types of habitat provide a wide range of medicinal plant resource-base for primary healthcare, especially in rural areas (Lindborg *et al.* 2012). This study has identified a fairly large number of plants used to treat various ailments, particularly among the Baduy community. The high diversity of species reported to be readily available for medicinal purposes could indicate not only a dependency on plants in the treatment of ailments among the Baduy but also an immense amount of local knowledge about herbal medicines in the community. Despite the widespread use of those plants, however, no pharmacological studies have been conducted to determine their efficacy and safe use. Hence, the identity of the medicinal plants used by the Baduy provided a platform for formulating further preclinical and clinical studies to determine the efficacy and safe use of herbal preparations in Indonesia and elsewhere.

## CONCLUSIONS

In summary, the study showed that the Baduy people of Banten Province, Indonesia, use immediate natural resources namely, 54 plant species, both as a whole plant and in part and as fresh and dried materials, and that they possess indigenous knowledge to treat digestive system disorders in their community.



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