



# An ethnobotanical study of medicinal plants and traditional therapies on Batan Island, the Philippines

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## ABSTRACT

**Ethnopharmacological relevance:** We studied the local knowledge and uses of medicinal plants among the Ivatan people of Batan Island by documenting their traditional practices.

**Aim of the study:** To identify the types of medicinal plants used in self-care by the indigenous people of Batan Island, the Philippines and to investigate the extent to which the plants are used. Conservation of medicinal plants and natural resources is becoming increasingly important; thus, this research aims to collect information from local people concerning the use of medicinal plants on Batan Island.

**Materials and methods:** A total of 116 informants were interviewed, allowing for calculated informant consensus factors (ICF), use value (UV), and fidelity levels (FL) for each medicinal plant species used to cure various ailments. This helped to establish a consensus on which species are effective for particular ailments, as well as the species' relative importance, and enabled us to understand the extent of the potential utilization of each species.

**Results:** We describe the therapeutic effects of 112 plant species used medicinally against 13 categories of ailments. The highest ICF value (1.00) was cited for diseases of the ear and respiratory system and for use during pregnancy, childbirth and the postnatal period. The maximum FL of 100% was found for *Carica papaya*, *Stachytarpheta jamaicensis*, *Musa sapientum*, and *Pedilanthus tithymaloides*, used for the treatment of constipation, cuts and wounds, diarrhea, and dislocations and fractures, respectively. The highest UV was for *Hibiscus rosa-sinensis* (0.67). All plants with high UV were used for exogenous diseases, certain infectious and parasitic diseases, injuries, poisonings and other consequences of external factors, and diseases of the skin and subcutaneous tissues. In addition to its use for endogenous disease and lifestyle-related diseases and illnesses, *Moringa oleifera* is also used for diseases of the circulatory system, with a UV of 0.57 and *Cocos nucifera* is used for diseases of the genitourinary system, with a UV of 0.56.

**Conclusions:** This study demonstrates that many plant species play an important role in local healing practices and that knowledge of traditional medicine is still utilized and plays a significant role on Batan Island. The documentation of this rich traditional ethno-medicinal knowledge has furnished us with novel information that not only will provide recognition of this undocumented knowledge but also could provide new avenues for pharmacological investigations to improve healthcare for a range of ailments.

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## 1. Introduction

Medicinal plants have been used for treatment since ancient times and are still in use all over the world. Of the 422,000 flowering plants found globally (Govaerts, 2001), more than 50,000 are used for medicinal purposes (Schippmann et al., 2002). The practices of plant-based traditional medicine are based on hundreds of years of belief and observations, which predate

the development of modern medicine (Aburjai et al., 2007). Batan Island in the Philippines is rich in wild resources including varied flora because of the Kuroshio Current's warm and rainy climate (Top, 1992). Moreover, the Kuroshio Current is known as a north–south route for the transmission of a variety of plant resources and knowledge of herbal therapies. Additionally, 129 of the 529 plant species on Batan Island were on Ryukyu Island in Japan (Hatusima, 1966). It is believed that there are more than 700 species of flowering plants on the Batanes Islands, and that, remarkably, these contain a high percentage of endemic species. At least 251 species of flowering plants have been found on Batan Island, 42 of which are endemic to the Philippines and seven to

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Batan Island. The local Ivatan people reportedly use 138 different species of plants for foods, medicines, and other uses (Batanes Protected Lands and Seascape, 2001).

The Ivatan people make their living mainly through agriculture and fisheries, with the main crops of the region being root crops such as yam (*Dioscorea alata*; “uvi,” “dukay”), sweet potato (*Ipomoea batatas*; “wakay”), and taro (*Colocasia esculenta*; “sudi”). The Ivatan people share cultural commonalities with the Yami people of Orchid Island, Taiwan, with whom they have interacted since ancient times (Kano, 1946). Because of Batan Island’s isolation between the Philippines and Taiwan, its rich flora and unique traditional culture have remained intact. However, in recent years, with further economic development in the Philippines, the nature of healthcare has turned towards Western medicine. The rapid disappearance of traditional culture and natural resources due to urbanization suggests that unrecorded folk knowledge and information may be lost forever. Hence, there is an urgent need to systematically document the medical practices of Batan Island. Traditional and folk medicines have served as the means of immediate therapy to maintain the health of people living in such dispersed island areas. The conservation of ethnobotanical knowledge is becoming increasingly important; thus this research aims to document the use of medicinal plants and healing practices on Batan Island, identify the most important species, determine the relative value of species and calculate the informant consensus factors.

## 2. Materials and methods

### 2.1. Study area

This fieldwork was undertaken with the aid of the Ivatan community on Batan Island of Batanes, the Philippines. The Batanes Islands are located approximately 162 km north of Luzon Island in the Philippines and 100 km south of Taiwan and have a total area of approximately 209 km<sup>2</sup>; they are the northernmost part of the Philippines and it is the smallest province in terms of both population and land area. The study site, Batan Island, is composed of four municipalities, Mahatao, Ivana, Uyugan, and Basco, the provincial capital. The indigenous people of Batan Island are Ivatan and number approximately 11,440 according to the 2007 Philippine Census (Philippine National Statistics Office, 2007). There is only one hospital and one doctor’s office,

referred to as the clinic, and this is in Basco. The hospital is the only health institution that can manage surgical and obstetric emergencies. Typically, local people visit the health center in each municipality to address their health concerns instead of visiting the hospital. Only when they cannot be treated at the health center do they choose to visit the hospital. On the entire island, 14% of the population has access to health facilities. All residents have access to sanitary toilet facilities and safe drinking water, and 90.2% have electricity. Annual income levels are lower than in other regions of the Philippines (Philippine National Statistics Office, 2007).

### 2.2. Data collection

Fieldwork was carried out for a total of six weeks in 2008 and 2009 on Batan Island. The work consisted of interviews, plant observations, and the collection of medicinal plants in four different sites: Basco, Mahatao, Ivana, and Uyugan (Fig. 1). We interviewed 116 local people on Batan Island (58 female and 58 male, aged between 20 and 93, with the median age being 54) from Basco ( $n=30$ ), Mahatao ( $n=26$ ), Ivana ( $n=29$ ), and Uyugan ( $n=31$ ). The data were collected through semi-structured interviews with residents and informal conversations with medical personnel from Batanes General Hospital, the clinic in Basco, and the Uyugan health center, using either English or Ivatan. The informants were asked about their knowledge of the plants they used to combat disease, the parts of the plant used, the modes of preparation, and details concerning how each plant is administered to patients, how such knowledge is obtained and transmitted, the frequency of use, the responses of patients who compare plant remedies with Western medicine, and how easy it is to find the necessary plants. The informants were selected randomly and no appointments were made prior to the visits. The plants were collected, pressed and dried in the field and the voucher specimens were later deposited at the Kochi University Herbarium. The plants’ vernacular names were collected with the help of local people. Scientific names were determined by identifying herbarium species and checked against references in the *Dictionary of Philippines Plant Names* (Madulid, 2001). Scientific names of plants were determined using *The Plant Names Index* (IPNI, 2004). The paired-sample  $t$  test was used to determine whether there were significant differences between known medicinal plants and those actually used. All of the analyses were conducted using the Excel 2003 software package for Windows.

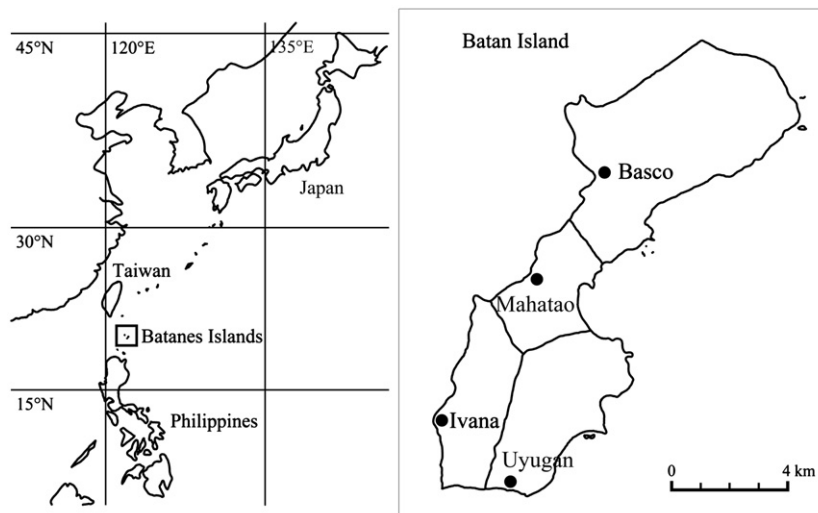


Fig. 1. Study sites (●) in Batan Island, the Philippines. The lines are divided into four municipalities; Basco, Mahatao, Ivana and Uyugan.

Of the inhabitants interviewed, 31% had a complete college education, 43% had a complete high school education, 21% had a complete elementary education, and 5% had an incomplete primary education. More than half of all informants were farmers, and most interviewees (67.2%) had annual personal cash incomes of 50,000 pesos or less. Approximately 60% of the people interviewed were members of PhilHealth (the Philippine Health Insurance Corporation), and one-third of people had also joined KsK (Kapanidungan sa Kalusugan), a community health insurance plan that the Batanes government established in 2003. Ten percent of informants subscribed only to KsK, meaning that a total of 70% were covered by some form of health insurance plan. The subscription rate to PhilHealth across the whole of the Philippines averaged 76% in 2008 (Philippine Health Insurance, 2009).

### 2.3. Data analysis

#### 2.3.1. Use categories

The medicinal plants were identified based on the information obtained from the informants in the study area, and the reported applicable ailments were classified into 13 categories based on the International Classification of Diseases (ICD-10) by the World Health Organization. The categories were infectious and parasitic diseases; endocrine, nutritional and metabolic diseases; diseases of the eye and adnexa; diseases of the ear and mastoid process; diseases of the circulatory system; diseases of the respiratory system; diseases of the digestive system; diseases of the skin and subcutaneous tissue; diseases of the musculoskeletal system and connective tissue; diseases of the genitourinary system; diseases during the postpartum period; undefined pains or illness; and injury and poisons from external causes (Table 1). Moreover, information on plants that have a medicinal use but that also used for food or other economical uses was also noted. Every time a plant was mentioned as being used to any extent, it was

considered to be one use-report. If one informant used a plant to treat more than one ailment in the same category, we considered it a single use-report (Amiguet et al., 2005). However, a multiple use-report was considered when at least two interviewees mentioned the same plant for the same ailments.

#### 2.3.2. Informant consensus factor

To determine the agreement between informants over which plants should be used for each category of ailment, we calculated the informant consensus factor (ICF) (Trotter and Logan, 1986) using the formula:  $ICF = (N_{ur} - N_t) / (N_{ur} - 1)$ , where  $N_{ur}$  refers to the number of use-reports in each category and  $N_t$  refers to the number of taxa used for a particular category by all informants. The ICF provides a range of 0–1, where high values (approaching 1) are obtained when there is a well-defined selection criterion in the community and/or if information is exchanged between informants, and values are low (near 0) when plants are chosen randomly or if there is no exchange of information about their use among informants.

#### 2.3.3. Use value

We calculated the use values for plants (Phillips et al., 1994) to provide a quantitative measure for the relative importance of species known locally:  $UV = (\sum U_i) / n$ , where  $U_i$  is the number of use-reports cited by each informant for a given species, and  $n$  refers to the total number of informants. Use values are high when there are many use-reports for a plant, implying that the plant is important, and low (approach to 0) when there are few reports related to its use. The use value, however, does not distinguish whether a plant is used for single or multiple purposes.

#### 2.3.4. Fidelity level

Because many plant species may be used in the same use category, we needed to determine the most preferred species

**Table 1**  
Categories of ailments and informant consensus factor (ICF).

Category	Diseases or ailments	ICD-10	No. of use-reports	% of all use-reports	No. of species	% of all species	ICF	Most frequently used species	% of all species	FL (%) in this category
Diseases of the ear and mastoid process	Earache	VIII	2	0.1	1	1.4	1.00	<i>Paederia scandens</i>	91	4
Diseases of the respiratory system	Asthma, nasal congestion, pneumonia cough, sore throat	X	5	0.3	1	1.4	1.00	<i>Datura metel</i>	100	50
Diseases of the eye and adnexa	Red eyes, sore eyes	VII	22	1.5	2	2.7	0.95	<i>Calophyllum inophyllum</i>	91	100
Diseases of the circulatory system	Anemia, high blood pressure	IX	155	10.8	10	13.5	0.94	<i>Allium sativum</i>	30	100
Injury and poisons of external causes	Allergy, burns, cuts and wounds, dislocation/fracture, sprain, insect bites, snake bites, poison	XIX	386	27.0	26	35.1	0.94	<i>Argemone mexicana</i>	15	100
Diseases of the genitourinary system	Urinary, chronic cystitis, kidney	XIV	75	5.2	6	8.1	0.93	<i>Cocos nucifera</i>	60	69
Undefined pains or illness	Abdominal pain, backache, body pain, cough, fever, headache, stunned	XVIII	322	22.5	25	33.8	0.93	<i>Piper betel</i>	20	30
Diseases during the postpartum period	Abortive, menstruation, new delivered	XV	11	0.8	2	2.7	0.90	<i>Radermachera fenicis</i>	64	100
Infectious and parasitic diseases	Ascariasis, chicken pox, head lice, herpes, ringworm, scabies	I	88	6.1	10	13.5	0.90	<i>Senna alata</i>	51	73
Diseases of the skin and subcutaneous tissue	Boils, skin eruptions	XII	155	10.8	17	23.0	0.90	<i>Hibiscus rosa-sinensis</i>	48	96
Diseases of the digestive system	Constipation, diarrhea, inflammation of rectum, ulcer, toothache	XI	149	10.4	15	20.3	0.91	<i>Carica papaya</i>	33	100
Endocrine, nutritional and metabolic diseases	Diabetes, nutrients, tonic	IV	26	1.8	5	6.8	0.84	<i>Moringa oleifera</i>	42	19
Diseases of the musculoskeletal system and connective tissue	Arthritis, rheumatism, swollen muscles	XIII	35	2.4	9	12.2	0.76	<i>Barringtonia asiatica</i>	31	48

Table 2

Medicinal plants used on Batan Island, the Philippines and use value (UV).

Plant no.	Scientific name	Family	Local name	No. of use-reports	Use value (UV) <sup>a</sup>	No. of categories <sup>b</sup>	Diseases or ailments	Parts used <sup>c</sup>	Preparation and administration <sup>d</sup>
1	<i>Epipremnum pinnatum</i> (L.) Engl.	Acoraceae	tudivachib	1	–	–	Cuts and wounds	Sp	E Apply
2	<i>Tetragonia tetragonoides</i> (Pall.) Kuntze	Aizoaceae	spinach	1	–	–	Anemia	Lf	I Eat raw or cooked leaves
3	<i>Allium cepa</i> L.	Alliaceae	bulyas	9	0.08	1*	Boils	Rz	E Apply pounded rizomes
4	<i>Deeringia polysperma</i> (Roxb.) Moq.	Amaranthaceae	adit	2	0.02	1*	Boils	Lf	E Apply
5	<i>Mangifera indica</i> L.	Anacardiaceae	mangas	1	–	–	Sore throat	Lf	I Drink decoction
6	<i>Annona squamosa</i> L.	Annonaceae	atis	4	0.03	1*	Fever	Lf	E Apply on a head as a cool compress
7	<i>Alstonia macrophylla</i> G. Don.	Apocynaceae	karayum	2	0.02	1*	Abdominal pain	Lf, Bk	E Apply
8	<i>Plumeria rubra</i> L.	Apocynaceae	kalachuchi	2	–	–	Skin eruption	Tk	E Apply sap from trunks with few drops of oil
9	<i>Tabernaemontana pandacqui</i> Lam.	Apocynaceae	manichit	17	0.15	2	Diarrhea; abdominal pain; body pain	Lf	E Wrap pounded or heated for 5 seconds with banana leaves around your waist line
10	<i>Alocasia macrorrhiza</i> (L.) G. Don	Araceae	vula	34	0.29	1	Snake bites; insect bites; poison; allergy (caused by "hateng")	Lf, St, Sp, Rt, Fr	E Apply sap from stems Apply pounded or crashed leaves, stems, roots, or fruits
							Cuts and wounds	Lf, St, Sp	E Apply sap from stems directly. Apply pounded or crashed leaves or stems
11	<i>Colocasia esculenta</i> (L.) Schott	Araceae	sudi	12	0.10	2	Boils; cuts and wounds	Lf, Sp	E Apply sap of stems or fresh leaves to open wounds
12	<i>Polyscias fruticosa</i> (L.) Harms	Araliaceae	papuida	1	–	–	Headache	Lf	E Apply on a head with oil
13	<i>Adonidia merrillii</i> Becc.	Arecaceae	dapiau	1	–	–	Diarrhea	Rt	I Drink decoction
14	<i>Areca catechu</i> L. var. <i>batanensis</i> Becc.	Arecaceae	vua	2	–	–	Ascariasis	Lf	I Eat chewed
15	<i>Cocos nucifera</i> L.	Arecaceae	ñuy	65	0.56	4	Abdominal pain	Lf	E Apply chewed leaves on stomach with tobacco leaves and garlic
							Difficulty of urination	Fr	I Drink fresh coconut water
							Ascariasis; constipation	Fr	I Drink coconut milk from matured fruits
							Scabies; skin eruption	Fr	E Apply coconut oil directly
16	<i>Aloe barbadensis</i> Mill.	Asphodelaceae	sabila	12	0.10	2	Skin eruption; cuts and wounds	Lf	E Apply crushed leaves
17	<i>Ageratum conyzoides</i> L.	Asteraceae	kamuyuvuyuk	8	0.07	1*	Cuts and wounds	Lf	E Apply pounded leaves
18	<i>Arnica montana</i> L.	Asteraceae	tintura arnica	1	–	–	Dislocation/fracture	Lf	E Apply
19	<i>Blumea balsamifera</i> (L.) DC.	Asteraceae	sambong	37	0.32	4	Boils	Lf	E Apply fresh leaves
							Headache	Lf	E Apply fresh or steamed leaves on a head
							High blood pressure; difficulty of urination; cough	Lf	I Drink decoction
20	<i>Chrysanthemum indicum</i> L.	Asteraceae	mansanilla	7	0.06	3	Diarrhea	Lf	E Apply heated leaves on a stomach
							Boils	Lf	E Apply decoction
							Abdominal pain	Lf	I Drink decoction
21	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Asteraceae	parachute	29	0.25	1*	Cuts and wounds	Lf, St	E Pounded and apply the juice
22	<i>Cyanthillium cinereum</i> (L.) H. Rob.	Asteraceae	sta maria	37	0.32	2	Abdominal pain; diarrhea	Lf	E Pounded and apply on navel or use as suppository
23	<i>Eclipta thermalis</i> Bunge	Asteraceae	yayod	3	0.03	1*	Tonic	Lf	I Drink decoction
24	<i>Impatiens balsamina</i> L.	Balsaminaceae	masitas	1	–	–	Headache	Lf	E Apply heated with little amount of oil on a forehead
25	<i>Ehretia microphylla</i> Lam.	Boraginaceae	tsaang gubat	1	–	–	Abdominal pain	Lf	I Drink decoction
26	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	pinya	4	0.03	1*	Constipation	Fr, Lf	I Eat fruits. Drink decoction of leaves
27	<i>Senna alata</i> (L.) Roxb.	Caesalpiniaceae	lingwa; kapulkuru	62	0.53	3	Arthritis	Lf	E Apply boiled or fresh leaves
							Scabies; ascariasis; ringworm; antifungal; skin eruption	Lf	E Apply pounded leaves
28	<i>Canna indica</i> L.	Cannaceae	lalasa	3	0.03	1*	Abdominal pain	Lf, Sd	I Eat raw leaves or seeds
29	<i>Carica papaya</i> L.	Caricaceae	kapaya	49	0.42	1*	Constipation	Fr	I Eat a lot of ripe fruits
30	<i>Calophyllum inophyllum</i> L.	Clusiaceae	vutalaw	20	0.17	1*	Sore eyes	Lf	E Soak young leaves in water whole night and use decoction for washing eyes
31	<i>Terminalia catappa</i> L.	Combretaceae	savidog	11	0.09	1*	High blood pressure; anemia	Fr	I Eat raw or cooked fruits
32	<i>Terminalia nitens</i> C. Presl	Combretaceae	tujit	5	0.04	1*	Abdominal pain	Lf	E Apply heated leaves as a hot compress
33	<i>Commelina benghalensis</i> L.	Commelinaceae	kuhasi	1	–	–	Cuts and wounds	Lf, St	E Pounded and apply juice
34	<i>Ipomoea aquatica</i> Forsskal.	Convolvulaceae	kangkong	2	–	–	Diabetes	Lf	I Drink decoction

Table 2 (continued)

Plant no.	Scientific name	Family	Local name	No. of use-reports	Use value (UV) <sup>a</sup>	No. of categories <sup>b</sup>	Diseases or ailments	Parts used <sup>c</sup>	Preparation and administration <sup>d</sup>
35	<i>Ipomoea batatas</i> (L.) Poir. var. <i>edulis</i> (Thunb.) Kuntze	Convolvulaceae	wakay	2	0.02	1*	Anemia	Lf	I Eat tops as vegetable
36	<i>Ipomoea pes-caprae</i> (Linn.) Roth	Convolvulaceae	vadinu	29	0.25	2	New delivered mother	Bk, Lf	E Pounded and extracted juice from fresh leaves or decoction of bark, and use as shampoo for new delivered mother
							Poison; insect bites	Lf, St	E Apply fresh, heated, steamed leaves on prick of poison fish, sea urchin, or insect bites
37	<i>Ipomoea</i> sp.	Convolvulaceae	gact	1	–	–	Diarrhea	Lf	I Eat
38	<i>Bryophyllum pinnatum</i> (L.f.) Oken	Crassulaceae	siemprebiba	24	0.21	1	Fever	Lf	E Apply on head as a cool compress
							Headache; abdominal pain; body pain	Lf	E Apply heated with oil or fresh leaves
39	<i>Cucurbita maxima</i> Duchesne ex Lam.	Cucurbitaceae	kalabasa	1	–	–	ascariasis	Lf	E Apply
40	<i>Momordica charantia</i> L.	Cucurbitaceae	palyak	31	0.27	3	Ascariasis	Lf	I Eat fresh leaves. Drink decoction
							Anemia; diabetes; ascariasis	Lf, Fr	I Eat cooked leaves or fruits as vegetable Drink decoction of leaves
41	<i>Weinmannia urdanetensis</i> Elm.	Cunoniaceae	karilang	1	–	–	Skin eruptions	Lf	E Apply pounded leaves when infected by “aryas” or “hating tree”
42	<i>Chamaesyce hirta</i> (L.) Millsp.	Euphorbiaceae	tairas	4	0.03	1*	Cuts and wounds	Sp	E Apply
43	<i>Jatropha curcas</i> L.	Euphorbiaceae	katawa	19	0.16	3	Arthritis; dislocation/fracture; sprain	Lf, Bk	E Fastened fresh leaves or barks Fastend heated barks with coconut oil for 3–5 s
44	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	carsava	1	–	–	Diarrhea	N/A	I Drink powdered leaves dissolved in water
45	<i>Melanolepis multiglandulosa</i> (Reinw. ex Blume) Rchb.f. et Zoll.	Euphorbiaceae	ahem	13	0.11	2	Rheumatism	Lf	E Put oil on the levees and heated before apply
							Fever; headache	Lf	E Apply on a forehead as acold compress
46	<i>Pedilanthus tithymaloides</i> (L.) Poit.	Euphorbiaceae	tukdu	10	0.09	1*	Dislocation/fracture	St	E Apply pounded stems
47	<i>Ricinus communis</i> L.	Euphorbiaceae	katawatawa	22	0.19	1	Abdominal pain	Lf	E Apply young leaves on waistline
							Body pain	Lf	E Fastened heated leaves for 3–5 s with coconut oil
							Headache; fever	Lf	E Apply fresh or heated leaves on a forehead
48	<i>Gliricidia sepium</i> (Jacq.) Kunth	Fabaceae	kakawati	5	0.04	2	skin eruption; scabies	Lf	E Apply pounded leaves
49	<i>Indigofera zollingeriana</i> Miq.	Fabaceae	dadin	1	–	–	Cuts and wounds	St	E Crushed and extracted juice from young stems and apply
50	<i>Mimosa pudica</i> L.	Fabaceae	kakuhanen	2	–	–	Diarrhea	Lf	I Drink decoction
							Mumps; boils	Lf	E Apply pounded leaves
51	<i>Pueraria phaseoloides</i> (Roxb.) Benth.	Fabaceae	vaay	4	0.03	1*	diarrhea	Fw	I Drink diluted by water
52	<i>Sesbania grandiflora</i> (L.) Pers. ‘Alba’	Fabaceae	katirai	2	–	–	Diarrhea	Bk	I Drink decoction
							Rheumatism	Rt	E Apply pounded roots
53	<i>Hydrangea subintegra</i> Merr.	Hydrangeaceae	gagadang	2	0.02	1*	Abdominal pain	Lf, St	I/ Drink decoction of stems Apply pounded leaves on abdomen
54	<i>Origanum vulgare</i> L.	Lamiaceae	oregano	2	0.02	1*	Abdominal pain	Lf	E Apply pounded leaves
55	<i>Orthosiphon aristatus</i> (Blume) Miq.	Lamiaceae	tahibu	13	0.11	2	Diabetes; high blood pressure	Lf	I Drink decoction
56	<i>Coleus scutellarioides</i> (L.) Benth.	Laminaceae	mayana	1	–	–	Cuts and wounds	Lf	E Crushed and extracted the juice and drop directly on the wounds
	<i>Coleus formosanus</i> Hayata								N/A
57	<i>Mentha arvensis</i> L.	Laminaceae	herba buena	1	–	–	Fever and headache	Lf	
58	<i>Persea americana</i> Mill.	Lauraceae	avocado	1	–	–	Diarrhea	Lf	I Drink decoction
59	<i>Barringtonia asiatica</i> (L.) Kurz	Lecythidaceae	vutun	23	0.20	2	Rheumatism; arthritis	Lf	E Apply heated leaves as a hot compress
							Abdominal pain	Lf, Fr	E Apply heated leaves with oil or fruits on abdomen
							Evil spirits (body pain)	Lf	E Apply heated leaves with oil to the sudden body pain believed caused by “anitus”
							Body pain; swollen muscles	Lf	E Apply as a cold compress
60	<i>Ormocarpum cochinchinense</i> (Lour.) Merr.	Leeaceae	antinitinid	29	0.25	2	Toothache	Rt, Bk	E Pounded and decocted the roots as mouth wash (gargle). Pounded roots or barks as tooth pick
61	<i>Allium sativum</i> L.	Liliaceae	acos	47	0.41	1*	Arthritis	Rt	I Drink decoction
							High blood pressure	Rz	I Eat 2 raw or half cooked bulbs 2–3 times a day. Drink decoction with calamanci
62	<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae	banaba	4	0.03	1*	Difficulty of urination	Lf, Fr	I Drink decoction
63	<i>Abelmoschus moschatus</i> Medik.	Malvaceae	okra	2	–	–	Constipation, ulcer	Fr	I Eat raw fruits 1 h before and after meals.

64	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	gumamela; kangaya	78	0.67	2	Boils	Lf, Fw	I/ E	Apply pounded leaves. Drink decoction of flower
65	<i>Hibiscus tiliaceus</i> L.	Malvaceae	hanut	1	–	–	Cuts and wounds	Lf, Fw	E	Wash with decoction
66	<i>Tinospora rumphil</i> Boerl	Menispermaceae	mabuga	1	–	–	Abdominal pain	Lf	E	Apply pounded young leaves on a stomach with salts
67	<i>Ficus septica</i> Burm.f.	Moraceae	yabnuy	42	0.36	3	scabies	Sp	E	Mix sap with oil and apply liberally on the affected part
							Fever; headache	Lf	E	Three leaves are overwrapped with coconut oil and tie or fastened to a forehead
							Insect bites; poison	Lf, Sm	E	Pounded or heated and apply to centipede bites or poisonous fish
							Cuts and wounds	Sp	E	Apply
68	<i>Morus alba</i> L.	Moraceae	tañud	17	0.15	1*	Arthritis; body pain	Lf	E	Apply heated leaves
							Cuts and wounds; burns	Sp, Bk, Rt	E	Apply sap directly Apply pounded barks/roots
69	<i>Moringa oleifera</i> Lam.	Moringaceae	malunggay	58	0.50	6	Diabetes	Lf, Sd, Fw	I	Drink decoction
							Nutrients	Lf	I	Eat cooked leaves as vegetable.
							Anemia, high blood pressure	Lf, Sd	I	Eat fresh or cooked leaves or seeds as vegetable Drink decoction of leaves
							Constipation	Lf	I	Eat cooked leaves as vegetable
							Ulcer	Lf	I	Drink decoction.
							Scabies; skin eruption; cuts and wounds	Lf	E	Apply crushed or boiled leaves
70	<i>Musa paradisiaca</i> L.	Musaceae	viniveh (guyud variety)	35	0.30	3	Fever; headache	Lf	E	Apply young leaves on a forehead with oil.
							Boils; cuts and wounds	Lf, Sp, Fw	E	Apply sap directly Apply pounded young leaves or young flowers
71	<i>Musa sapientum</i> L.	Musaceae	viniveh (tsina variety)	17	0.15	1*	Diarrhea	Fr	I	Eat ripe fruits three times a day
72	<i>Musa spp.</i>	Musaceae	viniveh	6	0.05	2	Abdominal pain	Sp	I	Drink sap
							Difficulty of urination	Lf	I	Drink decoction
73	<i>Psidium guajava</i> L.	Myrtaceae	bayawas	39	0.34	4	Diarrhea	Lf, Fr	I/ E	Drink decoction of leaves. Chewed young leaves or young fruits and swallowed Apply leaves on navel with oil
							Cuts and wounds	Lf, Sp	E	Apply sap directly Wash with decoction of leaves
							Scabies, skin eruption	Lf	E	Wash with decoction of leaves
74	<i>Fraxinus japonica</i> Blume ex K.Koch	Oleaceae	ash	1	–	–	Abdominal pain	Lf	E	Apply heated leaves on a navel
75	<i>Averrhoa bilimbi</i> L.	Oxalidaceae	camias	5	0.04	2	Inflammation of rectum	Lf	I	Drink decoction
							Fever	Lf	E	Chopped and boiled leaves for cold or hot bath sponges
76	<i>Pandanus amaryllifolius</i> Roxb.	Pandanaceae	tubayan	12	0.10	2	Rheumatism; difficulty of urination; chronic cystitis	Lf, Rt	I	Drink decoction
77	<i>Pandanus odoratissimus</i> L.f.	Pandanaceae	hago	4	0.03	1*	Scabies	Fr, Sd	E	Apply heated and pounded leaves Apply pulverized seeds with coconut
78	<i>Argemone mexicana</i> L.	Papaveraceae	karutung	56	0.48	1*	Cuts and wounds	Lf, St, Sp	E	Apply the sap from stems, leaves, or flowers Apply pounded stems or leaves
79	<i>Antidesma bunius</i> (L.) Spreng.	Phyllanthaceae	tapusan vuday	1	–	–	Snake bites; fish poison	Lf	E	Apply
80	<i>Piper betle</i> L.	Piperaceae	samuh	64	0.55	1	Cough	Lf	E	Rubbed fresh or steamed leaves with coconut oil then heat for 3–5 s before apply chest and back
							body pain; backache	Lf	E	Apply fresh, heated or steamed leaves
							Fever; headache	Lf	E	Apply on a head as a cool compress
81	<i>Piper nigrum</i> L.	Piperaceae	pamienta	1	–	–	Toothache	Lf	I	Decoction or infusion.
82	<i>Bambusa vulgaris</i> Schrad. ex J.C.Wendl.	Poaceae	kawayan	6	0.05	1*	allergy	St	I/ E	Apply ash from burned stems with coconuts oil. Drink decoction
83	<i>Imperata cylindrica</i> (L.) Beauv. var. major	Poaceae	vachid	1	–	–	Difficulty of urination	Lf	I	Drink decoction
84	<i>Oryza sativa</i> L.	Poaceae	paray	1	–	–	Diarrhea	N/A	I	Eat
85	<i>Saccharum officinarum</i> L.	Poaceae	onas	1	–	–	Cuts and wounds	St	E	Apply pounded stems
86	<i>Saccharum spontaneum</i> L.	Poaceae	tadayiv	1	–	–	Cuts and wounds	N/A	E	N/A
87	<i>Zea mays</i> L.	Poaceae	mayis	2	0.02	1*	High blood pressure	Sk	I	Drink decoction
88	<i>Ardisia confertiflora</i> Merr.	Primulaceae	payin	1	–	–	Skin eruptions	Lf	E	Apply ash from burned leaves with coconuts oil
89	<i>Morinda citrifolia</i> L.	Rubiaceae	dino	2	0.02	1*	High blood pressure	Fr, Rt	I	Drink decoction
90	<i>Paederia scandens</i> (Lour.) Merr.	Rubiaceae	rayi	49	0.42	4	Red eyes	Lf	E	Rub on as a cool compress



Table 2 (continued)

Plant no.	Scientific name	Family	Local name	No. of use-reports	Use value (UV) <sup>a</sup>	No. of categories <sup>b</sup>	Diseases or ailments	Parts used <sup>c</sup>	Preparation and administration <sup>d</sup>
							Earache Evil spirits; body pain	Sp Lf, St	E Put sap directly in ears E Rub fresh or heated leaves or heated stems all over the body includes sudden pain believed caused by the “anitus”
							Fever Abdominal pain Cuts and wounds	Lf Lf, St Lf, St, Sp	E Apply on a forehead E Apply fresh or heated leaves or stems E Apply sap of stems directly to wounds to stop bleeding Rub on crushed leaves or stems
91	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	kahayaw	2	0.02	1*	Boils	Lf	E Apply pounded leaves with salt
92	<i>Chrysophyllum cainito</i> L.	Sapotaceae	caimito	2	0.02	1*	Diarrhea	Fr	I Eat fresh fruits
93	<i>Palaquium formosanum</i> Hayata	Sapotaceae	natu	2	–	–	Cuts and wounds, boils	Lf	E Apply
94	<i>Capsicum frutescens</i> L.	Solanaceae	sili	1	–	–	Arthritis	N/A	E Rub with coconut oil as an irritant
95	<i>Datura metel</i> L.	Solanaceae	siva	10	0.09	3	Nasal congestion Abdominal pain Insect bites	Lf Fw Lf	E Apply steamed leaves on a chest E Apply pounded fresh or heated flowers E Apply pounded leaves
96	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	kamalutasit-kamates	4	0.03	1*	Abdominal pain	Lf	E Apply crushed leaves on abdomen
97	<i>Nicotiana tabacum</i> L.	Solanaceae	baku	8	0.07	1	Skin eruption Boils, skin eruption	Lf Lf	E Rub fresh leaves E Apply fresh or chopped dried leaves or heated leaves with oil
98	<i>Radermachera fenicis</i> Merr.	Solanaceae	valayvayan	7	0.06	1	Menstruation; abortive	Bk, Lf	I Drink decoction
99	<i>Solanum melongena</i> L.	Solanaceae	talong	2	–	–	Scabies	Lf, Rt, St	E Washing with decoction
100	<i>Solanum nigrum</i> L.	Solanaceae	nateng	11	0.09	2	High blood pressure; anemia; tonic	Lf	I Eat cooked leaves as vegetable. Drink decoction
101	<i>Leucosyke quadrinervia</i> C.B.Rob.	Urticaceae	mavuhu	5	0.04	1*	Cuts and wounds	Lf, St	E Apply pounded leaves or stems
102	<i>Premna odorata</i> Blanco	Verbenaceae	aryaw	27	0.23	4	Head lice Cough Fever Cuts and wounds Diarrhea; ulcer; stunned	Lf Lf Lf Lf Lf	E N/A I Drink decoction E Apply fresh leaves on a head with oil E Apply crushed leaves E Apply leaves on a navel with oil
103	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	sisiplo	48	0.41	1*	Cuts and wounds	Lf, St	E Apply pounded or crashed leaves
104	<i>Leea philippinensis</i> Merr.	Vitaceae	aniblawun	1	–	–	Skin eruptions	Lf	E Apply heated leaves
105	<i>Diplazium esculentum</i> (Retz.) Sw.	Woodsiaceae	tamidoc	14	0.12	2	High blood pressure; constipation	Lf, St	I Eat cooked leaves as vegetable
106	<i>Curcuma longa</i> L.	Zingiberaceae	hama	7	0.06	3	arthritis Cuts and wounds Cough; arthritis Arthritis	Rz Rz Rz Lf, Rz	I Drink decoction E Apply extracted juice from crushed rizomes I Drink decoction with honey or sugar E Fastened pounded and heated rhizomes or leaves with coconut oil
107	<i>Zingiber officinale</i> (Willd.) Roscoe	Zingiberaceae	luya	3	0.03	1*			
108	N/A		aduvut	26	0.22	3	Scabies; skin eruption (Severe head) wounds	Lf, St Lf, St, Fw	E Pounded and diluted by water and bath the whole body E Apply pounded leaves. Wash with pounded and diluted leaves stems or flowers by water
109	N/A		disolne	1	–	–	Diarrhea	Rt	I Drink mixed with warm water
110	N/A		kamusuy	29	0.25	1*	Cuts and wounds	Lf	E Pounded and apply the juice.
111	N/A		katana	17	0.15	2	Scabies Cuts and wounds Boils; allergy; chicken pox Abdominal pain	Lf, Bk Lf, Fr Bk Lf, St	E Drink decoction of leaves Apply heated leaves or barks E Apply pounded leaves or fruits E Apply ash from burned barks E Apply heated leaves or boiled stems
112	N/A		kawawakay	4	0.03	1*			

<sup>a</sup> UV is the sum of the number of use-reports cited by each informant for a given species divided by the total number of informants.

<sup>b</sup> Number of categories reported out of the 13 categories (\*FL=100%). For calculation of UV and number of categories, the use-report was considered when described by at least two interviewees mentioned the same plant for the same ailments.

<sup>c</sup> Bk, barks; Fr, fruits; Fw, flowers; Lf, leaves; Rt, roots; Rz, rhizomes; Sd, seeds; Sk, silk; Sp, sap/juice; St, stems; Tk, trunk.

<sup>d</sup> I, internal; E, external.

used for the treatment of a particular ailment, and we did so by calculating fidelity levels (FL) (Friedman et al., 1986):  $FL = N_p/N$ , where  $N_p$  is the number of use-reports cited for a given species for a particular ailment, and  $N$  is the total number of use-reports cited for any given species. High FL values (near 100%) are obtained for plants for which almost all use-reports refer to the same method of use, (that is, the plants were considered the most preferred species for a particular ailment category), whereas low FLs are obtained for plants that are used for many different purposes.

### 3. Results and discussion

#### 3.1. Knowledge of medicinal plants

Differences in occupation or educational background did not influence the reported knowledge of medicinal plants. Local people living in Basco reported fewer medicinal plant species than informants from other municipalities (a median of 8.3 plants vs. 15.3) ( $t_{(\alpha=0.01, df=47)}=4.56$ ;  $p<0.00005$ ). One of the most likely reasons for this result is that Basco is the provincial capital of Batanes and is served by the hospital, clinic and small shops, giving residents more opportunities to buy over-the-counter medicines and convenient access to professional healthcare compared with residents from other sites. Moreover, cash incomes in Basco were slightly higher than in other locations. Women also have slightly more information about medicinal plants than men ( $t_{(\alpha=0.05, df=112)}=2.34$ ;  $p<0.05$ ), reflecting their roles in household management and child care as well as their leading role in keeping families and communities generally healthy by providing preventive care and treatment. Women have long been associated with herbal healing because of their crucial role in plant diversity management and conservation at the household, village, and community levels (Braidotti et al., 1994). Additionally, those aged over 60 were more knowledgeable than their juniors ( $t_{(\alpha=0.01, df=87)}=2.28$ ;  $p<0.05$ ), and the use of medicinal plants decreased with decreasing age. Although almost all informants reported that knowledge of medicinal plants was inherited from their ancestors through oral tradition, the number reporting this varied by age, which means that knowledge of the use of medicinal plants may be disappearing.

#### 3.2. Frequency of use of medicinal plants

Of the inhabitants interviewed, 96.6% actually used medicinal plants and 0.6% possessed knowledge but had never used medicinal plants. Most people used medicinal plants occasionally (87.1%), and 4.3% of residents used them every day. They used traditional medicines for the treatment of diseases and also for nourishment and energy. Herbal medicines were used by the Ivatan people because most believed that they were more effective than Western medicines in all cases (68%) or in some cases (26%).

#### 3.3. Characteristics of medicinal plants

The data obtained from field surveys are summarized in Table 2. Both the scientific and vernacular names for the medicinal plants are given by taxonomic category and family. In this survey, 112 plant species were recorded for their medicinal use, and these belonged to 57 families and were used to cure 47 ailments in 13 categories. For five out of the 112 species, only the local name was documented. In terms of the number of species used, of the 107 plant species identified, Asteraceae and Solanaceae, with seven species each, were best represented, followed by

Euphorbiaceae and Poaceae with six species, Fabaceae with five species, and Lamiaceae with four species. This is not surprising—these families are very widespread around the world. The Euphorbiaceae and Solanaceae families contain a large variety of phytotoxins, mainly alkaloids, diterpene esters, glycosides, and ricin-type toxins (Yamane et al., 2010). These are sometimes used as medicines or spices; in general, they contain some toxins and strong irritants. Many medicinal plants used are members of the mint family, Lamiaceae, which includes basil, mint, and rosemary; these are used because of their rich and fragrant essential oils, which are composed principally of monoterpenes (Yamane et al., 2010).

The Philippine Department of Health (DOH) has recommended the following ten species of medicinal plants in its traditional health maintenance program: *Blumea balsamifera*, *Carmona retusa*, *Cassia alata*, *Psidium guajava*, *Allium sativum*, *Momordica charantia*, *Vitex negundo*, *Mentha* sp., *Quisqualis indica*, and *Peperomia pellucida*. The pharmacological effects of these plants have been clinically proven to be significant, and pamphlets concerning their use have been distributed from local health centers. The plants have also been discussed in science class in elementary schools on Batan Island. Of these ten medicinal plants recommended by the DOH, the first seven species mentioned above were reported in this survey, and five of these plants were utilized in all four municipalities. The utilization rates of these plants are higher than for any other plants. This fact indicates that knowledge of medicinal plants has been influenced by various media in recent years. We found that the usage of some plants varied between villages. For example, *Blumea balsamifera* was used mainly for “difficulty in urination” in Basco and Mahatao, but it was used mainly to treat boils and coughs in Ivana and to treat high blood pressure in Uyugan. Additionally, *Musa paradisiaca* was used to treat boils in Basco and Mahatao and for fevers, headaches, and cuts and wounds in Ivana and Uyugan; *Musa sapientum* was used to treat diarrhea in all four municipalities. During the interview, the plants themselves or plant pictures were shown to the informants to avoid misunderstandings concerning identification of the plants. Nevertheless, across different sites on Batan Island, there are differences in terms of which plant to use for which diseases, and same plant may be used to treat different diseases. Moreover, the regional mix of local names has been investigated, and it has been confirmed that different plants are sometimes given the same name. For example, *Jatropha curcas* is known as “katawa” in the southern part of Batan Island, around Uyugan, whereas residents living near Basco referred to this plant as “katana,” a word which itself indicates another plant species (*Ricinus communis*) to the residents of Uyugan. A further example is “manichit” (*Tabernaemontana pandacaku*), which is also called “pandakaki-puti” in Basco but is known as “gagadan zambales” in Uyugan, while “gagadang” is yet another species (*Hydrangea subintegra*) that is endemic to Batan Island. Confusion was observed across regions, indicating that proper plant identification using local names is only accurate within a particular village or municipality (Gothard and McWilliam, 1989).

#### 3.4. Collection sites

Medicinal plants are collected in the wild by individuals or their family members. Three percent of medicinal plants used were cultivated for medicinal purposes, and 21% were cultivated as vegetables, with 77% found growing wild in fields, backyards, or forests. Most plants could be easily found near homes, reflecting that the current study area is rich in natural resources allowing for the collection, rather than cultivation, of medicinal plants. However, in the future, to stem the loss of knowledge regarding medicinal plants and prevent the eradication of these



medicinal plant resources, it is necessary to consider intentional cultivation of these useful plants. One must consider that the medicinal properties of plants, as well as the secondary metabolites produced under stress and competition, are not always expressed in fast-growing monocultures. Rather, higher levels of active compounds may be present in wild populations where plants grow more slowly (Uniyal et al., 2000). Therefore, it is necessary to conduct further investigation into the components of medicinal plants and to conduct chemical analyses.

### 3.5. Plant part used

All parts of various plant species are used against a variety of diseases. The most frequently used part is the leaves (55%), followed by stems (9%), fruits (8%), bark (8%), and sap or juice (6%) (Fig. 2). In some cases, more than one organ of the same species, especially a combination of leaves and stems, are used in the preparation of different remedies. The fact that leaves are the most frequently used part corresponds to similar results reported in many other ethnomedicinal studies in Asia (Subramanyam et al., 2008; Langenberger et al., 2009; Srithi et al., 2009; Ugulu et al., 2009; Chowdhury and Koike, 2010; Upadhyay et al., 2011) and in other regions of the world (Giday, 2003; Gazzaneo et al., 2005; Jeruto et al., 2008; Ragunathan and Solomon, 2009). The ease of accessibility to leaves explains their frequent inclusion in most of the preparations (Singh and Lal, 2008). It was also observed that residents have been using leaves to identify medicinal plants. Additionally, leaves are the main photosynthetic organs in plants, and photosynthates are translocated to other parts, such as the roots, bark, fruits and seeds. These can act as toxins for protection against predators and some are of medicinal value to humans.

The utilization of the underground organs, both roots and rhizomes, was less widespread, whereas aerial organs were highly used. This is a result of the evergreen nature of the island climate. In contrast, many previous reports have noted that roots were frequently used, second only to leaves (Giday, 2003; Ragunathan and Solomon, 2009; Ugulu et al., 2009; Allabi et al., 2010; Rokaya et al., 2010; Upadhyay et al., 2011). Inhabitants of dry regions tend to focus their attention on plant parts that are continuously

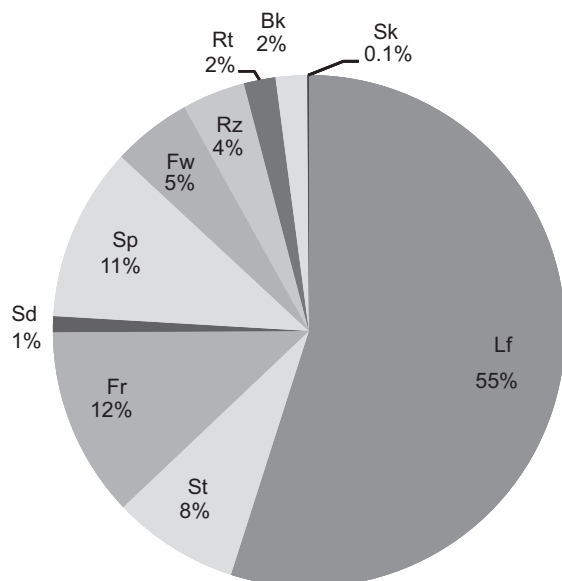
available, such as bark or roots because plants in such areas can be regularly exposed to long periods of drought and thus lose their leaves. However, using the roots is more damaging to the health of the individual plant compared to the use of its leaves or branches.

### 3.6. Preparation and administration

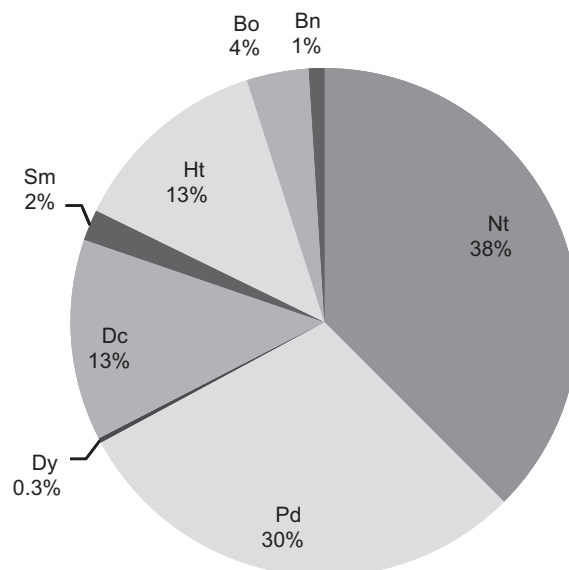
The main method of preparation was use of the intact plants (31%), followed by pounding or crushing (21%), decoction (20%), heating (15%), boiling (6%), and steaming (4%), while burning and drying represented the least used preparation methods (Fig. 3). In other words, 52% of the plants were used fresh and 48% were heated somehow. Both internal and external methods of administration were used to cure ailments. In most cases, the administration routes were external (68%) rather than internal (32%), differing significantly from practices elsewhere (Giday, 2003; Ragunathan and Solomon, 2009; Upadhyay et al., 2011). The advantage of external application is safety because external application results in indirect yet immediate local effects on the area and allows for easier regulation of dosages depending on the concentrations of beneficial or toxic compounds.

The data regarding parts used, preparation, and administration are summarized in Table 3. The most common use employs fresh (intact or pounded/crushed) leaves for external administration (23.6%); the use rate rises to 42% if all aerial parts are considered. The second most common use involves the decoction of leaves for internal administration (9%). Almost all of the species are used alone; very few mixtures have been identified, such as chewing mixture of garlic bulbs with *Areca catechu* and *Nicotiana tabacum* leaves like a gum for the production of poultices for abdominal pain. This supports other reports of stand-alone usages in other countries and regions (Akerreta et al., 2007; Ragunathan and Solomon, 2009; Upadhyay et al., 2011). Sometimes, local people also used other ingredients, such as oil, vinegar, and salt, to prepare the remedies.

In addition to having scientific efficacy, traditional medicines were strongly influenced by cultures, traditions, and personal beliefs because their use was handed down orally from ancient times. People decided to use plants based on the plants' forms or shapes. The manner in which various parts of the plants are used



**Fig. 2.** Plant part used for medicinal applications in Batan Island. Bk, barks; Fr, fruits; Fw, flowers; Lf, leaves; Rt, roots; Rz, rhizomes; Sd, seeds; Sk, silk; Sp, sap/juice; St, stems; Tk, trunk.



**Fig. 3.** Mode of preparation of medicinal plants in Batan Island. Nt, nothing; Pd, pounded/crushed; Dy, dried; Dc, decoction; Sm, steamed; Ht, heated; Bo, boiled; Bn, burned (use ashes).

**Table 3**

The number of use reports and their proportion (%) of total uses for medicinal plant parts used, and their preparation and administration on Batan Island.

Administration		Nothing	Pound/extract	Dry	Decoction	Steam	Heat	Boil	Burn	Total
Leaves	Internal	12 (0.4%)	0 (4.7%)	0 (5.9%)	105 (0.0%)	8 (0.0%)	29 (0.0%)	36 (0.0%)	0 (0.0%)	202 (0.0%)
	External	195 (7.0%)	311 (0.1%)	3 (0.0%)	25 (0.0%)	15 (0.0%)	135 (0.0%)	9 (0.0%)	0 (0.0%)	1196 (0.0%)
	<b>Total</b>	<b>207 (7.4%)</b>	<b>311 (0.0%)</b>	<b>3 (0.2%)</b>	<b>130 (0.2%)</b>	<b>23 (0.0%)</b>	<b>164 (0.0%)</b>	<b>45 (0.0%)</b>	<b>0 (0.0%)</b>	<b>1398 (0.0%)</b>
Stems	Internal	0 (0%)	0 (0.1%)	0 (0.2%)	2 (0.2%)	2 (0.0%)	0 (0.0%)	2 (0.0%)	0 (0.0%)	6 (0.0%)
	External	65 (2.3%)	52 (0.2%)	0 (0.8%)	0 (0.0%)	0 (0.0%)	6 (0.0%)	2 (0.0%)	5 (0.0%)	237 (0.0%)
	<b>Total</b>	<b>65 (2.3%)</b>	<b>52 (0.0%)</b>	<b>0 (0.1%)</b>	<b>2 (0.0%)</b>	<b>2 (0.0%)</b>	<b>6 (0.0%)</b>	<b>4 (0.0%)</b>	<b>5 (0.0%)</b>	<b>243 (0.0%)</b>
Fruits	Internal	142 (5.1%)	0 (0.2%)	0 (0.9%)	6 (0.0%)	2 (0.0%)	22 (0.0%)	2 (0.0%)	0 (0.0%)	316 (0.0%)
	External	18 (0.6%)	3 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.0%)	0 (0.0%)	0 (0.0%)	43 (0.0%)
	<b>Total</b>	<b>160 (5.7%)</b>	<b>3 (0.0%)</b>	<b>0 (0.0%)</b>	<b>6 (0.0%)</b>	<b>2 (0.0%)</b>	<b>26 (0.0%)</b>	<b>2 (0.0%)</b>	<b>0 (0.0%)</b>	<b>359 (0.0%)</b>
Seeds	Internal	10 (0.4%)	0 (0.1%)	0 (0.0%)	2 (0.0%)	0 (0.0%)	0 (0.0%)	6 (0.0%)	0 (0.0%)	28 (0.0%)
	External	0 (0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	3 (0.0%)
	<b>Total</b>	<b>10 (0.4%)</b>	<b>1 (0.0%)</b>	<b>0 (0.0%)</b>	<b>2 (0.0%)</b>	<b>0 (0.0%)</b>	<b>1 (0.0%)</b>	<b>6 (0.0%)</b>	<b>0 (0.0%)</b>	<b>31 (0.0%)</b>
Juice/sup	Internal	56 (2.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	113 (0.0%)
	External	123 (4.4%)	3 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	249 (0.0%)
	<b>Total</b>	<b>179 (6.4%)</b>	<b>3 (0.1%)</b>	<b>0 (0.1%)</b>	<b>1 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>362 (0.0%)</b>
Flowers	Internal	4 (0.1%)	0 (0.2%)	0 (0.1%)	2 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (0.0%)
	External	2 (0.1%)	70 (0.3%)	0 (0.3%)	3 (0.0%)	0 (0.0%)	3 (0.0%)	0 (0.0%)	0 (0.0%)	148 (0.0%)
	<b>Total</b>	<b>6 (0.2%)</b>	<b>70 (0.0%)</b>	<b>0 (0.0%)</b>	<b>5 (0.0%)</b>	<b>0 (0.0%)</b>	<b>3 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>158 (0.0%)</b>
Rhizomes	Internal	31 (1.1%)	0 (0.3%)	1 (0.4%)	8 (0.0%)	0 (0.0%)	9 (0.0%)	3 (0.0%)	0 (0.0%)	95 (0.0%)
	External	0 (0.0%)	13 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	26 (0.0%)
	<b>Total</b>	<b>31 (1.1%)</b>	<b>13 (0.8%)</b>	<b>1 (0.0%)</b>	<b>8 (0.0%)</b>	<b>0 (0.0%)</b>	<b>10 (0.0%)</b>	<b>3 (0.0%)</b>	<b>0 (0.0%)</b>	<b>121 (0.0%)</b>
Roots	Internal	0 (0%)	3 (0.9%)	0 (0.0%)	5 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (0.0%)
	External	2 (0.1%)	26 (0.2%)	0 (0.0%)	21 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	55 (0.0%)
	<b>Total</b>	<b>2 (0.1%)</b>	<b>29 (0.1%)</b>	<b>0 (0.3%)</b>	<b>26 (0.5%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>63 (0.0%)</b>
Bark	Internal	0 (0%)	0 (0.3%)	0 (0.3%)	6 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (0.0%)
	External	6 (0.2%)	5 (0.1%)	0 (0.0%)	3 (0.0%)	0 (0.0%)	7 (0.0%)	0 (0.0%)	13 (0.0%)	42 (0.0%)
	<b>Total</b>	<b>6 (0.2%)</b>	<b>5 (0.0%)</b>	<b>0 (0.0%)</b>	<b>9 (0.0%)</b>	<b>0 (0.0%)</b>	<b>7 (0.0%)</b>	<b>0 (0.0%)</b>	<b>13 (0.0%)</b>	<b>48 (0.0%)</b>
Silk	Internal	0 (0%)	0 (0.1%)	0 (0.0%)	2 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)
	External	0 (0%)	0 (5.0%)	0 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	<b>Total</b>	<b>0 (0.0%)</b>	<b>0 (1.9%)</b>	<b>0 (5.6%)</b>	<b>2 (0.6%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>0 (0.0%)</b>	<b>2 (0.0%)</b>
Total	Internal	255 (9.2%)	3 (6.9%)	1 (7.8%)	139 (0.6%)	12 (0.0%)	60 (0.0%)	49 (0.0%)	0 (0.0%)	786 (0.0%)
	External	411 (14.8%)	484 (0.0%)	3 (0.0%)	52 (0.0%)	15 (0.0%)	157 (0.0%)	11 (0.0%)	18 (0.0%)	1999 (0.0%)
	<b>Total</b>	<b>666</b>	<b>23.9</b>	<b>487 (0.0%)</b>	<b>4 (0.0%)</b>	<b>191 (0.0%)</b>	<b>27 (0.0%)</b>	<b>217 (0.0%)</b>	<b>60 (0.0%)</b>	<b>2785 (0.0%)</b>

does, however, suggest some understanding of their medicinal properties, which corresponds to a scientific understanding even if it is sometimes based on folklore and superstition. For example, sap has been used for cuts and wounds, and large, thick leaves have been used as hot or cold compresses to relieve pain and treat rheumatoid arthritis, abdominal pain, headache or fever. In addition, plants are sometimes pretreated by applying coconut oil to the leaves before application to the afflicted area. This is performed to facilitate adhesion or to facilitate transfers from leaf to skin. In addition, the coconut tree is widely distributed in the Philippines, so the use of this tree in medicinal folklore and in the preparation of other treatments is very common. Other examples include *Paederia scandens* and *Barringtonia asiatica*, which are used to treat sudden body pains believed to be caused by evil spirits known as “anitus,” and fresh or heated leaves are rubbed over the whole body for protection. *Paederia scandens* has a strong smell and *Barringtonia asiatica*, which flowers in the night, is viewed as an eerie tree and is even believed to be evil in Yami, Taiwan.

### 3.7. Use value (UV)

UVs, representing the relative importance of plants, were high for *Hibiscus rosa-sinensis* (0.67), *Cocos nucifera* (0.56), *Piper betle* (0.55), *Senna alata* (0.53), and *Moringa oleifera* (0.50). The lowest use value was calculated at 0.02, with only two people reporting utility (Table 2). High use-value plants, which were reported by residents of all four municipalities, are distributed across all of Batan Island and easy to obtain. These were the most frequently used plant species used for each ailment category: *Hibiscus rosa-sinensis* for diseases of the skin and subcutaneous issues, *Cocos nucifera* for diseases of the genitourinary system, *Piper betle* for undefined pains or illness, *Senna alata* for infection and

postpartum issues, and *Moringa oleifera* for endocrine illnesses, nutritional deficiencies and metabolic disorders. All plants showed a high UV when used for exogenous diseases, such as infectious and parasitic diseases (e.g., scabies, ascariasis), injury, poisoning and certain other consequences of external causes (e.g., cuts and wounds) or diseases of the skin and subcutaneous tissue (e.g., skin eruptions). *Moringa oleifera* and *Cocos nucifera* were also used for endogenous diseases and lifestyle-related diseases, problems of the circulatory system (e.g., high blood pressure, anemia), diseases of the digestive system (e.g., constipation), and for endocrine, nutritional and metabolic diseases. Our study shows that plants with higher UVs have become more widely used for a variety of diseases in modern times. This is an interesting result and shows the importance of medicinal plants in the region.

### 3.8. Informant consensus factor (ICF)

ICFs were calculated by using reports in each of the 13 categories. The results ranged from a low of 0.76 to a high of 1.00, with a mean value of 0.91 (Table 1). The highest ICF value, 1.00, indicates that people use a particular plant consistently in that category. However, the number of use-reports ( $N_{ur}$ ) in these high-ICF categories was extremely low. After excluding categories with a  $N_{ur}$  of less than eight (0.5%), the highest remaining ICF category was for diseases of the eye (0.95), followed by diseases of the circulatory system (0.94), injury and poisons from external causes (0.94), diseases of the genitourinary system (0.93), and undefined pains or illnesses (0.92). The most frequently used plant species in each category were those plants with either a high UV or the highest FL (100%), except in the case of *Barringtonia asiatica*, which had the lowest ICF value (0.76) for diseases of the musculoskeletal system and connective tissue. This low ICF

suggests a lesser level of agreement among informants on the use of plant species to treat this particular disease category. In addition, a low ICF was associated with many plants with almost equally high usage reports. This low ICF may also be explained by the availability of easily accessible pharmaceuticals that provide alternatives to traditional medicine. These pharmaceuticals may reduce the use of some traditional remedies.

The ailments with the highest ICF values (1.00) were ringworm infections, sore eyes, and toothaches, all of which were treated with specific plant species. Ringworm infections were treated with *Senna alata*, known as “lingwa” to the locals. The young leaves of *Calophyllum inophyllum*, when soaked in water overnight and decocted, can be used for washing sore eyes. *Calophyllum inophyllum* has been reported to have an antimicrobial effect (Saravanan et al., 2011). A decoction of *Ormocarpum cochinchinense* roots is used as a mouthwash (gargle), and pounded roots and bark of this plant are used as toothpicks to treat toothache. The calcium level in the plant has been found to be one of the reasons for its soothing effect (John et al., 2011).

The ailments that had high ICFs also had specific methods of treatment. The second highest ICF was for cough (0.95), which was treated by drinking a decoction (75%; e.g., *Premna odorata*, *Curcuma longa*, and *Blumea balsamifera*). This was followed by hypertension (ICF of 0.94), which was treated by eating plants as vegetables (36%; e.g., *Allium sativum*, *Diplazium esculentum*, and *Moringa oleifera*) or drinking decoctions of leaves (55%; e.g., *Orthosiphon aristatus*, *Zea mays*, and *Solanum nigrum*). The next highest ICF value (0.93) was for constipation, which could be treated by eating fruits or leaves (67%; e.g., *Ananas comosus*, *Moringa oleifera*, and *Carica papaya*). Cuts and wounds (ICF of 0.93) were treated by applying sap (39%; e.g., *Chamaesyce hirta*, *Argemone mexicana*, and *Ficus septica*) or by the application of pounded leaves or stems (50%; e.g., *Stachytarpheta jamaicensis*, *Psidium guajava*, and *Crassocephalum crepidioides*). Difficulty urinating (ICF of 0.93) could be treated by drinking a decoction of leaves (80%; e.g., *Blumea balsamifera*, *Pandanus amaryllifolius*, and *Lagerstroemia speciosa*). It is interesting that not only general diseases but also specific ailments such as hypertension and urinary disorders are present in the top five ailments. The incidence of hypertension on Batan Island is reportedly high. In fact, hypertension (6.3%) was the fourth leading cause of death (13.8%) on Batan Island in 2007, with heart disease being the top killer (Department of Health, 2007). This is a result of the introduction of Western culture that has occurred on Batan Island, including Western food, and also essential hypertension caused by specific genes in the tropics. According to the most recent survey of national health in the Philippines, the leading cause of death became lifestyle-related diseases in 2005, whereas infectious diseases were the leading killers in 1975. Moreover, hypertension ranked fifth in morbidity in 2005 in the Philippines. The current studies of ICF results support the finding that hypertension, which increases the risk of ischemic heart disease, strokes, and kidney disease, and other disorders when it occurs with obesity, hyperlipidemia, and diabetes, is a risk factor for the major cause of death in the Philippines, including Batan Island.

### 3.9. Fidelity level (FL)

FLs for plant species for a specific disease varied widely, ranging between 1% and 100% for plants in the study area. The maximum FL of 100% was found for 36 species, including *Carica papaya*, *Stachytarpheta jamaicensis*, *Musa sapientum*, and *Pedilanthus tithymaloides*, which are, respectively, used to treat constipation, cuts and wounds, diarrhea, and dislocations and fractures (Table 2). Most of the plants with high FL values have pharmacological effects that have been proven scientifically. On the other hand, the lowest FL, 1%, indicated less-preferred species for treating specific ailments. In contrast, these plants have been widely used

against several diseases. For example, *Moringa oleifera* is used for nine different ailments that can be divided into six categories, each of which garnered only low FL values: certain infectious and parasitic diseases (FL=5%), endocrine, nutritional and metabolic diseases (17%), diseases of the circulatory system (64%), diseases of the digestive system (6%), diseases of the skin and subcutaneous tissue (3%), and injury/poisoning from external causes (6%). Living up to its nickname as a Miracle Tree, *Moringa* contains many nutrients, such as vitamins, antioxidants, essential amino acids, and minerals, and many health and nutrition programs funded by various charitable organizations support its use. As a result, this useful plant might represent something of a panacea treatment even if it has low FL values for individual problems. The reported species were used to treat a wide range of ailments (ranging between 1 and 9). However, there were 32 plants used against two or more diseases, and 42 plants were used to cure a single ailment (Fig. 2). High ICFs and FLs for specific species suggest that the plants might contain valuable phytochemical compounds. These traditional medicines, handed down despite their traditional background, have high ICFs and FLs because of their efficacy and safety.

## 4. Conclusion

This study confirms that plants are still a major source of medicine for the local people living on Batan Island in the Philippines. Modern healthcare systems in this area are not adequate, and some parts of the population have limited means to buy modern medicine. Thus, traditional medicine remains the most popular solution to health issues.

We found that most recorded plants grew in the wild. Notably, the uses of some plants have not been reported in the literature. Our results also reveal the urgency of collecting ethnopharmacological data because knowledge of medicinal plants is vanishing.

As described above, increases in lifestyle-related diseases have become a serious problem on the island. Residents use several plants against conditions such as hypertension and urinary disorders. This study suggests that detailed pharmacological evaluation of these plants is required because the pharmacological basis for the activity of some plants has not been determined. Apart from this study, we recently discovered that some plants contribute to hypotensive activity on Batan Island. Further research can encourage the continued use of medicinal plants.

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