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Original Article

Ethnobotanical Survey of Medicinal Plants used by Ayta Communities in Dinalupihan, Bataan, Philippines

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ABSTRACT

Objectives: This study documented the species of medicinal plants used by Ayta communities in Dinalupihan, Bataan. The plant parts used for medicinal purposes, preparations, mode of administration of these medicinal plants were determined. The most important species based on use values and informant consensus factors were also calculated. **Methods:** A total of 26 informants were interviewed regarding the plants they utilize for medicinal purposes. Free and prior informed consents were obtained from the informants. Taxonomic identification was done in the Botany Division of the National Museum of the Philippines. Informant consensus factor (FIC) and use values (UV) were also calculated. **Results:** Ayta communities listed a total of 118 plant species classified into 49 families used as herbal medicines. The Family *Fabaceae* was the most represented plant family with 11 species. Leaves were the most used plant part (43%). Majority of medicinal preparations were taken orally (57%). It was found that *Psidium guajava* L. and *Lunasia amara* Blanco were the most commonly used medicinal plants in the three communities with the use value of 0.814. **Conclusion:** This documentation provides a catalog of useful plants of the Ayta and serves as a physical record of their culture for the education of future Ayta generations.

Key words: Ethnobotany, Medicinal plants, Ayta, Philippines, Traditional medicine.

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INTRODUCTION

The Flora of the Philippines contains more than 12000 plant species, around 1500 of which are used by the traditional herbalists of the indigenous peoples in traditional medicine.[1] Several medicinal plants have mechanical and chemical defense mechanisms that protect themselves from herbivores. These chemical compounds that deter herbivores have pharmacological effects against human diseases.[2] Indigenous communities in the Philippines have been using plants as remedies for several diseases ranging from common ones such as headache, stomachache, cough, colds, toothache, skin diseases to more serious and fatal ones such as urinary tract infection, chicken pox, and dysentery.[3]

Ethnobotanical surveys were conducted in different Ayta communities in other provinces of Central Luzon such as Pampanga. A study conducted by Ragragio *et al.*[4] documented that Ayta communities in Porac, Pampanga still use plants as food and medicines. However, there are no published resources on the ethnobotanical knowledge of the Ayta groups in Bataan. The Ayta communities of the Bataan Peninsula are considered as the least known and researched Ayta group in Central Luzon, Philippines. The Ayta communities in Bataan continue to reside in their forested ancestral lands and extensively depend on forest resources for food and medicines.[5] Indigenous people living near the forest and far from market town have higher levels of ethnobotanical knowledge compared to those living close to the market town.[6]

There were several bioactivity studies conducted on the indigenous plants used by Ayta communities in Bataan especially the Ayta from Sitio Kanawan, Morong, Bataan.[7-9] These studies indicate that the indigenous plants from Bataan can be potential sources of bioactive compounds thus further warrant the need for extensive documentation of ethno botanical knowledge of Ayta communities in Dinalupihan, Bataan.

The traditional knowledge held by indigenous peoples is an important resource that should be conserved. This knowledge continues to decline through time and there are only few indigenous communities with wide traditional and botanical knowledge.[10] In the Philippines, this knowledge is endangered by Western acculturation and modernization. The present study answers the need for systematic documentation the traditional knowledge of indigenous peoples before it is lost. This research documented the herbal medicines of the three Ayta communities in Dinalupihan, Bataan. Specifically, it aims to identify the species of these medicinal plants, determine which plant parts are used for medicinal purposes, preparations and mode of administration

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of these plants and identify the most important species and calculate the informant consensus factors.

MATERIALS AND METHODS

Study Sites

The ethnobotanical survey was conducted in the Ayta communities located in three rural barangays in Dinalupihan, Bataan namely Payangan, Tubo-Tubo, and Bayan-Bayanan during December 2015. Dinalupihan is located 95 kms east of Manila with the geographical coordinates of 14° 52' 34" North, 120° 27' 45" East (Figure 1).[11] It has a total land area of 92.52 km^2. As of May 1, 2010, the total population of Tubo-tubo is 342, Payangan is 554 and Bayan-bayanan is 447. It has a tropical climate with significant rainfall almost throughout the year. It is considered as an agricultural town whose main resources are palay, sugar cane, corn, root crops, legumes and fruits including livestock and poultry.[12]

Study Population

Data were collected through a semi-structured interview of 26 Ayta informants who are knowledgeable on medicinal plants. Informants were composed of the tribal chieftains, traditional healers and community elders. This semi-structured interview was composed of questions on medicinal plants, its utilization as traditional medicine, the diseases treated by the plants, the plants used for various diseases the parts that are used, how the parts are prepared and the frequency of use of these plants.

Ayta communities in Bataan has two languages, Filipino and their ethnic language which is Ayta Ambala. The older generations are fluent speakers of their ethnic language while the younger generations are more accustomed to speaking the Filipino language. Few Ayta hold leadership position in the community and the municipality of Dinalupihan. Majority of the Ayta in Dinalupihan, Bataan rely on farming for their living. They have fruit and vegetable plantation in the mountains and they sell their agricultural produce in the lowland markets. All of the Ayta communities have health centers but doctors and midwives only visit them once a week. The district hospital is far from their communities especially for those living in the mountains, thus people first consult traditional healers for common diseases.

Data Collection

Free and prior informed consents were obtained from all the informants. Permits were obtained from the chieftains and council of elders of the three Ayta communities in Dinalupihan, Bataan. The data were collected from 26 key informants composed of tribal chieftains, traditional healers and other elders through a semi-structured interview.[13] This semi-structured interview consisted of questions on their knowledge about medicinal plants, the diseases treated by the plants, parts that are used, how the parts are prepared and administered for medicinal purposes. The key informants also collected the plants which were used for taxonomic identification and part of the field collection of the researchers.

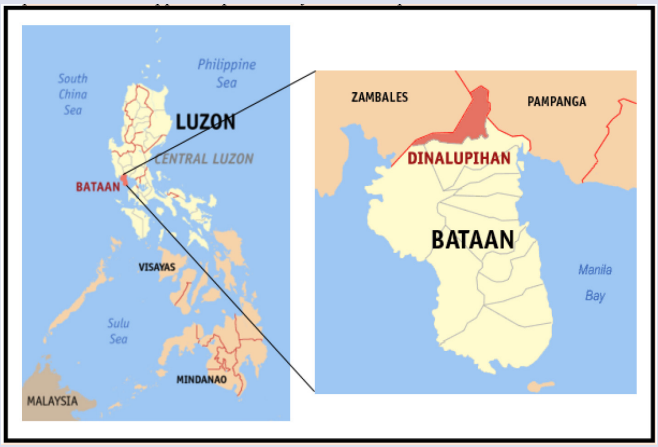

Figure 1: Map of Bataan and the location of the study site, Dinalupihan, Bataan (Google Maps, 2015).

Specimen Collection

Samples of the functional parts of medicinal plants were collected for taxonomic identification. The habitat, morphological characteristics, and reproductive parts of the plants were photographed and noted. Voucher specimens were preserved by immersing them in denatured alcohol and were sent to Mr. Danilo Tandang, botanist and researcher at the National Museum of the Philippines for identification and authentication. Scientific names of plants were determined and validated using The Plant List database.[14]

Data Analysis

The information on the Ayta individuals (socio-demographic data) and on the medicinal plants based on the interview was tabulated. Two values were calculated to quantify the ethnobotanical data gathered: the Use Value (*UV*) and the Informant Consensus Factor (*FIC*). The Use Value is defined as the ratio of the number citations per species (U) to the number of informants (N) and is given by the formula: $UV = U/N$.[13] High UV indicates high use-reports for a plant implying its relative importance to the local community. Low UV indicates few reports related to its use.[15] Informant Consensus Factor, on the other hand, is evaluated using the formula: FIC = (Nur – Nt)/ Nur – 1: where Nur is the number of use-reports in each category and Nt is the number of species used for a particular category by all informants[4]. The maximum value attained in this Formula, 1, means that the informants completely agree that the particular species cited could cure a particular ailment. A value of 0, the minimum value, means that there is no exchange in information among the informants about plants.[16] This simply means that the higher FIC value, the higher the possibility that the medicinal plants cited are the ones commonly and consistently used by the Ayta and assumed to be effective in treating a certain disease.[17]

RESULTS AND DISCUSSION

Profile of the Informants

A total of 26 informants from three barangays participated in the ethnobotanical surveys (Table 1). The informants were selected because of their knowledge on the medicinal plants they used. Ayta belonging the age group 46 years old and above have the highest number of informants for this ethnobotanical survey. The average number of plant species cited by all of the Ayta informants is 25.

Differences in educational background as well as profession of informants did not have significant impact on the knowledge on indigenous medicinal plants. It was also observed in the survey that their knowledge of medicinal plans were passed down from their ancestors through oral traditions. When Ayta communities encounter diseases, they use medicinal plants first. When their herbal medicines can no longer cure the diseases, they use over-the-counter medicines or go to the district hospital for consultation and treatment.

The use of traditional medicine is an important part of healthcare of the Ayta communities in Dinalupihan, Bataan. The result of this study is limited because of the small number of Ayta informants. However, steps to ensure the reliability of informants for ethnobotanical studies were followed based on the recommendations of Tongco.[18] This is very impor-

Table 1: Demographic profiles of the interviewed Ayta in the three different barangays in Dinalupihan, Bataan.

Barangay (Village)	Number of Respondents	Age (average)			Gender		Educational Attainment			Job		
		16-25	26-45	46 – up	M	F	E	H	C	BC	WC	Unemployed
Tubo-tubo	7	0	1	6	4	3	7	0	0	7	0	0
Payangan	12	1	6	5	3	9	0	12	0	9	2	1
Bayan-bayanan	7	0	4	3	1	6	6	1	0	1	4	2
Total:	26	1	11	14	8	18	13	13	0	17	6	3

M – Male, F – Female, E – Elementary, H – High school, C - College WC – White collar (professional, managerial and administrative work), BC – Blue collar (perform labor jobs)

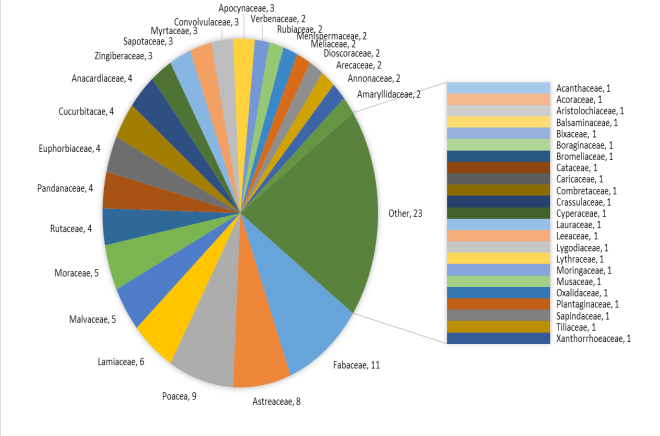

Figure 2: Number of plant species and their respective families.

tant in order to establish the reliability of the results even with low number of informants. The researchers made sure that the informants are reliable and competent in terms of their knowledge in medicinal plants. There were several consultations with the tribal leaders to identify key informants that will be included in this survey. Quality control was done to verify the data gathered during the interviews. After the completion of the study, the researchers went back to the three Ayta communities to verify the results and clarify several inconsistencies in the data gathered.

It was observed in this study that most of the traditional healers belong to the older generation. There were very few young Ayta who are knowledgeable about medicinal plants. This can indicate a decline in knowledge of the use of medicinal plants that pose a potential disappearance of this knowledge in the future. There were more women informants in this ethnobotanical survey compared to men. More medicinal plant species were cited by the women informants. This can be due to the fact that majority of traditional healers among Ayta communities in Dinalupihan were women. They are familiar with medicinal plants used against common diseases because they are usually left at home to take care of the children and the elderlies. Men usually go to the mountains to work in their agricultural lands.

Characteristics of Medicinal Plants

The list of medicinal plants obtained from ethnobotanical surveys are summarized in Table 2. Scientific and vernacular names, plant parts used, mode of administration and diseases treated were included in the list. A total of 118 plant species classified into 48 families have been documented to be used by the Ayta in the three communities (Figure 2). The most represented plant family is the Fabaceae family with 11 species, followed by Poaceae with 9 species, then Compositae and Lamiaceae with 8, Moraceae and Malvaceae with 5, and Anacardiaceae, Euphorbiaceae, Pandanaceae, *Rutaceae*, and *Cucurbitaceae* with 4 species each. The other 39 families have one to 3 representative species each.

Family *Fabaceae* is the most represented plant family in this ethnobotanical survey with a total of 11 species used as medicines. This is similar to the results of Ragragio *et al.*[4] in their study with the Ayta communities in Pampanga, Philippines. Family *Fabaceae* was also the most represented family in the Ayta of Pampanga with a total of fifteen species used as medicines. Another study conducted by Obico and Ragragio [19] on the medicinal plants used by Ayta communities in Porac, Pampanga as insect repellant also observed highest number of species belonging to Family *Fabaceae*. Family *Poaceae* is the second family with the highest citation for medicinal use. Several study conducted in Northern Surigao del Sur and Bukidnon, Philippines also listed highest number of medicinal plants from *Poaceae* family.[20,21]

Collection Sites of Medicinal Plants

Medicinal plants are collected from the roadside and home gardens of Ayta (68%), mountains and wild habitat (21%) or both (11%) (Figure 3). Based on interviews with the traditional healers in Dinalupihan, most of the medicinal plants grow randomly along the roadside and backyard of the Ayta. They usually do not cut down the growing plants in their backyards and on the roadside because these plants constitute a source of medicinal plants that can be used to treat common diseases in their communities. Since most of the Ayta communities are located near the forest, they have an abundance of medicinal plants in their surroundings. Some of these medicinal plants are also cultivated

Ragragio *et al.*[4] also noted that medicinal plants used by Ayta communities in Porac, Pampanga also came from kitchen garden and open fields. There are only few identified species that can only be found in the mountains. According to the Ayta informants, it was hard to find species that occur exclusively in the mountains especially those that are located in very steep mountainsides. Availability of the plants can be an important factor in their uses by the Ayta elders and healers as medicines.

Plant Part Used

Different parts of the plants are used for various diseases (Figure 4). Leaves are the most used plant part (43%), followed by the roots (18%), stem (15%), peel of the fruit (14%), skin of the stem (4%), flowers (2%) and seeds (1%). There are certain diseases that are treated with the whole plant. This accounts for 3% of the total plant species identified in this study and most are herbaceous plants.

Several ethnobotanical surveys conducted in the Philippines reported similar results with the leaves as the most frequently used plant parts.[15,20,22]One of the reasons for this is to protect the plants and ensure sustainability in the utilization of the plants. Harvesting the leaves are less destructive for the plants. Leaves are also easy to collect and are the most abundant plant parts. Secondary metabolites from the leaves

Table 2: List of plants recorded to have medicinal values to the Ayta in Dinalupihan, Bataan.

Plant Family	Plant Species	Vernacular	Plant Part used	Administration	Disease/ Ailment to be treated	Use Value
Acanthaceae	*Andrographis paniculata* (Burm.f.) Nees	Serpentina	Lf	Drink decoction	Cough, diarrhea, stomach ache	0.111
Acoraceae	*Acorus gramineus* Aiton	Lubigan	Lf	Drink decoction	Urinary tract infection	0.037
Amaryllidaceae	*Allium sativum* L.	Bawang	Lf	Apply on wound; Drink decoction	Dog bite and rabies; phlegm	0.037
	Allium cepa L.	Sibuyas	Pe	Smell heated peel	Measles	0.037
Anacardiaceae	*Anacardium occidentale* L.	Kasoy	Lf, Pe, St	Drink decoction, eat the stem and apply directly	Toothache; headache	0.296
	Mangifera indica L.	Mangga	Lf	Drink decoction; Use in bathing	Anhidrosis, Postpartum	0.074
	Dracontomelon dao (Blanco) Merr. & Rolfe	Lamyo	St	Drink decoction	Wound infection	0.037
	Spondias purpurea L.	sineguelas	Fr	Eat chewed	Oral sores	0.037
Annonaceae	*Goniothalamus amuyon* (Blanco) Merr.	Amuyong	Sd St	Apply the extracts to affected body parts Apply pounded stem mixed with oil	Arthritis and body pain Arthritis and body pain	0.111
	Annona muricata L.	Guyabano	Lf	Drink decoction; Smell the leaves	Stomach ache; dizziness	0.111
Apocynaceae	*Alstonia scholaris* (L.) R. Br.	Dita	Pe St	Drink decoction Use for bathing	Cough, colds, phlegm and malaria Post-pregnancy	0.074
	Tabernaemontana pandacaqui Lam.	Pandakaki	Rt, St	Use for gargling	Toothache	0.074
	Strophanthus caudatus (L.) Kurz	Baging	St	Apply sap on the wound	Bleeding wound	0.037
Arecaceae	*Cocos nucifera* L.	Niyog/ Buko	Rt Fr Fr	Drink root decoction; Apply on affected body part Apply directly Apply heated scraped shell on affected area	Kidney stone; Itchiness and sprain Chest pain Wound and snake venom	0.222
	Calamus rotang L.	Rattan	Th	Applied on head as cool compress	Headache	0.037
Aristolochiaceae	*Aristolochia tagala* Cham.	Malaube	Rt	Drink decoction	Stomach ache and fever	0.148
Compositae	*Artemisia vulgaris* L.	Damong maria	Lf	Drink decoction or sap	Fever, sore throat, colds, cough and phlegm	0.569
	Cyanthillium cinereum (L.) H.Rob.	Kulantro	Lf, Rt	Use for bathing; Smell heated roots	Measles	0.370
	Chromolaena odorata (L.) R.M.King & H.Rob.	Papaltok	Lf	Apply pounded leaves on wounds; Drink decoction	Wounds; Stomach ache, diarrhea, fever, vomiting	0.296
	Blumea balsimifera (L.) DC.	Sambong	Rt, Lf Lf	Drink decoction and smell the leaves; Use for bathing Apply fresh leaves as cold compress	Kidney stones, hypertension, cold, cough; Pregnancy Stomachache, fever	0.259
	Emilia sonchifolia (L.) DC. ex DC.	Tagulinaw	Rt Lf	Drink decoction Drink decoction or grind into powder and add milk	Diarrhea Post-pregnancy, Diarrhea; Stomach ache, indigestion, colds	0.111
	Pseudelephantopus spicatus (B.Juss. ex Aubl.) Rohr ex C.F.Baker	Dila-dila	Lf, Rt	Drink decoction, eat fresh leaves, apply heated leaves on affected body part	Skin infection; rabies and snake Snake bite, wounds	0.074

Continued....

Plant Family	Plant Species	Vernacular	Plant Part used	Administration	Disease/ Ailment to be treated	Use Value
	Ageratum conyzoides (L.) L.	Baho-baho	Lf	Apply pounded leaves on wounds	Wounds	0.037
Balsaminaceae	*Impatiens balsamina* L.	Kamantigue	Fl	Drink decoction	Asthma	0.037
Begoniaceae	*Begonia* sp	Pingol-bato	Lf	Apply heated leaves	White spots, pimples	0.037
Bixaceae	*Bixa orellana* L.	Asuete	Lf, Sh	Apply on forehead	Fever	0.111
			Fr	Eat fresh fruit or drink decoction	Hypertension	
Boraginaceae	*Cordia dichotoma* G.Forst.	Anonang	Lf, Pe	Drink decoction or peel extracts, Apply scraped peel on wounds	Wounds, infection and fever	0.333
Bromeliaceae	*Ananas comosus* (L.) Merr.	Pinya	Fr	Eat fresh fruits	Helminthiasis	0.074
Cactaceae	*Opuntia ficus-indica* (L.) Mill.	Cactus	St	Drink decoction	Diarrhea	0.037
Caricaceae	*Carica papaya* L.	papaya	Lf	Smell	Headache	0.037
Combretaceae	*Combretum indicum* (L.) DeFilipps	Bawebawe	Lf, Fr	Place heated leaves on affected area	Snake venom and animal bites	0.222
Convolvulaceae	*Ipomoea batatas* (L.) Lam.	Kamote	Lf	Eat cooked leaves	Hypertension	0.037
	Ipomoea sp.	Kamoteng baging	Lf	Eat cooked fruit	Low blood, diarrhea, hematochezia	0.037
	Ipomoea sp.	Kamoteng pula	Sh	Drink shoot decoction	Anemia	0.037
Crassulaceae	*Bryophyllum pinnatum* (Lam.) Oken	Kataka-taka	Lf	Apply heated leaves with salt on affected body part	Swelling, Boils	0.074
Cucurbitacea	*Lagenaria siceraria* (Molina) Standl.	Upo	Fr	Eat cooked fruit	Hypertension	0.074
	Cucurbita sp.	Kalabasa	Rt	Eat cooked roots	Pregnancy and post-pregnancy	0.111
	Momordica charantia L.	Ampalaya/ Ampalayang ligaw/ Marigoso	Lf	Drink extracted juice from leaves	Cough, phlegm, pneumonia	0.074
				Appy leaves on stomach	Stomach ache	
	Citrullus lanatus (Thunb.) Matsum. & Nakai	Kalingad/ Kalingag	St	Drink decoction	Any sickness of the lungs	0.037
			St	Chew young stem	Coughs	
			Sd	Apply pounded seeds on affected joints	Joint pains	
Cyperaceae	*Scleria scrobiculata* Nees & Meyen	Banglit	Lf, Rt	Drink decoction	Coughs, oral sores colds and fever	0.037
Dioscoreaceae	*Dioscorea hispida* Dennst.	Kalot	Rt	Apply on affected body part	Dog bites and rabies	0.037
	Dioscorea alata L.	Ube	Rt	Apply on affected body part	Boils	0.037
Euphorbiaceae	*Jatropha curcas* L.	Tuba-tuba/ Takumbaw/ Takumbong/ Galumbang	Lf, Pe	Apply heated leaves with oil on affected body part	Sprain, arthritis, muscle pain	0.148
	Homalanthus populneus (Geiseler) Pax	Balante	Rt	Drink decoction	Spasm	0.037
	Euphorbia tithymaloides L.	Susong dalaga	Rt	Drink decoction	Enhances lactation	0.037
Fabaceae	*Pithecellobium dulce* (Roxb.) Benth.	Kamatsile	Pe, St	Gargle decoction	Toothache	0.222
	Mimosa pudica L.	Makahiya	Lf, St, Rt	Drink decoction	Dysmenorrhea, Post-pregnancy, body pain, kidney disease	0.222
	Gliricidia sepium (Jacq.) Walp.	Kakawati/ Kakawata	Lf	Apply extract from leaves	Itchiness, rashes, skin infection and phlegm	0.148
			Sh	Use decoction for bathing	Wounds and skin irritation	
				Drink extract from shoot	Ringworm	

Continued....

Plant Family	Plant Species	Vernacular	Plant Part used	Administration	Disease/ Ailment to be treated	Use Value
	Cajanus cajan (L.) Millsp.	Kadyos	Lf, Pe	Apply leaves on eyes	Sore eyes and measles	0.148
	Tamarindus indica L.	Sampalok	Lf	Use decoction for bathing	Post-pregnancy; chicken pox, fever, cough, cold,	0.111
				Drink decoction with calamansi	Cough	
	Senna alata (L.) Roxb.	Akapulko	Lf	Place pounded leaves on affected body part	Ringworm and other fungal infections	0.037
	Lablab purpureus (L.) Sweet	Bataw	Sh	Drink extracted oil from heated shoot	Asthma and oral sores	0.037
	Entada phaseoloides (L.) Merr.	Gugo	St	Use pounded stem as soap	Wound and dandruff	0.037
	Leucaena leucocephala (Lam.) de Wit	Ipil-ipil	Fr	Eat fresh fruit	Helminthiasis	0.037
	Phaseolus lunatus L.	Lima-lima	Lef, Rt	Drink decoction	Spasm, stomachache	0.037
	Pterocarpus indicus Willd.	Narra	St	Drink decoction	Tuberculosis	0.037
Lamiaceae	*Origanum vulgare* L.	Oregano	Lf	Drink decoction	Asthma, cough, cold	0.222
	Vitex negundo L.	Lagundi	Lf	Drink decoction	Fever, cough, cold	0.148
	Tectona grandis L.f.	Tekla	Lf	Drink decoction	Menstruation, low blood pressure	0.111
	Hyptis capitata Jacq.	Lagare-lagarean	Rt	Smell heated root	Fever and spasm	0.037
	Leucas aspera (Willd.) Link	Pansi-pansi	Lf, Sh	Smell	Headache and diarrhea	0.037
	Ocimum tenuiflorum L.	Sulasi	Lf	Drink decoction	Cough, cold	0.037
	Vitex parviflora A.Juss.	Mulawin	Pe	Use for bathing	Pregnancy	0.519
			Lf	Use for bathing; Apply sap and water to abdomen		
			St	Use decoction for bathing	Post pregnancy	
	Premna odorata Blanco	Alagaw	Lf, Sh	Apply extracts directly	Wounds	0.037
Lauraceae	*Persea americana* Mill.	Avocado	Lf	Drink decoction	Diabetes	0.037
Leeaceae	*Leea* sp.	Amamali/ Imaali	Rt, St	Drink decoction	Toothache; Purge	0.037
Lygodiaceae	*Lygodium sp.*	Nito	Lf, Rt	Drink decoction or smell heated leaves/roots	Nausea, headache, dizziness; kidney disease	0.518
Lythraceae	*Lagerstroemia speciosa* (L.) Pers.	Banaba	Lf, Fr, Pe, St	Drink decoction	Diarrhea, urinary tract infection, kidney stone, delayed menstruation, headache, low blood pressure	0.370
Malvaceae	*Hibiscus rosa-sinensis* L.	Gumamela	Fl	Apply heated flowers on affected body part	Boils	0.111
	Sida acuta Burm.f.	Walis-walisan	Rt	Eat chewed	Headache, Fever	0.111
			Lf	Eat chewed	Fever	
	Gossypium sp.	Bulak	St	Drink decoction	Cleaning of the uterus after pregnancy	0.037
	Sterculia foetida L.	Kalumbang	Lf	Apply heated leaves mixed with oil to affected body part	Sprain	0.037
	Pterospermum diversifolium Blume	Bayog/ Bayukan	Rt	Drink decoction	Cleaning of the uterus after miscarriage	0.037
Meliaceae	*Sandoricum koetjape* (Burm.f.) Merr.	Santol	Lf	Drink decoction; apply to forehead or stomach	Phlegm	0.111
					Fever, headache, constipation	
	Swietenia mahogany L.	Mahogany	Fr	Drink decoction	Diahrrea, Malaria	0.074
			Sd	Drink decoction	Cleaning of the uterus after pregnancy	

Continued....

Plant Family	Plant Species	Vernacular	Plant Part used	Administration	Disease/ Ailment to be treated	Use Value
Menispermaceae	*Tinospora rumphii* Boerl.	Makabuhay	St	Drink decoction	Stomach ache, diabetes	0.37
			Lf	Apply decoction to affected body parts	Sprain, sore eyes	
				Drink decoction	Fever, flatulence, headache	
	Tinospora sp.	Kaytama/ Kaytana	St, Fr, Pe, Lf	Drink decoction	Menstruation, dysmenorrhea, indigestion, pneumonia, cleaning of the uterus, enhance breastfeeding capability	0.222
Moraceae	*Ficus nota* (Blanco) Merr.	Tibig	Lf	Apply leaves to forehead	Fever; Headache	0.296
				Apply heated leaves to stomach	Stomach ache	
	Ficus caulocarpa (Miq.) Miq.	Balete	Rt	Apply extracted oil from roots to affected body part	Body pain	0.037
	Streblus asper Lour.	Kalios	Fr, St	Apply extracted oil to affected body part; Apply fresh stem to neck	Body pain and sore throat	0.037
	Artocarpus heterophyllus Lam	Langka	Ft, Lf	Apply extract from fruits; apply heated leaves	Wounds	0.037
	Ficus sp.	Tiboy	Lf	Apply leaves to forehead	Fever	0.037
Moringaceae	*Moringa oleifera* Lam	Malunggay	Lf, Fl, Fr, Rt	Drink decoction	Low blood pressure, cough	0.148
				Apply roots to affected area	Toothache	
Musaceae	*Musa paradisiaca* L.	Saging	Ft	Eaten	Diarrhea	0.259
			Lf	Drink decoction; Apply extracted sap to affected tooth	Indigestion, high/low blood pressure; toothache	
			Lf	Apply heated leaves with oil to affected body part	Sprain	
			St	Drink decoction	Indigestion	
Myrtaceae	*Psidium guajava* L.	Bayabas	Lf, Fr, Pe	Drink decoction	Diarrhea, stomach ache, dizziness, toothache, cleaning of the uterus after pregnancy, phlegm, colds, indigestion, oral sores and wounds	0.814
	Syzygium cumini (L.) Skeels	Duhat	Lf, Fr, Pe, Sh	Drink decoction	Diarrhea, stomach ache	0.148
	Eucalyptus globulus Labill.	Kalyptus	Lf	Drink decoction	Asthma	0.037
Oxalidaceae	*Averrhoa bilimbi* L.	Kalamyas	Lf	Used decoction for bathing	Post-pregnancy; chicken pox	0.037
Pandanaceae	*Pandanus amaryllifolius* Roxb.	Pandan	Lf	Drink decoction	Hypertension and stomach ache	0.185
	Pandanus L.f	Pandang lalaki	Lf	Drink decoction	Kidney disease, stomach-ache, spasms and fever	0.111
	Pandanus luzonensis Merr.	Alas-as	Lf	Apply on the forehead	Headache	0.037
	Pandanus sp.	Pandang Pastulan	Lf	Drink decoction	Urinary Tract Infection	0.037
Phyllantacea	*Antidesma bunius* (L.) Spreng.	Bignay	St	Drink decoction	Arthritis and Low blood pressure	0.074
Plantaginaceae	*Scoparia dulcis* L.	Kula-kulantran	Lf	Drink decoction	Measles	0.037
Poaceae	*Schizostachyum lumampao* (Blanco) Merr.	Buho	Lf, Rt, Sh	Drink decoction	Cough, phlegm, colds, fever, enhances lactation	0.444

Continued....

Plant Family	Plant Species	Vernacular	Plant Part used	Administration	Disease/ Ailment to be treated	Use Value
	Imperata cylindrica (L.) Raeusch.	Cogon	Lf, Rt	Drink decoction	Coughs, colds, fever, hypertension, kidney stone, dizziness	0.259
			Lf	Apply extract of pounded leaves directly	Wounds	
	Bambusa blumeana Schult.f.	Kawayan	Rt, Lf	Drink decoction	Spasm, colds, coughs kidney stone, dengue	0.185
	Saccharum spontaneum L.	Talahib	Lf, Rt	Drink decoction	Coughs, colds, fever, spasms, enhances lactation	0.185
	Cymbopogon citratus (DC.) Stapf	Tanglad	Lf, Rt	Drink decoction	Pregnant women, headache, low blood pressure, Colds an post-pregnancy	0.185
	Eleusine indica (L.) Gaertn.	Sabong - Sabungan	Lf	Smell heated leaves	Fever	0.111
	Coix lacryma-jobi L.	Balantakan	Rt	Drink decoction	Kidney stones	0.037
	Bambusa sp.	Bamboo	Lf	Drink decoction	Coughs, colds	0.037
	Cynodon dactylon (L.) Pers.	Mala-tagyang	Rt	Drink decoction	For purging	0.037
Rubiaceae	*Mussaenda philippica* A.Rich	Hamiling/ Kalingag	Lf, Rt	Chew and swallow	Dizziness, Sore throat	0.185
	Coffea arabica L.	Kapi	Lf	Apply directly	Wound/ bleeding	0.037
Rutaceae	*Lunasia amara* Blanco	Lunas bundok	St, Fr, Lf	Drink decoction	Stomach ache, colds, body pain, skin irritation, diarrhea, dengue	0.814
	Citrus japonica Thunb.	Calamansi	Fr	Drink as juice; Grill and eat with honey	Cough, phlegm	0.037
	Citrus hystrix DC.	Kabuyaw	Rt	Drink decoction	Kidney disease	0.037
	Citrus maxima (Burm.) Merr.	Suha	Lf	Used decoction for bathing	Post-pregnancy, Hypertension	0.037
Sapindaceae	*Litchi chinensis* Sonn.	Alupag/ Alpay	St, Lf	Drink decoction; Use decoction for bathing	Post-pregnancy	0.074
Sapotaceae	*Chrysophyllum cainito* L.	Caimito	Lf, Sh	Drink decoction	Diarrhea and stomach ache	0.111
Solanaceae	*Solanum melongena* L.	Talong	Lf	Apply heated leaves mixed with oil on affected part	Body pain, arthritis and difficulty in breathing	0.185
			Rt	Drink decoction	Asthma	
Tiliaceae	*Muntingia calabura* L.	Aratiles	Lf, Sh	Drink decoction	Diarrhea, Stomach ache	0.074
Xanthorrhoeaceae	*Aloe vera* (L.) Burm.f.	Aloe vera	St	Use extracts as shampoo	Alopecia	0.037
Zingiberaceae	*Zingiber officinale*	Luya	Rh	Apply rhizome mixed with salt and gas	Phlegm and stomachache	0.111
	Kaempferia sp. Roscoe	Dusol	Lf	Apply heated leaves directly	Boils	0.037

Fr – Fruit, Lf – Leaf, Pe – Peel, Rh – Rhizome, Rt – Root, Se – Seed, Sh – Shoot, St – Stem

exhibit toxic, repellent and/or anti-nutritional effects on the herbivores.[23] These secondary metabolites such as alkaloids, saponins and phenolic compounds have exhibited antimicrobial and antifungal activities, which could be responsible for the pharmacological effects experienced by the Ayta communities.

Some of the plants listed by Ayta communities which utilized leaves for medicinal purposes include *Psidium guajava* which they use for the treatment of diarrhea, stomach ache, dizziness, toothache, cleaning of the uterus after pregnancy, phlegm, colds, indigestion, oral sores and wounds. Other ethnobotanical studies including one conducted in Kalinga, Philippines also used *P. guajava* leaves for the treatment of diarrhea, toothache and wounds.[24] This plant is also included in the 10 medicinal plants endorsed by the Philippine Department of Health.

The roots are less used compared to the leaves since extraction of the roots is more destructive for the plants and the environment.[24] Some of the medicinal plants that utilize roots as herbal medicines include *Lygodium* sp. which they use to treat nausea, headache, dizziness and kidney disease. Other ethnobotanical studies listed some species of *Lygodium* as medicinal plants however leaves are usually the most common plant part used. *Lygodium japonicum* is used by Kalanguya tribe in Ifugao for rheumatic attacks and relieves muscle pain.[22] Another species of *Lygodium lanceolatum* is used in Southeastern Madagascar for the treatment of pancreas pain and gonorrhea.[25]

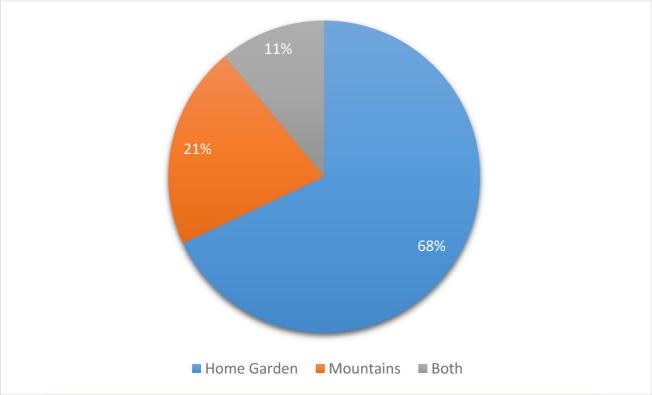

Figure 3: Location of the medicinal plants used by the Ayta.

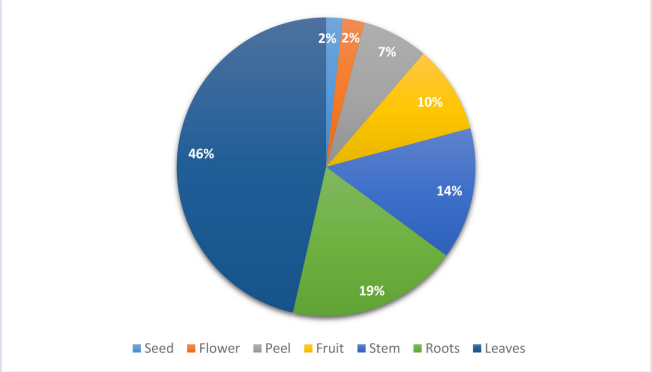

Figure 4: Plant parts used by the Ayta for medicinal purposes.

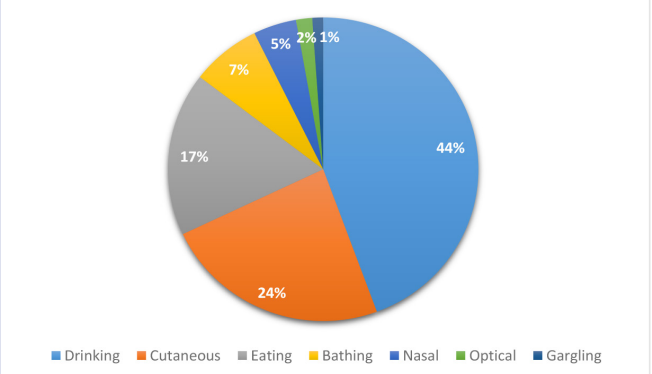

Figure 5: Modes of administration of the medicinal plants by the Ayta.

Preparation and Mode of Administration

The route of administration of these plants are also documented (Figure 5). The most common mode of administration is the oral route (drinking and eating) while the intravitreal administration is the least used mode of administration. Majority of medicinal preparations are taken orally (57%). Other routes of administration are dermal (36%) which includes rubbing and topical application on the affected part and traditional bath wash, nasal application (6%) which includes sniffing and smelling the aroma of the plant extract or the plant itself and (1%) intra¬vitreal administration.

Most of the medicinal preparations are taken orally (57%). This includes drinking decoction, eating and chewing fresh plants and gargling. This is congruent with other ethnobotanical surveys conducted in Bayabas, Sablayan in Benguet and Subanens in Dumingag, Zamboanga del Sur. Both previous studies noted that oral intake of decoction was the most common route of administration of medicinal plants. This involves boiling plant materials for a certain amount of time to soften the plants and extract its active compounds.[3,26]

The Ayta communities used both internal and external routes of administration to treat illnesses. Most of the plant species are used alone in treating diseases while there are few plants such as *Citrus japonica* Thunb. That are mixed with honey from bees and taken orally for treating cough and phlegm. Some plants such as *Goniothalamus amuyon* (Blanco) Merr and *Solanum melongena* L. that are used to treat arthritis and rheumatism and *Sterculia foetida* L. and *Musa paradisiaca* L., used to treat sprain are mixed with oils and massaged to affected parts of the body. *G. amuyon* and *S. melongena* have been previously reported as folk medicine for rheumatism. In Taiwan folk medicine, the seeds of *G. amuyon* are useful for the treatment of edema and rheumatism while *S. melongena* is useful for rheumatism, inflammation and foot pain.[27,28]

Use Value

The use value of the plants were computed to quantify the importance of a specific plant based on how often it is cited by a specific number of people (Table 2). The lowest use value was calculated at 0.037 for 33 plant species with only one to two informants citing their medicinal use. It was found that *P. guajava* (*Bayabas*) and *L. amara* (*Lunas Bundok*) were the most important medicinal plants in the three barangays with a use value of 0.814.

The decoction of *P. guajava* are used by Ayta in treating variety of diseases such as diarrhea, stomach ache, dizziness, toothache, cleaning of the uterus after pregnancy to help the uterus to contract and avoid excessive bleeding, phlegm, colds, indigestion and oral sores. It is also the most commonly used plant in treating diseases of the digestive system including stomach ache, diarrhea and toothache and diseases of the respiratory system including common colds and acute upper and lower respiratory infections.

The decoction of stem, fruits and leaves of *L. amara* is used to treat stomach ache, colds, body pain, skin irritation, diarrhea, and dengue. It is the most commonly used plant for the treatment of skin irritation, common colds, stomachache, and muscle and body pain. In another study conducted in Agusan del Sur, Philippines, Manobo people and traditional healers reported using infusion of *L. amara* bark with with coconut oil and tinctured with wine. They rub these on the surface of affected or infected parts. These include treatments of wounds, allergies, skin infection and bites of dogs, snakes and insects. Oral intake of decoction of wine-tinctured bark or root of *L. amara* is used to treat stomach troubles, poisoning, ulcer, nausea, diarrhea, gastroenteritis and has antitoxin, antibacterial and antiviral properties.[29]

All plant species with the highest use values are used to treat wide variety of communicable (bacterial and viral infections) and non-communicable diseases. *Artemisia vulgaris* L., *L. amara, P. guajava* and *Schizostachyum lumampao* (Blanco) Merr. are used to treat sore throat, colds, cough and phlegm; *Cordia dichotoma* G.Forst. and *P. guajava* are used to treat wounds and infection and *Cyanthillium cinereum* (L.) H.Rob. is used to treat measles. *Lygodium sp*. is used to treat kidney disease, which is a non-communicable disease.

Informant Consensus Factor

Diseases mentioned by the Ayta informants were first classified according the International Disease Classification – 10.[30] From these categories,

Table 3: Informant Consensus Factor (FIC) values of the diseases cured by the medicinal plants.

Category	Disease	ICD-10	Use Citation	Plant taxa used	FIC	Plant Most Used
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	Nausea, vomiting, dizziness and giddiness and fever	XVIII	142	21	.858	*Psidium guajava* L
Diseases of the skin and subcutaneous tissues	Skin irritation, itchiness, boils and skin eruptions	XII	43	8	.833	*Lunasia amara Blanco*
Diseases of the eye and the adnexa	Sore Eyes and red eyes	VII	22	3	.905	Tinospora rumphii Boerl.
Diseases of the genitourinary system	Urinary, chronic cystitis and kidney	XIV	64	12	.825	Lygodium sp.
Diseases of the nervous system	Migraine and other headache syndromes Fever	VI	142	25	.830	Artemisia vulgaris L.
Diseases of the musculoskeletal system and connective tissues	Arthritis, rheumatism, muscle and body pain	XIII	56	9	.855	*Lunasia amara Blanco*
Diseases of the digestive system	Constipation, Stomach ache, diarrhea, indigestion and toothache	XI	167	31	.819	Lunasia amara Blanco, Psidium guajava L.
Infectious and parasitic disease	Tuberculosis, measles, ringworm, chicken pox, helminthiasis, rabies and malaria	X	45	16	.659	Cyanthillium cinereum (L.) H.Rob.
Diseases of the circulatory system	Anemia, high and low blood pressure	IX	53	14	.750	Lagerstroemia speciosa (L.) Pers.
Diseases during the postpartum period	Relapse after giving birth, menstruation and new delivered	XV	41	6	.875	Vitex parviflora A.Juss.
Injury and poisons of external causes	Wounds, cuts and sprains	XIX	73	17	.778	Tinospora rumphii Boerl.
Diseases of the respiratory system	Common colds, asthma, pneumonia, acute upper and lower respiratory infections and lung disease	X	192	36	.817	*Psidium guajava* L., *Lunasia amara Blanco*
Endocrine, nutritional and metabolic diseases	Diabetes	IV	11	2	.818	Tinospora rumphii Boerl.

FIC values were calculated (Table 3). The values ranged from as low as 0.659 to as high as 0.905. FIC values determine the consistency on the utilization of a plant species for a certain disease. Higher values indicated that only few plant species are used by the informants to treat a particular disease, whereas low values indicated low agreement on which plant to use for a specific disease.[31]

The highest FIC value (0.905) is for the diseases of the eye and the adnexa (sore eyes). The Ayta informants cited three plant species for the treatment of sore eyes. *Tinospora rumphii* Boerl. is the most commonly used plant for this disease category. Balangcod *et al.*[32] reported the antibacterial activity of *T. rumphii* against *Staphylococcus aureus* which is a causative agent of bacterial conjunctivitis. The next highest FIC (0.875) was for the disease during the postpartum period. *Vitex parviflora* was the most commonly used plant for this disease category. The third highest FIC (0.858) was for the disease category for nausea, vomiting, dizziness and giddiness and fever. *P. guajava* was the most commonly used plant species for this disease category. A study conducted by Olorunfemi *et al.*[33] observed central amelioration of pain sensation by the *P. guajava* stem bark in albino rats. This study showed a dose-dependent increase in central analgesic activities of *P. guajava*. It also showed synergistic analgesic activity when combined with morphine. Plants that are most utilized for diseases with high FIC values also have high use values.

Some of the plants used by Ayta communities as medicines were listed in the National list of threatened plants in the Philippines.[34] Based on the, *V. parviflora* which is used for traditional bath after pregnancy, is classified as critically endangered species. On the other hand, *Dracontomelon dao* (Blanco) Merr. and Rolfe, which is used as treatment for wound infection, belonged to the vulnerable category.[35] Excessive use of these medicinal plants coupled with the threats from deforestation, land conversion or agricultural expansion, and natural disasters may put these plants in the danger of extinction. This record of the medicinal plants used by Ayta communities further echoes the need to protect and conserve these medicinal plant species because of their environmental and medicinal importance.

CONCLUSION

This study showed that the three Ayta communities in Dinalupihan, Bataan use a total of 118 identified plants for medicinal purposes. This documentation of ethnobotanical knowledge provides a catalog of useful plants of the Ayta, and will serve as a physical record of their culture for the education of the future Ayta generation. It will also strengthen Ayta culture by recognizing their traditional knowledge on medicinal plants and providing scientific basis for it. This can help in preserving the traditional knowledge of the Ayta which is slowly fading away due to modernization and the influence of the non-Ayta communities. This study can also serve as baseline knowledge for future functional bioactivity screening of indigenous plants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

ABBREVIATIONS

UV: Use Value; FIC: Informant Consensus Factor; **Nur:** Number of use reports in each category; **Nt:** number of species used for a particular category by all informants; **Fr:** Fruit; **Lf:** Leaf; **Pe:** Peel; **Rh:** Rhizome; **Rt:** Root; **Se:** Seed; **Sh:** Shoot; **St:** Stem.

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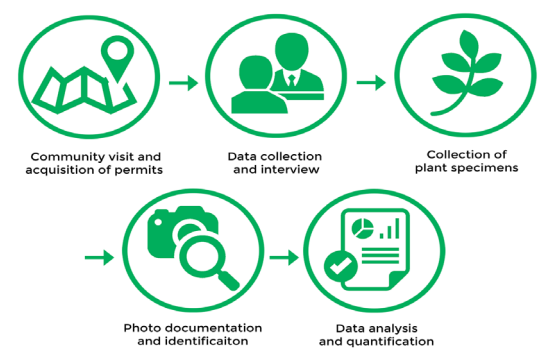
GRAPHICAL ABSTRACT



SUMMARY

- This study documented the species of medicinal plants used by Ayta communities in Dinalupihan, Bataan. A total of 26 informants were interviewed regarding the plants they utilize for medicinal purposes. Ayta communities listed a total of 118 plant species classified into 49 families used as herbal medicines. The Family Fabaceae was the most represented plant family with 11 species. Leaves were the most used plant part (43%). Majority of medicinal preparations were taken orally (57%). This documentation provides a catalog of useful plants of the Ayta and serves as a physical record of their culture for the education of future Ayta generations.

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