Ethnomedicinal plants used for the treatment of cuts and wounds by the Agusan Manobo of Sibagat, Agusan del Sur, Philippines

Mark Lloyd G. Dapar, Ulrich Meve, Sigrid Liede-Schumann, Grecebio Jonathan D. Alejandro

Research

Abstract

This study was conducted to investigate the ethnomedicinal plants used by the Agusan Manobo as potential drug leads for the treatment of cuts and wounds. Despite the prominence of the locality on medicinal plant use, the area was previously ignored due to distance and security threat from the Communist Party of the Philippines - New People's Army. Oral medicinal plant knowledge was documented.

Methods: Ethnomedicinal survey was conducted from October 2018 to February 2019 among 50 key informants through a semi-structured questionnaire; open interviews and focus group discussions were conducted to gather information on medicinal plants used as a treatment for cuts and wounds. Nonparametric inferential statistics Kruskal-Wallis and Mann-Whitney *U* tests were set at 0.05 level of significance to determine if there was a significant difference of ethnomedicinal knowledge among respondents when grouped according to location, social position, occupation, educational level, civil status, gender and age. Quantitative ethnomedicinal data was obtained from Family Importance Value and Relative Frequency of Citation.

Results: Present documentation enumerates 48 species of medicinal plants belonging to 45 genera and 26 families used by the community and their only tribal healer for the treatment of cuts and wounds. Asteraceae (7 species) was the best-represented family and *Piper* species were cited to be the most frequently used medicinal plant species. Statistically, the medicinal plant knowledge among respondents was significantly different ($p < 0.05$) when grouped according to occupation, educational level, civil status, gender, and age but not when grouped according to location ($p = 0.234$) and social position ($p = 0.580$).

Conclusion: The current study documents the medicinal plant knowledge of Agusan Manobo in the treatment of cuts and wounds. The traditional medicinal systems of Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) are sources of knowledge for bioprospecting. More ethnobotanical studies should be encouraged before the traditional knowledge of indigenous people vanishes.

Correspondence

Mark Lloyd G. Dapar[1,3*], Ulrich Meve[3], Sigrid Liede-Schumann[3], Grecebio Jonathan D. Alejandro[1,2,3]

[1]The Graduate School and Research Center for the Natural and Applied Sciences, University of Santo Tomas, España Boulevard, 1015 Manila, Philippines

[2]College of Science, University of Santo Tomas, España Boulevard, 1015 Manila, Philippines

[3]Department of Plant Systematics, University of Bayreuth, Universitätsstr. 30, D-95440 Bayreuth, Germany

*Corresponding author. E-mail address: marklloyd.dapar.gs@ust.edu.ph (M.L.G. Dapar)

Ethnobotany Research & Applications 19:31 (2020)

Manuscript received: 02/01/2020– Revised manuscript received: 11/03/2020 - Published: 17/03/2020

http://dx.doi.org/10.32859/era.19.31.1-18

Key words: Agusan Manobo; Cuts; Ethnomedicine; Sibagat; Wound

Abstract (Bisaya/Cebuano)

Background: Kini nga papel nag imbestigar sa gamit sa mga tanom alang sa pagpanambal sa mga Manobo sa Agusan isip potensyal nga idiskobre nga tambal alang sa mga hiwa ug samad. Bisan sa kaila sa ilang mga tanom gamit pagpanambal, wala madokumentar kini tungod sa kalayo ug kakuyaw sa mga Communist Party of the Philippines - New People's Army nga nagapuyo aning lugara. Ang ilang kahibalo sa pagpanambal nga gipasapasa pinaagi sa mga estorya, gidokumentar niining papela.

Methods: Gibuhat kining dokumentasyon gikan Oktubre 2018 hangtud Pebrero 2019 sa 50 ka mga taong maalamon pinaagi sa pakisestorya, pangutana, ug pakigpulong sa komunidad sa mga tambal nga tanom alang sa mga hiwa ug samad. Gigamitan ug estatistika pinaagi sa Kruskal-Wallis ug Mann-Whitney *U* na mga test sa 0.05 lebel sa significance kung adunay kalambigitan ang kaalam sa mga maalamon base sa lokasyon, posisyon sa tribo, trabaho, nahumang edukasyon, kahimtang sa kaminyoon, tawhanun, ug edad. Gilista ang maong mga tanom nga tambal ug ang pila ka mga nalitok sa mga maalamon pinaagi sa family importance value ug relative frequency of citation.

Results: Ang maong dokumentasyon nakalista ug 48 ka species nga mga tanom nga tambal ug mikabat ka 45 ka genera ug 25 ka pamilya nga gigamit sa komunidad ug sa ilang mananambal sa tribo alang sa mga hiwa ug samad. Ang pamilya sa Asteraceae (7 species) ang nagrepresentar ug dako ug ang Piper species ang pinakagigamit nga tanom alang sa pagpanambal. Base sa estatistika, ang kaalam sa tanom nga tambal sa mga maalamon kay adunay significant nga deperensiya ($p < 0.05$) kung igrupo sa unsang trabaho, nahumang edukasyon, kahimtang sa kaminyoon, tawhanun, ug edad apan walay significant nga deperensiya kung igrupo sa lokasyon ($p = 0.234$) ug posisyon sa tribo ($p = 0.580$).

Conclusions: Kini nga panukiduki nagpakita sa tradisyonal nga gamit ug kahibalo sa mga Manobo sa Agusan alang sa epektibong tanom pagpanambal sa mga hiwa ug samad. Ang systema sa pagpanambal sa mga Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) kay importante nga kaalam para sa pagdiskobre sa mga tambal. Daghan pang mga pagdokumentar ang gikinahanglan ug gidasig ang tanan sa pagtuki sa dili pa mawala ang mga kahibalo ug kaalam sa atong mga nitibo ug lumad.

Background

The Philippines is rich in traditional knowledge of medicinal plants used by various ethnic communities. WHO estimates around 2% of the world's population are currently disabled as a result of cuts and injury (Peabody *et al*. 2000); about 1–2% in developed countries will experience a chronic wound in their lifetime (Gottrup 2004). Although scant data on cuts and wounds are available for developing countries of Asia, such sufferings are a major health problem facing indigenous peoples.

WHO has also recorded around 60% of the world's population rely on herbal medicine (Farnsworth 1994). There are about 35,000–70,000 medicinal plant species worldwide (Schippmann *et al*. 2002), of which 7,000 species are in South Asia (Karki & William 1999) and ca. 6,500 species in Southeast Asia (Madulid 1989, Burns 1998). There are around 1,500 species of medicinal plants in the Philippines (Dela Cruz & Ramos 2006). A total of 120 medicinal plants have been scientifically validated for safety and efficacy (Eusebio & Umali 2004) which include some of the top 100 medicinal plants listed used in various treatments for cuts, wounds, infections and other diseases (Tan & Sia 2014). A number of these medicinal plants with folkloric bases were recently validated scientifically by evaluating their biological and biochemical properties (e.g. Abdulaziz *et al*. 2019, Añides *et al*. 2019, Dela Peña *et al*. 2019, Nadayag *et al*. 2019, Uy *et al*. 2019, Dapar *et al*. 2020b). Several plants are used for the treatment of cuts, wounds and skin infections. They are known to be used in the form of extracts, poultice and decoction from various ethnic groups, but yet to be documented from the Manobo community of Mindanao, Philippines.

Mindanao archipelago of Philippines is inhabited by various indigenous peoples (IPs) (UNDP 2010). Majority of these IPs belong to the Agusan Manobo community (NCIP 2010, NCCA 2015, Reyes *et al*. 2017). Etymologically, the term Manobo was named after 'Mansuba' meaning river people. They live along the Agusan river valley and Agusan marshland territories of the province (Dapar *et al*. 2020a). The municipality of Sibagat in Agusan del Sur province is listed among the localities approved with a Certification of Ancestral Domain Title (CADT) by the National Commission on Indigenous Peoples (NCIP). Their common livelihoods are traditional agriculture or animal husbandry and their source of food comes from their rice harvest, root crops, and vegetables. Recorded common ailments of Agusan Manobo were bites, cuts, wounds and skin infections based on current study but only one species locally named "Lunas-bagon" has yet been documented (Dapar & Demayo 2017) which was molecularly

confirmed recently as an indigenous *Piper decumanum* L. (Dapar et al. 2020b) and previously evaluated for its antimicrobial, cytotoxic and phytochemical properties (Dapar *et al*. 2018).

One of the riversides occupied by the tribe is their ancestral domain nearby Sibagat River, which is historically known as the battle zone of opposing tribes (PIMO 2012). During wars and conflicts, injuries such as cuts, wounds and burns were common, resulting in various medicinal plant usage to address them. Moreover, war conflicts involving secessionists and communist insurgents against the government have also affected the Agusan Manobo communities in their location. This conflict scenario inflicts injuries, particularly cuts and wounds resulting to increasing demand for medicinal plants. Their long tradition of preserving their medicinal plant knowledge have also proven to be useful in other situations such as motor vehicle accidents, burns, fractures, lacerations and animal interactions.

The law and order situation brought about by security threats posed by the Communist Party of the Philippines - New People's Army previously hindered possibilities of ethnomedicinal surveys. In this context, the recent reduction in conflicts and prevalence of peace makes it possible to conduct ethnobotanical studies. Therefore, this study was conceived to document ethnomedicinal plants used by the Agusan Manobo of selected CADT areas of Sibagat, Agusan del Sur, for the treatment of cuts and wounds.

Materials and methods

Study area

Sibagat is geographically located in the coordinates 8° 96' 61" N, 125° 76' 25" E, situated in the northeastern tip of the province of Agusan del Sur (Figure 1). It was formerly part of Bayugan and became an independent municipality in 1961 with a total of 24 barangays along the local river called "Sibagat River". Fieldwork was carried out in three purposively selected barangays with approved CADTs as endorsed by the municipal administration and NCIP focal personnel. Research intent was permitted by the tribal council, and approved by the NCIP, and the Provincial Environment and Natural Resources Office (PENRO) of the provincial and local administration of Agusan del Sur. There is only one hospital and health center in the municipality and poor access of the local healthcare can be observed due to limited facilities and distant location from the communities. Hence, the long traditional use of medicinal plants for treating cuts and wounds is still prevalent in the locality.

Field survey

A total of 38 field visits were conducted from October 2018 to February 2019 to collect ethnobotanical information on the treatment of cuts and wounds. The fieldwork was carried out after obtaining ethics approval, consents, resolution, certification, and permits. These were obtained prior to the actual interview and field sampling of medicinal plants in three selected barangays of Sibagat, namely Ilihan, Mahayahay and Villangit (Figure 1). This survey coordinated with the municipal administration of Sibagat and consulted the tribal council of elders to converse about research intent as purely academic. A Manobo ritual was observed for mutual agreement and respect with the tribal community (Figure 2). When all free prior informed consents, resolution and certification from the tribal community were secured, this survey was duly certified and permitted by the regional offices, namely NCIP and Department of Environment and Natural Resources Office (DENR) of CARAGA Administrative Region, respectively.

A total of 50 purposively and snowball sampled Manobo key informants (more than 10% of the total population of selected barangays) were interviewed using a semi-structured open-ended interview. There were 35 females and 15 males with an age range from 18 to 78 years old and an average age of 42. The sample also included their lone tribal healer, one Indigenous Peoples Mandatory Representative (IPMR), the municipal tribal chieftain, 13 tribal leaders, 34 tribal council of elders. A valid translation to Manobo dialect (Minanubu) was secured in coordination with the NCIP focal personnel and tribal elders. A total of 19 focus group discussions were performed with the municipal chieftain and IPMR, three respective barangay tribal leaders and the only tribal healer.

Collection and identification

Voucher specimens of medicinal plants were deposited in the University of Santo Tomas Herbarium (USTH) and folk names compared to the Dictionary of Philippine Plant Names by Madulid (2001). Plant identification was authenticated with the help of Danilo Tandang, a botanist and researcher at the National Museum of the Philippines. All scientific names were verified for spelling and synonyms, and family classification using The Plant List (2013), World Flora Online (2019), the International Plant Names Index (2019) and Tropicos (2019). Medicinal plant species occurrence, distribution, and species identification were further confirmed by referring to the updated Co's Digital Flora of the Philippines (CDFP 2011 onwards).

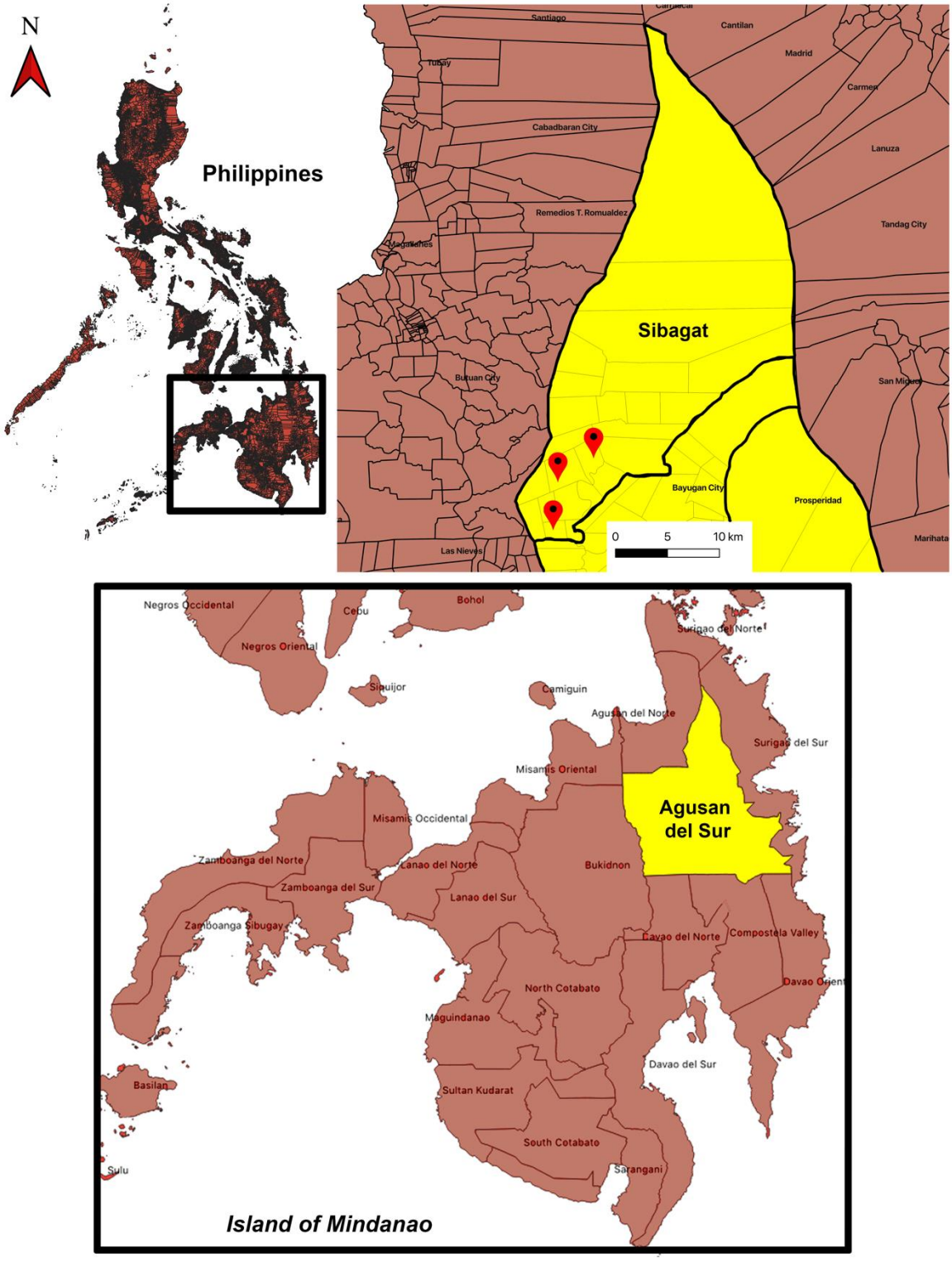

Figure 1. Map of Sibagat, Agusan del Sur, Philippines showing the three barangays (villages): Ilihan, Mahayahay, and Villangit (red pins).

Figure 2. Rituals being performed with the Manobo officials of Sibagat, Agusan del Sur: (A) The tribal chieftain, healer, leaders, and council of elders together with the National Commission on Indigenous Peoples (NCIP) focal personnel; (B) Ritual prayer asking permission to their deities; (C) Sacrificing chicken; (D) Offering to their deities; (E) Signing of certification using blood thumbmarks; and (F) Group photo on the approval of the conduct of study.

Table 1. Demographic profile of informants.

Category	Subcategory	No. of Informants	% of informants	Total No. of Species Cited
Location (barangay or village)	Ilihan	10	20	40
	Mahayahay	5	10	45
	Villangit	35	70	42
Educational level	Primary	9	18	33
	Secondary	24	48	36
	Higher education	17	34	31
Gender	Female	35	70	40
	Male	15	30	43
Social position	Tribal chieftain	1	2	36
	Tribal healer	1	2	43
	Tribal IPMR	1	2	38
	Tribal leaders	13	26	36
	Tribal council of elders	34	68	37
Occupation	Farming	30	60	43
	Animal husbandry	9	18	41
	Employed	10	20	31
	Unemployed	1	2	38
Civil status	Single	27	54	37
	Married	23	46	40
Age	18-34 years old	20	40	32
	35-49 years old	14	28	36
	50-65 years old	10	20	43
	More than 65 years	6	12	45

Quantitative ethnomedicinal analysis

Relative Frequency of Citation (RFC) helps in determining the local importance of each medicinal plant species. This is calculated using the formula: RFC = FC/N, where FC (frequency of citation) is the number of informants who cited the medicinal plant, and N is the total number of informants (Vitalini *et al*. 2013). RFC identifies the cultural importance of plant species in the area ranging in value from 0 to 1, with values closer to 1 represent the most important species. Family Importance Value (FIV) identifies the local importance of the medicinal plant families. This is calculated using the formula: FIV = (FC/N) x 100, where FC is the frequency of citation of the plant family, and N is the total number of informants (Ali *et al*. 2018). FIV determines the most important family based on the number of citation reports among key informants and the number of medicinal plant species used to treat cuts and wounds.

Statistical analysis

Medicinal plant knowledge of respondents on the number of medicinal plant species known were statistically analyzed by descriptive and non-parametric inferential statistics Mann-Whitney *U* and Kruskal-Wallis tests, grouped according to location, social position, occupation, educational level, civil status, gender and age. Statistical analyses were employed using IBM SPSS Statistics software v.23.

Results and discussion

Demographic profile of respondents

The study area comprises three barangays (villages) in the Municipality of Sibagat as shown in Table 1 and Figure 1. The field interviews conducted here included heterogenous informants with varying educational levels, gender, social position, occupation, civil status, and age. Indeed, medicinal plant knowledge is not homogenous but varies significantly among the respondents of the community (Voeks & Leony 2004; Voeks 2007; Camou-Guerrero *et al*. 2008)

The sample comprises of 30% female and 70% male informants. In terms of occupation, most of the key informants are farmers (60%) followed by formal employment (20%), animal husbandry (18%), and one unemployed (2%). Many of them finished secondary level (48%), followed by higher education (34%), and primary (18%). The sample involved both single (54%) and married (46%) respondents. Majority of them were Manobo council of elders (68%), followed by tribal leaders (26%%), and one each for tribal chieftain (2%), tribal healer (2%) and

tribal IPMR (2%). In terms of age, there was a decreasing number of informants with increasing years of age as 18-34 years (40%), 35-49 years (28%), 50-65 years (20%), and more than 65 years (12%). The total number of species cited varied relatively according to the demographic profile of the informants.

Medicinal plant knowledge

On the average, each Agusan Manobo key informant has a recorded knowledge of 35 medicinal plant species used for cuts and wounds. The relative frequency of citation (RFC) and family importance value (FIV) of medicinal plants were relatively dependent on the number of medicinal plants known among the Agusan Manobo respondents for the treatment of cuts and wounds. These number of medicinal plant knowledge among the key informants varied comparatively according to location, social position, occupation, educational level, civil status, gender and age. Descriptive and inferential statistics revealed significant factors influencing medicinal plant knowledge of Agusan Manobo key informants for cuts and wounds.

When grouped according to location and social position, Kruskal-Wallis test revealed no significant differences of medicinal plant knowledge ($p = 0.234$ and $p = 0.580$, respectively). This result may suggest that there could be an active exchange of knowledge in the three localities among the Agusan Manobo tribal communities within and among social positions. Sharing of information could be observed during their monthly social meeting and preparation which perpetuates the uses and knowledge of their medicinal plants used for cuts and wounds. However, when respondents were grouped according to occupation, nonparametric Kruskal-Wallis test showed significant difference ($p < 0.05$) on their knowledge of medicinal plants used for cuts and wounds.

Respondents doing farming had the highest medicinal plant knowledge (Md = 36, n = 30), followed by those doing animal husbandry (Md = 34, n = 9), employed respondents (Md = 29, n = 10), and the lowest was recorded from the lone unemployed respondent (Md = 28, n = 1). When grouped according to educational level, key informants who had secondary level as highest educational qualification had the highest medicinal plant knowledge (Md = 38, n = 24), followed by primary level (Md = 35, n = 9), and finally tertiary level (Md = 25, n = 17) as revealed by the highly significant difference in Kruskal-Wallis test ($p < 0.05$). Moreover, both nonparametric Kruskal-Wallis and Mann-Whitney *U* tests showed significant differences of key informants' medicinal plant knowledge when grouped according to civil status and gender ($p < 0.05$).

Married informants had more medicinal plant knowledge (Md = 35, n = 23) than single informants (Md = 32, n = 27). In terms of gender, male informants had more medicinal plant knowledge (Md = 36, n = 35) when compared to female informants (Md = 35, n = 25). On the other hand, key informants' plant knowledge when grouped according to age increases significantly by increasing age as revealed in the highly significant difference in Kruskal-Wallis test ($p < 0.05$). This result was presented starting from the lowest age range, 18–34 years old (Md = 27, n = 20), then 35–49 years old (Md = 34, n = 14), 50–65 years old (Md = 36, n = 10), and finally, more than 65 years old (Md = 39, n = 6). This result implies that medicinal plant knowledge for cuts and wounds among the Agusan Manobo could be attributed to the period duration of experience of medicinal plant practices as manifested in their age.

Medicinal plants used and their distribution

The present study documented ethnobotanical information on 48 species of medicinal plants belonging to 45 genera and 25 families for the treatment of cuts and wounds (Table 2). Most of these medicinal plants grow in the wild in various ecotypes as the Agusan Manobo believe that these plants with healing powers should thrive in their natural habitat.

Only three species (6.25%) were Philippine endemic, namely *Cinnamomum mercadoi* S.Vidal, *Homalomena philippinensis* Engl. ex Engl. & K.Krause, and *Omalanthus macradenius* Pax & Hoffm. On the other hand, the other 45 species (93.75%) were recorded not endemic. These species could be listed exotic species which could be either introduced or naturalized, or both. Two recorded introduced species were *Hippobroma longiflora* (L.) G. Don and *Jatropha curcas* L. Naturalized species included *Ageratum conyzoides* L., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Gmelina arborea* Roxb. ex Sm., *Jatropha gossypifolia* L., *Kalanchoe pinnata* (Lam.) Pers., *Phyllanthus amarus* Schumach. & Thonn., and *Piper aduncum* L. Other species were both naturalized and invasive species such as *Kalanchoe pinnata* (Lam.) Pers. while some species were both introduced and naturalized such as *Gliricidia sepium* (Jacq.) Kunth ex Steud., *Pseudelephantopus spicatus* (Juss.) Rohr, and *Psidium guajava* L. Some species were known native of the Neotropics, such as *Ageratum conyzoides* L., *Chromolaena odorata* (L.) R.M. King & H. Rob., and *Hyptis capitata* Jacq.

The prehistoric introduction of plants, mostly trees was preliminarily recorded among the Malayo-Polynesian settlers (Baguinon *et al*. 2003). Additional exotic trees and crops were brought to the Philippines through Acapulco trade during the Spanish regime (Baguinon *et al*. 2003) and even more exotic trees during the American regime (Caguioa 1953). Caguioa (1953) provides a good account of the introduction of plants to the Philippines. The introduction of exotics including medicinal plants continued during post-war and planting them were included in reforestation (Baguinon *et al*. 2003). Large number of invasive species were being used in various ethnic groups since these could have competitive advantage for the resilience of medical systems in the Philippines. Exotic species could increase species diversity of plant species considered by the tribal community as medicinal or therapeutic (Alencar *et al*. 2014).

Table 2. Ethnomedicinal plants used for the treatment of cuts and wounds

No.	Scientific name (Voucher No.)	Family	Origin	Folk name	FC	RFC	Used part	Mode of preparation and administration
1.	*Abroma augusta* (L.) L.f. (USTH 015637)	Byttneriaceae		Samboligawn	10	0.22	Bark, leaf	Decocted leaf and bark are washed on cuts and wounds.
2.	*Acmella grandiflora* (Turcz.) R.K.Jansen (USTH 015548)	Asteraceae		Lunas pilipo	37	0.74	Flower	Fresh flower is crushed and applied on cuts and wounds.
3.	*Ageratum conyzoides* L. (USTH 015602)	Asteraceae		Albahaca	15	0.30	Leaf	Leaf is pounded and applied on cuts and wounds.
4.	*Alstonia macrophylla* Wall. ex G.Don (USTH 015546)	Apocynaceae		Dita	29	0.58	Leaf	Leaf is crushed, heated and applied on cuts and wounds.
5.	*Anodendron borneense* (King & Gamble) D.J. Middleton (USTH 015639)	Apocynaceae		Lunas tag-uli	36	0.72	Stem	Stem infused with coconut oil is applied on to affected parts.
6.	*Arcangelisia flava* (L.) Merr. (USTH 015600)	Menispermaceae		Lagtang or Abutra	18	0.36	Stem	Stem infused with coconut oil is applied on to affected parts.
7.	*Bidens pilosa* L. (USTH 015582)	Asteraceae		Tuway-tuway	8	0.16	Leaf	Leaf is crushed and applied on cuts and wounds.
8.	*Chromolaena odorata* (L.) R.M. King & H. Rob. (USTH 015632)	Asteraceae		Hagonoy	33	0.66	Leaf sap	Leaf sap is applied on to cuts and wounds.
9.	*Cinnamomum mercadoi* S.Vidal (USTH 015585)	Lauraceae	Endemic	Kaningag	37	0.74	Bark, branch, root	Bark, branch and root infused with coconut oil is are applied on affected parts.
10.	*Coleus scutellarioides* (L.) Benth. (USTH 015644)	Lamiaceae		Mayana pula	33	0.66	Leaf	Leaf is crushed and applied on cuts and wounds.
11.	*Cratoxylum sumatranum* (Jack) Blume (USTH 015541)	Hypericaceae		Bansilay	17	0.34	Leaf	Leaf is pounded and applied on cuts and wounds.
12.	*Curcuma longa* L. (USTH 015674)	Zingerberaceae		Duwaw	10	0.20	Rhizome	Extract of the pounded rhizome is applied on to affected parts.
13.	*Dianella ensifolia* (L.) DC. (USTH 015656)	Xanthorrhoeaceae		Ikug-ikug	13	0.26	Leaf	Leaf is applied on to cuts and wounds.
14.	*Eleusine indica* (L.) Gaertn. (USTH 015569)	Poaceae		Bilabila	13	0.26	Leaf	Decocted leaf is washed on cuts and wounds.
15.	*Erechtites valerianifolius* (Link ex Spreng.) DC.	Asteraceae		Gapas-gapas bae	12	0.24	Leaf sap	Leaf sap is applied on to cuts and wounds.

	(USTH 015666)							
16.	*Euphorbia hirta* L. (USTH 015665)	Euphorbiaceae		Tawa-tawa	27	0.54	Leaf	Decocted leaf is washed on cuts and wounds.
17.	*Ficus concinna* (Miq.) Miq. (USTH 015552)	Moraceae		Balete	38	0.76	Bark, root	Decocted bark and root are washed on cuts and wounds.
18.	*Gliricidia sepium* (Jacq.) Kunth ex Steud. (USTH 015620)	Fabaceae		Madre de Cacao	26	0.52	Leaf sap	Leaf sap is applied on to cuts and wounds.
19.	*Gmelina arborea* Roxb. ex Sm. (USTH 015635)	Lamiaceae		Gemelina	24	0.48	Leaf	The leaf is applied on to cuts and wounds.
20.	*Hippobroma longiflora* (L.) G. Don (USTH 015583)	Campanulaceae		Elepanteng puti	14	0.28	Leaf	Decocted leaf is washed on cuts and wounds.
21.	*Homalomena philippinensis* Engl. ex Engl. & K.Krause (USTH 015597)	Araceae	Endemic	Payaw	13	0.26	Rhizome	Extract of the pounded rhizome is applied on to affected parts.
22.	*Hoya imbricata* Decne. (USTH 015618)	Apocynaceae		Pikot-pikot	10	0.20	Leaf	Burned and powdered leaf infused with coconut oil is applied on to affected parts.
23.	*Hydrocotyle vulgaris* L. (USTH 015563)	Araliaceae		Goto kola	16	0.32	Leaf sap	Leaf sap is applied on to cuts and wounds.
24.	*Hyptis capitata* Jacq. (USTH 015574)	Lamiaceae		Sawan-sawan	15	0.30	Leaf	Leaf is crushed and applied on cuts and wounds.
25.	*Jatropha curcas* L. (USTH 015595)	Euphorbiaceae		Tuba-tuba puti	19	0.38	Leaf	Decocted leaf is washed on cuts and wounds.
26.	*Jatropha gossypifolia* L. (USTH 015586)	Euphorbiaceae		Tuba-tuba tapol	22	0.44	Leaf	Decocted leaf is washed on cuts and wounds.
27.	*Kalanchoe pinnata* (Lam.) Pers. (USTH 015584)	Crassulaceae		Hanlilika	25	0.50	Leaf	Decocted leaf is washed on cuts and wounds.
28.	*Mangifera indica* L. (USTH 015591)	Anacardiaceae		Mangga	25	0.50	Leaf	Leaf is crushed and applied on cuts and wounds.
29.	*Melastoma malabathricum* L. (USTH 015588)	Melastomataceae		Hantutuknaw	11	0.22	Stem	Decocted stem is applied on cuts and wounds.
30.	*Mentha canadensis* L. (USTH 015670)	Lamiaceae		Sencia	10	0.20	Leaf	Leaf is decocted or crashed crushed and applied on affected parts.
31.	*Micromelum minutum* (G. Forst.) Wight & Arn. (USTH 015538)	Rutaceae		Lunas kahoy	39	0.78	Root, stem	Stem or root infused with coconut oil is applied on cuts and wounds.
32.	*Mikania cordata* (Burm.f.) B.L. Rob. (USTH 015543)	Asteraceae		Moti-moti	36	0.72	Leaf sap	Leaf sap is applied on to cuts and wounds.
33.	*Ocimum basilicum* L. (USTH 015630)	Lamiaceae		Sangig	12	0.24	Leaf	Leaf is crushed and applied on cuts and wounds.
34.	*Omalanthus macradenius* Pax & Hoffm. (USTH 015633)	Euphorbiaceae	Endemic	Banti	16	0.32	Leaf	Leaf is pounded and applied on cuts and wounds.
35.	*Paspalum conjugatum* P.J. Bergius	Poaceae		Miligoy	14	0.28	Root	Decocted root is washed on affected parts.

	(USTH 015627)						
36.	*Phyllanthus amarus* Schumach. & Thonn. (USTH 015590)	Phyllantaceae	Talikod or Likod-likod	23	0.46	Fruit, root	Decocted fruit and root are washed on affected parts.
37.	*Piper aduncum* L. (USTH 015568)	Piperaceae	Lunas buyo	25	0.50	Stem	Decocted stem is applied on cuts and wounds.
38.	*Piper decumanum* L. (USTH 015544)	Piperaceae	Lunas bagon tapol	42	0.84	Stem	Stem infused with coconut oil is applied on to cuts and wounds.
39.	*Piper nigrum* L. (USTH 015560)	Piperaceae	Lunas bagon puti (wild)	40	0.80	Stem	Stem infused with coconut oil is applied on to cuts and wounds.
40.	*Pipturus arborescens* (Link) C.B. Rob. (USTH 015673)	Urticaceae	Handamay	16	0.32	Bark	Bark is scraped and applied on cuts and wounds.
41.	*Poikilospermum acuminatum* (Trecul.) Merr. (USTH 015655)	Urticaceae	Hanupi	14	0.28	Root	Decocted root is washed on affected parts.
42.	*Premna odorata* Blanco (USTH 015559)	Lamiaceae	Abgaw	25	0.50	Leaf	Leaf is crushed and applied on cuts and wounds.
43.	*Pseudelephantopus spicatus* (Juss.) Rohr (USTH 015564)	Asteraceae	Kukog banog	11	0.22	Leaf sap	Leaf sap is dropped on affected parts.
44.	*Psidium guajava* L. (USTH 015663)	Myrtaceae	Bayabas	38	0.76	Leaf	Decocted leaf is washed on cuts and wounds.
45.	*Rosa* sp. (USTH 015628)	Rosaceae	Rose (wild)	12	0.24	Flower	Flower is infused with hot water and applied on affected parts.
46.	*Sida rhombifolia* L. (USTH 015601)	Malvaceae	Eskuba laki	12	0.24	Bark, leaf	Decocted leaf and bark are washed on cuts and wounds.
47.	*Tinospora crispa* (L.) Hook.f. & Thomson (USTH 015566)	Menispermaceae	Panyawan	28	0.56	Stem sap	Stem sap is dropped on affected parts.
48.	*Urena lobata* L. (USTH 015664)	Malvaceae	Dupang bae	14	0.28	Whole plant	Burn the whole plant as incense and smolder smoke it around the affected parts.

Folk plant names

Folk plant names are highly essential in the field of ethnopharmacology, pharmacognosy, and pharmacovigilance (Farah *et al*. 2006, De Boer *et al*. 2014) and very useful basis of ethnoclassification (Ghorbani *et al*. 2017, Dapar *et al*. 2020a, 2020b). Interestingly, previous investigations also showed that plant names could serve as indicators of the local knowledge patterns (Franco 2009) and linguistic stratigraphy (Bostoen 2007) of the community.

Our findings reveal that folk names of medicinal plants among the Agusan Manobo are based on the traditional uses of plants as a treatment for a particular disease or health condition. Accordingly, two *Piper* species, namely *Piper decumanum* L. (*lunas bagon tapol*), and the wild *Piper nigrum* L. (*lunas bagon puti*) have local name similarity denoted with the first word *lunas* (meaning cure in Minanubu and Bisayan dialects). The respondents distinguish these two *Piper* species based on the leaf and stem coloration with shades of white for *P. nigrum* while shades of red for *P. decumanum*. Another *lunas* named *Piper* species is *Piper aduncum* L. (*lunas buyo*) which has nothing to do with the ethnoclassification of colour. These folk names are essential ethnoclassification references but reliance on these names can cause confusion resulting to incorrect identification of plant species

which must be confirmed using molecular data (Dapar *et al*. 2020a, 2020b), or evaluation of its constituent present and cytotoxic properties (Dapar *et al*. 2020b). Recently, two *Piper* species used by the Agusan Manobo were molecularly confirmed as an indigenous *Piper decumanum* and an introduced *Piper aduncum* (Dapar *et al*. 2020b). Other associated *lunas* named species were *Anodendron borneense* (King & Gamble) D.J.Middleton (*lunas tag-uli*), *Acmella grandiflora* (Turcz.) R.K.Jansen (*lunas pilipo*), and *Micromelum minutum* (G.Forst.) Wight & Arn. (*lunas kahoy*). However, among the identified *lunas* named species, two species, namely *A. borneense* and *P. decumanum* were novel ethnomedicinal reports for cuts and wounds to date and only reported among the Agusan Manobo in Mindanao, Philippines.

Relative importance of medicinal plant species and families

Two *Piper* species were cited to be the most important medicinal plant species in the three barangays (villages) of Sibagat for the treatment of cuts and wounds. These were *Piper decumanum* L. (RFC=0.84) and wild *Piper nigrum* (RFC=0.80). *Piper* extracts are widely known, particularly in South Asian medicinal practices as effective antibacterial (Scott *et al*. 2008), with diverse phytochemicals and essential oils as an effective treatment of diseases (Salehi *et al*. 2019). The most commonly used spice *Piper* species, *P. nigrum*, is known to have remarkable pharmacological activities including wound healing properties (Salehi *et al*. 2019). *Piper nigrum* in this study was collected from the wild as believed to be a potent medicinal plant for cuts and wounds among the respondents. Correspondingly, cultivated or commercialized *P. nigrum* could only be used as additives in foods and not as effective as collected from the wild for treatment of cuts and wounds of the Agusan Manobo.

Other highly cited and relatively important species are members of other families. These species were *Anodendron borneense* (King & Gamble) D.J.Middleton (RFC=0.72, Apocynaceae), *Acmella grandiflora* (Turcz.) R.K.Jansen (RFC=0.74, Asteraceae), and *Micromelum minutum* (G.Forst.) Wight & Arn. (RFC=0.78, Rutaceae). The wound healing potentials of these species could be supported by previous wound healing investigations under the same genus or family. These species were *Piper* species (Piperaceae) (Durant-Archibold *et al*. 2018; Salehi *et al*. 2019); *Carissa spinarum* L. (Apocynaceae) (Sanwal & Chaudhary 2011); *Acmella oleracea* (L.) R.K.Jansen and *Achyrocline satureioides* (Lam.) DC. (both Asteraceae) (Yamane *et al*. 2016); and *Clausena excavata* Burm.f. (Rutaceae) (Albaayit *et al*. 2015).

The best-represented family was Asteraceae with seven species, also with the highest FIV (337.78), followed by Lamiaceae (FIV=264.44) with six species. Third highest FIV was Piperaceae (237.78) with three species and followed by Euphorbiaceae (FIV=186.67) with four species as tabulated in Table 3. Asteraceae (sunflower family) is the largest family of flowering plants with uncounted pharmacological properties against inflammation, tumor, bacterial, and fungal infections (Koc *et al*. 2015). Lamiaceae (mint family) possesses a wide range of medicinal and aromatic plants with abundant essential oils that are used in traditional and modern medicine (Mamadalieva *et al*. 2017). Piperaceae (pepper family) contains species of herbs known to have medicinal properties as effective antibacterial (Scott *et al*. 2008; Rekha *et al*. 2014), as a potential treatment for skin infections, cuts and wounds. Euphorbiaceae (spurge family) are mostly of herbs often showing effective remedies against various skin ailments, inflammation, and injuries like several species under the genus *Euphorbia* L. (Ernst *et al*. 2015).

Table 3. FIV values of medicinal plants used by the Agusan Manobo for cuts and wounds.

No.	Family	Family Importance Value (FIV)
1.	Anacardiaceae	55.56
2.	Apocynaceae	166.67
3.	Araceae	28.89
4.	Araliaceae	35.56
5.	Asteraceae	337.78
6.	Byttneriaceae	22.22
7.	Campanulaceae	31.11
8.	Crassulaceae	55.56
9.	Euphorbiaceae	186.67
10.	Fabaceae	57.78
11.	Hypericaceae	37.78
12.	Lamiaceae	264.44
13.	Lauraceae	82.22
14.	Malvaceae	57.78
15.	Melastomataceae	24.44
16.	Menispermaceae	102.22
17.	Moraceae	84.44
18.	Myrtaceae	84.44
19.	Phyllantaceae	51.11
20.	Piperaceae	237.78
21.	Poaceae	60.00
22.	Rosaceae	26.67
23.	Rutaceae	86.67
24.	Urticaceae	66.67
25.	Xanthorrhoeaceae	28.89
26.	Zingerberaceae	22.22

Asteraceae, the highest FIV in this study, is among the largest families of flowering plants in the world (Hattori & Nakajima 2008) with ca. 1600 genera and ca. 23,000 species botanically described (Funk *et al*. 2009) and even more revisions in relation to its biology and chemistry. Asteraceae has a very wide

distribution dispersed in all continents except Antarctica (Jeffrey 2007) but with cosmopolitan representation in temperate and semiarid regions of the tropics and subtropics (Roque & Bautista 2008) including the Philippines. The family is very diverse with very complex morphology and taxonomy. The current classification recognizes 12 subfamilies, and 43 tribes which are often herbaceous plants and small shrubs, but rarely trees (Campos *et al*. 2016). Nationwide distribution of this medicinal plant family is widespread as used by various ethnic tribes throughout the Philippine archipelago. Asteraceae dominates medicinal plant collections in a number of Philippine ethnobotanical surveys in several ethnic groups, namely the Higaonon (Olowa *et al*. 2012), the Ivatan (Abe & Ohtani 2013), the Muslim Maranao (Olowa & Demayo 2015), the Ilongot-Eǵongot (Balberona *et al*. 2018), the Ayta (Tantengco *et al*. 2018), and the Subanen (Alduhisa & Demayo 2019) with the emphasis for the treatment of cuts and wounds.

Comparison with other ethnomedicinal studies for cuts and wounds

Comparative evaluation of ethnobotanical studies of medicinal plants used for cuts and wounds across countries showed either convergent or divergent data as shown in Table 4. Useful species and plant parts including mode of preparation varied geographically across continents. Leaves remained the mostly used aerial plant part prepared in several ways for treatment of cuts and wounds. Useful species in different countries were also diverse indicating divergent information primarily depending on the ecological types and habitats of these medicinal plant species to thrive.

Current findings also showed that the leaves of the documented medicinal plants used by the Agusan Manobo have traditional wound healing potential. The highest percentage of using leaves was previously reported in ethnobotanical studies across divergent cultural communities in the Philippines (Olowa *et al*. 2012, Abe & Ohtani 2013, Ong & Kim 2014, Morilla *et al*. 2014, Olowa & Demayo 2015, Pizon *et al*. 2016, Balangcod & Balangcod 2018, Tantengco *et al*. 2018, Dapar *et al.* 2020a). Most of these ethnic tribes cited more than one plant part like leaves, stems, barks, and roots of the same species. Sometimes, a mixture of multiple plant parts was suggested for a more effective treatment. Decoction as the most common method of preparation is similar to previous ethnobotanical investigations of medicinal plants among other Philippine indigenous tribes such as the Higaonon (Olowa *et al*. 2012), Ati Negrito (Ong & Kim 2014), the Muslim Maranaos (Olowa & Demayo 2015), the Subanens (Morilla *et al*. 2014; Pizon *et al*. 2016), and the Ayta (Tantengco *et al*. 2018).

The majority of the documented medicinal plants were herbs (39%), followed by trees (23%), shrubs (21%), and climbers (17%) as shown in Figure 3. The most frequently used plant part is the leaves (49%) with decoction as the most common mode of preparation (31%) as illustrated in Figures 4 and 5, respectively.

This is the first ethnomedicinal documentation of medicinal plants focusing on cuts and wounds among the ethnic tribes in the Philippines.

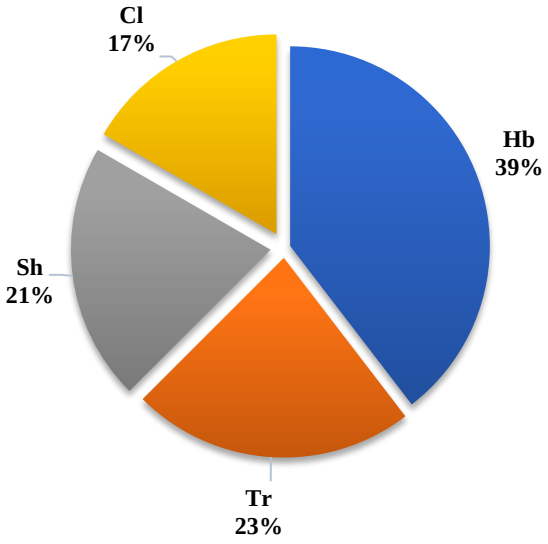

Figure 3. Plant habit of medicinal plants. Cl, climber; Hb, herb; Sh, shrub; Tr, tree

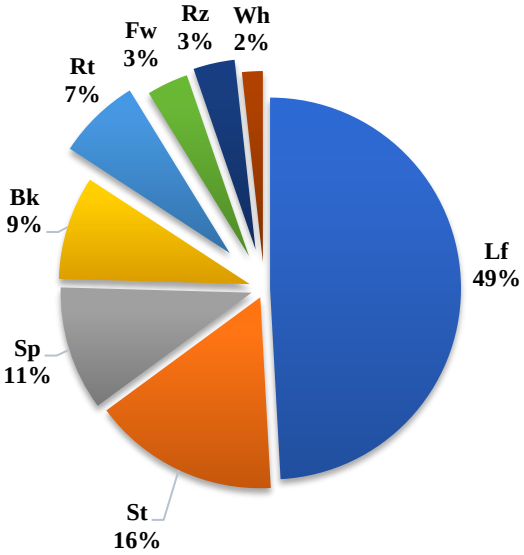

Figure 4. Medicinal plant parts used. Bk, bark; Br, branch; Fw, flower; Lf, leaf; Rt, root; Rz, rhizome; St, stem; Wh, whole plant.

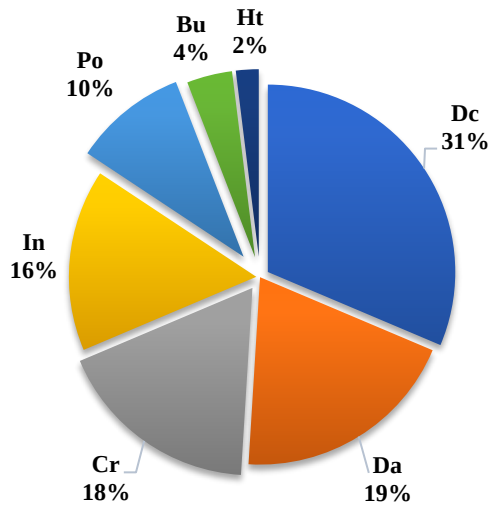

Figure 5. Mode of preparation and administration of medicinal plants. Bu, burning; Cr, crushing; Da, directly applying; Dc, decoction; Ht, heating; In, infusion; Po, pounding.

Research highlights

1. The present study presents ethnomedicinal information on plants used by the Agusan Manobo to treat cuts and wounds.

2. Two documented indigenous species, namely *A. borneense* and *P. decumanum* are novel ethnomedicinal information used to treat cuts and wounds reported only from the Agusan Manobo community.

3. The ethnomedicinal information documented through this study could serve as lead for further pharmacological investigations and clinical studies.

4. Relative medicinal importance of the reported species in this study will serve as reference for future conservation priorities.

5. This study demonstrated the importance of documenting ethnomedicinal knowledge to perpetuate cultural traditions and save traditional knowledge for future use and advantage.

Conclusions

This study discussed the rich ethnomedicinal plant knowledge of Agusan Manobo on medicinal plants used to treat cuts and wounds. The results obtained include new reports of medicinal uses from two indigenous species documented for the first time for cuts and wounds only known from the Agusan Manobo. This study highlights the need for more comprehensive documentation of medicinal plants used for treating different ailments. This wealth of traditional knowledge of Agusan Manobo could be lost unless it is transmitted in its entirety to the younger generation. Our results reinforce the need for complete documentation of indigenous traditional knowledge related to wound healing before it becomes lost and forgotten. It is also essential to recognize the role of indigenous knowledge for future drug discovery and development, sustainability and conservation of plant genetic resources.

Table 4. Comparative ethnomedicinal information of medicinal plants used for cuts and wounds across continents.

Location	Useful Parts	Mode of Preparation	Useful species for cuts and wounds	Reference
Eastern Cape, South Africa	Leaf, stem bark, root, bulb, and corm	Poultice, infusions made from fresh or dried material, extracted juice, lotion, powder, and ointment	*Polystichum pungens*, *Cheilanthes viridis*, *Malva parvifolia*, and *Grewia occidentalis*	Grierson & Afolayan 1999
Russia and Central Asia	Leaf, flower, root, seed, rhizome	Galenical, essential oil, powder, juice	*Vitis* spp., *Punica granatum*, *Simmondsia* spp., *Arnica chamissonis*, *Arnica foliosa*, *Arnica montana*, *Hippophae rhamnoides*, *Aloe arborescens*, *Plantago major*, *Plantago psyllium*, *Viola tricolor*	Mamedov *et al*. 2005
Izmir Province, Turkey	Leaf, aerial parts, seed, tuber, gum, petal	Salve, poultice, oil, powder, decoction, juice	*Achillea millefolium*, *Arctium tomentosum*, *Calendula officinalis*, *Borago officinalis*, *Capsella bursapastoris*, *Hypericum perforatum*, *Momardica charantia*, *Trigonella foenum-graecum*, *Rosmarinus officinalis*, *Asphodelus aestivus*, *Malva sylvestris*, *Papaver rhoeas*, *Pinus pinea*, *Rumex patientia*, *Paliurus spina-christi*, *Rosa damescena*, *Rubus canescens*, *Verbascum thapsus*, *Veronica officinalis*, *Solanum nigrum*, and *Parietaria Judaica*	Ugulu *et al*. 2009

Luzon, Philippines	Leaf, stem	Fresh stem latex or leaf sap, poultice	*Epipremnum pinnatum*, *Alocasia macrorrhiza*, *Colocasia esculenta*, *Aloe barbadensis*, *Ageratum conyzoides*, *Crassocephalum crepidioides*, and *Commelina benghalensis*	Abe & Ohtani 2013
Visayas, Philippines	Leaf, bark	Infusions, fresh stem latex or leaf sap and extract	*Mangifera indica*, *Annona squamosa*, and *Parameria laevigata*	Ong & Kim 2014
Kerala, India	Leaf, root, bark, latex, tuber, inflorescence, and whole plant	Fresh juice, powder, paste and decoction	*Tridax procumbens*, *Mimosa pudica*, *Viscum articulatum*, *Hemigraphis colorata*, *Leonotis nepatifolia*, *Melastoma malabathricum*, *Cleome viscosa*, *Euphorbia hirta*, *Tagetes erecta*, *Oxalis corniculata*, and *Ziziphus enoplia*	Thomas *et al*. 2014
Dobruja (South-East Romania)	Leaf, fruit, aerial parts, bulb	Fermented, distilled, dried	*Cydonia oblonga, Malus domestica*, *Nicotiana tabacum*, *Plantago major*, *Prunus armeniaca*, *Prunus cerasifera*, *Prunus domestica*, *Prunus persica*, and *Pyrus communis*, and *Vitis vinifera*	Pieroni *et al*. 2015
Mediterranean	Aerial parts	Oil, wash, compress or poultice, and ointment	*Hypericum perforatum* L.*, Juglans regia* L.*,* and *Plantago lanceolata* L.	Tsioutsiou *et al.* 2017
Azad Jammu and Kashmir, Pakistan	Leaf and resin	Paste, powder, and poultice	*Hypericum perforatum*, *Berberis lycium*, *Sapindus mukorossi*, *Adiantum venustum*, and *Rumex dentatus*	Amjad *et al*. 2017
Balkan region (Southeast Europe)	Rhizome, bulb, root, stem, fruit, flower, seed, resin, and whole plant	Infusion, decoction, tincture, syrup, oil, ointment, and balm, or direct to the skin	*Plantago major*, *Hypericum perforatum*, *Plantago lanceolata*, *Achillea millefolium*, *Calendula officinalis, Sambucus nigra*, *Tussilago farfara*, and *Prunus domestica*.	Jarić *et al*. 2018

Declarations

List of abbreviations: CDFP: Co's Digital Flora of the Philippines; DENR: Department of Environment and Natural Resources; USTGS-ERC: University of Santo Tomas Graduate School - Ethics Review Board; FIV: Family Importance Value; FPIC: Free Prior Informed Consent; IPMR: Indigenous Peoples Mandatory Representative; NCIP: National Commission on Indigenous Peoples; PENRO: Provincial Environment and Natural Resources Office; RFC: Relative Frequency of Citation

Ethical approval and consent to participate: Free prior informed consents (FPICs) were obtained from the municipal mayor and all participants. Certifications from the tribal council of elders and the National Commission on Indigenous Peoples of CARAGA Administrative Region (NCIP-CARAGA, no. R13-2019-01) were granted. Wildlife gratuitous permit was issued from the Department of Environment and Natural Resources of CARAGA Administrative Region (DENR-CARAGA, no. R13-2019-12) granting permission for wild plant collection. Ethics approval was acquired from the University of Santo Tomas Graduate School - Ethics Review Board (USTGS-ERC, protocol no. GS-2019-PN007).

Consent for publication: Consent was obtained for photographing individuals.

Availability of data and materials: Data can be obtained from the corresponding author upon request.

Conflict of interests: The authors declare that they have no competing financial interest.

Funding: This research was supported by the Department of Health - Philippine Institute of Traditional and Alternative Health Care (DOH-PITAHC).

Authors' contributions: MLD proposed the study and conducted the fieldwork, collection and analysis of data. MLD and GJA developed the manuscript. UM and SLS improved the manuscript and critically analyzed all data. All authors read, corrected and approved the final manuscript.

Acknowledgements

We are very thankful to the Manobo indigenous community of Sibagat, Agusan del Sur who participated in our study. We also extend our gratitude to the DOH-PITAHC, the local government

units (LGUs), provincial government administration, PENRO-LGU and NCIP-LGU of Agusan del Sur, DENR-CARAGA, NCIP-CARAGA, and USTGS-ERC. The first author would like to thank his scholarship grant from the Department of Science and Technology - Accelerated Science and Technology Human Resource Development Program - National Science Consortium (DOST-ASTHRDP-NSC) and Alexander von Humboldt Foundation as a Junior Researcher. The last author thanks the Alexander von Humboldt Foundation for a renewed research stay at the University of Bayreuth (Germany) in 2019.

Literature cited

Abdulaziz AA, Dapar MLG, Manting MME, Torres AJ, Aranas AT, Mindo RAR, Cabrido CK, Demayo CG. 2019. Qualitative evaluation of the antimicrobial, antioxidant, and medicinally important phytochemical constituents of the ethanolic extracts of the leaves of *Gliricidia sepium* (Jacq.). Pharmacophore 10(4):72–83.

Abe R, Ohtani K. 2013. An ethnobotanical study of medicinal plants and traditional therapies on Batan Island, the Philippines. Journal of Ethnopharmacology 145(2):554–565.

Albaayit SF, Abba Y, Rasedee A, Abdullah N. 2015. Effect of *Clausena excavata* Burm. f. (Rutaceae) leaf extract on wound healing and antioxidant activity in rats. Drug Design, Development and Therapy 9:3507–3518.

Alduhisa GU, Demayo CG. 2019. Ethnomedicinal plants used by the Subanen tribe in two villages in Ozamis City, Mindanao, Philippines. Pharmacophore 10(4):28–42.

Alencar NL, Santoro FR, Albuquerque UP. 2014. What is the role of exotic medicinal plants in local medical systems? A study from the perspective of utilitarian redundancy. Revista Brasileira de Farmacognosia 24(5).

Ali A, Badshah L, Hussain F. 2018. Ethnobotanical appraisal and conservation status of medicinal plants in Hindukush Range, District Swat, Pakistan. Journal of Herbs, Spices and Medicinal Plants 24(4):332–355.

Amjad MS, Qaeem MF, Ahmad I, Khan SU, Chaudhari SK, Zahid Malik N, Shaheen H, Khan AM. 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLoS ONE 12(2):e0171896.

Añides JA, Dapar MLG, Aranas AT, Mindo RAR, Manting MME, Torres MAJ, Demayo CG. 2019. Phytochemical, antioxidant and antimicrobial properties of the white variety of 'Sibujing' (*Allium ampeloprasum*). Pharmacophore 10(1):1–12.

Baguinon NT, Quimado MO, Francisco GJ. 2003. Country report on forest invasive species in the Philippines. Country reports. Proceedings of the Asis-Pacific Forest Invasive Species Conference in Kunming, China.

Balangcod TD, Balangcod KD. 2018. Plants and culture: plant utilization among the local communities in Kabayan, Benguet Province, Philippines. Indian Journal of Traditional Knowledge 17(4):609–622.

Balberona AN, Noveno JJ, Angeles MGB, Santos RI, Cachin EJDJ, Cruz KGJ. 2018. Ethnomedicinal plants utilized by the Ilongot-Eǵongot community of Bayanihan, Maria Aurora, Aurora, Philippines. International Journal of Agricultural Technology 14:145–159.

Bostoen K. 2007. Bantu plant names as indicators of linguistic stratigraphy in the Western Province of Zambia. Selected Proceedings of the 37th Annual Conference on African Linguistics, ed. Doris L. Payne and Jaime Peña, 16-29. Somerville, MA: Cascadilla Proceedings Project.

Burns G. 1998. Nature-guided therapy: brief integrative strategies for health and well-being. Taylor & Francis DOI 10.4324/9781315803586.

Caguioa V. 1953. Planting exotic species in the Philippines. Soil resources and forestry, Pacific Science Congress 5:499-532.

Camou-Guerrero A, Reyes-García V, Martínez-Ramos M, Casas A. 2008. Knowledge and use value of plant species in a Rarámuri community: a gender perspective for conservation. Human Ecology 36:259-272.

Campos FR, Bressan J, Jasinski VCG, Zuccolotto T, Silva LE, Cerqueira LB. 2016. *Baccharis* (Asteraceae): chemical constituents and biological activities. Chemistry and Biodiversity 13:1–17.

CDFP; Pelser PB, Barcelona JF, Nickrent DL. 2011 onwards. Co's Digital Flora of the Philippines. [Accessed January 02, 2020] www.philippineplants.org.

Dapar MLG, Demayo CG. 2017. Folk medical uses of Lunas *Lunasia amara* Blanco by the Manobo people, traditional healers and residents of Agusan del Sur, Philippines. Science International (Lahore) 29(4):823–826.

Dapar MLG, Alejandro GJD, Meve U, Liede-Schuman S. 2020a. Quantitative ethnopharmacological documentation and molecular confirmation of medicinal plants used by the Manobo tribe of Agusan del Sur, Philippines. Journal of Ethnobiology and Ethnomedicine 16:14.

Dapar MLG, Demayo CG, Meve U, Liede-Schuman S, Alejandro GJD. 2020b. Molecular confirmation,

constituents and cytotoxicity evaluation of two medicinal *Piper* species used by the Manobo tribe of Agusan del Sur, Philippines. Phytochemistry Letters 36:24–31.

Dapar MLG, Demayo CGD, Senarath WTPSK. 2018. Antimicrobial and cellular metabolic inhibitory properties of the ethanolic extract from the bark of 'Lunas-bagon' (*Lunasia* sp.). International Journal of Pharmaceutical Sciences and Research 9(1):88–97.

De Boer HJ, Ouarghidi A, Martin G, Abbad A, Kool A. 2014. DNA barcoding reveals limited accuracy of identifications based on folk taxonomy. PLoS ONE 9(1): e84291.

Dela Cruz P, Ramos AG. 2006. Indigenous health knowledge systems in the Philippines: a literature survey. Paper presented at the 13th CONSAL Conference, Manila, Philippines.

Dela Peña JF, Dapar MLG, Aranas AT, Mindo RAR, Cabrido CK, Torres MAJ, Manting MME, Demayo CG. 2019. Assessment of antimicrobial, antioxidant and cytotoxic properties of the ethanolic extract from *Dracontomelon dao* (Blanco) Merr. & Rolfe. Pharmacophore 10(2):18–29.

Durant-Archibold AA, Santana AI, Gupta MP. 2018. Ethnomedical uses and pharmacological activities of most prevalent species of genus *Piper* in Panama: A review. Journal of Ethnopharmacology 10(217):63-82.

Ernst M, Grace OM, Saslis-Lagoudakis, CH, Nilsson N, Simonsen HT, Rønsted N. 2015. Global medicinal uses of *Euphorbia* L. (Euphorbiaceae). Journal of Ethnopharmacology 176:90–101.

Eusebio J, Umali B. 2004. Inventory, documentation and status of medicinal plants research in the Philippines. Medicinal Plants Research in Asia, Volume 1: The Framework and Project Workplans. In Batugal, A., Kanniah, J., Young, L.S. & Oliver, J. edition. International Plant Genetic Research Institute-Regional Office of Asia, the Pacific and Oceana (IPGRI-APO), Serdang, Selangor, DE, Malaysia.

Farah MH, Olsson S, Bate J, Lindquist M, Edwards R, Simmonds MS, Leon C, de Boer HJ, Thulin M. 2006. Botanical nomenclature in pharmacovigilance and a recommendation for standardization. Drug Safety 29:1023–9.

Farnsworth, NR. 1994. Ethnopharmacology and drug development. Ciba Foundation Symposium 185:42–59.

Franco M, Narasimhan D. 2009. Plant names and uses as indicators of knowledge patterns. Indian Journal of Traditional Knowledge 8(4):645–648.

Funk VA, Susanna A, Stuessy TF, Robinson H. 2009. Classification of Compositae. In: Funk, V.A., Susanna, A., Stuessy, T.F., Bayer, R.J. (Eds.), Systematics, Evolution, and Biogeography of Compositae. International Association for Plant Taxonomy. Vienna, Austria, pp. 171–189.

Ghorbani A, Saeedi Y, de Boer HJ. 2017. Unidentifiable by morphology: DNA barcoding of plant material in local markets in Iran. PLoS One 12(4):e0175722.

Gottrup F. 2004. A specialized wound-healing center concept: importance of a multidisciplinary department structure and surgical treatment facilities in the treatment of chronic wounds. The American Journal of Surgery 187:38–43.

Grierson DS, Afolayan AJ. 1999. An ethnobotanical study of plants used for the treatment of wounds in the Eastern Cape, South Africa. Journal of Ethnopharmacology 67:327–332.

Hattori EKO, Nakajima JN. 2008. A família Asteraceae na Estação de Pesquisa e Desenvolvimento Ambiental Galheiros, Perdizes, Minas Gerais, Brasil. Rodriguésia 59:687–749.

IPNI. 2019. The International Plant Names Index. [Accessed March 16, 2020] https://www.ipni.org.

Jarić S, Kostić O, Mataruga Z, Pavlović D, Pavlović M, Mitrović M, Pavlović P. 2018. Traditional wound-healing plants used in the Balkan region (Southeast Europe). Journal of Ethnopharmacology 211:311–328.

Jeffrey C. 2007. Compositae: introduction with key to tribes. In: Kubitzki K, editor. The families and genera of vascular plants. Berlin: Springer Verlag pp. 61–87.

Karki M, William JT. 1999. Priority Species of Medicinal Plants in South Asia. In: Report of an Expert Consultation on Medicinal Plants Species Prioritization for South Asia held on 22–23 September 1997 New Delhi, India.

Koc S, Isgor BS, Isgor YG, Moghaddam NS, Yildirim O. 2015. The potential medicinal value of plants from Asteraceae family with antioxidant defense enzymes as biological targets. Pharmaceutical Biology 53:746–751.

Madulid DA. 2001. A dictionary of Philippines plant names. Vol. I: local name- scientific name. Vol. II: scientific name-local name. Makati City, Bookmark.

Madulid DA, Gaerlan FJM, Romero EM, Agoo EMG. 1989. Ethnopharmacological study of the Ati tribe in Nagpana, Barotac Viejo, Iloilo. Acta Manilana 38:25–40.

Mamadalieva NZ, Akramov DK, Ovidi E, Tiezzi A, Nahar L, Azimova S, Sarker SD. 2017. Aromatic medicinal plants of the Lamiaceae family from Uzbekistan: ethnopharmacology, essential oils composition, and biological activities. Medicines (Basel) 4(1):8.

Mamedov N, Gardner Z, Craker LE. 2005. Medicinal plants used in Russia and Central Asia for the

treatment of selected skin conditions. Journal of Herbs, Spices & Medicinal Plants 11:1–2,191–222.

Morilla LJG, Sumaya NHN, Rivero HI, Madamba MRSB. 2014. Medicinal plants of the Subanens in Dumingag, Zamboanga del Sur, Philippines. Presented in the International Conference on Food, Biological and Medical Sciences in Bangkok, Thailand.

Nadayag J, Dapar MLG, Aranas AT, Mindo RAR, Cabrido CK, Manting MME, Torres MAJ, Demayo CG. 2019. Qualitative assessment of the antimicrobial, antioxidant, and phytochemical properties of the ethanolic extracts of the inner bark of *Atuna racemosa*. Pharmacophore 10(1):52–59.

NCCA. 2015. Manobo. [Accessed March 16, 2020] http://ncca.gov.ph/about-culture-and-arts/culture-profile/manobo/.

NCIP. 2010. Primer on census for indigenous peoples. Quezon City, Philippines: National Commission on Indigenous Peoples.

Olowa L, Demayo CG. 2015. Ethnobotanical uses of medicinal plants among the Muslim Maranaos in Iligan City, Mindanao, Philippines. Advances in Environmental Biology 9(27):204–215.

Olowa LF, Torres MAJ, Aranico EC, Demayo CG. 2012. Medicinal plants used by the Higaonon tribe of Rogongon, Iligan City, Mindanao, Philippines. Advances in Environmental Biology 6(4):1442–1449.

Ong HG, Kim YD. 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras island, Philippines. Journal of Ethnopharmacology 157:228–242.

Peabody JW, Rahman MO, Gertler PJ, Mann J, Farley DO, Luck J. 2000. Policy and health: implications for Development in Asia. Cambridge University Press.

Pieroni A, Nedelcheva A, Dogan Y. 2015. Local knowledge of medicinal plants and wild food plants among Tatars and Romanians in Dobruja (South-East Romania). Genetic Resources and Crop Evolution 62:605–620.

PIMO. 2012. Provincial information management office: province of Agusan del Sur. [Accessed March 16, 2020] http://agusandelsur.gov.ph/index/governance/2011-11-17-16-33-48/2011-08-15-05-52-42/sibagat.

Pizon JRL, Nuñeza OM, Uy MM, Senarath WTPSK. 2016. Ethnobotany of medicinal plants used by the Subanen tribe of Lapuyan, Zamboanga del Sur. Bulletin of Environment, Pharmacology and Life Sciences 5(5):53–67.

Rekha VP, Kollipara M, Gupta BRSS, Bharath Y, Pulicherla K. 2014. A review on Piper betle L.: nature's promising medicinal reservoir. American Journal of Ethnomedicine 1(5):276–89.

Reyes CM, Mina CD, Asis RD. 2017. Inequality of opportunities among ethnic groups in the Philippines. United Nations University World Institute for Development Economic Research WIDER Working Paper 154:20.

Roque N, Bautista H. 2008. Asteraceae e caracterização e morfologia floral. Universidade Federal da Bahia, Salvador.

Salehi B, Zakaria ZA, Gyawali R, Ibrahim SA, Rajkovic J, Shinwari ZK, Khan T, Sharifi-Rad J, Ozleyen A, Turkdonmez E, Valussi M, Tumer TB, Fidalgo LM, Martorell M, Setzer W. 2019. *Piper* species: a comprehensive review on their phytochemistry, biological activities and applications. Molecules 24(7):1364.

Sanwal R, Chaudhary AK. 2011. Wound healing and antimicrobial potential of *Carissa spinarum* Linn. in albino mice. Journal of Ethnopharmacology 135(3):792-796.

Schippmann U, Cunningham AB, Leaman DJ. 2002. Impact of cultivation of medicinal plants on biodiversity: global trends and issues, In: FAO, Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries. Satellite event on the occasion of the Ninth Regular Session of the Commission on Genetic Resources for Food and Agriculture, Rome, 12–13 October 2002. Inter-Departmental Working Group on Biological Diversity for Food and Agriculture, Rome, Italy. pp. 143–167.

Scott IM, Jensen HR, Philogène BJR, Arnason JT. 2008. A review of *Piper* spp. (Piperaceae) phytochemistry, insecticidal activity and mode of action. Phytochemistry Reviews 7(1):65–75.

Tan JG, Sia IC. 2014. The Best 100 Philippine Medicinal Plants. The National Library Cataloguing in Publication.

Tantengco OAG, Condes MLC, Estadilla HHT, Ragragio EM. 2018. Ethnobotanical survey of medicinal plants used by Ayta communities in Dinalupihan, Bataan, Philippines. Pharmacognosy Journal 10(5):859–870.

The Plant List. 2013. Version 1.1. [Accessed January 02, 2020] http://www.theplantlist.org/.

Thomas B, Arumugam R, Veerasamy A, Ramamoorthy S. 2014. Ethnomedicinal plants used for the treatment of cuts and wounds by Kuruma tribes, Wayanadu districts of Kerala, India. Asian Pacific Journal of Tropical Biomedicine 4:488–491.

Tropicos. 2019. Missouri Botanical Garden. [Accessed January 02, 2020] http://www.tropicos.org.

Tsioutsiou EE, Miraldi E, Governa P, Biagi M, Giordani P, Cornara L. 2017. Skin wound healing: from Mediterranean ethnobotany to evidence based phytotherapy. Athens Journal of Sciences, pp. 199–211.

Ugulu I, Baslar S, Yorek N, Dogan Y. 2009. The investigation and quantitative ethnobotanical evaluation of medicinal plants used around Izmir province, Turkey. Journal of Medicinal Plants Research 3(5):345–367.

UNDP. 2010. Indigenous Peoples in the Philippines. [Accessed March 16, 2020] http://www.ph.undp.org/content/philippines/en/home/library/democratic_governance/FastFacts-IPs.html.

Uy IA, Dapar MLG, Aranas AT, Mindo RAR, Manting MME, Torres MAJ, Demayo CG. 2019. Qualitative assessment of the antimicrobial, antioxidant, phytochemical properties of the ethanolic extracts of the roots of *Cocos nucifera* L. Pharmacophore 10(2):63–75.

Vitalini S, Iriti, M, Puricelli, C, Ciuchi, D, Segale, A, Fico, G. 2013. Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy)—An alpine ethnobotanical study. Journal of Ethnopharmacology 145(2):517–529.

Voeks RA. 2007. Are women reservoirs of traditional plant knowledge? Gender, ethnobotany and globalization in northeast Brazil. Singapore Journal of Tropical Geography 28:7–20.

Voeks RA, Leony A. 2004. Forgetting the forest: Assessing medicinal plant erosion in eastern Brazil. Economic Botany 58:294–306.

WFO. 2019. World Flora Online. [Accessed January 02, 2020] http://www.worldfloraonline.org.

Yamane LT, de Paula E, Jorge MP, de Freitas-Blanco VS, Junior IM, Figueira GM, Anholeto LA, de Oliveira PR, Rodrigues, RAF. 2016. *Acmella oleracea* and *Achyrocline satureioides* as sources of natural products in topical wound care. Evidence-Based Complementary and Alternative Medicine Article ID 3606820.