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

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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.

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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. Abdualiziz 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

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 idiskubre 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 pinagmi nga sa mga estorya, gidokumentar niining papel.

Methods: Gibuhat kining dokumentasyon gikan Oktubre 2018 hangtud Pebrero 2019 sa 50 ka mga taong maalamon pinagmi nga pakisestorya, pangutana, ug pakigpulong sa komunidad sa mga tambal nga tanom alang sa mga hiwa ug samad. Gigamitan ug estatistika pinagmi 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 Piper species nga tamal ug ang pila ka mga nalitok sa mga maalamon pinagmi 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 pamiliya nga gigamit sa komunidad ug sa ilang mananambal sa tribo alang sa mga hiwa ug samad. Ang pamiliya sa Asteraceae (7 species) ang nagrepresentar ug dako ug ang Piper species nga pinakagigamit nga tanom alang sa pagpanambal. Base sa estatistika, ang kaalam sa tanom nga tambal sa mga maalamon kay adunay significant nga depensiyon ($p < 0.05$) kung igrupo sa unsang trabaho, nahumang edukasyon, kahimtang sa kaminyoon, tawhanun, ug edad apan walay significant nga depensiyon 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 sistema 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 gidais laban sa pagtuki sa dili pa mawala ang mga kahibalo ug kaalam sa atong mga nitibo ug lumad.
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 Villagit (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            | 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 spinatus* (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).

| 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 | Decoction of leaf and bark are washed on cuts and wounds. |
| 2.  | *Acmeila grandiflora* (Turcz.) R.K.Jansen (USTH 015548) | Asteraceae | Lunas plipo | 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.  | *Arcangelica 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 wounds. |
| 9.  | *Cinnamomum mercadoi* S.Vidal (USTH 015585) | Lauraceae | Ende mic | Kaningag | 37 | 0.74 | Bark, branch, root | Bark, branch and root infused with coconut oil is applied on to affected parts. |
| 10. | *Colesus scutellarioides* (L.) Benth. (USTH 015644) | Lamiaceae | Mayana pula | 33 | 0.66 | Leaf | Leaf is crushed and applied on cuts and wounds. |
| 11. | *Cratoxylum sumatrana*um (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 | Decoction leaf is washed on cuts and wounds. |
| 15. | *Erecthites valerianifolius* (Link ex Spreng.) DC. | Asteraceae | Gapas-gapas bae | 12 | 0.24 | Leaf sap | Leaf sap is applied on to cuts and wounds. |
| 16. | Euphorbia hirta L. | Euphorbiaceae | Tawa-tawa | 27 | 0.54 | Leaf | Decoked leaf is washed on cuts and wounds. Decoked bark and root are washed on cuts and wounds. |
| 17. | Ficus concinna (Miq.) Miq. | Moraceae | Balete | 38 | 0.76 | Bark, root | The leaf is applied on to cuts and wounds. 👈 |
| 18. | Gliricidia sepium (Jacq.) Kunth ex Steud. | Fabaceae | Madre de Cacao | 26 | 0.52 | Leaf sap | Leaf sap is applied on to cuts and wounds. |
| 19. | Gmelina arborea Roxb. ex Sm. | Lamiaceae | Ge melina | 24 | 0.52 | Leaf | Leaf is applied on to cuts and wounds. |
| 20. | Hippobroma longiflora (L.) G. Don | Campanulaceae | Elepanteng puti | 14 | 0.28 | Leaf | Decoked leaf is washed on cuts and wounds. |
| 21. | Homalomena philippinensis Engl. ex Engl. & K.Krause | Araceae | Ende mic Payaw | 13 | 0.26 | Rhizome | Extract of the pounded rhizome is applied on to affected parts. |
| 22. | Hoya imbricata Decne. | 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. | Araliaceae | Goto kola | 16 | 0.32 | Leaf sap | Leaf sap is applied on to cuts and wounds. |
| 24. | Hyptis capitata Jacq. | Lamiaceae | Sawan-sawan | 15 | 0.30 | Leaf | Leaf is crushed and applied on cuts and wounds. |
| 25. | Jatropha curcas L. | Euphorbiaceae | Tuba-tuba puti | 19 | 0.38 | Leaf | Decoked leaf is washed on cuts and wounds. |
| 26. | Jatropha gossypifolia L. | Euphorbiaceae | Tuba-tuba tapol | 22 | 0.44 | Leaf | Decoked leaf is washed on cuts and wounds. |
| 27. | Kalanchoe pinnata | Crassulaceae | Hanlilika | 25 | 0.50 | Leaf | Decoked leaf is washed on cuts and wounds. |
| 28. | Mangifera indica L. | Anacardiaceae | Mangga | 25 | 0.50 | Leaf | Leaf is crushed and applied on cuts and wounds. |
| 29. | Melastoma malabathricum L. | Melastomataceae | Hantutuknav | 11 | 0.22 | Stem | Decoked stem is applied on cuts and wounds. |
| 30. | Mentha canadensis L. | Lamiaceae | Sencia | 10 | 0.20 | Leaf | Leaf is crushed or crashed crushed and applied on affected parts. |
| 31. | Micromelum minutum (G. Forst.) Wight & Am. | 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. | Asteraceae | Moti-moti | 36 | 0.72 | Leaf sap | Leaf sap is applied on to cuts and wounds. |
| 33. | Ocimum basilicum L. | Lamiaceae | Sangig | 12 | 0.24 | Leaf | Leaf is crushed and applied on cuts and wounds. |
| 34. | Omalanthus macadenius Pax & Hoffm. | Euphorbiaceae | Ende mic 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 | Decoked root is washed on 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 ethnoscience (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 ethnoscience of colour. These folk names are essential ethnoscience references but reliance on these names can cause confusion resulting to incorrect identification of plant species.

| No. | Scientific Name | Family | Common Name | Use | Part Used |
|-----|----------------|--------|--------------|-----|-----------|
| 36. | Phyllanthus amarus Schumach. & Thonn. (USTH 015590) | Phyllantaceae | Talikod or Likod-likod | Fruit and root | Decocted fruit and root are washed on affected parts. |
| 37. | Piper aduncum L. (USTH 015568) | Piperaceae | Lunas buyo | Stem | Decocted stem is applied on cuts and wounds. |
| 38. | Piper decumanum L. (USTH 015544) | Piperaceae | Lunas bagon tapol | Stem | Stem infused with coconut oil is applied on to cuts and wounds. |
| 39. | Piper nigrum L. (USTH 015560) | Piperaceae | Lunas bagon puti (wild) | Stem | Stem infused with coconut oil is applied on to cuts and wounds. |
| 40. | Pipturus arborescens (Link) C.B. Rob. (USTH 015673) | Urticaceae | Handamay | Bark | Bark is scraped and applied on cuts and wounds. |
| 41. | Poikilospermum acuminatum (Trecul.) Merr. (USTH 015655) | Urticaceae | Hanupi | Root | Decocted root is washed on affected parts. |
| 42. | Premna odorata Blanco (USTH 015559) | Lamiaceae | Abgaw | Leaf | Leaf is crushed and applied on cuts and wounds. |
| 43. | Pseudelephantopus spicatus (Juss.) Rohr (USTH 015564) | Asteraeae | Kukog banog | Leaf sap | Leaf sap is dropped on affected parts. |
| 44. | Psidium guajava L. (USTH 015663) | Myrtaceae | Bayabas | Leaf | Decocted leaf is washed on cuts and wounds. |
| 45. | Rosa sp. (USTH 015628) | Rosaceae | Rose (wild) | Flower | Flower is infused with hot water and applied on affected parts. |
| 46. | Sida rhombifolia L. (USTH 015601) | Malvaceae | Eskuba laki | Bark, leaf | Decocted leaf and bark are washed on cuts and wounds. |
| 47. | Tinospora crispa (L.) Hook.f. & Thomson (USTH 015566) | Menispermaceae | Panyawan | Stem sap | Stem sap is dropped on affected parts. |
| 48. | Urena lobata L. (USTH 015664) | Malvaceae | Dupang bae | Whole plant | Burn the whole plant as incense and smolder smoke it around the affected parts. |
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 potential of these species could be supported by previous wound healing investigations under the same genus or family. These species were Piper species (Piperaceae) (Durant-Archibald 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                   | 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. | Phyllanthaceae           | 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-Égongot (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.

![Pie chart showing plant habit of medicinal plants. Cl: climber; Hb: herb; Sh: shrub; Tr: tree.](image1)

![Pie chart showing medicinal plant parts used. Bk: bark; Br: branch; Fw: flower; Lf: leaf; Rt: root; Rz: rhizome; St: stem; Wh: whole plant.](image2)
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, Momordica charantia, Trigonella foenum-graecum, Rosmarinus officinalis, Asphodelus aestivus, Malva sylvestris, Papaver rhoes, Pinus pinea, Rumex patientia, Palirus spinia-christi, Rosa damascena, Rubus canescens, Verbascum thapsus, Veronica officinalis, Solanum nigrum, and Parietaria judaica | Ugulu et al. 2009 |
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| 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 nepetifolia, Melastoma malabathricum, Cleome viscosa, Euphorbia hirta, Tagetes erecta, Oxalis corniculata, and Ziziphus enoplia | Thomas et al. 2014 |
| Dobrojua (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. | Tsoutsou 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 obtained 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.

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**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.

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