Volume 1 | Issue 2 | Jul - Dec 2023
ISSN: 2984-9969

Ethnopharmacological Assessment of the Medicinal Plants of Agtas in Peñablanca, Cagayan, Philippines

Karima Lex A. Caleda
karimacaleda@gmail.com
Kim Charles L. Adsuara
kxmcharles@gmail.com
David Jonathan T. Dollaga
david.dollaga28@gmail.com
Eldren Joi L. Malsi
eldrenmalsi160601@gmail.com
Catherine Alexandra P. Melegrito
cmelegrito27@gmail.com
Jinky Marie T. Chua
ichua@csu.edu.ph
orcid.org/0000-0002-4564-8033
Cagayan State University - Andrews Campus
Tuguegarao City, Cagayan, Philippines

ABTRACT

This study highlights the Agtas' utilization of ethnobotanicals as a treatment for different illnesses. Generally, the study aimed to conduct an ethnopharmacological assessment of the medicinal plants of Agtas in Peñablanca, Cagayan. A descriptive survey design was utilized; a semi-structured questionnaire was used for the survey with a total of 77 informants. The researchers provided phytochemical results of the medicinal plants from collated existing related literature. Of about 46 of 60 plant species mentioned by the informants, leaves were the most frequently used plant part (49.5%) and handpicking (63.1%) is the primary way of collecting the parts needed; the primary preparation method of medicinal plants used by the respondents was decoction (53.2%); on the basis of their primary uses, 17 of these plants were reported to relieve fever and wounds, and 12 for cough, and the more common route of administration of medicinal plants was internal (64.9%). Most of the medicinal plants were reactive to alkaloids, terpenoids and flavonoids. All the ailments were grouped into nine (9) disease categories, in which the urinary system disorders category had the highest Informant Consensus Factor value (0.97) that includes *Persea americana* (Avocado) for kidney stones and urinary retention, and *Blumea balsamifera* (Sambong) for urinary tract infections. *Parsonsia barbata* Blume. (Sagid or Sadak) had the maximum Use Value (0.333); and Origanum vulgare (Oregano) had the highest Rank Order Priority (86) among the 14 medicinal plants that attained values above 50 (30.4%). To conclude, the study revealed that various medicinal plant species are still utilized to treat different ailments by the Agtas of Peñablanca, Cagayan that most of these were uncommon. A primary recommendation by the researchers is to perform firsthand comprehensive laboratory phytochemical analysis on the plants collected from the different locales.

Keywords: *Agtas, ethnopharmacological assessment, medicinal plants, traditional medicine, phytochemical components, descriptive survey, ethnobotanical data.*

INTRODUCTION

In fields of medicine and pharmacology, medicinal plants have been utilized and researched worldwide. About 80% of the world population values herbs and other traditional medicines for their primary health care and have established three kinds of herbal medicines: raw plant material, processed plant material, and herbal products; and about 25% of prescribed medicines in developed countries are obtained from wild plant species.[1] Ethno-medicine is more prominent in developing countries such as in China, where traditional herbs are used to 30-50% of total medicinal consumption; in Ghana, Mali, Nigeria, and Zambia, where nearly 60% of children suffering from malaria were treated with herbal medicine as first-line treatment; and in San Francisco, London, and South Africa where nearly 70% of people suffering from HIV/AIDS use traditional medicine (WHO).

Ten percent of all vascular plants are used as medicinal plants, and there are estimated to be between 350,000 and almost half a million species of them. The remaining plant species are expected to increase more so that there are still unidentified areas around the globe and can propagate in a faster range. Plant species are used medicinally worldwide such as in countries of India (20.0%), China (18.9%), Vietnam (17.1%), Sri Lanka (16.6%), Thailand (15.5%), United States of America (11.8%), Nepal (10.0%), Philippines (9.9%), Malaysia (7.7%), Pakistan (6.1%), and Indonesia (4.4%) (Sharma BK. 2011).

The World Health Organization revealed that 60% of the world's population depends on traditional medicine, and 80% of the population in developing countries depends almost entirely on traditional medicine practices for their primary health care needs (Chikezie CP, *et al.* 2015). Though the use of medicinal plants is part as traditional and survival need, there is a widespread misconception that "natural" always means "safe" and a common belief that remedies from natural origin are harmless and carry no risk. Some medicinal plants are inherently toxic; although most medicines were produced from plant extracts, chemical experts find the synthetic versions do not carry the same therapeutic effects and may result negative effects, unlike using the whole plant source (WHO 2004). Presently, the demand for herbal products is sold as capsules, tablets, powder, test extracts, and fresh or dried plants. Without any hesitation, people tend to consume these herbals without any prescription though these are traditionally known as harmless, that some may cause alterations in reactions and are non-effective with other drugs (5Yadav NP, Dixit VK. 2008).

The Philippines is considered a mega-diversity country for it hosts more than 52,177 described species of which more than half is found nowhere else in the world (Biodiversity Management Bureau, 2016); and more than one-tenth of plant species are used in drugs and health products, with more than 50,000 species being used. Ethnobotanical studies have been conducted to search for potential medicinal information on the plants in indigenous people communities, and could be used as a positive indicator of pharmaceutical potentials of the medicinal plant species.

Region II, with a great number of indigenous people groups who lives mostly in the three mountain ranges that border the region has a wealth of indigenous knowledge which needs to be preserved and protected. The indigenous communities, particularly the Agta, are living in mountainous locations, keeping themselves diverted from modernization. They retain the traditional ways of surviving that they inherited from their ancestors and continue the legacy. By that, these people are too far from accessible clinics and hospitals in case of immediate treatment thus they provide their own medicinal remedies, first-aid, and course of healing.

The gap in between multiple reasons returning into herbal therapies is a "sense of control, a mental comfort from taking action," which aids to explain that people taking herbs who have chronic or incurable diseases often see that conventional medicine has failed them. When patients use home remedies for acute, self-limited conditions, it is often due to the fact that professional care is not immediately available, too inconvenient, costly, or time- consuming.

Objectives of the Study

Since this indigenous medicinal knowledge is now being translated into herbal medicines for human consumption. There is a need to establish a compendium to keep the knowledge intact and to develop a conservation scheme to prevent the loss of the plant species which will be used for the herbal medicine industry. This study is designed to start the preservation of knowledge on the medicinal plants of the indigenous people. Hence, this study aimed to conduct an ethnopharmacological assessment of the medicinal plants used by Agtas in Peñablanca, Cagayan, Philippines.

MATERIALS AND METHODS

Research Design

Descriptive survey design was utilized in the study, with two approaches. The first was a qualitative approach through an ethnopharmacological survey to determine the medicinal plants and practices of the Agtas in Peñablanca, Cagayan; the second was a quantitative approach through an ethnobotanical data analysis using different quantitative indices including Informant Consensus Factor (ICF), Use Value (UV), Relative Frequency of Citation (RFC), Fidelity Level (FL), Relative Popularity Level (RPL), and Rank Order Priority (ROP).

Sampling Technique

Probability sampling was used in this study, specifically, the stratified random sampling procedure in selecting the respondents to ensure an equal presentation from the given population. The stratification was based on the different barangays of Peñablanca, Cagayan. Within each barangay, from the population who qualified the inclusion criteria set, the respondents were randomly selected.

With the use of Lynch formula (1972) cited by Ardoles (1992), where, n is the sample size, N is the total population (97), z is the value of the normal variables (1.96) for a reliability level of 0.95, d is the level of significance (0.05), and p is the largest possible proportion (0.50). The sample size of the respondents that participated in the conduct of study was derived. A total of 77 individual respondents per household were subjected to ethnopharmacological surveys out of the 97-household population size of the different barangays of Peñablanca, Cagayan. From the population, the highest number of households was in Barangay Aggugaddan with a household of 28; followed by Barangay Bugatay having a household of 21; Barangay Minanga, having a household of 18; and lastly, having the least number of households which is 10, Barangay Quibal.

$$n = \frac{Nz^2 p\,(1-p)}{Nd^2 + z^2 p\,(1-p)}$$

The subject

The respondents of the study were the Agtas of Peñablanca, Cagayan from the 4 (out of 24) barangays of Peñablanca, Cagayan. A total of 77 individuals, as a representative of each household were subjected to ethnopharmacological survey, specifically through a questionnaire-guided interview as permitted by the National Commission for Indigenous Peoples (NCIP), Regional Office No. 2.

Key informant tribal leaders and focal person of each of the aforementioned barangays were also cross-examined through a key-informant interview to further enrich the insights and for in-depth discussions of the study.

Research Instruments

As suggested by the Department of Health—Philippine Institute of Traditional and Alternative Health Care (DOH-PITAHC), a semi-structured questionnaire by Dapar, Alejandro, Meve and Schumann (2020) based from the

Traditional Knowledge Digital Library (TKDL) template was adapted by the researchers. The same template was used in their study, "Ethnomedicinal Appraisal and Conservation Status of Medicinal Plants Among the Manobo Tribe of Bayugan City" as evidenced in related literature of the study.

The questionnaire consisted of two parts. The first part comprised the personal profile or socioeconomic information of the respondent. This included their name (optional), age, sex, and marital status. The second part was a set of questions for the ethnopharmacological survey that provided about the details of the local name of the medicinal plants, part/s of the plant they use, method/s of collection, ailment/s they use it for, preparation of the plants, frequency of application, dosage of the plant, and mode of application/s.

The questionnaire was translated and modified into English and Filipino and their respective dialect, which is Ilocano as well, with the help of a community member, most likely the focal person of every barangay to break the communication barrier upon the conduct of ethnopharmacological survey.

RESULTS AND DISCUSSION

Ethnopharmacological Survey of the Medicinal Plants

Of the 60 medicinal plants collected and mentioned by the informants, and subjected for plant authentication, only 46 were certified as authentic species and termed as "known or identified" medicinal plants. The remaining 14 that do not possess the scientific names and families, as well as the secondary metabolites were termed as "unknown or unidentified" medicinal plants, thus, compelled for submission on plant validation in the future.

Table 1.1. Parts of the Plants Being Used

PARAMETER	FREQUENCY	PERCENTAGE
bark	5	4.5
bulb	4	3.6
core	2	1.8
flower	3	2.7
fruit	7	11.7
leaves	55	49.5
rhizome	3	2.7
roots	12	10.8
sap	1	0.9
seed	3	2.7
stem	4	3.6
whole plant	12	10.8
Total	**111**	**100**

In table 1.1, it shows that twelve different medicinal plant parts were used to address twenty-seven (27) diseases and health-related conditions documented in the study. The most frequently used plant parts for the preparation of remedy were the leaves (49.5%), followed by fruits (11.7%), roots and whole plant (10.8%), bark (4.5%), bulb and stem (3.6%), flower, rhizome and seed (2.7%), core (1.8%), and sap (0.9%). More than one plant part of the same species was used in combination, like leaves, barks, stems, and roots for preparation and administration, which the locals believed to have a synergistic effect and a more effective medication. The use of leaves as the most preferred medicinal plant part to address medical conditions was supported in a study by Dapar et al. and comparable to other ethnobotanical surveys conducted throughout the archipelago.

As a tropical country, leaves are always available for most plant species at all seasons and are readily accessible in case of emergencies. The current evidence strongly supports the claim by Jain et al. that collection of leaves is more sustainable than gathering other plant parts such as barks and roots that can cause damaging effects and even mortality to a plant when harvested in large quantities.

Table 1.2. Method/s of Collection of the Plants

PARAMETER	FREQUENCY	PERCENTAGE
cuttings	14	12.6
handpicking	70	63.1
fluid collection	1	0.9
soil digging	26	23.4
Total	**111**	**100**

Table 1.2 reveals that handpicking (63.1%) is the primary way of collecting the parts needed, followed by soil digging (23.4%), cuttings (12.6%), and fluid collection (0.9%). The method of collection was correlated to the specific part of the plant used by the informants. Cuttings indicate for the collection of bark, stem, and vine; soil digging for the bulbs, rhizomes, roots, and whole plant; fluid collection for the sap on the bark of the plant; and handpicking for the rest of the parts like leaves, flowers, and fruits.

The findings suggest that the local inhabitants of the area had an attitude of preserving their environment since extraction of the different plants, aside from handpicking like cuttings and digging or uprooting destructs the whole plant which can cause destruction to the environment. A method of collecting parts of the plants through handpicking provides conservation for the plants for it can be easier and safer for the collector; this statement shows consistency in the claim of Tindowen *et al.* in 2016.

Table 1.3. Preparation/s of the Plants

PARAMETER	FREQUENCY	PERCENTAGE
burned and diluted	1	0.9
crushed	10	9.0
crushed and juice	8	7.2
decoction	59	53.2
heated or warmed	8	7.2
juice	12	10.8
raw or natural form	11	9.9
tincture	2	1.8
Total	**111**	**100**

Table 1.3 reveals that the primary preparation method of medicinal plants used by the respondents was decoction (53.2%), followed by juice (10.8%), raw or natural form (9.9%), crushed (9.0%), crushed and juice (7.2%), heated or warmed (7.2%), tincture (1.8%), and burned and diluted (0.9%). These findings were further supported by Baddu & Ouano (2018), Tantengco *et al.* (2018), and Morilla *et al.* (2014) that revealed most of the medicinal plants were prepared by decoction, by boiling the parts in water then consumed orally. It is also highlighted in the data that the Agtas prepared medicinal plants in either single way (e.g. crushed only) or in combination (e.g. crushed and juice). They do not solely rely on single preparations but carry out trials on combining for which may be more beneficial and more effective.

Table 1.4. Frequency of Application

PARAMETER	FREQUENCY	PERCENTAGE
1x /day	32	28.8
2x /day	20	18.0
3x /day	46	41.4
4x /day	1	0.9
indefinite	12	10.8
Total	**111**	**100**

Table 1.4 reveals that most plants are applied 3x/day (41.4%), followed by 1x/day (28.8%) and 2x/day (18.0%). Some plants are also applied indefinitely in accordance on the severity of the ailment (10.8%), and 4x/day (0.9%). The researchers validated from the informants that once a day indicates a single application at anytime or at the moment of appearance of the ailment; twice a day indicates morning and night application; thrice a day for morning, noon, and evening; four times a day indicating morning, noon, evening, and midnight; and indefinite indicate more than the desired, depending on the severity of the ailment.

It is observed in the data that the Agtas had proper intervals of taking or applying medicinal plants. The data may be associated to

an article by Toronto General Hospital, indicated that regular intake of medications is a must to ensure an effective amount inside the body. Inversely to that, the level of medicine in the blood can effectively stop the virus from multiplying, giving a chance to mutate and become resistant to the effects.

The duration of application of all the medicinal plants relied upon the severity of the corresponding ailments treated for. This finding is similar to the result of the study by Agua (2015) that showed the constituents are taken internally by drinking the juice thrice a day or more often (alternative to water).

Table 1.5. Mode of Application/s of the Plants

PARAMETER	FREQUENCY	PERCENTAGE
applied dip cotton	1	0.9
inhalation	5	4.5
oral absorption	59	53.2
bath	11	9.9
poultice	8	7.2
topical application	27	24.3
Total	**111**	**100**

Table 1.5 reveals that the more common route of administration of medicinal plants was internal (64.9%) – oral absorption (53.2%), followed by poultice (7.2%), and inhalation (4.5%), rather than external (35.1%) – topical application (24.3%), followed by bath (9.9%), and applied dip cotton (0.9%). This means that they take medications internally rather than externally, making them believe that it is more effective.

There is a correlation to the results on this table and in the first three highest ailments being used for of the medicinal plants —fever, wound and cough (see Table 1.4). Fever and cough may be treated through oral absorption, which is the primary mode of application internally, that implies similarity to the findings of other ethnobotanical surveys by Tantengco et al. (2018) and Morilla et al. (2014). Both previous studies documented that oral intake of decoction is the most common route of administration of medicinal plants. However, wound may be treated through topical application, which is the second to the highest mode of application externally, that was supported by the claim by Abbassi *et al.* (2010) as used in treatment for skin diseases and its used in folk cosmetics.

Phytochemical Screening of the Medicinal Plants

Table 2.1. Parameter used

PHYTOCHEMICAL COMPONENT	FREQUENCY	PERCENTAGE
alkaloids	39	84.8
coumarins	19	41.3
cycloglycosides	32	69.6
flavonoids	35	76.1
phlobatannins	11	23.9
quinones	22	47.8
saponins	34	73.9
steroids	25	54.3
tannins	33	71.7
terpenoids	37	80.4
total phenols	34	73.9
Total	**46**	**100**

In this table, 11 parameters (secondary metabolites) were used, namely: alkaloids, coumarins, cycloglycosides, flavonoids, phobatannins, quinones, saponins, steroids, tannins, terpenoids, and total phenols. Table 3 reveals that most of the medicinal plants are reactive to alkaloids (84.8%), followed by terpenoids (80.4%), flavonoids (76.1%), saponins and total phenols (73.9%), tannins (71.7%), cycloglycosides (69.6%), steroids (54.3%), quinones (47.8%), coumarins (41.3%), and phlobatannins (23.9%).

The researchers searched electronic databases, providing different web sources and collated existing related literature to extract the existing known secondary metabolites of the medicinal plants used by the Agtas. Out of forty-six (46) collected medicinal plants, four of

them had no existing related literature (indicated as not known); specifically these are: *Dimocarpus didyma* (Alupig or Alupag), *Ouratea angustifolia* (Barsik or Bansilai), *Pinanga sp.* (Butag or Gunung batu) and *Pterocarpus indicus* L. (Narra). Only the plant *Impatiens balsamina* (Kamantigi) was reactive for all the 11 phytochemical components and is used for the treatment of snake bite.

The findings imply that the medicinal plants was reactive to alkaloids, except the plants *Allium lancipetalum* (Kuchay), *Conzya canadensis* (Payukpuk), *Origanum vulgare* (Oregano), *Solidago virgaurea* (Tantanduk) and the four with no provided related studies. The phytochemicals present in plants are responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to understand the underlying mechanism of their action. As supported by the different studies, all of the phytochemical components have anti-inflammatory property, concluding the reason of the plant use in treating common ailments. The correlation of the most dominant secondary metabolite to the top three ailments (fever, wound, cough) that the Agtas used for of the medicinal plants was supported in the claims by Wu *et al.* (2013), and Staerk *et al.* (2000) describing that alkaloids are among the most potent and therapeutically significant plant compounds having antibacterial, anti-fungal, antiviral, anti-inflammatory, anti-asthmatic, anti-anaphylactic, and respiratory stimulation and relaxation properties.

Terpenoids, being the second most commonly present secondary metabolite was consistent in its use for fever, wound and cough where it used as anti-inflammatory, analgesic, antipyretic, antioxidant, antiviral, anti-allergic, and antipruritic (Sultana & Ata, 2008; Shah et al., 2009). Another correlation in the treatment for headaches and migraines as concluded by O'Leary (2020) supports the use of the medicinal plants by the Agtas in the treatment of fever. Moreover, for the treatment of wounds, Sasidharan *et al.* (2010) promoted terpenoids in the wound healing process, mainly due to astringent and antimicrobial properties, which seem to be responsible for wound contraction and an increased rate of epithelialization.

Flavonoids are mainly used as antioxidant, analgesic, and anti-inflammatory (Ferraz *et al.*, 2020). Terpenoids and flavonoids, in combination, share anti-inflammatory, analgesic, anxiolytic, and anti-microbial properties and may also have dental or oral applications (Lowe *et al.*, 2021). These show reliability in the use of the medicinal plants by Agtas in treating different ailments.

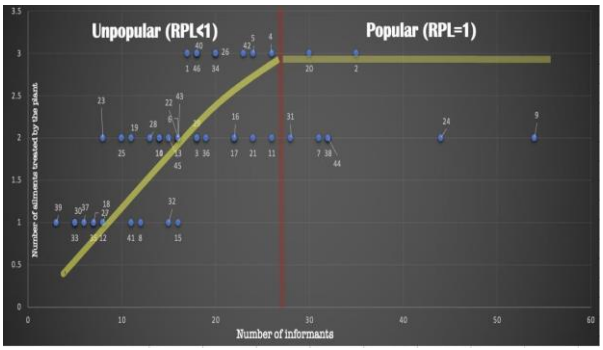

Figure 1. Relationship between number of informants who cited a particular plant and the number of its uses.

The Relative Popularity Level (RPL) was used in order to distinguish the healing potential of plants with similar FL values, but known to several informants, a correlation coefficient or index was calculated as follows. The plants were divided into 'popular' and 'unpopular' groups (Ali-Shtayeh, 2000). The RPL assumes a value of 0 (no ailments treated by plant species) as unpopular and 1 (major ailments treated by plant species) as popular. Popular plants are those which were cited by more than half of the maximum number of informants (i.e. 54 informants in this study) who reported a plant for any medical use. The remaining plants were designated unpopular. A co-ordinate system was utilized in which the X- axis corresponds to the number of informants citing

a plant for any medical use, while the Y-axis corresponds to the number of different uses reported for each plant. For plants with a low popularity level, a linear increase was assumed (with a correlation coefficient of r = 0.5058), namely, a greater number of informants cited the plant for any use, hence a greater average number of uses per species. On the other hand, for popular plants a horizontal line was assumed namely, the average number of uses per plant is independent of the number of informants who know the species; hence, the average number of uses of a popular plant does not increase with the increased number of informants who cite the plant for any medical use. For popular plants, the relative popularity level (RPL) was arbitrarily selected to equal unity (i.e. equals 1). For plants within the unpopular group, the RPL is less than 1. RPL values may be calculated for each specific plant in accordance with its position on the graph.

Forty-six plant species were mentioned by 77 informants surveyed in this study, for one to three different types of ailments per plant. For species cited by 0 to 26 informants, the number of uses per plant increases linearly with the increase in the number of informants. On the other hand, the average number of uses for plants cited by 27 informants or more does not increase with the increased number of informants. All plants cited by 26 or fewer informants (i.e, thirty-eight species) are therefore classified as unpopular, whereas those mentioned by 27 informants or more (eight species) are classified as popular. The dividing line between the popular and unpopular groups occurs at the point where the average number of uses per plant ceases to increase with further increase in the number of informants.

The popular plant species with the highest RPL values (1.0) were *Achyranthes aspera*, *Euphorbia hirta*, *Goniothalamus sp.*, *Annona muricata*, *Areca catechu*, *Psidium guajava* L., and *Tinospora rumphii* Boerl. (1.0). The high efficacy of these plant species and the awareness of the community members who specify their usage as herbal medicine may be the reason of their significant popularity.

Of the 46 species, only 14 attained ROP values above 50 (30.4%) probably due to the decreasing popularity of herbal medicine among the Agta population. *Origanum vulgare* and *Citrofortunella microcarpa* with ROPs of 86 and 63 are used to relieve respiratory disorders, primarily cough. This is followed by *Psidium guavaja* L. with an ROP of 81 used for wound healing; *Annona muricata* used for fever with an ROP also of 81; *Tinospora rumphii* Boerl. used for stomach ache with an ROP 63; and *Blumea balsamifera* for urinary tract infection with an ROP also of 63.

Sixteen of the forty-six plant species cited by the informants are primarily used to relieve fever. Of these, the following species were most widely used: *Annona muricata* (ROP=81), Areca catechu (ROP=61), *Goniothalamus sp.* (ROP=57), and Euphorbia hirta (ROP=81).

CONCLUSIONS

The study revealed that various medicinal plant species are still utilized to treat different ailments by the Agtas of Peñablanca, Cagayan. Most of the plants were uncommon, and the fact that the Agtas of Peñablanca, Cagayan are still using these plants as their traditional medicine despite having access to modern health care services shows the value of medicinal plants as a part of their culture and heritage. Our findings provide baseline data to make a link between the traditional health practitioners and scientific communities, which could be significant in novel drug development

RECOMMENDATIONS

The researchers have put forth several recommendations to promote the use and study of indigenous medicine based on their findings and conclusions. Firstly, it was

suggested that the Agta Community should focus on propagating uncommon medicinal plants to further explore their medicinal properties. In addition, communities like Barangay Bugatay, Minanga, and Quibal are encouraged to establish Community Herbal Gardens to enhance access to medicinal plants, and Barangay Aggugadan should expand its existing community garden.

The National Commission on Indigenous Peoples is advised to support and recommend related studies to Indigenous Peoples (IP) students and other interested students to explore the curative effectiveness of the mentioned medicinal plants. The Department of Agriculture - Bureau of Plant Industry is encouraged to perform soil analysis alongside comprehensive laboratory phytochemical analysis to ensure accurate results for future researchers.

The Philippine Institute of Traditional and Alternative Health Care and the Department of Health should consider extending the target year bracket in their Strategic Plan 2017-2022 to encourage more research in this field. The National Museum is recommended to accept uncommon medicinal plants suitable for plant validation.

Herbal processing companies are encouraged to conduct advanced tests to discover the healing effects of medicinal plants. Pharmaceutical companies are advised to convert medicinal plants into synthetic products only with the approval of the Agtas community.

Communities, in general, are encouraged to propagate common medicinal plants for increased accessibility during times of need. Future researchers are urged to conduct comprehensive laboratory phytochemical analysis, align data collection with the appropriate season for plant growth, investigate curative effectiveness and side effects, explore additional diseases treatable by ethnomedicinal plants, and determine how a single plant can address multiple ailments. These recommendations aim to foster the exploration and application of indigenous medicine for the benefit of both the Agta Community and broader society.

REFERENCES

Baddu, V. D., & Ouano, N. B. (2018, May 19). Ethnobotanical Survey of Medicinal Plants Used by the Y'Apayaos of Sta. Praxedes in the Province of Cagayan, Philippines.

Biodiversity Management Bureau (2016). Status of Philippine Diversity. Retrieved from: https://www.goo.gl/JswiAt.

Chikezie CP, et al. (2015). Herbal Medicine: Yesterday, Today and Tomorrow, Altern Integr Med 4:195. Dpo: 10.4172/2327.

Morilla, L. J. G., Sumaya, N. H. N., Rivero, H. I., &Madamba, M. R. S. B. (2014, January). Medicinal plants of the Subanens in Dumingag, Zamboanga del Sur, Philippines. In International conference on food, biological and medical sciences (Vol. 10).

Philippine Institute of Traditional and Alternative Health Care Call for Proposal- Strategic Plan 2017-2022. (20 February 2017). University of the Philippines Manila. Available from: https://www.google.com/url?sa=t&source=web&rct=j&url [Accessed 13 December 2021].

Sharma BK. 2011. Ethnomedicine: Study of Traditional medicine. Biotech articles 18, 30 31.

Tantengco, O. A. G., Condes, M. L. C., Estadilla, H. H. T., & Ragragio, E. M. (2018). Ethnobotanical survey of medicinal plants used by Ayta communities in Dinalupihan, Bataan, Philippines. Pharmacognosy Journal, 10(5).

Tindowen D.C. (2016) The Economic Life of the Aetas of Northern Philippines. Volume 19.Availablefrom:https://www.researchgate.net/publication/319544217_The_Economic_Life_of_Aetas_of_Northern_Philippines. [Accessed 13 December 2021].

WHO 2004. Guidelines on Safety Monitoring on Herbal Medicines in Pharmacovigilance Systems. Genera 2004.https://apps.who.int/iris/bitstream/handle/10665/43034/9241592214_eng.pdf