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Ethnobotanical documentation and preliminary cytotoxic screening of culturally important medicinal plants used by the Manobo tribe of southern Philippines

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ABSTRACT

Traditional medicinal knowledge of indigenous communities represents an important source of information for biodiversity conservation and the discovery of bioactive compounds. This study documented the medicinal plants traditionally used by the Manobo tribe in Don Marcelino, Davao Occidental, Philippines, and conducted a preliminary cytotoxicity evaluation of the most culturally important species. Ethnobotanical data were collected from 30 purposively selected traditional healers through semi-structured interviews, field observations, and focus group discussions, in accordance with Free and Prior Informed Consent (FPIC) protocols. Quantitative ethnobotanical indices, including Relative Frequency of Citation (RFC) and Use Value (UV), were calculated to determine the cultural importance of each species. The cytotoxic potential of *Psidium guajava* and *Moringa oleifera*, identified as priority species based on their ethnobotanical importance, was assessed using the brine shrimp lethality test (BSLT). A total of 41 medicinal plant species belonging to 28 botanical families were documented. *Psidium guajava* recorded the highest Relative Frequency of Citation (RFC = 1.00), whereas *Moringa oleifera* exhibited the highest Use Value (UV = 3.58), reflecting their central role in the Manobo traditional healthcare system. Leaves were the most frequently utilized plant part, and decoction was the predominant method of preparation. Brine shrimp lethality assay revealed estimated LC_{50} values of 0.92 ppm for *P. guajava* and 3.34 ppm for *M. oleifera*, indicating strong cytotoxic activity. These findings demonstrate a close correspondence between ethnobotanical importance and preliminary biological activity, supporting the value of indigenous knowledge in prioritizing medicinal plants for pharmacological investigation. This study contributes to the documentation and preservation of the Manobo tribe's traditional medicinal knowledge while providing preliminary scientific evidence supporting the bioactivity of culturally important medicinal plants. The integration of ethnobotanical documentation with laboratory validation highlights the potential of indigenous knowledge systems in biodiversity conservation, natural product research, and future drug discovery.

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INTRODUCTION

The Philippines is one of the world's megabiodiverse countries and is home to more than one hundred Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs), each possessing unique Indigenous Knowledge Systems and Practices (IKSP) shaped by long-term interactions with their local environments (National Commission on Indigenous Peoples, nd). Among these knowledge systems, the traditional use of medicinal plants represents an important component of Traditional Ecological Knowledge (TEK), reflecting generations of empirical observation regarding the therapeutic properties of native flora (Dapar *et al.*, 2020; IPBES, 2022). Besides supporting community health, these practices contribute to biodiversity conservation through the sustainable use and protection of culturally important plant species.

Ethnobotanical research plays a critical role in documenting indigenous medicinal knowledge and identifying plant species with potential pharmacological value. Traditional knowledge has contributed substantially to modern drug discovery, with numerous pharmaceutical compounds originating from plants first used in indigenous medicine (Atanasov *et al.*, 2021). Consequently, documenting culturally important medicinal plants not only preserves threatened knowledge systems but also provides a rational basis for selecting species for phytochemical and pharmacological investigation.

Although several ethnobotanical studies have documented medicinal plants used by indigenous communities in the Philippines, research remains geographically uneven. Most published studies involving the Manobo people have focused on northern and central Mindanao, whereas the Manobo communities of Don Marcelino, Davao Occidental, remain largely undocumented despite inhabiting one of the country's biologically rich landscapes (Dapar *et al.*, 2020). As environmental degradation, land-use change, modernization, and declining intergenerational knowledge transfer continue to threaten Indigenous Knowledge Systems, the medicinal plant knowledge of this community is at increasing risk of being lost before it is systematically documented.

An equally important gap exists in the biological validation of ethnomedicinal plants used by Philippine indigenous communities. While ethnobotanical inventories are increasing, relatively few studies have evaluated whether culturally important medicinal plants possess measurable biological activity. In particular, cytotoxicity data for medicinal plants traditionally used by the Manobo of Don Marcelino are virtually unavailable, limiting the prioritization of species for further phytochemical and pharmacological research. Preliminary bioassays, such as the Brine Shrimp Lethality Test (BSLT), provide a rapid and inexpensive screening method for identifying biologically active plant extracts that warrant more detailed chemical and pharmacological investigation (Meyer *et al.*, 1982; Sarah *et al.*, 2017). Although BSLT does not demonstrate therapeutic efficacy, it is widely accepted as an initial screening tool for detecting bioactive compounds.

Therefore, this study documents the medicinal plants traditionally used by the Manobo tribe in selected barangays of Don Marcelino, Davao Occidental, Philippines, and evaluates the preliminary cytotoxic activity of the most culturally important species identified through Relative Frequency of Citation (RFC) and Use Value (UV). By integrating ethnobotanical documentation with preliminary biological screening, this study addresses important gaps in the documentation of Manobo ethnomedicinal knowledge and provides baseline information for future phytochemical, pharmacological, and conservation research while supporting the preservation of Indigenous Knowledge Systems.

MATERIALS AND METHODS

Study sites

The study was conducted in three barangays in Don Marcelino, Davao Occidental, namely barangay Kinanga, Lawa, and Lanao (Fig. 1). Don Marcelino covers a total area of 40,640 hectares and is divided into alienable and disposable (AandD) land and forest land. Barangay Kinanga encompasses 615.83 hectares, Lawa 1,103.62 hectares, and Lanao 514.26 hectares. All three barangays are located along the coastline (Philippine Statistics Authority, 2015). According to the latest population data from the Philippine Statistics Authority (2021), Don Marcelino has a total population of 47,904, with Kinanga having 3,860 inhabitants, Lawa 3,269, and Lanao 1,044. The population is predominantly composed of Indigenous Peoples (IPs), particularly the Manobo tribe, numbering approximately 18,452 individuals in Don Marcelino (PhilAtlas, 2022).

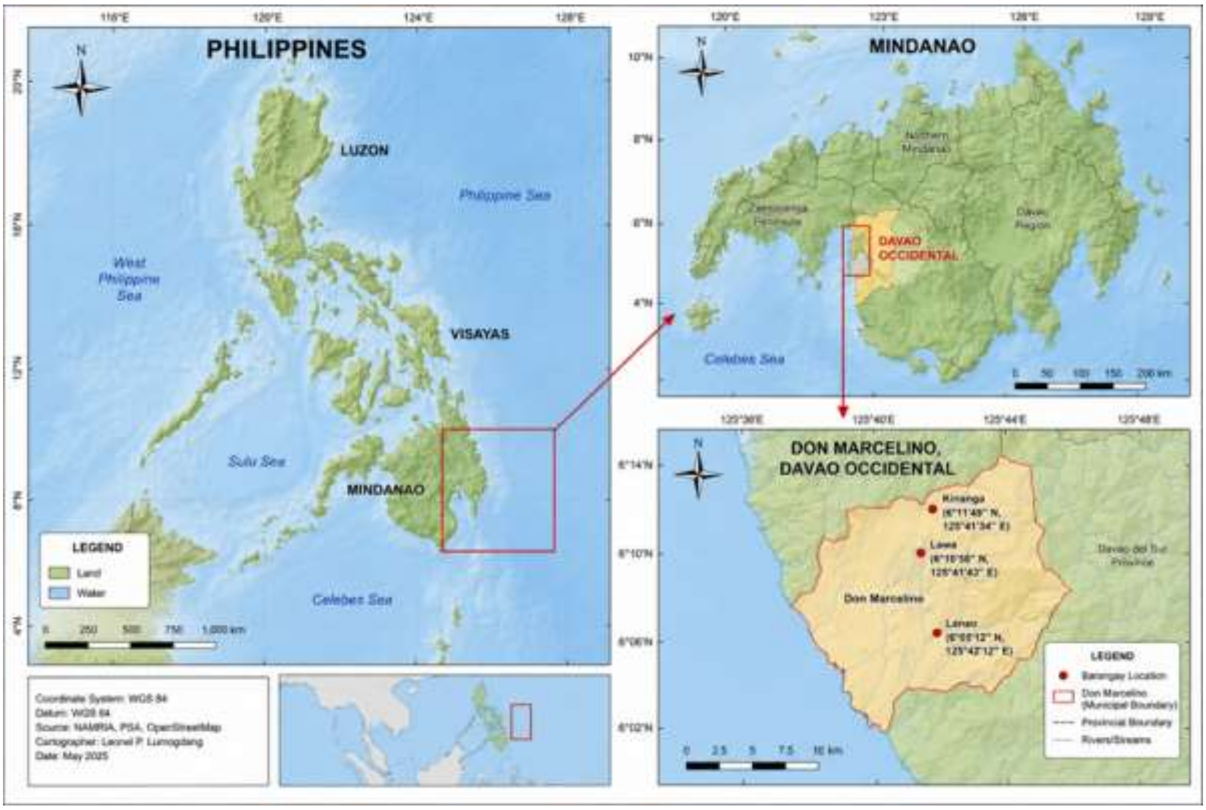

Fig. 1. Map showing the selected sampling sites in Don Marcelino, Davao Occidental

Research design

An observational–descriptive survey design was employed to document the ethnobotanical knowledge of the Manobo tribe regarding medicinal plant use. Data collection methods included structured questionnaires and focus group discussions (FGDs) to obtain and validate information on medicinal plants, their uses, preparation methods, and utilization patterns. The data were then organized and analyzed to identify key species and traditional practices.

Data gathering procedure

Prior to data collection, all necessary permits and ethical clearances, including Free and Prior Informed Consent (FPIC), were obtained from the National Commission on Indigenous Peoples (NCIP, 2012), tribal leaders, Indigenous Peoples Mandatory Representatives (IPMRs), and barangay officials of the selected barangays. Purposive sampling was used to select knowledgeable informants, specifically practicing Manobo traditional healers recommended by IPMRs, due to their extensive indigenous knowledge of medicinal plants (Lewis and Sheppard, 2006). Thirty respondents were purposively selected from the three barangays upon recommendation by tribal elders. Structured questionnaires were used to collect data on medicinal plants, plant parts used, preparation methods, routes of administration, and ailments treated. Responses were compiled and analyzed to characterize the ethnobotanical practices of the Manobo community.

A. Ethnobotanical study

Thirty individuals, primarily traditional healers, were selected from the three barangays based on recommendations from knowledgeable elders. Traditional healers were purposively selected as respondents because they are recognized as the primary custodians of Indigenous medicinal knowledge, acquired through long-term practice, intergenerational transmission, and close interaction with their local environment. Their specialized knowledge of medicinal plant identification, therapeutic uses, preparation methods, and administration makes them the most reliable key informants for ethnobotanical research (Martin, 2014; Albuquerque *et al.*, 2019). Restricting respondents to traditional healers enhances the accuracy and cultural validity of ethnobotanical data while minimizing information bias in the calculation of quantitative indices, such as Relative Frequency of Citation (RFC) and Use Value (UV) (Weckerle *et al.*, 2018). This approach also supports the documentation and preservation of Indigenous Knowledge Systems and Practices (IKSP), which are increasingly threatened by modernization and the erosion of traditional knowledge (IPBES, 2022). Data were collected through semi-structured interviews, field observations, and group discussions conducted in Bisaya and translated into English. Information recorded included local plant names, ailments treated, plant parts used, preparation methods, and routes of administration. Plant specimens were collected and identified in the field, and samples were processed at the SPAMAST Research and Laboratory Science Center (RLSC).

B. Cytotoxicity study

Plant samples collected from the selected barangays were processed at the SPAMAST Research and Laboratory Science Center (RLSC). Crude extracts were prepared using three extraction methods: decoction, hydro-ethanol (50:50, v/v), and ethanol. For the decoction extract, freshly chopped plant materials were boiled in distilled water, filtered, and freeze-dried. Hydro-ethanolic and ethanolic extracts were prepared by air-drying the plant materials, pulverizing them into fine powder, and extracting them with the respective solvents. The filtrates were concentrated and dried to obtain the crude extracts following standard procedures for medicinal plant extraction (Harborne, 1998; Houghton and Raman, 1998).

Brine shrimp (*Artemia salina*) eggs were obtained from the SPAMAST hatchery and hatched in filtered sterile seawater using a two-compartment hatching chamber under continuous aeration and illumination. Eggs were placed in the dark compartment, while a light source positioned above the illuminated compartment attracted newly hatched nauplii. After 48 h of incubation, actively swimming nauplii were collected for the bioassay following the standard Brine Shrimp Lethality Test (BSLT) protocol (Meyer *et al.*, 1982; Sarah *et al.*, 2017).

Leaf extracts of *Psidium guajava* and *Moringa oleifera* prepared using decoction, hydro-ethanol, and ethanol were evaluated for cytotoxic activity. Stock solutions (10,000 ppm) were prepared by dissolving 36.5 mg (decoction), 25.18 mg (hydro-ethanol), and 35.4 mg (ethanol) of each extract in their respective solvents. Alcohol-based extracts were allowed to evaporate completely before the residues were reconstituted with dimethyl sulfoxide (DMSO), whereas decoction extracts were dissolved directly in distilled water. Serial dilutions were prepared to obtain final concentrations of 10, 100, 500, and 1000 ppm, as recommended for preliminary toxicity screening using the BSLT (Meyer *et al.*, 1982; Sarah *et al.*, 2017).

Three replicates were prepared for each concentration together with a seawater control. Ten actively swimming *Artemia salina* nauplii were transferred into each test tube containing 5 mL of the test solution. Mortality was recorded after 6 and 24 h of exposure, and non-motile nauplii were considered dead. Percentage mortality was calculated, and median lethal concentration (LC_{50}) values were estimated by regression analysis. Extracts with LC_{50} values below 1000 ppm were classified as biologically active according to the toxicity criterion proposed by Meyer *et al.* (1982), whereas higher LC_{50} values were considered non-toxic (Meyer *et al.*, 1982; Sarah *et al.*, 2017).

RESULTS AND DISCUSSION

Thirty purposively selected Manobo traditional healers participated in the study, the majority of whom were female (80%) and aged 46 years or older (86.7%) (Table 1). The predominance of elderly respondents suggests that ethnomedicinal knowledge within the Manobo community remains concentrated among older generations. Similar demographic patterns have been reported among the Manobo of Agusan del Sur (Dapar *et al.*, 2020), the Higaonon of Northern Mindanao (Olowa *et al.*, 2012), the Talaandig of Bukidnon (Odchimar *et al.*, 2017), and other indigenous communities in Southeast Asia where medicinal knowledge is primarily transmitted orally through observation, apprenticeship, and practical experience (IPBES, 2022).

Table 1. Demographic profile of the Manobo tribe respondents

Age classes	Frequency	Percentage (%)
46 above	26	86.07
41-45	4	13.03
Gender		
Male	4	20
Female	26	80
Educational background		
Level	Frequency	Percentage (%)
Elementary graduate	7	23.03
High school level	7	23.03
High school graduate	16	53.03
College graduate	0	0
Civil status		
Status	Frequency	Percentage (%)
Married	23	76.07
Widowed	1	3.03
Separated	6	20
Single	0	0

The limited participation of younger community members may indicate a gradual decline in intergenerational knowledge transmission. Modernization, migration, formal education, and increasing dependence on conventional healthcare have contributed to the erosion of Indigenous Knowledge Systems worldwide (IPBES, 2022). Consequently, documenting traditional medicinal knowledge has become increasingly important not only for preserving cultural heritage but also for safeguarding valuable ecological knowledge that may contribute to future biodiversity conservation and natural-product research (Atanasov *et al.*, 2021).

A total of 41 medicinal plant species representing 28 botanical families were documented (Table 2), illustrating the remarkable ethnomedicinal diversity maintained by the Manobo community of Don Marcelino. This richness is comparable to previous ethnobotanical studies among Philippine indigenous communities, although variations in species composition likely reflect differences in local flora, ecological conditions, disease prevalence, and cultural traditions (Dapar *et al.*, 2020; Tantengco *et al.*, 2018).

The documented species were traditionally used to manage a broad spectrum of ailments, including respiratory diseases, gastrointestinal disorders, wounds, inflammation, fever, diabetes, dermatological conditions, musculoskeletal disorders, and circulatory diseases. These findings indicate that medicinal plants continue to serve as primary healthcare resources in geographically isolated communities where access to modern healthcare facilities remains limited (World Health Organization [WHO], 2025).

Leaves were the most frequently utilized plant part, while decoction was the predominant method of preparation. Similar observations have consistently been reported among indigenous communities in the Philippines and elsewhere (Olowa *et al.*, 2012; Dapar *et al.*, 2020; Tangjitman *et al.*, 2020). Leaves are generally preferred because they are readily available year-round, contain diverse secondary metabolites, and can be harvested sustainably without destroying the entire plant (Atanasov *et al.*, 2021). Likewise, decoction facilitates the extraction of water-soluble phytochemicals using simple household equipment, making it particularly suitable for traditional community-based healthcare systems**.**

Relative Frequency of Citation (RFC) and Use Value (UV) identified several medicinal plants with high cultural importance within the Manobo healthcare system. *Psidium guajava* recorded the highest RFC (1.00), indicating unanimous recognition among respondents, whereas *Moringa oleifera* exhibited the highest UV (3.58), reflecting its wide range of therapeutic applications (Table 2).

Table 2. Ethnobotanical profile of medicinal plants used by the Manobo tribe from Don Marcelino, Davao Occidental, Philippines

Family	Manobo name	Scientific name	Plant part(s) used	Mode of preparation	Therapeutic uses (Diseases treated)	RFC	Use value
Myrtaceae	Bayabas	*Psidium guajava*	Leaves	Decoction, infusion, poultice, pounded	Digestive disease; respiratory disease; bites and bleeding; dermatological disease; oral and pharyngeal disease; gastrointestinal disease; wounds; sprain; diabetes; circulatory disease; fever	1.00	3.32
Myrtaceae	Tambis	*Syzygium jambos*	Leaves, bark	Decoction	Fever; respiratory disease; eye infection	0.10	0.13
Bignoniaceae	Yellow Bell	*Allamanda cathartica*	Leaves	Infusion, poultice	Gastrointestinal disease	0.07	0.10
Asphodelaceae	Aloe Vera	*Aloe barbadensis*	Leaves	Extraction	Falling hair	0.06	0.63
Arecaceae	Nyog-nyogan	*Areca catechu*	Seeds	Decoction, paste, eaten fresh	Dermatological disease; respiratory disease; bites and bleeding; oral and pharyngeal disease; gastrointestinal disease	0.03	0.93
Arecaceae	Lubi	*Cocos nucifera*	Fruit, roots, bark	Infusion, poultice, powdered, eaten fresh, extraction	Wounds; inflammation; body pain; fever	0.60	0.63
Moraceae	Nangka	*Artocarpus heterophyllus*	Leaves, roots, bark	Decoction, infusion	Fever; dermatological disease; wounds; gastrointestinal disease; respiratory disease; sprain; anemia; kidney disease; oral and pharyngeal disease; bites and bleeding	0.67	1.33
Moraceae	Kolo	*Artocarpus communis*	Leaves, fruits	Decoction, eaten fresh	Antidiabetic; fever; oral and pharyngeal disease; gastrointestinal disorder; arthritis; body pain; circulatory disease	0.13	0.40
Meliaceae	Neem tree	*Azadirachta indica*	Leaves, bark	Decoction, paste	Inflammation; fever; respiratory disease; gastrointestinal disease; dermatological disease; bites and bleeding	0.17	0.40
Poaceae	Kawayan	*Bambusa vulgaris*	Roots, bark	Decoction	Falling hair; relapse; gastrointestinal disease; circulatory disease	0.23	0.26
Poaceae	Tanglad	*Cymbopogon citratus*	Stem	Decoction	Circulatory disease; gastrointestinal disease; inflammation	0.90	1.17
Basellaceae	Alugbati	*Basella alba*	Leaves	Pounded, paste, eaten fresh	Fever; sprain; gastrointestinal disease; inflammation; digestive disease; kidney disease; dermatological disease	0.67	1.00
Crassulaceae	Handilika	*Bryophyllum pinnatum*	Leaves	Pounded	Bites and bleeding; respiratory disease; dermatological disease; oral and pharyngeal disease; wounds; inflammation; headache; bruises; circulatory disease; fever	0.97	3.52
Solanaceae	Sili	*Capsicum frutescens*	Leaves, fruits	Decoction, infusion, poultice, pounded, paste, powdered	Circulatory disease; arthritis; oral and pharyngeal disease; respiratory disease; gastrointestinal disease	0.80	0.96
Caricaceae	Kapayas	*Carica papaya*	Leaves, fruits	Pounded, eaten fresh	Dengue; digestive disease; respiratory disease; dermatological disease; oral and pharyngeal disease; wounds; poisoning	0.87	1.83
Rutaceae	Lemosito	*Citrus limon*	Fruit	Extraction	Gastrointestinal disease; respiratory disease; headache	0.97	1.63
Lamiaceae	Kalabo	*Coleus aromaticus*	Leaves	Pounded, extraction	Gout; fever; sprain; gastrointestinal disease; headache; respiratory disease; dermatological disease	0.93	2.56
Lamiaceae	Lagundi	*Vitex negundo*	Leaves	Decoction, infusion, poultice	Respiratory disease; fever	0.97	1.03
Zingiberaceae	Luy-ang Dilaw	*Curcuma domestica*	Rhizome	Infusion, poultice, paste, powdered, extraction	Digestive disease; respiratory disease; kidney disease; dermatological disease; gastrointestinal disease; wounds; inflammation; sprain; bruises; fever	0.73	2.63
Zingiberaceae	Luy-ang Tapul	*Alpinia galanga*	Rhizome	Infusion, poultice, paste, powdered	Respiratory disease; fever; headache; body pain; gastrointestinal disease; overfatigue; digestive disease; oral and pharyngeal disease; inflammation; dermatological disease; poisoning	1.00	2.79
Zingiberaceae	Luy-a	*Zingiber officinale*	Rhizome	Infusion, poultice, paste	Gastrointestinal disease; respiratory disease; fever; digestive disease; inflammation; dermatological disease; oral and pharyngeal disease	0.80	1.50
Euphorbiaceae	Tawa-tawa	*Euphorbia hirta*	Whole plant	Decoction, paste, squeezing	Inflammation; respiratory disease; bites and bleeding; dermatological disease; gastrointestinal disease; dengue; eye infection; fever	0.93	3.13
Euphorbiaceae	Balanghoy	*Manihot utilissima*	Roots, bark	Decoction, paste	Gastrointestinal disease; digestive disease; wounds	0.33	0.67
Moraceae	Baliti	*Ficus elastica*	Leaves, bark	Pounded, paste	Sprain; body pain; headache	0.17	0.09
Fabaceae	Makahiya Yaya	*Mimosa pudica*	Roots	Decoction, infusion, poultice, pounded, paste, extraction	Poisoning; menstrual flow; fever; gastrointestinal disease; wounds; kidney disease; bites and bleeding; dermatological disease	0.43	0.68
Fabaceae	Akasya	*Acacia nilotica*	Bark	Decoction	Body pain	0.07	0.07
Fabaceae	Mani	*Arachis hypogaea*	Seeds	Eaten fresh	Malnutrition; respiratory disease	0.10	0.06
Fabaceae	Sambag	*Tamarindus indica*	Fruit, flower	Decoction, infusion, poultice, eaten fresh	Fever; respiratory disease; gastrointestinal disease; headache; eye infection	0.27	0.57
Bixaceae	Switis	*Bixa orellana*	Seeds	Decoction, infusion, poultice, pounded	Relapse; wounds; gastrointestinal disease	0.23	0.23
Moringaceae	Kamunggay	*Moringa oleifera*	Leaves	Decoction, pounded	Respiratory disease; wounds; fever; kidney disease; circulatory disease; oral and pharyngeal disease; inflammation; eye infection; paralysis; gout; headache; diabetes	0.93	3.58
Musaceae	Saging (Cardava)	*Musa paradisiaca*	Leaves, fruits, roots, stem	Decoction, infusion, poultice, pounded, paste, eaten fresh	Gastrointestinal disease; circulatory disease; wounds; poisoning; anemia	0.70	1.27
Lauraceae	Abukado	*Persea americana*	Leaves	Decoction, infusion, poultice, eaten fresh	Dermatological disease; diabetes; bites and bleeding; circulatory disease; headache; gastrointestinal disease; oral and pharyngeal disease; kidney disease; respiratory disease	0.27	0.63
Lythraceae	Granada	*Punica granatum*	Fruit	Decoction, eaten fresh	Gastrointestinal disease; fever	0.07	0.20
Combretaceae	Talisay	*Terminalia catappa*	Leaves	Decoction, paste, extraction	Wounds; relapse; inflammation; sprain; dermatological disease	0.30	0.30
Annonaceae	Labana	*Annona muricata*	Leaves, fruits	Decoction, infusion, poultice, paste, eaten fresh	Sprain; kidney disease; respiratory disease; diabetes; circulatory disease; wounds; myoma; digestive disease	0.93	2.00
Oxalidaceae	Iba	*Averrhoa bilimbi*	Leaves, fruits	Decoction, infusion, poultice, eaten fresh, extraction	Respiratory disease; fever; wounds; gastrointestinal disease; digestive disease; beriberi; oral and pharyngeal disease; dermatological disease; inflammation; headache	0.57	2.02
Oxalidaceae	Balimbing	*Averrhoa carambola*	Leaves, fruits	Decoction, pounded, paste	Fever; bites and bleeding; dermatological disease	0.07	0.13
Convolvulaceae	Camote	*Ipomoea batatas*	Leaves, roots	Decoction, infusion, poultice, eaten fresh	Anemia; malnutrition; gastrointestinal disease; digestive disease	0.67	0.73
Piperaceae	Buyo	*Piper betle*	Leaves	Paste	Gastrointestinal disease; respiratory disease; wounds; sprain; dermatological disease; oral and pharyngeal disease; inflammation; circulatory disease; body pain; arthritis	0.53	1.43
Menispermaceae	Panyawan	*Tinospora crispa*	Leaves, bark	Decoction, infusion, poultice, pounded, paste, squeezing	Respiratory disease; gastrointestinal disease; body pain; oral and pharyngeal disease; circulatory disease; wounds; diabetes; dermatological disease; eye infection	0.97	2.03

Other highly cited species included *Bryophyllum pinnatum*, *Alpinia galanga*, *Tinospora crispa*, and *Vitex negundo*. These species have also been identified as culturally important medicinal plants among other Philippine indigenous communities, including the Manobo, Higaonon, Ayta, and Talaandig peoples (Olowa *et al*., 2012; Tantengco *et al*., 2018; Dapar *et al*., 2020). The recurrence of these species across geographically distinct indigenous groups suggests that they possess enduring cultural importance and may represent priority candidates for pharmacological investigation.

High RFC values indicate widespread community recognition, whereas high UV values reflect the diversity of medicinal applications attributed to individual species (Tardío and Pardo-de-Santayana, 2008). Nevertheless, these indices should not be interpreted as evidence of therapeutic efficacy. Rather, they provide quantitative measures of cultural importance that can assist researchers in prioritizing medicinal plants for subsequent phytochemical and pharmacological investigations (Phillips and Gentry, 1993; Albuquerque *et al*., 2019).

Based on their high ethnobotanical importance, *Psidium guajava* and *Moringa oleifera* were selected for preliminary cytotoxic screening using the Brine Shrimp Lethality Test (BSLT). Both species exhibited estimated LC_{50} values below 1000 ppm, which, according to the toxicity classification proposed by Meyer *et al.* (1982), indicates the presence of biologically active constituents (Table 3).

Table 3. Brine shrimp lethality assay of *Psidium guajava* and *Moringa oleifera* leaf extracts and estimated LC_{50} values

Plant species	Concentration (ppm)	Brine shrimp mortality (%)	LC_{50} (ppm)	R^2	Toxicity classification*
Psidium guajava	50	90	0.92	0.517	Highly toxic
	100	90			
	500	90			
	1,000	100			
Moringa oleifera	50	90	3.34	0.917	Highly toxic
	100	90			
	500	100			
	1,000	100			

The observed cytotoxicity suggests that these species contain secondary metabolites capable of producing measurable biological effects. *Psidium guajava* has previously been reported to contain flavonoids, tannins, triterpenoids, and phenolic compounds with antioxidant, antimicrobial, anti-inflammatory, and antiproliferative activities (Atanasov *et al*., 2021; Díaz-de-Cerio *et al*., 2020). Similarly, *Moringa oleifera* is known to contain glucosinolates, isothiocyanates, flavonoids, phenolic acids, and vitamins that exhibit antioxidant, anti-inflammatory, antimicrobial, and anticancer properties (Leone *et al*., 2022).

However, these findings should be interpreted cautiously. The Brine Shrimp Lethality Test is a general toxicity assay intended for preliminary screening and cannot determine the specific pharmacological mechanism responsible for the observed activity (Sarah *et al*., 2017). Likewise, BSLT does not establish therapeutic efficacy, clinical safety, or disease-specific biological activity. Therefore, the present findings should be regarded only as preliminary evidence supporting the selection of these species for more comprehensive phytochemical characterization and bioassay-guided pharmacological investigations.

Moreover, although both extracts produced high mortality among *Artemia salina* nauplii, the limited variability in mortality across the tested concentrations may reduce the precision of LC_{50} estimation. Future studies should evaluate a broader concentration range, employ probit regression analysis, and report confidence intervals to improve the robustness and reproducibility of toxicity estimates (Meyer *et al*., 1982; Sarah *et al*., 2017).

The integration of quantitative ethnobotanical indices with preliminary laboratory screening provides a practical framework for prioritizing medicinal plants for future pharmacological investigation. In the present study, species receiving the highest community consensus also demonstrated measurable biological activity in the BSLT, suggesting that ethnobotanical information can serve as an effective starting point for identifying promising medicinal plants.

Nevertheless, ethnobotanical consensus should not be considered direct evidence of pharmacological efficacy. Traditional medicinal use reflects accumulated community experience, accessibility of plant resources, cultural preferences, and empirical observations accumulated over generations, whereas laboratory assays evaluate biological activity under controlled experimental conditions (Heinrich *et al.*, 2020). Consequently, both knowledge systems should be regarded as complementary rather than interchangeable.

This integrative approach has become increasingly recognized in ethnopharmacology because indigenous knowledge substantially improves the efficiency of natural product discovery by narrowing the selection of candidate species for laboratory investigation (Atanasov *et al.*, 2021; Heinrich *et al.*, 2020). However, comprehensive phytochemical profiling, compound isolation, mechanism-of-action studies, toxicity assessment using mammalian cell lines, and clinical investigations remain necessary before therapeutic claims can be scientifically validated.

Beyond identifying medicinal plants with potential biological activity, this study contributes to preserving Indigenous Knowledge Systems among the Manobo people of Don Marcelino. As traditional medicinal knowledge continues to decline because of modernization, environmental degradation, migration, and changing lifestyles, systematic ethnobotanical documentation becomes increasingly important for protecting both cultural heritage and biological diversity (IPBES, 2022).

The medicinal plant inventory generated by this study provides an important baseline for future ethnopharmacological investigations. Future research should focus on phytochemical profiling, bioassay-guided fractionation, antimicrobial and anti-inflammatory assays, molecular target identification, toxicity evaluation using mammalian cell lines, and ultimately clinical validation. Integrating indigenous knowledge with modern biomedical research while respecting Free and Prior Informed Consent (FPIC), equitable benefit-sharing, and Indigenous intellectual property rights will strengthen both biodiversity conservation and sustainable natural-product drug discovery (Convention on Biological Diversity, 2022b; Atanasov *et al.*, 2021).

CONCLUSION

This study documented 41 medicinal plant species across 28 botanical families traditionally used by the Manobo tribe of Don Marcelino, Davao Occidental, Philippines, highlighting the richness of their Indigenous Knowledge Systems and Practices (IKSP) and Traditional Ecological Knowledge (TEK). Core species—such as *Psidium guajava*, *Alpinia galanga*, *Bryophyllum pinnatum*, *Vitex negundo*, *Tinospora crispa*, and *Moringa oleifera*—had the highest Relative Frequency of Citation (RFC) and Use Value (UV). Their widespread and continued use reflects generations of empirical observation and intergenerational knowledge transmission, underscoring the strong link between Manobo cultural traditions and their natural environment.

Preliminary cytotoxicity screening showed that extracts of *Psidium guajava* and *Moringa oleifera* are biologically active, supporting the Manobo community's therapeutic claims. This convergence between traditional knowledge and laboratory evidence highlights the value of Indigenous Knowledge Systems as foundations for pharmacological research and drug discovery, and emphasizes the importance of integrating indigenous wisdom with modern scientific approaches.

In addition to its ethnopharmacological contributions, this study helps safeguard the intangible cultural heritage of the Manobo people. Documenting traditional medicinal knowledge preserves practices threatened by environmental change, modernization, and declining knowledge transmission. The findings support the conservation of both biological and cultural diversity, recognizing that biodiversity and Indigenous Knowledge Systems are mutually reinforcing. Preserving medicinal plant knowledge also promotes sustainable resource management and continued protection of culturally important species.

This study also aligns with national and international commitments to protecting Indigenous peoples and biodiversity. In the Philippines, it supports the Indigenous Peoples' Rights Act of 1997 (Republic Act No. 8371) by recognizing the cultural integrity and collective rights of Indigenous Cultural Communities and reinforcing Free and Prior Informed Consent (FPIC) in research. Internationally, the findings contribute to the objectives of the Convention on Biological Diversity (CBD), the Nagoya Protocol, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), and the Kunming–Montreal Global Biodiversity Framework, all of which position indigenous peoples as key partners in biodiversity conservation and sustainable resource management.

Future research should go beyond preliminary cytotoxicity screening to include comprehensive phytochemical and pharmacological studies, toxicological evaluation, and clinical validation of culturally important medicinal plants. Equally important is the adoption of ethical, participatory, and community-centered research that recognizes Indigenous peoples as knowledge holders and partners, ensuring equitable benefit-sharing and intellectual property protection. Such integrative approaches will strengthen ethnobotanical research's role in conserving biodiversity, preserving Indigenous heritage, and advancing sustainable healthcare innovation.

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