



RESEARCH ARTICLE

# The medicinal plants utilized by Butuanon in Butuan City, Philippines

Leila A. Ombat\*, Meljan T. Demetillo, Bluman O. Tiongson & Jonathan Ian H. Ponio

Department of Biology, College of Mathematics and Natural Sciences, Caraga State University, Ampayon, Butuan City 8600, Philippines

\*Email: [laombat@carsu.edu.ph](mailto:laombat@carsu.edu.ph)

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## Abstract

The Butuanon is one of the ethnolinguistic groups in the Philippines. The artefacts discovered by the locals and treasure hunters in Butuan City demonstrated that Butuanon is rich in history, culture, and tradition. However, they need more records of their traditional healthcare knowledge and practices. Therefore, this study documented Butuanon's traditional knowledge and practices for managing illnesses and diseases using medicinal plants. Thirteen key informants were identified and interviewed through the snowball technique after obtaining their consent. The informants used a total of 132 plant species, which correspond to 116 genera and 57 families. The highest-represented family was Fabaceae, followed by Lamiaceae, with 11 and nine species, respectively. Many of the documented plants were herbaceous (37%), followed by trees (29%), shrubs (23%), and vines (11%). The informants commonly used leaves (43%), followed by roots (15%), bark (12%), fruit (7%), and flowers (5%). These plant species treated 93 different illnesses and diseases, of which fever had the highest number of plants used (18%), followed by diabetes (17%), urinary tract infection (16%), cough (15%), hypertension (14%), diarrhoea (11%), cuts and wounds (11%), relapse (8%), kidney dysfunction and disease (6%), and arthritis (6%). In conclusion, this study sheds light on the Butuanon community's ongoing utilization of medicinal plants for their healthcare needs. This underscores the need to preserve their traditional alternative medicine and conserve Philippine medicinal plants.

## Keywords

Ethnomedicine; Philippine medicinal plants; alternative medicine; ethnolinguistic group

## Introduction

Before discovering modern medicines, people relied on medicinal plants and other natural resources to recover from illnesses and survive. Significant evidence from various sources, like written documents, preserved monuments, and even ancient botanical therapies showed that the connection between man and his search for medicines in nature dates a long time ago (1).

Butuanon is among the more than 182 ethnolinguistic groups in the Philippines (2). This community has its own unique traditional knowledge (TK) and practices on healing and wellness, which connect it to its surrounding flora. For the past decades, most of their traditional healthcare knowledge that fulfilled the needs and saved the lives of the local

community, was verbally transferred generation after generation. However, colonial influence and modern practices resulted in the devaluing, displacement, and loss of most knowledge and practices that emanated from the old folks without even being put into the records and used by the present generation.

The Butuan City Library has limited references documenting the history of the Butuanon. Among these references, one briefly mentioned the ethnomedicine practices employed by the tribespeople. During 1902 and 1903, cholera outbreaks occurred in Leyte, Surigao, and Agusan, including Butuan (3), resulting in many fatalities. The primary factor contributing to the disease's spread was the contamination of wells, which served as the community's source of drinking water. The native population resorted to practices such as opium smoking, drinking wine from coconut inflorescence (locally known as "tuba"), and betel chewing to prevent the disease. However, with the advent of common-sense practices and modern medicine, the spread of the disease was eventually controlled.

Pigafetta, the most trusted man who served as the recorder of Ferdinand Magellan, described the appearance, clothing, body apparel, and habits of natives in the Mazua Part of Butuan Island (3-4). One of the practices observed among the natives involved chewing the fruits of areca or *bonga* (*Areca catechu* L.). The natives cut the fruits into four parts, each wrapped in betel leaves and mixed with a small amount of lime (3). They thoroughly chew this mixture and subsequently spit out the chewed material. According to them, this practice provided them with benefits, including soothing the stomach, preventing tooth decay, promoting fresh breath, and imparting a reddish color to the lips.

The Butuanon tribe utilized various herbs for medicinal purposes, although the specific names of these plants were not mentioned (3). They used herbs to heal wounds through direct application or ingesting their decoctions. Remarkably, significant healing was reported within 24 hours. Before engaging in battle, the tribe members used herbs to prevent excessive bleeding when struck by swords or spears. They also applied herbs to their bodies to alleviate fatigue and increase their endurance. Additionally, they held an herb in their mouth to prevent fainting and enhance vigor and strength, even during two-day journeys without food. Furthermore, they utilized the sap of balete (*Ficus* sp.) roots, collected from the eastern side, to treat bruises, with observed healing occurring within 24 hours.

Accounts suggested that Butuanon may have had other traditional healing practices, which they should have put into the record. Thus, this study focused on documenting Butuanon's traditional knowledge and practices in managing illnesses and diseases using Philippine medicinal plants. Awareness of therapeutic plant usage results from the many years of struggles against diseases during which man learned to pursue drugs in barks, seeds, fruits, roots, and other parts of plants. With these in mind,

documenting the traditional knowledge and practices that affect the health of Philippine ethnolinguistic groups would be vital steps to preserve that knowledge and practice. This record will eventually become the primary ground for advancing scientific endeavors and the conservation of plants with medicinal value.

## Materials and Methods

### Locale of the study

This study was conducted from December 2018 to August 2020 in Butuan City, a highly urbanized city in the Philippines and the regional centre of Caraga, or Region XIII. The city is 6.77 meters above sea level, with geographical coordinates of 8° 57' 5.5764" N (or 8.951549 latitudes) and 125° 31' 39.8100" E (or 125.527725 longitudes). It is in the north-eastern part of the Agusan Valley, Mindanao, sprawling across the Agusan River (Fig. 1). It is bounded to the North, West, and South by Agusan del Norte, to the east by Agusan del Sur; and to the northwest by Butuan Bay. It has a land area of 816.62 km<sup>2</sup>, which is roughly 4.1% of the total area of the Caraga region. The key informants (traditional healers) in this study were living in the ten barangays within and near the city proper of Butuan, namely: Amparo, Maguinda, Pigdaulan, Kinamlutan, Ambago, Babag, Maug, Banza, Mahogany, and Sumilihon.

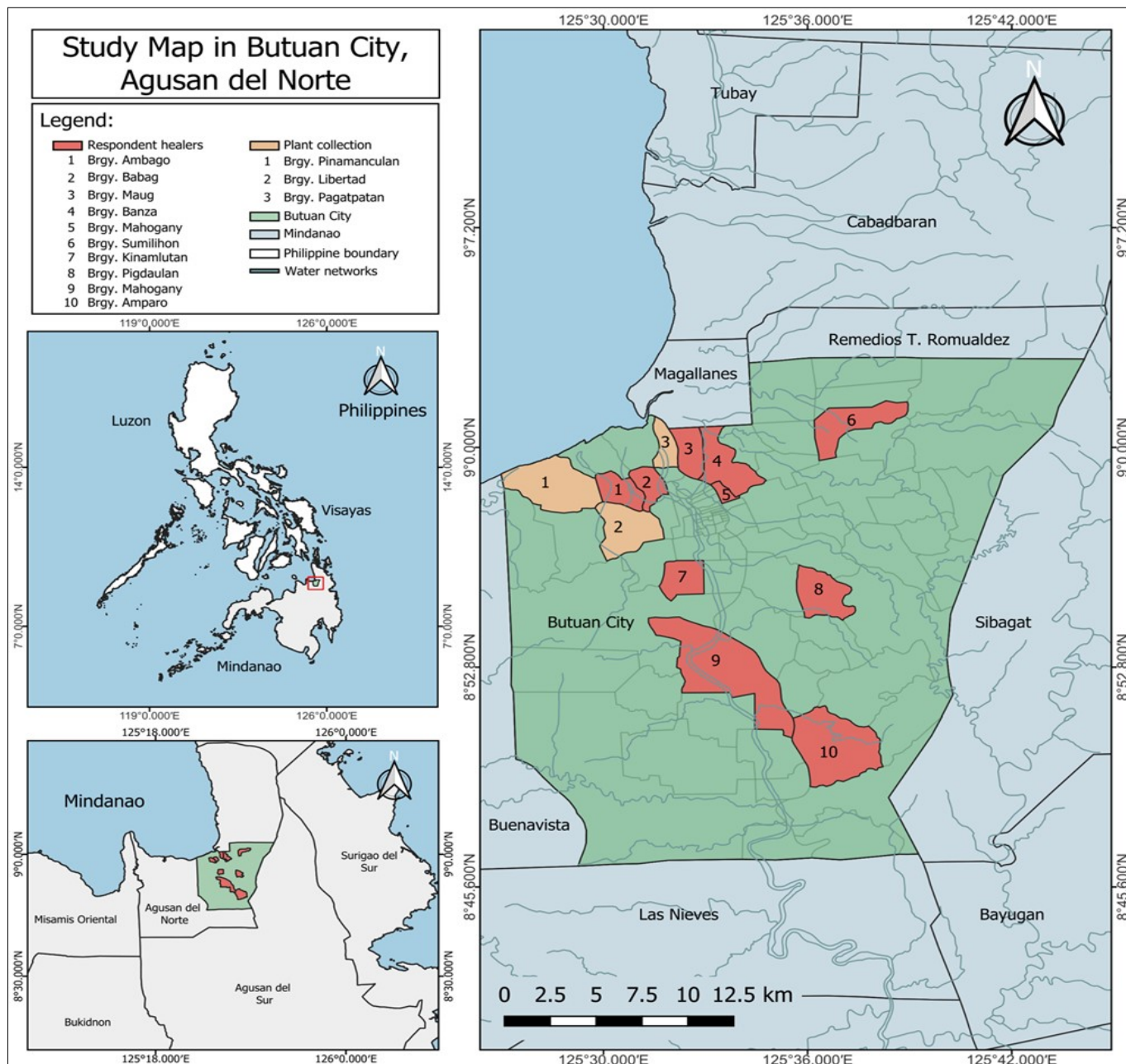
### Ethical considerations

The informed consent and the structured questionnaire used in this study were reviewed and approved by the National Ethics Committee (NEC) for use. The informed consent was presented and signed by the informants before interviewing them. It indicated the title of the project confidentiality agreements, management of output/data, protection of data, rights/ownership and responsibilities to data, community's access to data, project benefits and harm, conditions for publication, and photo/audio recording. The informants were also oriented regarding the study objectives, significance, methods, desired output, and risks and benefits of having the option to join or not join the study.

### Collection and validation of data

The sampling was done in the ten barangays within and near the city proper. Through the snowball or referral sampling technique, 13 individuals were identified and included as key informants in the study. Their qualification as an informant was based on the following criteria: (a) they are traditional healers as recognized by the community, (b) they stayed at least ten years in Butuan City, (c) they are non-healers but recognized by the community as elderly Butuanon, (d) expressed willingness and capacity to participate, and (e) the peace and order situation in the sites where the informant lives. Key informants' interviews were done using the semi-structured questionnaire after they signed the informed consent. The data obtained were consolidated and analyzed. Respect for the informant's practices and beliefs was observed during the survey. The correctness of the data gathered was assessed and confirmed by the key informants, the inter-agency



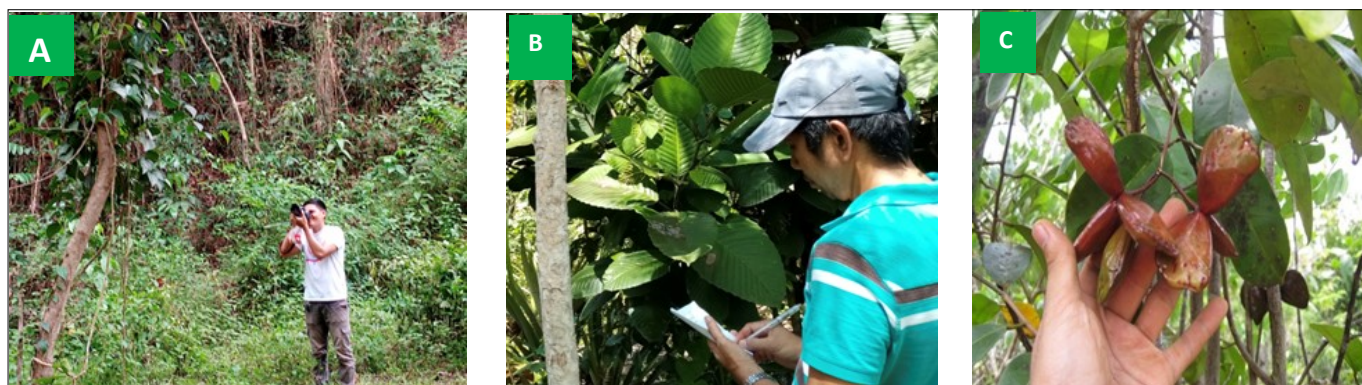


**Fig. 1.** Location of the key informants and plant collection area in Butuan City, Agusan del Norte province, Mindanao Island, Philippines.

technical working group (TWG), and selected Butuanon senior citizens from the three barangays: Maug, Babag, and Banza, to avoid misinterpretation and ensure an accurate account of the community's traditional practices.

#### Collection and identification of plant species

A series of walk-throughs were conducted with the informants within the community and the forest of neighboring places to identify the plants they used, determine their growth habits, take their photos in their natural habitat (Fig. 2), and collect the parts (e.g., leaves, flowers, and



**Fig. 2.** Documentation of medicinal plants in their natural habitat. (A) Photo-documentation (B), Recording the plants identified by the key informant, *Aquilaria cumingiana* (Decne.) Ridl. fruit.

fruits) of rare plants for verification. Those plants that were not seen in the vicinity of Butuan City were collected from Surigao del Sur and Magsaysay, Misamis Oriental. The plant's accepted scientific and family names were identified using online sources, such as Plant List (5), Co's Digital Flora of the Philippines (6), and Medicinal Plant Names Services (7), and verified by the plant taxonomist, Prof. Mark Gregory Rule of Mindanao State University, Marawi City, Philippines.

## Results and discussion

### Key informants' demographic profile

The demographic profile of the 13 key informants is summarized in Table 1. They comprised six men and seven women, aged 44 to 81 years old. Twelve informants are engaged in traditional medicine as their primary

**Table 1** Summary of the demographic profile of the 13 study key informants.

Profile	Frequency
<b>Gender</b>	
Men	6
Women	7
<b>Age</b>	
44 - 50	1
51 - 60	4
61-70	5
71 - 80	2
81	1
<b>Occupation</b>	
Traditional healer	12
Farmer	3
Food vendor	2
Tribal chieftain (Lapaknon)	1
Barangay Utility worker	1
Barangay Councillor	1
Community Based Organization (CBO)	1
<b>Years of experience as a traditional healthcare provider</b>	
10-20	5
21-30	2
31-40	4
41-50	1
51-60	1
<b>Diagnosing the illness</b>	
Touching the patient	4
Checking the eyes	3
Interview	3
Feeling the pulse rate ( <i>Himulso</i> )	2
Physical observation	1
Goosebumps (if <i>Buyagan</i> )	1

<b>Healing practices</b>	
Use of medicinal plants & other materials	13
<i>Hilot</i>	10
<i>Tayhop</i>	5
Latin prayer ( <i>Orasyon</i> )	4
Talking/consulting the spirits for guidance	2
Smoke and steam bath ( <i>Tuob</i> )	2
Food Offering ( <i>Halad</i> )	1
Casting out the spirit that causes the illness	1
Ritual: Singing, praying, a food offering, candle lighting, dancing/walking on burning wood charcoal, candle lighting,	1

occupation, while one informant is a tribal chieftain of Lapaknon who advocates for herbal medicine. Each of them has provided traditional healthcare services for a period ranging from 11 to 60 years. They administered treatments to individuals within their community and those from other areas who sought healing. Their diagnostic methods include touching the patient, eye examination, interviews, pulse rate assessment (known as *himulso*), physical observation, and the experience of goosebumps, particularly when the illness is believed to be caused by a spirit (*buyagan*). The primary healing modality these informants employ is medicinal plants, which they firmly believe can effectively treat various illnesses and diseases. Their confidence in recommending herbal medicine is based on personal experiences and the positive outcomes they have witnessed in their patients.

Most informants practiced *hilot*, which involved rubbing or massaging the affected area with medicinal oil derived from the homemade infusion of coconut oil and selected medicinal plant materials. Alternatively, they used commercially available liniments. This healing practice effectively alleviated symptoms such as gas and muscle pains, sprains, and bone dislocations. Some informants also employed a variant of *hilot* that focused on touching the lower abdomen to locate and manipulate the uterus, aiming to restore it to its normal position. This technique facilitated pregnancy or repositioned a breech child in the mother's womb. Some informants employed *tuob*, which used the steam from hot plant decoction, and smoke from the burning, dried plant latex (*Canarium ovatum*) to cure illness. Furthermore, two informants conducted rituals aimed at summoning spirits to gain insights into future events and guide them in diagnosing and treating ailments. It is important to note that the preceding traditional healing practices should be understood within the cultural context of the informants and may need more scientific evidence supporting their efficacy.

### The Philippine medicinal plants utilized by Butuanon

This study recorded 132 species of medicinal plants used by the traditional healing practitioners of Butuanon (Supplementary Table ). These species correspond to 116 genera in 57 families. The family Fabaceae (Leguminosae) had 11 representative species, which is the highest among the families, followed by Lamiaceae with nine species,

Malvaceae with seven species, Asteraceae, Euphorbiaceae, and Poaceae (Gramineae) with six species each; Amaryllidaceae with five representatives; Araceae and Piperaceae, each with five species; and Annonaceae, Moraceae, Myrtaceae, Rutaceae, and Verbenaceae, each with three species (Fig. 3). Out of the remaining families, 16 families were represented by two species. In contrast, 27 families had a single representative species.

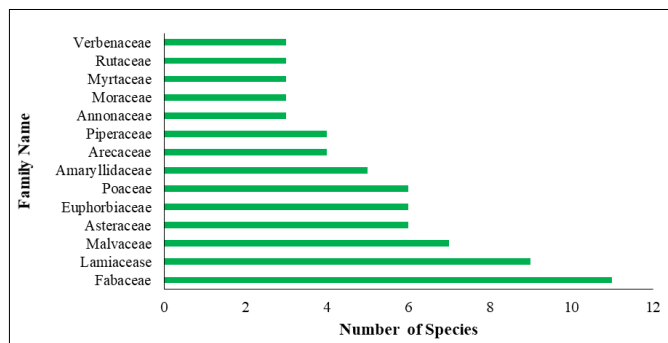


Fig. 3. Top 14 plant families represented by a higher number of species.

The findings of this study are consistent with previous research on the Ayta communities in Dinalupian, Bataan (8), and Pampanga, Philippines (9). These studies also demonstrated that the Fabaceae was the most prevalent or represented group regarding medicinal plant usage. In India, an investigation uncovered that the indigenous population has traditionally utilized numerous species from the Fabaceae as remedies for various diseases (10). Generally, Fabaceae is the third largest group of angiosperms worldwide next to Orchidaceae (736 genera and 28,000 species) and Asteraceae (1,623 genera and 24,700 species), consisting of 751 genera and 19,500 species, of which the vast majority are trees, shrubs and herbaceous plants with economic importance (11). The Lamiaceae family, commonly known as the mint family, emerged as another significant group. Like Fabaceae, Lamiaceae is a widespread flowering plant family comprising approximately 7,530 species, grouped into 241 genera (12). This family is also known for its ease of propagation and importance in providing flavors, fragrances, and medicinal properties. The specific composition of this family includes monoterpenes derived from essential oils, such as thymol, thymine, and carvacrol, which potentially treat disorders affecting the respiratory, nervous, and cardiovascular systems and use antimicrobial and antioxidant agents (12). In a study conducted in Panay Bukidnon, Lambunao, Iloilo, Philippines (13), Lamiaceae was found to be the second most prevalent family. Additionally, a separate study reported that Lamiaceae plants have numerous medicinal uses in North Cotabato, Mindanao, Philippines (9). Many plant species mentioned in this study exhibited distinct healing properties, and many used it in combination with other species for medicinal preparations targeting specific illnesses.

#### The plant growth habit

Plant species have different growth habits (Fig. 4), which allow them to grow, survive and reproduce in a particular habitat. Among the 132 medicinal plant species cited by

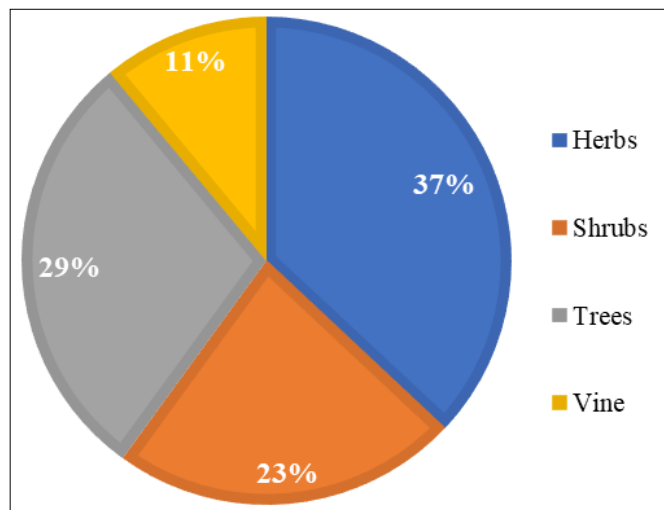


Fig. 4. Growth habit of plants used by Butuanon informants.

the informants, herbs had the highest representative species (39%), followed by trees (29%), shrubs (23%), and vines (11%). As part of the tropical region, the Philippines is rich in all these plant groups all year round. Herbs, the non-woody vascular plants, including grass and grass-like species, are the most numerous plant groups in the country. They are readily available in the community for food, flavorings and preservation, aroma/fragrances, and curative uses. In the case of trees, their roots and bark are frequently utilized for treatment purposes due to the long-term storage of bioactive compounds in these plant parts. The informants believed that these parts were potent materials to cure ailments.

#### Plant parts used

The Butuanon community uses different plant parts to treat various diseases (Fig. 5). The most frequently used plant parts by the informants were leaves (43%), which were followed by roots (15%), barks (12%), fruits (7%), and flowers (5%). The informants rarely mentioned using the shoot, stem, juice/sap, leaf stalk, seed, bulb, rhizome, and whole plant in treatment. Several ethnobotanical surveys conducted in the Philippines (14-17) reported leaves as the most frequently used plant parts. Leaves are the site of manufacture and storage of secondary metabolites such as alkaloids, tannins, coumarins, flavonoids, and essential oils that are active components of most herbal preparations in high concentrations (18). Harvesting and

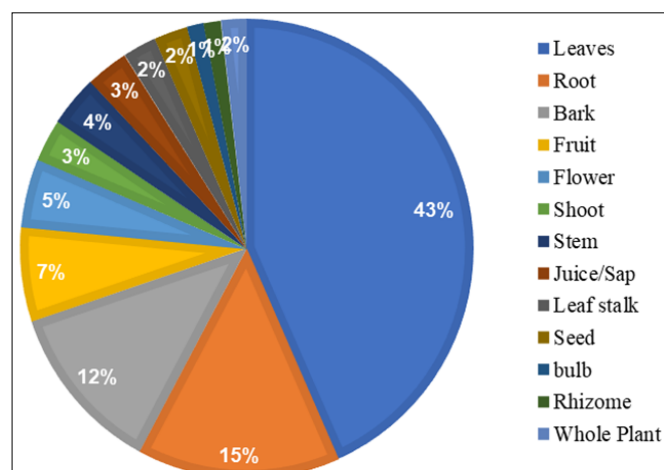


Fig. 5. Frequency (%) of plant parts used by Butuanon informants.



utilizing leaves for treatment purposes contributes to the conservation of plants, as it is less destructive compared to methods that involve uprooting roots or whole plants. Leaves are abundant, readily available, easy to collect and process, and quickly regenerate.

Some of the most frequently utilized plants, whose leaves are collected for treating several illnesses, are the following: *Psidium guajava* (guava), *Artemisia vulgare* (hilbas), *Moringa oleifera* (kamunggay), *Blumea balsamifera* (halib-on or gabon), *Vitex negundo* (lagundi), *Coleus amboinicus* (kalabo), and *Lagerstroemia speciosa* (banaba). The informants mainly did not specify the exact number of leaves and the size or weight of stems and roots to be used because they believed that the plant-based medicine had no overdose or side effects. However, they recommended using an odd number of leaves, such as 3s, 5s, 7s, or 21s.

Roots are the second most used part for treatment. The informants of this study asserted that roots contain curative substances that are highly effective in treating cancer, diabetes, goitre, and other body conditions. In this study, the healers frequently used the roots of *Laportea meyeniana* (alingatong). They made decoction or soaked the roots in a bottle of wine and used the tincture for cleansing the body, kidney diseases and dysfunction, colon cancer, and diabetes. The roots of this species are being sold in the market and even through online platforms.

The key informants frequently utilized bark as the third most common plant part for treatment. These barks were primarily sourced from the trees identified in this study and used to treat cancer, goitre, kidney stones, heart disease, and hypertension. The informants likely prepared infusions using wine, rum, or palm oil to extract the active compounds from the bark. The extracts were then stored for several months or even years to enhance their efficacy in treating various illnesses and diseases. Notable tree species utilized included *Cinnamomum mercadoi* (kalingag), *Lunas* sp. (lunas-kahoy), *Ormosia calavensis* (bahai), and *Myristica philippensis* (duguan). These tree species are predominantly found in the forest, making them rare and challenging to collect.

Phytochemicals are distributed in plant body parts in different amounts, and some may contain the same metabolites while others are absent. For example, polyphenols exhibit wide distribution through various plant organs (19). Phenolic acids are commonly found in seeds, leaves, roots, and stems (20). Conversely, flavonoids are predominantly present in aerial parts of plants, while tannins are typically found in roots, bark, and seeds (21). Alkaloids are also widely distributed in all organs, such as leaves, flowers, seeds, roots, stems, fruits, barks, and bulbs (22). A study showed that mango (*Mangifera indica*) leaves had higher amounts of flavonoids, while the stem bark had higher amounts of alkaloids, phenols, saponins, and tannins (23). The phytochemical analysis of *Annona muricata* (soursop) leaves demonstrated the presence of various compounds belonging to the classes annonaceous

acetogenin, alkaloids, flavanol triglycoside, and megastigmane (24). Similarly, the plant's bark, roots, and fruits contained metabolites from the annonaceous acetogenin and alkaloids classes. Additionally, phenolic compounds were identified in the fruits.

#### Preparation and administration of plant materials

In this study, it was observed that nearly half (49%) of the plant materials used for remedies were primarily prepared through decoction or boiling (Fig. 6), followed by squeezing (9%), pounding/crushing, cleaning/washing, infusion, heating over a low flame or burning charcoal, scraping, and slicing/cutting. Simmering and steaming were preparation methods rarely used (1%).

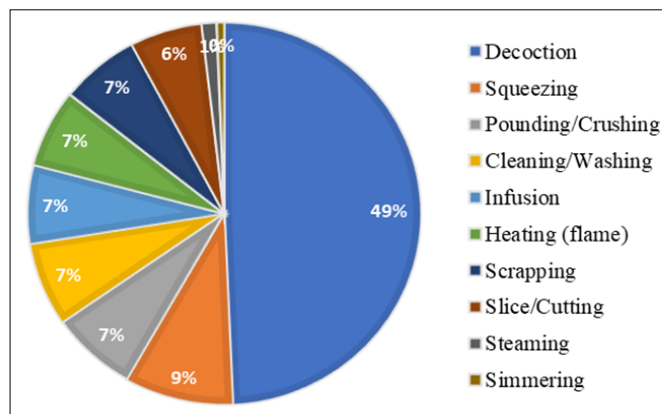


Fig. 6. Methods of medicinal plant material preparation.

The decoction process typically involves boiling the leaves, stem, or roots until the original volume of water is reduced by half. For instance, if two glasses of water are used, the resulting decoction should be one glass in volume. The decoction can be taken orally to treat serious to chronic diseases or used for bathing and washing wounds/cuts. It is also used for a steam bath to treat body pain and relapse (*bughat*). Some plant materials are pounded, crushed, heated over low flame, scraped, and steamed before applying as a poultice or squeezed to extract the juice/sap. Infusion is prepared by soaking the plant materials in warm or cold water, wine, or palm oil to extract and preserve the medicinal properties of the phytochemicals. Secondary metabolites quickly deteriorate and become less potent or inactive when the plant materials are boiled.

Similarly, it was observed in the study conducted in Mexico that boiling affected the nutritional composition of plants' soluble compounds, such as sugars and soluble fibres, ash, ascorbic acid, and phenolic compounds (25). Hence, leaves are sometimes prepared by steaming or placing them over the newly cooked rice, and the fresh juice (e.g., the miracle fruit) is simmered before use and stored. Simmering may kill pathogenic microorganisms but only allows the juice to be stored for a shorter period.

More than half of the prepared materials for treatment were taken orally (65%) (Fig. 7). This includes drinking (58%), eating (5%), gargling (1%), and chewing (1%). The remaining materials were applied externally (36%), which involves the use of a poultice (12%), rubbing/massage (8%), "haklop" (7%), steam bath (5%), washing/bathing (2%), as well as smoke bath, hitting the body with the plant material and eye application (1%) or tapping.

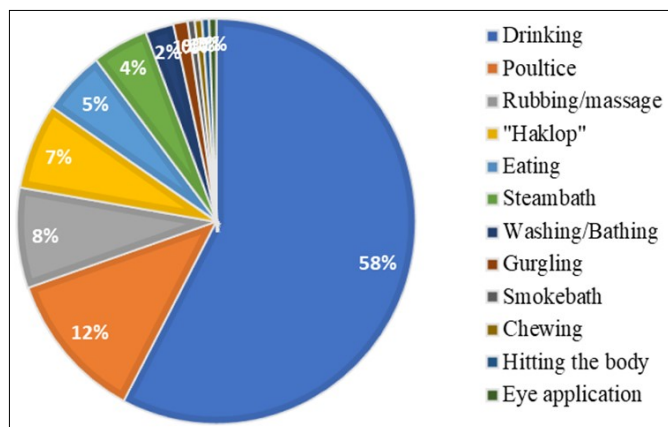


Fig. 7. Different modes of applications of prepared plant material.

The materials prepared for oral consumption were typically obtained through boiling (decoction), infusion, heating over low flame, steaming, simmering, and squeezing fresh juice. Poultices were commonly used for treating wounds/cuts, burns, skin swelling, and boils. They apply plant extracts through rubbing and massaging, relieving body pains such as gas and muscle pains. Healers often add a small amount of salt or commercial liniment to enhance the effectiveness of the heated materials or extracts. In the case of *haklop*, fresh or heated leaves were placed over the affected area, such as body pain, sprain, and bone dislocation. During the smoke bath, the dried latex of the "pili" (*Canarium ovatum*) was placed in burning charcoal, and the resulting smoke was used to treat body ailments caused by an evil spirit (locally called *buyag*). Additionally, the leaves of *Urena lobata*, commonly named *dawpang* were used to cure another form of *buyag*, called *dupang* or *hangin-hangin*. This condition is known as a hive or nettle rash, which manifests itchy skin swellings that range from white to pink or reddish. The *dawpang* leaves were applied through gentle tapping on the body to alleviate the swelling. The above healing practices have no scientific evidence, but these reflect how the informants manage different illnesses and diseases of the individuals who sought healing.

#### Ailments and plants used for treatment

The 13 key informants mentioned 93 illnesses and diseases in this study. The 132 medicinal plants were prepared and applied in various ways, depending on the type of ailment. Each of the plant species can treat multiple body disorders. Among the human body systems (Fig. 8), the digestive and poison/venom-related diseases have the highest

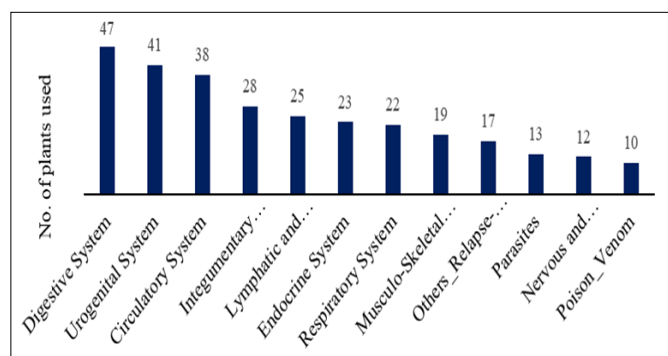


Fig. 8. The "12" categories of ailments prevented or cured by the 132 plants identified by the 13 informants in Butuan City, Philippines.

(n=47) and the least (n=10) number of plants used for treatment, respectively. Some of the conditions mentioned by the informants are life-threatening. If not managed earlier and adequately, may lead to death due to poisoning, cancer, hypertension, diabetes, kidney stones, and kidney dysfunction.

The illnesses that have the highest number of plants used to manage them are fever (n=24, 18%), diabetes (n=22, 17%), urinary tract infection (UTI, n=21, 16%), cough (n=20, 15%), hypertension (n=18, 14%), diarrhoea (n=15, 11%), wounds/cuts (n=15, 11%), relapse (n=10, 8%), kidney dysfunction (n=8, 6%) and arthritis (n=8, 6%) (Fig. 9). In clinical diagnosis, the physical examination, laboratory tests, and fever characteristics, provided clues on the fever's origin (26). Although fever is a nonspecific immune response that controls invading pathogens, its discomforts affect the individual. In the absence of a thermometer, it is common practice to place someone's back of the hand on the forehead to feel the patient's body temperature. The healer also performed *himulso* (by feeling the pulse beat) to determine the patient's fever's origin. This practice was the basis for the patient's treatment procedure and recommendation of herbal medicine. The plant parts for fever were mostly boiled and taken orally. Some plants used by the healers for fever were also reported to act as antipyretic, such as *A. muricata* (27), *B. balsamifera* (28), *L. amara* (29), *N. orientalis* (30), and *P. acuminata* (31). These antipyretic compounds work by inhibiting the enzyme cyclooxygenase and reducing Prostaglandin E (PGE) concentrations within the hypothalamus (32).

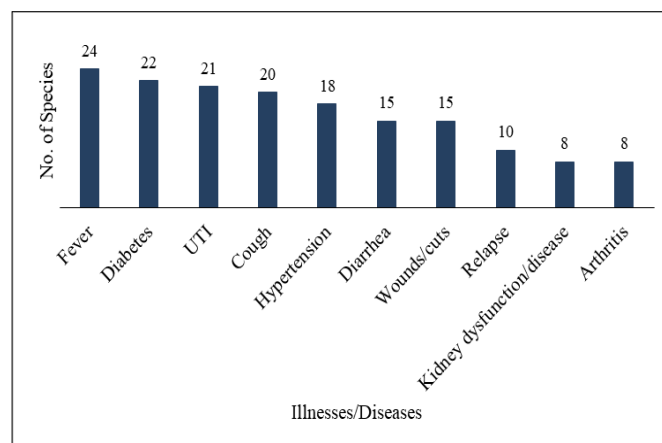


Fig. 9. The top 10 illnesses/diseases with the corresponding number of plants used for treatment.

Most of the plants used by the informants to treat diabetes are also reported to reduce blood sugar levels, and their bioactive components were already isolated and identified (33-35). Examples of these antidiabetic plants are *Andrographis paniculata* (marevelosa), *Allium sativum* (garlic), and *Annona muricata* (soursop or guayabano). *A. paniculata*'s ethanolic extract possesses an antihyperglycaemic property and could also reduce the oxidative stress of streptozotocin-induced type 1 diabetic rats (33). This plant's antihyperglycemic activity and therapeutic uses are recorded in the Indian Pharmacopoeia and Chinese Medicine (34). This plant possesses several phytochemicals that are useful in Ayurvedic medicine. Its bitter taste is

contributed mainly by the colorless crystalline andrographolide (ANDRO, diterpene lactone), neoandrographide (NAG), and 14-deoxyandrographolide (DAG) (35). The plant's leaves contain the maximum amount of andrographolide (1.0% to 2.39%), the seeds have the most negligible content of this metabolite, and its young leaves at pre-flowering harvest are richer in ANDRO, NAG, and DAG than matured leaves (34).

Several published articles have reported the plants used by the 13 informants from Butuan City in managing urinary tract infections (36-40). The papers showed that most plants mentioned by the informants have anti-inflammatory and antimicrobial activities, like *Angelica keiskei* (36-37), *Annona muricata* (19), *Arcangelisia flava* (38), *Averrhoa carambola* (39), and others. These medicinal properties will aid in killing the pathogens that cause UTIs and relieving the inflamed tissues brought about by the innate immune system responding to injury or infection, respectively. Plants with antimicrobial, antioxidant, and anti-inflammatory actions are known to contain secondary metabolites, such as alkaloids, coumarins, tannins, terpenes, and flavonoids, which are sources of bioactive compounds that have several biological activities (40).

The informants have identified several plants with antimicrobial, antibacterial, and antiviral properties that inhibit growth or eliminate respiratory pathogens, such as *Lagerstroemia speciosa* (41), *Nauclea orientalis* (30), and *Citrus microcarpa* (42). Some plants, like *Premna odorata* (43), are reported to manage phlegm and have anti-allergy properties, like *Curcuma longa* (44). Both *Allium odorum* (ganda) and *Allium fistulosum* (sibuyas-dahon) are usually prepared by heating over a low flame or burning charcoal and adding a small amount of salt. The extract is massaged as a balm on the body, or the warm material is directly applied to the back and chest while body massaging to relieve colds. The external application of the extract from the heated leaves primarily releases gases from the body (*panuhot*), which are believed to cause cough or asthma.

Several studies have been conducted on plants to remedy hypertension, including those used by Butuanon traditional healers to lower blood pressure and cholesterol levels and relieve hypertension (27, 45-48). Aside from being antihypertensive, these plants are also thrombolytic, anticoagulant, anti-ischemic, cardio-protective, blood purifier, and promote blood flow like *Antidesma bunius* or locally known as *bugnay* (48). *Capsicum frutescens* was reported to encourage blood flow, and lipid motility (49). Then, both *Allium* sp. (sibujing) and *A. sativum* (garlic) are used to control hypercholesterolemia (50). The plants mentioned by the key informants for diarrhoea are also reported in some studies, like *Heritiera littoralis* (51), *Mangifera indica* (45), *Musa sapientum* (45), and *Psidium guajava* (8). A survey of the native people of Lomela Village in Congo (52) showed that the plants they used as anti-dysenteric and anti-diarrhoeal contained tannins, alkaloids, saponins, flavonoids, sterols, triterpenes, and reducing sugar. Among the numerous phytochemicals pre-

sent in active extracts, tannins and flavonoids are thought to be responsible for anti-diarrhoeal activity by increasing colonic water and electrolyte reabsorption, and in contrast; other active compounds act by inhibiting intestinal motility (53).

The plants used by Butuanon to treat wounds or cuts are also used by other communities in the Philippines and other countries (29, 55-57). These plants are reported to have antibacterial and anti-inflammatory properties, such as *Chromolaena odorata* (54), *Lunasia* sp. (29), *Tectona grandis* (55), and *Theobroma cacao* (56), while others are pain relievers like *Nypa fruticans* (57). Relapse (*bughat*) occurs when an ill person is not yet fully recovered but their illness has recurred. This condition is also experienced by a mother who has not yet fully recovered from giving birth but already does household chores and carries heavy things. The person with relapse may experience severe headaches, body pain, nausea, and vomiting. The healers recommended a decoction of the ten plants to treat relapse through drinking, bathing, and steam bathing. After steam bathing, the patient will be massaged from head to toe with plant extract added with oil or commercial liniment to relieve relapse.

In 2010, the Department of Health (DOH) recorded 9,716 Filipino patients who underwent dialysis due to kidney failure, which increased to 21,535 in 2016 (58). Furthermore, in 2013, kidney disease ranked as the sixth leading cause of illness, and one Filipino suffered chronic kidney failure every hour (58). This study documented that aside from UTI, the healers also treat kidney dysfunction and disease with the decocted roots of *Annona muricata*, *Pandanus tectorius*, *Laportea meyeniana*, and *Jatropha podagrica*; the bark of *Ormosia calavensis*; and the leaves of *Leucosyke capitellata* and *Terminalia catappa*. Plants like *Crescentia cujete* were reported for urinary problems (45), *J. podagrica* as anti-inflammatory and anti-cancer (59), and *Terminalia catappa* as anti-cancer (45).

Arthritis can be an acute or chronic inflammation of joints, which could be coupled with tissue damage and pain. The healers used the decoction of each of the following plants to treat arthritis: *Jatropha podagrica* roots, *Annona muricata*, *Artemisia vulgaris* leaves, *Ormosia calavensi*, *Cinnamomum mercandoi*, and *Syzygium cumini* barks. The simmered *Crescentia cujete* fruit juice and extract from the *Curcuma longa* rhizome were also given to patients with arthritis. These plants could have anti-inflammatory, analgesic, and healing properties beneficial to manage arthritis by relieving inflamed and damaged tissues and pain.

The result of this study could significantly provide additional information on traditional knowledge and practices affecting the health of Butuanon, which could potentially contribute to public health promotion and disease prevention intervention programs and services that target the well-being of Butuanon and other ethnolinguistic or indigenous peoples, and in crafting local and national health policies.



## Conclusion

This documentation reveals Butuanon's traditional knowledge and practices for managing illnesses using medicinal plants. A total of 132 medicinal plants were documented and used by the Butuanon traditional healthcare practitioners. These plants are primarily herbaceous, trees, shrubs, and vines that can cure 93 illnesses. Many of these plants may contain undiscovered pharmacological properties that can serve as active ingredients in the development of drugs. The traditional healers' continuous use of these plants indicates the plants' effectiveness in curing varied illnesses and diseases, even with modern synthetic drugs. However, more pharmacologic and more profound studies are still needed to provide a scientific basis for the efficacy of these claimed medicinal plants. In addition, it is imperative to assist traditional healers as alternative healthcare providers in preserving their knowledge and practices and enhancing their skills through seminars and training.

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## Authors contributions

JHP and BOT were the two research assistants that collected the data from the key informants through interviews. BOT and LAO (the project leader) consolidated, tabulated, and analyzed the collected data. Then, LAO and MTD (the co-project leader) drafted, edited, and revised the manuscript into a publishable article. MTD also identified the medicinal plants' local and scientific names for proper classification. All authors read and approved the final manuscript.

## Compliance with ethical standards

**Conflict of interest:** Authors do not have any conflict of interests to declare.

**Ethical issues:** None.

## Supplementary data

Supplementary Table 1. List of documented plant species used by Butuanon ethnolinguistic community.

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