

RESEARCH ARTICLE

Diversity of edible plants with ethnomedicinal properties utilized by the Ayangans of Northern Philippines

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Abstract

This ethnobotanical study documents the customary wisdom on medicinal edible plants used by the Ayangan community of the Northern Philippines. Semi-structured interviews with 50 informants were conducted and assessed using quantitative indices such as the fidelity level (FL), informant consensus factor (ICF), frequency of citation (RFC) and use value (UV). The study recorded 64 medicinal edible plants from 33 families, the most prevalent of which is the Fabaceae family. The majority of the edible plants were classified as vegetables. The leaf was the most commonly exploited plant portion for medical purposes. The Ayangans used these plants to treat 57 medical conditions, with cough being the most frequently reported. The decoction was the predominant preparation method and direct consumption of fresh or cooked edible plants was the primary mode of administration using a single plant or plant part. *Capsicum frutescens* L. had the highest RFC, while *Carica papaya* L. had the highest UV. The species with 100% fidelity levels included *Ageratum conyzoides* L., *Citrus aurantifolia* (Christm.) Swingle, *Carica papaya* L., *Areca catechu* L. and *Psidium guajava* L., highlighting their significance in traditional medicine. Dermatological conditions had the highest ICF. These findings can help protect local plant biodiversity, traditional knowledge and future pharmaceutical developments of the identified edible plants with medicinal properties.

Keywords

Ayangan; ethnomedicine; Ifugao; wild edible plants

Introduction

Food security remains one of the worlds' most urgent issues. In 2022, the number of individuals who faced hunger globally ranged from 691 to 783 million (1). Consequently, each member of the United Nations (UN) has prioritized addressing food security as one of the 17 Sustainable Development Goals (SDGs) they want to attain by 2030 (2). The UN SDG 2 strives to achieve food security by fostering ecologically sustainable agriculture, eradicating hunger and improving humanity's nutritional quality (3). The United Nations emphasized the potential benefits of conventional wisdom in securing reliable food sources by efficiently using local natural resources (2).

Among the diverse solutions to address food insecurity is using wild edible plants (WEPs). WEPs have become a key resource, specifically for the indigenous and rural areas in developing regions (4). These plants grow naturally in various habitats without nurturing or cultivation, providing significant nutritional benefits. Communities worldwide have long relied on them, particularly during times of crisis or food scarcity (4, 5). WEPs supply

food diversity, filling the nutrition gaps and augmenting the overall nourishment level of diets (6, 7). In addition to their nutritional contents, WEPs have significant medicinal properties, acting as natural remedies for various medical conditions in rural and indigenous communities (8, 9).

In many areas, WEPs coexist with naturalized plant species introduced to a region and have acclimated to local environments without human cultivation. These plants and the WEPs often become integrated into traditional food systems, further enhancing local food security and resilience (10-14). While there is a growing number of research studies documenting the utilization of WEPs worldwide, notable gaps remain in the ethnobotanical knowledge of these plants, specifically in certain areas like the Philippines (5).

The Philippines is home to more than 10000 plant species and precisely 110 indigenous groups but still faces the challenge of food insecurity (15). Despite the country's biological diversity, many indigenous groups struggle with food security, highlighting the need for ethnobotanical studies that document and preserve local plant resources (15). Several studies have been conducted on WEPs used by ethnic groups in the Philippines; however, there is a lack of comprehensive studies, particularly on the Ayangans of Lamut, Ifugao and their use of wild and naturalized plants (16-18).

Like many indigenous groups, the Ayangans possess an extensive knowledge system. The knowledge system revolves around using plant species for food and medicine. These plants play a vital role in food security, particularly during scarcity. WEPs and naturalized species provide key nutrients and serve as therapeutic remedies for various health issues (19, 20). This research seeks to document the variety of plants possessing ethnomedicinal properties utilized by the Ayangans of Lamut, Ifugao. By recording the variety of plants they use, this research seeks to preserve traditional knowledge and contribute to ongoing efforts to safeguard indigenous food systems and enhance food security.

Materials and Methods

Study area

The municipality of Lamut in the Ifugao province spans a land area of 159.65 km² (Fig. 1). The location coordinates 16° 39' North and 121° 13' East (21). The main inhabitants of this multicultural metropolitan municipality are the provinces' ethnolinguistic groups, including the Ayangans and Tualis, as well as other groups like the Ilocanos and Tagalogs. As of 2020, the population density was 160 people per km², with 26235 residents (22). The landscape has rugged and rocky terrain, mainly composed of mountains in the north and west parts, while the southern portions have the gentlest slopes and lowest elevations. There are 2 seasons: the wet season, which begins from May until November and the arid season, which starts in December and lasts until April. Nonetheless, there are both wet and dry periods all year round. They fluctuate daily and may lead to prolonged intervals of either precipitation or aridity. Most of the soil is made up of sandy loam and clay loam. Due to its unique environment, the vegetation is diverse, encompassing rice paddies, forests, endemic plants, grasslands, open spaces and crops.

Ethnobotanical data collection

This work has obtained approval from the Review Committee of Ifugao State University. Following the International Society of Ethnobiologists' criteria, we conducted this study between May 2023 and February 2024 (23). We obtained permission, coordinated appropriately, had previous discussions and received free and informed consent before commencing this study. We also made it clear that the only objective of this research was academic.

The various barangay officials purposefully selected 50 informants from the 5 barangays of Lamut, Ifugao, to conduct interviews. Semi-structured interviews, focus groups, plant and field observations and the gathering of therapeutic edible plants were the methods used to gather data. Several barangay officials in Lamut, Ifugao,

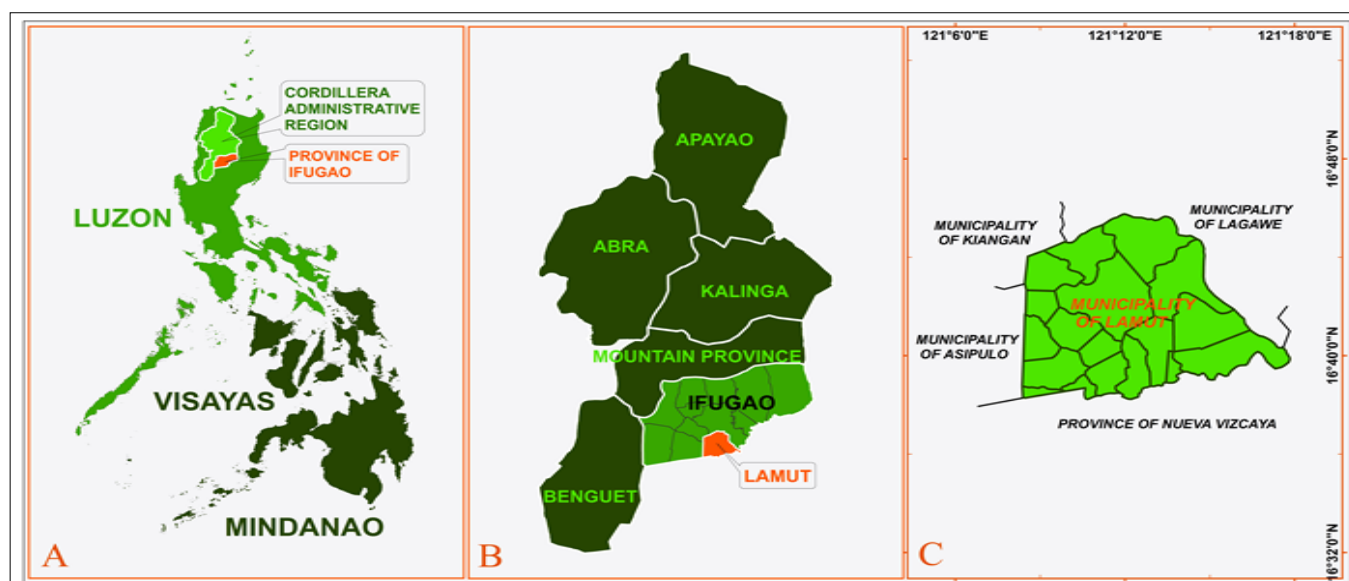


Fig. 1. Location of the study area in the shade: A. Map of Ifugao Province, Cordillera Administrative region in the Philippine archipelago; B. Municipality of Lamut, Ifugao in the Cordillera Administrative Region; C. Municipality of Lamut.

deliberately selected 50 informants from the 5 barangays for interviews. The techniques for acquiring data included semi-structured interviews, focus groups, field and plant observations and the collection of therapeutic edible plants. The demographic profile of the informants was obtained through a semi-structured questionnaire which included their age, sex, barangay or area, education, occupation and the various edible plants they are familiar with or employ in ethnomedicine (24, 25). We also inquired about the vernacular or Ayangan names, food group classification, therapeutic uses, plant parts they used and how they prepared and administered these therapeutic plants.

All edible plants with ethnomedical properties were gathered, pressed and stored for precise species identification at the herbarium during the fieldwork. We identified all floral species utilizing the Plants of the World Online (26). The Ifugao State University Herbarium (IFSUH) in Nayon, Lamut, Ifugao, received the completed plant specimens for future study or reference. The Philippine National Herbarium received the unidentified species for identification and authentication. We verified the scientific names and families using the International Plant Names Index databases (27).

Quantitative analysis

Among the Ayangans of Lamut, Ifugao, the relative frequency of citation (RFC) reveals the importance of an individual plant species. RFCs are calculated by dividing the number of informants who mention a specific plant species by the total number of informants (28). The use values (UVs) are calculated by dividing the number of citations per species by the total number of informants (29). This is an indicator that gauges the relative relevance of helpful plants. We determined the fidelity level (FL), or the percentage of the most valued and suggested medicinal plant for a specific ailment or application category, using the following formula (30):

FL = total number of informants who cited a medicinal plant for any other purpose or usage / (number of informants who cited or discussed the use of that plant for a specific disease category) (Eqn. 1)

The Informant Consensus Factor (ICF) was the degree of agreement among study participants about using a certain plant species to cure a particular disease. We calculated it using Equation 2 formula (31):

$$ICF = (Nur - Nt) / (Nur - 1) \quad (\text{Eqn. 2})$$

Where Nur represents the number of use reports or citations for each illness category and Nt signifies the number of species used in that category.

Microsoft Excel 365 was utilized for data processing and analysis of the demographic profiles of the informants, as well as for conducting RFC, UV, FL and ICF analyses.

Results

Ayangans from Lamut, Ifugao, who served as the study's informants, have their demographic information in Table 1. A total of 50 informants were purposively selected from 5

barangays in Lamut, Ifugao: Nayon, Bimpal, Payawan, Lucban and Panopdopan, with each barangay contributing 10 informants (20%). The age of the informants ranged from 49 to 70 years, with the majority belonging to the 50-59 (30 %) and 60-69 (30%) age groups, mostly from barangay Bimpal (24%). As to sex distribution, the majority of the informants were female (60%), while males constituted 40 %, with barangay Bimpal (40%) having the highest representation. Regarding educational attainment, 30% of the informants had completed college, with a significant proportion from barangay Nayon (12%). Additionally, 20% attained primary education, primarily from barangay Bimpal (8%) and 18% completed vocational education, predominantly from barangay Nayon (6%). Another 18% had reached college-level education without completing a degree, mainly from barangay Nayon (6%). Secondary education was completed by 10% of the informants, mostly from barangay Bimpal (4%), while 4% had postgraduate qualifications, equally distributed between barangays Nayon (2%) and Bimpal (2%). As for occupation, most informants were farmers (40%), with a substantial number from barangay Bimpal (16%). Self-employed individuals, primarily from barangay Nayon, followed at 26%. Retired teachers accounted for 20%, health providers comprised 14% and the latter groups mainly represented in barangays Nayon (4%) and Bimpal (4%).

The Ayangans of Lamut in Ifugao Province utilized 64 edible plants with medicinal properties from approximately 33 different families, as noted in this ethnobotanical survey (Table 2). The roster of therapeutic plants includes the taxonomic names, Ayangan/local names, plant families, food group classifications, utilized plant parts, medicinal applications, preparation methods, administration techniques and their corresponding RFC and UV values.

The families of Fabaceae (9.4%), Solanaceae (7.8%), Asteraceae (6.3%), Cucurbitaceae (6.3%) and Poaceae (6.3%) were the largest with edible plant species (Fig. 2).

Fig. 3 illustrates the various food group classifications of edible plants and their ethnomedical applications. Vegetables (50.00%) made up the majority of the edible plants, followed by fruits (31.08%), legumes (6.76%), roots and tubers (6.76%), herbs and spices (2.70%) and nuts and seeds (2.70%).

The most exploited plant parts were the leaves (32.76%), fruits (25%), seeds (6.9%), stems (6.9%), young

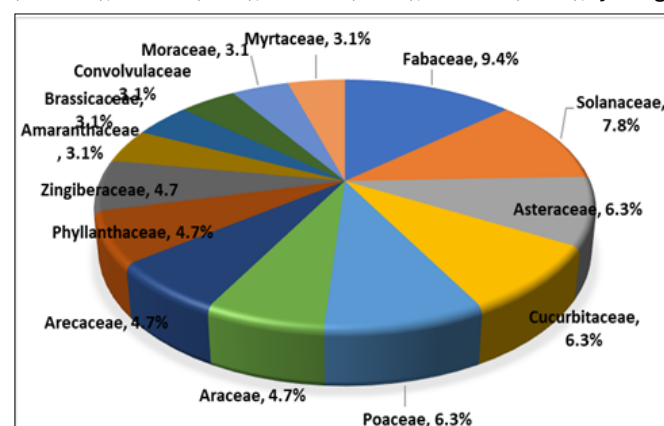


Fig. 2. Botanical families of the therapeutic edible plants.

Table 2. Therapeutic edible plants used by the Ayangan communities , Therapeutic WEPs used by the Ayangan communities

Scientific Name	Local Name	Family	Food Group Classification	Parts Used	Medicinal Uses	Means of Preparation	RFC	UV
<i>Ageratum conyzoides</i> L.	Haphapon	Asteraceae	Vegetable	Leaves, Stem	Rheumatism, wounds, bruises, burns, fever, headache, colic, dyspepsia, pneumonia	Pound or crush the stem and leaves, then apply the sap to the affected area. Boil the leaves and stem, then use the decoction to wash the affected area or drink the decoction.	0.4	0.45
<i>Allium ramosum</i> L.	Kutchay	Amaryllidaceae	Vegetable	Leaves	Fever, asthma, sore throat, cough, dyspepsia, dysentery, diarrhoea	Pound or crush the leaves, then apply the sap to the affected area; Boil the leaves and drink the decoction.	0.3	0.45
<i>Alocasia macrorrhizos</i> (L.) G. Don	Phila	Araceae	Vegetable	Leaves, Stem	Acne, snake bite, boil, pimple	Cut the stem and apply the sap to the affected area. Pound or crush the leaves, then use the sap to the affected area. Boil the leaves and drink the decoction.	0.2	0.35
<i>Amaranthus spinosus</i> L.	Aladjon	Amaranthaceae	Vegetable	Leaves, Roots, Young Shoot	Diuretic, snakebite, fever, constipation	Pound or crush the leaves and roots, then apply the sap to the affected area. Boil the leaves and roots, then drink the decoction; Saute or boil the young shoot, then eat.	0.22	0.4
<i>Amaranthus viridis</i> L.	Aladjon	Amaranthaceae	Vegetable	Whole Plant	Constipation, acne, UTI, boil, ulcer	Pound or crush the whole plant, then apply the sap to the affected area. Boil the entire plant, then use the decoction to wash the affected area or drink the decoction.	0.22	0.35
<i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson	Kolong	Araceae	Tuber, Root	Tuber	Rheumatism, cough, asthma, bronchitis	Boil the tuber and drink the decoction.	0.16	0.3
<i>Antidesma montanum</i> Blume	Phugnay	Phyllanthaceae	Fruit	Fruit, Root, Leaves	Wound, stomachache, ulcer, headache, UTI, common cold, cough	Boil the leaves and roots and use the decoction to wash the affected body parts or drink the decoction. Eat the fruit directly.	0.24	0.4
<i>Areca catechu</i> L.	Momah	Arecaceae	Vegetable	Fruit, Root	Tapeworm infection, diarrhoea, bronchitis, UTI, cough	Boil the roots and drink the decoction; Chew the fruit.	0.52	0.52
<i>Artocarpus heterophyllus</i> Lam.	Kakaw	Moraceae	Fruit, Nuts, Seeds	Leaves, Fruit	Wound, ringworm, lower blood pressure, asthma, diarrhoea	Heat and pound the leaves and apply the sap to the affected area. Directly eat the fruit; Boil the leaves and drink the decoction.	0.36	0.4
<i>Averrhoa bilimbi</i> L.	Piyas	Oxalidaceae	Fruit	Fruit, Leaves, Flower	Cough, common cold, itchy skin, rheumatism, animal bite, insect bites	The fruit can be eaten directly. Heat and pound the leaves and apply them to the affected area. Soak the flower in a certain amount of water and drink the infusion to treat the cough.	0.28	0.5
<i>Bambusa bambos</i> (L.) Voss	Fajug	Poaceae	Vegetable	Leaves, Shoot	Tapeworm, indigestion	Boil and drink the decoction; Cook the shoot and eat.	0.16	0.2
<i>Bambusa spinosa</i> Roxb. ex Buch.-Ham.	Kawayan	Poaceae	Vegetable	Leaves	Diabetes, tapeworm infection, hypertension	Boil and drink the decoction.	0.16	0.5
<i>Bidens bipinnata</i> L.	Onggwad	Asteraceae	Vegetable	Leaves	Anti-helmitic, sore throat, dysentery, eye problem, toothache	Boil the leaves and drink the decoction or apply it to the affected body part; Chew the leaves; Pound or crush the leaves and apply the sap to the infected body part.	0.22	0.5
<i>Bidens pilosa</i> L.	Onggwad	Asteraceae	Vegetable	Leaves	Wound, cut, bruise, ulcer, hypertension, malaria, cough	Pound or crush the leaves and apply the sap to the affected body part. Boil the leaves and drink the decoction.	0.22	0.45
<i>Bischofia javanica</i> Blume	Tuhwoh	Phyllanthaceae	Fruit	Stem, Bark	Dysmenorrhea, ulcer, tuberculosis, stomachache; athletes' foot	Pound the stem or bark and apply the sap to the affected body part; Boil the stem or bark and drink the decoction, or use the decoction to wash the infected body part.	0.16	0.45
<i>Calamus manillensis</i> (Mart.) H. Wendl.	Littuu	Arecaceae	Vegetable, Fruit	Fruit, Root	Fever, skin infection, cough, common cold, stomachache	Boil the roots and drink the decoction; The fruit is eaten directly.	0.48	0.5
<i>Calamus rotang</i> L.	Ghiwi	Arecaceae	Vegetable, Fruit	Root, Leaves, Fruit	Fever, snake bite, diarrhoea, wound, dysentery, kidney problem, skin disorder, cough, eye problem	The roots are boiled and the decoction is applied to the infected body parts, or the decoction is drunk. The leaves are cooked and the decoction is applied to the infected body parts, or the decoction fruit is eaten directly.	0.46	0.54

<i>Capsicum frutescens</i> L.	Pahtiw	Solanaceae	Vegetable, Herb, Spices	Fruit	Cough, wound, common cold, sore throat, rheumatism, rabies, tapeworm infection	Pound or crush the fruit, apply it to the infected body parts or eat it directly.	0.54	0.55
<i>Carica papaya</i> L.	Tappay	Caricaceae	Fruit, Vegetable	Leaves, Fruits	Tuberculosis, anaemia, arthritis, wound, hypertension, indigestion, ringworm, lactation, animal bites, constipation, dengue	The leaves are boiled and the decoction is drunk. Pound or crush the leaves and apply the sap to the infected body parts. Eat the fruit directly; Cook the unripe fruit to boost milk in nursing mothers.	0.5	0.6
<i>Citrus medica f. aurantifolia</i> (Christm.) M. Hiroe	Chalajap	Rutaceae	Vegetable	Fruit, Roots	Cough, common cold, lower cholesterol, headache, stomachache, dizziness, fever, colic, dysentery	Drink the juice or drink the infusion of the fruit. The skin of the fruit is ingested to relieve stomach pain and dizziness.	0.46	0.53
<i>Coffea arabica</i> L.	Kopeh	Rubiaceae	Nuts, Seeds	Leaves, Seed	Malaria, dyspepsia	Boil the leaves and drink the decoction; pound the roasted seeds and boil, then drink.	0.28	0.4
<i>Colocasia esculenta</i> (L.) Schott	Phila	Araceae	Vegetable, Tuber, Root	Corm, Leaves	Lower blood pressure, diarrhoea, asthma, arthritis, skin problem	Boil the leaves and drink the decoction; Cook the corm and eat directly; Pound or crush the leaves, then apply the sap to the affected areas.	0.2	0.3
<i>Corchorus olitorius</i> L.	Saluyut	Malvaceae	Vegetable	Leaves, Young Shoot	Fever, dysentery, headache, body pain, constipation	Boil or cook the leaves and eat them directly.	0.12	0.35
<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Onggwad	Asteraceae	Vegetable	Leaves	Wound, burn, diabetes, ulcer, boil, indigestion	Pound or crush the leaves, then apply the sap to the affected area. Boil the leaves and drink the decoction.	0.26	0.35
<i>Cucurbita moschata</i> Duchesne ex Poir.	Alubfa	Cucurbitaceae	Vegetable	Flower, Seed	Chickenpox, measles, diabetes, fever	Boil the flower and seeds and drink the decoction;	0.14	0.25
<i>Dioscorea esculenta</i> (Lour.) Burkill	Paghattan	Dioscoreaceae	Tuber, Root	Tuber	Skin disorders, wounds, rheumatism, arthritis, fungal infections, burns, stomachache	Boil the tuber and eat directly. Cut the tuber and apply the sap to the affected body parts.	0.34	0.52
<i>Diplazium esculentum</i> (Retz.) Sw.	Appau	Athyriaceae	Vegetable	Leaves	Rheumatism, diabetes, headache, measles, constipation, wound	Boil the leaves and eat immediately or drink the decoction.	0.3	0.35
<i>Glochidion gigantifolium</i> (S.Vidal) J.J.Sm.	Podpod	Phyllanthaceae	Fruit	Roots, Fruits	UTI, cough	Boil the roots and drink the decoction; Directly eat the fruit.	0.1	0.2
<i>Ipomoea aquatica</i> Forssk.	Kangkong	Convolvulaceae	Vegetable	Young Shoots, Leaves	Bronchitis, lower blood pressure, burn	Cook the leaves or young shoots and directly eat them. Pound or crush the leaves, then apply the sap to the affected area.	0.06	0.15
<i>Ipomoea batatas</i> (L.) Lam.	Luhtu	Convolvulaceae	Tuber, Root, Vegetable	Leaves, Young Shoot	Anaemia, diabetes, wounds, bruises, cuts, hypertension	The leaves or young shoots are cooked and eaten directly. Pound or crush the leaves and apply them to the affected areas.	0.3	0.35
<i>Leptosolenia haenkei</i> C. Presl	Allawag	Zingiberaceae	Fruit	Rhizome, Fruit	Wound, ringworm, abrasion, diarrhoea, diuretic	Pound the rhizome and apply the sap to the infected body parts; directly eat the fruit.	0.16	0.35
<i>Mangifera foetida</i> Lour.	Manggah	Anacardiaceae	Fruit	Leaves, Seeds, Fruits, Bark	Fever, scabies, eczema, cough, common cold, diabetes, kidney problems	Boil the leaves and bark and drink decoctions, or use the decoctions for washing the affected body parts. Eat the fruit directly.	0.2	0.4
<i>Manihot esculenta</i> Crantz	Kahoy	Euphorbiaceae	Vegetable, Tuber, Root	Leaves	Hypertension, fever, body pains, headache, diarrhoea	Boil the leaves and drink the decoction.	0.12	0.35
<i>Melastoma malabathricum</i> L.	Fittajun	Melastomataceae	Fruit	Leaves, Bark, Fruit, Roots	Toothache, dysentery, diarrhoea, wounds, cuts, stomachache	Pound the leaves, bark, or roots and apply the sap to the affected body parts. Boil the roots and leaves, then drink the decoction. Eat the fruit directly.	0.24	0.35
<i>Melothria pendula</i> L.	Pipino	Cucurbitaceae	Fruit	Fruit	Anaemia, asthma, common cold, cough	Eat the fruits directly.	0.16	0.25
<i>Miscanthus sinensis</i> Andersson	Philau	Poaceae	Vegetable	Shoot	Cough, animal bites	Boil the shoot and drink the decoction; Pound the shoot and apply it to the affected body parts.	0.1	0.25
<i>Momordica charantia</i> L.	Apapet	Cucurbitaceae	Vegetable	Leaves, Fruits, Seeds	Diabetes, lower cholesterol, wound, cut, burn, fever	Boil the fruit or leaves, then eat directly or drink decoction. Pound or crush the leaves or seeds, then apply to the affected body parts.	0.34	0.35

<i>Monochoria vaginalis</i> (Burm.f.) C.	Hahhahlong	Pontederiaceae	Vegetable	Leaves, Roots	Cough, common cold, stomachache, fever, toothache	Pound or crush the leaves and drink the sap; Boil the roots and leaves, then drink the decoction.	0.1	0.3
<i>Muntingia calabura</i> L.	Saraisa	Muntingiaceae	Fruit	Leaves, Fruits	Ulcer, headache, cough, common cold, asthma	Boil the leaves and drink the decoction; Eat the fruits directly.	0.2	0.4
<i>Musa acuminata</i> Colla	Phalat	Musaceae	Fruit	Flower	Dysentery, bronchitis, ulcer, diabetes	Cook the flower and directly eat it.	0.2	0.3
<i>Nasturtium officinale</i> R. Br.	Tanghoy	Brassicaceae	Vegetable	Whole plant	Cough, dysentery, fever, bronchitis, wound, cut, bruises	Pound or crush the entire plant, then apply the sap to the affected body parts. Half-cook the whole plant and eat directly.	0.3	0.4
<i>Paratrophis glabra</i> (Merr.) Steenis	Galliway	Moraceae	Fruit	Fruit	Cough, common cold, asthma	Eat the fruits directly.	0.2	0.3
<i>Passiflora foetida</i> L.	Masaplora	Passifloraceae	Fruit	Fruit, Leaves	Cough, common cold, asthma, wounds, cuts, abrasion	Drink the juice of the fruit; Pound or crush the leaves, then apply the sap to the affected body parts.	0.14	0.4
<i>Peperomia pellucida</i> (L.) Kunth	Panpanhit	Piperaceae	Vegetable	Leaves, Stem	UTI, cough, common cold, sore throat, asthma	Boil the leaves and stem, then drink the decoction.	0.14	0.3
<i>Phaseolus lunatus</i> L.	Papallang	Fabaceae	Legume	Seeds	Diarrhea, dyspepsia, constipation	Boil the seeds, then drink the decoction. Eat the boiled seeds directly for constipation.	0.14	0.3
<i>Phaseolus vulgaris</i> L.	Antah	Fabaceae	Legume	Leaves, Seeds	UTI, constipation	Boil the seeds and leaves, then drink the decoction.	0.1	0.15
<i>Physalis angulata</i> L.	Ammahit	Solanaceae	Fruit	Leaves, Fruit	Wound, cut, bruises, cough, common cold, asthma	Pound or crush the leaves, then apply the sap to the affected area. Eat the fruit directly.	0.16	0.4
<i>Physalis peruviana</i> L.	Ghupah-ghupah	Solanaceae	Vegetable	Fruit	Cough, common cold, asthma	Eat the fruit directly.	0.14	0.25
<i>Portulaca oleracea</i> L.	Papait	Portulacaceae	Vegetable	Leaves, stem, Young shoot	Diarrhea, dysentery, cough, stomachache	Boil the leaves and stem, then drink the decoction; Cook the young shoot and eat directly.	0.18	0.25
<i>Psidium guajava</i> L.	Geh-ab	Myrtaceae	Fruit	Leaves, Fruit	Cough, wounds, cuts, abrasion, diarrhoea, dysentery	Eat the fruits directly, boil the leaves and use decoction to wash the affected body parts.	0.5	0.5
<i>Psophocarpus tetragonolobus</i> DC.	Fuligan	Fabaceae	Vegetable, Legume	Pods	Diabetes, lower blood pressure	Boil the pods, then make decoctions; Cook the young pods, then eat directly.	0.2	0.25
<i>Rorippa indica</i> (L.) Hiern	Unchoy	Brassicaceae	Vegetable	Stem, Leaves	Cough, asthma, bronchitis, diarrhoea	Cook the stem and leaves, then eat directly; boil the stem and leaves and then drink the decoction.	0.2	0.3
<i>Rubus fraxinifolius</i> Poir.	Pinit	Rosaceae	Fruit	Roots, Stem, Leaves, Fruits	Diarrhea, cough, asthma	Boil the leaves, stem and roots, then drink the decoction; Eat the fruit directly.	0.12	0.35
<i>Saccharum spontaneum</i> L.	Patpat	Poaceae	Vegetable	Roots, Young shoot	Abdominal pain, nausea, dyspepsia, cough, asthma	Cook the young shoot, then eat directly; Boil the roots, then drink the decoction.	0.14	0.4
<i>Sandoricum koetjape</i> (Burm. f.) Merr.	santol	Meliaceae	Fruit	Fruit, Leaves	Cough, asthma, sore throat, diarrhoea, stomachache	Eat fruits immediately; Boil the leaves, then drink decoctions.	0.16	0.4
<i>Sechium edule</i> Sw.	Sayote	Cucurbitaceae	Vegetable	Leaves, Fruits	Lower blood pressure, kidney problems, ulcers, hyperacidity	Boil the leaves, drink the decoction, Cook the fruit and eat directly.	0.12	0.3
<i>Solanum americanum</i> Mill.	Amti	Solanaceae	Vegetable	Leaves, Stem	Wound, cuts, bruises, ulcer, headache	Pound or crush the leaves and stems, then apply the sap to the affected area. Boil the leaves and stems, then drink the decoction.	0.24	0.35
<i>Solanum pimpinellifolium</i> L.	Ammahet	Solanaceae	Vegetable	Fruit	Burns, headache, rheumatism, cough, sore throat	Eat the fruit directly.	0.28	0.35
<i>Syzygium malaccense</i> (L.) Merr. & L.M. Perry	Upang	Myrtaceae	Fruit	Fruit	Cough, sore throat, diabetes	Eat the fruit directly.	0.2	0.35
<i>Tamarindus indica</i> L.	Salamague	Fabaceae	Fruit	Fruit; Leaves	Cough, sore throat, cut, wounds, abrasion	Eat the fruit directly; Pound the leaves, then apply the sap to the affected area.	0.24	0.35
<i>Vanoverberghia vanoverberghii</i> (Merr.) Funak. & Docot	Allawag	Zingiberaceae	Fruit	Fruit	Cough, sore throat, asthma	Eat the fruit directly.	0.14	0.2
<i>Vigna radiata</i> (L.) R. Wilczek	Fallatong	Fabaceae	Legume	Seed	Diabetes, rheumatism	Cook the seed and eat it directly.	0.1	0.15
<i>Vigna unguiculata</i> (L.) Walp.	Antah	Fabaceae	Vegetable; Legume	Seed	Diabetes, lower cholesterol	Cook seeds and eat them directly.	0.12	0.15
<i>Zingiber officinale</i> Roscoe	Lajah	Zingiberaceae	Herb, Spices	Root	Sore throat, cough, arthritis, rheumatism	Boil the pounded roots and drink the decoction.	0.24	0.25

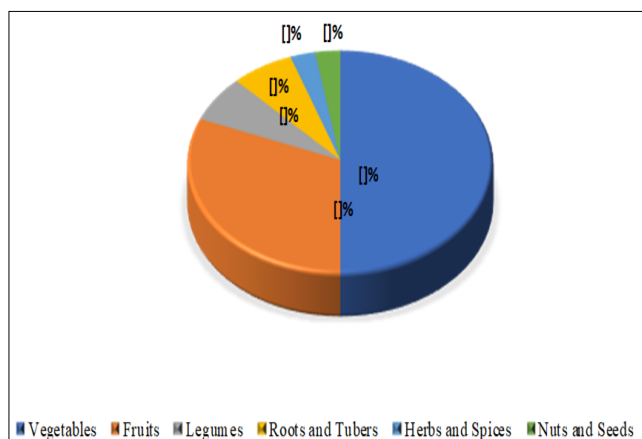


Fig. 3. Food group classification of the therapeutic edible plants.

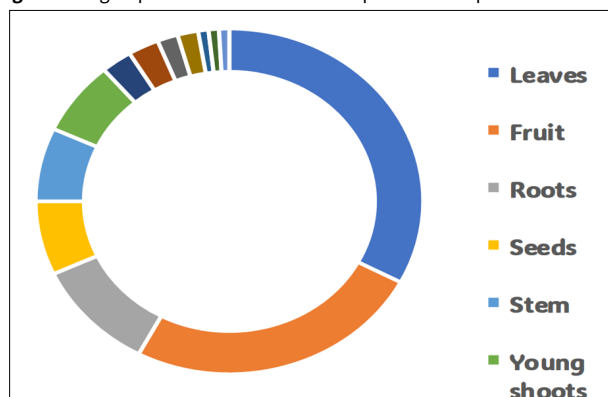


Fig. 4. Plant parts of the therapeutic edible plants used by the Ayangan communities.

shoots (5.17%), roots (10.34%) and seeds (6.9%), as shown in Fig. 4.

The Ayangan community utilized 57 edible plants with ethnomedicinal properties to cure various ailments (Fig. 5). The most frequent medicinal applications included cough (10.66%), asthma (5.02%), diarrhoea (4.70%), common cold (4.39%), fever (4.08%), diabetes (3.76%), cuts (3.13%) and dysentery (3.13%).

Results revealed the different ethnomedicinal preparation methods employed by the Ayangans of Lamut when using the medicinal edible plants (Fig. 6). The most frequently used preparation techniques were decoction

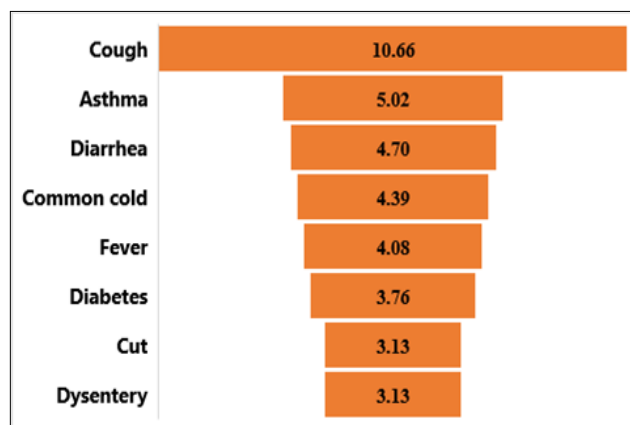


Fig. 5. Medicinal applications of the therapeutic edible plants.

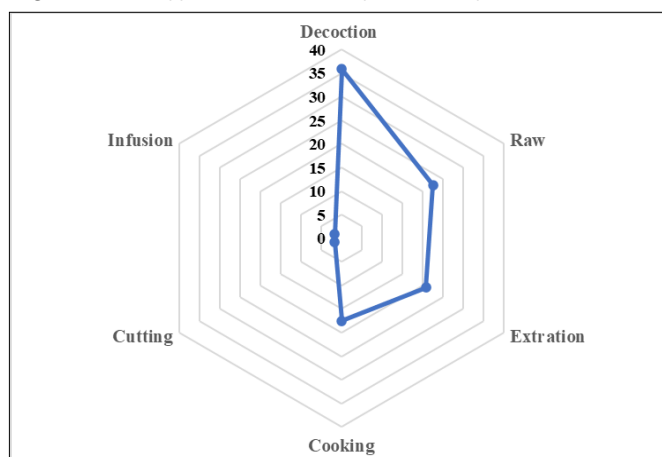


Fig. 6. Ethnomedicinal preparations of the therapeutic edible plants.

(35.83%), raw application (22.50%), extraction (20.83%), cooking (17.50%), cutting (1.67%) and infusion (1.67%).

Regarding plant part preparation, using a single plant and a single plant part was the most prevalent (90%) practice among the Ayangans, followed by combining 2 or more plant parts (7%). Using a combination of 2 or more plant species was the least common, accounting for only 3%, as illustrated in Fig. 7.

Fig. 8 illustrates the different ways in which the Ayangans apply the various ethnomedicinal edible plants. The most common method was eating the fresh or cooked edible

Table 1. Demographic information of the Ayangan informants

Variables	Barangays										Total	
	Nayon		Bimpal		Payawan		Lucban		Panopdopan			
	f	%	f	%	f	%	f	%	f	%	f	%
Age												
≤49	1	2	2	4	2	4	2	4	3	6	10	20
50-59	4	8	5	10	2	4	3	6	1	2	15	30
60-69	5	10	7	14	1	2	1	2	1	2	15	30
≥70	2	4	5	10			2	4	1	2	10	20
Sex												
Male	7	14	7	14	2	4	3	6	1	2	20	40
Female	10	20	13	26	2	4	4	8	1	2	30	60
Education												
Primary	3	6	4	8	1	2	1	2	1	2	10	20
Secondary	1	2	2	4	1	2	1	2		0	5	10
Vocational	3	6	2	4	2	4	1	2	1	2	9	18
College Level	3	6	2	4	1	2	2	4	1	2	9	18
College Graduate	6	12	4	8	2	4	1	2	2	4	15	30
Post Graduate	1	2	1	2							2	4
Occupation												
Farming	3	6	8	16	4	8	3	6	2	4	20	40
Teaching (Retired)	5	10	4	8		0	1	2		0	10	20
Health Practitioners	2	4	2	4	1	2	1	2	1	2	7	14
Self-Employed	7	14	2	4	2	4	1	2	1	2	13	26

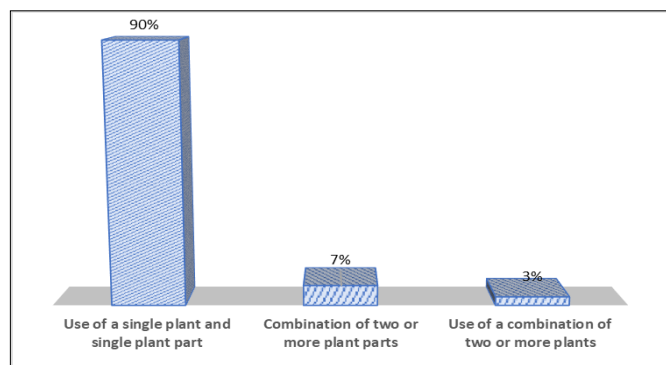


Fig. 7. Modes of plant part preparation of the therapeutic edible plants.

plants directly (37.19%), followed by drinking the decoction or infusion (34.71%), direct application (21.49%), bathing or washing (5.79%) and ingestion (0.83%).

The RFC had a mean of 0.23 and varied from 0.04 to 0.54, as reported by the informants (Table 3). Therefore, the species with the highest RFC were *Capsicum frutescens* L. (0.54), *Areca catechu* L. (0.52) and *Ipomoea aquatica* Forssk. (0.06). Table 3 presents the UV values of the therapeutic edible plants ranging from 0.15 to 0.6 with a mean of 0.36, as mentioned by the Ayangan informants. *Carica papaya* L. (0.6), *Capsicum frutescens* L. (0.55) and the remaining four plant species obtained the lowest UV values. High FL values indicate that many Ayangan informants highly recommended and approved a specific kind of therapeutic plant as a cure for a

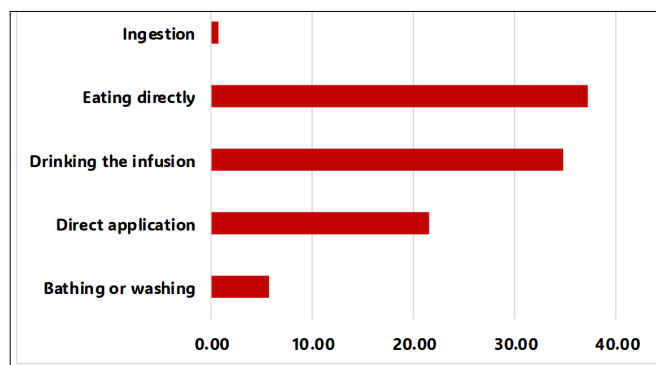


Fig. 8. Ethnomedicinal application of the Ayangan communities.

particular ailment. The edible plants with 100% FL were *Ageratum conyzoides* L., *Citrus aurantifolia* (Christm.) Swingle, *Carica papaya* L., *Areca catechu* L. and *Psidium guajava* L. (Table 4).

The Ayangans of Lamut, Ifugao, grouped the various medical illnesses based on ethnomedicinal usage and derived the ICF values from each category (Table 5). Dermatological problems were the most prevalent, with an ICF value of 0.57. They included athletes' feet, boils, ringworms, abrasions, skin infections, bruises, wounds, cuts, burns and itchy skin. The conditions classified as otorhinolaryngological, with an ICF value of 0.47, were the next most prevalent and included toothaches, sore throats and eye problems. The informants didn't seem to agree on

Table 3. Therapeutic edible plants with the highest RCF and UV

Rank	Medicinal plants	Plant part	RCF	Rank	Medicinal plants	Plant part	UV
1	<i>Capsicum frutescens</i>	Fruit	0.54	1	<i>Carica papaya</i>	Leaves, Fruit	0.6
2	<i>Areca catechu</i>	Fruit, Root	0.52	2	<i>Capsicum frutescens</i>	Fruit	0.55
3	<i>Carica papaya</i>	Leaves, Fruit	0.5	3	<i>Calamus rotang</i>	Root, Leaves, Fruit	0.54
3	<i>Psidium guajava</i>	Leaves, Fruit	0.5	4	<i>Citrus medica f. aurantifolia</i>	Fruit, Root	0.53
4	<i>Calamus manillensis</i>	Fruit, Root	0.48	5	<i>Dioscorea esculenta</i>	Tuber	0.52
5	<i>Calamus rotang</i>	Root, Leaves, Fruit	0.46	5	<i>Areca catechu</i>	Fruit, Root	0.52
5	<i>Citrus medica f. aurantifolia</i>	Fruit, Root	0.46				

Table 4. Therapeutic edible plants with 100% FL

Medicinal plants	Local name	Plant part	Medicinal uses	Fidelity level (%)
<i>Ageratum conyzoides</i>	Haphapon	Leaf, Stem	Wound	100
<i>Citrus aurantifolia</i>	Chalajap	Fruit, Root	Common cold	100
<i>Carica papaya</i>	Tappay	Leaf, Fruit	Constipation	100
<i>Areca catechu</i>	Momah	Fruit, Root	Diarrhea	100
<i>Psidium guajava</i>	Geh-ab	Leaf, Fruit	Diarrhea	100

Table 5. ICF values of the various ailment categories identified by the Ayangan communities

Categories of indigenous uses	N _{ur}	N _t	ICF
Dermatological (pimple, eczema, bruise, wound, cuts, burns, scabies, boil, skin disorder, ringworm, abrasion, skin infection, athletes' foot, fungal infection, itchy skin)	61	27	0.57
Otorhinolaryngological (common cold, toothache, sore throat, eye problem)	37	20	0.47
Gastrointestinal (antihelmintic, dyspepsia, diarrhoea, tapeworm infection, constipation, dysentery, ulcer, indigestion, stomachache)	62	35	0.44
Animal bites (rabies, snake bite)	6	4	0.40
Respiratory (cough, asthma, bronchitis, pneumonia)	57	38	0.34
Hematologic (anemia, malaria)	5	4	0.25
Musculoskeletal (rheumatism, arthritis)	13	10	0.25
Communicable (tuberculosis, measles, chicken pox)	5	4	0.25
Others (abdominal pain, body pains, dizziness, nausea)	8	7	0.14
Urological (urinary tract infection, kidney problem, diuretic)	11	10	0.10
Cardiovascular (hypertension, lower blood pressure, lower cholesterol)	14	13	0.08
Endocrinological (diabetes)	12	12	0.00
Fever	13	13	0.00
Neurological (headache)	10	10	0.00
Gynaecological-Obstetrics (dysmenorrhea, lactation)	2	2	0
Culture-Bound Syndromes (colic)	3	3	0

using the therapeutic edible plants to treat fevers, neurological disorders, gynaecological-obstetric problems and culture-bound syndromes. This was clear because the ICF values for these conditions were the lowest.

Discussion

This ethnobotanical study sheds important light on the wide range of edible plants that the Ayangan populations of Lamut, Ifugao employ for medical purposes. Notably, many therapeutic edible plants were Fabaceae or legume family members. Other research conducted in the Philippines among various ethnic groups, such as the Higaonon tribe, the Ati Negrito indigenous group and rural populations in Mina, Iloilo, aligns with this finding (15, 18, 32). The informants emphasized that the Fabaceae species are common in the Ayangan community since they are fond of protein from plant-based sources. Their way of life, which usually entails labour-intensive activities like farming and calls for nutritious meals, probably motivates this choice. Pharmacological research shows that many Fabaceae species are helpful for health reasons, like fighting cancer, free radicals, inflammation, infections, ulcers, diabetes, rheumatism and parasites (33, 34). *Vigna unguiculata* (L.) Walp. is an example of a species in this family. Its parts contain steroids, flavonoids, saponins, alkaloids, phenolic compounds, tannins, fatty acids, vitamins, carbohydrates, carotenoids, amino acids and fibres (35). These parts have a lot of different medical uses, both in vivo and in vitro. In addition to controlling blood sugar, they can stop atherosclerosis, kill germs, stop sickness, fight cancer and change how the brain works (35). *Psophocarpus tetragonolobus* (L.) DC. is another type that has gallic acid, quercetin, phytate and phaseolin that can fight free radicals, fungi, inflammation, pain and cell growth (36).

Vegetables make up the majority of edible plants. The informants attribute this finding to the accessibility, abundance and proximity of these plant resources. The findings from earlier ethnobotanical research in the country (15) align with this observation. The fact that fruit and vegetable-based edible plants with medicinal properties are so common in Ayangan shows that the people who live there know and use a lot of different kinds of plants. The informants stated they can quickly obtain and always have these plant-based resources in their backyards or communities.

The leaves are the most used medicinal plants in the Ayangan community because they are plentiful, accessible and sustainable. The result aligns with other ethnobotanical research in the country (15, 18, 32, 38, 39). Additionally, the Ayangans' traditional knowledge goes beyond just using leaves. Interviewees reported using stems, fruits, seeds, roots, young shoots and other plant parts, either separately or in combination, to treat various medical conditions (37). Among the different illnesses and ailments, cough was the most frequently treated with various medicinal edible plants. The informants clarified that this is primarily due to the abrupt weather changes, particularly affecting the young and the elderly. Another traditional way for the Ayangans to treat cough is to eat the fruits of *Averrhoa bilimbi* L. along with *Calamus manillensis* (Mart.) H. Wendl., *Paratrophis glabra*

(Merr.) Steenis, *Calamus rotang* L., or *Tamarindus indica* L. They also like to drink fresh juice from *Passiflora foetida* L. and *Citrus medica f. aurantifolia* (Christm.) M. Hiroe, or they make teas with *Physalis peruviana* L. and *Zingiber officinale* Roscoe.

The Ayangan people use various ethnomedicinal preparations therapeutically; the most common techniques are decoction, raw eating, extraction, cooking, cutting and infusion. Previous research throughout the nation has reported similar findings (38, 39). Many therapeutic remedies come from plants like *Antidesma montanum* Blume, *Areca catechu* L., *Artocarpus heterophyllus* Lam., *Bambusa spinosa* Roxb. Ex Buch.-Ham., *Bidens pilosa* L. and *Calamus manillensis* (Mart.) H. Wendl. Most informants strongly preferred using raw or fresh edible plants to cure various diseases and ailments. Similarly, the Ayangans preferred using a single plant to prepare their plant remedies. This preference for using a single plant and part may reflect a deep-rooted understanding of the specific medicinal properties of these plants among the Ayangans.

The Ayangan communities most frequently consume edible plants directly, whether raw or cooked. The nations' earlier ethnobotanical research aligns with this result (32). They eat the sour, raw fruits of *Syzygium malaccense* (L.) Merr. & L.M. Perry, *Sandoricum koetjape* (Burm.f.) Merr. and *Tamarindus indica* L. They also drink the fresh juices of *Passiflora foetida* L. and *Citrus medica f. aurantifolia* (Christm.) M. Hiroe. They also frequently prepare decoctions from *Zingiber officinale* Roscoe and *Solanum americanum* Mill to help address ailments such as colds and coughing. The informants confirmed using edible plant-based plants for medicinal purposes, citing their safety and naturalness, which makes the dosage insignificant.

According to the informants, the most popular plant species with the highest RFC value is *Capsicum frutescens* L. People apply this versatile shrub to cure various illnesses, including cough, wounds, common cold, sore throat, rheumatism, rabies and tapeworm infection, spanning 6 different disease categories. Further national research has corroborated the application of *Capsicum frutescens* L. to treat wounds and rabies (40). The informants frequently cited this plant due to its popularity as a spice, abundance, usefulness, nutritional value and economic significance within the community. There are many bioactive phytochemicals in *Capsicum frutescens* L. fruits (41). Some of them are carotenoids, flavonoids, phenolics and other antioxidants. Capsaicinoid alkaloids, which have pharmacological, neurological and dietary effects, are responsible for pungency. When included in a regular diet at modest levels, these compounds have shown intense antibacterial activity and the capacity to decrease blood cholesterol levels (42).

Among all the edible plants with ethnomedicinal properties identified by the Ayangan informants, *Carica papaya* L. was the most useful plant species. The community popularly uses it to treat animal bites, especially those from dogs and snakes. Community members often cook unripe fruit for nursing mothers to enhance lactation. Other uses include tuberculosis, anaemia, arthritis, wounds, hypertension, indigestion, ringworm and lactation. Research of a similar nature confirms its effectiveness in wounds, ringworm, digestive disorders and dengue (43, 44). The phytochemicals found in the plant include

pro-anthocyanidins, phenols, alkaloids, anthraquinones, tannins, terpenoids, steroids, flavonoids, saponins and antioxidant properties (45). Research has found food fibres, zinc, magnesium, copper, potassium and B-complex vitamins like folate and pantothenic acid (43).

The most frequently cited plant species among the Ayangan communities were *Ageratum conyzoides* L., *Citrus medica f. aurantifolia* (Christm.) M. Hiroe, *Carica papaya* L., *Areca catechu* L. and *Psidium guajava* L. Historically, people have used these plants to treat various health conditions, including *Ageratum conyzoides* L. for wound healing, *Citrus medica f. aurantifolia* (Christm.) M. Hiroe for the common cold, *Carica papaya* L. for constipation and *Areca catechu* L. and *Psidium guajava* L. for diarrhoea. The study's results highlight the Ayangan communities' therapeutic beliefs and practices about these ethnomedicinal plants, supporting those of earlier studies (46–48). The country's Department of Health has approved the use of *Psidium guajava* L. (49), further validating the community's traditional knowledge.

Dermatological conditions emerged as the medical category with the highest ICF. This category encompassed a wide range of skin-related ailments, including pimples, eczema, bruises, wounds, cuts, burns, scabies, boils, skin disorders, ringworm, abrasions, skin infections, athletes' foot, fungal infections and itchy skin. Within this category, *Ageratum conyzoides* L. was the most commonly used plant, with a remarkable 100% fidelity level. The Ayangan informants stressed that to cure wounds, they typically crush or pound *Ageratum conyzoides* L. leaves and stems and apply them directly to the affected area by squeezing. *Ageratum conyzoides* L. is known to have numerous pharmacological activities, like analgesic, antibacterial, antioxidant, anticancer, antiprotozoal, antidiabetic, spasmolytic and allelopathic effects (50). While this study provides valuable insights, potential limitations such as sample size and biases in informant selection should be acknowledged. These factors could affect the generalizability of the results and future research should seek to expand the sample size and diversify the informants to provide a more comprehensive understanding of the ethnomedicinal practices in the Ayangan community.

Conclusion

In this study, the ethnobotanical method quantitatively assessed the therapeutic edible plants used by the Ayangans of Lamut, Ifugao. The Ayangan communities recorded 64 plant species, representing 33 families, for treating 57 medical diseases and conditions. However, biodiversity conservation faces significant challenges, including habitat destruction due to deforestation and land conversion, climate change affecting plant growth and distribution and the excessive use of natural resources jeopardizing the sustainability of medicinal plant use. The study's results will make more people aware of the need to protect biodiversity and local practices related to using easily accessible and edible medicinal plants in communities. They will also lay the groundwork for future pharmaceutical research, especially on the most important, popular and widely used medicinal plants.

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Compliance with ethical standards

Conflict of interest: The author does not have any conflict of interest to declare

Ethical issues: None

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used QuillBot (quillbot.com) to enhance the clarity and coherence of this manuscript. The application was primarily for the following purposes: paraphrasing and rephrasing, grammar and style checking and summarization. After using this tool/service, the author reviewed and edited the content as needed and take full responsibility for the content of the publication.

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