



Ethnobotanical study of the uses of medicinal plants in the Nasa ethnic group in the Colombian Andes

Estudio etnobotánico de los usos de plantas medicinales del grupo étnico Nasa en los Andes colombianos

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Abstract:

Background and Aims: The main therapeutic sources of the traditional medicine of the Nasa ethnic group in the Colombian Andes is obtained from experts, midwives and traditional doctors (*Thë' Wala*) located in the central mountain range of the Colombian Andes, which occupies an area of 25,400 hectares. Our ethnobotanical research is based on the hypothesis that Nasa traditional knowledge reveals crucial information about native species with therapeutic potential.

Methods: All species collected were identified in the herbarium of the University of Cauca (CAUP). Total ailments were classified into 15 disease categories. The informant consensus factor (ICF) was employed to assess the degree and cultural relevance of the use of the taxa for the different disease categories. The use value (UV) index was applied to establish a consensus on the effectiveness of the species used to cure the different illnesses.

Results: Our study reports 106 medicinal plants, belonging to 45 families. Asteraceae formed the most predominant family, followed by Lamiaceae. Ailments affecting the digestive system were the most frequently targeted group, making use of 26 plant species (24.5%). ICF values ranged between 0.96 and 1, with the highest values recorded for cancer and poisoning (1 each). Some plants are cultivated in the herb garden, or *Tul*, and others are collected in mountainous regions or in páramo (high moorland) areas, indicating the fragility of the pharmacopoeia in these regions.

Conclusions: The findings of this study underline the importance of medicinal plants and their integral role in daily human activities and disease management of the Nasa ethnic group. Certain native species with high medicinal value, but sharply declining wild populations, ought to be studied for the purposes of resource assessment and conservation. Future research on the chemical composition and bioactivity of medicinal plants is needed.

Key words: ethnobotany, herb-herb combination, indigenous knowledge, medicinal plants.

Resumen:

Antecedentes y Objetivos: Las principales fuentes terapéuticas de la medicina tradicional de la etnia Nasa en los Andes colombianos provienen de expertos, parteras y médicos tradicionales (*Thë' Wala*) ubicados en la cordillera central de los Andes colombianos, la cual ocupa una superficie de 25,400 hectáreas. Nuestra investigación etnobotánica parte de la hipótesis que el conocimiento tradicional Nasa revela información crucial sobre plantas nativas con potencial terapéutico.

Métodos: Todas las especies colectadas fueron determinadas en el herbario de la Universidad del Cauca (CAUP). Las dolencias se clasificaron en 15 categorías de enfermedades. Se utilizó el factor de consenso del informante (ICF) para evaluar el grado y la relevancia cultural del uso de los taxones para las diferentes categorías de enfermedades, y el índice de valor de uso (UV) para establecer un consenso sobre la efectividad de las especies utilizadas para curar las diferentes dolencias.

Resultados: Nuestro estudio reporta 106 plantas medicinales, pertenecientes a 45 familias. Asteraceae constituye la familia más predominante, seguida de Lamiaceae. Las dolencias que afectan al sistema digestivo fue el grupo más afectado, utilizándose 26 especies de plantas (24.5%). Los valores del ICF oscilaron entre 0.96 y 1, registrándose los valores más altos para el cáncer y el envenenamiento (1 cada uno). Algunas plantas se cultivan en la huerta o "*Tul*" y otras se recolectan en regiones montañosas o en zonas de páramo, confirmando la fragilidad de la farmacopea en estas regiones.

Conclusiones: Los hallazgos de este estudio subrayan la importancia de las plantas medicinales y su papel integral en las actividades humanas diarias y el manejo de enfermedades de la etnia Nasa. Ciertas especies nativas con alto valor medicinal, pero con poblaciones silvestres en marcada disminución, deberían estudiarse con fines de evaluación y conservación de recursos. Se necesitan futuras investigaciones sobre la composición química y la bioactividad de las plantas medicinales.

Palabras clave: combinación planta-planta, conocimiento indígena, etnobotánica, plantas medicinales.

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Received: September 25, 2023.

Reviewed: November 23, 2023.

Accepted by Marie-Stéphanie Samain: February 29, 2024.

Published Online first: May 6, 2024.

Published: Acta Botanica Mexicana 131 (2024).



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To cite as: Paz Perafán, G. M. and G. Montenegro Paz. 2024. Ethnobotanical study of the uses of medicinal plants in the Nasa ethnic group in the Colombian Andes. Acta Botanica Mexicana 131: e2257. DOI: <https://doi.org/10.21829/abm131.2024.2257>

e-ISSN: 2448-7589

Introduction

Medicinal plants have traditionally been used in rural areas and indigenous communities for many years. In developing countries, because many drugs are expensive or not available locally, medicinal plants are considered the front line of health care (Ekor, 2014). In fact, according to the World Health Organization (WHO, 2019), 80% of the global human population depend on traditional and complementary medicine. It is estimated that there are about 400,000 species of flowering plants on earth (Hosseini et al., 2021). Of these, only 6% have been evaluated for their biological properties and more than 90% of the species remain unknown today (Hosseini et al., 2021). As such, ethnobotanical research on medicinal plants contributes to the development of new medicines for the treatment of a number of existing diseases, as well as to meeting the growing demand of pharmaceuticals caused by the emergence of new ailments and the development of resistance to antibiotics in the particular instance of infectious diseases.

Colombia accounts for approximately 10% of the world's plant biodiversity (Clerici et al., 2019). This country is home to about 26,134 species of plants (Bernal et al., 2016), of which 2404 are medicinal and 204 endemic (Bernal and Mesa, 2022; García et al., 2011). Of these medicinal plants, only 119 are included in the Colombian Vademecum of Medicinal Plants (MPSC, 2008).

This study has been carried out in the Nasa ethnic group in the northeast of the department of Cauca, specifically in the locality of Jambaló. They use medicinal plants found in the wild in remote regions and from home gardens, known as *Tul* (traditional agricultural system of the Nasa), which have remained in many families as a measure of food security and prevention of malnutrition. For several years, however, the community has cultivated coca and poppy as a means of subsistence, which has generated an increasing destruction of habitats, threatening the sustainable use of wild medicinal plant resources over the last decades (Castaño Canoas, 2017; van de Sandt, 2017). In these rural areas, traditional knowledge of botanical ethnomedicine is passed down orally and has not been comprehensively recorded (van de Sandt, 2017). Thus, obtaining accurate information on wild and cultivated medicinal plants, their current uses and their associated traditional knowledge are critical issues.

The identified Nasa traditional medicine experts are the following:

1. The *Thë' Wala* ("wise man"), or traditional doctor, who possesses the most profound understanding of nature as well as medicinal and spiritual wisdom. A person might get visions in dreams that suggest being *Thë' Wala* is their destiny. Others teach interested persons that may be relatives or friends, instructing them in knowledge of the plants and medicines, as well as teaching them how to decipher the messages delivered by the spirits and cosmic beings. Some may see the spirits and thus be certain of becoming *Thë' Wala* (Portela Guarín, 2002).

2. Midwives, also known as *tutxh baxísa* (warm bellies), who are specialists in biological reproduction. Their contribution is to women in states of menstruation, pregnancy and childbirth, and to the diets of mothers, reiterating cultural principles that benefit the future of women, mothers, children, and the entire community in terms of health (Portela Guarín, 2002).

3. Herbalists, who are specialists in traditional medicine. Herbalists are characterized by their extensive knowledge of the use and preparation of medicinal plants. They do not know about spiritual work and can be either men or women (housewives, farmers, teachers, or any other person in the community) (Portela Guarín, 2002).

Our ethnobotanical research is based on the hypothesis that the traditional knowledge of the Nasa ethnic group regarding the use of medicinal plants can reveal important information on native medicinal plant species with potential therapeutic efficacy. The most significant medicinal plants, according to Phillips et al. (1994), are those that stand out for their use value (UV). In order to prevent them from going extinct, cultivation and conservation efforts must be addressed. Heinrich et al. (1998) suggested the informant consensus factor (ICF) as a valuable indicator for selecting plant species that are most suited to pharmacological objectives and for these to be submitted to phytochemical analysis.

The objectives of this work were to 1) obtain an inventory of the medicinal species of the Nasa ethnic group, documenting the methods of preparation and use of these medicinal plants, and 2) analyze the information obtained and reveal the current understanding and application of the



ethnobotanical knowledge of the residents. These findings will fill the information gap on the ethnobotanical knowledge and medicinal flora of this region and will provide references for the conservation and use of native traditional medicinal plants.

Material and Methods

Study area

The municipality of Jambaló (pronounced ham-ba-LO) is located in the central mountain range of the Colombian

Andes, in the northeast of the department of Cauca, at 80 km from the city of Popayán, between 2.783056N and 76.333056W UTM (Fig. 1). Jambaló is currently both a municipality and an indigenous reserve, with 97.7% of its residents belonging to the Nasa and Misak ethnic groups and at least one third speaking *Nasa Yuwe* and *Namtrik* (Castaño Canoas, 2017; van de Sandt, 2017). The region is composed of 35 villages or hamlets (*veredas*) and some 96% of the 25,400 hectares constitute protected land, the exception being the town of Jambaló itself. It ranges in altitude from

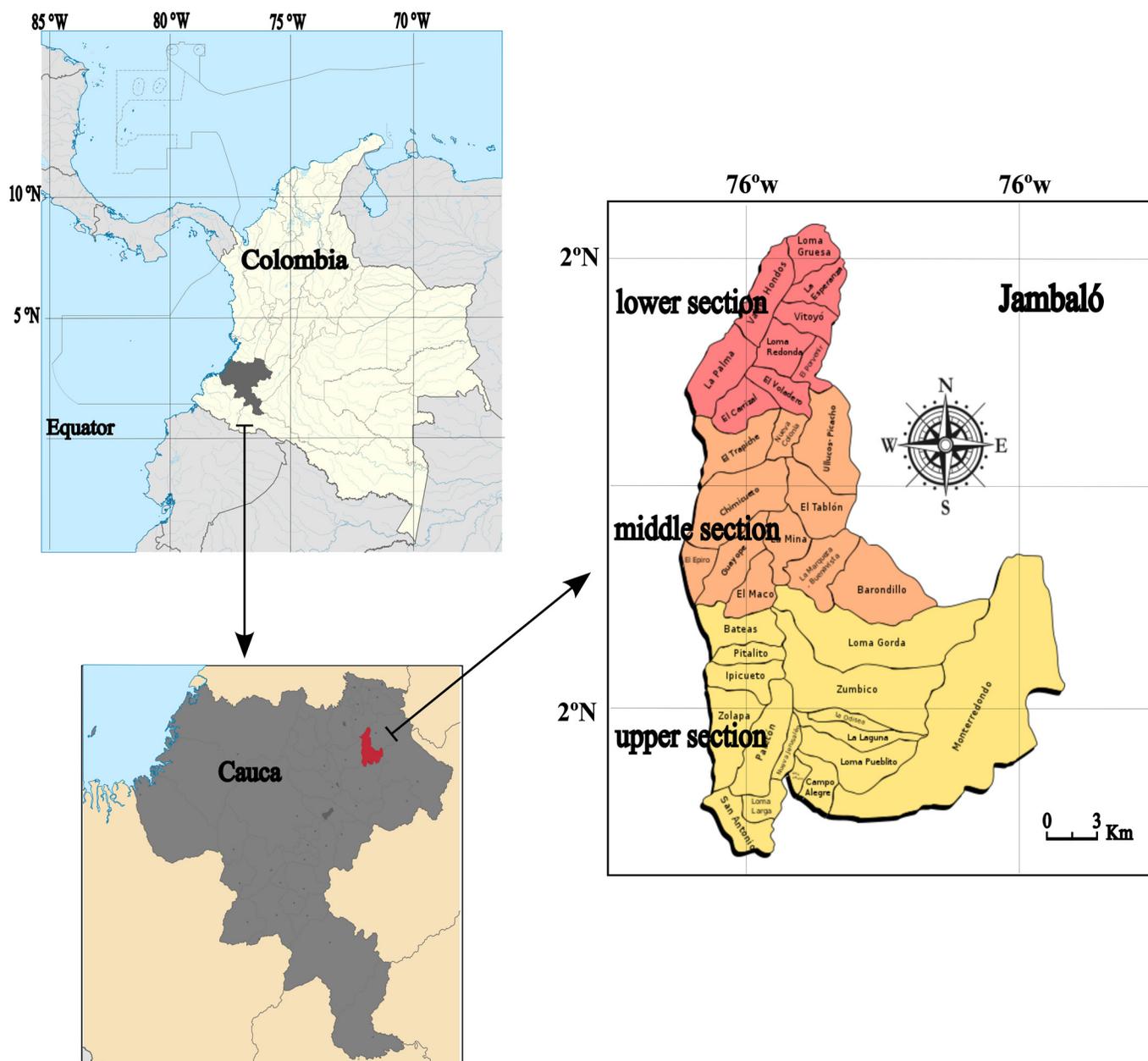


Figure 1: Location of the study area, Jambaló indigenous reserve, Cauca, Colombia, indicating the upper section (south), middle section and lower section (north), with their respective population centers.



1700 to 3800 m, with temperate, cold, and páramo thermal strata (Castaño Canoas, 2017). Jambaló thus easily divides into three zones - upper, middle and lower, each of which houses a diverse variety of medicinal plants (Castaño Canoas, 2017). The area of páramo in the Monterredondo village represents the highest point at 3800 m a.s.l. (upper zone), where it can be as cold as 4 °C. In contrast, the town of Valles Hondos located at 1600 m a.s.l. (lower zone) consistently experiences temperatures above 20 °C (Fig. 1) (Castaño Canoas, 2017).

Plants form the main therapeutic resource of traditional medicine in Jambaló. Their use continues to be deeply rooted in some sectors of the population and supported by housewives, herbalists, traditional doctors, and those regarded as authorities in the spiritual realm (Paz Perafán and Montenegro Paz, 2019).

Ethnobotanical data collection

An ethnobotanical survey was conducted in August 2016. Additionally, from April to July 2023, follow-up trips were conducted with key participants. This was done to continue updating participants and explore whether they could add new data to enrich the study. Prior to ethnobotanical data collection, an overview of the focus and significance of the study was shared with participants before obtaining their consent to participate. After engagement, consent was sought to participate in the study. The criteria for participation in the study was that they should have previous experience in the use of medicinal plants, to ensure that the knowledge was of an active nature. The number of traditional doctors, herbalists, and other participants was not predetermined, as it was the maximum amount of people identified by the community for this study.

All the participants met for the interviews in a community house, and on a subsequent occasion, they were invited to an excursion to the páramo, the lowland regions or the *Tul* to collect the medicinal plants that are traditionally used for healing. The informants were thus interviewed at least twice, in August 2016 and July 2023. Some plants were identified in their own language - *Nasa Yuwe* or *Namtrik*. Four collection excursions of at least two days each were carried out, since the trips to some villages took six to eight hours of walking in the open countryside with two

guides from the area, to obtain the medicinal plants, and at times ask for “spiritual permission” through a ritual in some regions for the collection. Several herbalists were contacted again during the final data collection to confirm the results and interpretations. Furthermore, information on the documented treatment mode of each medicinal plant was compared to the regional pharmacopoeias.

In order to discover if there were any medicinal plants not yet recognized in Colombia for the preparation of phytotherapeutic products, data collected from the informants regarding their knowledge of medicinal plants were compared with data from the technical book, Colombian Vademecum of Medicinal Plants (MPSC, 2008), which provides general knowledge on medicinal plants recognized in Colombia for the preparation of phytotherapeutic products (Ministry of Social Protection Res 2834 of July 30 (MPSC, 2008)). In addition, relevant literature (POWO, 2023) was reviewed in order to identify the geographical distribution of the medicinal plant species found.

Categories of ailments

The usage of medicinal plants was divided into 15 disease categories, based on a study by Kamsani et al. (2020): (1) Circulatory/Vascular, (2) Digestive, (3) Endocrine/Metabolic, (4) Exocrine, (5) Musculo-skeletal, (6) Nervous, (7) Genitourinary, (8) Respiratory, (9) Gynecological, (10) Infection/Infestation, (11) Poisoning, (12) Nutritional, (13) Supernatural, (14) Cancer, and (15) Others. A single mention in a use category was recorded if a plant was used to treat an ailment. If a plant was used to treat more than one ailment, two or more mentions in various categories were recorded. The category “others” refers to ailments that do not belong to any of the abovementioned categories. We added the category “none” to identify plants that are known as medicinal by other cultures but are not recognized as such by the Nasa community of Jambaló. This is important because there may be medicinal plants in the Jambaló region that are used by other cultures, but still unknown to the Nasa ethnic group.

Plant material

After the interviews, excursions were made to the villages and sites for collecting the plants, accompanied by the



informants. Botanical identification of the collected specimens was carried out in the herbarium of the University of Cauca (CAUP), Colombia, where they were deposited for future reference. All species names and classifications were checked online (WFO, 2022). The habitat preference and exotic status were also determined for each species (POWO, 2023). This information is important. Several plant species used by the Nasa ethnic group are native to other regions, where they may have different traditional uses. All plant names and associated information are listed in the Appendix.

Data collection and analysis

Data obtained from the interviews were entered into a Microsoft Excel v. 16.8 file in order to perform statistics aimed at providing an understanding of the healing practices of the traditional doctors, midwives and herbalists of Jambaló. We made use of basic quantification, such as the number of species collected and the number of informants. We employed ethnobotanical indices including use value (UV) and informant consensus factor (ICF). Additional information about the plants was requested, including common names, names in their native language, specific treatment details, the part of the plant used, preferred preparation methods, and how traditional doctors or interested communities can access and learn about this crucial knowledge of medicinal plant use. The percentages of the plant part used, growth habits, and preparation methods were determined.

Use value (UV)

A use value index was applied to examine the collected ethnobotanical data. This established a consensus on the species effective for curing the different diseases and their relative importance. In addition, it facilitated an understanding of the potential utility of each species. The use value (UV) was calculated based on the following formula (Phillips et al., 1994):

$$UV = \sum U/n$$

where U indicates the number of reports mentioned by informants for a given plant taxon and n is the total number of informants that participated in the study. The UV val-

ue ranges from 0 to 1, with 1 being the species with the highest use value, indicating that it is valued and sought-after as highly useful.

Informant consensus factor (ICF)

The ICF highlights the species of particular cultural relevance as well as agreement in their utilization. It helps to recognize diversity among medicinal plants and determine the plant taxa of particular interest. The diseases were grouped into categories to analyze ICF, and more ethno-pharmacologically interesting plant taxa might thus be identified. ICF was calculated with the formula proposed by Heinrich et al. (1998), which is applied to test the hypothesis of knowledge homogeneity, as follows:

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

where Nur is the number of use reports (citations) in each ailment category and Nt is the number of plant taxa employed for particular ailments. The ICF always ranges from 0 to 1. A high range (nearest to 1) means relatively few taxa are employed by a large number of people, while a low range means participants disagree on the taxa employed within a particular category of diseases (Gazzaneo et al., 2005). ICF values are always higher when single or few plant taxa are recorded to be used by a maximum number of informants to cure a particular illness.

Results

Demographic characteristics

Two traditional doctors (*Thë' Wala*) recognized by the community were interviewed, both men, from two different villages (Table 1), as well as 19 herbalists (one midwife and 18 women), 18 farmers (11 men and seven women), nine housewives familiar with the use of medicinal plants and one teacher. All participants were chosen by Jambaló community leaders. Of the 49 people selected by the community for the interview, 31 were men (63.3%) and 18 women (36.7%).

Medicinal plants

A total of 106 medicinal plant taxa belonging to 45 families were documented in this study. The families with the



Table 1: Information of the respondents of the ethnobotanical study carried out among the Nasa ethnic group in Jambaló, Cauca, Colombia.

Characteristic	Number
Traditional doctors (men)	2
Ages	65-72
Villages	2
Herbalists (1 midwife+18 women)	19
Ages	24-65
Villages	10
Farmers (11 men+7 women)	18
Ages	32-77
Villages	8
Housewives	9
Ages	40-69
Villages	3
Teacher (woman)	1
Age	45
Villages	1
Total respondents	49

highest number of species were Asteraceae and Lamiaceae (18 and 9 species each), followed by Verbenaceae (6), Solanaceae (6), Rosaceae (4), Poaceae (4), Crassulaceae (3), Ericaceae (3), Euphorbiaceae (3), Acanthaceae (3), Rutaceae (3), Phytolaccaceae (2), Malvaceae (2), Rubiaceae (2), Amaranthaceae (2), Myrtaceae (2), Boraginaceae (2), Amarillidaceae (2), Clusiaceae (2), Fabaceae (2), and Apiaceae (2) (Appendix).

We identified seven species (6.6%) in the current study that are traditionally utilized by the local population but are not listed in the Colombian Vademecum of Medicinal Plants (MPSC, 2008). These plants are: *Erythroxylum novogranatense* (D. Morris) Hieron., *Espeletia grandiflora* Bonpl. var. *grandiflora*, *Eucalyptus melliodora* A. Cunn. ex Schauer, *Kalanchoe blossfeldiana* Poelln., *Ocotea infrafoveolata* van der Werff, *Pseudelephantopus spiralis* (Less.) Cronquist, and *Salvia amethystina* subsp. *ampelophylla* (Epling) J.R.I. Wood & Harley.

Four of the species used by the Jambaló Nasa community (3.8%) are endemic to Colombia: *Calea sessiliflora* Less., *Monticalia trichopus* (Benth.) C. Jeffrey, of which two

species exist only in the páramo region of the Colombian Andes: *Hypericum goyanesii* Cuatrec. as well as *Espeletia grandiflora* var. *grandiflora* (POWO, 2023).

Part of the plant used, growth habits, and preparation methods

Aerial parts were the most commonly used plant parts (42 species, 44%), followed by leaves (28, 29%), more than one plant part (11, 11%), fruits (six, 6%), the whole plant, modified stems, bark (two, 2% each), and seeds (one, 1%) (Appendix, Fig. 2). Herbs were the most frequently used habit in treatments (56 species, 59%), followed by shrubs (25, 24%), trees (10, 10%), grasses (three, 3%), and subshrubs and climbers (one species each, 1%) (Appendix, Fig. 2).

Infusion (69 species, 73.4%) was the most widely used method of preparation, followed by herbal bath (15, 15.9%), decoction (11, 11.7%), poultice (13, 13.8%), plaster (six, 6.3%), juice (five, 5.3%), steam (two, 2.1%), and raw (8, 8.5%); each plant can have more than one form of use (Appendix, Fig. 3). Plain water was used to boil the medicinal plants into a decoction. In some cases, the target ailment of the same species varied depending on the mode of preparation. For example, *Petiveria alliacea* L. can be prepared in two ways: decoction of leaves is used as a healing agent, while vaporization is used for sinusitis. *Senecio wedglicialis* Cuatrec. is used as a plaster for superficial blows, while in infusion it is used to treat parasites (Appendix).

Ailments and treatments

Most of the medicinal plants were used in the treatment of chronic but non-life-threatening conditions. The traditional knowledge of the community is concerned with each of the groups of diseases applied in this study. A total of 26 species (24.5%) were found to be used for ailments affecting the digestive system. The other commonly treated ailments include the respiratory system (24 species, 22.6%); infections/infestations (21 species, 19.8%), other purposes (19 species, 17.9%); gynecological (12 species, 11.3%); genitourinary systems (9 species, 8.5%); problems with the circulatory or vascular system (9 species, 8.5%); musculo-skeletal (6 species, 5.7%); supernatural purposes (5 species, 4.7%); problems with the endocrine/metabolic system (4 species, 3.8%), nutritional (16 species, 15.1%), exocrine (4 species,



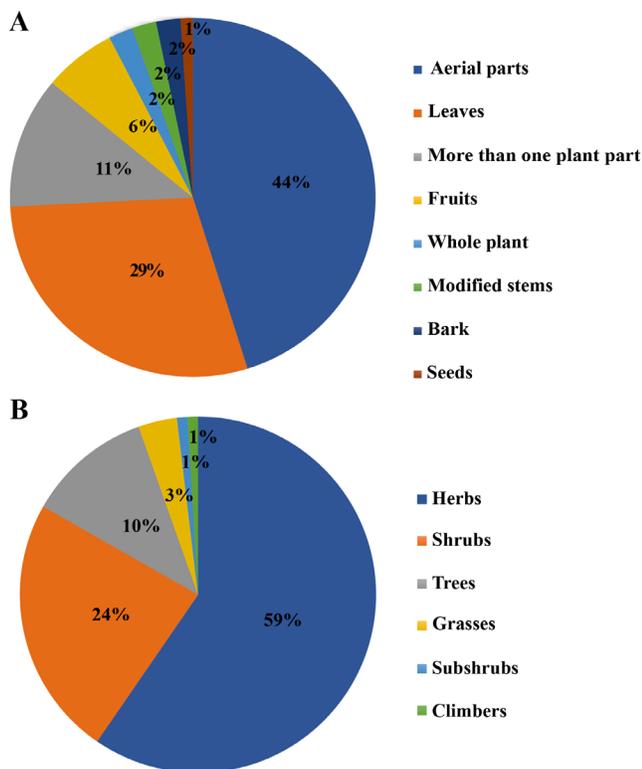


Figure 2: Characteristics of the plants used as herbal medicines by the Nasa ethnic group of Jambaló, Cauca, Colombia. A. plant part used; B. growth habit.

3.8%), nervous system (5 species, 4.7%); and cancer and poisoning (1 species each, 0.9%) (Appendix, Fig. 4). Some diseases of the digestive system include diarrhea, gastritis, and stomach inflammation. In the realm of respiratory conditions, one may encounter cough and flu. In the category of infections/infestations, ailments such as conjunctivitis and tonsil infection are presented (Appendix).

Twelve species (9.4%) have been recognized as medicinal plants in the literature, but the Nasa community does not know them as such, or they have been given other uses either as food or for other purposes. These plants are: *Bejaria resinosa* L.f. and *Cynoglossum amabile* Stapf & J.R. Drumm., used by other cultures in the treatment of respiratory illnesses (García Barriga, 1992; Quattrocchi, 2012), *Centratherum punctatum* Cass. and *Nicandra physalodes* (L.) Gaertn. are used against cancer and infection in other locations (Pawar and Arumugam, 2011; Shankaran et al., 2017; Zhang et al., 2019), *Garcinia madruno* (Kunth) Hammel is used against infection (Suffredini et al., 2006), *Hypericum silenoides* Juss. and *Papaver somniferum* L. against pain (Muhammad et al., 2021; Sanchez Vega, 2014) and *Phytolacca bogotensis* Kunth for circulatory treatments

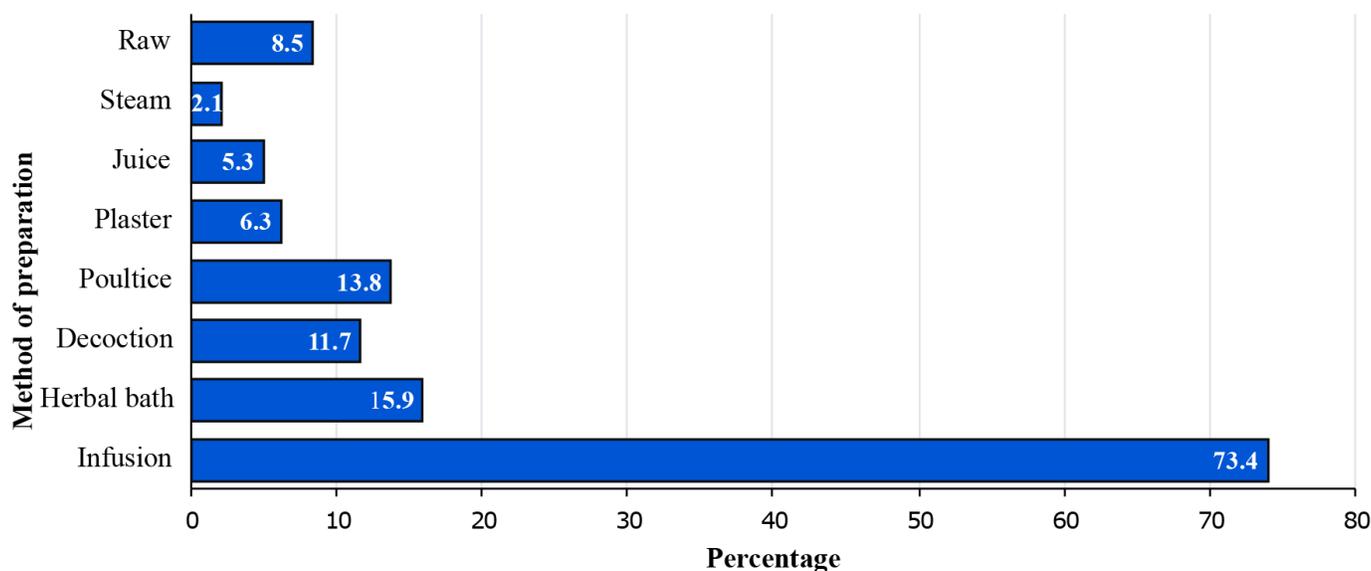


Figure 3: Method of preparation of medicinal plants used by the Nasa ethnic group of Jambaló, Cauca, Colombia.



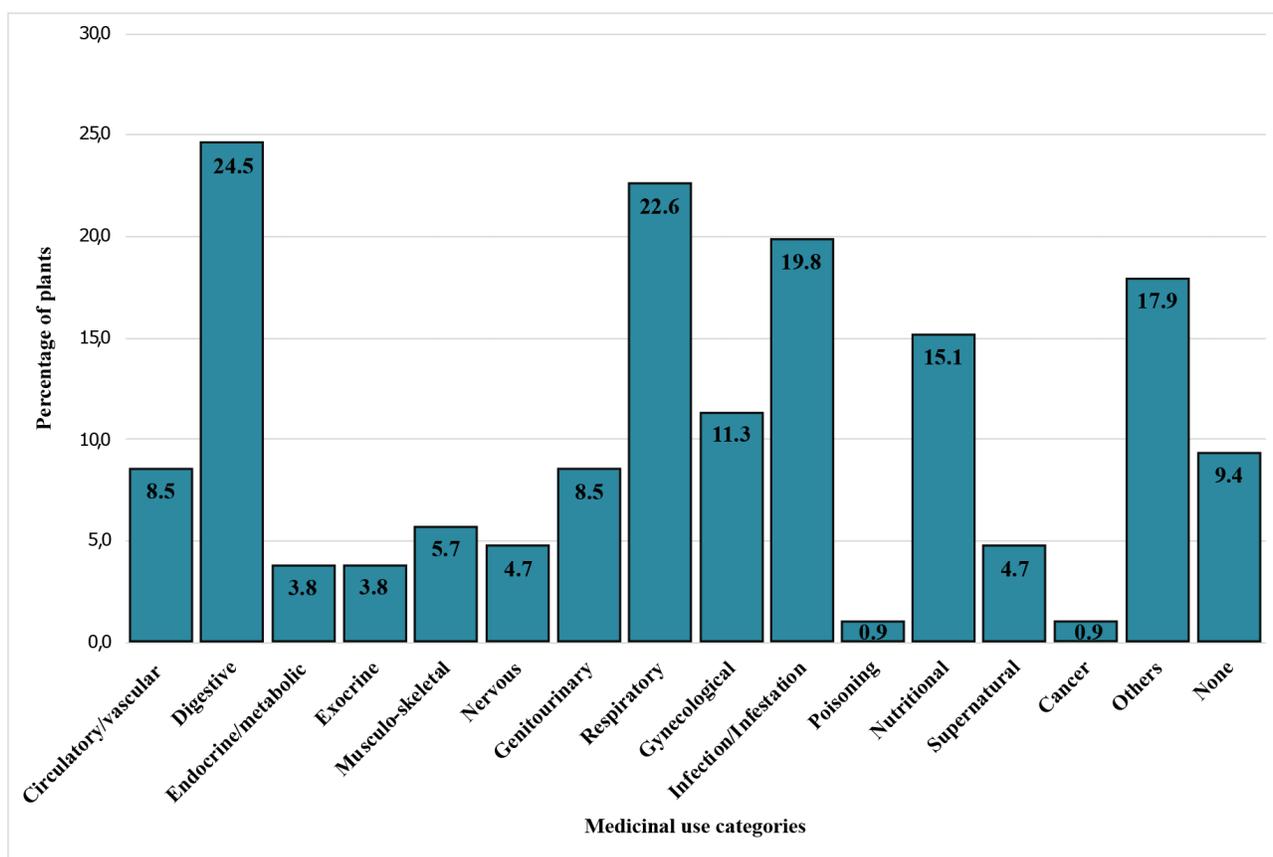


Figure 4: Percentage of medicinal plants used as phytotherapeutic resources by the Nasa ethnic group in Jambaló, Cauca, Colombia, according to the use categories of Kamsani et al. (2020). The classification of “none” refers to the percentage of plants that are not recognized as medicinal by the Nasa ethnic group but that are reported in the literature as such.

(MPSC, 2008). *Prunus persica* (L.) Batsch, peach, for rheumatism, has antibacterial and antioxidant properties (Belhadj et al., 2016); *Gynerium sagittatum* (Aubl.) P. Beauv, known as “caña brava”, is used by this Nasa community to make headwear, but in the Peruvian Amazon the fresh exudate of the stem is drunk in the morning against viral hepatitis diseases (Roumy et al., 2020). *Vaccinium meridionale* Sw., a plant traditionally used by the Nasa to make wine, is described as an antioxidant and with anti-aging activity in the literature (Bravo et al., 2016). *Xanthosoma sagittifolium* (L.) Schott, known as “Majaja” in Jambaló, is edible. This plant is reported to have anti-inflammatory properties and magical-religious and ritual beliefs (Quattrocchi, 2012) (Appendix).

Interestingly, the Nasa ethnic group utilizes *Disterigma empetrifolium* (Kunth) and *Cinchona pitayensis* (Wedd.) Wedd for diverse spiritual rituals and *Erythroxylum novogranatense* is one of the medicinal plants more com-

monly used as a digestive, and as well as an energizer in the harsh tasks of the field.

Use value (UV)

In our study, UV varied from 0.20 to 0.98 (Appendix, Table 2). Maximum UV (0.98) was recorded for *Erythroxylum novogranatense*, *Lippia alba* (Mill.) N.E.Br. ex Britton & P. Wilson, *Aloe vera* (L.) Burm.f., *Apium graveolens* L., *Calendula officinalis* L., *Dysphania ambrosioides* (L.) Mosyakin & Clemants, *Gentiana sedifolia* Kunth, *Matricaria* sp., *Mentha spicata* L., and *Psidium guineense* Sw., while the lowest values of UV were recorded for *Rhaphirolepis bibas* (Lour.) Galasso & Banfi (0.20) and *Chromolaena corymbosa* (Aubl.) R.M. King & H. Rob. (0.22). Some of the other plants with high UV values are *Ruta graveolens* L. (0.90), *Aloysia citriodora* Palau, *Artemisia absinthium* L., and *Austroeupeatorium inulifolium* (Kunth) R.M. King & H. Rob. (0.86 each), *Lepechinia conferta* (Benth.) Epling, *Lippia*



Table 2: Medicinal plants with the highest use value (UV) and most common use among the Nasa ethnic group in the Jambaló region of Colombia. The level of use (LU) is outlined following Kamsani et al. (2020).

Species	Family	Local name	Ailment	Mode of preparation	LU	UV
<i>Aloe vera</i> (L.) Burm.f.	Xanthorrhoeaceae	Sábila	Cough, fever, headache, blemishes on the face, aging, gastritis, bumps, burns, colon	Crystal juice, poultice, frozen suppository	2, 8, 15	0.98
<i>Aloysia citriodora</i> Palau	Verbenaceae	Cedrón	Inflammation of the stomach, stomach pain, nerve baths in children	Infusion, herbal bath	2, 6	0.86
<i>Apium graveolens</i> L.	Apiaceae	Apio	Stomach pain, diarrhea, vomiting, superficial wounds, antiseptic, anti-inflammatory	Infusion	2, 10	0.98
<i>Artemisia absinthium</i> L.	Asteraceae	Ajenjo de páramo	Diarrhea, stomachache, liver cleanser, fever, headache	Plaster	2, 4	0.86
<i>Austroeupatorium inulaefolium</i> (Kunth) R.M. King y H. Rob.	Asteraceae	Salvia blanca	Stomach pain, vomiting in pregnant women, itchy skin, diarrhea, infection in wounds, nerves	Infusion	2, 6, 10	0.86
<i>Calendula officinalis</i> L.	Asteraceae	Caléndula	Inflammation, pain, to drain, scars, bruises, colic and wash wounds	Infusion, poultice, herbal bath	1, 2, 10	0.98
<i>Coffea arabica</i> L.	Rubiaceae	Café caturro	Headache	Infusion	12, 15	0.80
<i>Croton hibiscifolius</i> Kunth ex Spreng	Euphorbiaceae	Sangregado o Drago	Cleansing the intestine, gastritis	Infusion	2	0.80
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amaranthaceae	Paico	Parasites, diarrhea, wounds, stomachache	Infusion, poultice	2, 10	0.98
<i>Erythroxylum novogranatense</i> (D. Morris) Hieron.	Erythroxylaceae	Coca	Stomach pain, stomach fullness, headache, toothache, to reduce inflammation, parasites, pain	Infusion	2, 5, 15	0.98
<i>Gentiana sedifolia</i> Kunth	Gentianaceae	Hierba alegre	Headache	Infusion	15	0.98
<i>Hypericum goyanesii</i> Cuatrec.	Hypericaceae	Pino de páramo	Pain, prostate	Infusion	5, 7	0.80
<i>Lepechinia conferta</i> (Benth.) Epling	Lamiaceae	Salvia negra o morada	Prostate	Infusion	7	0.82
<i>Lippia alba</i> (Mill.) N.E.Br. Ex Britton & P.Wilson	Verbenaceae	Pronto alivio	Stomach pain, flu, body aches, chest pain, high blood pressure, diarrhea	Infusion	1, 2, 5, 8	0.98
<i>Lippia dulcis</i> Trevir.	Verbenaceae	Orosul	Cough, fever	Infusion	8	0.82
<i>Matricaria</i> L.	Asteraceae	Manzanilla pequeña	Stomachache, flu, fever, conjunctivitis, colic and diarrhea	Infusion	2, 8, 10	0.98



Table 2: Continuation.

Species	Family	Local name	Ailment	Mode of preparation	LU	UV
<i>Melissa officinalis</i> L.	Lamiaceae	Toronjil	Stomach upset, discouragement, nerves, fever, fright	Infusion	2, 6	0.80
<i>Mentha spicata</i> L.	Lamiaceae	Hierba buena o Yerbabuena	Stomachache	Infusion	2	0.98
<i>Petiveria alliacea</i> L.	Phytolaccaceae	Anamú	Heal wounds, sinusitis, kidneys	Decoction, steam	7, 8, 10	0.80
<i>Plantago major</i> L.	Plantaginaceae	Llantén	Urinary infection	Infusion	7	0.82
<i>Psidium guineense</i> Sw.	Myrtaceae	Guayabilla	Diarrhea	Raw, infusion, plaster	2, 12	0.98
<i>Salvia rosmarinus</i> Spenn.	Lamiaceae	Romero	Flu, fever	Infusion	8, 15	0.80
<i>Ruta graveolens</i> L.	Rutaceae	Ruda	Pain and menstrual cramps, colic or cold in pregnancy	Infusion, herbal bath	9	0.90
<i>Solanum betaceum</i> Cav.	Solanaceae	Tomate de árbol	High cholesterol, breathing problems, tonsil infection, for mumps	Juice and raw	3, 8, 10, 12	0.80
<i>Solanum lycopersicum</i> L.	Solanaceae	Tomate de mesa	Prostate, infection	Infusion	4, 10, 12	0.80

dulcis Trevir. and *Plantago major* L. (0.82). It is interesting to find that native plants in Colombia's páramo region, such as *Hypericum goyanesii*, have a high use value (0.80).

Informant consensus factor (ICF) and disease category

The values of the consensus factor of the informants for medicinal plants was between 0.96 and 1.00. The highest ICF value was recorded for cancer and poisoning (1.0 each). These two disease categories each had one taxon and several usage reports, thus exhibiting high degrees of consensus. Following these, the digestive system, the exocrine, musculo-skeletal, neurological, and circulatory/vascular diseases had the highest values (0.98 each), while the lowest ICF values were recorded for nutritional uses (0.96) (Table 3).

The highest number of plant taxa and use reports for conditions were the digestive group (1012 use reports and

26 plant species), followed by the respiratory group (814 use reports and 24 plant species) and the infection/infestation group (746 use reports and 21 plant species) (Appendix, Table 3). These three pathological groups had the highest number of plant taxa and use reports and the ICF values are also high, probably because the medicinal plants used by the Nasa ethnic group are well-recognized for the purposes mentioned.

Stomachache, stomach pain or stomach upset were the most common conditions (659 use reports and 17 plant species), followed by cough or dry cough (420 use reports and 14 plant species), flu (425 use reports and 12 plant species) and diarrhea (424 use reports and 13 plant species) (Appendix). These four ailments were the most common, with the largest number of plants identified. We believe that the Nasa ethnic group usually treated these conditions using herbal medicines according to the effectiveness and accessibility of the plants.



Table 3: Recorded informant consensus factor for ethnomedicinal diseases among the Nasa ethnic group in Jambaló, Cauca, Colombia.

Number	Disease categories	No. of plant taxa employed (nt)	Number of use reports (nur)	Informant consensus factor (ICF)
1	Circulatory/ Vascular	9	321	0.98
2	Digestive	26	1012	0.98
3	Endocrine/ Metabolic	4	109	0.97
4	Exocrine	4	137	0.98
5	Musculo-skeletal	6	203	0.98
6	Neurological	5	192	0.98
7	Genitourinary	9	315	0.97
8	Respiratory	24	814	0.97
9	Gynecological	12	405	0.97
10	Infection/ Infestation	21	746	0.97
11	Poisoning	1	37	1.00
12	Nutritional	16	377	0.96
13	Supernatural	5	135	0.97
14	Cancer	1	19	1.00
15	Others	19	656	0.97

Treatments involving a combination of plants

We recorded seven combinations used in healing. In one case, *Costus laevis* Ruiz & Pav. was blended with four other species: *Citrus × aurantium* L., *Cymbopogon citratus* (DC.) Stapf, *Lippia dulcis*, and *Lippia alba* to treat the flu. Likewise, *Citrus limon* (L.) Osbeck was mixed with *Pentacalia trichopus* (Benth.) Cuatrec., *Eucalyptus melliodora* and *Gentiana sedifolia* to cure the same illness. *Citrus × aurantium* L. and *Mentha* sp. are used to treat coughs, while *Erythroxylum novogranatense* is combined with *Lippia dulcis* for treating the cough and fever, and *Viola odorata* L. is blended with *Lippia dulcis* and *Sambucus peruviana* Kunth for curing dry cough. *Dysphania ambrosioides* mixed with *Austroeupatorium inulaefolium* and *Calea sessiliflora* to treat intestinal parasites, and *Lippia alba* is combined with *Mentha spicata* for digestive treatments (Table 4). To improve the taste of the blend, the community frequently incorporates honey with the plants.

Transmission of traditional knowledge to healing practices

Analyses of the influence of social factors on medicinal plant use indicated that male, adult, experienced respondents were the most widely represented among phytotherapists. The *Thë' Wala* of the Jambaló Nasa ethnic group learn healing techniques from their grandparents, parents, relatives, or traditional doctor friends through oral tradition and constant interaction. Such student apprentices should have the motivation and desire to gain knowledge about the use of medicinal plants and learn the spiritual work of the traditional doctor while collecting the plants and healing the patients. Midwives and herbalists get their knowledge from traditional doctors, family members, or acquaintances. Although they lack the spiritual understanding to treat illnesses, their deep understanding of the use and preparation of medicinal herbs makes them crucial figures in community health care.

Discussion

Medicinal plants

Taxa belonging to the Asteraceae and Lamiaceae families were the most widely used for medical treatments in our study area. According to the non-random medicinal plant selection theory, certain medicinal plant families are selectively targeted in traditional pharmacopoeias due to the presence of secondary metabolites. Most studies investigating non-random medicinal plant selection theory report Asteraceae as the most popular over-utilized plant family (Robles Arias et al., 2020; Zaman et al., 2021). Asteraceae is also widely represented in other local pharmacopoeias (Mendoza Hernandez et al., 2021; Rodríguez et al., 2018). The leaves of this family are known to be rich in components of medicinal value such as inulin, a polysaccharide with strong prebiotic properties; they also possess arctiin, a ligand with antioxidant, antiproliferative, and desmutagenic activity (Rolnik and Olas, 2021).

In the present study, Asteraceae taxa (18 species) were preferred for their aerial parts. Within this family, three species: *Calea sessiliflora*, *Espeletia grandiflora* var. *grandiflora* and *Monticalia trichopus* are native to Colombia (POWO, 2023). This information is crucial since it is necessary to conduct population studies on native or endemic species in Colombia in order to understand their genetic diversity and create conservation projects for these spe-



Table 4: Association of medicinal plants in medicinal mixtures among the Nasa ethnic group in Jambaló, Cauca, Colombia.

Principal plant	Mixed with other plants	Treatment
<i>Costus laevis</i> Ruiz & Pav.	<i>Citrus × aurantium</i> L.	flu
	<i>Cymbopogon citratus</i> (DC.) Stapf	
	<i>Lippia dulcis</i> Trevir.	
	<i>Lippia alba</i> (Mill.) N.E.Br.	
<i>Citrus limon</i> (L.) Osbeck	<i>Pentacalia trichopus</i> (Benth.) Cuatrec.	flu
	<i>Eucalyptus melliodora</i> A.Cunn. ex Schauer	
	<i>Gentiana sedifolia</i> Kunth	
<i>Citrus × aurantium</i> L.	<i>Mentha</i> L.	Cough
<i>Erythroxylum novogranatense</i> (D. Morris) Hieron.	<i>Lippia dulcis</i> Trevir.	Cough, fever
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	<i>Austroepatorium inulaefolium</i> (Kunth) R.M. King and H. Rob.	Parasites
	<i>Calea sessiliflora</i> Less.	
<i>Lippia alba</i> (Mill.) N.E.Br. Ex Britton & P.Wilson	<i>Mentha spicata</i> L.	Digestive
<i>Viola odorata</i> L.	<i>Lippia dulcis</i> Trevir.	Dry cough
	<i>Sambucus peruviana</i> Kunth	

cies. The Colombian Vademecum of Medicinal Plants does not include an additional species frequently mentioned by the Nasa etnia and belonging to the Asteraceae family: *Pseudelephantopus spiralis*, which has historically been used by the people of Jambaló to treat menstrual colic (Paz Perafán and Montenegro Paz, 2019).

Interestingly, Lamiaceae, a family that frequently punches above its weight in traditional pharmacopeias for its important medicinal value such as anti-cancer, anti-inflammation, antioxidative and anti-virus effects as well as hepatoprotective and neuroprotective properties (Shen et al., 2021), also takes center stage in this study with nine species and several uses, including for the digestive system, respiratory system, and infections/infestations. For example, *Salvia amethystina* subsp. *ampelophylla* is used by the Nasa ethnic group as a disinfectant to wash wounds. *Diplostegium glandulosum* Hieron. has traditionally been used for treating respiratory ailments, and *Lepechinia conferta*, a plant native to Colombia and Venezuela, is used by the Nasa ethnic group to cure genitourinary ailments.

Part of the plant used, growth habits, and preparation methods

In this study, eight parts of plants were recorded, of which the aerial parts and the leaves were the most frequently cited. Other ethnobotanical studies in Colombia (Mendoza Hernandez et al., 2021) and in most of the tribal communities around the world (Monigatti et al., 2013; Silambarasan and Ayyanar, 2015; Tahir et al., 2021) similarly make use of leaves for the preparation of herbal medicines due to their availability throughout the year and the ease with which they can be collected from the forests. Furthermore, harvesting leaves has less impact on the persistence of plant species, whereas harvesting roots adversely affects plant survival.

Herbs were the most commonly used plant habit in treatments. This might be due to their easy availability to local people and their abundance. Likewise, other studies reported the dominance of herbs for medicine (Hu et al., 2020; Lu et al., 2022; Silambarasan and Ayyanar, 2015). According to this research, the Nasa ethnic group studied



prepares the therapeutic plants in eight different ways. The most frequently cited mode of preparation was infusion (69 species). This result is consistent with other studies in Colombia and South America (Di Stasi et al., 2002; Mendoza Hernandez et al., 2021).

Ailments, treatments and use value (UV)

Digestive disorders were treated by the highest number of species (24.5%), followed by respiratory diseases (22.6%). This distribution of applications agrees with other studies in Brazil (Bolson et al., 2015; De Santana et al., 2016). It is important to note that different ethnic groups have employed medicinal plants more regularly to treat digestive problems in various regions of the world, as recorded in the Andean region of Perú (Monigatti et al., 2013) and in even farther regions such as Guanxi, China (Lu et al., 2022) and Nepal (Rokaya et al., 2010). Likewise, the highest use value (UV) was recorded for 10 species which were directly related to the digestive system. These findings are important since it seems that digestive disorders are one of the most prevalent illnesses in the study population.

There is a great wealth of knowledge about the usefulness and use of medicinal plants in the Nasa ethnic group of the Colombian Andes (Calderón Farfán et al., 2021; Vasquez et al., 2012). However, of the 106 plant species presented in this study, 12 have been recorded in scientific literature for their medicinal effectiveness in treating bacterial infections, anti-aging, anti-cancer, and addressing liver diseases, among other applications (Suffredini et al., 2006; Quattrocchi, 2012; Caetano et al., 2015; Belhadj et al., 2016; Bravo et al., 2016; Zhang et al., 2019; Roumy et al., 2020; Muhammad et al., 2021). However, even though these plants have been recognized in the Jambaló region, the Nasa ethnic group does not consider them as medicinal plants. This could possibly be due to the successive loss of ancestral knowledge or a lack of awareness of the people regarding their use as medicinal plants.

In contrast, this Nasa ethnic group traditionally uses four species native to Colombia as medicines: 1. *Calea sessiliflora* (chicharrón), a treatment for liver issues; 2. The tree *Ocotea infrafoveolata* is used to treat pregnancy-related and intestinal disorders; 3. *Monticalia trichopus* (botoncillo grande), which is employed as an anti-inflammatory

plant; 4. *Hypericum goyanesii* (pino de páramo), which is utilized to treat prostate disease. These plants have not been mentioned in the literature as medicinal plants and represent a significant contribution of the knowledge of the Nasa ethnic group studied here to the field of ethnobotany.

Moreover, two little-studied species are of particular interest. *Salvia amethystina* subsp. *ampelophylla* (hoja de paño), native to Colombia and Venezuela, is traditionally used by the Nasa ethnic group to wash wounds. It is considered vulnerable (VU) in the Red Book of Plants of Colombia (Fernández-Alonso and Rivera-Díaz, 2006). *Espeletia grandiflora*, known as “Frailejón”, is used by this ethnic group to calm ailments during pregnancy. These species might constitute a valuable source for future studies that look for novel secondary metabolites for treating different diseases.

The Nasa people and other Colombian communities agree on the use value of several medicinal plants. For instance, the indigenous Pijao people describe the utilization of *Aloe vera* to cure skin and digestive issues and report use levels that are similar to our findings (UV=0.96 and 0.98, respectively) (Mendoza Hernandez et al., 2021), while plants such as *Mentha spicata*, employed for treating digestive issues, had a high UV in our study (UV=0.98). The same practice is seen in other remote cultures like Nepal, but with a lower UV (UV=0.68) (Rokaya et al., 2010).

These UV could be relative, meaning that if there are many medicinal plants in a community that share the same properties for a certain disease, this figure of a particular species may be lower as a result of the abundance of available species. Possibly there is a similar geographic distribution of medicinal plants identified in the Jambaló region. The ancient knowledge of traditional doctors and the experience of local people with their utilization as medicine may contribute to the maximum UV values of these plants.

In light of this, medicinal species were found in the Nasa community with very low use values, an example being *Rhaphiolepis bibas* (UV=0.20). This species is used by the *Thë' Wala* to treat urinary tract infections, and studies have reported that the species has diuretic and antitumor activity, as well as hypoglycemic and antitussive properties (Liu et al., 2016). A further illustration is *Chromolaena*



corymbosa (UV=0.22), which is utilized by the Nasa community as an infusion to soothe coughs and has been mentioned in the literature to have anti-inflammatory and antibacterial properties (Agarwal et al., 2022). These findings could demonstrate the fact that, while the use value of some medicinal plants may be low, community knowledge of their uses may be critical for future research on the development of new medicines in understudied species.

Informant consensus factor (ICF)

The extremely high (0.96-1.00) consensus factor of the informants for medicinal plants affirms the reliability of the data. These findings could be the result of the interviewees being chosen by the community for their leadership and expertise in the usage of therapeutic herbs. The higher values of the informant consensus factor for ailments such as cancer and poisoning may be indicative of the presence of a similar knowledge in the Nasa community about medicinal plants for this use. According to Heinrich et al. (1998), a high ICF value is vital for discovering species with higher probability of containing interesting bioactive components. In our study, the use of *Cannabis sativa* L. and *Nicotiana tabacum* L. is reported against cancer conditions and poisoning, respectively. These results agreed with what was found in the literature review for these two species (Emhemmed et al., 2022; O'Brien, 2022; Schep et al., 2009).

Other high ICF values were found for gastrointestinal illnesses, for which we found the most plants (26 species). These findings are the outcome of the numerous reports of the usage of plant species such as *Lippia alba* and *Mentha spicata*, used to cure diarrhea and stomach pain. These species are reported with the same applications in previous studies (Mahboubi, 2021; Oliveira et al., 2006), probably due to the presence of the same chemical compounds, such as carvone and limonene (Blank et al., 2015; Mahboubi, 2021). Other plants used in treating these conditions include *Austroeupatorium inulaefolium* (salvia blanca), *Dysphania ambrosioides* (paico), *Erythroxylum novogranatense* (coca), and little-studied species such as *Ocotea infrafoveolata* (canela de páramo).

Regarding the group of the respiratory system, the Nasa community uses 24 species, among them *Viola*

odorata and *Aloe vera*, to soothe coughs. Previous studies have also reported that these species have antitussive properties (Mahboubi and Taghizadeh Kashani, 2018; Šutovská, 2010). Other species used against these ailments are *Lantana camara* L., *Rubus floribundus* Kunth var. *floribundus*, *Lippia dulcis* and *Sambucus peruviana*, to soothe coughs and flu. Other cultures in the world have also reported the highest ICF values for diseases of the digestive and respiratory systems (Guo et al., 2022; Lu et al., 2022), indicating the prevalence of this type of ailment in their territories.

A high informant consensus factor is also an important argument when it comes to deciding which species to conserve in an environment that is under pressure of having medicinal plant species gradually disappearing (Tahir et al., 2021). In our survey, we report four species of medicinal plants native to Colombia, two of which exist in the páramo region of the Andes: *Hypericum goyanesii* and *Espeletia grandiflora* var. *grandiflora* (POWO, 2023). There is not much research on these species, but due to their medicinal importance, ongoing medical research, phytochemical analysis, and conservation efforts are crucial (Crockett et al., 2018).

Treatments involving a combination of plants

The concept of combining medicinal plants for the treatment or cure of various diseases has been recognized in traditional medicine for hundreds of years (Caesar and Cech, 2019; Che et al., 2013) and continues in many American cultures. In the community of Jambaló, the interview participants believe that combining different plants can improve efficacy and reduce adverse effects. We found seven important combinations that help treat diseases related to the respiratory system and the digestive system.

Such herb-herb combinations have been studied in other medicinal species, observing synergistic mechanisms between the chemical components of plants (Elford et al., 1987; Rath et al., 2004; Zhou et al., 2016). However, it can also produce adverse effects or may be toxic, especially when the herbs are incompatible (Delerue et al., 2021; Suberu et al., 2013; Zhou et al., 2016). Thus, a mixture of multiple herbs could either provide a synergistic effect or an antagonistic one. Traditional knowledge to determine the



correct combination of medicinal plants and the appropriate dose will be a factor decisive to whether the combination is beneficial or detrimental to the patient.

Some of the medicinal plants used by these remote communities in Colombia are native to distant places, such as *Apium graveolens*, whose range is from Macronesia to Northern Africa, Europe to West Himalaya; *Calendula officinalis*, native to Spain; and *Mentha spicata*, native to Europe. Similarly, some species are native to the Americas, such as *Chenopodium ambrosioides* L., *Lippia alba*, and *Erythroxylum novogranatense*, while other species, such as *Hypericum goyanesii*, are native plants of Colombia with a distribution in the highland regions (POWO, 2023), important for their conservation.

Conclusions

This is the first ethnobotanical study to document medicinal knowledge in the Jambaló Nasa ethnic group. We categorize medicinal plant taxa, highlight the richness of medicinal plant species, and record the ethnobotanical knowledge of the Jambaló people. A total of 106 species belonging to 45 families were recorded, of which herbal medicine plants comprised the vast majority. The ethnobotanical applications were given of four newly recorded plant species. The study also documented the preparation methods and applications of these medicinal plants and revealed the current understanding and application of the ethnobotanical knowledge of the residents.

The findings also indicated that the knowledge of the medicinal plants of this Nasa ethnic group is typical of traditional doctors who have spiritual knowledge, as well as health professionals and people interested in the subject. Furthermore, traditional medicinal plants that have been used by locals for generations to treat various ailments could provide a rich source of data for future pharmacological and phytochemical research.

The traditional medicinal knowledge is the result of the experience gained and accumulated over a long time and through the communication of many generations. The decrease in the populations of wild plants due to the extension of the agricultural frontier, the monocultures of other different species and the departure of young people towards the cities can greatly diminish the cultural tradition

of these regions and therefore the loss of ancient knowledge. The results of this research encourage us to continue registering medicinal species and their uses for the conservation of all this knowledge that can help to preserve not only the genetic resource but also the possible search for new drugs due to the extraordinary and structurally diverse bioactive compounds present in the medicinal plants.

Author contributions

GMPP and GMP designed the research, conducted the fieldwork, and participated in the preparation of interviews. GMP contacted the Jambaló communities. GMPP recorded and analyzed the data, reviewed the nomenclature and was responsible for structuring the manuscript.

Funding

This research was supported by the Universidad del Cauca VRI-ID5894 and the Federación Nacional de Cafeteros, Comité departamental Cauca, Colombia.

Acknowledgements

We are grateful to the Jambaló community members for agreeing to collaborate with us. While we have made efforts to maintain their anonymity for ethical reasons, it should be noted that they are the custodians of the traditional knowledge provided in this article and are to be identified as partners for Intellectual Property Rights and any benefit-sharing purposes. We are grateful to Andres Felipe Murcia Gomez and Yordi Werley Polindara, for their assistance in collecting plant material in the field, as well as the Universidad del Cauca Herbarium (CAUP) for their assistance in plant characterization.

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Appendix: Plants with medicinal properties employed by the Nasa ethnic community living in the Jambaló region, Cauca, Colombia. Species not included in the Colombian Vademecum of Medicinal Plants (MPSC, 2008) are indicated with the symbol “+” at the beginning of each taxon. LN/NY: Local name/Nasa Yuwe name (the names of 57 species in Nasa-Yuwe are indicated); Nr: Not reported; H: Habit; of the species: Climber (Cl); Grasses (G); Herb (H); Shrub (Sh); Subshrub (sSh); Tree (T). LU= Level of use according to Kamsani et al. (2020): (1) Circulatory/Vascular, (2) Digestive, (3) Endocrine/Metabolic, (4) Exocrine, (5) Musculo-skeletal, (6) Nervous, (7) Genitourinary, (8) Respiratory, (9) Gynecological, (10) Infection/Infestation, (11) Poisoning, (12) Nutritional, (13) Supernatural, (14) Cancer, and (15) Others; M/T: Medicinal/traditional uses: If the “/” symbol is not shown, it indicates that both medicinal and traditional uses are identical; Mode of preparation (MP): Crystal juice (C); Decoction (D); Frozen suppository (F); Herbal bath (Hb); Infusion (I); Juice (J); None (No); Plaster (Pl); Poultice (P); Raw (R); Steam (S); Part of the plant used (P): Aerial part (Ap); Bark (B); Fruit (Fr); Leaves (L); Modified stems (Ms); More than one plant part (*); Seeds (Sd); Whole plant (W); N: Number of medicinal reports; UV: Use value; CAUP: Herbarium University of Cauca (CAUP) voucher number.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
MONILOPHYTA										
EQUISETACEAE										
<i>Equisetum bogotense</i> Kunth.	Cola de caballo/ Nr	H	7, 15	Chest pain, cystitis	I	Ap	Tropical & S South America	38	0.78	53763
MAGNOLIIDS										
CHLORANTHACEAE										
<i>Hedyosmum cumbalense</i> H. Karst	Granizo/kwatub	T	15	Headache	I	L	Colombia, Ecuador, Peru	28	0.57	36920
LAURACEAE										
+ <i>Ocotea infrafoveolata</i> van der Werff	Canela de páramo/Nr	T	2, 9	Gastritis, stomach pain due to childbirth and to control menstruation	I	B	Colombia, Ecuador and Peru	30	0.61	35568
PIPERACEAE										
<i>Peperomia</i> sp.	Siempre viva dulce/ sxunu'sxa	H	15	Internal fever/ Identical	D	Ap	Tropics & subtropics	35	0.71	44575
MONOCOTS										
AMARYLLIDACEAE										
<i>Allium fistulosum</i> L.	Cebolla/spulla	H	2	Heartburn	I	*	North-Central China, South- Central China	23	0.47	53747
<i>Allium sativum</i> L.	Ajo macho, ajo pequeño/ akhus piçthe	H	2, 8, 10	Diarrhea, cough, premature ejaculation, purgative, skin fungus	D, P	Ms	Iran, Kazakhstan, Kirgizstan, Tadzhikistan, Turkmenistan, Uzbekistan	13	0.27	44548
ARACEAE										
<i>Xanthosoma sagittifolium</i> (L.) Schott	Majaja, rascadera, bore/Nr	H	12	No/Edible	No	*	Costa Rica to S tropical America.	0	0.00	40113



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
ASPARGACEAE										
<i>Cordyline fruticosa</i> (L.) A. Chev.	No descrito/Nr	Sh	1	Heart	I, P	Ap	Tropical & subtropical Asia to N Australia	25	0.51	53748
CYPERACEAE										
<i>Cyperus articulatus</i> L.	Chandur/ dacxa'k	H	9	Baths in pregnant diet	Hb	*	Tropics & subtropics	28	0.57	44573
MUSACEAE										
<i>Musa acuminata</i> Colla	Guineo/Nr	H	2, 10, 12	Spider bites, malaria, gastritis	P, J, D	Ap	S Asia	38	0.78	53762
POACEAE										
<i>Cymbopogon citratus</i> (DC.) Stapf	Limoncillo/ nxusa ta'sxkwe	G	2, 6, 8, 10	Cough, flu, fever, common cold, diarrhea, nerves, parasites, stomach pain	I	Al	India, Sri Lanka	35	0.71	53759
<i>Cymbopogon nardus</i> (L.) Rendle	Citronela/Nr	G	2	Cold, stomachache	I	L	South Sudan to S Africa and Indo-China	37	0.76	53760
<i>Gynerium sagittatum</i> (Aubl.) P.Beauv.	Cañabrava/Nr	G	No	No/Weave hats, to place on the roofs	No	Ap	Mexico to tropical America	0	0.00	53758
<i>Zea mays</i> L.	Choclo, maíz/ çut	G	7, 12	Kidneys, cystitis	I	Fr	Central & SW Mexico to W Guatemala	34	0.69	53761
XANTHORRHOACEAE										
<i>Aloe vera</i> (L.) Burm.f.	Sábila/Nr	Sh	2, 8, 15	Cough, fever, headache, blemishes on the face, aging, gastritis, bumps, burns, colon	C, P, F	L	Oman	48	0.98	44549
ZINGIBERACEAE										
<i>Costus laevis</i> Ruiz & Pav.	Cañagre/ Nr	H	8	Flu	I	L	Mexico (Oaxaca, Chiapas) to Bolivia	25	0.51	53738
EUDICOTS										
ACANTHACEAE										
<i>Dianthera secunda</i> (Lam.) Griseb.	Insulina o quinua/Nr	T	3	Diabetes	I	Ap	S Caribbean to Venezuela and Ecuador	26	0.53	53750



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
<i>Hygrophila tyttha</i> Leonard	Amansa machos/ çxayuçe wala	H	13	Spiritual use/ To remove the bravery of men and animals	I	Ap	Colombia, Ecuador	20	0.41	53745
<i>Trichanthera gigantea</i> Humb. & Bonpl. ex Steud.	Nacedero/ yu' kmbuçxa'sa	T	3	Slimming	I	L	Panama to S tropical America	29	0.59	44628
ADOXACEAE										
<i>Sambucus peruviana</i> Kunth	Asauco o sauco/ phiwa'th	H	8	Cough	I	Ap	Costa Rica to NW Argentina	38	0.78	44586
AMARANTHACEAE										
<i>Alternanthera lanceolata</i> (Benth.) Schinz	Descansé/Nr	H	15	Slow down the fever	I	L	Mexico to Argentina	23	0.47	53751
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Paico/ sxawâte yuçe	H	2, 10	Parasites, diarrhea, wounds, stomachache/ Identical	I, P	L	America	48	0.98	44564
APIACEAE										
<i>Apium graveolens</i> L.	Apio/Nr	H	2, 10	Stomach pain, diarrhea, vomiting, superficial wounds, antiseptic, anti- inflammatory/ Identical	I	Ap	Macaronesia to N Africa, Europe to W Himalaya	48	0.98	44173
<i>Niphogeton ternata</i> (Willd. ex Schult.) Mathias & Constance	Apio de páramo/Nr	H	1, 2, 10	Stomach pain, diarrhea, vomiting, superficial wounds, antiseptic, anti- inflammatory	I	Ap	Colombia, Ecuador, Venezuela	32	0.65	44552
ASTERACEAE										
<i>Ambrosia arborescens</i> Mill.	Altamisa/Nr	Sh	9	Menstrual cramps, washes or vaporization for women on a diet, or in a state of pregnancy when cold	I, Hb	Ap	W South America to Chile	25	0.51	44538



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
<i>Artemisia absinthium</i> L.	Ajenjo de páramo/ we'pe ajenjo	H	2, 4	Diarrhea, stomachache, liver cleanser, fever, headache	PI	L	Europe to Siberia and W Himalaya	42	0.86	44545
<i>Austroeupeatorium inulifolium</i> (Kunth) R.M. King & H. Rob.	Salvia blanca/Nr	H	2, 6, 10	Stomach pain, vomiting in pregnant women, itchy skin, diarrhea, infection in wounds, nerves	I	Ap	Panama to S tropical America, Trinidad	42	0.86	44528
<i>Calea sessiliflora</i> Less.	Chicharrón/ wagath	H	4, 15	Liver pain, like bitter herb bath	Hb	Ap	Colombia	24	0.49	44529
<i>Calendula officinalis</i> L.	Caléndula/Nr	H	1, 2, 10	Inflammation, pain, to drain, scars, bruises, colic and wash wounds	I, P, Hb	Ap	W Mediterranean	48	0.98	44544
<i>Centratherum punctatum</i> Cass.	No descrito/Nr	H	No	No	No	No	S tropical America	0	0.00	44521
<i>Chamaemelum nobile</i> (L.) All.	Manzanilla grande/Nr	H	2, 8, 10	Stomach pain, flu, fever, conjunctivitis, colic and diarrhea	I	Ap	Azores, W Europe to NW Africa	30	0.61	44574
<i>Chromolaena corymbosa</i> (Aubl.) R.M.King & H.Rob.	Hierba de chivo/Nr	H	8	Cough	I	Ap	Bahamas, Cuba, Dominican Republic, French Guiana, Leeward Islands, Puerto Rico, Windward Islands	11	0.22	53746
<i>Cynara cardunculus</i> L. subsp. <i>cardunculus</i>	Alcachofa/Nr	H	3, 12	Slimming	I	Fr	Macaronesia, Mediterranean	15	0.31	44539
+ <i>Espeletia grandiflora</i> Bonpl. var. <i>grandiflora</i>	Frailejón/weve çs	sSh	9	Gestational and menstrual cramps, fever	I, Hb	L	Colombia	35	0.71	44554
<i>Heliopsis buphthalmoides</i> Dunal	Botoncillo pequeño/ bucx cxitx	H	5	Arthritis	I	Ap	Mexico to Venezuela and Bolivia, French Guiana	12	0.24	53743



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
<i>Matricaria chamomilla</i> L.	Manzanilla de páramo/Nr	H	2, 8, 10	Stomach pain, flu, fever, conjunctivitis, colic and diarrhea	I	Ap	Eurasia to Indo-China	38	0.78	44543
<i>Matricaria</i> sp.	Manzanilla pequeña/Nr	H	2, 8, 10	Stomachache, flu, fever, conjunctivitis, colic and diarrhea	I	Ap	Temperate & subtropical northern hemisphere	48	0.98	44578
<i>Monticalia trichopus</i> (Benth.) C. Jeffrey	Botoncillo grande/ bucx cxitx wala	Sh	15	Inflammation, fever	PI	Ap	Colombia	38	0.78	53756
+ <i>Pseudelephantopus spiralis</i> (Less.) Cronquist	Cubre tierra/ bucx	H	9	Menstrual colic	I	L	Tropical America	35	0.71	44584
<i>Senecio wedglacialis</i> Cuatrec.	Árnica de montaña/ Nr	H	1, 2, 10	Blows, superficial wounds, stomach pain, parasites	I, PI	W	Bolivia (La Paz)	34	0.69	44557
<i>Smallanthus riparius</i> (Kunth) H. Rob.	Botoncillo Mediano/ bucx cxitx cuspyāj	Sh	5	Arthritis	I	Ap	Mexico (Chiapas) to Venezuela and Bolivia	37	0.76	44505
<i>Tagetes verticillata</i> Lag. & Rodr.	Mata pulga/Nr	H	15	Insecticide	No	L	Colombia to Venezuela and Ecuador	25	0.51	45413
BORAGINACEAE										
<i>Borago officinalis</i> L.	Borraja/ ak yuce	H	8	Cough, discouragement, lower fever, as an expectorant	I, P	*	W & Central Mediterranean	22	0.45	44549
<i>Cynoglossum amabile</i> Stapf & J.R. Drumm.	No descrito/Nr	H	No	No	No	No	Central Nepal to Central China and Thailand	0	0.00	44804
CANNABACEAE										
<i>Cannabis sativa</i> L.	Marihuana/Nr	H	5, 10, 14	Cancer, arthritis, cold sore	P, R	*	Central Asia to Xinjiang and Pakistan	19	0.39	45230
CLUSIACEAE										
<i>Garcinia madruno</i> (Kunth) Hammel	Madroño/Nr	T	12	No/Edible	R	Fr	Trinidad to Central & S tropical America	0	0.00	49175



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
CRASSULACEAE										
<i>Aeonium nobile</i> (Praeger) Praeger	Chulepa, Oreja de perro grande o de páramo/ sxulepha alku thuwa.	H	15	Fever, headache	I	L	Canary Islands (La Palma)	22	0.45	44533
<i>Echeveria quitensis</i> (Kunth) Lindl.	Chulepa (oreja de perro de zona baja, orejuela)/ sxulepha alku thuwa ta'sxuwe'sx	H	15	Fever in children, cleaning and bathing	I, Hb	L	Colombia, Ecuador, Peru, Venezuela	35	0.71	44534
+ <i>Kalanchoe blossfeldiana</i> Poelln.	Chulepa de perro u Oreja de perro de zona media/ sxulepha alku thuwa pxa'jtewe'sx	H	15	Fever, headache	I	L	NE Madagascar	24	0.49	44535
CUCURBITACEAE										
<i>Cucurbita maxima</i> Duchesne	Zapallo/ ape	Cl	10, 12	Parasites	I, D, P	*	Bolivia to N Argentina	17	0.35	53744
ERICACEAE										
<i>Bejaria resinosa</i> Mutis ex L.f.	No descrito/Nr	Sh	No	No	No	No	W South America to Venezuela	0	0.00	44559
<i>Disterigma empetrifolium</i> (Kunth) Nied	Mizclillo de páramo/Nr	Sh	13	Spiritual use	I	Ap	Bolivia, Colombia, Ecuador, Peru, Venezuela	25	0.51	44553
<i>Vaccinium meridionale</i> Sw.	Mortiño/ kamanxu'n	Sh	No	No/Make wine	No	Fr	Colombia to Venezuela	0	0.00	53752
ERYTHROXYLACEAE										
+ <i>Erythroxylum novogranatense</i> (D. Morris) Hieron.	Coca/sx	Sh	2, 5, 15	Stomach pain, stomach fullness, headache, toothache, to reduce inflammation, parasites, pain	I	L	Colombia, Venezuela and Peru	48	0.98	44532



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
EUPHORBIACEAE										
<i>Croton hibiscifolius</i> Kunth ex Spreng.	Sangregado Drago/dlagu	T	2	Cleansing the intestine, gastritis	I	B	Colombia, Ecuador and Venezuela	39	0.80	44531
<i>Euphorbia milii</i> Des Moul.	Corona de Cristo/dxuus kpa witsa.	Sh	1	Brain hemorrhages, fever, epistaxis	PI	L	Madagascar	37	0.76	44571
<i>Tragia volubilis</i> L.	Ortiga/khās	H	1, 4, 9	Hypertension, drain blood, prostate, womb pain, womb swelling and hair loss.	I	Ap	Mexico to tropical America, Tropical Africa	32	0.65	44592
FABACEAE										
<i>Myroxylon balsamum</i> (L.) Harms	Tache/tāçe	T	9	Midwives use it to rub the stomach like hot baths	D	L	Mexico to S tropical America	28	0.57	44565
<i>Zornia reticulata</i> Sm.	Cargadita/Nr	H	7	Urinary infection	I	Ap	Tropical & subtropical America	37	0.76	53753
GENTIANACEAE										
<i>Gentiana sedifolia</i> Kunth	Hierba alegre/çxayuçe jxuth	H	15	Headache	I	L	Mexico (Chiapas), Costa Rica to NW Venezuela and Bolivia	48	0.98	44560
HYPERICACEAE										
<i>Hypericum goyanesii</i> Cuatrec.	Pino de páramo/we'pe pino	Sh	5, 7	Pain, prostate	I	L	Colombia	39	0.80	44556
<i>Hypericum silenoides</i> Juss.	No descrito/Nr	H	No	No	No	No	Mexico to Honduras, W South America to NW Argentina	0	0.00	44753
LAMIACEAE										
<i>Clinopodium brownei</i> (Sw.) Kuntze	Poleo/klaa puta jxãa	H	2, 8	Cough, straining, diarrhea in children	I	L	Tropical & subtropical America	32	0.65	44581
<i>Diplostephium glandulosum</i> Hieron.	Romero de páramo/Nr	Sh	8, 15	Hair, fever, flu	I	Ap	SW Colombia y Ecuador	38	0.78	44555



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
<i>Lepechinia conferta</i> (Benth.) Epling	Salvia negra o morada/Nr	Sh	7	Prostate	I	L	Colombia to NW Venezuela	40	0.82	49402
<i>Melissa officinalis</i> L.	Toronjil/Nr	H	2, 6	Stomach upset, discouragement, nerves, fever, fright	I	L	Mediterranean to Central Asia	39	0.80	53757
<i>Mentha spicata</i> L.	Hierba buena o Yerbabuena/ tãaçxka'	H	2	Stomachache	I	L	Europe to China	48	0.98	49364
<i>Mentha</i> sp.	Menta/Nr	H	10	Nausea in children due to worms	I	Ap	Cosmopolitan	35	0.71	49365
<i>Ocimum basilicum</i> L.	Albahaca/çey çeyçitx	H	9	Postpartum diet baths	D	Ap	S Asia	38	0.78	53739
<i>Salvia rosmarinus</i> Spenn.	Romero/Nr	Sh	8, 15	Flu, fever/For hair, fever and flu	I	Ap	Mediterranean	39	0.80	44536
+ <i>Salvia amethystina</i> subsp. <i>ampelophylla</i> (Epling) J.R.I. Wood & Harley	Hoja de paño/ mugí	H	10	Wash the wounds	Hb	Ap	Colombia to NW Venezuela	38	0.78	44565
MALVACEAE										
<i>Hibiscus</i> sp.	Mizclillo/u'z im	H	2, 6, 13	Fever, fullness, nerves, spiritual treatments	D	Sd	Tropics & subtropics to N America	34	0.69	53751
<i>Malva</i> sp.	Malva/Nr	H	9	Vaginal inflammation/ Identical	Hb	Ap		34	0.69	53740
MORACEAE										
<i>Ficus carica</i> L.	Brevo/pecu'c	Sh	9	Menstrual cramps	Hb	*	E Mediterranean to Central Asia and Afghanistan	38	0.78	44568
MYRTACEAE										
+ <i>Eucalyptus melliodora</i> A.Cunn. ex Schauer	Eucalipto/Nr	T	8	Cough	S	L	SE Queensland to Victoria	36	0.73	53764
<i>Psidium guineense</i> Sw.	Guayabilla/ pkid leeçxkwe wuala	Sh	2, 12	Diarrhea	R, I, PI	*	Mexico to tropical America	48	0.98	45186
PAPAVERACEAE										
<i>Papaver somniferum</i> L.	Amapola/Nr	H	No	No/Narcotics, heroin manufacturing	Nr	Ap	Macaronesia, W & Central Mediterranean	0	0.00	10866



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
PHYTOLACCACEAE										
<i>Petiveria alliacea</i> L.	Anamú/Nr	H	7, 8, 10	Heal wounds, sinusitis, kidneys	D, S	W	Tropical & subtropical America	39	0.80	45219
<i>Phytolacca bogotensis</i> Kunth	Altusada/Nr	H	No	No	No	No	W & S South America to NW Venezuela	0	0.00	44551
PLANTAGINACEAE										
<i>Plantago major</i> L.	Llantén/Nr	H	7	Urinary infection	I	Ap	Eurasia to Arabian Peninsula, Macaronesia, N & S Africa	40	0.82	53742
POLYGONACEAE										
<i>Rumex crispus</i> L.	Lengua de vaca/ klaa thune jxuth	H	15	Inflammation	I	*	Macaronesia, N Africa, Temperate Eurasia	38	0.78	44580
PORTULACACEAE										
<i>Portulaca oleracea</i> L.	Amansa guapos/ çxayuçe wala	H	13, 15	Neutralize energies, fever in children, ear pain	Hb, PI	Ap	Macaronesia, Tropical Africa, Mediterranean to Pakistan and Arabian Peninsula	28	0.57	44583
ROSACEAE										
<i>Prunus persica</i> (L.) Batsch	Durazno/Nr	T	12	No/Edible	R	Fr	N Central China	0	0.00	53754
<i>Rhaphiolepis bibas</i> (Lour.) Galasso & Banfi	Míspero/Nr	Sh	7, 12	Urinary infection	I	Ap	South-Central China	10	0.20	53755
<i>Rubus floribundus</i> Kunth var. <i>floribundus</i>	Mora de páramo/ weí'pe syun	H	8, 12	Flu, cough	J, R	Fr	W South America	30	0.61	44558
<i>Rubus urticifolius</i> Poir	Mora silvestre/ yukh syun	H	8, 12	Flu, cough	J, I, R	Fr	Mexico to S tropical America	30	0.61	44566
RUBIACEAE										
<i>Cinchona pitayensis</i> (Wedd.) Wedd.	Quina/yu ki'jnxy	T	13	Spiritual use, sacred plant	I, P	*	S Colombia to Central Ecuador	28	0.57	48858
<i>Coffea arabica</i> L.	Café caturro/ fxtu nxinx tasx leçsa	Sh	12, 15	Headache	I	Ap	Ethiopia, Kenya, Sudan	39	0.80	44562



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
RUTACEAE										
<i>Citrus × aurantium</i> L.	Naranja Silvestre/yukh Ixima	T	8	Cough	D	Fr	Artificial hybrid	34	0.69	53737
<i>Citrus limon</i> (L.) Osbeck	Limón/ Iximun	T	8	Flu, fever, headache	I, Hb	Ap	Artificial hybrid	37	0.76	44567
<i>Ruta graveolens</i> L.	Ruda/Nr	H	9	Pain and menstrual cramps, colic or cold in pregnancy	I, Hb	Ap	N Balkan Peninsula to Krym	44	0.90	44541
SANTALACEAE										
<i>Phoradendron undulatum</i> (Pohl ex DC.) Eichler	Suelda con suelda o mata palo/fxtu iknas	Sh	9	Menstrual cramps	I	Ap	Mexico (Chiapas) to tropical America	38	0.78	44582
SOLANACEAE										
<i>Nicandra physalodes</i> (L.) Gaertn.	Yambico o Yambo/ Nr	H	12	No/Edible	R	Fr	Peru to NW Argentina	0	0.00	44589
<i>Nicotiana tabacum</i> L.	Tabaco/ w 'jx	H	11	Poisoning/ Scorpion itch	P	L	Bolivia	37	0.76	44588
<i>Solanum betaceum</i> Cav.	Tomate de árbol/ lyem ta'sx	Sh	3, 8, 10, 12	High cholesterol, breathing problems, tonsil infection, for mumps	J, R	Fr	S tropical America	39	0.80	40240
<i>Solanum lycopersicum</i> L.	Tomate de mesa/ busxtewe'sx yem	Sh	4, 10, 12	Prostate, infection	I	Ap	Peru	39	0.80	49455
<i>Solanum sisymbriifolium</i> Lam.	Guinda/ Nr	H	1, 7	Urinary infection, improve blood circulation	I	Ap	S tropical America	38	0.78	44516
<i>Solanum tuberosum</i> Lam.	Papa guata/ ka'ka guata	H	12, 15	Headache, fever	D, P	Ms	S tropical America	38	0.78	44547
URTICACEAE										
<i>Urtica laciniata</i> Wedd.	Ortiga grande/ khās wala	Sh	1	Improve blood circulation	I	L	Central & S tropical America	27	0.55	39190



Appendix: Continuation.

Clade/Family/Taxon	LN/NY	H	LU	Med./Trad. use	MP	P	Origin	N	UV	CAUP
VERBENACEAE										
<i>Aloysia citriodora</i> Palau	Cedrón/ Nr	Sh	2, 6	Inflammation of the stomach, stomach pain, nerve baths in children	I, Hb	Ap	S Bolivia to NW Argentina	42	0.86	44570
<i>Lantana camara</i> L.	Tango o gurupacha o Murupacha/ garrupacha morapacha	H	8	Cough, flu	D, I, Hb	Ap	Mexico to tropical America	27	0.55	44563
<i>Lippia alba</i> (Mill.) N.E.Br. ex Britton & P.Wilson	Pronto alivio/ kwekwe iw tsa	Sh	1, 2, 5, 8	Stomach pain, flu, body aches, chest pain, high blood pressure, diarrhea	I	L	Tropical & subtropical America	48	0.98	44561
<i>Lippia dulcis</i> Trevir.	Orosul/phã yuçe	Sh	8	Cough, fever	I	Ap	Mexico to Venezuela, Caribbean	40	0.82	53749
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	Verbena negra/ belbena çhuçx	H	10	Parasites	I, Hb	*	S Mexico to tropical America	32	0.65	44590
<i>Verbena litoralis</i> Kunth	Verbena blanca/ belbena çxhime	H	10	Purgative	I	L	Mexico to S tropical America	34	0.69	44530
VIOLACEAE										
<i>Viola odorata</i> L.	Violeta/ misx yiph	H	8	Dry cough	I, P	*	Europe to W & N Iran, NW Africa	37	0.76	44537

