



Knowledge and traditional use of plants in the communities of Tepeite and Los Ailes, Santa María Ahuacatlán, Morelos, México†

[Conocimiento y uso tradicional de las plantas en las comunidades de Tepeite y Los Ailes, Santa María Ahuacatlán, Morelos, México]

Julieta Berenice Cabrera-González¹, Alejandro García-Flores^{2*},
José Manuel Pino-Moreno³, Erika Román-Montes de Oca¹
and María Eugenia Bahena-Galindo²

¹ Faculty of Agricultural Sciences, Autonomous University of the State of Morelos, Av. Universidad 1001, Chamilpa, Cuernavaca, Morelos, México. Email:

julybcg@hotmail.com; erika.romann@uaem.edu.mx

² Center for Biological Research, Autonomous University of the State of Morelos, Av. Universidad 1001,

Chamilpa, Cuernavaca, Morelos, México. Email: alejandro.garcia@uaem.mx;
bahenam@uaem.mx

³ Institute of Biology, National Autonomous University of México. Third Circuit S/N, University City, Coyoacán, México City, México. Email: jpino@ib.unam.mx

*Corresponding author

SUMMARY

Background: The historical relationship of traditional societies with their territory allowed them to develop a set of knowledge, practices and meanings associated with the use and management of natural resources. Through multiple interactions with their plant environment, these societies have incorporated various floristic species into their belief systems and conceptions of the world, being a key element to reproduce socially and culturally. **Objective:** To record the richness of useful plants, the categories of use, as well as the quantitative evaluation of the cultural value of the species. **Methods:** In-depth and semi-structured interviews were carried out with 10% of the population, key collaborators were previously selected, a focus group was established and rapport and participant observation were carried out. Guided tours were also carried out and botanical material was collected for identification. Using indicators such as frequency of mention and categories of use, the cultural value of floristic species was quantitatively evaluated. **Results:** In this research, 48 families, 88 genera, 104 species, and one variety were recorded, to which inhabitants assign medicinal, food, condiment, construction, fuel, ornamental, symbolic use, and household uses. Medicinal plants, mostly herbs, are used to treat diseases related to the digestive and gynecological systems. The cultural value index records the Hass avocado (*Persea americana* variety hass Mill) and the Criollo avocado (*Persea americana* Mill) (3.0 each) as the most important species. **Implications:** The use of the plants in both communities must be managed rationally otherwise the resources will be threatened and with it, the social well-being. **Conclusion:** The communities of Tepeite and Los Ailes registered a richness of 104 species and a variety of plants that are used as medicine and food. The species with the highest IIC were the Criollo and Hass avocado.

Key words: peasants; use categories; ethnobotany; traditional knowledge.

RESUMEN

Antecedentes: La relación histórica de las sociedades tradicionales con su territorio les permitió desarrollar un conjunto de conocimientos, prácticas y significados asociados al uso y manejo de los recursos naturales. A través de múltiples interacciones con su entorno vegetal, estas sociedades han incorporado diversas especies florísticas a sus sistemas de subsistencia, cognitivos, perceptuales y de interpretación del mundo, siendo un elemento clave para reproducirse social y culturalmente. **Objetivo:** Registrar la riqueza de plantas útiles, las categorías de uso, así como la

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ORCID = J.B. Cabrera-González: <https://orcid.org/0000-0002-2748-7774>; A. García-Flores: <https://orcid.org/0000-0002-1122-5059>; J.M. Pino-Moreno: <https://orcid.org/0000-0002-1193-6125>; E. Román-Montes de Oca: <https://orcid.org/0000-0002-9490-6422>; M.E. Bahena-Galindo: <http://orcid.org/0000-0002-6784-3390>

evaluación cuantitativa del valor cultural de las especies. **Metodología:** Se aplicaron entrevistas abiertas en profundidad y semiestructuradas al 10% de la población, previamente se seleccionaron colaboradores clave, se consolidó el grupo focal y con ellos se estableció rapport y la observación participante, también se hicieron recorridos guiados y se colectó el material botánico para efectuar su identificación; y el análisis de la información se utilizó para obtener el índice de valor cultural de las especies. **Resultados:** Se registraron 48 familias, 88 géneros, 104 especies y una variedad; a las cuales los habitantes les asignan un uso medicinal, alimentario, condimento, construcción, combustible, ornamental, místico religioso y enseres domésticos. Las plantas medicinales, en su mayoría hierbas, son utilizadas para tratar enfermedades ligadas al sistema digestivo y ginecológicas. El índice de valor cultural registra al aguacate hass (*Persea americana* variedad hass Mill) y el aguacate criollo (*Persea americana* Mill) (3.0 cada uno) como las especies más importantes. **Implicaciones:** El aprovechamiento de las plantas en ambas comunidades debe tener un manejo racional de lo contrario el recurso se verá amenazado y con ello el bienestar social. **Conclusión:** Las comunidades de Tepeite y Los Ailes registraron una riqueza de 104 especies y una variedad de plantas que son aprovechadas como medicina y alimento. Las especies con mayor IIC fueron el aguacate criollo y hass.

Palabras clave: campesinos; categorías de uso; etnobotánica; saberes tradicionales.

INTRODUCTION

Contemporary societies face the challenge of addressing a set of socio-environmental issues that are causing the degradation of the planet's ecosystems and the deterioration of human quality of life. In Mexico, socio-environmental problems stem from economic policies designed and operated from a capitalist logic (Ríos García *et al.*, 2015). For capitalism, geographical space is a means to accumulate capital; thus, for its reproduction and expansion, it appropriates the territories of local communities through processes of dispossession (Harvey, 2003; Carrillo Carrera & Carrera Chávez, 2017). In recent decades, territory has undergone transformation processes where urban growth is a factor in land-use change, driven by the expansion of the real estate sector, commercial activities, and industries. This process has favored economic production to the detriment of primary productive sectors (Flores-Reséndiz *et al.*, 2019).

In this context, the lifestyle of peasant communities has adapted to agrarian changes and the reduction of public policies directed at the countryside, as has historically happened since the implementation of neoliberalism in Mexico. In synergy with factors such as market price vulnerability and pressure on natural resources due to territorial processes such as the change in agricultural and forest land use, this has increased the precariousness of peasant life and generated greater mobility between rural and urban areas (Guzmán & López, 2014). The integration of peasant economies into the market logic has caused their natural resources, products, and labor to become commodities destined for markets, impacting their way of life by reducing the diversity of their resources, self-sufficiency, and non-market exchanges (Morales, 2004).

In this scenario, peasants as a heterogeneous social group have developed multiple productive, economic, and social strategies to achieve social reproduction. Although it has been suggested that peasant groups engage in fewer primary activities, motivated by the substitution with secondary and tertiary activities, peasant economies continue to depend on the natural resources of their environment for social reproduction (Silvetti, 2011). The historical relationship of peasant communities with their territory has allowed them to acquire a set of knowledge, practices, and meanings regarding the use and management of natural resources, which has shaped their relationships with nature (Toledo *et al.*, 2019).

This has led to the generation of extensive knowledge on the use and management of various plant species through complex interactions between traditional communities and their plant environment, forming part of their belief systems and worldviews, and being a key element for reproducing their social and cultural life (Casas *et al.*, 2016; Caballero *et al.*, 1998). In Mexico, a wide spectrum of interactions between people and plants has been documented, including individual, population, or community management of wild, weedy, and domesticated plants through various agricultural and silvicultural practices such as planting and transplanting, tolerance and protection, as well as direct harvesting (Blancas *et al.*, 2010). As a result of these historical interactions in the territories of mestizo and indigenous peoples, approximately 7,800 useful plant species have been recorded, representing about one-third of the total vascular flora in the country (Caballero *et al.*, 2022). Plants are mainly used for medicinal, ornamental, edible, forage, and fuel purposes, with most species being wild plants collected from forests. Specifically, in temperate forests, human groups living in this biome use approximately 1,440 plant species (Caballero *et al.*, 2022).

The Chichinautzin Biological Corridor (COBIO) is one of the mountainous areas of the state of Morelos whose towns preserve a remarkable biocultural heritage related to the plant environment. However, ethnobotanical knowledge in this region is threatened by processes such as migration, land-use change, and cultural change, impacting the interactions of use and management of plant resources (Blancas *et al.*, 2023).

Based on these premises, the hypothesis was posed that the inhabitants of El Tepeite and Los Ailes, living in a socio-ecological environment of temperate forest on the outskirts of urbanization in Cuernavaca, Mexico, retain traditional knowledge associated with the use of plants in various degrees of management within their territory. The research questions posed were: Which plant species have social and cultural importance for the inhabitants of the study area? Which plant species have the highest cultural value? The objective was to conduct an ethnobotanical study to document the richness of useful plants, categories of use, and quantitatively evaluate the cultural value of the species.

MATERIALS AND METHODS

Study area

This project is contextualized in the region of the Chichinautzin Biological Corridor (COBIO). The area is located south of the Trans-Mexican Volcanic Belt (Espinosa & Ocegueda, 2007). It covers an area of 65,721 hectares belonging to the Morelos municipalities of Huitzilac, Cuernavaca, Tepoztlán, Yautepec, Tlalnepantla, Totolapan, and Tlayacapan; Ocuilan in the State of Mexico, and parts of the Milpa Alta and Tlalpan districts in Mexico City. It is situated at an altitudinal gradient from 1,250 to 3,450 meters above sea level, with a wide environmental heterogeneity. The region features both tropical and temperate vegetation types, the latter being more diverse and covering a larger area, represented by pine, oyamel, oak, and pine-oak forests (Santillán *et al.*, 2010). The study communities are El Tepeite and Los Ailes, part of the town of Santa María Ahuacatitlan, located in the municipality of Cuernavaca, north of the state of Morelos, Mexico (Figure 1).

The area is situated at an altitude of 2048 meters above sea level, with coordinates 19° 00' 66" North and 99° 17' 89" West. The climate is classified as C (w2) (w) b i g, with a subhumid temperate climate, with rainfall in the summer and an average annual precipitation of 1000 to 1200 mm. The present vegetation is oak forest (Miranda & Hernández, 1963) consisting of various species, such as *Quercus mexicana* Bonpl., *Quercus crassipes* Bonpl., *Quercus macrophylla* Née, *Quercus rugosa* Née, *Quercus crassifolia* Bonpl., *Pinus montezumae* Lamb., *Pinus lawsonii* Roetzl ex Gordon, *Pinus patula* Schiede ex Schltdl. & Cham., *Pinus pringlei* Shaw., *Pinus rudis* Endl., *Pinus teocote* Schied. ex Schltdl. & Cham., *Arbutus xalapensis* Kunth, and *Ternstroemia lineata* DC (Santillán *et al.*, 2010).

According to the registry of Towns of America (2025) the community of Los Ailes has 57 inhabitants, while El Tepeite has 3 inhabitants. Both communities are rural and engage in traditional productive activities such as collecting mushrooms and seasonal fruits, making charcoal, and providing services. They lack public facilities such as electricity, drainage, potable water, education, and health, resulting in a high level of marginalization (CONEVAL, 2014).

Methodological planning

During the project's development, the normative principles for working with communities described in the Code of Ethics of the Latin American Society of Ethnobiology (Cano *et al.*, 2016) were considered. To introduce the research setting, the project was presented to local authorities to explain the objectives and obtain permission to carry it out. Access to the community was achieved through a key collaborator, as recommended by Taylor and Bogdan (1992).

A mixed methodological approach, both qualitative and quantitative, was applied. Field information was obtained through data triangulation, using ethnobiological research techniques such as interviews, participant observation, and guided tours were conducted at homegardens and areas surrounding the house which correspond to a type of temperate forest vegetation (Albuquerque *et al.*, 2014).

With the help of a local informant, key collaborators were identified, forming the sample of native inhabitants of both communities.

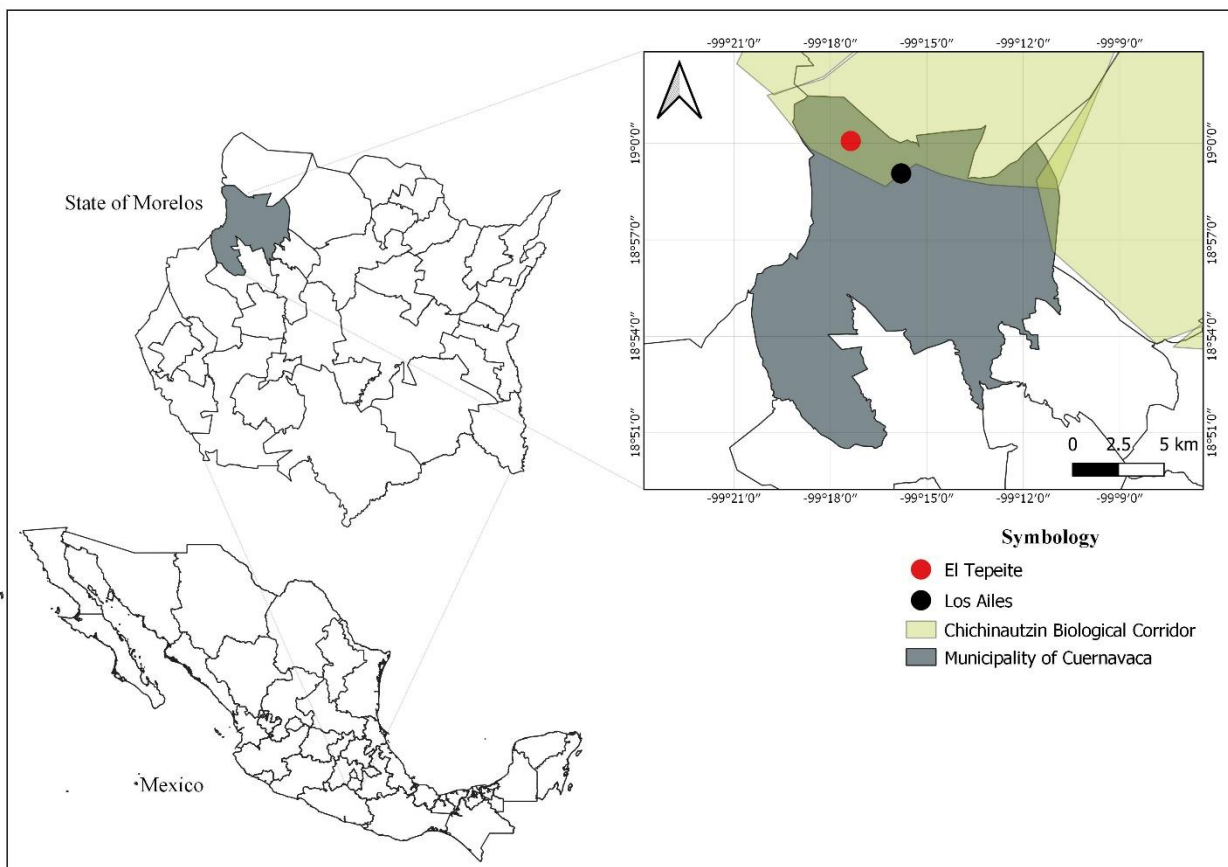


Figure 1. Location of El Tepelite and Los Ailes communities, Santa María Ahuacatlán, Cuernavaca Morelos, Mexico (Author's own work).

Semi-structured interviews based on a script were conducted with 10% of the total population of both communities from January to December 2024 according to the following criteria: a. One member per family; b. Time availability; c. Carry out activities related to the countryside; and d. Be native to the community as recommended by Phillips and Gentry (1993) and Taylor and Bogdan, (1992). Information was recorded on local nomenclature, knowledge about the use and management of plant species, usage categories, parts used, preparation methods, and commercialization. Complementarily, information on the use and management of the plant environment was recorded through participant observation (Taylor & Bogdan, 1992), by participating in key collaborators' activities such as firewood collection, mushroom harvesting, and fruit gathering (Kremen *et al.*, 1998; Reyes-García *et al.*, 2006). For taxonomic determination and correct association with local names, guided tours were conducted by local informants for the collection and herbarium MORE-UAEM preparation of botanical material. The identification of botanical specimens was carried out using literature relevant to each family and the literature reported by Monroy-Ortiz & Monroy (2006)

and Monroy-Ortiz and Monroy (2004), as well as comparison with herbarium specimens. The scientific names were updated through The Plant List website (2021).

Information analysis

The information obtained during the interviews was captured in an Excel software database. The conditions were recorded according to the emic approach which were classified according to the International Classification of Diseases and Related Health Problems of the World Health Organization (Organización Mundial de la Salud, 2015) and sickness with the Panamerican Health Organization (Organización panamericana de la salud, 2003). The cultural value index (VCe) proposed by Reyes-García *et al.* (2006) was used to measure the effective use and significance of species for a specific social group, which is important in communities with high marginalization (Gallegos, 2017).

$$VCe = \left(\frac{N^u e}{N^c}\right) \times \left(\frac{F^c e}{N}\right) \times \sum_{u=1}^{uN^c} \sum_{i=1}^{iN} URiu/N$$

Where: $\mathcal{N}Ue$ = Number of use categories for species e, $\mathcal{N}C$ = Number of use categories considered in the study, $\mathcal{F}Cf$ = Citation frequency, \mathcal{N} = Total number of participants in the study, $\mathcal{U}Riu$ = Total number of reported uses

Finally, the mentioned frequency (Fm) was calculated from the results obtained and arranged in a free list to also consider it as an indicator of species use preference (Burrola-Aguilar, 2012):

$Fm = (\text{Number of mentions of the species}) / (\text{Total number of informants})$

RESULTS

Information from the interviewees

Sixty-four percent of the interviewees from both communities were women and 36% were men, whose age ranged from 34 to 81 years; regarding their education, 83% completed elementary school and 17%

had not completed high school. The collaborators develop activities such as: wood collect, collect and sell seasonal countryside products such as mushrooms, orchids, loquats, lime blossom flowers and avocados; charcoal making, traditional doctor (healer) and construction workers.

Botanical knowledge

A richness of species was recorded from 48 families, 88 genera, 104 species, and one variety (Table 1), indicating families arranged alphabetically, scientific names, common names, category of use or change, part used, mention frequency, and cultural value. The family best represented was Orchidaceae with 11 species, followed by Asteraceae with 10; it is noteworthy that 32 families are represented by only one species in the study area. The genus with the highest number of species was *Quercus* with 6 species, followed by *Pinus* with 3; 10 genera had 2 each and 77 genera had a single species. 78 of these are wild and 27 are cultivated.

Table 1. Plants registered in Ailes and Tepeite, Santa Maria Ahuacatitlan, Morelos, Mexico.

Family/Scientific name	Common name	Category of use or change	Part used	F m	CVi x
Acanthaceae					
<i>Justicia spinigera</i> Urb. & Ekman	Muicle	M	Lf	0.7	1.3
Amaranthaceae					
<i>Beta vulgaris</i> L.	Acelga	F/SI	Lf	0.5	0.5
<i>Teloxys ambrosioides</i> L. W. A. Weber	Epazote	Sn	Lf	0.2	0.2
Anacardiaceae					
<i>Schinus molle</i> L.	Pirul	M	Lf	0.3	1.0
<i>Spondias purpurea</i> L.	Ciruela	F/SI	Fr	0.7	0.7
Apiaceae					
<i>Coriandrum sativum</i> L.	Cilantro	F	Sm/Lf	0.2	0.2
<i>Daucus carota</i> L.	Zanahoria	F/SI	Rt	0.2	0.2
Araceae					
<i>Zantedeschia aethiopica</i> (L.) Spreng.	Alcatraz	O/SI	Fl	0.5	0.5
Araliaceae					
<i>Oreopanax peltatus</i> Linden ex Regel	Papayo cimarrón	Fl	Sm	0.3	0.3
Asparagaceae					
<i>Yucca elephantipes</i> Regel.	Yuca	F	Fl	0.3	0.7
Asphodelaceae					
<i>Aloe vera</i> (L.) Burm. f.	Sábila	M	Lf	0.3	0.3
Asteraceae					
<i>Ageratina conspicua</i> R.M. King & H. Rob.	De la clin	M	Lf	0.8	0.8
<i>Artemisia ludoviciana</i> var. <i>mexicana</i> (Willd. ex Spreng.) Fernald	Estafiate	M	Lf	0.2	0.2
<i>Brickellia cavanillesii</i> (Cass.) A. Gray	Prodigiosa	M	Lf	0.3	0.3
<i>Cichorium endivia</i> L.	Lechuga escarole	F/SI	Lf	0.2	0.2
<i>Gnaphalium bourgovii</i> A. Gray	Gordolobo	M	Lf/Fl	0.5	0.5
<i>Gnaphalium viscosum</i> Kunth	Gordolobo	M	Lf/Fl	0.5	0.5
<i>Senecio salignus</i> DC.	Jarilla	M	Lf	0.7	0.7
<i>Tagetes filifolia</i> Lag	Anís silvestre	M	Lf	0.3	0.3
<i>Tagetes lucida</i> Cav.	Pericón	M/Sn/Su/SI	Fl	0.3	0.3

Family/Scientific name	Common name	Category of use or change	Part used	F m	CVi x
<i>Tanacetum parthenium</i> L. Sch. Bip. Begoniaceae	Santa María	M	Lf	0.5	0.5
<i>Begonia gracilis</i> Kunth Betulaceae	Xokoyoli	F	Sm	0.2	0.2
<i>Alnus</i> sp.	Flor de tila	M/F/Con/Fl/ Sl	Sm/Fl	0.5	2.0
<i>Carpinus caroliniana</i> Walter Bromeliaceae	Milpilla	Con/Fl	Sm/L	0.3	0.3
<i>Tillandsia prodigiosa</i> (Lem.) Baker Burseraceae	Piña	Su	Fl	0.3	0.7
<i>Bursera cuneata</i> (Schltdl.) Engl. <i>Bursera</i> sp.	Copal blanco Copal prieto	M/Fl M	Sm/Re Re	0.2 0.2	0.2 0.3
Cactaceae <i>Opuntia</i> sp.	Nopal cimarrón	F	Lf	0.7	1.3
Campanulaceae <i>Lobelia laxiflora</i> Kunth Clethraceae	Chilitos	M	Lf	0.3	0.3
<i>Clethra mexicana</i> DC. Cucurbitaceae	Mameytillo	Fl	Sm	0.3	0.3
<i>Cucurbita ficifolia</i> Bouché <i>Cucurbita pepo</i> L.	Chilacayote Calabaza amarilla	F/Sl F/Sl	Fr Fr	0.7 0.3	1.3 0.3
<i>Sechium edule</i> (Jacq.) Sw. <i>Sicyos parviflorus</i> Willd	Chayote Tetzilin	M/F/Sl F	Fr Lf	0.7 0.2	1.3 0.2
Cupressaceae <i>Cupressus lindleyi</i> Klotzsch ex Endl. <i>Juniperus deppeana</i> Steud.	Pino Cedro	Con/Fl Fl	Sm Sm	0.2 0.5	0.3 0.5
Ebenaceae <i>Diospyros digyna</i> Jacq.	Zapote negro	F	Fr	0.2	0.2
Ericaceae <i>Arbutus xalapensis</i> Kunth. Euphorbiaceae	Madroño	Fl	Sm	0.5	0.5
<i>Euphorbia umbellata</i> (Pax) Bruyns Fabaceae	Pegahueso	M	Lx	0.3	0.3
<i>Canavalia villosa</i> Benth <i>Erythrina americana</i> Mill	Gallitos Tzompantle	F F/Sl	Fl Fl	0.5 0.8	0.5 0.8
<i>Eysenhardtia polystachya</i> (Ortega) Sarg. <i>Leucaena leucocephala</i> (Lam.) de Wit.	Palo dulce Guaje	Con F/Sl	Sm Fr	0.5 0.3	1.0 0.3
<i>Phaseolus coccineus</i> L. Fagaceae	Frijolitos	F	Fl	0.3	0.3
<i>Quercus candicans</i> Née <i>Quercus obtusifolia</i> (A. DC.) Rydb.	Encino de hoja ancha Copa de oro	Fl/Sl M	Sm Fr	1.0 0.2	1.0 0.2
<i>Quercus crassifolia</i> Bonpl. <i>Quercus laurina</i> Bonpl.	Encino prieto Laurelillo	M/Fl/Sl Fl/Sl	Sm Sm	1.0 1.0	1.0 0.3
<i>Quercus obtusata</i> Bonpl. <i>Quercus rugosa</i> Née	Encino Encino de hoja china	Fl/Sl Fl/Sl	Sm Sm	1.0 1.0	1.0 2.0
Flacourtiaceae <i>Xylosma flexuosa</i> (Kunth) Hemsl. Garryaceae	Espina de brujo	Fl/Sl	Sm	0.5	0.5
<i>Garrya laurifolia</i> Hartw. ex Benth. Lamiaceae	Palo de zorro	Con/Fl/Sl	Sm	0.3	0.3
<i>Mentha arvensis</i> L. <i>Ocimum basilicum</i> L.	Yerbabuena Albahaca	M/Sn M	Lf Lf	0.5 0.3	0.5 0.3
<i>Origanum majorana</i> L. <i>Origanum vulgare</i> L.	Mejorana Oregano	M M/Sn	Lf Lf	0.5 0.5	0.5 1.0

Family/Scientific name	Common name	Category of use or change	Part used	F m	CVi x
<i>Plectranthus hadiensis</i> (Forssk.) Schweinf. ex Sprenger	Planta del vaporub	M	Lf	0.3	0.3
<i>Rosmarinus officinalis</i> L.	Romero	M/Sn	Lf	0.3	0.3
<i>Satureja macrostema</i> (Moc. & Sessé ex Benth.) Briq.	Tabaquillo	F/SI	Lf	0.5	0.5
<i>Stachys officinalis</i> L. Trevis Lauraceae	Britonica	M	Lf	0.5	0.5
<i>Litsea glaucescens</i> Kunth	Laurel	Sn	Lf	0.5	0.5
<i>Persea americana</i> Mill	Aguacate criollo	M/F/Sn/SI	Lf/Fr	1.0	3.0
<i>Persea americana</i> var. hass Mill Malvaceae	Aguacate hass	M/F/Sn/SI	Lf/Fr	1.0	3.0
<i>Sida haenkeana</i> L. Moraceae	Alacle	HI/SI	Sm	0.3	0.3
<i>Ficus carica</i> L. Myrtaceae	Higo	F/SI	Fr	0.2	0.2
<i>Psidium guajava</i> L. Oleaceae	Guayaba	M/F/SI	Lf/Fr	0.5	0.5
<i>Fraxinus uhdei</i> (Wenz.) Lingelsh Onagraceae	Fresno	Fl	Sm	0.3	0.3
<i>Oenothera rosea</i> L'Hér. ex Aiton Orchidaceae	Hierba del golpe	M	Sm/Lf/Fl	0.5	0.5
<i>Dichaea squarrosa</i> Lindl.	Orquídea pasto lila	O/SI	Fl	0.2	0.2
<i>Encyclia varicosa</i> (Bateman ex Lindl.) Schltr.	Orquídea de botellita	O/SI	Fl	0.2	0.2
<i>Epidendrum matudae</i> L.O. Williams	Orquídea de arbolito	O/SI	Fl	0.3	0.3
<i>Epidendrum parkinsonianum</i> Hook.	Orquídea colguita	O/SI	Fl	0.5	0.5
<i>Laelia autumnalis</i> (La Llave & Lex.) Lindl.	Orquídea San Diego	O/SI	Fl	0.2	0.2
<i>Oncidium pachyphyllum</i> Hook	Orquídea orejona	O/SI	Fl	0.2	0.2
<i>Oncidium unguiculatum</i> Lindl.	Orquídea papa blanca	O/SI	Fl	0.5	0.5
<i>Pleurothallis retusa</i> (Lex.) Lindl.	Orquídea morada	O/SI	Fl	0.2	0.2
<i>Rhynchosstele áptera</i> (La Llave & Lex.) Soto Arenas & Salazar	Orquídea bolitas verdes	O/SI	Fl	0.3	0.3
<i>Rhynchosstele cervantesii</i> (La Llave & Lex.) Soto Arenas & Salazar	Orquídea blanca	O/SI	Fl	0.3	0.7
<i>Stanhopea hernandezii</i> (Kunth) Schltr. Papaveraceae	Orquídea torito	O/SI	Fl	0.2	0.2
<i>Bocconia arborea</i> S. Watson Pentaphragaceae	Llora sangre	M	Sm	0.5	0.5
<i>Ternstroemia lineata</i> DC. Pinaceae	Flor de tila	M/F/Con/Fl/SI	Sm/Fl	0.7	0.7
<i>Abies religiosa</i> (Kunth) Schldl. & Cham.	Oyamel	Fl	Sm	0.5	0.5
<i>Pinus ayacahuite</i> C. Ehrenb. ex Schldl.	Ocote piña grande	M/Fl/SI	Sm/Re	0.7	1.3
<i>Pinus montezumae</i> Lamb.	Ocote piña chica	M/Fl/SI	Sm/Re	0.7	1.3
<i>Pinus patula</i> Schldl. & Cham. Piperaceae	Ocote chino	M/Fl/SI	Sm/Re	0.7	0.7
<i>Peperomia</i> sp. Poaceae	Copalito	M	Lf	0.5	0.5
<i>Avena sativa</i> L.	Avena	F/SI	Sm/Fr	0.2	0.2
<i>Cymbopogon citratus</i> (DC.) Stapf	Té limón	F	Lf	0.3	0.3
<i>Zea mays</i> L. Proteaceae	Maíz	Su	Lf	0.3	0.3
<i>Macadamia integrifolia</i> Maiden & Betche Rosaceae	Nuez de macadamia	F	Fr	0.3	0.3
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Níspero	M/F/SI	Lf/Fr	0.7	2.0
<i>Prunus persica</i> (L.) Batsch	Durazno criollo	F/SI	Fr	0.8	0.8

Family/Scientific name	Common name	Category of use or change	Part used	Fm	CVix
<i>Pyrus communis</i> L. Rubiaceae	Pera	F/Sl	Fr	0.3	0.3
<i>Chiococca alba</i> (L.) Hitchc Rutaceae	Guía blanca	O	Sm	0.2	0.3
<i>Citrus aurantiifolia</i> (Chistm) Swingle	Limón	F/Sl	Fr	0.8	0.8
<i>Citrus aurantium</i> L.	Naranja agria	M/F/Con/Sl	Sm/Lf	0.8	0.8
<i>Ruta chalepensis</i> L. Sapindaceae	Ruda	M	Lf	0.8	1.7
<i>Dodonaea viscosa</i> Jacq Scrophulariaceae	Chapulistle	M/Con	Sm/Lf	0.8	0.8
<i>Buddleja sessiliflora</i> Kunth Selaginellaceae	Tepozán	M	Lf	0.2	0.2
<i>Selaginella lepidophylla</i> (Hook. & Grev.) Spring	Doradilla	M	Lf	0.3	0.3
Smilacaceae					
<i>Smilax moranensis</i> M. Martens & Galeotti	Cocolmecha	M	Rt	0.5	0.5
Solanaceae					
<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Sweet	Florifundio	M	Fl	0.3	1.3
<i>Capsicum pubescens</i> Ruiz & Pav.	Chile manzano	F/Sl	Fr	0.7	0.7
<i>Solanum nigrum</i> L. Styraceae	Hierba mora	M	Sm/Lf/Fr	0.5	0.5
<i>Styrax ramirezii</i> Greenm.	Aguacatillo	Con/Fl	Sm	0.7	1.3

Category of use or change: M. Medicinal; F. Food; Sn. Seasoning; Fl. Fuel; Con. Construction; Su. Symbolic Use; O. Ornamental; HI. Household items; Sl. Sale., Part used: Lf. Leaf; Fr. Fruit; Sm Stem; Fl. Flower, Re. Resin; Br. Bark; Rt. Root; Lx. Latex, Fm. Frequency of mention; CVix. Cultural value index.

Biological Growth Form

The biological growth form by category of use reports that herbs are the most used in medicinal aspect, symbolic use and domestic items. For the alimentary, construction, and fuel use, mostly trees are used; in ornamental use, they are mostly epiphytes. While for the seasoning use, the same number of trees and herbs are recognized (Figure 2).

Categories of use

The categories of use granted to species are mentioned according to the number of registered species: medicinal with 46; followed by food use with 35. Other registered uses were fuel (21 species), ornamental (13), construction (9), seasoning (7), symbolic use (3), and the manufacture of household items (1) (Figure 3).

The main botanical families for the medicinal use category were Asteraceae (nine species) and Lamiaceae (seven species). The food category

recorded 14% of species from the Fabaceae family (Figure 4).

The species used in construction are nine and belong to eight families, with Betulaceae being the family with the highest number of species. The ornamental species, comprising 11 belong to the Orchidaceae family, and the Araceae and Rubiaceae families have one species each.

In the fuel category, the Fagaceae family (five species) and Pinaceae family four species stand out. While the symbolic use category groups three species, one for each of the families Asteraceae, Bromeliaceae, and Poaceae, which are used in festivities such as Day of the Dead, Christmas, and the Day of the Cross, respectively. The use of seasoning involves four families, with the most abundant being Lamiaceae and Lauraceae at three species each. Lastly, one species from the Malvaceae family was mentioned for the production of domestic utensils (Figure 3).

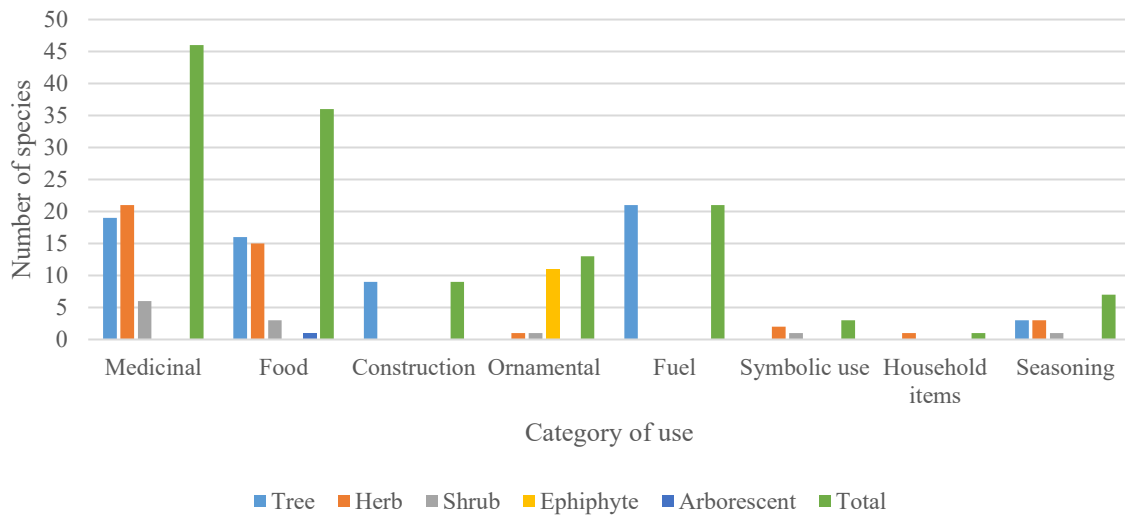


Figure 2. Relationship between species, biological form, and use of plants recorded in the Tepeite and Los Ailes communities, Santa María Ahuacatlán, Morelos, Mexico.

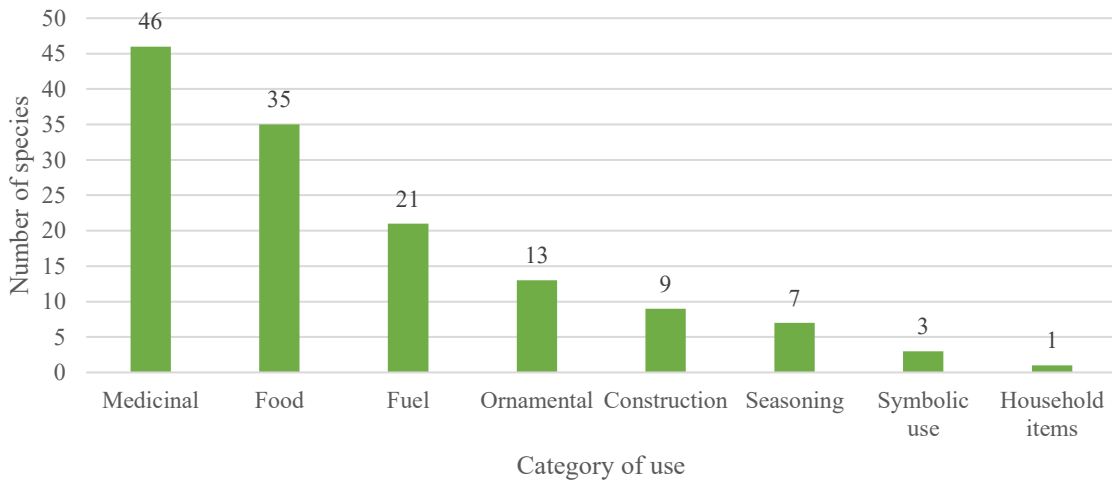


Figure 3. Relationship between the categories of use and the number of registered plant species in the Ailes and Tepeite, Santa María Ahuacatlán, Morelos, Mexico.

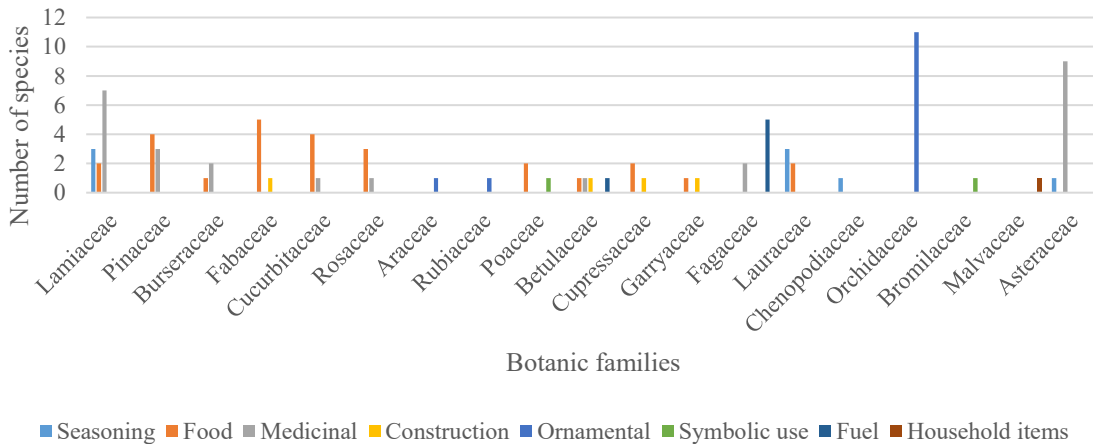


Figure 4. Relationship of species by family with use category.

Medicinal use and treated illnesses

Medicinal species were 46 and recorded from 25 families, treating 12 different illnesses. Plants used for digestive system ailments accounted for nine species musculoskeletal system illnesses and women's ailments such as menstrual cramps accounted for seven species each (Table 2).

Table 2. Proportion of illnesses treated with plants in the Tepeite and Los Ailes communities, Santa María Ahuacatlán, Morelos, Mexico.

Diseases OPS (2003)	Number of species
Digestive system	9
Women's ailments	7
Musculoskeletal system	7
Respiratory system	6
Urinary system	5
Sickness	5
Signs and symptoms	4
Trauma	4
Nervous system	3
Skin and appendage ailments	1
Children's illnesses	1
Therapeutic practices	1

Other illnesses treated with medicinal plants recorded in the studied communities are anemia, and wound healing (aseptic process), fever, injuries, pain in the kidneys, knees, stomach, and head, indigestion, gastritis, preventing loose teeth, alleviating the effects of anger, and relaxing and treating cramps.

The inhabitants of Tepeite and Los Ailes mention ailments such as air which is characterized by headache and general malaise considered according to Kleinman (1988) as sickness, this represents those diseases where the importance of the sickness is highlighted due to its social and cultural connotation, the studied community is aware of the symptoms and factors that cause this illness, and the remedy for relief is using rude (*Ruta chalepensis*).

Another sickness is *mocashanear* (which refers to a postpartum illness that occurs when women do not take care of themselves during the quarantine period. The characteristic symptoms are muscle and joint pains, headaches, mood swings, and bone pain).

This ailment is treated with postpartum baths using *níspero* (*Eriobotrya japonica*) and criollo avocado (*P. americana*) plants. The baths involve steeping the leaves of these plants in hot water and letting them rest. Before leaving the bath, the water is applied to the body.

The illnesses are treated with some parts of the plant (organ, tissue or secretion), such as the leaves with 27 species. The use of flowers accounts for seven species and resin accounts for five species. The use of fruit, bark, latex, stem, and root is also recorded.

Food Category

In terms of food, 34 plant species were reported in both communities, with six species consumed raw, such as plum (*Spondias purpurea*) and peach (*Prunus persica*). Likewise, tea is prepared using four species such as tila flowers (*T. lineata*) and tabaquillo (*Satureja macrostema*). Chayote (*Sechium edule*) is prepared with broth, and gallitos (*Canavalia villosa*) are cooked as fritters. Guajes (*Leucaena leucocephala*) are used in sauce, and lemon (*Citrus aurantiifolia*) is used to make fresh water. Wild nopal (*Opuntia* sp.) is roasted, and chilacayote (*Cucurbita ficifolia*) is used to make candy. Tzompantles (*Erythrina americana*) are prepared with beans, and oats (*Avena sativa*) are boiled. It is worth mentioning that some species have more than one preparation method recorded.

Fuel Category

There are 21 species used for fuel, either as firewood or to make charcoal. The trees used are aguacatillo (*Styrax ramirezzi*), mameyillo (*Clethra mexicana*) and laurelillo (*Quercus laurina*). The local inhabitants use the firewood for cooking. Women collect firewood near their homes or on vegetation-covered paths. Men in the communities make charcoal, which takes about a week to produce, because ovens have to be built and put on the fire, the most appreciated species to generate a "good ember" are the encino de hoja china (*Q. rugosa*).

Ornamental Category

There are 13 ornamental species found in the courtyards of those interviewed, selected for their appearance, color, and shape, and also as an additional source of income through their sale. One example is the white orchid (*Rhynchosstele cervantesii*), which is kept on trees in their yards.

Construction Category

The examples cited for this category in this study are palo de zorro (*Garrya laurifolia*), milpilla (*Carpinus caroliniana*), and palo dulce (*Eysenhardtia polystachya*), with the latter being preferred for outdoor poles due to its harder heartwood, i.e. the center of the stem is more resistant compared to other species. The species in this category are used for constructing poles, fences, house roofs, and benches for seating.

Seasoning Category

Seasoning is defined as a substance added to food to give it more flavor or make it more appetizing. Eight species are used, such as avocado leaves for *clemole* which is beef broth with guajillo chili and vegetables; spearmint leaves for chicken broth, and *pericon* (*Tagetes lucida*) in the cooking of corn, as well as for adding color.

Symbolic use

The leaves of maize *Zea mays*, also called totomoxtle, are used to decorate the crosses that mark the entrance to the Tepeite community during the celebration of the Holy Cross Day on May 3rd. This activity is carried out in the community where the decorations are made and then taken to the crosses distributed throughout the community.

Another species used is the Mexican marigold or pericon (*T. lucida*), with which crosses are made that, according to the responses of the informants, must be placed on the doors of houses during the celebration of Saint Michael on September 30th because it protects them from evil forces that arise on this date. Lastly, the prodigious pineapple (*Tillandsia prodigiosa*) is used to decorate homes during the Christmas season.

Household Items Category

The alacle (*Sida haenkeana*) is the species used to make brooms. For this, they must wait for the grass to grow to a meter in height, then cut it and let it dry. Once dry, they are tied together at one end.

Items for sale

In this case, 47 reported species are sold locally, with the Orchidaceae family standing out by registering 11 species of the plants in this category, followed by Fagaceae with six, and Pinaceae, Cucurbitaceae, and Rosaceae with three each (Table 1). The marketing of these species has typical examples such as traditional charcoal making, they are also collected for firewood, medicine, and decoration.

The plants are sold in the center of Santa María Ahuacatlán on Wednesdays at a tianguis located in the ayudancy, and on Sundays at the town's church.

The main plants sold in different types of measures are:

- Linden flower. Sardina (110 grams) is sold for \$ 2.5 dollars.
- Charcoal and firewood are sold by order.

- Charcoal. It is sold in sacks, with a value of \$ 20 dollars per sack.
- Firewood. It is measured by loads, and a load costs between \$ 10 dollars to \$ 15 dollars.
- Nispero. For sale by bunches (approximately 100 grams) with a price range of \$ 1 dollar:
- Orchids. Prices for these are assigned according to the species, guided by their abundance and distribution in the community. For example, the “white potato orchid” (*Oncidium unguiculatum*) is considered easy to collect since they can be found on the paths, and its price is \$ 5 dollars. On the other hand, the bull orchid (*Stanhopea hernandezii*) is found on rocks or hard-to-reach areas, and if sold, its price is \$ 20 dollars.
- Criollo avocados. These fruits are sold by the pile (three to four avocados) with a price of \$ 3 dollars.

Frequency of mention

The most frequently mentioned species are represented as floristic components of the temperate forest, as examples we have the encino (*Q. obtusata*), encino de hoja ancha (*Q. candicans*), encino de hoja china (*Q. rugosa*), and encino prieto (*Q. crassifolia*) obtained a value of 1.0 (Table 1). The *Quercus* genus species stand out for having multiple uses, i.e., they are used as fuel, medicine, and for constructing fences and houses.

Cultural Value Index

The species with the highest cultural value index correspond to woody plants such as the “criollo” avocado (*Persea americana*) and the Hass avocado (*P. americana* variety hass) with an index of 3.0. These are characteristic of both communities since Ahuacatlán means “place among avocados”. Followed by the Encino de hoja china (*Q. rugosa*), the large-leaved lime flower (*Alnus* sp.), and the “nispero” (*E. japonica*), whose index was 2.0 for each.

DISCUSSION

The availability and utilization of registered plants in the studied communities demonstrate the diversity of vegetal resources at various management levels, as well as the associated knowledge maintained by the inhabitants. The specific richness (n=104) reported in this study corresponds to 17.1% of the total number of useful plant species recorded for Morelos (Monroy-Ortiz & Monroy, 2004). Nationally, it represents 1.33% of the useful plants recorded in the country (n=7823 species) and 7.22% of those documented in

temperate forests (n=1440 species) (Caballero *et al.*, 2022). Regionally, the documented ethnoflora represents 18.06% of the utilized species (n=576) (Blancas *et al.*, 2023) and 8.22% of the vascular flora recorded in COBIO (n=1265) (Flores-Castorena & Martínez-Alvarado, 2010).

The most representative botanical families in terms of the number of species with use were Orchidaceae and Asteraceae. It is common for families with greater species richness to be frequently mentioned in ethnobotanical studies (Silva, 2004), such as orchids and asters within the diversity of vascular flora in Mexico (Villaseñor, 2016) and in COBIO (Flores-Castorena & Martínez-Alvarado, 2010). At the COBIO level, asters contribute the largest number of utilized species; however, this is not the case for orchids, of which (Blancas *et al.*, 2023) reported eleven species in use (1.9% of the ethnoflora in COBIO), a richness similar to what is documented in this study. This may indicate a need for greater ethnobotanical research efforts in the region for this group of plants.

Orchidaceae species are significant as a source of economic income due to their ornamental value, similar to other regions in Mexico where these plants grow (Juárez-Muñoz *et al.*, 2023; Jiménez-López *et al.*, 2019; Molina-Luna *et al.*, 2015). In the central part of the country, practices for their collection and sale, especially for ornamental plants, have been established (Emeterio-Lara *et al.*, 2016). Given the context of utilization both in the study area and other regions, further analysis is needed concerning the number and status of commercially interesting populations, extraction and commercialization volumes, and management strategies related to the use of this plant resource. Orchidaceae is the third richest botanical family in the country (Villaseñor, 2016) and the second in terms of protected plant species within Mexican regulations (SEMARNAT, 2010) with a predominance of direct extraction from wild populations for sale (Emeterio-Lara *et al.*, 2016).

The second most representative botanical family is Asteraceae, with 9.5% of the species. The relevance of the Asteraceae family is explained by its abundance and diversity in Mexico (Monroy-Ortiz & Monroy, 2004; Rzedowski, 1991). It may also be due to their distribution in temperate forests (Rojas, 2006). Species of the *Quercus* and *Pinus* genera are characteristic of the vegetation type in the study area, suggesting that local knowledge and use are linked to the arboreal vegetal resource surrounding the community (Bello-González *et al.*, 2015; Navarro & Avendaño, 2002). This pattern coincides with what Blancas *et al.* (2023) described, noting these genera as the primary ones in terms of the number of useful plant species in the Chichinautzin Biological Corridor. Studies on the use

of oaks in Mexico highlight their timber use due to their physical, mechanical, and anatomical properties, but also their non-timber use (Luna, 2003) as described in this work where residents use *Q. obtusifolia*, *Q. crassifolia*, *Q. laurina*, *Q. obtusata*, and *Q. rugosa* as fuel and as raw material in traditional medicine practices.

The predominant use categories were medicinal and food purposes, which are common in inventories of useful plants (Bernal-Ramírez *et al.*, 2019). This utilization pattern is similar to what is recorded nationally and regionally, where these are the primary reasons mestizo and indigenous groups use their vegetal surroundings (Blancas *et al.*, 2023; Caballero *et al.*, 2022). In these categories, the species recorded in this work represent 58.23% and 50.72% of the medicinal and food plants documented in COBIO (Blancas *et al.*, 2023). However, the ornamental and fuel use of registered plant species in the studied communities also rank among the main forms of flora utilization in the country and COBIO (Blancas *et al.*, 2023; Caballero *et al.*, 2022).

Traditional knowledge associated with the practice of traditional medicine is preserved, recreated, transmitted, and continuously enriched within the social and cultural context of marginalized sectors of society, such as rural areas or urban peripheries. This is the case in the study area, representing a strategy to cope with inequality by providing an affordable and culturally relevant health care option (González, 2017). In this context, many Mexican communities have a diverse and deeply rooted tradition in using medicinal plants, with Asteraceae being one of the botanical families with the most species used for therapeutic purposes (Cilia-López *et al.*, 2021; Heinrich *et al.*, 1998). This study records that 20% of the species belong to this plant group. Half of the medicinal species documented in this study are associated with treating digestive, women's health, and musculoskeletal system diseases. Digestive system ailments are common among many people, with plant-based remedies widely used for their treatment. In Mexico, gastrointestinal diseases are frequent in highly marginalized and impoverished communities, caused by contaminated water or food (Lilian Pérez-Ochoa *et al.*, 2019).

The second most important use category in the studied communities was food use, with 33% of the species, both cultivated and wild, forming part of the inhabitants' food culture. The most mentioned species include *S. purpurea*, *Alnus* sp., *Opuntia* sp., *C. ficifolia*, *S. edule*, *C. villosa*, *E. americana*, *P. americana*, *Psidium guajava*, *Prunus pérsica*, *Citrus aurantium*, *C. aurantiifolia*, *Capsicum pubescens*, and *Beta vulgaris*. While dietary habits have changed over recent decades, with most of the country's population

adopting a more Western diet due to the globalization of food markets (Guibrunet *et al.*, 2023) various food plant resources in Mexico continue to be widely used traditionally by rural populations (Mapes & Basurto, 2016).

The residents of Tepeite and Los Ailes earn economic resources from the sale of plants, fruits, firewood, or charcoal, with the income used to purchase products to complement their basic food basket, as reported in other Morelos communities where the commercialization of vegetal resources contributes to family sustenance (Morayta & Saldaña, 2014; Monroy-Ortiz & Monroy, 2004).

Although the most frequently mentioned species by the inhabitants are floristic components of the temperate forest, such as encinos (*Quercus* spp.), the species with the highest cultural value are woody plants like the native avocado (*P. americana*) and the Hass avocado (*P. americana* variety hass) with an index of 3.0. These are characteristic of both communities since Ahuacatlán means "place among avocados." The importance of this high cultural value fruit species lies in its versatility of uses beyond being a food source, as it is also used for medicinal purposes, as a condiment, and for generating income through sales.

According to the results obtained in this research, various programs and scientific projects related to flora conservation should consider the utilitarian results and economic importance within the social group studied. For example, it is more appropriate to conserve and manage native species, such as the reported oaks used traditionally, to primarily avoid anthropogenic impacts on ecosystems (Castañeda, 2014).

CONCLUSION

The Tepeite and Los Ailes knowledge, use, and management of 104 plant species and a variety with which they meet their basic needs, assigning them eight categories of use, highlighting medicinal and food uses, followed by fuel, ornamental, construction, condiment, symbolic use, and to produce household utensils. These plants are found in home gardens and along forest paths where they appropriate them. Medicinal plants, mostly herbs, are used to treat digestive and gynecological diseases, as well as sickness. The species with the highest cultural importance index were: criollo avocado (*P. americana*) and Hass avocado (*P. americana* variety hass) with an index of 3.0. Followed by "Chinese" (*Q. rugosa*), large leafed lime flower (*Alnus* sp.), loquat (*E. japonica*), and rude (*R. chalepensis*), each with an index of 2.0. Herbs are mostly used for medicinal purposes, while trees are more commonly used as food, fuel, and for construction. 44 % of the species are locally commercialized, which allows peasant families

in the communities to obtain economic income that complements their basic needs. In addition, other activities such as mushroom collection allow them to satisfy their basic needs. As mentioned earlier, these communities have a high index of marginalization and poverty, meaning that traditional and current knowledge, as well as rational management of renewable plant resources, is essential for the survival of people living in these communities.

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Data availability: Data are available with corresponding author (alejandrogarcia@uaem.mx)

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