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Portada



El proceso comunitario de aprendizaje y aprovechamiento sustentable de hongos comestibles a partir de residuos agrícolas, como rastrojo de maíz y frijol, representa una alternativa agroecológica que fortalece la soberanía alimentaria, promueve el uso responsable de recursos locales y contribuye a la revitalización del conocimiento etnomicológico tradicional. La participación comunitaria, el intercambio gastronómico y la transmisión intergeneracional de saberes reflejan la estrecha relación entre patrimonio biocultural, innovación tecnológica y resiliencia social en contextos rurales indígenas.

The community-based process of learning and sustainable use of edible mushrooms through agricultural residues, such as maize and bean straw, represents an agroecological alternative that strengthens food sovereignty, promotes the responsible use of local resources, and contributes to the revitalization of traditional ethnomycological knowledge. Community participation, gastronomic exchange, and the intergenerational transmission of knowledge reflect the close relationship between biocultural heritage, technological innovation, and social resilience in indigenous rural contexts.

por/by
Rafael Fernández Nava

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Departamento de Botánica
Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional
Apdo. Postal 17-564, CP 11410, Ciudad de México

Correo electrónico:
polibotanica@gmail.com
rfernand@ipn.mx

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Medicinal plants used for respiratory diseases among inhabitants of Pisaflores, Hidalgo, Mexico**Plantas medicinales utilizadas para enfermedades respiratorias en habitantes de Pisaflores, Hidalgo, México**

Lara Reimers, Eduardo Alberto; Montesinos Adan, Leonel Rosario; Mora Olivo, Arturo; García Martínez, José Eduardo; Cruz García, Francisco; González Fuentes, José Antonio; Encinas Domínguez, Juan Antonio; Preciado Rangel, Pablo

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Lara-Reimers, Eduardo Alberto / <https://orcid.org/0000-0002-7321-8129>

Departamento Forestal, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.

Montesinos-Adan, Leonel Rosario / <https://orcid.org/0009-0009-0183-3788>

Departamento Nutrición Animal, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.

Mora-Olivo, Arturo / <https://orcid.org/0000-0002-9654-0305>

Instituto de Ecología Aplicada / Facultad de Ingeniería y Ciencias, Universidad Autónoma de Tamaulipas, Ciencias. Centro Universitario Victoria, Ciudad Victoria, Tamaulipas, 87149, México

García-Martínez, José Eduardo / <https://orcid.org/0000-0002-0612-7040>

Departamento Nutrición Animal, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.

Cruz-García, Francisco / <https://orcid.org/0000-0001-5258-3728>

*Autor de correspondencia: guarimochi_494@hotmail.com
Departamento Forestal, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.*

González-Fuentes, José Antonio / <https://orcid.org/0000-0002-0612-7040>

Departamento de Horticultura, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.

Encinas-Domínguez, Juan Antonio / <https://orcid.org/0000-0002-2758-1197>

Departamento de Recursos Naturales, Universidad Autónoma Agraria Antonio Narro, Saltillo, Coahuila 25315, México.

Preciado-Rangel, Pablo / <https://orcid.org/0000-0002-3450-4739>

Facultad de Ingeniería y Ciencias, Universidad Autónoma de Tamaulipas, Centro Universitario Victoria, Cd. Victoria, Tamaulipas 87149, México

ABSTRACT: The main objective of this research was to register the medicinal plants used for respiratory affections. The study considered 20 localities of the Municipality of Pisaflores in the state of Hidalgo, Mexico. Ethnobotanical surveys and interviews were from January to July 2020. A total of 135 collaborators were interviewed, by semi-structured and open-ended interviews in Spanish. The quantitative data were analyzed by using the ethnobotanical index as Cultural Importance (IC), Relative Importance (IR), Family Importance Value (FIV) and Collaborator Consensus Factor (FCI). The Statistical method used in this study is the non-probabilistic snowball method. The survey registered 32 medicinal species distributed in 30 genera, represented in 21 families for the treatment of 12 types of respiratory disorders. The most used species according to the Cultural Importance Index were *Citrus x aurantium* L., *Mentha x verticillata* L., *Bursera simaruba* (L.) Sarg., *Arracacia rigida* J.M.Coult. & Rose., *Tithonia tubeaformis* (Jacq.) Cass., *Bougainvillea glabra* Choisy., *Citrus x aurantifolia* (Christm) Swingle., *Struthanthus quercicola* (Schltdl. & Cham.) D.Don and

Bidens odorata L. The most common conditions treated with these medicinal plants were bronchitis, flu, cough, common cold, fever, sore throat, and pneumonia. The most common disorders and ailments treated with these medicinal plants were bronchitis, flu, cough, cold, fever, sore throat, and pneumonia. The most frequently used parts were the leaves (55%), followed by stems (18%) and flowers (11%), which were administered as infusion (67%) and steam baths (19%). The collaborators described and cited the different uses of these plants because their medicinal uses and effects are well-known in the community for treating respiratory disorders and herbal remedies recorded in this research are the evidence of the people are using and consuming plants frequently along the year to be healthy.

Key words: ethnobotanical Indices, respiratory disorders, cultural importance.

RESUMEN: El objetivo principal de esta investigación fue registrar las plantas medicinales utilizadas para afecciones respiratorias. El estudio consideró 20 localidades del municipio de Pisaflores, en el estado de Hidalgo, México. Las encuestas etnobotánicas y entrevistas se realizaron de enero a julio de 2020. Se entrevistó a un total de 135 colaboradores, mediante entrevistas semiestructuradas y abiertas en español. Los datos cuantitativos fueron analizados utilizando índices etnobotánicos como el Índice de Importancia Cultural (IC), Importancia Relativa (IR), Valor de Importancia Familiar (FIV) y el Factor de Consenso del Informante (FCI). El método estadístico empleado en este estudio fue el método no probabilístico de bola de nieve. La encuesta registró 32 especies medicinales distribuidas en 30 géneros, representados en 21 familias, utilizadas para el tratamiento de 12 tipos de trastornos respiratorios. Las especies más utilizadas según el Índice de Importancia Cultural fueron *Citrus x aurantium* L., *Mentha x verticillata* L., *Bursera simaruba* (L.) Sarg., *Arracacia rigida* J.M.Coult. & Rose., *Tithonia tubaeformis* (Jacq.) Cass., *Bougainvillea glabra* Choisy., *Citrus x aurantifolia* (Christm) Swingle., *Struthanthus quercicola* (Schltdl. & Cham.) D.Don y *Bidens odorata* L. Las afecciones más comunes tratados con estas plantas medicinales fueron para bronquitis, gripe, tos, resfriado, fiebre, dolor de garganta y neumonía. Las partes más utilizadas fueron las hojas (55%), seguidas por los tallos (18%) y las flores (11%), las cuales se administraron principalmente en infusión (67%) y en baños de vapor (19%). Los colaboradores describieron y mencionaron los diferentes usos de estas plantas debido a que sus propiedades medicinales y efectos son bien conocidos en la comunidad para el tratamiento de trastornos respiratorios, y los remedios herbales registrados en esta investigación son evidencia de que la población sigue utilizando y consume plantas a lo largo del año para mantenerse saludables.

Palabras clave: índices etnobotánicos, trastornos respiratorios, importancia cultural.

INTRODUCTION

For centuries, humanity has turned to nature to meet its basic needs. Medicinal plants are part of traditional medical system, which can maintain health and improve quality of life (Prieto *et al.*, 2004). It's estimated that around 80% of the world's population relies on herbal medicine, and at least 35,000 plants have medicinal potential for use in human health (Annan & Houghton, 2008). In Mexico, there are more than 23,400 vascular plants and 5,000 species used for medicinal purposes. The most important families for medicinal use in Mexico and other countries are Asteraceae, Lamiaceae, Fabaceae, and Euphorbiaceae (Casas, *et al.*, 2001; Camou-Guerrero *et al.*, 2008; Alonso-Castro *et al.*, 2012).

Medicinal plants are important in public health, especially in areas where ancient customs and uses of these species are still preserved and, of course, where plants remain a valuable resource of food, material construction, fodder, fibers, textile, traditions, religion, and the most important medicine (Süntar, 2020). Some indigenous communities have great knowledge about medicinal, food, spiritual herbs, and the knowledge of growing these plants, this knowledge passed down through generations forms the basis of global biocultural diversity and the sustainable use of these resources. Nevertheless, it is necessary to promote support actions that guarantee the conservation of these plants and create written records that encourage more in-depth studies of their therapeutic

properties (Gómez-Álvarez, 2012). Currently, ancient knowledge accumulated of medicinal plant uses over time is in danger, it is due to the form in the oral transmission of the knowledge from one person to another person, globalization, the new health care system, migration, and the lack of written records (Hernández-Álvarez *et al.*, 2009).

In Mexico, as in other countries, medicinal plants are a basic part of the group of users and low-cost resources (Torres, 1999). According to Pérez-Padilla (2001) in Mexico and other countries, respiratory affections have low visibility and priority, a result of that a historical emphasis has been given to disease infectious and then cardiovascular and more recently cancer in general and metabolic disorders like diabetes and obesity. According to Masera, K *et al.*, (1992) and Hernández-Garduño *et al.*, (2017), in Mexico, firewood is widely used in communities for cooking, this is used in 69% of households, and it is associated with causing bronchitis and obstructive respiratory problems, reducing quality of life in rural inhabitants.

There are communities that lack medical services where midwives, shamans, or healers are responsible for the health of the local inhabitants, but where medical services are available, patients also use traditional medicine as complementary multi treatment. Several groups of diseases highlight the need to strengthen assistance and training programs for both adults and children. In adults, these include **cor pulmonale** (enlargement of the right ventricle of the heart due to chronic lung disease), **pulmonary hypertension and vascular diseases**, **obesity-related hypoventilation and sleep apnea syndrome** (already a major source of morbidity and increasing in parallel with obesity) **thoracic tumors** (both benign and malignant), **respiratory complications of HIV**, and **acute and chronic respiratory failure**. Nevertheless, the majority of respiratory-related deaths are caused by **pneumonia and influenza** (Pérez-Padilla, 2018).

In central Mexico, particularly in the state of Hidalgo, some studies have been carried out on the traditional use of medicinal plants (Sánchez-González *et al.*, 2008; Molina-Mendoza *et al.*, 2012). However, some regions in the north of the state have not yet been explored in this sense, as is the case of the municipality of Pisaflores, where herbal medicine in rural communities is important in the attention to health problems. Currently, there are no research or written records on plants and their uses for respiratory disorders in the study region, therefore the main objective was to carry out this type of research that helps to rescue, preserve, and promote traditional local medicine knowledge used for respiratory disorders.

Because more than 60% of the localities in the Municipality of Pisaflores, belong to isolated rural communities, difficult to access, with high poverty rates and public health services are scarce and inefficient, the inhabitants continue resorting to traditional medicine to treat their diseases in the first instance, however, this study would be the first record of ethnomedicinal uses with its epidemiological picture in the municipality.

METHODOLOGY

Study area

Ethnomedicinal information for respiratory disorders were obtained from twenty localities: Chalahuite, El Rayo, La Ameca, Pisaflores, San Pedro, Las Moras, El Bonigu, El Garabato, Gargantilla, San Rafael, Tlacuilola, El Caracol, El Zacatal, La Arena, El Higuerón, El Amolar, El Cuamirro, El Pie De La Cuesta, Palmitas, Plan De Ayala (Figure 1).

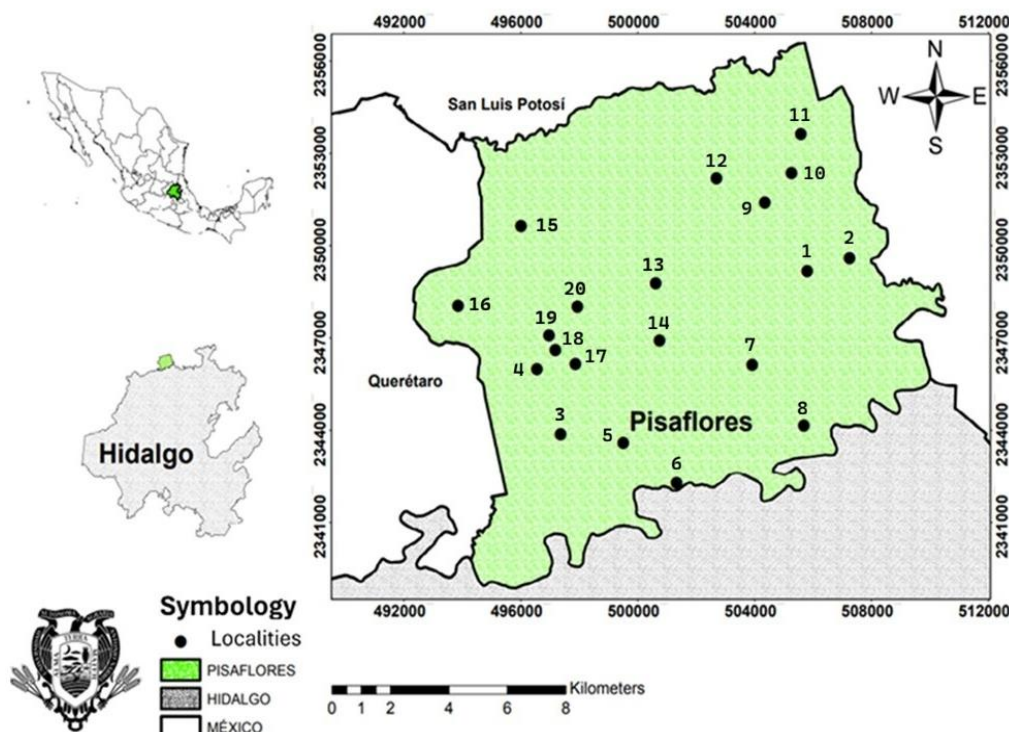


Figure 1. Study area and communities sampled in Pisaflores, Hidalgo. Chalahuite (1), La Ameca (2), El Pie De La Cuesta (3), El Cuamirro (4), Pisaflores (5), Plan De Ayala (6), El Caracol (7), El Garabato (8), Gargantilla (9), La Arena (10), Las Moras (11), El Amolar (12), El Bonigu (13), San Pedro (14), San Rafael (15), Tlacuilola (16), El Zacatal (17), El Higuérón (18), Palmitas (19) and El Rayo (20).

Figura 1. Área de estudio y comunidades muestreadas en Pisaflores, Hidalgo. Chalahuite (1), La Ameca (2), El Pie De La Cuesta (3), El Cuamirro (4), Pisaflores (5), Plan De Ayala (6), El Caracol (7), El Garabato (8), Gargantilla (9), La Arena (10), Las Moras (11), El Amolar (12), El Bonigu (13), San Pedro (14), San Rafael (15), Tlacuilola (16), El Zacatal (17), El Higuérón (18), Palmitas (19) y El Rayo (20).

The municipality of Pisaflores is located north of the State of Hidalgo, between parallels $21^{\circ} 08'$ and $21^{\circ} 19'$ north latitude; the meridians $98^{\circ} 53'$ and $99^{\circ} 05'$ of west longitude; at an altitude above sea level between 200 and 1,500 m. It borders to the north with the state of San Luis Potosí; to the east with the state of San Luis Potosí and the municipality of Chapulhuacán; to the south with the municipalities of Chapulhuacán and La Misión; to the west with the states of Querétaro and San Luis Potosí (Figure 1). It occupies 0.87% of the surface of the State, has 84 municipalities with around 4,690 (4,514 rural and 176 urban) localities and a total population of 3,082,841 inhabitants (INEGI, 2020). Pisaflores is located in the Sierra Hidalguense and its terrain is made up of hills and ravines, of very fertile land with an abundance of water, and this makes it present a high plant diversity.

The climates that the municipality of Pisaflores represents are humid semi-warm with rains all year. The temperature range corresponds to $18 - 24^{\circ}\text{C}$ and a precipitation range of 1,100 to 2,600 mm.

The use of land for the agricultural sector is 12% and the urban sector occupies 0.38%, within the municipality, there are three types of vegetation such as tropical and subtropical forest (63%), forest (17%), and grassland (7.62%) According to (INEGI, 2009), there are in the municipality of Pisaflores 18,244 inhabitants, of which 9,115 are men and 9,129 are women. The percentage of the indigenous population corresponds to 2.09%. The average size of households in the municipality is 4.4 members (INEGI, 2009).

In 2010, the percentage of people without access to health services was 14.9%, equivalent to 2,533 people, this is because more than 60% of the population live in rural conditions. The degree of marginalization found is high with 78.3% of its population in multidimensional poverty, of which 30.9% suffers extreme poverty, there are 42 localities with medium lag, proportional to 59.7% of the population, while 5.9% of the population lives with low social backwardness. The study area faces a real challenge to achieve sustainable economic development since the main economic activity is the primary sector (agriculture); however, it has not been possible to exploit and generate an improvement in this activity.

Ethnobotanical Protocols and Consent

Ethnobotanical protocols were strictly followed in accordance with Martin (2004) during the interview period spanning January to July 2020. Ethnomedicinal data were obtained through semi-structured and open-ended interviews. Prior Informed Consent (PIC) was secured in writing using a questionnaire specifically designed for the documentation of ethnomedicinal knowledge (Alexiades, 1995).

Participants and Data Collection

A total of 135 local collaborators of varying age groups, gender, educational levels, and experiential backgrounds in the use of plants as traditional remedies for respiratory affections were interviewed. For each plant species reported, the following information was systematically recorded: Vernacular name, Source of acquisition, Plant part utilized, Mode of traditional preparation, Sociodemographic profile of the collaborators (age, gender, economic activity, educational background).

A non-probabilistic snowball sampling method was employed (Goodman, 1961), wherein initial collaborators identified subsequent participants until a sufficient sample size was achieved (Salamanca & Martín-Crespo, 2007). Interviews were conducted face-to-face; the majority of respondents were housewives.

Data Processing and Indices

Both qualitative and quantitative data regarding the use and prioritization of medicinal plant species were analyzed through the application of ethnomedicinal indices. Additional information was collected on practices related to harvesting, drying, storage, and processing of medicinal plants.

Respiratory affections reported by collaborators were classified into 8 major categories, following the International Statistical Classification of Diseases and Related Health Problems (WHO, 2008).

Plant Specimen Collection and Identification

Plant species employed in the treatment of respiratory disorders in the municipality of Pisaflores were collected, dried, and preserved for taxonomic identification (Lot & Chiang, 1986). Voucher specimens were deposited in the Herbarium of the Universidad Autónoma Agraria Antonio Narro (UAAAN), Department of Botany. Botanical nomenclature and family assignments were verified using:

Flora Fanerogámica del Valle de México (Calderón & Rzedowski, 2001)

Flora de Chihuahua (Villarreal-Quintanilla *et al.*, 2017)

International Plant Names Index (IPNI; <https://www.ipni.org>)

Web of Science and Google Scholar

Data Management

All information was initially recorded using pre-prepared physical forms during fieldwork. Subsequently, data were digitized and organized into a Microsoft Excel 2010 database, where ethnomedicinal indices were applied for systematic analysis.

Ethnobotanical indices

Relative frequency of citation (RFC) and family importance value (FIV)

Traditional knowledge was quantitatively assessed using various measures like RFC, FIV, Use Value (UV), and Factor Informant Consensus (FIC). RFC and FIV were calculated to quantitatively determine the consensus between the collaborators on the use of wild medicinal plants in the region. It gives the local importance of a species or a family. RFC was calculated using the standard method of Vitalini *et al.* (2013), which is:

$$RFC = \frac{FCs}{N} = \frac{\sum_{i=1}^N URi}{N}$$

The value of RFC for species and families of medicinal plants is based on the citing percentage of collaborators for that particular species and family. RFC is the relative frequency citation; FC is the number of collaborators who mentioned the species while N is the total number of collaborators participating in the study. UR is all the information data that were tabulated and analyzed according to the quantitative ethnobotanical indices described in the following sections. Family importance value (FIV) was calculated by taking the percentage of collaborators mentioning the family.

$$FIV = \frac{FC \text{ (familiar)}}{N} (100)$$

where, FC is the number of collaborators mentioning the family while N is the total number of collaborators participating in the study.

Cultural importance index (CI)

The cultural importance index (Reyes-García & Martí-Sanz, 2008) reflects a measure of relative importance per plant use. This index considers not only the spread of the use (number of collaborators) for each species, but also its versatility (i.e., the diversity of its uses). The index was calculated using the following formula:

$$CIe = \sum_{u=1}^{uNC} \sum_{i=1}^{iN} URuie / N$$

The theoretical maximum value of the index is the total number of different use-categories (NC), reached in the unlikely case that all the collaborators mention the use of a particular species for all the use categories considered in the survey. In the case of a species with only one use, this index would be equal to the RFC index.

Informant consensus factor (ICF)

The informant consensus factor expresses whether there is agreement among collaborators on the use of plant species in particular ailment categories (Heinrich *et al.*, 1998):

$$ICF = \frac{nUR - nt}{nUR - 1}$$

In this formula, nUR is the number of use reports for a particular ailment category, and nt is the number of species used for that ailment category by all the collaborators. The range of the index is between 0 and 1, with a higher number (close to 1) reflecting agreement among the collaborators that the plant is used to cure a particular ailment category (Gazzaneo *et al.*, 2005).

RESULTS

Demographic characteristics of collaborators

The demographic data collaborators are presented in Table 1. A total of 135 interviews were carried out; the most interviewed collaborators in this research were women (Female: 79%; Male: 21%).

Table 1. Demographic characteristics of 150 collaborators.

Tabla 1. Características demográficas de 150 colaboradores.

Demographic variable	Demographic category	Number of collaborators	%	Average number of plant species cited
Gender	Male	28	21	19.21
	Female	107	79	27.29
Age	20-30	2	1	18
	31-40	17	13	20.52
	41-50	29	21	19.27
	51-60	13	10	24.23
	61-70	25	19	25.64
	> 71	49	36	31.81
Residence location	Rural	123	91	25.17
	Urban	12	9	31.92
Health insurance	Insured	131	97	25.23
	Uninsured	4	3	32.00
Occupation	House wife	105	78	27.42
	Farmer	10	7	17.7
	Merchant	4	3	21.75
	Cattle rancher	2	1	21.5
	Others	14	11	19.61

Female collaborators are usually in charge of preparing herbal remedies to treat respiratory diseases and take care of sick relatives, while the men work in the field. All the information was categorized into different sociodemographic categories. Based on age, collaborators were classified into six major groups. The most represented group was aged above 71 years (49 collaborators), representing 36% of the total. The older the people, the higher the number of cited plants: ages 20–30 cited 18 plants, while those >71 cited 31 plants. Most of the interviewees belonged to rural communities, representing 92% of the total, while 8% came from the municipal seat (urban area). Even though 97% of the collaborators have health insurance, they reported using medicinal plants as their primary health care option.

Ethnobotany data: life forms and herbal preparations

The ethnopharmacological survey revealed 32 species belonging to 30 genera, represented in 21 families, for treating 12 respiratory affections. In most cases, collaborators preferred herbal remedies over visiting clinics due to the long distances to health facilities and the associated economic costs. Regarding plant life forms, herbs accounted for 55%, shrubs 19%, and trees 26% (Figure 2a).

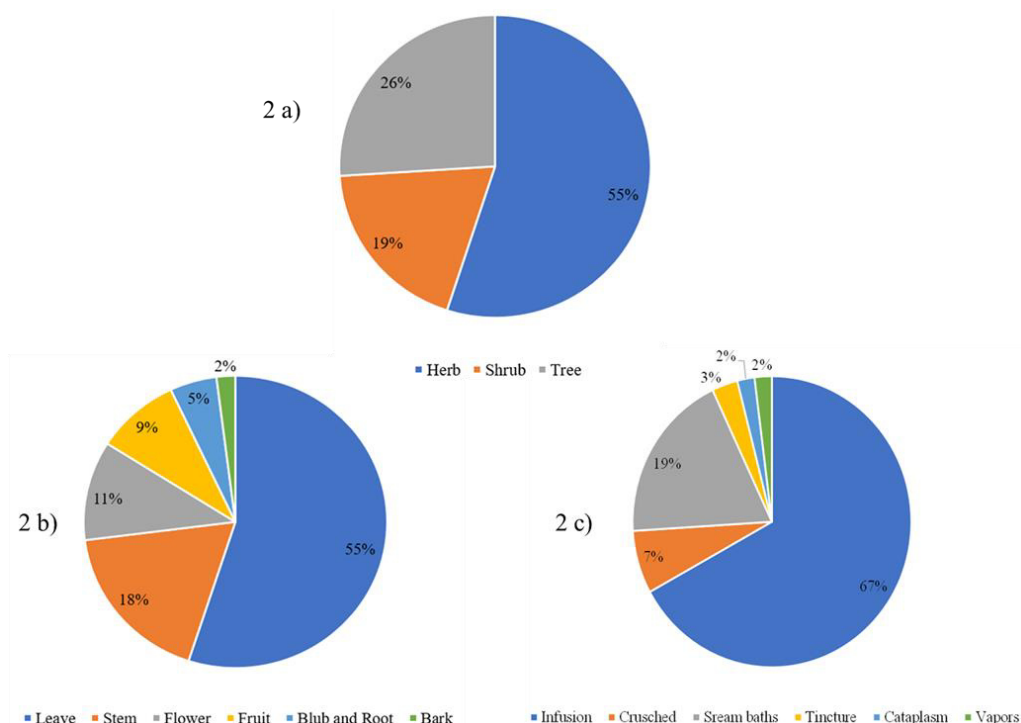


Figure 2. Ethnobotanical knowledge: **2 a)** Life forms of traditional plants. **2 b)** Plant part used. **2 c)** Preparation mode of herbal remedies.

Figura 2. Conocimiento etnobotánico: **2 a)** Formas de vida de las plantas tradicionales. **2 b)** Parte de la planta utilizada. **2 c)** Modo de preparación de los remedios herbales.

The most frequently used parts of the plants were the leaves (55%), followed by stems (18%), flowers (11%), fruits (9%), bulbs and roots (5%), and barks (2%) (Figure 2b). Herbal remedies used plant parts that were usually fresh. This could be explained by the availability of all plants in the region, with 86% of collaborators growing medicinal plants in their backyards. However, all of them reported still engaging in wild gathering.

The most important administration modes were infusion (67%), steam baths (19%), raw-crushed (7%), tincture (3%), vapours (2%), and cataplasms (2%) (Figure 2c). In terms of disease therapy, locals preferred using 32 medicinal plants to treat different disorders and ailments (cough, body weakness-immune system strengthening, sore throat, fever nasal congestion (profuse mucous discharges) related with the respiratory system and diseases such as asthma, bronchitis, flu, pneumonia, cold, asthmatic cough (bronchial problems), and tuberculosis. It is very common for inhabitants to use mixtures of different species to treat the mentioned disorders. Vapors and steam baths were used by inhaling steam and smoke through the nose and mouth.

Family importance value (FIV)

The most common families described in the FIV results were Rutaceae, which was the dominant family with 87 FIV, followed by Lamiaceae (44), Apiaceae and Burseraceae (38 each), Asteraceae (32), Nyctaginaceae (29), Loranthaceae (20), and Myrtaceae (10). The families with the least FIV values were Amaryllidaceae, Boraginaceae, Ranunculaceae, and Sapotaceae (1.5 FIV each), as well as Crassulaceae, Fabaceae, and Meliaceae (0.7 FIV each). The families most frequently found in the municipality were Rutaceae (26% of Uses Report), Lamiaceae (13.3%), Apiaceae and Burseraceae (11.3% each), and Asteraceae (9.6%) (Figure 3).

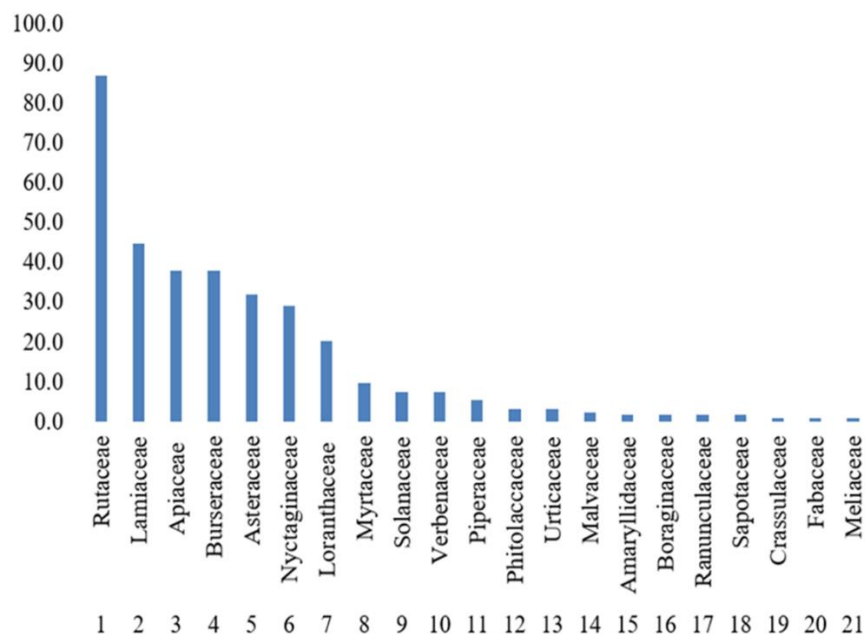


Figure 3. Family Importance Value.
Figura 3. Valor de importancia familiar

The Rutaceae family showed the most diverse uses for treating various respiratory ailments such as colds, bronchitis, coughs, and flu. Lamiaceae and Verbenaceae were mainly used to strengthen the immune system and treat coughs. Burseraceae and Apiaceae were effectively used to reduce fever. Nyctaginaceae was used exclusively to treat coughs, Loranthaceae for bronchitis, Myrtaceae for asthmatic cough, and Urticaceae appeared to have a specific therapeutic effect against tuberculosis (Figure 4).

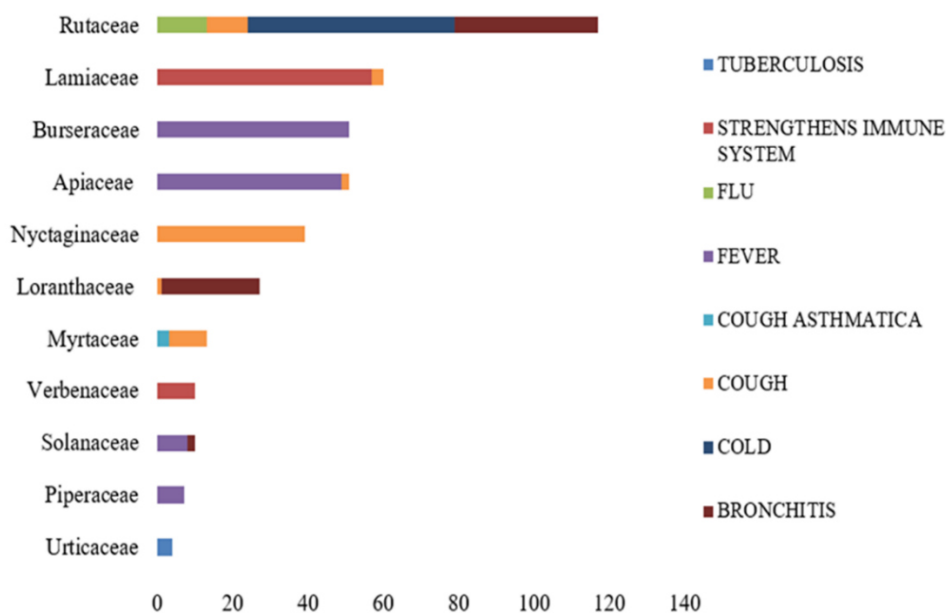


Figure 4. Report of uses by family and affections.
Figura 4. Reporte de usos por familia y afecciones.

Relative frequency citation (RFC) and affections

Relative Frequency Citation, it shows those medicinal plants occurring more frequently by the collaborators. The collaborators usually described and cited the following plants because its medicinal uses and effects are well-known in the community for treating respiratory disorders. All collaborators (100%) reported actively using medicinal plants to treat respiratory disorders. The most consumed plant species cited by the collaborators for this index were *Mentha x verticillata* L. (0.380), *Bursera simaruba* (L.) Sarg. (0.340), *Arracacia rigida* J.M.Coult. & Rose. (0.327), *Bougainvillea glabra* Choisy (0.260), *Citrus x aurantifolia* (Christm) Swingle (0.253), *Struthanthus quercicola* (Schltdl. & Cham.) D.Don (0.173), *Bidens odorata* L. (0.127), *Citrus limon* (L.) Osbeck (0.087), *Citrus x aurantium* L. (0.073), *Petrea volubilis* L. (0.067), and *Piper trigonum* C.DC (0.047) (Figure 5).

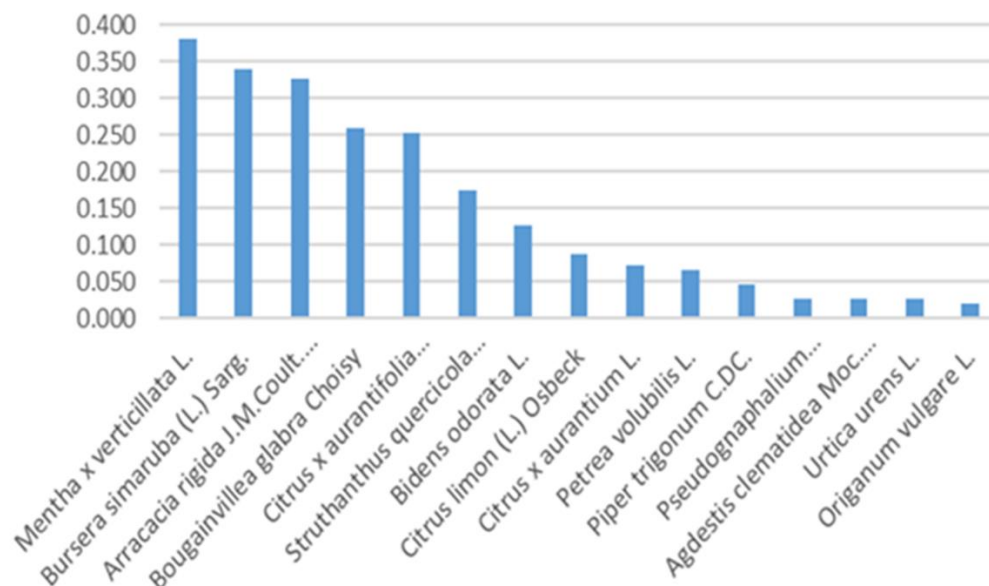


Figure 5. Relative Frequency Citation (RFC).

Figura 5. Frecuencia relativa de citas (RFC).

The documented species demonstrate a clear ethnomedicinal focus on respiratory health, with infusions predominating as the preparation method. Treatments addressed both common respiratory infections (cough, cold, flu, bronchitis) and systemic conditions (fever, tuberculosis, body weakness), highlighting the diversity of traditional therapeutic strategies in the studied community.

Ethnomedicinal Uses of Documented Plant Species

1. Respiratory Infections and Symptom Relief

Several species were employed to alleviate cough, sore throat, flu, cold, and related respiratory conditions, primarily through infusions:

Mentha x verticillata: most frequently cited, used as fresh infusions (two to three times daily) for body weakness, sore throat, flu, cold, and cough.

Bougainvillea glabra: floral infusions administered for cough and early manifestations of influenza and the common cold.

Citrus x aurantifolia: leaf and fruit infusions for bronchitis, cough, and nasal congestion.

Struthanthus quercicola: infusions for bronchitis.

Bidens odorata: infusions for pulmonary disease, cough, sore throat, and nasal congestion.

Citrus limon and *Citrus × aurantium*: leaf and fruit infusions to relieve sore throat, cough, flu, and cold.

Eucalyptus globulus and *Pseudognaphalium oxyphyllum*: teas prepared for cough, asthma, nasal congestion, and asthmatic cough.

2. Fever Management

Plants were applied through external methods such as steam baths and cataplasms to reduce fever:

Bursera simaruba: steam baths with fresh leaves.

Arracacia rigida: cataplasms applied to the head, chest, back, or neck.

Piper trigonum: steam baths for fever reduction.

3. Immune Support and General Strengthening

Petrea volubilis: reported to enhance body strength and support immune function.

4. Severe Respiratory Conditions

Urtica urens: infusions cautiously prepared for tuberculosis due to its irritant properties.

Cultural importance index (CI)

The results showed the highest values in the Cultural Importance index (CI) for the following species (Table 2):

Table 2. Cultural importance index.
Tabla 2. Índice de importancia cultural.

Common name	Scientific name	Cultural importance index
Naranja agria	<i>Citrus x aurantium</i> L.	0.4889
Hierba Buena	<i>Mentha x verticillata</i> L.	0.4222
Chaca	<i>Bursera simaruba</i> (L.) Sarg.	0.3778
Hierba del oso	<i>Arracacia rigida</i> J.M.Coult. & Rose.	0.3638
Acahual	<i>Tithonia tubeaformis</i> (Jacq.) Cass.	0.3185
Camelina morada	<i>Bougainvillea glabra</i> Choisy	0.2889
Lima chichona	<i>Citrus x aurantifolia</i> (Christm) Swingle	0.2815
Injerto de limón-naranja	<i>Struthanthus quercicola</i> (Schltdl. & Cham.) D.Don	0.2
Aceitilla- Mozote	<i>Bidens odorata</i> L.	0.1556
Gordolobo	<i>Pseudognaphalium oxyphyllum</i> (DC.)	0.1259
Eucalipto	<i>Eucalyptus globulus</i> Labill.	0.0963
Limón	<i>Citrus limon</i> (L.) Osbeck	0.0963
Rapa sombrero	<i>Petrea volubilis</i> L.	0.0741
Cordonsillo	<i>Piper trigonum</i> C.DC.	0.0519
Hinojo	<i>Foeniculum vulgare</i> Mill.	0.0296
Tripa de vaca	<i>Agdestis clematidea</i> Moc. & Sessé ex	0.0296
Chapada	<i>Cestrum nocturnum</i> L.	0.0296
Ortiga	<i>Urtica urens</i> L.	0.0296
Oregano	<i>Origanum vulgare</i> L.	0.0222
Malvarisco blanco	<i>Sida rhombifolia</i> L.	0.0222
Hierba mora	<i>Solanum nigrum</i> L.	0.0222
Jitomate	<i>Lycopersicon esculentum</i> L.	0.0222

Common name	Scientific name	Cultural importance index
Ajo	<i>Allium sativum</i> L.	0.0148
Cempasúchitl	<i>Tagetes erecta</i> L.	0.0148
Barba de chivo	<i>Clematis grossa</i> Benth.	0.0148
Mamey	<i>Pouteria glomerata</i> (Miq.) Radlk.	0.0148
Borraja	<i>Borago officinalis</i> L.	0.0074
Lentejuelilla	<i>Lepidium virginicum</i> L.	0.0074
Admirable	<i>Kalanchoe pinnata</i> (Lam.) Pers.	0.0074
Cabello de angel	<i>Calliandra houstoniana</i> var. <i>anomala</i> (Kunth) Barneby	0.0074
Cedro	<i>Cedrela odorata</i> L.	0.0074

Informant Consensus Factor (ICF)

The most frequently treated affections were fever, and the main affections using medicinal plants were bronchitis, cold, and asthma. Locals commonly consume herbal remedies to prevent infections and strengthen their immune system, especially when experiencing body weakness.

The Informant Consensus Factor (ICF) results showed a high degree of agreement among collaborators regarding the use of plants against respiratory infections (Table 3), indicating specific plant use with potential biological activity. Peppermint (*Mentha x verticillata* L.) was the most cited species, with 55 use reports. It is commonly used to treat respiratory problems, digestive issues, nausea, and vomiting.

Table 3. ICF values of traditional medicinal plants for treating respiratory problems in the study region.
Tabla 3. Valores de ICF de plantas medicinales tradicionales para el tratamiento de problemas respiratorios en la región de estudio.

Affections Disorders and ailments	Plant species	Number of taxa (nt)	Uses report (UR)	ICF
Cold	<i>Citrus x aurantium</i> L. (55)	1	55	1
Flu	<i>Citrus limon</i> (L.) Osbeck (13)	1	13	1
Body weakness (Strengthens immune system)	<i>Mentha x verticillata</i> L. (55), <i>Petrea volubilis</i> L. (10), <i>Allium sativum</i> L. (1)	3	68	0.970
Fever	<i>Bursera simaruba</i> (L.) Sarg. (51), <i>Arracacia rigida</i> J.M.Coult. & Rose. (49), <i>Piper trigonum</i> C. DC. (7), <i>Agdestis clematidea</i> Moc. & Sessé ex DC. (4), <i>Sida rhombifolia</i> L. (3), <i>Lycopersicon esculentum</i> L. (3), <i>Solanum nigrum</i> L. (3), <i>Cestrum nocturnum</i> L. (2) <i>Tagetes erecta</i> L. (2), <i>Lepidium virginicum</i> L. (1), <i>Kalanchoe pinnata</i> (Lam.) Pers. (1), <i>Cedrela odorata</i> L. (1)	12	127	0.913

Affections Disorders and ailments	Plant species	Number of taxa (nt)	Uses report (UR)	ICF
Cough	<i>Bougainvillea glabra</i> Choisy (39), <i>Bidens odorata</i> L. (19), <i>Pseudognaphalium oxyphyllum</i> (DC.) Kirp. (13), <i>Citrus x aurantium</i> L. (11), <i>Eucalyptus globulus</i> Labill. (10), <i>Origanum vulgare</i> L. (3), <i>Pouteria glomerata</i> (Miq.) Radlk. (2), <i>Struthanthus quercicola</i> (Schltdl. & Cham.) D.Don (1), <i>Calliandra houstoniana</i> var. <i>anomala</i> (Kunth) Barneby (1), <i>Borago officinalis</i> L. (1), <i>Allium sativum</i> L. (1), <i>Tagetes erecta</i> L. (1), <i>Foeniculum vulgare</i> Mill. (2), <i>Tithonia tubeaformis</i> (Jacq.) Cass. (2)	14	106	0.876
Sore throat,	<i>Bidens odorata</i> L. (1)	1	1	0
Nasal congestion	<i>Clematis grossa</i> Benth. (1)	1	1	0
Diseases				
Tuberculosis	<i>Urtica urens</i> L. (4)	1	4	1
Bronchitis	<i>Struthanthus quercicola</i> (Schltdl. & Cham.) D.Don (26), <i>Citrus x aurantifolia</i> (Christm) Swingle (38), <i>Cestrum nocturnum</i> L. (2), <i>Clematis grossa</i> Benth. (1)	4	67	0.955
Asthma	<i>Pseudognaphalium oxyphyllum</i> (DC.) Kirp. (4), <i>Eucalyptus globulus</i> Labill. (3)	2	7	0.833
Pneumonia	<i>Bidens odorata</i> L. (Pneum. 1)	1	1	0

DISCUSSION

Studies such as that Case *et al.*, 2005, indicate that the use and knowledge of medicinal plants increase with geographic isolation and that people use more medicinal species due to the lack of health centres and pharmaceutical supplies in remote regions. Other studies, such as Ceuterick *et al.* (2008), suggest that the use of medicinal plants correlates with low economic resources and a lack of health insurance. However, in this study, most of the collaborators had insurance but still preferred traditional remedies. It is also important to note that in Mexico, knowledge about herbal uses is traditionally transmitted orally among locals, often passed down by relatives who use plants for medicinal or magical-religious purposes (Lara-Reimers *et al.*, 2018). Another important point to highlight in this study is that the majority of the collaborators turned out to be housewives. This coincides with what was reported in previous studies (Nunkoo & Mahomoodally, 2012; Lara-Reimers *et al.*, 2018, which describe how, in most research, women commonly have greater knowledge of medicinal plants and men of timber and craft plants, due to their roles within the family.

Herbal preparations and respiratory disorders

The main reason for using plants fresh is that, in this way, most of the bioactive compounds are preserved, which results in a greater medicinal effect (Siew *et al.*, 2014). Leaves are the most frequently used organ, partly due to their ease of collection and transport throughout the year. Additionally, they are one of the organs with the highest content of bioactive compounds (Ayyanar & Ignacimuthu, 2011; Dávila-Rangel *et al.*, 2024). According to Cruz-Pérez *et al.*, (2021), local communities collect wild plants through selective harvesting, extracting only the parts of interest such as leaves, fruits, or bark in small quantities and only when needed. This practice prevents the complete removal of individuals and contributes to ensuring the regeneration and persistence of medicinal plant species. Similarly, Papageorgiou *et al.*, (2020)

point out that local medicinal plant gatherers employ sustainable harvesting practices, such as collecting only small quantities or specific plant parts (leaves, flowers, or stems) and avoiding the complete removal of individuals, in order to promote the natural regeneration of populations and ensure the persistence of wild medicinal species.

Most of the investigations indicate that the use of plants is most common through infusion, likely due to the ease of preparation. Additionally, they can be used alongside medicines, which becomes a standard method among the inhabitants. This practice is thought to provide better results, save money, and reduce the side effects of medications (Picking *et al.*, 2011). When making mixtures of different species, the range of bioactive compounds increases, which can modify their effect, either enhancing or reducing the medicinal effect (Aniya *et al.*, 2020).

Medicinal plants, as described by Corroto *et al.* (2021), hold socioeconomic importance for communities that practice traditional medicine. Herbal remedies offer both nutritional and active health benefits. Consequently, communities utilize the medicinal plants found in their region and assign specific uses to them for various diseases based on the outcomes they observe.

Relative Frequency Citation (RFC) and Affections

The high RFC values for species like *Mentha x verticillata*, *Bursera simaruba*, and *Arracacia rigida* reflect their cultural importance and trusted efficacy within the community for managing respiratory disorders. The use of plants is influenced by knowledge about them and their distribution, as well as by cultural values and socio-economic activities specific to a given region. Although these plants may be present in other communities and ecosystems, their density or use can be limited or non-existent due to factors such as lack of awareness, species growth dynamics and dominance, the ecological role they play in their environment, and their relationship with local inhabitants (Hinton *et al.*, 2019). The repeated use of infusions and steam baths highlights the simplicity, accessibility, and effectiveness of traditional preparation methods.

The preference for fresh plant material, observed earlier, is consistent with the preparation of most of these remedies. The combination of different plant parts (leaves, stems, roots, and fruit) and their specific applications (e.g., teas, steam baths, cataplasms) indicates a complex and localized knowledge system grounded in empirical observation.

Moreover, the reported use of *Urtica urens* for tuberculosis and the caution required in its preparation underline the depth of traditional understanding, not only about benefits but also about risks. This reinforces the importance of preserving and documenting ethnopharmacological knowledge, which remains crucial for primary healthcare in rural and underserved areas. Mzid *et al.*, (2017) reported that the leaves of *Urtica urens* contain phenols, flavonoids, and tannins as major phytochemical components, and that extracts of this plant demonstrated significant antioxidant activity and anti-inflammatory effects in experimental models, thereby supporting the traditional medicinal use of this species. However, Carvalho *et al.*, (2017), in their study on the phenolic composition, safety, and biological activities of species of the genus *Urtica* (including *Urtica urens*), indicated that although the extracts did not show cytotoxicity at bioactive concentrations, safety reports include mild gastrointestinal disturbances and allergic reactions as potential adverse effects in humans. Therefore, it is important to consider and report these effects when using nettle-based preparations.

Cultural Importance Index (CI)

The Cultural Importance index (CI) reflects a measure of the relative significance of plant use within a community, considering both the number of collaborators citing a plant and the diversity of its uses (Reyes-García & Martí-Sanz, 2008). The high CI values observed indicate that these species are widely recognized for their effectiveness in treating respiratory ailments such as throat infections, colds, flu, and bacterial complications (table 2). Suggesting that these plants may have a greater likelihood of exhibiting bioactive properties compared to other species. The cultural importance of species is closely linked to sociocultural factors and ethnic identity. In Oaxaca (Cruz-Pérez *et al.* 2021), patterns of specialization in the use of medicinal plants have been documented among different ethnic groups. For example, the Zapotec and Zoque primarily use plants to treat conditions related to pregnancy, childbirth, and the postpartum period, whereas the

Mazatec, Mestizo, Mixtec, Mixe, and Chinantec mainly employ them for digestive disorders, injuries, and culture-bound syndromes such as mal de ojo (evil eye) and espanto.

This suggests that the selection and valuation of species respond not only to their ecological availability but also to specific health needs and cultural frameworks. Therefore, the high CI values observed in this study may reflect a local therapeutic specialization focused on respiratory ailments, highlighting the close relationship between culture, health, and biodiversity.

The widespread use of the *Citrus* genus may be influenced by the region's economic activity. Several authors have documented this connection, noting that favourable climatic conditions support its abundant growth and fruit production for commercial purposes. Additionally, traditional healers continue to promote its use due to its high therapeutic potential and degree of domestication, considering it a valuable medicinal by an underutilized product (Hamdan *et al.*, 2024). Its easy availability in home gardens and orchards, along with its effectiveness in treating respiratory conditions, has facilitated its incorporation into community healthcare practices in various regions worldwide (Heinrich *et al.*, 1998; Vasudeva *et al.*, 2015; Hamdan *et al.*, 2024). These findings highlight the important medicinal role these plants play in the daily lives of local inhabitants. The documentation of this traditional knowledge could support broader community health initiatives in Pisaflores, Hidalgo, by promoting the informed use of medicinal plants as accessible and culturally relevant therapeutic resources.

Informant Consensus Factor (ICF) and description of the most important medicinal plants

Respiratory illnesses are among the most prevalent health problems in Mexican communities, often leading to severe health outcomes if left untreated. In 2015, chronic obstructive pulmonary disease (COPD)—excluding asthma and bronchiectasis—caused 23,851 deaths in Mexico, significantly higher than deaths caused by cervical cancer (3,899), breast cancer (6,200), prostate cancer (6,309), and HIV (4,742) (Pérez-Padilla, 2018).

The high ICF values observed in this study align with previous findings, such as those reported by Faruque *et al.*, (2018), who found an ICF of 0.65 for respiratory infections, suggesting a strong consensus on the use of certain species for specific ailments. These values not only reflect agreement among collaborators but also indicate that the plants used may have biologically active compounds with therapeutic potential.

Environmental factors and poverty, which may contribute to malnutrition, are key contributors to the incidence of respiratory diseases in these communities (Alonso-Castro *et al.*, 2017).

Mentha x verticillata has been widely recognized in previous studies for its medicinal properties, primarily due to the presence of carvone and limonene (Mansoori *et al.*, 2022; León & Domínguez, 2020). These compounds reinforce its relevance in the treatment of respiratory disorders. Additionally, this plant is predominantly used for digestive issues, as it exhibits analgesic and antispasmodic effects, particularly in gastric and colonic conditions. Moreover, it is considered safe and effective, with no reported side effects (Keifer *et al.*, 2008).

Bursera simaruba, commonly known as 'chakchakan' by the Mayans of Yucatán, has been extensively documented for its medicinal properties. Traditionally, it has been used to treat a wide range of conditions, including infected gums, bloody stools, fever, burns, urine retention, blood in the urine, tonsillitis, itchy rashes, and ulcers caused by venereal diseases. Its applications extend to anti-inflammatory and anti-asthmatic treatments, as well as preparation for childbirth. Research has highlighted its effectiveness against infections and respiratory issues, with some studies suggesting its potential for managing serious conditions such as diabetes (Rojas-Rodríguez, 2006). Additionally, its strong anti-inflammatory activity (Abad, *et al.*, 1996; Carretero *et al.*, 2008) supports its role in traditional medicine, particularly the efficacy of its leaves in alleviating inflammation.

Bougainvillea glabra has been widely recognized for its medicinal properties, particularly its anti-diabetic effects and benefits on the blood lipid profile, which support its use in diabetes treatment (Soares *et al.*, 2017). Additionally, its leaves have shown potential in preventing neurological disorders, including Parkinson's disease. In traditional medicine, fresh flowers are commonly prepared as an infusion to relieve coughs, highlighting their relevance in respiratory treatments and local healthcare practices.

Citrus x aurantium L. (bitter orange) is widely recognized in Mexico for its diverse medicinal applications, particularly in treating respiratory and gastrointestinal disorders. Its pharmacological effects include vasoconstriction, blood pressure elevation, and bronchial muscle relaxation (Suryawanshi, 2011; Sandoval-Montemayor *et al.*, 2012; Miller *et al.*, 2015). These properties are largely attributed to the presence of phenylethylamine alkaloids, such as octopamine, synephrine, tyramine, and N-methyltyramine, as well as vitamin C, flavonoids, and volatile oils. In addition to its traditional uses, this plant has demonstrated anti-cancer, anxiolytic, anti-obesity, antibacterial, antioxidant, and anti-diabetic potential. The essential oil is noted for its antispasmodic effects, though caution is advised due to possible skin reactions (Swerdlin *et al.*, 2010; Sutar *et al.*, 2018).

Bidens odorata, commonly known as 'mozote blanco,' is widely used in Mexico for its medicinal properties. It is recognized for its diuretic, hypoglycemic, anti-inflammatory, antipyretic, and antitussive effects, making it a valuable remedy for gastrointestinal disorders, kidney diseases, and respiratory ailments. Its applications include managing coughs and other inflammatory conditions, supporting its role in traditional medicine (Hernández-Sánchez *et al.*, 2018; Astudillo-Vázquez *et al.*, 2008).

Struthanthus quercicola, commonly known as 'muérdago,' is a mistletoe species with diverse medicinal applications. It has been identified as a valuable remedy for neurological and dermatological conditions, as well as for managing stress and depression (Alcántara-Quintana *et al.*, 2022). Traditionally, it has been used to treat epilepsy, pre-menstrual syndrome, nervous tension, and various skin disorders, reinforcing its importance in natural medicine.

The medicinal plants discussed in this study reflect a deep connection between local communities and their environment, with a wide range of plant species being used for the treatment of respiratory and other health issues. The findings support the notion that these plants hold significant potential for further investigation and could be utilized to complement modern healthcare practices.

CONCLUSION

This study confirms the persistence and functional relevance of traditional knowledge regarding the use of medicinal plants for the treatment of respiratory ailments in the municipality of Pisaflores, Hidalgo. The diversity of recorded species and the high level of agreement among collaborators indicate a structured ethnomedical system, supported by well-defined cultural criteria for the selection, preparation, and administration of plant resources.

The preference for infusions prepared from fresh plant material, the domestic cultivation of most species, and complementary wild harvesting represent local strategies that ensure resource availability and intergenerational transmission of knowledge. The recurrent citation of species such as *Mentha × verticillata* and *Bursera simaruba*, together with the high consensus values, suggests a solid empirical basis that supports their therapeutic relevance and highlights their potential for further phytochemical and pharmacological research.

In this context, the systematic documentation of traditional knowledge in Pisaflores not only provides relevant ethnobotanical information for the region but also constitutes a fundamental tool for biocultural conservation, contributing to the social valuation of local plant resources and to the preservation of ethnomedical heritage in the face of sociocultural change and biodiversity loss.

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