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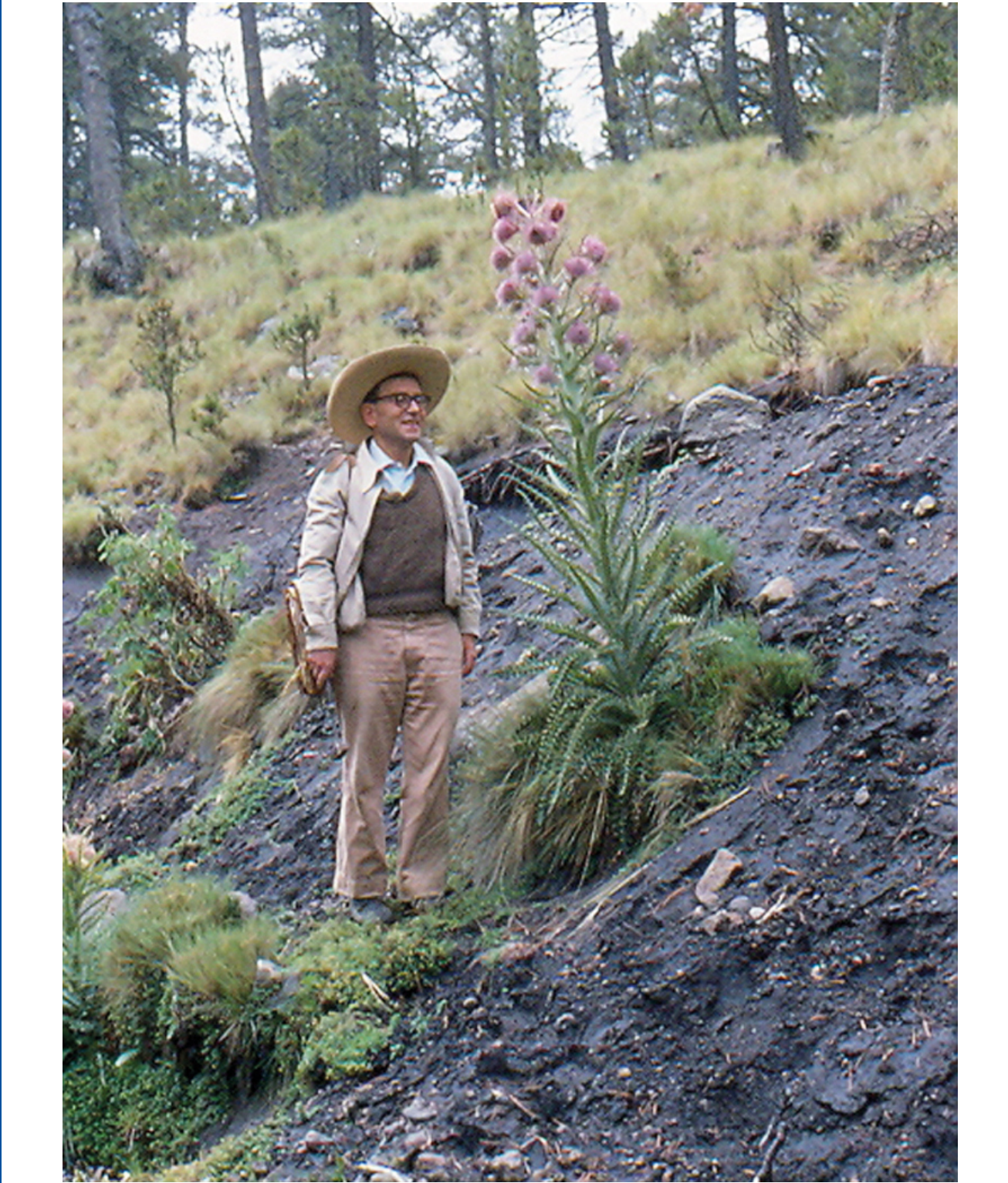
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Julio 2023

Núm. 56

POLIBOTÁNICA



Núm. 56



Julio 2023

PÁG.

CONTENIDO

- 1 Riqueza y distribución altitudinal de hepáticas epifitas del bosque mesófilo de montaña de Hidalgo, México
Richness and altitudinal distribution of epiphytic liverworts from the cloud forest of Hidalgo, Mexico
José Francisco Juárez López | Arturo Sánchez González | Maritza López Herrera | Dorismilda Martínez Cabrera
- 17 Descripción e ilustración del desarrollo morfogenético de los gametófitos y esporófitos jóvenes de *Asplenium blepharophorum* Bertol. (Aspleniaceae-Polypodiidae) en tres sustratos naturales
Description and illustration of the morphogenic development of the young gametophytes and sporophytes of Asplenium blepharophorum Bertol. (Aspleniaceae-Polypodiidae) in three natural substrates
Adriana Rojas Cano | María de la Luz Arreguín Sánchez | Rafael Fernández Nava | David Leonor Quiroz García
- 39 Análisis morfométrico de *Agave sensu stricto* (Asparagaceae: Agavoideae) en Veracruz y áreas adyacentes de Puebla, México
Morphometric analysis of Agave sensu stricto (Asparagaceae: Agavoideae) in Veracruz and adjacent areas of Puebla, Mexico
Carlos Rafael Arzaba Villalba | Miguel Cházaro Bazáñez | Mario Luna Cavazos | Edmundo García Moya
- 61 Variación clinal de caracteres fenotípicos y fisiológicos en *Pinus hartwegii* Lindl., para la Estación Forestal Experimental Zoquiapan, México
Clinical variation of phenotypic and physiological characters in Pinus hartwegii Lindl., for the Zoquiapan Experimental Forest Station, Mexico
Adrián López López | María Isabel Palacios Rangel | Cuauhtémoc Sáenz Romero | Villanueva Morales Antonio | Victoria Pacheco Almaraz
- 81 Composición, estructura y estado de la regeneración arbórea en un gradiente altitudinal en un bosque templado de Guadalupe y Calvo, Chihuahua
Composition, structure and status of tree regeneration in an altitudinal gradient in a temperate forest of Guadalupe y Calvo, Chihuahua
Samuel Alberto García García | Eduardo Alanís Rodríguez | Oscar Alberto Aguirre Calderón | Eduardo Javier Treviño Garza | Luis Gerardo Cuéllar Rodríguez | Alejandro Collantes Chávez Costa
- 101 Efectos del manejo forestal en la emisión de CO₂ de un suelo umbrisol en bosques de Durango, México
Effects of forest management on the soil CO₂ emission of an umbrisol in forests from Durango, Mexico
Erik Orlando Luna Robles | Israel Cantú Silva | Francisco Javier Hernández | Silvia Janeth Béjar Pulido
- 115 Influencia del conocimiento ecológico tradicional y la altitud en la estructura y diversidad arbórea de los cercos vivos del corredor biológico Chichinautzin, México
Influence of traditional ecological knowledge and altitudinal gradient on richness, structure and tree diversity of live fences in the Chichinautzin biological corridor, Mexico
Emir Basurto García | Hortensia Colín Bahena | Rafael Monroy Ortiz | Alejandro García Flores | Leonardo Beltrán Rodríguez
- 151 Efecto del medio de cultivo y escotoperiodo en la germinación de semillas y crecimiento *in vitro* de *Guarianthe skinneri* (Bateman) Dressler & W.E. Higgins (Orchidaceae)
Effect of culture media and skotoperiod on the germination of seeds and growth in vitro of Guarianthe skinneri (Bateman) Dressler & W.E. Higgins (Orchidaceae)
Fabiola Hernández Ramírez | Leobardo Iracheta Donjuan | Anne Damon | Sylvia Patricia Fernández Pavía | Karina Guillén Navarro
- 171 Plant regeneration from indirect somatic embryogenesis of *Agave salmiana* Otto ex Salm-Dyck subsp. *salmiana* using zygotic embryo obtained by in-casa pollination as explants
Regeneración de plantas por embriogénesis somática indirecta de Agave salmiana Otto ex Salm-Dyck subsp. salmiana usando embriones cigóticos obtenidos por polinización In-casa como explantes
Blanca Vianey Angeles Vázquez | Jorge Álvarez Cervantes | Xóchitl Tovar Jiménez | Benjamín Rodríguez Garay
- 183 Flavonoids, anthocyanins and total macronutrients in handmade products of blackberry (*Rubus* sp.) from Atecoxil, Veracruz, Mexico
Flavonoides, antocianinas y macronutrientes totales en productos artesanales de zarzamora (Rubus sp.) de Atecoxil, Veracruz, México
Vianey del Rocio Torres Pelayo
- 203 Composición química, actividad antioxidante, antiinflamatoria y antiproliferativa del extracto de callos derivado de *Acalypha californica* Benth
Chemical composition, antioxidant, antiinflammatory and antiproliferative activity of callus extract derived from Acalypha californica Benth
Lesyanny Hechavarría Pérez | Luisa Alondra Rascón Valenzuela | Armando Tejeda Mansir | José Alberto Pérez Burgos | Gloria Irma Ayala Astorga
- 225 Dinámica de la Etnobotánica médica de los pobladores de Córdoba, Argentina. Aportes de la Encuesta Nacional de Folklore (1921) a la comprensión de los cambios en el uso y percepción de plantas medicinales
Dynamics of the medical Ethnobotany of the inhabitants of Córdoba, Argentina. Contributions of the National Survey of Folklore (1921) to understanding changes in the use and perception of medicinal plants
Cecilia Trillo | Bárbara Arias Toledo
- 249 Ethnobotany of medicinal plants Used for healers of the Chol ethnic group from Tila, Chiapas, Mexico
Etnobotánica de plantas medicinales usadas por curanderos del grupo étnico Chol de Tila, Chiapas, México
José del Carmen Rejón Orantes | Sabina Andrea Sánchez-Cartela | Wilbert Gutiérrez-Sarmiento | Oscar Farrera-Sarmiento | Miguel Pérez de la Mora
- 265 Estudio de plantas medicinales utilizadas en San José Iturbide, Guanajuato, México
Study of medicinal plants used in San Jose Iturbide, Guanajuato, Mexico
Eduardo Alberto Lara Reimers | Carlos Omar Hernández Robledo | Pablo Preciado Rangel | Oscar Sariñana Aldaco
- 287 Percepción y significados del guaje rojo *Leucaena esculenta* (DC.) Benth. en la cultura ngiwa de Puebla, México
Perception and meanings of the red guaje Leucaena esculenta (DC.) Benth. in the ngiwa culture from Puebla, Mexico
Guadalupe García Maceda | Arturo Hernández Montes | María Carmen Ybarra Moncada | Rocio Guadalupe Casañas Pimentel
- 311 Intergenerational transmission of traditional ecological knowledge about medicinal plants in a riverine community of the Brazilian Amazon
Transmisión intergeneracional del conocimiento ecológico tradicional sobre las plantas medicinales en una comunidad ribereña de la Amazonía Brasileña
Rogério Lima Mota | Iani Dias Lauer-Leite | Jailson Santos de Novais

POLIBOTÁNICA

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Portada

Jerzy Rzedowski Rotter (1926-2023). Considerado uno de los botánicos más influyentes de México. Incursionó en diversas disciplinas botánicas como taxonomía, florística, fitogeografía y ecología. Formó varios herbarios institucionales y recolectó muestras de la flora mexicana, logrando una colección que superó los 50,000 ejemplares. Trabajó en la Flora Fanerogámica del Valle de México y en la Flora del Bajío y Regiones Adyacentes; también escribió el libro *La Vegetación de México*, obra clásica de la literatura botánica mexicana. A lo largo de su carrera, se dedicó además a la enseñanza y formación de botánicos. Su obra incluye la publicación de 7 libros, 47 capítulos de libros, 128 artículos en revistas científicas y 31 fascículos de floras. Descubrió alrededor de 190 nuevas especies de plantas mexicanas y más de 85 especies de hongos, plantas y animales mexicanos recibieron su nombre en su honor.

Jerzy Rzedowski Rotter (1926-2023). Considered one of the most influential botanists in Mexico. He ventured into several botanical disciplines such as taxonomy, floristics, phytogeography, and ecology. He formed several institutional herbaria, and collected samples of Mexican flora, achieving a collection that exceeded 50,000 numbers. He worked on the Phanerogamic Flora of the Valley of Mexico and the Flora of the Bajío and Adjacent Regions; he also wrote the book *The Vegetation of Mexico*, a classic work of Mexican botanical literature. Throughout his career, he was also dedicated to teaching and training botanists. His work includes the publication of 7 books, 47 book chapters, 128 articles in scientific journals, and 31 fascicles of floras. He discovered about 190 new species of Mexican plants and more than 85 species of Mexican fungi, plants, and animals were named in his honor.

por/by **Rafael Fernández Nava**



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POLIBOTÁNICA

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
rfernan@ipn.mx

Dirección Web
http://www.polibotanica.mx

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ETHNOBOTANY OF MEDICINAL PLANTS USED IN THE CHOL ETHNIC GROUP FROM TILA, CHIAPAS, MEXICO

ETNOBOTÁNICA DE PLANTAS MEDICINALES USADAS EN EL GRUPO ÉTNICO CHOL DE TILA, CHIAPAS, MÉXICO

Rejón-Orantes, José del Carmen; Sabina Andrea Sánchez-Cartela, Wilbert Gutiérrez-Sarmiento; Oscar Farrera-Sarmiento y Miguel Pérez de la Mora

ETHNOBOTANY OF MEDICINAL PLANTS USED IN THE CHOL ETHNIC GROUP FROM TILA, CHIAPAS, MEXICO

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Ethnobotany of medicinal plants used in the Chol ethnic group from Tila, Chiapas, Mexico**Etnobotánica de plantas medicinales usadas en el grupo étnico Chol de Tila, Chiapas, México**José del Carmen Rejón-Orantes / rejonjose@hotmail.com

Sabina Andrea Sánchez-Cartela

Wilbert Gutiérrez-Sarmiento

Chiapas Medicinal Plants Research Center, Pharmacobiology Experimental Laboratory, Autonomous University of Chiapas, Mexico

Oscar Farrera-Sarmiento

Faustino Miranda Botanical Garden Museum, Secretariat of the Environment and Natural History

Miguel Pérez de la Mora

*Division of Neurosciences. Cellular Physiology Institute. National Autonomous University of Mexico*Rejón-Orantes, José del
Carmen; Sabina Andrea
Sánchez-Cartela, Wilbert
Gutiérrez-Sarmiento; Oscar
Farrera-Sarmiento y Miguel
Pérez de la MoraETHNOBOTANY OF
MEDICINAL PLANTS USED
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GROUP FROM TILA,
CHIAPAS, MEXICO.ETNOBOTÁNICA DE
PLANTAS MEDICINALES
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ÉTNICO CHOL DE TILA,
CHIAPAS, MÉXICO

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ABSTRACT: Herbalism is one of the basic pillars of traditional medicine in Mexico. The use of medicinal plants by the Chol ethnic group of Mexico is scarcely documented. In this work, we analyzed the traditional medicine information provided by three Chol healers from Tila, Chiapas, Mexico. The research was carried out in Tila, Chiapas, Mexico between April and June of the year 2018. Semi-structured interviews were applied to Chol healers about medicinal plants from in this region, collecting specimens of plants, classified and deposited in a recognised herbarium. The databases PubMed/Medline, Web of Science, Scopus, Wiley Online Library, ScienceDirect, and Google Scholar were the basis to explore the medicinal use of such plants.

We reported 35 plants with medicinal uses, 25 of them are considered endemic, while 10 are considered introduced. The Lamiaceae family is predominant with five specimens; most of the reported plants act on the gastrointestinal system or as an anti-inflammatory factor. The most common route of administration is oral. The knowledge of traditional Mexican herbalism has a fundamental role in the treatment of various diseases in the Chol communities. The dissemination and registration are essential for the protection and preservation of this knowledge culture.

Key words: Chol culture, ethnopharmacology, healer, herbalism, traditional medicine.

RESUMEN: La herbolaria es uno de los pilares básicos de la medicina tradicional en México. El uso de plantas medicinales por la etnia Chol en México está escasamente documentado. En este trabajo analizamos la información de medicina tradicional proporcionada por tres “curanderos” Chol de Tila, Chiapas, México. La investigación fue realizada en Tila, Chiapas, México entre Abril y Junio del año 2018. Se aplicaron entrevistas semiestructuradas a los curanderos Choles sobre plantas medicinales de la región, se recolectaron especímenes de plantas, se clasificaron y fueron depositadas en un herbario reconocido. Se usaron los siguientes buscadores para explorar el uso medicinal de dichas plantas: PubMed/Medline, Web of Science, Scopus, Wiley Online Library, ScienceDirect, and Google Académico. Se reportan 35 plantas con uso medicinal, 25 de ellas son consideradas como endémicas y 10 como introducidas. La familia Lamiaceae es la más predominante con 5 especies; la mayoría de las plantas reportadas actúan sobre el sistema gastrointestinal o como antiinflamatorio. La vía de administración más común es la oral. El conocimiento de la herbolaria tradicional mexicana tiene un papel fundamental en el tratamiento de diversas enfermedades en las comunidades choles. La difusión y el registro son fundamentales para la protección y preservación de esta cultura del conocimiento.

Palabras clave: Cultura Chol, etnofarmacología, chamanes, herbolaria, medicina tradicional.

INTRODUCTION

Mexico is the fifth place with the greatest wealth of plants and animals, and the seventh in endemism. This country has 68 indigenous languages and 364 spoken variants. Mesoamerica is one of the centers of origin and domestication, 30% of the population is indigenous, peasant, or Afro-Mestizo (Toledo & Barrera-Bassols, 2008).

Among the countries with the greatest cultural and biological diversity, Mexico holds the second position (INECOL, 2022). The biocultural relationship is based on the responsible use and care of the environment, parallel to the perpetuity of traditions and customs of the established culture in a certain region. The biocultural resources are species of plants, animals, and fungi that are part of the articulation between the use, management, and traditional knowledge of communities (Dunn, 2017).

The documentation of traditional knowledge in Mexico is important as many rural communities are losing their socioeconomic and cultural characteristics. According to the Comisión Nacional para el Desarrollo de los Pueblos Indígenas (CDI), there are 23 ethnolinguistic groups categorized in "accelerated extinction", 15 in "slow extinction", and 14 are already in disappearance. Consequently, the documentation and preservation of native cultural knowledge are essential.

The term *traditional medicine* refers to all the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness (WHO, 2013). Traditional medicine in Mexico is based mainly on herbalism, as it is the most accessible and effective medicine for both Mexican people in general as well as communities. More than 5,000 species represent 23% of the Mexican flora that has some traditional use; out of this total, 3,000 species are considered medicinal plants (SEMARNAT, 2021). Although the majority of principles that constitute the main ingredients of patented medicines are derived from plant species, only 5% of all these plants have been analysed pharmacologically (SEMARNAT, 2021). Based on relevance, Chiapas is considered the second state with the greatest biocultural wealth in Mexico (INECOL, 2022), with ethnic groups such as the Tojolabal, Mame, Mochó, Tzeltal, Lacandona, Zoque, Tzotzil, Chol, etc. The majority are descendants of the Mayan culture. In addition to this, Chiapas owns one of the highest levels of vascular plants in the world's biodiversity (Barthlott *et al.*, 1996).

The Chol ethnic group represents 12.5% of the population with an indigenous language that habit in the northeast of Chiapas, between the municipalities of Palenque, Salto de Agua, Tumbalá, Tila, and Sabanilla which form an area of approximately 4,000 km, located in the Northern Chiapas Mountains and the transition zone to the Gulf plain (IIS-UNAM, 2012). The main vegetation found in these regions is typical of a rainforest. Few ethnobotanical studies have been carried out in Mexico with quantitative tools that allow corroborating ancestral knowledge for the treatment of diseases.

This is the first report about the medicinal plant knowledge in the Chol region of the state of Chiapas, Mexico.

MATERIALS AND METHODS

Study site. The municipality of Tila is located in the north of Chiapas under coordinates: latitude 17°09'56.52"N and longitude 92°39'33.48"W (Fig. 1 A-B). Tila belongs to the

rainforest area, so it has representative vegetation from the region, and it has 133 localities with a total of 83,505 inhabitants. The territorial extension is 798.57 km², which represents 0.93% of the state surface. The altitude is 840 m above sea level, and its climate varies according to the altitude: warm humid with rain throughout the year, and semi-warm humid above 1,000 m. (Fig. 1C) (INEGI, 2010).

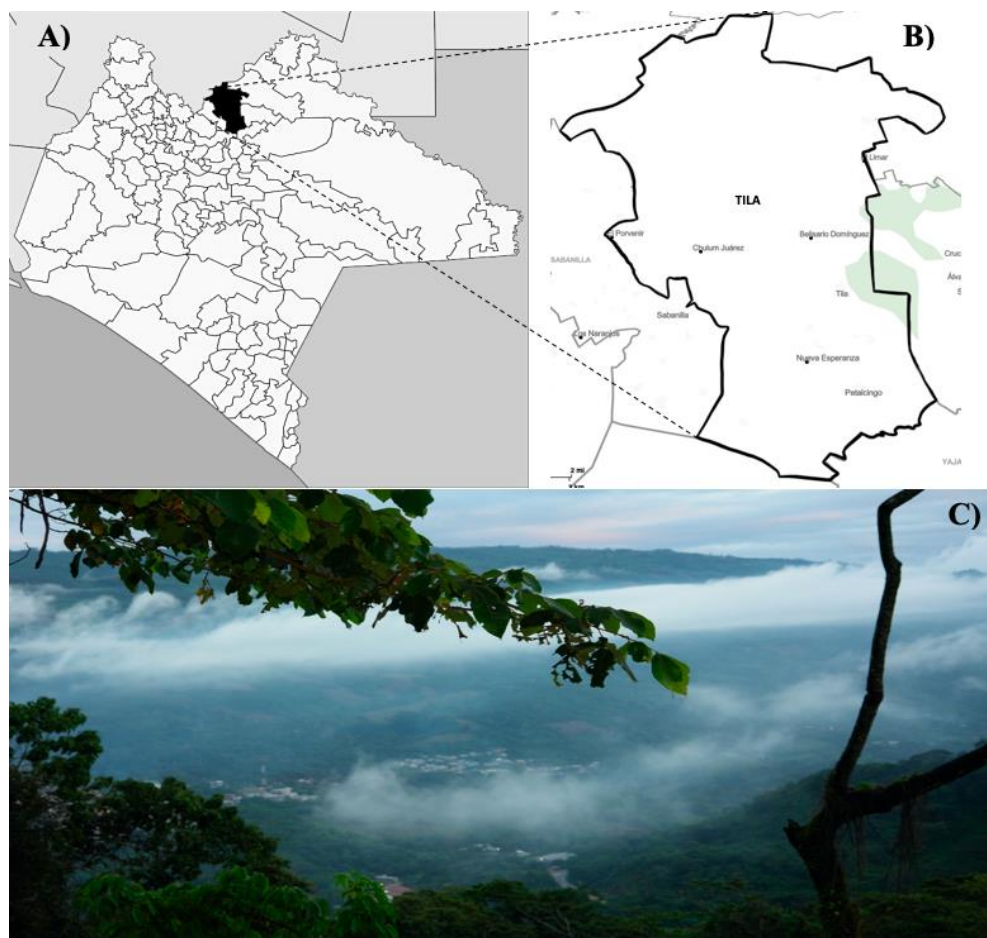


Fig. 1. A) State of Chiapas indicating the location of Tila B) Map of Tila municipality. C) The town of Tila taken from nearby mountains and fog

Data collection. The research began in April 2018 and concluded in June of the same year. It was carried out in the community of Tila, Chiapas, Mexico. The ethnobotanical information was obtained through face-to-face semi-structured interviews with three healers (informants) from the region; two men (aged between 60-70 years old) and a female (62 years old). They shared the medicinal uses they give to plants and allowed us to keep a specimen of each species. Each specimen that was recognized as useful in the traditional Chol medicine was photographed and collected by recording data such as common name(s) in Spanish and Chol language, the use descriptions, categories of use and used parts of plants. All the specimens were temporarily placed in containers with water and soil until the investigation was finished; later brown paper bags were used for their transport in which they were carefully wrapped.

Data analysis. All the specimens obtained in Tila were carried to the botanical garden Faustino Miranda, which serves as the Secretariat of the Environment and Natural History in Tuxtla Gutierrez, Chiapas, Mexico. The curator Oscar Farrera Sarmiento (expert botanist) analyzed and classified the plants based on the International Plant Names Index guideline (IPNI). Finally, exhaustive research of each of the classified plants was carried out 1) to find out records of the plants as well as the medicinal uses attributed to them and 2) to contrast and/or add relevant information to the knowledge provided by Chol healers.

RESULTS

In this research, 49 medicinal plants of the Chol culture were documented. Among them, 14 plants were not classified, while 35 different species were fully identified. They are distributed along 23 taxonomically botanical families. Table 1 shows the total of recollected, documented, and classified plants in the Chol culture for the treatments of different symptoms and ailments. Vouchers list is found in Appendix 1. A total of 25 plants were considered as endemic to either North, Central, and South America but currently grown in Mexico. On the other hand, 10 were considered “introduced plants” according to the botanic classification as their origins are not from the previously mentioned continents.

Table 1. The ethnobotanical information of Chol culture from Tila, Chiapas, Mexico.

Family	Scientific name	Common name (Chol name)	Life form	Part used	Application: Oral (O), Topic (T)	Native (N) or introduced (I)	Ailment/ Symptoms	Folio	Match between healers
Adoxaceae	<i>Sambucus canadensis</i>	Sauco (Chijitye)	Shrub	Cortex	O	N	Diuretic	44549	3
Annonaceae	<i>Rollinia</i> sp	Cabeza de Mono	Tree	Fruit	O	I	Syncope	51468	3
Apiaceae	<i>Foeniculum vulgare</i> Mill	Hinojo	Herbs	Stem and leaves	O	I	Colic	31048	3
Asteraceae	<i>Calea urticifolia</i> (Mill.) DC.	Cruz Pimel	Shrub	Leaves	O	N	Anti-inflammatory	38625	2
Asteraceae	<i>Critonia morifolia</i>	(Koj m chimay)	Shrub	Leaves	T	N	Hits, local antiinflammatory	45319	2
Asteraceae	<i>Tagetes erecta</i> L	Cempoasuchil	Herb	Flowers	O	N	Colitis	53871	3
Begoniaceae	<i>Begonia glabra</i> Aubl	(Pozlon Pimel)	Herb	Flowers	T	N	Boils	45289	3
Begoniaceae	<i>Begonia heracleifolia</i> S.&C.	(Paj Tyok)	Herb	Leaves	O	N	Stomachache	41946	1
Begoniaceae	<i>Begonia thiemei</i> C. DC.	Monte agrío (Pajtyo Pimel)	Herb	Leaves	O	N	Stomachache	34209	1
Bignoniaceae	<i>Tabebuia rosea</i> (Bertol.) Bertero ex A.DC.	Maculis Bertol	Tree	Leaves, cortex	O	N	Fever, parasites	47256	3
Commelinaceae	<i>Tradescantia zebrina</i>	Cucaracha (Chachak tsiwi)	Herb	Leaves	O	N	Colic, gastric ulcer	53872	3
Costaceae	<i>Costus ruber</i> C. Wrigth ex Griseb	Cañita agría	Herb	Stem	O	I	Kidneys, throat	35173	3
Crassulaceae	<i>Bryophyllum pinnatum</i>	Bella dona (Leslespimel)	Shrub	Leaves	T/O	I	Local anti-inflammatory, superficial wounds	39984	2
Crassulaceae	<i>Kalanchoe gastonis-bonniieri</i>	Malamadre	Herb	Leaves	O,T	I	Headache, burns, superficial wounds	10193	2
Equisetaceae	<i>Equisetum myriochaetum</i>	Cola de caballo	Herb	Stem and leaves	O	N	Diuretic	8438	3
Euphorbiaceae	<i>Euphorbia graminea</i> Jacq	(Sa'sak Pimel)	Herb	Leaves	T	N	Warts, ulcers	53873	2
Euphorbiaceae	<i>Croton draco</i> Schlttdl	Árbol de hoja blanca (Chichitye)	Tree	Leaves, cortex	T	N	Superficial wounds	21596	3

Lamiaceae	<i>Ocimum</i> aff. <i>campechianum</i> Mill.	Flor Blanco	Herb	Leaves	O	N	Stomachache	53875	1
Lamiaceae	<i>Ocimum</i> sp.	(Suk Nich)	Herb	Leaves	O	I	Decreased menstrual bleeding		3
Lamiaceae	<i>Salvia coccinea</i>	Yermatin	Herb	Flowers	O	N	Decreased menstrual bleeding	53877	3
Lamiaceae	<i>Salvia rubiginosa</i> Benth	(Juku wej Pimel)	Herb	Flowers and leaves	O	N	“Dolor de hueso y la reuma”	53879	3
Malvaceae	<i>Malvaviscus arboreus</i> Cav	Tulipan	Shrub	Flowers and leaves	O	N	Dysentery	23956	3
Nyctaginaceae	<i>Bougainvillea glabra</i> Choisy	Buganvillea	Climber	Flower	O	I	Cough	50197	3
Phytolaccaceae	<i>Petiveria alliacea</i> L.	Monte Zorro	Herb	Leaves	O	N	Menstruation onset induction	53880	2
Piperaceae	<i>Peperomia liebmannii</i> C. DC.	Monte de Erisipela	Herb	Leaves	T	N	Erysipelas	20225	2
Plantaginaceae	<i>Plantago major</i> L	(Lanté)	Herb	Leaves	O	I	“dolor de corazón”	53881	3
Poaceae	<i>Saccharum officinarum</i> L.	Caña roja	Herb	Stem	O	I	Cough without expectoration	38697	2
Rutaceae	<i>Ruta graveolens</i>	Ruda	Herb	Leaves	O	I	Colic, Fever	13086	1
Solanaceae	<i>Solanum cordovense</i> Sesse & Moc	Arbol hoja blanca	Herb	Leaves	O	N	Urinary tract diseases	53882	3
Urticaceae	<i>Cecropia obtusifolia</i> Bertol	Guarumbo (K'olok)	Tree	Leaves, branches, bark, root	O	N	Hyperglycemia control	35732	3
Urticaceae	<i>Myriocarpa heterostachya</i>	(Jojotzin)	Shrub	Leaves	O/T	N	Local anti-inflammatory, superficial wounds	53884	2
Urticaceae	<i>Pilea microphylla</i> (L.) Liebm	(Wosvos Pimel)	Herb	Leaves	T	N	Warts	53885	3
Verbenaceae	<i>Verbena litoralis</i> HBK	Verbena (Wich'ak'ach)	Herb	Flowers	O	N	Puke	40013	3
Verbenaceae	<i>Lippia dulcis</i> Trevir	Monte dulce (Tsa'j Tsa'j Pimel)	Herb	Leaves and flowers	O	N	Cough	40102	3
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Jengibre	Herbs	Roots	O	I	Cough	8529	2

There are several plants with multiple medicinal purposes. Table 2 shows the five medicinal preparations that mix two or more plants to treat ailments such as urinary tract infection, hair loss, calm crying in children, gastritis, and decrease anger. The combinations of medicinal plants suggest that the pharmacological effect might be enhanced; most of the combinations are used in water or milk infusions.

Table 2. Combinations of plant species used for medicinal purposes in Tila, Chiapas, México.

Plant species and part used	Plant species and part used	Plant species and part used	Presentation	Ailment/Symptoms
<i>Salvia coccinea</i> leaves	<i>Croton draco</i> Schltldl leaves		Infusion	Urinary tract infection
<i>Agetes erecta</i> L. Flowers	<i>Mentha spicata</i> leaves		Ointment	Hair loss
<i>Sambucus canadensis</i> frut	<i>Equisetum myriochaetum</i>		Mixed with water	Hair loss
<i>Calea urticifolia</i> (Mill.) DC.	<i>Ruta graveolens</i>	<i>Ocimum basilicum</i>	Infusion	Calm crying in children
<i>Tradescantia zebrina</i> leaves	<i>Agave stem</i>	<i>Aloe vera</i>	Mixed with milk	Gastritis
<i>Foeniculum vulgare</i> Mill	<i>Chamaemelum nobile</i>		Infusion	Decrease anger

The most abundant family found was Lamiaceae represented by five species (Fig. 2), followed by Begoniaceae, Urticaceae, and Asteraceae with three species; Euphorbiaceae, Crassulaceae and Verbenaceae with two species each, and the rest Moraceae, Zingiberaceae, Solanaceae, Rutaceae, Poaceae, Plantaginaceae, Piperaceae, Phytolaccaceae, Nyctaginaceae, Malvaceae, Equisetaceae, Costaceae, Commelinaceae, Bignoniaceae, Apiaceae, Annonaceae and Adoxaceae with one representative species.



Fig. 2. Photos of plants collected in Tila, Chiapas, Mexico in their wild form. A) “Monte de Erisipela”, *Peperomia liebmannii* C. DC. B) *Ocimum* aff. *campechianum* Mill. C) “Yermatin”, *Salvia coccinea*.

Oral administration through preparations for infusion is the most common route of administration documented in this investigation, followed by topical administration.

During the collection of medicinal plants in Tila, Chiapas, Mexico, 49 specimens were obtained, of which only 35 could be classified by botanical experts. The variety of presentation of medicinal plants used in this region are mainly: herbs (the most common), shrubs and trees.

DISCUSSION

The importance of medicinal plants in our country is undeniable, several ethnic groups of Chiapas Mexico have documented their traditional medicine, however, little information exists on Chol medicinal plants. Lamiaceae is the most common family of plants used in the Chol culture of Tila, Chiapas. This family included several genus of plants which has been documented with medicinal used in others regions of the world. An example of Lamiaceae member is the *Ocimum*, also called Tulsi, which has been associated with the treatment of gastrointestinal problems. It is a huge genus plant that belongs to the Lamiaceae family, which comprises about 64 species of aromatic medicinal herbs with traditional uses (Zahran *et al.*, 2020). In general, *Ocimum* plants can be considered shrubs that contain essential oils of various aromas which are valuable in the pharmaceutical, perfumery, and food processing industries (Zahran *et al.*, 2020). Several reports have proven its medicinal benefits such as anti-inflammatory, analgesic, anti-viral, antipyretic, antioxidant, radical scavenging, anticancer, anti-ulcerogenic, and ulcer healing (Maurya & Sangwan, 2020). These pharmacological actions are associated with the presence of specific bioactive phytoconstituents (Maurya & Sangwan, 2020). The two major classes of secondary metabolites, phenylpropanoids, and terpenoids are found in essential oils (Maurya & Sangwan, 2020).

The *Ocimum campechianum* Mill (Voucher #53875), also used in the Chol culture, is an interesting native species of the South and Central American tropics (Tacchini *et al.*, 2020). This plant is also known as “Albahaca de campo” or “Albahaca silvestre” and is widely used by the indigenous population both for culinary and medicinal purposes (Tacchini *et al.*, 2020). The *Ocimum campechianum* Mill leaves are used in infusions for the treatment of respiratory tract problems, cold, flu, fever, stomach disorders (as reported in this article), dysentery, rheumatism, paralysis, epilepsy, and mental illnesses (Can-Sulu, 2015). Different attributions to this species are analgesic, anticonvulsant, antispasmodic, antifungal properties, anesthetic, analgesic, and anti-inflammatory activities. The predominant essential oil constituents such as methyl chavicol, eugenol linalool, camphor, and methyl cinnamate have been detected in this plant (Bomma *et al.*, 2020). In addition, it can be used topically during the bath to treat skin conditions, crushed leaves to treat nasal myiasis (parasitic disease), and root cooking to treat digestive problems (Can-Sulu, 2015). Subsequently, this plant has been studied especially for leaf and aerial parts which have shown to have antifungal, insect repellent, and analgesic activities (Tacchini *et al.*, 2020).

The *Ocimum Micranthum* Willd (Voucher #53874) is an herbaceous plant distributed in regions of Mexico in the states of Campeche, Chiapas, Colima, Jalisco, Oaxaca, Puebla, Queretaro, Quintana Roo, Sinaloa, Tabasco, Tamaulipas, Veracruz, and Yucatan (Caamal-Herrera *et al.*, 2018). Reports indicate that this plant contains essential oils responsible for medicinal activities against human pathogens, fungi, insects, and larvae in addition to its antioxidant, antiprotozoal, anti-inflammatory, and contraceptive properties (Caamal-Herrera *et al.*, 2018). These medicinal activities have been associated with the presence of diverse chemical compounds in the leaves of this plant (Caamal-Herrera *et al.*, 2018).

The *Salvia* is the most diverse genus of the Lamiaceae family, 306 *Salvia* species are found in Mexico; many have been used for centuries in traditional medicine, as antihydrotics, tonics, antirheumatoids, antimicrobials, antispasmodics, antiseptics, astringents, digestives, anti-inflammatories, carminatives, and chronic painkillers (Grzeszczuk *et al.*, 2018). Also, several studies have identified it as one of the most valuable sources of natural antioxidants (Grzeszczuk *et al.*, 2018). Several phytochemical compounds have been identified in this genus. The main chemical components identified in sage are essential oils, hydroxycinnamic acid derivatives, phenolic diterpenes, triterpenes, flavonoids, phenolic glycosides, and polysaccharides (Grzeszczuk *et al.*, 2018). Other major present antioxidants are the carnosol and carnosic (phenolic diterpenes), the rosmarinic, caffeic, ferulic, chlorogenic, (hydroxycinnamic acid derivatives), the salvianolic (dimer of rosmarinic acid). In addition, some essential oil compounds (camphor, 1, 8-cineole, α -thujone, β -thujone) and flavonoids (flavones of apigenin and luteolin, and their hydroxylated derivatives) (Grzeszczuk *et al.*, 2018) reported. Finally, the use of *Salvia Rubiginosa* Benth (Voucher #53879) is also mentioned in the Tzeltal and Tzotzil groups of the Chiapas Highlands, mainly to treat stomach and respiratory ailments, constituting a fundamental part of their ethnopharmacology (Martínez, 2011).

The Begoniaceae family was represented by three species of medicinal plants found in the region of Tila used by the Chol culture. Many species that belong to the Begoniaceae family are used for medicinal purposes; the *Begonia glabra* is used to heal shallow open wounds; while the *Begonia fimbriatipula* reduces the fever, it is also used as a cough medicine, pain reliever, and is processed into drinks as the bitter tea (Siregar *et al.*, 2018). Zubair *et al.*, (2016) suggests potential anticancer activity of alkaloid and glycoside-type compounds from *Begonia* species. The flowers of this species are used as a topical treatment to treat boils in this Chol culture or Tila, Chiapas. On the other hand, the ethanolic extract from *Begonia thiemei* species against *Citrobacter freundii*, suggest a potential source of new antimicrobial agents for the antibiotics development (Buyun *et al.*, 2019).

The Asteraceae family classified in this plant documentation was represented by three different species of plants. The *Calea urticifolia* (Mill.) DC. (Voucher #38625), commonly known as "bitter of the mount" is one of the most used plants in the traditional medicine in Yucatan as a remedy for pain, mainly stomach pain, malaria, and gastric ulcers (Mijangos-Ramos *et al.*, 2018). This agrees with the anti-inflammatory property attributed to it in this article. This can be found from Mexico to Panama, its leaves are used as a topical bactericide or as a treatment for gastric ulcers (Gogineni *et al.*, 2019). Another Asteraceae family is the *Critonia morifolia* (Voucher #45319), which has been reported with anticancer qualities by causing degradation of cell cycle regulators and downregulation of cyclin D1 and c-Myc proto-oncogenes, which have an important role in the development of various types of cancer (Unger *et al.*, 2012). This article documented the topical anti-inflammatory use.

Tagete is another member of the Asteraceae family and has around 50 plant species. Many medicinal properties have been demonstrated from the use of these plants; the leaves are used as an antiseptic, applied in boils and anthrax, for kidney problems, hemorrhoids, and muscle pain. Several studies have demonstrated medicinal properties in *Tagetes erecta* such as: antinociceptive, anti-inflammatory, antioxidant, insecticide, larvicidal, hepatoprotective, antipyretic, cicatrizant, antibacterial, antimicrobial, antiepileptic and antifungal (Singh *et al.*, 2020). In the Chol culture, its flowers are used to treat colitis. Several phytochemical components were found in different parts of *Tagetes erecta*, such as: quercetageetin-7-O-glucoside, 7 β -hydroxysterol, erythrodiol-3-palmitate, erythrodiol, 1-[5-(1-propyn-1-yl) - [2, 2-bithiophen]-5-yl]-ethanone, α -terthienyl, β -sitosterol, daucosterol, quercetageetin, quercetageetin-7-methylether, kaempferol, syringic acid, gallic acid, lupeol, 3- α -galactosyl disyringic acid, 3- β - galactosyl disyringic acid, 6-ethoxy-2, 4- dimethylquinoline, oplodiol, (3S, 6R, 7E)-hydroxy- 4,7-megastigmadien-9-one, palmitin, ethylene glycollinoleate, and n-hexadecane (Li-Wei, 2011).

Two species of the Crassulaceae family are commonly known by Chol healers. The *Bryophyllum pinnatum* (Voucher #39984) species, also known as the "leaf of life", is a succulent medicinal herb. It usually grows in tropical, subtropical, and warm temperate zones used in traditional medicine in Africa, tropical America, India, China, and Australia (Adibe *et al.*, 2019). This plant is used as anthelmintic, immunosuppressive, hepatoprotective, antinociceptive, anti-inflammatory (same use given by the traditional Chol medicine), antidiabetic, nephroprotective, antioxidant, antimicrobial, analgesic, anticonvulsant, neuropharmacological, and antipyretic activities (Ogidi *et al.*, 2019). *Kalanchoe gastonis-bonniieri* (Voucher #10193) is another medicinal herb that belongs to the Crassulaceae family. This plant is used in Latin America as a vaginal contraceptive as well as in the treatment of genital-urinary and vaginal infections (Palumbo *et al.*, 2019). In contrast to these uses, in the Tila region, this plant is used to treat headaches and is used topically for superficial wounds.

Out of the Euphorbiaceae family, two species were identified during the Chol medicinal plant documentation. Several members of the *Euphorbia* genus have been reported to be administered for ailments such as skin disease, rheumatism, gonorrhea, mucous membrane infections, boil, sores, hypertension, and in assisting wound healing, additional to be useful as purgatives and with exfoliant properties (Bolaji *et al.*, 2019). Ikpefan *et al.* (2020), have highlighted that chloroform extraction and chromatographic vacuum liquid subtraction of *Euphorbia graminea* have shown the highest antimicrobial activity. This explains the wide use that is given in terms of skin diseases that have a microbial agent as their origin. Also, the *Croton* genus, a plant of the Euphorbiaceae family, has shown interesting uses in traditional medicine. The presence of diterpenes, cyclitols, triterpenes, steroids, phenolic substances, and flavonoids have been reported, as they have biological properties (Barrera *et al.*, 2016) they undoubtedly promote the investigation of new bioactive substances of therapeutic interest. In the Chol region, people use it for superficial wounds.

Two genera from the Urticaceae were collected in this work. According to a study conducted by Ria *et al.* (2014), the antimicrobial activity of several species of Urticaceae is demonstrated. This explains the scientific basis for the medicinal use of this species in the treatment of wounds also observed in this work. In addition, the traditional use of the *Pilea microphylla* has been reported as a treatment for bacterial infections. Facey *et al.* (1999), verified the antimicrobial effect that this plant, finding some antibacterial activity against *Staphylococcus aureus* from a mixture of acetone and ethyl acetate from *Pilea microphylla*.

The following genus was the only one documented for this respective taxonomic family of plants. The *Malvaviscus arboreus* is a species of plant used by the Tila healers as a medicinal flower for gastrointestinal diseases, especially dysentery. Hesham *et al.* (2021), reported medicinal properties found in the *Malvaviscus arboreus* such as antioxidant, cytotoxic, hepatoprotective, and anti-infective activities attributed to the presence of a variety of phytochemicals.

As for the Adoxaceae family, the Chol population in this region uses the bark of the *Sambucus mexicana* (Voucher #44549) as a diuretic. The leaves and inner bark can be used as an insecticide and a dye. In several Mexican regions, the elderberry fruit is usually used to treat fever, cough, and respiratory diseases such as bronchitis. Furthermore, it is traditionally used in the treatment of digestive disorders, diarrhea, and red dysentery. Previous documentation demonstrates that it is also prescribed as a purgative, disinfectant, and diuretic to heal cavities, conjunctivitis, eye and ear infections, parasites, and rabies. The presence of di- and tri-terpene, glycosides, and phenols (e.g. flavonoids, tannins, and coumarins) has been associated with medicinal properties (Wright *et al.*, 2007).

The genus *Rollinia* generally grows in Central and South America. Antimicrobial effects of *Rollinia* extracts against *Leishmania* species have been proved to be major active metabolites due to a relation with acetogenins and alkaloids (Osorio *et al.*, 2007).

In the case of the *Foeniculum vulgare*, it is an herb with wide medicinal use. Fennel seeds are used as an analgesic, anti-inflammatory, diuretic, carminative, and antispasmodic (Ahmed *et al.* 2019). This last property coincides with that reported by healers from the Chol region. It is also used in indigenous medicine for the treatment of organ obstructions such as blood vessels, gall bladder, and liver; as well as for indigestion, nausea, colic, and flatulence (Ghazanfarpour *et al.*, 2018). *Tabebuia* is a genus of plants commonly used in traditional medicine to treat several ailments such as fever, pain, snake bite, as vermifuge or blood thinner, anemia, antimicrobial, nasal congestion, conjunctivitis, wounds, influenza, cardiac and stomach problems, kidney, skin and throat inflammations, as well as cancer and tumors (Gómez & Luiz, 2018). The species of *Tabebuia rosea* is a neotropical species documented for infectious diseases treatment such as pruritic diseases and infections with fungi and yeast. Several phytochemical compounds have been associated with microbial inhibition. Along different extracts has been reported the presence of terpenes, steroids, sesquiterpene, flavonoids, and phenolic acids from leaves and roots (Jimenez-Gonzalez *et al.*, 2018). These phytochemical compounds play an important role in the bioactivity of medicinal plants. In conclusion, the reported uses of *Tabebuia* in other bibliographies correspond with the reported ones in this article and are supported by Jimenez-Gonzalez *et al.* (2018).

Tradescantia zebrina (Voucher #53872) is a perennial herbaceous species from the Commelinaceae family, which has been used to treat diseases related to blood disorders (Grace *et al.*, 2020). The extract of this plant has been used to hasten blood coagulation; this explains the medicinal use in gastric ulcers by Chol people in Tila. Several phytochemical compounds such as saponins, phenolic compounds, and flavonoids have been detected for methanol extract from *T. zebrina*, as well as 15-lipoxygenase activity with possible applications in the treatment of asthma (Alaba & Chichioco-Hernandez, 2014).

The *Costus ruber* C. Wright ex Griseb (Voucher #35173), which belongs to the Costaceae family and is also called “caña agría”, is used in traditional medicine. *Costus pulverulentus* is used for the empirical treatment of inflammation, pain, and cancer (Nascimento *et al.*, 2016).

The species of *Equisetum myriochaetum* (Voucher #8438) is widely distributed in Mexico, where has been associated with medicinal benefits, including antimicrobial, antioxidant, antiproliferative, and diuretic properties also reported in this work. The presence of phytochemicals such as saponins, alkaloids, triterpenoids, and flavonoids may support its wide spectra of bioactive effects, including its antiproliferative potential that has been paired with other members of this genus of plants (Olarzarán-Santibañez *et al.*, 2021). Revilla-Monsalve *et al.* (2007), demonstrated a hypoglycemic effect from aqueous extracts of *Cecropia obtusifolia* (traditional form of consumption in Mexico) containing isoorientin and chlorogenic acid, without apparent adverse effects or hepatotoxicity. This hypoglycemic effect of *Cecropia obtusifolia* Bertol (Voucher #35732) is widely documented (Cadena-Zamudio *et al.*, 2019). In this sense, these research projects fundament the use that Chol healers give to this plant.

Bougainvillea glabra is used in traditional medicine as an anti-inflammatory and analgesic, as well as to treat gastrointestinal disorders (diarrhea, stomach pain, nausea, etc.), and hypotension. Studies conducted on crude extracts, isolated pure compounds, or solvent fractions of *B. glabra* have shown antibacterial, antidiabetic, antifungal, analgesic, antioxidant, cytotoxic, anti-inflammatory, and antipyretic properties. The effects have been attributed to various secondary metabolites of flavonoids, betacyanins, terpenoids, glycosides, and essential and phenolic oils (Saleem *et al.*, 2020). In the Tila region, this plant is used to treat cough.

Lateef *et al.* (2018) conducted a study that determined the antimicrobial, anticoagulant, and antioxidant activity of the *Petiveria alliacea* L. (Voucher #53880) leaf extract through the synthesis of silver nanoparticles from this herb. The effects of *Petiveria alliacea* L. have impacted positively on the central nervous system, specifically in processes such as memory and learning, where cognitive improvements may be achieved. Zavala-Ocampo *et al.* (2022) carried out a study that states that the methanol fraction of *P. alliacea* and its subfractions have antioxidant activity in addition to inhibiting acetylcholinesterase, which explains the cognitive improvement attributed to this herb. Contrary to other texts, this plant is used by Chol healers for the induction of menstrual bleeding.

Several medicinal properties have been connected with the *Plantago major*, and recent studies have confirmed it as an antitussive, anti-inflammatory, hemostatic, anti-infective, antihemorrhagic, diuretic, wound healing, antipyretic, laxative, and astringent (Najafian *et al.*, 2018). The traditional doctors of Tila use it for "dolor de corazón" referring to an emotional illness.

The presence of bioactive compounds with antimicrobial potential has been observed from the aqueous ethanolic extract of the *Saccharum officinarum* bark. It should be noted that based on the scoop in which the sugar cane bark is edible, a certain level of safety and tolerability may be assured for human beings (Uchenna *et al.*, 2015).

Ruta graveolens (Voucher #13086) is widely known and used in traditional medicine regarding the antispasmodic, sedative, and stimulating effects for the beginning of the menstrual cycle; and wound healing, among others. These effects are supported by its high content of phytochemicals. Recently, Pavić *et al.* (2019) evaluated the total phenolic content of *R. graveolens* and its antioxidant and antibacterial activity through in vitro studies. Donadu *et al.* (2021), pointed out that the *R. graveolens* has satisfactory antifungal activity against the *Candida tropicalis* and *Candida albicans* associated with oral candidiasis. In the Tila region, it is used to treat fever, so it may be connected with previous documentation about antimicrobial properties.

Antimicrobial peptides have been reported in the structure of several plants of the Solanaceae genus, the reason is that these peptides serve as chemical shields to protect themselves from pests and other microorganisms (Afroz *et al.*, 2020). This article detailed its use for urinary tract disorders.

In the case of *Verbena littoralis* H. B. K. (Voucher #40013) is a medicinal plant belonged to Verbenaceae widely distributed in South America. This plant has been used to treat liver intoxication and other hepatic disorders (Vestena *et al.*, 2019). Other uses such as shrub has been widely used in folk medicine as an effective antidiarrhetic, it has also been claimed as a remedy for typhoid fever, and cancer (Umasa & Castro, 1990). Verbenalin 1 and Brasoside 2 are phytochemicals identified from the ethanolic extract of the aerial parts (Umasa & Castro, 1990). According to healers choles, it is also attributed a certain antiemetic effect.

Lippia dulcis Trev (Voucher #40102), this is one of the most traditional, natural, and medicinal plants that belongs to the Verbenaceae family. Several compounds from the *Lippia dulcis* Trev have been reported, including the verbascoside (kucagin, acteoside), a phenolic compound and a very strong antioxidant that provides anti-inflammatory and pain-relieving benefits, as well as immunosuppressive, immune modeling, anticancer and hepatoprotective properties (Tomaszewska-Sowa, 2020). In addition, the *Lippia dulcis* Trev has been used in the treatment of bronchitis, cough (as reported in this article), indigestion, liver disorders, hypertension, and dysentery (Tomaszewska-Sowa, 2020).

Finally, the documentation of *Zingiber officinale*, identified as a Jengibre, is an herb used in the treatment of coughs in the Chol culture. Hasan *et al.* (2012), informed about the chemical composition and antimicrobial activity of *Zingiber officinale*. It is suggested that this property comes from the gingerol produced by this herb since as soon as it comes into contact with the cell wall it breaks it, leading to the death of the microorganism.

CONCLUSIONS

Medicinal plants are a fundamental resource for the state of Chiapas, Mexico. Twelve indigenous peoples from Chiapas; Tseltal, Tsotsil, Chol, Zoque, Tojolabal, Mame, Kakchiquel, Lacandón, Mocho, Jacalteco, Chuj and Kanjobal, preserve the use of medicinal plants in their traditional medicine. Ethnobotanical studies of medicinal plants used by the Chol culture are scarce. This work is an effort carried out in the context of traditional knowledge of medicinal plants, most of which are collected from nature. It can be verified that inter-ethnic cultural interaction has influenced the coincident uses given to some wild plants, although different uses of the same plant were also observed in other regions of the country, the same situation that is observed in introduced plants. All this is the heritage of the Chol culture, the present work is an effort to contribute to the conservation of this knowledge.

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Declarations of interest

None

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