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Review / Revisión

Ethnopharmacology of the Asteraceae family in Mexico

La etnofarmacología de la familia Asteraceae en México

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Abstract

Background: In Mexico, the Asteraceae are part of traditional knowledge where its members have several uses, but they are particularly remarkable in traditional medicine and are used for different purposes.

Questions: What pharmacologically studies have been carried out with Asteraceae species used in Mexican traditional medicine? What pharmacological activities have been tested? What compounds are responsible for the tested activities?

Species studied: Asteraceae species used in Mexican traditional medicine pharmacologically tested.

Methods: A database including scientific studies on Asteraceae species which studies on pharmacological activity or phytochemical characterization was compiled and analyzed.

Results: From 249 reviewed studies only 202 fulfilled the criteria for our analysis. A total of 101 species distributed in 65 genera and 16 tribes were registered. The tribes Heliantheae and Senecioneae were the most studied. *Ageratina pichinchensis*, *Artemisia ludoviciana*, *Heliopsis longipes*, and *Heterotheca inuloides* were the most studied species. In Mexico, the Asteraceae family is mainly used in the treatment of diseases or symptoms related to the digestive and respiratory systems. In 48 % of the studies some biocidal activity was evaluated but only 21.8 % included phytochemical characterizations.

Conclusions: The antimicrobial activity and phytochemical characterizations are the main kind of ethnopharmacological studies for Asteraceae in Mexico. Most of the compounds responsible for the activities have not been identified yet. The uses of Asteraceae in Mexico are similar to other countries emphasizing its cultural importance in the world. Mexican Asteraceae should be prioritized in conservation and bioscreening schemes.

Key words: Compositae, ethnobotany, herbal medicine, natural compounds, traditional knowledge.

Resumen

Antecedentes: En México la familia Asteraceae es parte del conocimiento tradicional, sus miembros tienen varios usos, especialmente en la medicina tradicional con diferentes propósitos.

Preguntas: ¿Qué estudios farmacológicos se han realizado con especies de Asteraceae usadas en la medicina tradicional mexicana? ¿Cuáles son las actividades farmacológicas comprobadas? ¿Cuáles son los compuestos responsables de las actividades comprobadas?

Especies en estudio: Especies de Asteraceae usadas en la medicina tradicional mexicana probadas farmacológicamente.

Métodos: Se construyó y analizó una base de datos con estudios de asteráceas en los que se realizaron caracterizaciones fitoquímicas o estudiaron actividades farmacológicas.

Resultados: De 249 estudios revisados solo 202 cubrieron los criterios de inclusión del análisis. Se registraron 101 especies distribuidas en 65 géneros y 16 tribus. Heliantheae y Senecioneae fueron las tribus más estudiadas. *Ageratina pichinchensis*, *Artemisia ludoviciana*, *Heliopsis longipes* y *Heterotheca inuloides* fueron las especies más estudiadas. En México, la familia Asteraceae se utiliza principalmente en el tratamiento de enfermedades o síntomas relacionados con los sistemas digestivo y respiratorio. El 48 % de los estudios evaluó alguna actividad biocida y el 21.8 % incluyen caracterizaciones fitoquímicas.

Conclusiones: la actividad antimicrobiana y caracterizaciones fitoquímicas son los principales estudios realizados con asteráceas mexicanas. La mayoría de los compuestos responsables de las actividades farmacológicas evaluadas aún no han sido identificados. Los usos de Asteraceae en México son similares a los de otros países, lo que resalta su importancia cultural en el mundo. Las Asteraceae mexicanas debe ser priorizadas en planes de conservación y en estudios de bioprospección.

Palabras clave: Compositae, compuestos naturales, conocimiento tradicional, etnobotánica, herbolaria.

Historically, the plant kingdom has been the best source of remedies for a variety of diseases and pain. Plants are primary therapeutic agents used for treating illness, an integral element of health care systems, and the best testimony of cultural importance (Mata *et al.* 2019). In many cultures, plants are elemental for ancient traditional medicine systems and continue enriching our modern knowledge of herbal medicine. Therefore, medicinal plants have a fundamental role in the maintenance of global human health (Egamberdieva & Teixeira da Silva 2015). Traditional medicine is part of the evolutionary process where humans and plants interact; communities and individuals continue to discover practices and transforming techniques. Many modern drugs have origin in ethnopharmacology and traditional medicine (Helmstädter & Staiger 2014). Pharmaceutical and scientific communities have paid particular attention to medicinal plants; numerous studies have validated the traditional use of plants and characterized phytochemically large species (Salazar-Aranda *et al.* 2013, Buenz *et al.* 2018).

The Mexican diversity of vascular plants has been estimated at 23,314 species (Villaseñor 2018), and more than 50 % are endemic to the country. More than 3,000 are used as medicinal plants but only a small proportion (1-2 %) has been studied (Villaseñor 1993, Espejo-Serna *et al.* 2004, Salazar-Aranda *et al.* 2013). Many members of Asteraceae are part of the traditional knowledge of our country where they are used as food, live fences, construction materials, and source of oils, insecticides, and garden ornamentals; however, they are specially used in traditional medicine (Heinrich *et al.* 1998, Leonti *et al.* 2003, Canales *et al.* 2005, Paredes-Flores *et al.* 2007, Estrada-Castillón *et al.* 2012, Gómez 2012, Ávila-Uribe *et al.* 2016, Casas *et al.* 2016, Vibrans 2016, Lara Reimers *et al.* 2019).

The Asteraceae or Compositae is one of the largest and most diverse families, comprising 10 % of all flowering plant species, rivaled only by Orchidaceae and Fabaceae (Mandel *et al.* 2019). It includes between 950 and 1,450 genera, with an estimated 25,000 to 35,000 species in the world and is the richest family of Mexican flora in genera and species (Villaseñor 2016, Mandel *et al.* 2019). Mexico is considered a center of diversification of this family with 417 genera and 3,113 species and it is the richest country for the family in Neotropics (Villaseñor 2018). Its wide distribution, from sea level (dunes or coastal vegetation) to the mountains, is attributed to its excellent dispersal capacity, genetic plasticity, and the presence of a wide variety of secondary metabolites synthesized as a protection strategy against predators or competitors (Villaseñor 2018). The members of Asteraceae are identified by inflorescences arranged in a capitulum or head, surrounded by an involucre with involucral bracts or phyllaries. On the capitulum there are two kinds of flowers: the outermost or ray flowers and the central or disc flowers. All the flowers are gamopetalous and lack of calyx or modified in a variable and peculiar structure called pappus (Villaseñor 1993). Due to its diversity, the Asteraceae family is divided in 36-38 tribes (Funk *et al.* 2005). In Mexico, there are 24 tribes of native species and two (Arctotideae and Calenduleae) of introduced species (Villaseñor 2018).

The vast diversity in Asteraceae is reflected in the presence of different bioactive compounds important for the pharmaceutical industry too (Kostić *et al.* 2020). Members of Asteraceae are known by their pharmacological activities as antibacterial, anti-inflammatory, wound-healing, anti-hemorrhagic, antipyretic, hepatoprotective, anti-tussive, antitumor, antiparasitic, and antispasmodic (Carvalho *et al.* 2018, Panda & Luyten 2018). Several species are used in Mexican traditional medicine since its antibacterial properties (Sharma *et al.* 2017) and they are mainly used in the treatment of gastrointestinal, respiratory, and dental infectious diseases (Heinrich *et al.* 1998, Murillo-Álvarez *et al.* 2001, Hernández *et al.* 2003, Leonti *et al.* 2003, Canales *et al.* 2005, Paredes-Flores *et al.* 2007, Alonso-Castro *et al.* 2011, Rosas-Piñón *et al.* 2012, Sharma *et al.* 2017, Lara Reimers *et al.* 2019). Some of the most popular medicinal plants used in México are estafiate (*Artemisia ludoviciana*), Mexican arnica (*Heterotheca inuloides*), zoapatle (*Montanoa tomentosa*), and cempazúchitl (*Tagetes erecta*).

More than 5,000 compounds have been identified in Asteraceae, generally associated with some pharmacological activity. The presence of sesquiterpene lactones (SQLs), diterpenes, triterpenes, inulin-type fructans, polyacetylenes, pentacyclic triterpene alcohols, benzofurans, flavones, flavonoids, and unsaturated fatty acids are common compounds in Asteraceae (Heywood *et al.* 1977a, b, Calabria *et al.* 2009). The SQLs are the major chemical compounds in Asteraceae, with at least 3,000 known structures involved in the defense against herbivores and parasites The SQLs, acetylenic compounds, and inulin-type fructans are as characteristic of Asteraceae as their inflorescences (Heywood *et al.* 1977a, b, Heinrich *et al.* 1998).

Despite the discovery of several secondary metabolites in Asteraceae, they attracted disproportionately little attention in the context of ethnopharmacological research, resulting in few systematic explorations and few commercialized products (Panda *et al.* 2019, Kostić *et al.* 2020). In this review we answer the following questions: What pharmacologically studies have been carried out with Asteraceae species used in Mexican traditional medicine? What pharmacological activities have been tested? What compounds are responsible for the tested activities? The goal of our research was to synthesize the knowledge of the ethnopharmacology of the Asteraceae in Mexico.

Materials and methods

We conducted systematics searches for scientific studies of the pharmacological activity, or the phytochemical characterization of Asteraceae used in Mexican traditional medicine. The information was collected from scientific databases including ScienceDirect, Springerlink, Scopus, PubMed, Redalyc, Scielo, EBSCO, ACS Publications, BioMed Central, and Wiley online library, for entries published from 1983 to 2020. The keywords for our searches included: Mexican Asteraceae, medicinal Asteraceae, asteráceas mexicanas, asteráceas medicinales, Mexican traditional medicine, Asteraceae, Compositae. We only include studies that provide information on the collection site, the part used, the species identified, and the herbarium specimen, as recommended by the Guidelines on Good Herbal Processing Practices for Herbal Medicines (WHO 2018).

Species were classified based on the tribe scheme for Mexican Asteraceae by Villaseñor (2018). The nomenclature was based on taxonomic studies for the family including Ortiz-Bermudez *et al.* (1998), Cabrera (2001), Funk *et al.* (2009), Estrada-Castillón & Villarreal-Quintanilla (2010), Schilling & Panero, 2011, Villaseñor & Ortiz (2012), García-Sánchez *et al.* 2014, Redonda-Martínez (2017), Redonda-Martínez (2020), and Villarreal-Quintanilla *et al.* (2020). To identify the native species to Mexico, the studies of Sosa & De-Nova (2012) and Villaseñor (2016) were consulted. The information was arranged alphabetically by tribe, genus, species, traditional uses, and pharmacological/phytochemical studies.

Results

A total of 249 studies where pharmacological activities and/or phytochemical characterizations were assessed for Asteraceae were found. The analysis of the information was carried out with 202 studies that fulfilled the recommendations of the Guidelines on Good Herbal Processing Practices for Herbal Medicines (Appendix 1). Forty-seven studies were not included since they were conducted with parts of plants (leaves, roots, etc.) or plant material purchased or acquired from laboratories, markets, supermarkets or they did not provide information about herbarium specimen.

A total of 101 species with ethnopharmacological and/or phytochemical studies from 16 tribes and 65 genera were recorded. Heliantheae has been the most studied tribe with 30 species and 19 genera, followed by Senecioneae with 17 species and seven genera (Appendix 1). The remaining tribes registered less than 10 species. The states

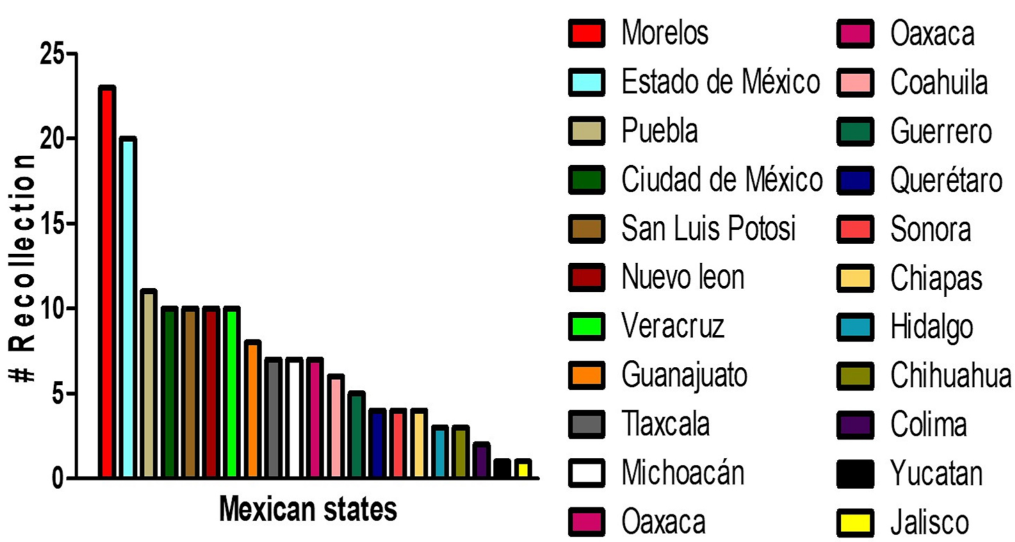

Figure 1. Number of collections by state of Mexican Asteraceae with ethnopharmacological studies.

Table 1. Traditional uses and ethnopharmacological studies of Asteraceae in Mexico

Traditional use (illness/affection/symptom)	Mentions in the reviewed studies % (*)	Activity evaluated	Studies performed % (*)
Gastrointestinal disorders/diseases: diarrhea, stomachache, dysentery, gastritis, indigestion, vomit, dyspepsia, deworming, lack of appetite, tapeworm, purge	20.73 (57)*	Antibacterial	30.7 (62)*
Aches, pain, analgesic, toothache, lumbago, migraine	15 (41)*	Phytochemical characterization	21.8 (44)*
Respiratory infections: cough, bronchitis, expectorant, flu, tuberculosis, cold, asthma	10.2 (28)*	Cytotoxity	12.4 (25)*
Anti-inflamatory, neuritis, bruises	7.6 (21)*	Antifungal	8.0 (16)*
Skin infections: welts herpes, sores, scabies, skin wounds, baby rash, dermatophytosis, astringent	7.3 (20)*	Anti-inflamatory	7.0 (14)*
Fever	5.1 (14)*	Antiprotozoal	4.95 (10)
		Spasmolityc	4.95 (10)*
Colic, spasmolytic	4 (11)*	Analgesic	4.46 (9)*
Diabetes	3.6 (10)*	Antioxidant	4.46 (9)*
Anxiolytic	2.2 (6)*	Antimicrobial	3.96 (8)*
Labor	2.2 (6)*		

*Number of mentions in the reviewed studies.

where the specimens were collected are Morelos (23), Estado de Mexico (20), Puebla (11), Mexico City (10), San Luis Potosi (10), Nuevo Leon (10), and Veracruz (10). Yucatan and Jalisco are less explored by one mention each one (Figure 1).

The traditional uses referred in the reviewed studies are mainly on diseases or symptoms related to the digestive system (20.73 %), followed by treatment of different types of pain (15 %), and for the treatment of diseases associated to the respiratory system (10.2 %). Other uses were anti-inflammatory (7.6 %), and skin infections (7.3 %) (Table 1, Appendix 1). From the 202 reviewed studies, 62 (30.7 %) analyzed antibacterial activity and 44 (21.8 %) were phytochemical characterizations. Other assessed activities were cytotoxicity (12.4 %) and anti-inflammatory (7 %). Some activities, such as healing, diuretic, antimalarial, aphrodisiac, immunostimulant, among others, were evaluated only once. From 101 species, 21 were evaluated for their antibacterial activity, 13 were only characterized phytochemically, and five to assess their analgesic activity. Thirty-nine were studied only once. The most studied species have been *Heliopsis longipes* (18 studies, Figure 2C), *Ageratina pichinchensis* (16, Figure 2A), *Artemisia ludoviciana* (13, Figure 2B), and *Heterotheca inuloides* (10, Figure 2D). These species were mentioned in the 28.1 % of the reviewed studies. According to their distribution, 54 species are native to Mexico, 41 are endemic, and five are introduced. The Heliantheae presented the highest proportion of native (13) and endemic (17) species, followed by Senecioneae with five native and 12 endemics (Appendix 1).

Discussion

Traditional knowledge is the best evidence of the efficacy of medicinal plants in treating diseases, their symptoms, and other ailments (Firenzuoli & Gori 2007, Helmstädter & Staiger 2014). Ethnobotany and traditional knowledge about the preparation and administration of medicinal plants provide valuable information around active compounds. Several phytochemical compounds with biological activities were discovered from traditional knowledge and they have been a starting point for new therapeutics (Salazar-Aranda *et al.* 2013, Buenz *et al.* 2018). From the 122 plant-derived chemical products currently used in medicine, 80 % are used congruently to their ethnomedical application (Saslis-Lagoudakis *et al.* 2011). These compounds have played a crucial role in treating and preventing human diseases. The artemisinin drug against parasitic diseases such as malaria was isolated from *Artemisia annua* used in traditional medicine for the treatment of respiratory diseases (Helmstädter & Staiger 2014, Helmstädter 2017). This is a prominent example of how the traditional knowledge regarding medicinal plants plays a key role in the identification of new bioactive agents or new drugs.

Ethnopharmacology of the Asteraceae in Mexico. Heliantheae, Senecioneae, Eupatorieae, and Astereae are the tribes with the highest number of genera and species in Mexico (Villaseñor 2018) and they are well represented in the reviewed ethnopharmacological and phytochemical studies. The species of Heliantheae and Senecioneae are the most evaluated and include most of the endemic studied species. On the other hand, from 26 tribes in México only 16 are represented in ethnopharmacological studies, possibly because some of them have a few species (*e.g.*, Arctotideae, Chaenactideae, Gochnatieae, Liabeae, Onoserideae). But other tribes, such as Astereae and Eupatorieae are among the largest tribes in Asteraceae, with well-recognized species in Mexican traditional medicine. However, genera like *Ageratina, Conyza*, *Erigeron*, *Eupatorium*, *Gymnosperma*, *Solidago*, and *Stevia*, among others, are scarcely represented in ethnopharmacological studies.

From the best represented species in Mexican ethnopharmacological studies *Ageratina pichinchensis* (Figure 2A), named axihuitl or manrrubio, is a plant widely used in Mexican traditional medicine, whose pharmacological activities have been confirmed in preclinical and clinical studies (Aguilar-Guadarrama *et al.* 2009, Sánchez-Mendoza *et al.* 2013, Romero-Cerecero *et al.* 2017). This species is used in the treatment of diseases caused by or related to fungal and skin infections, wounds, and to treat pain and gastric ulcers (Aguilar-Guadarrama *et al.* 2009, Sánchez-Mendoza *et al.* 2013, Romero-Cerecero *et al.* 2017). Additionally, *A. pichinchensis* has wound healing, antiulcer, gastroprotective, antinociceptive, and anti-inflammatory effects (Sánchez-Mendoza *et al.* 2010, Romero-Cerecero *et al.* 2012a, Romero-Cerecero *et al.* 2013, Sánchez-Mendoza *et al.* 2013). Pharmacological evaluations showed that its extracts exhibit antifungal activity against *Trichophyton mentagrophytes*, *T. rubrum*, and *Candida albicans* (Ríos *et al.* 2003), and have shown therapeutic and mycological effectiveness in patients with vulvovaginal candidiasis (Romero-Cerecero *et al.* 2017). The antimicrobial activity of encecalin, taraxerol, β-sitosterol, and stigmasterol isolated from this species has been demonstrated (Aguilar-Guadarrama *et al.* 2009). The antinociceptive activity and gastroprotective effect of *A. pichinchensis* are related to the presence of 3,5-diprenyl-4-hydroxyacetophenone (HYDP) isolated from its leaves (Sánchez-Mendoza *et al.* 2013). Studies showed that 7-O-(b-D-glucopyranosyl)-galactin is the compound associated with the effects of *A. pichinchensis* in cell proliferation and healing activity in skin lesions in an animal model of diabetes (Romero-Cerecero *et al.* 2013, Romero-Cerecero 2014). The healing properties of *A. pichinchensis* have been assessed in human clinical trials. It has demonstrated effectiveness in the treatment of chronic venous leg ulcers (Romero-Cerecero *et al.* 2012a), and diabetic foot ulcers (Romero-Cerecero *et al.* 2015b).

Artemisia ludoviciana (Figure 2B) has been used in Mexican traditional medicine since pre-Hispanic times. It is commonly named estafiate, ajenjo del país, azumate, or iztauhyatl (Calzada *et al.* 2007, Estrada-Soto *et al.* 2012, Anaya-Eugenio *et al.* 2016). This species is widely used to treat gastrointestinal disorders as parasites, indigestion, diarrhea, and dysentery. Also, it is used in the treatment of colic, bronchitis, dandruff, inflammation, diabetes, antimalarial, and analgesic (Calzada *et al.* 2007, Estrada-Soto *et al.* 2012, Anaya-Eugenio *et al.* 2016). Studies in animal models have described antidiarrheal and antispasmodic activities of the essential oil obtained from aerial parts from *A. ludoviciana* (Said Fernández *et al.* 2005, Calzada *et al.* 2010, Estrada-Soto *et al.* 2012). Leaf extracts from this plant have antimicrobial activity against microorganisms responsible for gastrointestinal diseases such as *Entamoeba histolytica*, *Escherichia coli*, *Giardia lamblia*, *Vibrio cholerae*, and other responsible for infectious diseases as *Candida albicans*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* (Navarro *et al.* 1996, Said Fernández *et al.* 2005, Damián-Badillo et al. 2008). Most relevant is the activity of *A. ludociviana* against *Helicobacter pylori*, the major etiological agent of chronic gastritis and peptic ulcer disease linked to gastric carcinoma (Castillo-Juárez *et al.* 2009). It has been documented its anti-*Myco-*

bacterium tuberculosis activity (Jiménez-Arellanes *et al.* 2003). However, the compounds responsible for the mentioned antimicrobial activities have not elucidated yet. Additionally, Anaya-Eugenio *et al.* (2014) demonstrated the hypoglycemic and antihyperglycemic effects of arglanin and salvinine isolated from *A. ludoviciana* in mice, which supports its effectiveness in the treatment of diabetes in folk medicine.

Heliopsis longipes (Figure 2C), named chilcuague, chilcuán, pelitre, raíz de oro, and pyrethrum; it is endemic to the Sierra Gorda and Sierra de Álvarez in the limits of the states of Guanajuato, San Luis Potosí, and Querétaro (Cilia-López *et al.* 2008). This species is employed to calm toothaches, muscle aches, arthritis, rheumatism, as anti-inflammatory, in the treatment of oral herpes, oral infections, deworming, diarrhea, and muscle soreness (Cilia-López *et al.* 2008). It has antibacterial activity against *Escherichia coli,* as well as antifungal and anti-aflatoxigenic activity (Molina-Torres *et al.* 1999, Buitimea-Cantúa *et al.* 2020). The anti-inflammatory, antinociceptive, and anti-arthritic activities of *H. longipes* have been demonstrated in animal models (Acosta-Madrid *et al.* 2009, Hernández *et al.*

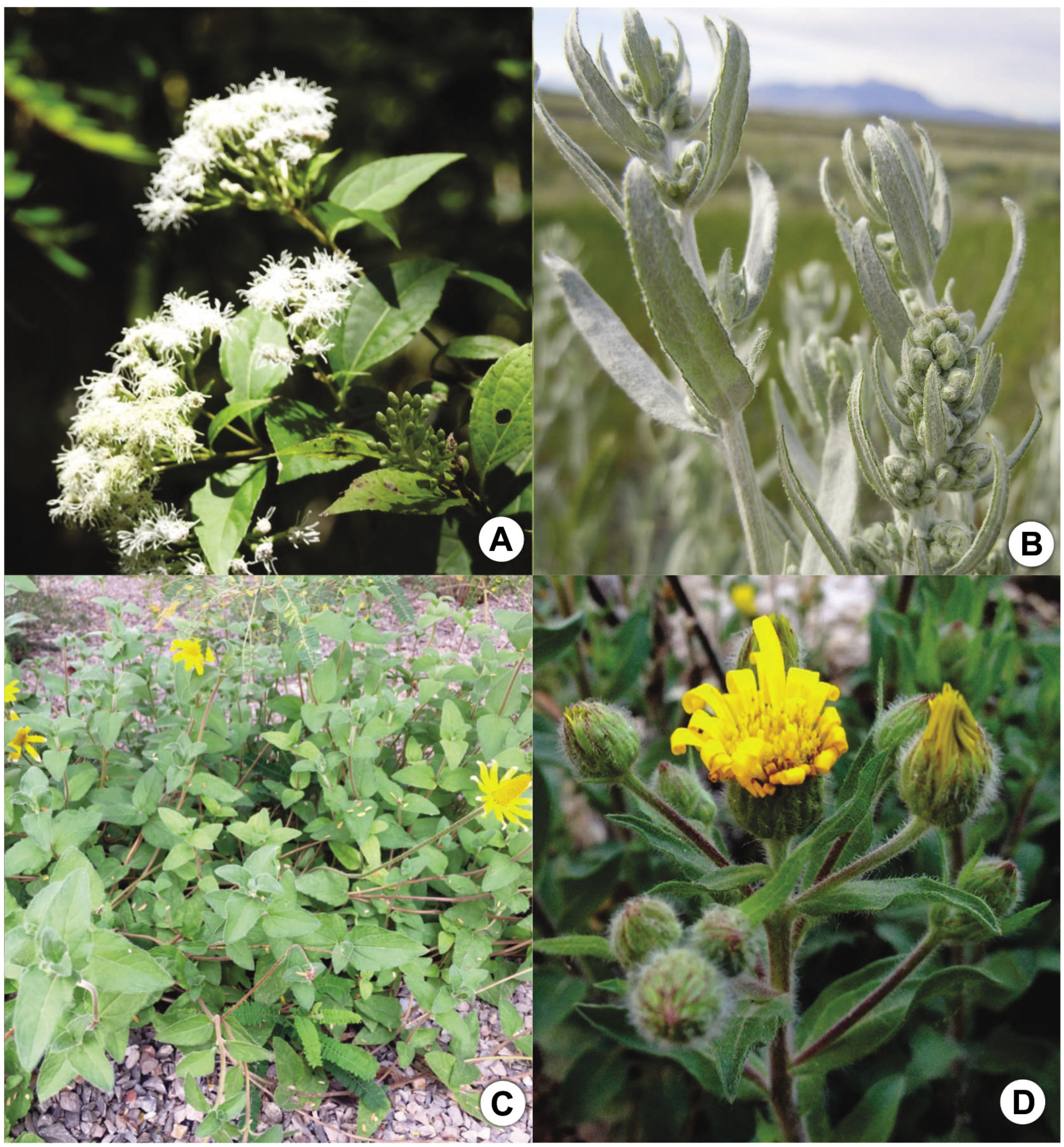

Figure 2. Most studied Asteraceae in the Mexican ethnopharmacology. A) *Ageratina pichinchensis* (Eupatorieae), B) *Artemisia ludoviciana* (Anthemideae), C) *Heliopsis longipes* (Heliantheae), D) *Heterotheca inuloides* (Astereae). Images from Enciclovida. Credits: A) Neptalí Ramírez Marcial, C) Arturo de Nova, D) Bodo Nuñez Oberg.

2009, Cariño-Cortés *et al.* 2010, Cilia-López *et al.* 2010, Arriaga-Alba *et al.* 2013, Escobedo-Martínez *et al.* 2017, de la Rosa-Lugo *et al.* 2017). It has been demonstrated that its anti-inflammatory and anti-arthritic activities are higher than the reference drug phenylbutazone. Moreover, its extracts prevent the occurrence of secondary lesions, this makes it a better alternative for this type of chronic condition (Escobedo-Martínez *et al.* 2017). These biological activities are attributed to affinin, the main bioactive compound present in the roots of *H. longipes* (Molina-Torres *et al.* 1999). Ríos *et al.* (2007) established that the GABAergic system is involved in the analgesic response of affinin in *H. longipes* and de la Rosa-Lugo *et al.* (2017) indicate that it can be used for the treatment of orofacial pain. Affinin also induces the vasodilation showing its therapeutic potential in the treatment of cardiovascular diseases (Castro-Ruiz *et al.* 2017). In addition, the antimutagenic activity of affinin has been demonstrated (Cariño-Cortés *et al.* 2010, Arriaga-Alba *et al.* 2013).

Heterotheca inuloides (Figure 2D) is one of the most used plants in Mexican traditional medicine with a high market demand. It is commonly named Mexican arnica,

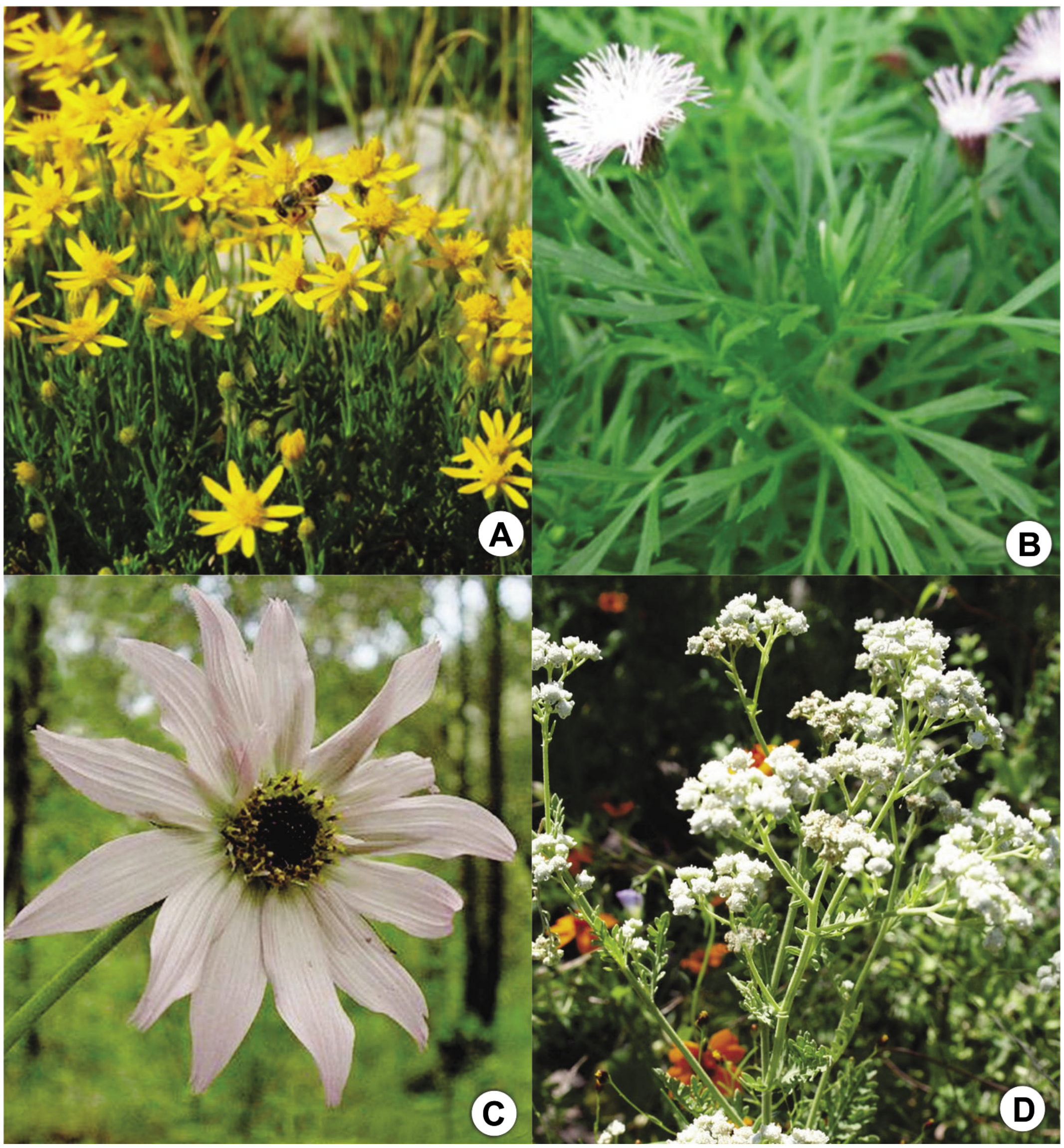

Figure 3. Some important Asteraceae to the ethnopharmacology in Mexico. A) *Chrysactinia mexicana* (Tageteae), B) *Hofmeisteria schaffneri* (Eupatorieae), C) *Iosthephane heterophylla* (Heliantheae), D) *Parthenium hysterophorus* (Heliantheae). Images from Enciclovida. Credits: A) Arturo Cruz, B) Ignacio Vargas, C) Guillermo Ibarra, D) Aaron Balam.

acahual, cuauteteco, and xochihuepal (Rodríguez-Chávez *et al.* 2017). This species is widely used for the treatment of inflammatory conditions, skin wounds, fever, contusions, bruises, biliary disorders, cough, respiratory problems, gastritis, hemorrhoids, rheumatism, toothache, and urinary tract inflammation (Gené *et al.* 1998, Delgado *et al.* 2001, Rodríguez-Chávez *et al.* 2017, Egas *et al.* 2018). It has antibacterial activity against *Helicobacter pylori* and *Streptococcus mutans* and its flowers are effective against *Giardia intestinalis* trophozoites (Rosas-Piñón *et al.* 2012, Rodríguez-Chávez *et al.* 2015c, Egas *et al.* 2018). Several studies have assessed the anti-inflammatory and antinociceptive activities of *H. inuloides* in different pharmacological models (Gené *et al.* 1998, Delgado *et al.* 2001, Maldonado-López *et al.* 2008, Egas *et al.* 2015, Rodríguez-Chávez et al. 2015a). The anti-inflammatory activity of *H. inuloides* has been associated to the presence of quercetin and sesquiterpenes (Delgado et al. 2001, Maldonado-López *et al.* 2008). The hepatoprotective and chemopreventive activities of *H. inuloides* are associated with the antioxidant activity of quercetin, one of the main compounds of this plant (Coballase-Urrutia et al. 2011, Ruiz-Pérez et al. 2014). The cytotoxic properties, chelating, and tyrosinase inhibitory activity of *H. inuloides* have been described (Rodríguez-Chávez *et al.* 2017). Infusions of this plant showed antioxidant activity *in vitro* (Coballase-Urrutia *et al.* 2010, Rodríguez-Chávez *et al.* 2015a, Rodríguez-Chávez *et al.* 2015c).

Traditional medicinal uses and the pharmacological activities of compounds. Many studies on Asteraceae around the world focused on chemical analysis, have nearly isolated 7,000 different compounds (Panda & Luyten 2018). Ethnopharmacological studies have been useful in the identification of phytochemical compounds since they involve the characterization and isolation of compounds with pharmacological activity. The Asteraceae family in Mexican traditional medicine is mainly used in the treatment of gastrointestinal and respiratory diseases due to its antimicrobial activity (Murillo-Álvarez *et al.* 2001, Canales *et al.* 2005, Calzada *et al.* 2009, Salazar-Aranda *et al.* 2011, Rosas-Piñón *et al.* 2012, Robles-Zepeda *et al.* 2013). The use of this family in Mexico for the treatment of diseases related to the digestive system is similar to other countries as Nepal, New Zealand, and South Africa, where several of its species are used to treat infectious diseases (Saslis-Lagoudakis *et al.* 2011). The frequent use of Asteraceae as antimicrobial resources in different cultures highlights the importance of the family in the entire world and reveal cultural and chemical patterns where common traditional uses are similar in plant groups to treat related conditions or diseases.

The presence of secondary metabolites in Asteraceae as polyacetylenes and flavonoids with antibacterial and bacteriostatic activities, confirm the traditional medicine use of the family in the treatment of infectious diseases (Heinrich *et al.* 1998, Calabria *et al.* 2009). In the reviewed studies, some compounds with antimicrobial activities have been identified, especially those against bacteria causing infectious diseases, such as diarrhea, pneumonia, and tuberculosis. Research related to new natural antibiotics has a crucial worldwide interest, due to bacterial resistance. Microorganisms responsible for worrying and often fatal infections such as *Candida albicans*, *Escherichia coli*, *Mycobacterium tuberculosis*, *Staphylococcus aureus*, *Streptococcus pneumonia*, and *Trypanosoma* spp. are a worldwide concern, highlighting the importance of antibiotics research to treat these diseases (OMS 2016). Natural products have been a source of bactericides in traditional medicine, and they have been served as potential therapeutics against pathogenic bacteria since the golden age of antibiotics in the mid-20th century (Rossiter *et al.* 2017). However, the exploration of natural products as a source for new antibiotics has been greatly reduced over the past 20 years (Silver 2015).

The main pharmacological activity in the reviewed studies is antimicrobial. The ent-trachyloban-19-oic acid, isolated from the roots of *Iostephane heterophylla* (Figure 3C), is a potent antibacterial agent in the treatment of oral pathogens as *Streptococcus mutans* (Hernández *et al.* 2012). Two SQLs identified in *Ambrosia confertiflora*, santamarine and reynosin have bactericidal activity against *Mycobacterium tuberculosis* (Coronado-Aceves *et al.* 2016). Thymol esters of different short-chain fatty acids are the active principles for antimicrobial activity of *Hofmeisteria schaffneri* (Figure 3B) against *Bacillus subtilis*, *Candida albicans*, and *Staphylococcus aureus*, three of the main microorganisms responsible for several infections (Pérez-Vásquez *et al.* 2011). Essential oil and 5-(3-buten-1-ynyl)-2, 2'-bithieny of *Chrysactinia mexicana* (Figure 3A) have antibacterial activity against *Streptococcus pneumoniae*, one of the major agents of infectious diseases of the respiratory tract and resistant to penicillin (Guevara Campos *et al.* 2011). The encecalin and demethylencecalin isolated from *Helianthella quinquenervis* exhibited antifungal activity against *Trichophyton mentagrophytes* responsible for various skin infections (Castañeda *et al.* 1996). Ambrosin and incomptine B, two

SQLs, isolated from *Parthenium hysterophorus* (Figure 3D) and *Decachaeta incompta* possess high trypanocidal activity. Both compounds are more effective than the current trypanocidal drugs used clinically (Sepúlveda-Robles et al. 2019).

Other pharmacological activities evaluated in the reviewed studies were cytotoxicity, anti-inflammatory, analgesic, antioxidant, and spasmolytic (Table 1). The hofmeisterin III and other thymyl derivatives are the main antinociceptive agents from *Hofmeisteria schaffneri* (Figure 3B) (Angeles-López *et al.* 2010). In *Calea ternifolia* used in the treatment of diabetes, the chromenes 1 and 2, caleins A, and C compounds were identified. These compounds reduced the postprandial hyperglycemia, one of the most common abnormalities in the early phase of type 2 diabetes (Escandón-Rivera *et al.* 2017). *Vernonia liatroides* endemic to Mexico and used in menstrual disorders and dysentery, have been identified the sesquiterpenes α-methylene γ-lacton, which has muscle relaxant activity in animal models (Campos *et al.* 2003). Two species have been tested against cancer cell lines, *Gonzalezia decurrens*, which has displayed cytotoxic activity against colon cancer *in vitro* (Marquina *et al.* 2001), and *Smallanthus maculatus*, from which ursolic acid was isolated and showed cytotoxic activity against cancer cell lines (Jacobo-Herrera *et al.* 2016).

Limitations of the reviewed studies. In the current review, 43 % of the studies report pharmacological activities but the responsible compounds have not been identified, and some species were studied only once. For example, *Artemisia ludoviciana* is one of the most studied species and its potent antimicrobial activity has been assessed, but the responsible compounds have not been identified. In the other hand, 8 % of the studies are phytochemical characterizations where the pharmacological activity of the compounds was not assessed.

The WHO (2018) recommends that ethnopharmacological studies of medicinal plants should be supported by information of herbarium specimen, used part of the plant, traditional preparation, among others. However, in our review, 47 studies do not include information on herbarium specimens and/or traditional uses, so the identification of the studied species cannot be corroborated. Providing this information is crucial, especially since the ultimate goal of ethnopharmacological studies is to ensure the safe and correct use of herbal remedies (Davidson *et al.* 2013, Helmstädter & Staiger 2014, Helmstädter 2017).

There are other impediments to using ethnopharmacology in the drug discovery process that limit the growth of herbal medicine as an industry to perform bioprospecting, as the generational loss of traditional medicine knowledge, loss of biodiversity, over-exploitation, and a historic lack of a legal framework on the use of medicinal plants (Buenz *et al.* 2018, Mata *et al.* 2019). In addition, studies on medicinal plants should involve a sustainable approach based on traditional knowledge, regulation, and quality control as essential points the development of a rational use of traditional medicine and herbal remedies (Buenz *et al.* 2018, Mata *et al.* 2019).

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Literature cited

Acosta-Madrid II, Castañeda-Hernández G, Cilia-López VG, Cariño-Cortés R, Pérez-Hernández N, Fernández-Martínez E, Ortiz MI. 2009. Interaction between *Heliopsis longipes* extract and diclofenac on the thermal hyperalgesia test. *Phytomedicine* **16**: 336-341. DOI: https://doi.org/10.1016/j.phymed.2008.12.014

Aguilar MI, Delgado G, Hernández ML Villarreal ML. 2001. Bioactive compounds from *Iostephane heterophylla* (Asteraceae). *Natural Product Letters* **15**: 93-101. DOI: https://doi.org/10.1080/10575630108041265

Aguilar MI, Osorio N, Bernal I, Navarrete A, Bye R. 2007. Development and validation of a liquid chromatography method for quantification of xanthorrhizol in roots of *Iostephane heterophylla* (Cav.) Benth ex Hemsl. *Journal of AOAC International* **90**: 892-896. https://doi.org/10.1093/jaoac/90.4.892

Aguilar-Guadarrama B, Navarro V, León-Rivera I, Ríos MY. 2009. Active compounds against tinea pedis dermatophytes from *Ageratina pichinchensis* var. *bustamenta*. *Natural Products Research* **23**: 1559-1565. DOI: https://doi.org/10.1080/14786410902843301

Aguirre-Crespo F, Castillo-España P, Villalobos-Molina R, López-Guerrero JJ, Estrada-Soto S. 2005. Vasorelaxant effect of Mexican medicinal plants on isolated rat aorta. *Pharmaceutical Biology*. **43**: 540-546. DOI: https://doi.org/10.1080/13880200500220839

Alarcón-Aguilar FJ, Fortis-Barrera A, Angeles-Mejía S, Banderas-Dorantes TR, Jasso-Villagómez EI, Almanza-Pérez JC, Blancas-Flores G, Zamilpa A, Díaz-Flores M, Román-Ramos R. 2010. Anti-inflammatory and antioxidant effects of a hypoglycemic fructan fraction from *Psacalium peltatum* (H.B.K.) Cass. in streptozotocin-induced diabetes mice. *Journal of Ethnopharmacology* **132**: 400-407. DOI: https://doi.org/10.1016/j.jep.2010.08.003

Alonso-Castro A, Villarreal ML, Salazar-Olivo LA, Gómez-Sánchez M, Domínguez F, García-Carranca A. 2011. Mexican medicinal plants used for cancer treatment: Pharmacological phytochemical and ethnobotanical studies. *Journal of Ethnopharmacology* **133**: 945-972. DOI: https://doi.org/10.1016/j.jep.2010.11.055

Alonso-Castro AJ, González-Chávez MM, Zapata-Morales JR, Verdinez-Portales AK, Sánchez-Recillas A, Ortiz-Andrade R, Isiordia-Espinoza M, Martínez-Gutiérrez F, Ramírez-Morales MA, Domínguez F, Juache-Flores ME, Martínez R. 2017. Antinociceptive activity of ent-dihydrotucumanoic acid isolated from *Gymnosperma glutinosum* Spreng Less. *Drug Development Research* **78**: 340-348. DOI: https://doi.org/10.1002/ddr.21397

Anaya-Eugenio GD, Rivero-Cruz I, Rivera-Chávez J, Mata R. 2014. Hypoglycemic properties of some preparations and compounds from *Artemisia ludoviciana* Nutt. *Journal of Ethnopharmacology* **155**: 416-425. DOI: https://doi.org/10.1016/j.jep.2014.05.051

Anaya-Eugenio GD, Rivero-Cruz I, Bye R, Linares E, Mata R. 2016. Antinociceptive activity of the essential oil from *Artemisia ludoviciana. Journal of Ethnopharmacology* **179**: 403-411. DOI: https://doi.org/10.1016/j.jep.2016.01.008

Angeles-López G, Pérez-Vásquez A, Hernández-Luis F, Déciga-Campos M, Bye R, Linares E, Mata R. 2010. Antinociceptive effect of extracts and compounds from *Hofmeisteria schaffneri. Journal of Ethnopharmacology* **131**: 425-432. DOI: https://doi.org/10.1016/j.jep.2010.07.009

Arciniegas A, Pérez-Castorena AL, Reyes S, Contreras JL, Romo de Vivar A. 2003. New oplopane and eremophilane derivatives from *Robinsonecio gerberifolius. Journal of Natural Products* **66**: 225-229. DOI: https://doi.org/10.1021/np0203739

Arciniegas A, Pérez-Castorena AL, Villaseñor JL, Romo de Vivar A. 2006a. Cacalol derivatives from *Roldana angulifolia. Journal of Natural Products* **69**: 1826-1829. DOI: https://doi.org/10.1021/np0604073

Arciniegas A, Pérez-Castorena AL, Cuevas G, del Río-Portilla F, Romo de Vivar A. 2006b. Eremophilane esters of *Robinsonecio gerberifolius* and their rearranged products. Study of the coupling constants2JH, H,3JH, H and 4JH, H. *Magnetic Resonance in Chemistry*. **44**: 30-34. DOI: https://doi.org/10.1002/mrc.1719

Arciniegas A, Polindara LA, Pérez-Castorena AL, García AM, Ávila G, Villaseñor JL, Romo de Vivar A. 2011. Chemical composition and biological activity of *Laennecia schiedeana. Zeitschrift fuer Naturforschung C* **66**: 115-122. DOI: https://doi.org/10.1515/znc-2011-3-404

Arriaga-Alba A, Rios MY, Déciga-Campos M. 2013. Antimutagenic properties of affinin isolated from *Heliopsis longipes* extract. *Pharmaceutical Biology* **51**: 1035-1039. DOI: https://doi.org/10.3109/13880209.2013.775161

Arroyo AR, Chacon B, Maki KA. 2004. Screening and selection of plants by positive pharmacologic effect on jejunum muscular contractility. *Pharmaceutical Biology* **42**: 24-29. DOI: https://doi.org/10.1080/13880200490505357

Astudillo-Vázquez A, Dávalos-Valle H, De Jesús L, Herrera G, Navarrete A. 2008. Investigation of *Alternanthera repens* and *Bidens odorata* on gastrointestinal disease. *Fitoterapia* **79**: 577-580. DOI: https://doi.org/10.1016/j.fitote.2008.07.001

Avallone R, Zanoli P, Puia G, Kleinschnitz M, Schreier P, Baraldi M. 2000. Pharmacological profile of apigenin, a flavonoid isolated from *Matricaria chamomilla. Biochemical Pharmacology* **59**: 1387-94. DOI: https://doi.org/10.1016/S0006-2952(00)00264-1

Avelino-Flores MCG, Bibbins-Martínez MD, Vallejo-Ruiz V, Reyes-Leyva J. 2019. Evaluación *in vitro* de la actividad citotóxica y antitumoral de plantas medicinales recomendadas en Cuetzalan del Progreso, Puebla, México. *Polibotánica* **47**: 113-135. DOI: https://doi.org/10.18387/polibotanica.47.9

Ávila-Uribe MM, García-Zárate SN, Sepúlveda-Barrera AS, Godínez-Rodríguez MA. 2016. Plantas medicinales en dos poblados del municipio de San Martín de las Pirámides, Estado de México. *Polibotánica* **42:** 215-245. DOI: https://doi.org/10.18387/polibotanica.42.11

Ávila-Villarreal G, González-Trujano ME, Carballo-Villalobos AI, Aguilar-Guadarrama B, García-Jiménez S, Giles-Rivas DE, Castillo-España P, Villalobos-Molina R, Estrada-Soto S. 2016. Anxiolytic-like effects and toxicological studies of *Brickellia cavanillesii* (Cass.) A. Gray in experimental mice models. *Journal of Ethnopharmacology* **192**: 90-98. DOI: https://doi.org/10.1016/j.jep.2016.07.006

Barrera-Figueroa BE, Loeza-Lara PD, Hernández-García A, López-Meza JE, Molina-Torres J, del Río-Torres

REN, Martínez-Pacheco MM, López-Gómez R, Salgado-Garciglia R. 2011. Antibacterial activity of flower extracts from *Helenium mexicanum* H.B.K. *Emirates Journal of Food & Agriculture* **23**: 258-264.

Bautista E, Calzada F, Yepez-Mulia L, Chavez-Soto M, Ortega A. 2012. Incomptines C and D, two heliangolides from *Decachaeta incompta* and their antiprotozoal activity. *Planta Medica* **78**: 1698-1701. DOI: https://doi.org/10.1055/s-0032-1315255

Bonilla-Jaime H, Guadarrama-Cruz G, Alarcon-Aguilar FJ, Limón-Morales O, Vázquez-Palacios G. 2015. Antidepressant-like activity of *Tagetes lucida* Cav. is mediated by 5-HT(1A) and 5-HT(2A) receptors. *Journal of Natural Medicines* **69**: 463-470. DOI: https://doi.org/10.1007/s11418-015-0909-5

Bork PM, Schmitz ML, Weimann C, Kist M, Heinrich M. 1996. Nahua Indian medicinal plants (Mexico): Inhibitory activity on NF-κB as an anti-inflammatory model and antibacterial effects. *Phytomedicine* **3**: 263-269. DOI: https://doi.org/10.1016/S0944-7113(96)80064-X

Buenz EJ, Verpoorte R, Bauer BA. 2018. The ethnopharmacologic contribution to bioprospecting natural products. *Annual Review of Pharmacology and Toxicology* **58**: 509-530. DOI: https://doi.org/10.1146/annurev-pharmtox-010617-052703

Buitimea-Cantúa GV, Buitimea-Cantúa NE, Rocha-Pizaña MR, Rosas-Burgos EC, Hernández-Morales A, Molina-Torres J. 2020. Antifungal and anti-aflatoxigenic activity of *Heliopsis longipes* roots and affinin/spilanthol against *Aspergillus parasiticus* by down regulating the expression of alfD and aflR genes of the aflatoxins biosynthetic pathway. *Journal of Environmental Science and Health, Part B* **55**: 210-219. DOI: https://doi.org/10.1080/03601234.2019.1681818

Cabrera RL. 2001. Six new species of Acourtia (Asteraceae) and a historical account of *Acourtia mexicana. Brittonia* **53**: 416-429. DOI: https://doi.org/10.1007/BF02809796

Calabria LM, Emerenciano VP, Scotti MT, Mabry TJ. 2009. Secondary chemistry of Compositae. *In:* Funk VA, Sussana A, Stuessy TF, Bayer RJ, eds. *Systematics, Evolution and Biogeography of the Compositae*. Vienna, Austra: International Association for Plant Taxonomy (IAPT). pp. 73-88. ISBN 978-3-9501754-3-1

Calzada F, Meckes M, Cedillo-Rivera R, Tapia-Contreras A, Mata R. 1998. Screening of Mexican medicinal plants for antiprotozoal activity. *Pharmaceutical Biology* **36**: 305-309. DOI: https://doi.org/10.1076/phbi.36.5.305.4653

Calzada F, Cedillo-Rivera R, Mata R. 2001. Antiprotozoal activity of the constituents of *Conyza filaginoides. Journal of Natural Products* **64**: 671-673. DOI: https://doi.org/10.1021/np000442o

Calzada F, Yépez-Mulia L, Tapia-Contreras A. 2007. Effect of Mexican medicinal plant used to treat trichomoniasis on *Trichomonas vaginalis* trophozoites. *Journal of Ethnopharmacology* **113**: 248-251. DOI: https://doi.org/10.1016/j.jep.2007.06.001

Calzada F, Yepez-Mulia L, Tapia-Contreras A, Ortega A. 2009. Antiprotozoal and antibacterial properties of *Decachaeta incompta. Revista Latinoamericana de Química* **37**: 97-103.

Calzada F, Arista R, Pérez H. 2010. Effect of plants used in Mexico to treat gastrointestinal disorders on charcoal-gum acacia-induced hyperperistalsis in rats. *Journal of Ethnopharmacology* **128**: 49-51. DOI: https://doi.org/10.1016/j.jep.2009.12.022

Campos M, Oropeza M, Ponce H, Fernández J, Jiménez-Estrada M, Torres H, Reyes-Chilpa R. 2003. Relaxation of uterine and aortic smooth muscle by glaucolides D and E from *Vernonia liatroides. Biological and Pharmaceutical Bulletin* **26**: 112-115. DOI: https://doi.org/10.1248/bpb.26.112

Campos-Bedolla P, Montaño LM, Flores-Soto E, Aguilar A, Puebla AM, Lozoya X, Vargas MH. 2005. Effect of *Gnaphalium conoideum* HBK on guinea pig airway smooth muscle: role of L-type Ca2+ channels. *Journal of Ethnopharmacology* **97**: 267-272. DOI: https://doi.org/10.1016/j.jep.2004.11.005

Canales M, Hernández T, Caballero J, Romo de Vivar A, Ávila G, Duran A, Lira R. 2005. Informant consensus factor and antibacterial activity of the medicinal plants used by the people of San Rafael Coxcatlán, Puebla, México. *Journal of Ethnopharmacology* **97**: 429-439. DOI: https://doi.org/10.1016/j.jep.2004.11.013

Canales M, Hernández T, Serrano R, Hernández LB, Duran A, Ríos V, Sigrist S, Hernández HL, García AM, Angeles-López O, Fernández-Araiza MA, Ávila G. 2007. Antimicrobial and general toxicity activities of *Gymnosperma glutinosum*: A comparative study. *Journal of Ethnopharmacology* **110**: 343-347. DOI: https://doi.org/10.1016/j.jep.2006.10.002

Canales M, Hernández T, Rodríguez-Monroy MA, Jiménez-Estrada M, Flores CM, Hernández LB, Gijón IC, Quiroz S, García AM, Ávila G. 2008. Antimicrobial activity of the extracts and essential oil of *Viguiera dentata. Pharmaceutical Biology* **46**: 719-723. DOI: https://doi.org/10.1080/13880200802215727

Cárdenas J, Reyes-Pérez V, Hernández-Navarro MD, Dorantes-Barrón AM, Almazán S, Estrada-Reyes R. 2017. Anxiolytic and antidepressant-like effects of an aqueous extract of *Tanacetum parthenium* L. Schultz-Bip (Asteraceae) in mice. *Journal of Ethnopharmacology* **200**: 22-30. DOI: https://doi.org/10.1016/j.jep.2017.02.023

Cariño-Cortés R, Gayosso-De-Lucio JA, Ortiz MI, Sánchez-Gutiérrez M, García-Reyna PB, Cilia-López VG, Pérez-Hernández N, Moreno E, Ponce-Monter H. 2010. Antinociceptive, genotoxic and histopathological study of *Heliopsis longipes* S.F. Blake in mice. *Journal of Ethnopharmacology* **130**: 216-221. DOI: https://doi.org/10.1016/j.jep.2010.04.037

Carro-Juárez M, Cervantes E, Cervantes-Méndez M, Rodríguez-Manzo G. 2004. Aphrodisiac properties of *Montanoa tomentosa* aqueous crude extract in male rats. *Pharmacology, Biochemistry and Behavior* **78**: 129-134. DOI: https://doi.org/10.1016/j.pbb.2004.03.001

Carro-Juárez M, Alcázar C, Ballesteros-Polvo E, Villalobos-Peñalosa P. 2009. Increase of ejaculatory capacity by systemic administration of the oquichpatli (*Senecio cardiophyllus*) aqueous crude extract in male rats. *Journal of Ethnopharmacology* **126**: 506-511. DOI: https://doi.org/10.1016/j.jep.2009.09.006

Carro-Juárez M, Rodríguez-Landa JF, Rodríguez-Peña ML, Rovirosa-Hernández MJ, García-Orduña F. 2012. The aqueous crude extract of *Montanoa frutescens* produces anxiolytic-like effects similarly to diazepam in Wistar rats: Involvement of GABAA receptor. *Journal of Ethnopharmacology* **143**: 592-598. DOI: https://doi.org/10.1016/j.jep.2012.07.022

Carro-Juárez M, Franco MA, Rodríguez-Peña ML. 2014. Increase of the ejaculatory potency by the systemic administration of aqueous crude extracts of cihuapatli (*Montanoa* Genus) plants in spinal male rats. *Journal of Evidence-Based Complementary & Alternative Medicine* **19**: 43-50. DOI: https://doi.org/10.1177/2156587213510006

Carvalho Jr AR, Diniz RM, Suarez MAM, Figueiredo CSSS, Zagmignan A, Grisotto MAG, Fernandes ES, da Silva LCN. 2018. Use of some Asteraceae plants for the treatment of wounds: from ethnopharmacological studies to scientific evidences. *Frontiers in Pharmacology* **9**: 784. DOI: https://doi.org/10.3389/fphar.2018.00784

Casas A, Lira R, Torres I, Delgado A, Moreno-Calles AI, Rangel-Landa S, Blancas J, Larios C, Solís L, Pérez-Negrón E, Vallejo M, Parra F, Farfán-Heredia B, Arellanes Y, Campos N. 2016. Ethnobotany for sustainable ecosystem management: a regional perspective in the Tehuacán Valley. *In:* Lira R, Casas C, Blancas J eds. *Ethnobotany of Mexico Interactions of People and Plants in Mesoamerica*. New York, Springer Netherlands, pp. 179-206. DOI: https://doi.org/10.1007/978-1-4614-6669-7; ISBN: 978-1-4939-7935-6

Cassani J, Ferreyra-Cruz OA, Dorantes-Barrón AM, Vigueras-Villaseñor RM, Arrieta-Baez D, Estrada-Reyes R. 2015. Antidepressant-like and toxicological effects of a standardized aqueous extract of *Chrysactinia mexicana* A. Gray (Asteraceae) in mice. *Journal of Ethnopharmacology* **171**: 295-306. DOI: https://doi.org/10.1016/j.jep.2015.05.055

Castañeda P, Gómez L, Mata R, Lotina-Hennsen B, Anaya AL, Bye R. 1996. Phytogrowth-inhibitory and antifungal constituents of *Helianthella quinquenervis*. *Journal of Natural Products* **59**: 323-326. DOI: https://doi.org/10.1021/np960199m

Castillo-Juárez I, González V, Jaime-Aguilar H, Martínez G, Linares E, Bye R, Romero I. 2009. Anti-*Helicobacter pylori* activity of plants used in Mexican traditional medicine for gastrointestinal disorders. *Journal of Ethnopharmacology* **122**: 402-405. DOI: https://doi.org/10.1016/j.jep.2008.12.021

Castro-Ruiz JE, Rojas-Molina A, Luna-Vázquez FJ, Rivero-Cruz F, García-Gasca T, Ibarra-Alvarado C. 2017. Affinin (Spilanthol) isolated from *Heliopsis longipes*, induces vasodilation via activation of gasotransmitters and prostacyclin signaling pathways. *International Journal of Molecular Sciences* **18**: 218. DOI: https://doi.org/10.3390/ijms18010218

Céspedes CL, Avila J, Martinez A, Serrato B, Calderon-Mugica JC, Salgado-Garciglia R. 2006. Antifungal and antibacterial activities of Mexican tarragon (*Tagetes lucida*). *Journal of Agriculture and Food Chemistry* **54**: 3521-3527. DOI: https://doi.org/10.1021/jf053071w

Cilia-López VG, Aguirre-Rivera JR, Reyes-Agüero JA, Juárez-Flores BI. 2008. Etnobotánica de *Heliopsis longipes* (Asteraceae: Heliantheae). *Boletin de la Sociedad Botánica de México* **83**: 81-87. DOI: https://doi.org/10.17129/botsci.1790

Cilia-López VG, Juárez-Flores BI, Aguirre-Rivera JR, Reyes-Agüero JA. 2010. Analgesic activity of *Heliopsis longipes* and its effect on the nervous system. *Pharmaceutical Biology* **48**: 195-200. DOI: https://doi.org/10.3109/13880200903078495

Coballase-Urrutia E, Pedraza-Chaverri J, Camacho-Carranza R, Cárdenas-Rodríguez N, Huerta-Gertrudis B, Medina-Campos ON, Mendoza-Cruz M, Delgado-

Lamas G, Espinosa-Aguirre JJ. 2010. Antioxidant activity of *Heterotheca inuloides* extracts and of some of its metabolites. *Journal of Ethnopharmacology* **276**: 41-48. DOI: https://doi.org/10.1016/j.tox.2010.06.013

Coballase-Urrutia E, Pedraza-Chaverri J, Cárdenas-Rodríguez N, Huerta-Gertrudis B, García-Cruz ME, Ramírez-Morales A, Sánchez-González DJ, Martínez-Martínez CM, Camacho-Carranza R, Espinosa-Aguirre JJ. 2011. Hepatoprotective effect of acetonic and methanolic extracts of *Heterotheca inuloides* against CCl(4)-induced toxicity in rats. *Experimental and Toxicolic Pathology* **63**: 363-70. DOI: https://doi.org/10.1016/j.etp.2010.02.012

Coronado-Aceves EW, Velázquez C, Robles-Zepeda RE, Jiménez-Estrada M, Hernández-Martínez J, Gálvez-Ruiz JC, Garibay-Escobar A. 2016. Reynosin and santamarine: two sesquiterpene lactones from *Ambrosia confertiflora* with bactericidal activity against clinical strains of *Mycobacterium tuberculosis. Pharmaceutical Biology* **54**: 2623-2628 DOI: https://doi.org/10.3109/13880209.2016.1173067

Cortes-Morales JA, Olmedo-Juárez A, Trejo-Tapia G, González-Cortazar M, Domínguez-Mendoza BE, Mendoza-de Gives P, Zamilpa A. 2019. *In vitro* ovicidal activity of *Baccharis conferta* Kunth against *Haemonchus contortus*. *Experimental Parasitology* **197**: 20-28. DOI: https://doi.org/10.1016/j.exppara.2019.01.003

Cruz-Reyes A, Chavarin C, Campos-Arias MP, Taboada J, Jimenez M. 1989. Molluscacide activity of piquerol isolated from *Piqueria trinervia* (Compositae) on 8 species of pulmonate snails. *Memórias do Instituto Oswaldo Cruz* **84**: 35-40. DOI: https://doi.org/10.1590/S0074-02761989000100007

Damián-Badillo LM, Salgado-Garciglia R, Martinez-Muñoz RE, Martínes-Pacheco MM. 2008. Antifungal properties of some Mexican medicinal plants. *The Open Natural Products Journal* **1**: 27-33. DOI: https://doi.org/10.2174/1874848100801010027

Davidson E, Vlachojannis J, Cameron M, Chrubasik S. 2013. Best available evidence in Cochrane reviews on herbal medicine?. *Evidence-Based Complementary and Alternative Medicine* **2013**: 163412. DOI: https://doi.org/10.1155/2013/163412

de la Rosa-Lugo V, Acevedo-Quiroz M, Déciga-Campos M, Rios MY. 2017. Antinociceptive effect of natural and synthetic alkamides involves TRPV1 receptors. *Journal of Pharmacy and Pharmacology* **69**: 884-895. DOI: https://doi.org/10.1111/jphp.12721

de la Torre Rodríguez YC, Martínez Estrada FR, Flores Suarez AE, Waksman-de Torres TN, Salazar-Aranda R. 2013. Larvicidal and cytotoxic activities of extracts from 11 native plants from Northeastern Mexico. *Journal of Medical Entomology* **50**: 310-313. DOI: https://doi.org/10.1603/ME12056

Déciga-Campos M, Ríos MY, Aguilar-Guadarrama AB. 2010. Antinociceptive effect of *Heliopsis longipes* extract and affinin in mice. *Planta Medica* **76**: 665-670. DOI: https://doi.org/10.1055/s-0029-1240658

Delgado G, Olivares MS, Chávez MI, Ramírez-Apan T, Linares E, Bye R, Espinosa-García FJ. 2001. Antiinflammatory constituents from *Heterotheca inuloides. Journal of Natural Products* **64**: 861-864. DOI: https://doi.org/10.1021/np0005107

Delgado-Altamirano R, Monzote L, Piñón-Tápanes A, Vibrans H, Rivero-Cruz JF, Ibarra-Alvarado C, Rojas-Molina A. 2017. *In vitro* antileishmanial activity of Mexican medicinal plants. *Heliyon* **3**: e00394. DOI: https://doi.org/10.1016/j.heliyon.2017.e00394

Domínguez M, Nieto A, Marin JC, Keck AS, Jeffery E, Céspedes CL. 2005. Antioxidant Activities of extracts from *Barkleyanthus salicifolius* (Asteraceae) and *Penstemon gentianoides* (Scrophulariaceae). *Journal of Agricultural and Food Chemistry.* **53**: 5889-5895. DOI: https://doi.org/10.1021/jf0504972

Egamberdieva D, Teixeira da Silva JA. 2015. Medicinal plants and PGPR: A new frontier for phytochemicals. *In*: Egamberdieva D, Shrivastava S, Varma A, eds. *Plant-Growth-Promoting Rhizobacteria (PGPR) and Medicinal Plants*. Switzerland: Springer International Publishing, pp. 287-303 DOI: https://doi.org/10.1007/978-3-319-13401-7_14

Egas V, Toscano RA, Linares E, Bye R, Espinosa-García FJ, Delgado G. 2015. Cadinane-type sesquiterpenoids from *Heterotheca inuloides*: absolute configuration and anti-inflammatory activity. *Journal of Natural Products*. **78**: 2634-2641. DOI: https://doi.org/10.1021/acs.jnatprod.5b00571

Egas V, Salazar-Cervantes G, Romero I, Méndez-Cuesta C, Rodríguez-Chávez JL, Delgado G. 2018. Anti-*Helicobacter pylori* metabolites from *Heterotheca inuloides* (Mexican arnica). *Fitoterapia* **127**: 314-321. DOI: https://doi.org/10.1016/j.fitote.2018.03.001

Enciso-Díaz OJ, Méndez-Gutiérrez A, Hernández JL, Sharma A, Villarreal ML, Cardoso-Taketa A. 2012. Antibacterial activity of *Bougainvillea glabra*, *Eucalyptus globulus*, *Gnaphalium attenuatum*, and *Propolis* collected in Mexico. *Pharmacology & Pharmacy* **3**: 433-438. DOI: https://doi.org/10.4236/pp.2012.34058

Escandón-Rivera S, González-Andrade M, Bye R, Linares E, Navarrete A, Mata R. 2012. α-glucosidase inhibitors from *Brickellia cavanillesii. Journal of Natural Products* **75**: 968-974. DOI: https://doi.org/10.1021/np300204p

Escandón-Rivera S, Pérez-Vásquez A, Navarrete A, Hernández M, Linares E, Bye R, Mata R. 2017. Antihyperglycemic activity of major compounds from *Calea ternifolia. Molecules* **22**: 2017. DOI: https://doi.org/10.3390/molecules22020289

Escobedo-Martínez C, Guzmán-Gutiérrez SL, Hernández-Méndez MM, Cassani J, Trujillo-Valdivia A, Orozco-Castellanos LM, Enríquez RG. 2017. *Heliopsis longipes*: anti-arthritic activity evaluated in a Freund's adjuvant-induced model in rodents. *Revista Brasileira de Farmacognosia* **27**: 214-219. DOI: https://doi.org/10.1016/j.bjp.2016.09.003

Espejo-Serna A, López-Ferrari AR, Salgado-Ugarte I. 2004. A current estimate of angiosperm diversity in Mexico. *Biodiversity and Conservations* **53**: 127-130. DOI: https://doi.org/10.2307/4135497

Estrada-Camarena E, Sollozo-Dupont I, Islas-Preciado D, González-Trujano ME, Carro-Juárez M, López-Rubalcava C. 2019. Anxiolytic- and anxiogenic-like effects of *Montanoa tomentosa* (Asteraceae): dependence on the endocrine condition. *Journal of Ethnopharmacology* **241**: 112006. DOI: https://doi.org/10.1016/j.jep.2019.112006

Estrada-Castillón E, Villarreal-Quintanilla JA. 2010. Flora del centro del estado de Chihuahua, México. *Acta Botanica Mexicana* 92: 51-118. DOI: https://doi.org/10.21829/abm92.2010.283

Estrada-Castillón E, Garza-López M, Villarreal-Quintanilla JA, Salinas-Rodríguez MM, Soto-Mata BE, González-Rodríguez H, González-Uribe DU, Cantú-Silva I, Carrillo-Parra A, Cantú-Ayala C. 2012. Ethnobotany in Rayones, Nuevo León, México. *Journal of Ethnobiology and Ethnomedicine*. **10**: 62. DOI: https://doi.org/10.1186/1746-4269-10-62

Estrada-Soto S, Sánchez-Recillas A, Navarrete-Vázquez G, Castillo-España P, Villalobos-Molina R, Ibarra-Barajas M. 2012. Relaxant effects of *Artemisia ludoviciana* on isolated rat smooth muscle tissues. *Journal of Ethnopharmacology* **139**: 513-518. DOI: https://doi.org/10.1016/j.jep.2011.11.041

Firenzuoli F, Gori L. 2007. Herbal medicine today: Clinical and research issues. *Frontiers in Pharmacology* **4**: 37-40. DOI: https://doi.org/10.1093/ecam/nem096

Fischer HN, Lee IY, Fronczek FR, Chiari G, Urbatsch LE. 1984. Three new furanone-type heliangolides from *Calea ternlfolla* and the molecular structure of 8β-angeloyloxy-9α-hydroxycalyculatolide. *Journal of Natural Products* **47**: 419-425. DOI: https://doi.org/10.1021/np50033a004

Flores-San Martin D, Perea-Flores MJ, Morales-López J, Centeno-Alvarez MM, Pérez-Ishiwara G, Pérez-Hernández N, Pérez-Hernández E. 2013. Effect of *Heterotheca inuloides* essential oil on rat cytoskeleton articular chondrocytes. *Natural Products Research* **27**: 2347-2350. DOI: https://doi.org/10.1080/14786419.2013.828289

Frei B, Heinrich M, Bork PM, Herrmann D, Jaki B, Kato T, Kuhnt M, Schmitt J, Schühly W, Volken C, Sticher O. 1998. Multiple screening of medicinal plants from Oaxaca, Mexico: ethnobotany and bioassays as a basis for phytochemical investigation. *Phytomedicine* **5**: 177-186. DOI: https://doi.org/10.1016/S0944-7113(98)80025-1

Funk VA, Bayer RJ, Keeley S, Chan R, Watson L, Gemeinholzer B, Schilling E, Panero JL, Baldwin BG, Garcia-Jacas N, Susanna A, Jansen RK. 2005. Everywhere but Antarctica: using a supertree to understand the diversity and distribution of the Compositae. *Biologiske Skrifter* **55**: 343-374.

Funk VA, Sussana A, Stuessy TF, Bayer RJ. 2009. *Systematics, Evolution and Biogeography of the Compositae*. Viena, Austria: International Association for Plant Taxonomy (IAPT). ISBN: 978-3-9501754-3-1

Gallegos AJ. 1983. The zoapatle I - a traditional remedy from Mexico emerges to modern times. *Contraception* **27**: 211-225. DOI: https://doi.org/10.1016/0010-7824(83)90001-X

Gao F, Miski M, Gage DA, Norris JA, Mabry TJ. 1985a. Terpenoid constituents of *Viguiera dentata. Journal of Natural Products* **48**: 316-318. DOI: https://doi.org/10.1021/np50038a021

Gao F, Miski M, Gage DA, Mabry TJ. 1985b. Terpenoids from *Viguiera potosina. Journal of Natural Products* **48**: 489-490. DOI: https://doi.org/10.1021/np50039a026

García-Sánchez CA, Sánchez-González A, Villaseñor JL. 2014. La familia Asteraceae en el Parque Nacional Los Mármoles, Hidalgo, México. *Acta Botanica Mexicana* **106**: 97-116. DOI: https://doi.org/10.21829/abm106.2014.219

Garduño-Ramírez ML, Trejo A, Navarro V, Bye R, Linares E, Delgado G. 2001. New modified eremophilanes from the roots of *Psacalium radulifolium*. *Journal* *of Natural Products* **64**: 432-435. DOI: https://doi.org/10.1021/np000385z

Gené RM, Segura L, Adzet T, Marín E, Iglesias J. 1998. *Heterotheca inuloides*: Anti-inflammatory and analgesic effect. *Journal of Ethnopharmacology* **60**: 157-162. DOI: https://doi.org/10.1016/S0378-8741(97)00155-4

Gómez AR. 2012. Plantas medicinales en una aldea del estado de Tabasco, México. *Revista de Fitotecnia Mexicana* **35**: 43-49.

Gómez-Flores R, Verástegui-Rodríguez L, Quintanilla-Licea R, Tamez-Guerra P, Monreal-Cuevas E, Tamez-Guerra R, Rodríguez-Padilla C. 2009. Antitumor properties of *Gymnosperma glutinosum* leaf extracts. *Cancer Investigation* **27**: 149-155. DOI: https://doi.org/10.1080/07357900802192190

Gómez-Flores R, Quintanilla-Licea R, Verde-Star MJ, Morado-Castillo R, Vázquez-Díaz D, Tamez-Guerra R, Tamez-Guerra P, Rodríguez-Padilla C. 2012. Long-chain alkanes and ent-labdane-type diterpenes from *Gymnosperma glutinosum* with cytotoxic activity against the murine lymphoma L5178Y-R. *Phytotherphy Research* **26**: 1632-1636. DOI: https://doi.org/10.1002/ptr.4625

Gómez-Flores R, Espinosa-Ramos D, Quintanilla-Licea R, Barrón-Gonzalez MP, Tamez-Guerra P, Tamez-Guerra R, Rodriguez-Padilla C. 2016. Antimicrobial activity of *Gymnosperma glutinosum* (Spreng.) Less. (Asteraceae) methanol extracts against *Helicobacter pylori. African Journal of Traditional, Complementary and Alternative Medicines* **13**: 55-59. DOI: https://doi.org/10.21010/ajtcam.v13i4.9

González-Trujano ME, Gutiérrez-Valentino C, Hernández-Arámburo MY, Díaz-Reval MI, Pellicer F. 2019. Identification of some bioactive metabolites and inhibitory receptors in the antinociceptive activity of *Tagetes lucida* Cav. *Life Sciences* **231**: 116523. DOI: https://doi.org/10.1016/j.lfs.2019.05.079

Guadarrama-Cruz G, Alarcón-Aguilar FJ, Lezama-Velasco R, Vázquez-Palacios G, Bonilla-Jaime H. 2008. Antidepressant-like effects of *Tagetes lucida* Cav. in the forced swimming test. *Journal of Ethnopharmacology* **120**: 277-281. DOI: https://doi.org/10.1016/j.jep.2008.08.013

Guadarrama-Cruz G, Alarcón-Aguilar FJ, Vega-Ávila E, Vázquez-Palacios G, Bonilla-Jaime H. 2012. Antidepressant-like effect of *Tagetes lucida* Cav. extract in rats: involvement of the serotonergic system. *The American Journal of Chinese Medicine* **40**: 753-768. DOI: https://doi.org/10.1142/S0192415X12500565

Guevara Campos BMM, Torres Cirio A, Rivas Galindo-VM, Salazar Aranda R, Waksman de Torre N, Pérez-López LA. 2011. Activity against *Streptococcus pneumoniae* of the essential oil and 5-(3-buten-1-ynyl)-2, 2'-bithienyl isolated from *Chrysactinia mexicana* roots. *Natural Products Communications* **6**: 1035-1038. DOI: https://doi.org/10.1177/1934578X1100600728

Gutiérrez-Lugo MT, Barrientos-Benítez T, Luna B, Ramírez-Gama RM, Bye R, Linares E, Mata R. 1996. Antimicrobial and cytotoxic activities of some crude drug extracts from Mexican medicinal plants. *Phytomedicine* **2**: 341-347 DOI: https://doi.org/10.1016/S0944-7113(96)80079-1

Heinrich M, Robles M, West JE, Ortiz de Montellano BR, Rodriguez E. 1998. Ethnopharmacology of Mexican Asteraceae (Compositae). *Annuals Review of Pharmacology and Toxicology* **38**: 539-565. DOI: https://doi.org/10.1146/annurev.pharmtox.38.1.539

Helmstädter A. 2017. The botanical explorer's legacy: a promising bioprospecting tool. *Drug Discovery Today* **22**: 757-760. DOI: https://doi.org/10.1016/j.drudis.2016.11.011

Helmstädter A, Staiger C. 2014. Traditional use of medicinal agents: a valid source of evidence. *Drug Discovery Today* **19**: 4-7. DOI: https://doi.org/10.1016/j.drudis.2013.07.016

Hernández T, Canales M, Ávila JG, Duran A, Caballero J, Romo de Vivar A, Lira R. 2003. Ethnobotany and antibacterial activity of some plants used in traditional medicine of Zapotitlán de las Salinas, Puebla (México). *Journal of Ethnopharmacology* **88**: 181-188. DOI: https://doi.org/10.1016/S0378-8741(03)00213-7

Hernández I, Márquez L, Martinez I, Dieguez R, Delporte C, Prieto S, Molina-Torres J, Garrido G. 2009. Anti-inflammatory effects of ethanolic extract and alkamides-derived from *Heliopsis longipes* roots. *Journal of Ethnopharmacology* **124**: 649-652. DOI: https://doi.org/10.1016/j.jep.2009.04.060

Hernández DM, Díaz-Ruiz G, Rivero-Cruz BE, Bye RA, Aguilar MI, J. Rivero-Cruz JF. 2012. *Ent*-trachyloban-19-oic acid isolated from *Iostephane heterophylla* as a promising antibacterial agent against *Streptococcus mutans* biofilms. *Fitoterapia* **83**: 527-531. DOI: https://doi.org/10.1016/j.fitote.2011.12.022

Hernández T, García-Bores AM, Serrano R, Ávila G, Dávila P, Cervantes H, Peñalosa I, Flores-Ortiz CM, Lira R. 2015. Fitoquímica y actividades biológicas de plantas de importancia en la medicina tradicional del Valle de Tehuacán-Cuicatlán. *TIP Revista Especializa-*

da en Ciencias Químico-Biológicas **18**: 116-121. DOI: https://doi.org/10.1016/j.recqb.2015.09.003

Hernández-Cruz J, Luna-Cruz A, Loera-Alvarado E, Villanueva-Sánchez E, Landero-Valenzuela N, Zárate-Nicolás BH, Diego-Nava F, Granados-Echegoyen CA. 2019. Efficiency of the essential oil of *Porophyllum linaria* (Asteraceae) a Mexican endemic plant against *Sitophilus zeamais* (Coleoptera: Curculionidae). *Journal of Insect Science* **19**: 1-9 DOI: https://doi.org/10.1093/jisesa/iez079

Hernández-Sánchez KM, Garduño-Siciliano L, Luna-Herrera J, Zepeda-Vallejo LG, Lagunas-Rivera S, García-Gutiérrez GE, Vargas-Díaz ME. 2018. Antimycobacterial and hypolipemiant activities of *Bidens odorata* (Cavanilles). *Journal of Ethnopharmacology* **222**: 159-164. DOI: https://doi.org/10.1016/j.jep.2018.04.028

Heywood VH, Harbome JB, Turner BL. 1977a. *The Biology and Chemistry of the Compositae. Vol I.* University of Texas. Texas, USA: Academic Press. 619 p. ISBN 0123468027, 9780123468024

Heywood VH, Harbome JB, Turner BL. 1977b. *The Biology and Chemistry of the Compositae*. *Vol II*. University of Texas.Texas, Texas, USA: Academic Press. 1189 p. ISBN 0123468027, 9780123468024

Jacobo-Herrera NJ, Jacobo-Herrera FE, Zentella-Dehesa A, Andrade-Cetto A, Heinrich M, Pérez-Plasencia C. 2016. Medicinal plants used in Mexican traditional medicine for the treatment of colorectal cancer. *Journal of Ethnopharmacology* **179**: 391-402. DOI: https://doi.org/10.1016/j.jep.2015.12.042

Jiménez-Arellanes A, Meckes M, Ramírez R, Torres J, Luna-Herrera J. 2003. Activity against multidrug-resistant *Mycobacterium tuberculosis* in Mexican plants used to treat respiratory diseases. *Phytotherapy Research* **17**: 903-908. DOI: https://doi.org/10.1002/ptr.1377

Juárez-Vázquez MC, Alonso-Castro AJ, Rojano-Vilchis N, Jiménez-Estrada M, García-Carrancá A. 2013 Maturin acetate from *Psacalium peltatum* (Kunth) Cass. (Asteraceae) induces immunostimulatory effects *in vitro* and *in vivo*. *Toxicology in Vitro* **27**: 1001-1006. DOI: https://doi.org/10.1016/j.tiv.2013.01.021

Kato T, Frei B, Heinrich M, Sticher O. 1996. Sesquiterpenes with antibacterial activity from *Epaltes mexicana. Planta Medica* **62**: 66-67. DOI: https://doi.org/10.1055/s-2006-957803

Knauth P, Acevedo-Hernández GJ, Cano ME, Gutiérrez-Lomelí M, López Z. 2018. *In vitro* bioactivity of methanolic extracts from *Amphipterygium adstringens* (Schltdl.) Schiede ex Standl., *Chenopodium ambrosioides* L., *Cirsium mexicanum* DC., *Eryngium carlinae* F. Delaroche, and *Pithecellobium dulce* (Roxb.) Benth. used in traditional medicine in Mexico. *Evidence-Based Complementary and Alternative Medicine* **2018:** Article ID 3610364. DOI: http://doi.org/10.1155/2018/3610364

Kostić AZ, Janaćković P, Kolašinac SM, Dajić-Stevanović ZP. 2020. Balkans' Asteraceae species as a source of biologically active compounds for pharmaceutical and food industry. *Chemistry & Biodiversity* **17**: e2000097. DOI: https://doi.org/10.1002/cbdv.202000097

Lara Reimers EA, Fernández CE, Lara Reimers DJ, Chaloupkova P, Zepeda del Valle JM, Milella L, Russo D. 2019. An ethnobotanical survey of medicinal plants used in Papantla, Veracruz, Mexico. *Plants* **8**: 246. DOI: https://doi.org/10.3390/plants8080246

Leonti M, Ramírez RF, Sticher O, Heinrich M. 2003. Medicinal flora of the Popoluca, Mexico: a botanical systematical perspective. *Economic Botany* **57**: 218-230. DOI: https://doi.org/10.1663/0013-0001(2003)057[0218:MFOTPM]2.0.CO;2

Malagón F, Vázquez J, Delgado G, Ruiz A. 1997. Antimalaric effect of an alcoholic extract of *Artemisia ludoviciana mexicana* in a rodent malaria model. *Parassitologia* **39**: 3-7.

Maldonado-López Y, Linares-Mazari E, Bye R, Delgado G, Espinosa-Garcia FJ. 2008. Mexican arnica anti-inflammatory action: plant age is correlated with the concentration of anti-inflammatory sesquiterpenes in the medicinal plant *Heterotheca inuloides* Cass. (Asteraceae). *Economic Botany* **62**: 161-170. DOI: https://doi.org/10.1007/s12231-008-9015-x

Mandel JR, Dikow RB, Siniscalchi CM, Thapa R, Watson LE, Funk VA. 2019. A fully resolved backbone phylogeny reveals numerous dispersals and explosive diversifications throughout the history of Asteraceae. *Proceedings of the National Academy of Sciences* **116**: 14083-14088. DOI: https://doi.org/10.1073/pnas.1903871116

Marín-Loaiza JC, Ávila JG, Canales M, Hernández T, Céspedes CL. 2008. Antifungal and antibacterial activities of endemic *Pittocaulon* spp. from Mexico. *Pharmaceutical Biology* **46**: 66-71. DOI: https://doi.org/10.1080/13880200701734505

Marín-Loaiza JC, Nieto-Camacho A, Céspedes CL. 2013. Antioxidant and anti-inflammatory activities of *Pittocaulon* species from México. *Pharmaceutical Biology* **51**: 260-266. DOI: https://doi.org/10.3109/13880209.2012.718352

Marquina S, Maldonado N, Garduño-Ramírez MA, Aranda E, Villarreal ML, Navarro V, Bye R, Delgado G, Alvarez L. 2001. Bioactive oleanolic acid saponins and other constituents from the roots of *Viguiera decurrens*. *Phytochemistry* **56**: 93-97. DOI: https://doi.org/10.1016/S0031-9422(00)00283-1

Martínez AL, Madariaga-Mazón A, Rivero-Cruz I, Bye R, Mata R. 2017. Antidiabetic and antihyperalgesic effects of a decoction and compounds from *Acourtia thurberi. Planta Medica* **83**: 534-544. DOI: https://doi.org/10.1055/s-0042-119652

Martínez-Loredo E, Izquierdo-Vega JA, Cariño-Cortes R, Cilia-López VG, Madrigal-Santillán EO, Zuñiga-Pérez C, Valadez-Vega C, Moreno E, Sánchez-Gutiérrez M1. 2016. Effects of *Heliopsis longipes* ethanolic extract on mouse spermatozoa *in vitro*. *Pharmaceutical Biology* **54**: 266-271. DOI: https://doi.org/10.3109/13880209.2015.1033560

Mata R, Rodríguez V, Pereda-Miranda O, Kaneda N, Kinghorn D. 1992. Stevisalioside a, a novel bitter-tasting ent-atisene glycoside from the roots of *Stevia salicifolia. Journal of Natural Products* **55**: 660-666. DOI: https://doi.org/10.1021/np50083a017

Mata R, Martinez E, Bye R, Morales G, Singh MP, Janso JE, Maiese WM, Timmermann B. 2001. Biological and Mechanistic Activities of xanthorrizol and 4-(1',5'-Dimethylhex-4'-enyl)-2-methylphenol Isolated from *Iostephane heterophylla*. *Journal of Natural Products* **64**: 911-914. DOI: https://doi.org/10.1021/np010076o

Mata R, Rivero-Cruz I, Rivero-Cruz B, Bye R, Timmermann BN. 2002. Sesquiterpene lactones and phenylpropanoids from *Cosmos pringlei. Journal of Natural Products* **65**: 1030-1032. DOI: https://doi.org/10.1021/np010615p

Mata R, Figueroa M, Navarrete A, Rivero-Cruz I. 2019. Chemistry and biology of selected Mexican medicinal plants. *In:* Kinghorn AD, Falk H, Gibbons S, Kobayashi J, Asakawa Y, Liu JK eds. *Progress in the Chemistry of Organic Natural Products* **108**: pp. 1-142 DOI: https://doi.org/10.1007/978-3-030-01099-7_1

Meckes M, Calzada F, Paz D, Rodríguez J, Ponce-Monter H. 2002. Inhibitory effect of xanthomicrol and 3 alpha-angeloyloxy-2 alpha-hydroxy-13,14Z-dehydrocativic acid from *Brickellia paniculata* on the contractility of guinea-pig ileum. *Planta Medica* **68**: 467-469. DOI: https://doi.org/10.1055/s-2002-32092

Meckes M, David-Rivera AD, Nava-Aguilar V, Jiménez A. 2004. Activity of some Mexican medicinal plant extracts on carrageenan-induced rat paw edema. *Phytomedicine* **11**: 446-451. DOI: https://doi.org/10.1016/j.phymed.2003.06.002

Medina-López CF, Plascencia-Jatomea M, Cinco-Moroyoqui FJ, Yépiz-Gómez MS, Cortez-Rocha MO, Rosas-Burgos EC. 2016. Potentiation of antifungal effect of a mixture of two antifungal fractions obtained from *Baccharis glutinosa* and *Jacquinia macrocarpa* plants. *Journal of Environmental Science and Health, Part B* **51**: 760-768. DOI: https://doi.org/10.1080/03601234.2016.1198641

Meléndez Camargo ME, Berdeja B, Miranda G. 2004. Diuretic effect of the aqueous extract of *Bidens odorata* in the rat. *Journal of Ethnopharmacology* **95**: 363-366. DOI: https://doi.org/10.1016/j.jep.2004.08.005

Meléndez-Rodríguez M, Cerda-García-Rojas CM, Joseph-Nathan P. 2002. Quirogane, prenopsane, and patzcuarane skeletons obtained by photochemically induced molecular rearrangements of longipinene derivatives. *Journal of Natural Products* **65**: 1398-1411. DOI: https://doi.org/10.1021/np020158s

Molina-Salinas GM, Ramos-Guerra MC, Vargas-Villarreal J, Mata-Cárdenas BD, Becerril-Montes P, Said-Fernández S. 2006. Bactericidal activity of organic extracts from *Flourensia cernua* DC against strains of *Mycobacterium tuberculosis. Archives of Medical Research* **37**: 45-49. DOI: https://doi.org/10.1016/j.arcmed.2005.04.010

Molina-Salinas GM, Pérez-López A, Becerril-Montes P, Salazar-Aranda R, Said-Fernández S, Waksman de Torres N. 2007. Evaluation of the flora of Northern Mexico for in vitro antimicrobial and antituberculosis activity. *Journal of Ethnopharmacology* **109**: 435-441. DOI: https://doi.org/10.1016/j.jep.2006.08.014

Molina-Salinas GM, Peña-Rodríguez LM, Mata-Cárdenas BD, Escalante-Erosa F, González-Hernández S, Torres de la Cruz VM, Martínez-Rodríguez HG, Said-Fernández S. 2011. *Flourensia cernua*: hexane extracts a very active mycobactericidal fraction from an inactive leaf decoction against pansensitive and panresistant *Mycobacterium tuberculosis. Evidence-Based Complementary and Alternative Medicine* **2011:** 782503. https://doi.org/10.1155/2011/782503

Molina-Torres J, García-Chávez A, Ramírez-Chávez E. 1999. Antimicrobial properties of alkamides present in flavouring plants traditionally used in Mesoamerica: affinin and capsaicin. *Journal of Ethnopharmacology* **64**: 241-248. DOI: https://doi.org/10.1016/S0378-8741(98)00134-2

Molina-Torres J, Salazar-Cabrera CJ, Armenta-Salinas

C, Ramírez-Chávez E. 2004. Fungistatic and bacteriostatic activities of alkamides from *Heliopsis longipes* roots: affinin and reduced amides. *Journal of Agricultural and Food Chemistry* **52**: 4700-4704. DOI: https://doi.org/10.1021/jf034374y

Monterrosas-Brisson N, Herrera-Ruiz M, Jiménez-Ferrer E, Bahena-Pérez R, Avilés-Flores M, Fuentes-Mata M, Martínez-Duncker I, González-Cortazar M. 2019. Anti-inflammatory activity of coumarins isolated from *Tagetes lucida Cav. Natural Product Research* **34**: 3244-3248. DOI: https://doi.org/10.1080/14786419.2018.1553172

Moreno-Peña DP, Cordero-Pérez P, Leos-Rivas C, Bucio L, Viveros-Valdez JE, Munoz-Espinosa LE, Galindo-Rodríguez SA, Rivas-Morales C. 2017. Evaluation of hypocholesterolemic activity of extracts of *Bidens odorata* and *Brickellia eupatorioides. Pakistan Journal of Pharmaceutical Sciences* **30**: 613-617.

Murillo JI, Encarnación-Dimayuga R, Malmstrøm J, Christophersen C, Franzblau SG. 2003. Antimycobacterial flavones from *Haplopappus sonorensis*. *Fitoterapia* **74**: 226-230. DOI: https://doi.org/10.1016/S0367-326X(03)00033-9

Murillo-Álvarez JI, Encarnación DR, Franzblau SG. 2001. Antimicrobial and cytotoxic activity of some medicinal plants from Baja California Sur (Mexico). *Pharmaceutical Biolog*y **39**: 445-449. DOI: https://doi.org/10.1076/phbi.39.6.445.5877

Navarro V, Villarreal ML, Rojas G, Lozoya X. 1996. Antimicrobial evaluation of some plants used in Mexican traditional medicine for the treatment of infectious diseases. *Journal of Ethnopharmacology* **53**: 143-147. DOI: https://doi.org/10.1016/0378-8741(96)01429-8

Navarro García VM, González A, Fuentes M, Avilés M, Ríos MY, Zepeda G, Rojas MG. 2003. Antifungal activities of nine traditional Mexican medicinal plants. *Journal of Ethnopharmacology* **87**: 85-88. DOI: https://doi.org/10.1016/S0378-8741(03)00114-4

OMS [Organización Mundial de la Salud]. 2016. Plan de acción mundial sobre la resistencia a los antimicrobianos. https://www.who.int/antimicrobial-resistance/global-action-plan/es/ (accessed July 26, 2020).

Ortiz MI, Cariño-Cortés R, Pérez-Hernández N, Ponce-Monter H, Fernández-Martínez E, Castañeda-Hernández G, Acosta-Madrid II, Cilia-López VG. 2009. Antihyperalgesia induced by *Heliopsis longipes* extract. *Proceedings of the Western Pharmacology Society* **52**: 75-77.

Ortiz-Bermúdez E, Villaseñor J, Téllez O. 1998. La familia Asteraceae en el estado de Nayarit (México). *Acta Botanica Mexicana* **44**: 25-57. DOI: https://doi.org/10.21829/abm44.1998.805

Osuna L, Tapia-Pérez ME, Jiménez-Ferrer JE, Carrillo-Quiroz BA, Silva-Sánchez J. 2005. Screening of *Alternanthera repens, Boerhavia coccinea, Flaveria trinervia, Tournefortia densiflora*, and *Vitex mollis* extracts to evaluate their antibacterial activity and effect on smooth muscle. I. *Pharmaceutical Biology* **43**: 749-753. DOI: https://doi.org/10.1080/13880200500406412

Palacios-Espinosa F, Déciga-Campos M, Mata R. 2008. Antinociceptive, hypoglycemic and spasmolytic effects of *Brickellia veronicifolia. Journal of Ethnopharmacology* **118**: 448-454. DOI: https://doi.org/10.1016/j.jep.2008.05.012

Panda SK, Luyten W. 2018. Antiparasitic activity in Asteraceae with special attention to ethnobotanical use by the tribes of Odisha, India. *Parasite* **25**: 10 DOI: https://doi.org/10.1051/parasite/2018008

Panda SK, da Silva LCN, Sahal D, Leonti M. 2019. Editorial: ethnopharmacological studies for the development of drugs with special reference to Asteraceae. *Frontiers in Pharmacology* **10**: 955 DOI: https://doi.org/10.3389/fphar.2019.00955

Paredes-Flores M, Lira Saade R, Dávila Aranda PD. 2007. Estudio etnobotánico de Zapotitlán Salinas, Puebla. *Acta Botanica Mexicana* **79**: 13-61. DOI: https://doi.org/10.21829/abm79.2007.1037

Passreiter CM, Sandoval-Ramirez J, Wright CW. 1999. Sesquiterpene lactones from *Neurolaena oaxacana. Journal of Natural Products* **62**: 1093-1095. DOI: https://doi.org/10.1021/np990038t

Peraza-Sánchez SR, Chan-Che EO, Ruiz-Sánchez E. 2005. Screening of Yucatecan plant extracts to control *Colletotrichum gloeosporioides* and isolation of a new pimarene from *Acacia pennatula*. *Journal of Agricultural and Food Chemistry* **53**: 2429-2432. DOI: https://doi.org/10.1021/jf040422i

Perez RM, Cervantes H, Zavala MA, Sanchez J, Perez S, Perez C. 2000. Isolation and hypoglycemic activity of 5, 7,3’-trihydroxy-3,6,4’-trimethoxyflavone from *Brickellia veronicaefolia. Phytomedicine* **7**: 25-29. DOI: https://doi.org/10.1016/S0944-7113(00)80018-5

Pérez GRM, Vargas SR, Martinez MFJ, Cordova RI. 2004. Antioxidant and free radical scavenging activities of 5,7,3’-trihydroxy-3,6,4’-trimethoxyflavone from *Brickellia veronicaefolia. Phytotherphy Research* **18**: 428-430. DOI: https://doi.org/10.1002/ptr.1445

Pérez-Castorena AL, Arciniegas A, Castro A, Villaseñor

JL, Toscano RA, Romo de Vivar A. 1997. Pyrrolizidine alkaloids from *Senecio roseus* and *Senecio helodes*. *Journal of Natural Products* **60**: 1322-1325. DOI: https://doi.org/10.1021/np9702289

Pérez-Castorena AL, Arciniegas A, Pérez R, Gutiérrez H, Toscano RA, Villaseñor JL, Romo de Vivar A. 1999. Iodanthine, a pyrrolizidine alkaloid from *Senecio iodanthus* and *Senecio bracteatus*. *Journal of Natural Products* **62**: 1039-1043. DOI: https://doi.org/10.1021/np980562k

Pérez-Castorena AL, Arciniegas A, Guzmán SL, Villaseñor JL, Romo de Vivar A. 2006. Eremophilanes from *Senecio mairetianus* and some reaction products. *Journal of Natural Products* **69**: 1471-1475. DOI: https://doi.org/10.1021/np060307x

Pérez-González C, Vega RS, González-Chávez M, Sánchez MA, Gutiérrez SP. 2013. Anti-inflammatory activity and composition of *Senecio salignus* Kunth. *BioMed Research International* **2013:** 814693. DOI: https://doi.org/10.1155/2013/814693

Pérez-Gutiérrez RM, Pérez-González C, Zavala-Sánchez MA, Pérez-Gutiérrez S. 1998. Actividad hipoglucemiante de *Bouvardia terniflora*, *Brickellia veronicaefolia* y *Parmentiera edulis*. *Salud Pública de México* **40**: 354-358.

Pérez-Ortega G, González-Trujano ME, Ángeles-López GE, Brindis F, Vibrans H, Reyes-Chilpa R. 2016. *Tagetes lucida* Cav.: Ethnobotany, phytochemistry and pharmacology of its tranquilizing properties. *Journal of Ethnopharmacology* **181**: 221-228. DOI: https://doi.org/10.1016/j.jep.2016.01.040

Pérez-Ortega G, Angeles-López G, Argueta-Villamar A, González-Trujano ME. 2017. Preclinical evidence of the anxiolytic and sedative-like activities of *Tagetes erecta* L. reinforces its ethnobotanical approach. *Biomedicine & Pharmacotherapy* **93**: 383-390. DOI: https://doi.org/10.1016/j.biopha.2017.06.064

Pérez-Vásquez A, Reyes A, Linares E, Bye R, Mata R. 2005. Phytotoxins from *Hofmeisteria schaffneri:* Isolation and synthesis of 2'-(2"-Hydroxy-4"-methylphenyl)-2'-oxoethyl Acetate. *Journal of Natural Products* **68**: 959-962. DOI: https://doi.org/10.1021/np0501278

Pérez-Vásquez A, Linares E, Bye R, Cerda-García-Rojas CM, Mata R. 2008. Phytotoxic activity and conformational analysis of thymol analogs from *Hofmeisteria schaffneri. Phytochemistry* **69**: 1339-1347. DOI: https://doi.org/10.1016/j.phytochem.2008.01.011

Pérez-Vásquez A, Capella S, Linares E, Bye R, Angeles-López G, Mata R. 2011. Antimicrobial activity and chemical composition of the essential oil of *Hofmeisteria schaffneri. Journal of Pharmacy and Pharmacology* **63**: 579-586. DOI: https://doi.org/10.1111/j.2042-7158.2010.01243.x

Pérez-Vásquez A, Ángeles-López G, Rivero-Cruz I, Flores-Bocanegra L, Linares E, Bye R, Mata R. 2017. Spasmolytic action of preparations and compounds from *Hofmeisteria schaffneri. Natural Products Communications* **12**: 475-476. DOI: https://doi.org/10.1177/1934578X1701200401

Piña-Vázquez DM, Mayoral-Peña Z, Gómez-Sánchez M, Salazar-Olivo LA, Arellano-Carbajal F. 2017. Anthelmintic effect of *Psidium guajava* and *Tagetes erecta* on wild-type and Levamisole-resistant *Caenorhabditis elegans* strains. *Journal of Ethnopharmacology* **202**: 92-96. DOI: https://doi.org/10.1016/j.jep.2017.03.004

Proksch P, Proksch, M, Towers GHN, Rodriguez E. 1983. Phototoxic and insecticidal activities of chromenes and benzofurans from *Encelia*. *Journal of Natural Products* **46**: 331-334. DOI: https://doi.org/10.1021/np50027a006

Quintanilla-Licea R, Morado-Castillo R, Gomez-Flores R, Laatsch H, Verde-Star MJ, Hernández-Martínez H, Tamez-Guerra P, Tamez-Guerra R, Rodríguez-Padilla C. 2012. Bioassay-guided isolation and identification of cytotoxic compounds from *Gymnosperma glutinosum* leaves. *Molecules* **17**: 11229-1124. DOI: https://doi.org/10.3390/molecules170911229

Ramírez G, Zavala M, Pérez J, Zamilpa A. 2012. *In vitro* screening of medicinal plants used in Mexico as antidiabetics with glucosidase and lipase inhibitory activities. *Evidence-Based Complementary and Alternative Medicine* **2012**: 701261. DOI: https://doi.org/10.1155/2012/701261

Redonda-Martínez R. 2017. Diversidad y distribución de la tribu Vernonieae (Asteraceae) en México. *Acta Botanica Méxicana*. **119**: 115-138. DOI: http://dx.doi.org/10.21829/abm119.2017.1235

Redonda-Martínez R. 2020. La subtribu Plucheinae (Inuleae, Asteraceae) en México: taxonomía, diversidad y distribución. *Acta Botanica Méxicana*. **127**: e1718. DOI: https://doi.org/10.21829/abm127.2020.1718

Reyes-Pérez V, Pérez-Vásquez A, Déciga-Campos M, Bye R, Linares E, Mata R. 2019. Antinociceptive potential of *Zinnia grandiflora*. *Journal of Natural Products* **82**: 456-461. DOI: https://doi.org/10.1021/acs.jnatprod.8b00758

Ríos MY, Aguilar-Guadarrama AB, Navarro V. 2003. Two new benzofuranes from *Eupatorium aschenbornianum* and their antimicrobial activity. *Planta Medica* **69**: 967-970. DOI: https://doi.org/10.1055/s-2003-45113

Ríos MY, León I. 2006. Chemical constituents and cytotoxic activity of *Smallanthus maculatus* (Cav.) H Rob. (Asteraceae). *Chemistry of Natural Compounds* **42**: 497-498. https://doi.org/10.1007/s10600-006-0193-4

Ríos MY, Aguilar-Guadarrama AB, Gutiérrez MC. 2007. Analgesic activity of affinin, an alkamide from *Heliopsis longipes* (Compositae). *Journal of Ethnopharmacology* **110**: 364-367. DOI: https://doi.org/10.1016/j.jep.2006.09.041

Rivero-Cruz B, Rivero-Cruz I, Rodríguez JM, Cerda-García-Rojas CM, Mata R. 2006. Qualitative and quantitative analysis of the active components of the essential oil from *Brickellia veronicaefolia* by nuclear magnetic resonance spectroscopy. *Journal of Natural Products* **69:** 1172-1176. DOI: https://doi.org/10.1021/np060180b

Robles-Zepeda RE, Coronado-Aceves EW, Velázquez-Contreras CA, Ruiz-Bustos E, Navarro-Navarro M, Garibay-Escobar A. 2013. *In vitro* anti-mycobacterial activity of nine medicinal plants used by ethnic groups in Sonora, Mexico. *BMC Complementary and Alternative Medicine* **13**: 329. DOI: https://doi.org/10.1186/1472-6882-13-329

Rocha-Gracia RC, Hernández AMM, Lozano ZP, Hernández CB, Santiago RH, Cedillo PE, Zayas PMT, López-Olguín JF. 2011. Antibacterial activity of crude extracts from Mexican plants against methicillin-resistant Staphylococcus. African Journal of Biotechnology **10**: 13202-13218

Rodeiro I, Donato MT, Jiménez N, Garrido G, Molina-Torres J, Menéndez R, Castell JV, Gómez-Lechón MJ. 2009. Inhibition of human P450 enzymes by natural extracts used in traditional medicine. *Phytotherapy Research* **23**: 279-282. DOI: https://doi.org/10.1002/ptr.2613

Rodríguez-Chávez JL, Coballase-Urrutia E, Nieto-Camacho A, Delgado-Lamas G. 2015a. Antioxidant capacity of "Mexican arnica" *Heterotheca inuloides* Cass natural products and some derivatives: their anti-inflammatory evaluation and effect on *C. elegans* life span. *Oxidative Medicine and Cellular Longevity* **2015**: Article ID 843237. DOI: https://doi.org/10.1155/2015/843237

Rodríguez-Chávez JL, Coballase-Urrutia E, Sicilia-Argumedo G, Ramírez-Apan T, Delgado G. 2015b. Toxicological evaluation of the natural products and some semisynthetic derivatives of *Heterotheca inuloides* Cass (Asteraceae). *Journal of Ethnopharmacology* **175**: 256-265. DOI: https://doi.org/10.1016/j.jep.2015.08.055

Rodríguez-Chávez JL, Rufino-González Y, Ponce-Macotela M, Delgado G. 2015c. *In vitro* activity of 'Mexican arnica' *Heterotheca inuloides* Cass natural products and some derivatives against *Giardia intestinalis*. *Parasitology* **142**: 576-584. DOI: https://doi.org/10.1017/S0031182014001619

Rodríguez-Chávez JL, Egas V, Linares E, Bye R, Hernández T, Espinosa-García FJ, Delgado G. 2017. Mexican Arnica (*Heterotheca inuloides* Cass. Asteraceae: Astereae): Ethnomedical uses, chemical constituents and biological properties. *Journal of Ethnopharmacology* **195**: 39-63 DOI: https://doi.org/10.1016/j.jep.2016.11.021

Rodríguez-Chávez JL, Franco-Navarro F, Delgado G. 2018. *In vitro* nematicidal activity of natural and semisynthetic cadinenes from *Heterotheca inuloides* against the plant-parasitic nematode *Nacobbus aberrans* (Tylenchida: Pratylenchidae). *Pest Management Science* **75**: 1734-1742. DOI: https://doi.org/10.1002/ps.5294

Rodriguez-Garcia A, Galan-Wong LJ, Arevalo-Niño K. 2010. Development and *in vitro* evaluation of biopolymers as a delivery system against periodontopathogen microorganisms. *Acta Odontológica Latinoamericana* **23**: 158-163.

Rodríguez-Landa JF, Vicente-Serna J, Rodríguez-Blanco LA, Rovirosa-Hernández MJ, García-Orduña F, Carro-Juárez M. 2014. *Montanoa frutescens* and *Montanoa grandiflora* extracts reduce anxiety-like behavior during the metestrus-diestrus phase of the ovarian cycle in Wistar rats. *BioMed Research International* **2014**: 938060. DOI: https://doi.org/10.1155/2014/938060

Rodríguez-Landa JF, Cueto-Escobedo J, Flores-Aguilar LA, Rosas-Sánchez GU, Rovirosa-Hernández MJ, García-Orduña F, Carro-Juárez M. 2018. The aqueous crude extracts of *Montanoa frutescens* and *Montanoa grandiflora* reduce immobility faster than fluoxetine through GABAA receptors in rats forced to swim. *Journal of Evidence-Based Integrative Medicine* **23**: 1-12. DOI: https://doi.org/10.1177/2515690X18762953

Rodríguez-Ramos F, Navarrete A. 2009. Solving the confusion of gnaphaliin structure: gnaphaliin A and gnaphaliin B identified as active principles of *Gnaphalium liebmannii* with tracheal smooth muscle relaxant properties. *Journal of Natural Products* **72**: 1061-1064. DOI: https://doi.org/10.1021/np800746j

Rojas A, Villena R, Jiménez A, Mata R. 1991. Chemical studies on Mexican plants used in traditional medicine,

XXI. Ratibinolide 11, a new sesquiterpene lactone from *Ratlblda latipalearis*. *Journal of Natural Products* **54**: 1279-1282. DOI: https://doi.org/10.1021/np50077a006

Rojas A, Hernandez L, Pereda-Miranda R, Mata R. 1992. Screening for antimicrobial activity of crude drug extracts and pure natural products from Mexican medicinal plants. *Journal of Ethnopharmacology* **35**: 275-283. DOI: https://doi.org/10.1016/0378-8741(92)90025-M

Rojas A, Cruz S, Rauch V, Bye R, Linares E, Mata R. 1995. Spasmolytic potential of some plants used in Mexican traditional medicine for the treatment of gastrointestinal disorders. *Phytomedicine* **2:** 51-55. DOI: https://doi.org/10.1016/S0944-7113(11)80049-8

Rojas A, Bah M, Rojas JI, Serrano V, Pacheco S. 1999. Spasmolytic activity of some plants used by the Otomi Indians of Queretaro (Mexico) for the treatment of gastrointestinal disorders. *Phytomedicine* **6**: 367-371. DOI: https://doi.org/10.1016/S0944-7113(99)80061-0

Rojas G, Lévaro J, Tortoriello J, Navarro V. 2001. Antimicrobial evaluation of certain plants used in Mexican traditional medicine for the treatment of respiratory diseases. *Journal of Ethnopharmacology* **74**: 97-101. DOI: https://doi.org/10.1016/S0378-8741(00)00349-4

Rojas A, Mendoza S, Moreno J, Arellano RO. 2003. Extracts from plants used in Mexican traditional medicine activate Ca2+-dependent chloride channels in *Xenopus laevis* oocytes. *Phytomedicine* **10**: 416-421. DOI: https://doi.org/10.1078/0944-7113-00199

Romero-Cerecero O, Rojas G, Navarro V, Herrera-Arellano A, Zamilpa-Alvarez A, Tortoriello J. 2006. Effectiveness and tolerability of a standardized extract from *Ageratina pichinchensis* on patients with tinea pedis: an explorative pilot study controlled with ketoconazole. *Planta Medica* **72**: 1257-1261. DOI: https://doi.org/10.1055/s-2006-951694

Romero-Cerecero O, Zamilpa A, Jiménez-Ferrer JE, Rojas-Bribiesca G, Román-Ramos R, Tortoriello J. 2008. Double-blind clinical trial for evaluating the effectiveness and tolerability of *Ageratina pichinchensis* extract on patients with mild to moderate onychomycosis. A comparative study with ciclopirox. *Planta Medica* **74**: 1430-1435. DOI: https://doi.org/10.1055/s-2008-1081338

Romero-Cerecero O, Román-Ramos R, Zamilpa A, Jiménez-Ferrer JE, Rojas-Bribiesca G, Tortoriello J. 2009. Clinical trial to compare the effectiveness of two concentrations of the *Ageratina pichinchensis* extract in the topical treatment of onychomycosis. *Journal of Ethnopharmacology* **126**: 74-78. DOI: https://doi.org/10.1016/j.jep.2009.08.007

Romero-Cerecero O, Zamilpa-Álvarez A, Jiménez-Ferrer E, Tortoriello J. 2012a. Exploratory study on the effectiveness of a standardized extract from of *Ageratina pichinchensis* in patients with chronic venous leg ulcers. *Planta Medica* **78**: 304-310. DOI: https://doi.org/10.1055/s-0031-1280448

Romero-Cerecero O, Zamilpa A, Jiménez-Ferrer E, Tortoriello J. 2012b. Therapeutic effectiveness of *Ageratina pichinchensis* on the treatment of chronic interdigital tinea pedis: a randomized, double-blind clinical trial. *The Journal of Alternative and Complementary Medicine* **18**: 607-611. DOI: https://doi.org/10.1089/acm.2011.0319

Romero-Cerecero O, Zamilpa A, González-Cortazar M, Alonso-Cortés D, Jiménez-Ferrer E, Nicasio-Torres P, Aguilar-Santamaría L, Tortoriello J. 2013. Pharmacological and chemical study to identify wound-healing active compounds in *Ageratina pichinchensis*. *Planta Medica* **79**: 622-627. DOI: https://doi.org/10.1055/s-0032-1328462

Romero-Cerecero O, Zamilpa A, Díaz-García ER, Tortoriello J. 2014. Pharmacological effect of *Ageratina pichinchensis* on wound healing in diabetic rats and genotoxicity evaluation *Journal of Ethnopharmacology* **156**: 222-227. DOI: https://doi.org/10.1016/j.jep.2014.09.002

Romero-Cerecero O, Zamilpa A, Tortoriello J. 2015a. Pilot study that evaluated the clinical effectiveness and safety of a phytopharmaceutical elaborated with an extract of *Ageratina pichinchensis* in patients with minor recurrent aphthous stomatitis. *Journal of Ethnopharmacology* **173**: 225-230. DOI: https://doi.org/10.1016/j.jep.2015.06.021

Romero-Cerecero O, Zamilpa A, Tortoriello J. 2015b. Effectiveness and tolerability of a standardized extract from *Ageratina pichinchensis* in patients with diabetic foot ulcer: a randomized, controlled pilot study. *Planta Medica* **81**: 272-278. DOI: https://doi.org/10.1055/s-0034-1396315

Romero-Cerecero O, Islas-Garduño AL, Zamilpa A, Tortoriello J. 2017. Effectiveness of *Ageratina pichinchensis* extract in patients with vulvovaginal candidiasis. A randomized, double-blind, and controlled pilot study. *Phytotherapy Research* **31**: 885-890. DOI: https://doi.org/10.1002/ptr.5802

Rosas-Piñón Y, Mejía A, Díaz-Ruiz G, Aguilar MI, Sánchez-Nieto S, Rivero-Cruz JF. 2012 Ethnobotanical survey and antibacterial activity of plants used in the Altiplane region of Mexico for the treatment of oral cavity infections. *Journal of Ethnopharmacology* **141**: 860-865. DOI: https://doi.org/10.1016/j.jep.2012.03.020

Rossiter SE, Fletcher MH, Wuest WM. 2017. Natural products as platforms to overcome antibiotic resistance. *Chemical Reviews* **117**: 12415-12474. DOI: https://doi.org/10.1021/acs.chemrev.7b00283

Rufino-González Y, Ponce-Macotela M, Jiménez-Estrada M, Jiménez-Fragoso CN, Palencia G, Sansón-Romero G, Anzo-Osorio A, Martínez-Gordillo MN. 2017. *Piqueria trinervia* as a source of metabolites against *Giardia intestinalis*. *Pharmaceutical Biology* **55**: 1787-1791. DOI: https://doi.org/10.1080/13880209.2017.1325912

Ruiz de Esparza R, Bye R, Meckes M, Torres López J, Jiménez-Estrada M. 2007. Antibacterial activity of *Piqueria trinervia*, a Mexican medicinal plant used to treat diarrea. *Pharmaceutical Biology* **45**: 446-452. DOI: https://doi.org/10.1080/13880200701389011

Ruiz-Cancino A, Cano AE, Delgado G. 1993. Sesquiterpene lactones and flavonoids from *Artemisia ludoviciana* ssp. *mexicana*. *Phytochemistry* **33**: 1113-l115 DOI. https://doi.org/10.1016/0031-9422(93)85032-M

Ruiz-Pérez NJ, Arriaga-Alba M, Sánchez-Navarrete J, Camacho-Carranza R, Hernández-Ojeda S, Espinosa-Aguirre JJ. 2014. Mutagenic and antimutagenic effects of *Heterotheca inuloides. Scientific Reports* **4**: 6743. DOI: https://doi.org/10.1038/srep06743

Saad I, Díaz E, Chávez I, Reyes-Chilpa R, Rubluo A, Jiménez-Estrada M. 2000. Antifungal monoterpene production in elicited cell suspension cultures of *Piqueria trinervia. Phytochemistry* **55**: 51-57. DOI: https://doi.org/10.1016/S0031-9422(00)00211-9

Said Férnandez S, Ramos Guerra MC, Mata Cárdenas BD, Vargas Villarreal J, Villarreal Treviño TL. 2005. *In vitro* antiprotozoal activity of the leaves of *Artemisia ludoviciana*. *Fitoterapia* **76**: 466-468. DOI: https://doi.org/10.1016/j.fitote.2005.04.009

Salazar-Aranda R, Pérez-López LA, López-Arroyo J, Alanís-Garza BA, Waksman TN. 2011. Antimicrobial and antioxidant activities of plants from Northeast of Mexico. *Evidence-Based Complementary and Alternative Medicine* **2011**: 536139. DOI: https://doi.org/10.1093/ecam/nep127

Salazar-Aranda R, Pérez-López LA, Rivas-Galindo V, de Torres NW. 2013. Antimicrobial activity of plants used in México for gastrointestinal and respiratory disorders. *In:* Shahid M, Malik A, ASahai S. eds. *Recent Trends in Biotechnology and Therapeutic Applications of Medicinal Plants*. New York London: Dordrecht Springer. pp. 131-188. DOI: https://doi.org/10.1007/978-94-007-6603-7_7; ISBN: 978-94-007-6602-0

Sánchez-Medina A, García-Sosa K, May-Pat F, Peña-Rodríguez LM. 2001. Evaluation of biological activity of crude extracts from plants used in Yucatecan traditional medicine part I. Antioxidant, antimicrobial and β-glucosidase inhibition activities. *Phytomedicine* **8**: 144-151. DOI: https://doi.org/10.1078/0944-7113-00020

Sánchez-Mendoza ME, Torres G, Arrieta J, Aguilar A, Castillo-Henkel C, Navarrete A. 2007. Mechanisms of relaxant action of a crude hexane extract of *Gnaphalium liebmannii* in guinea pig tracheal smooth muscle. *Journal of Ethnopharmacology* **111**: 142-147 DOI: https://doi.org/10.1016/j.jep.2006.11.001

Sánchez-Mendoza ME, Reyes-Trejo B, Sánchez-Gómez P, Rodríguez-Silverio J, Castillo-Henkel C, Cervantes-Cuevas H, Arrieta J. 2010. Bioassay-guided isolation of an anti-ulcer chromene from *Eupatorium aschenbornianum*: Role of nitric oxide, prostaglandins and sulfydryls. *Fitoterapia* **81**: 66-71. DOI: https://doi.org/10.1016/j.fitote.2009.07.009

Sánchez-Mendoza ME, Rodríguez-Silverio J, Rivero-Cruz JF, Rocha-González HI, Pineda-Farías JB, Arrieta J. 2013. Antinociceptive effect and gastroprotective mechanisms of 3,5-diprenyl-4-hydroxyacetophenone from *Ageratina pichinchensis*. *Fitoterapia* **87**: 11-19. DOI: https://doi.org/10.1016/j.fitote.2013.03.015

Sánchez-Ramos M, Marquina-Bahena S, Romero-Estrada A, Bernabé-Antonio A, Cruz-Sosa F, González-Christen J, Acevedo-Fernández JJ, Perea-Arango I, Alvarez L. 2018. Establishment and phytochemical analysis of a callus culture from *Ageratina pichinchensis* (Asteraceae) and its anti-inflammatory activity. *Molecules* **23**: 1258. DOI: https://doi.org/10.3390/molecules23061258

Saslis-Lagoudakis CH, Williamson EM, Savolainen V, Hawkins JA. 2011. Cross-cultural comparison of three medicinal floras and implications for bioprospecting strategies. *Journal of Ethnopharmacology* **135**: 476-487 DOI: https://doi.org/10.1016/j.jep.2011.03.044

Sepúlveda-Robles O, Espinoza-Gutiérrez B, Gomez-Verjan JC, Guzmán-Gutiérrez SL, De Ita M, Silva-Miranda M, Espitia-Pinzón CI, Fernández-Ramírez F, Herrera-Salazar A, Mata-Rocha M, Ortega-Hernández A, Reyes-Chilpa R. 2019. Trypanocidal and toxicological assessment in vitro and in silico of three sesquiterpene lactones from Asteraceae plant species. *Food and Chemical Toxicology* **125**: 55-61. DOI: https://doi.org/10.1016/j.fct.2018.12.023

Sharma A, Flores-Vallejo RC, Cardoso-Taketa A, Villarreal ML. 2017. Antibacterial activities of medicinal plants used in Mexican traditional medicine. *Journal of Ethnopharmacology* **208**: 264-329. DOI: https://doi.org/10.1016/j.jep.2016.04.045

Schilling EE, Panero JL. 2011. A revised classification of subtribe Helianthinae (Asteraceae: Heliantheae) II. Derived lineages. *Botanical Journal of the Linnean Society* **167**: 311–331. DOI: https://doi.org/10.1111/j.1095-8339.2011.01172.x

Silver LL. 2015. Natural products as a source of drug leads to overcome drug resistance. *Future Microbiololgy* **10**: 1711-1718. DOI: https://doi.org/10.2217/fmb.15.67

Sollozo-Dupont I, Estrada-Camarena E, Carro-Juárez M, López-Rubalcava C. 2015. $GABA_A$/benzodiazepine receptor complex mediates the anxiolytic-like effect of *Montanoa tomentosa. Journal of Ethnopharmacology* **162**: 278-286. DOI: https://doi.org/10.1016/j.jep.2014.12.070

Sosa V, De-Nova JA. 2012. Endemic angiosperm lineages in México: Hotspots for conservation. *Acta Botanica Mexicana* **100**: 293-315. https://doi.org/10.21829/abm100.2012.38

Southam L, Pedrón N, Ponce-Monter H, Girón H, Estrada A, Lozoya X, Enríquez GR, Bejar E, Gallegos AJ. 1983. The Zoapatle IV - toxicological and clinical studies. *Contraception* **27**: 255-265. DOI: https://doi.org/10.1016/0010-7824(83)90004-5

Tapia-Pérez ME, Tapia-Contreras A, Cedillo-Rivera R, Osuna L, Meckes M. 2003. Screening of Mexican medicinal plants for antiprotozoal activity Part II. *Pharmaceutical Biology* **41**: 180-183. DOI: https://doi.org/10.1076/phbi.41.3.180.15100

Tequida-Meneses M, Cortez-Rocha M, Rosas-Burgos EC, López-Sandoval S, Corrales-Maldonado C. 2002. Efecto de extractos alcohólicos de plantas silvestres sobre la inhibición de crecimiento de *Aspergillus flavus, Aspergillus niger, Penicillium chrysogenum, Penicillium expansum, Fusarium moniliforme* y *Fusarium poae. Revista Iberoamericana de Micología* **19**: 84-88.

Torres-González L, Muñoz-Espinosa LE, Rivas-Estilla AM, Trujillo-Murillo K, Salazar-Aranda R, Waksman de Torres N, Cordero-Pérez P. 2011. Protective effect of four Mexican plants against CCl-induced damage on the Huh7 human hepatoma cell line. *Annals of Hepatology* **10**: 73-79. DOI: https://doi.org/10.1016/S1665-2681(19)31590-X

Vásquez Rivera SE, Escobar-Saucedo MA, Morales D, Aguilar CN, Rodríguez-Herrera R. 2014. Synergistic effects of ethanolic plant extract mixtures against food-borne pathogen bacteria. *African Journal of Biotechnology* **13**: 699-704. DOI: https://doi.org/10.5897/AJB2013.12273

Velázquez-Domínguez J, Marchat LA, López-Camarillo C, Mendoza-Hernández G, Sánchez-Espíndola E, Calzada F, Ortega-Hernández A, Sánchez-Monroy V, Ramírez-Moreno E. 2013. Effect of the sesquiterpene lactone incomptine a in the energy metabolism of *Entamoeba histolytica. Experimental Parasitology* **135**: 503-510. DOI: https://doi.org/10.1016/j.exppara.2013.08.015

Ventura-Martínez R, Ángeles-López GE, Rodríguez R, González-Trujano ME, Déciga-Campos M. 2018. Spasmolytic effect of aqueous extract of *Tagetes erecta* L. flowers is mediated through calcium channel blockade on the guinea-pig ileum. *Biomedicine & Pharmacotherapy* **103**: 1552-1556. DOI: https://doi.org/10.1016/j.biopha.2018.04.166

Vibrans H. 2016. Ethnobotany of Mexican weeds. *In:* Lira R, Casas C, Blancas J, eds. *Ethnobotany of Mexico interactions of people and plants in Mesoamerica*. New York: Springer Sciences.pp. 179-206. DOI: https://doi.org/10.1007/978-1-4614-6669-7; ISBN: 978-1-4939-7935-6

Villagómez-Ibarra JR, Sánchez M, Espejo O, Zúñiga-Estrada A, Torres-Valencia JM, Joseph-Nathanc P. 2001. Antimicrobial activity of three Mexican *Gnaphalium* species. *Fitoterapia* **72**: 692-694. DOI: https://doi.org/10.1016/S0367-326X(01)00303-3

Villarreal ML, Álvarez L, Alonso D, Navarro V, García P, Delgado G. 1994. Cytotoxic and antimicrobial screening of selected terpenoids from Asteraceae species. *Journal of Ethnopharmacology* **42**: 25-29. DOI: https://doi.org/10.1016/0378-8741(94)90019-1

Villarreal-Ibarra EC, Lagunes-Espinoza LC, López PA, García-López E, Palma-López DJ, Ortiz-García CF, Oranday-Cárdenas MA. 2015. Evaluación etnofarmacológica de plantas con propiedades hipoglucémicas usadas en la medicina tradicional del sureste de México. *Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas* **14**: 99-112.

Villarreal-Quintanilla JA, Estrada- Castillón AE, Encina-Domínguez JA. 2020. Dos cambios de rango taxonómico en *Pseudognaphalium* (Gnaphalieae, Asteraceae) de

México. *Acta Botanica Mexicana* **127**: e1582 DOI: https://doi.org/10.21829/abm127.2020.1582

Villaseñor JL. 1993. La familia Asteraceae en México. *Revista de la Sociedad Mexicana de Historia Natural* **XLIV**: 117-124.

Villaseñor JL. 2016. Checklist of the native vascular plants of Mexico. *Revista Mexicana de Biodiversidad* **87**: 559-902. DOI: https://doi.org/10.1016/j.rmb.2016.06.017

Villaseñor JL. 2018. Diversidad y distribución de la familia Asteraceae en México. *Botanical Sciences* **96**: 332-358. DOI: https://doi.org/10.17129/botsci.1872

Villaseñor JL, Ortiz E. 2012. La familia Asteraceae en la Flora del Bajío y de regiones adyacentes. *Acta Botanica Mexicana* **100**: 259-291. https://doi.org/10.21829/abm100.2012.37

WHO [World Health Organization]. 2018. Annex 1. WHO guidelines on good herbal processing practices for herbal medicines. Technical Report Series. No. 1010. 72 p. https://www.who.int/traditional-complementary-integrative-medicine/publications/trs1010_annex1.pdf?ua=1 (accessed January 25, 2021).

Zamilpa A, Tortoriello J, Navarro V, Delgado G, Álvarez L. 2002. Antispasmodic and antimicrobial diterpenic acids from *Viguiera hypargyrea* roots. *Planta Medica* **68**: 281-283. DOI: https://doi.org/10.1055/s-2002-23146

Zavala-Mendoza D, Alarcon-Aguilar FJ, Pérez-Gutierrez S, Escobar-Villanueva MC, Zavala-Sánchez MA. 2013. Composition and antidiarrheal activity of *Bidens odorata* Cav. *Evidence-Based Complementary and Alternative Medicine* **2013**: 170290. DOI: https://doi.org/10.1155/2013/170290

Zavala-Mendoza D, Grasa L, Zavala-Sánchez MÁ, Pérez-Gutiérrez S, Murillo MD. 2016. Antispasmodic effects and action mechanism of essential oil of *Chrysactinia mexicana* A. Gray on rabbit ileum. *Molecules* **21**: E783. DOI: https://doi.org/10.3390/molecules21060783

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Appendix 1. Ethnopharmacological studies for the Asteraceae family in Mexico from 1983 to 2020.

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
ANTHEMIDEAE	*Artemisia absinthium* L. (INT)	Stomach-ache, labor, colic, bile, diarrhea	Antibacterial, antiprotozoal	Hernández *et al.* (2003), Canales *et al.* (2005), Calzada *et al.* (2007)
	Artemisia ludoviciana Nutt. (NAT)	Gastrointestinal disorders, parasitic diseases, upset stomach, diarrhea, dysentery, antispasmodic, malfunction of the gall bladder, pain, diabetes, colds, bronchitis, throat, head sores	Phytochemical characterization, antiprotozoal, antimalarial, antifungal, analgesic, antibacterial, muscle relaxant	Ruiz-Cancino *et al.* (1993), Navarro *et al.* (1996), Malagón *et al.* (1997), Hernández *et al.* (2003), Jiménez-Arellanes *et al.* (2003), Said Fernández *et al.* (2005), Calzada *et al.* (2007), Damián-Badillo et al. (2008), Castillo-Juárez *et al.* (2009), Calzada *et al.* (2010), Estrada-Soto *et al.* (2012), Anaya-Eugenio *et al.* (2014), Anaya-Eugenio *et al.* (2016)
	Matricaria recutita L. (INT)	Sedative, spasmolytic, anti-inflammatory stomachaches, menstrual colic, eyewash, anxiety	Antibacterial, antiprotozoal, anxiolytic, phytochemical characterization	Avallone *et al.* (2000), Hernández *et al.* (2003), Calzada *et al.* (2007), Calzada *et al.* (2010)
	Tanacetum parthenium (L.) Sch. Bip. (INT)	Convulsions, susto (fear), migraine, epilepsy, sedative, migraine, headache, rheumatoid arthritis, stomachache, toothache, analgesic, anti-inflammatory, antispasmodic	Antibacterial, anxiolytic, antidepressant	Hernández *et al.* (2003), Cárdenas *et al.* (2017)
ASTEREAE	*Baccharis conferta* Kunth (NAT)	Cold, vomit, sickness	Antibacterial, anti-helmintic	Rocha-Gracia *et al.* (2011), Cortes-Morales *et al.* (2019)
	Baccharis heterophylla Kunth (NAT)	Fever, wound healing	Muscle relaxant, spasmolytic	Rojas *et al.* (1999), Rojas *et al.* (2003)
	Baccharis glutinosa Pers. (NAT) (*Baccharis salicina* Torr. & A.Gray)		Antibacterial, cytotoxicity, antifungal.	Murillo-Álvarez *et al.* (2001), Tequida-Meneses *et al.* (2002), Medina-López *et al.* (2016)
	Gymnosperma glutinosum (Spreng.) Less. (NAT)	Diarrhea, anti-inflammatory, renal diseases, pain, fever, cancer	Spasmolytic, phytochemical characterization, antibacterial, antifungal, toxicity, antitumoral, cytotoxicity, analgesic, anti-inflammatory,	Rojas *et al.* (1995), Hernández *et al.* (2003), Canales *et al.* (2007), Gómez-Flores *et al.* (2009), Gómez-Flores *et al.* (2012), Quintanilla-Licea *et al.* (2012), Hernández *et al.* (2015), Gómez-Flores *et al.* (2016), Alonso-Castro *et al.* (2017)
	Heterotheca inuloides Cass. (END)	Bruises, pain, anti-inflammatory, wounds, bruises, rheumatisms, colic and other painful conditions	Antioxidant, anti-inflammatory, analgesic, antibacterial, toxicity, antiprotozoal, phytochemical characterization, nematicide, cytotoxicity, anti-mutagenic, osteoarthritis model, hepatoprotective	Gené *et al.* (1998), Delgado *et al.* (2001), Maldonado-López *et al.* (2008), Coballase-Urrutia *et al.* (2010, 2011), Rosas-Piñón *et al.* (2012), Flores-San Martin *et al.* (2013), Ruiz-Pérez *et al.* (2014), Rodríguez-Chávez *et al.* (2015a), Rodríguez-Chávez *et al.* (2015b), Rodríguez-Chávez *et al.* (2015c), Egas *et al.* (2015), Egas *et al.* (2018), Rodríguez-Chávez *et al.* (2018)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Laennecia filaginoides DC (NAT) (*Conyza filaginoides* Hieron)	Gastrointestinal diseases, hepatic cramps, bile	Spasmolytic, antimicrobial, antiprotozoal, antieishmaniana	Rojas *et al.* (1995), Gutiérrez-Lugo *et al.* (1996), Calzada *et al.* (1998), Calzada *et al.* (2001), Delgado-Altamirano *et al.* (2017)
	Laennecia schiedeana (Less.) G.L. Nesom (NAT)	Gastrointestinal diseases, bronchitis, gut, rheumatism, fever, sedative, anti-inflammatory	Phytochemical characterization	Arciniegas *et al.* (2011)
	Xanthisma spinulosum (Pursh) D.R. Morgan & R.L. Hartm. (END) (*Haplopappus spinulosus* (Pursh) DC. subsp. *scrabellus* (Greene) Hall)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Xylothamia diffusa (Benth.) G.L.Nesom (NAT) (*Haplopappus sonoriensis* (Gray) Blake)	Bodily shaking, fever, cold	Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001), Murillo *et al.* (2003)
CALENDULEAE	*Calendula oficinalis* L. (INT)	Analgesic, antiseptic, wound healing	Antibacterial	Rodriguez-Garcia *et al.* (2010), Rosas-Piñón *et al.* (2012)
CARDUEAE	*Centaurea melitensis* L. (INT) (*Centaurea americana* Nutt.)	Liver damage	Antitumoral	Torres-González *et al.* (2011)
	Cirsium mexicanum DC (NAT)	Cancer, diabetes	Antimicrobial	Rosas-Piñón *et al.* (2012), Knauth *et al.* (2018)
COREOPSIDEAE	*Bidens odorata* Cav. (NAT)	Gastrointestinal diseases, kidney pain, anti-inflammatory, antipyretic, hypoglycemic, pulmonary, cough	Diuretic, lipid-lowering, phytochemical characterization, hypocholesterolemic, antibacterial, antidiarrheal	Meléndez-Camargo *et al.* (2004), Astudillo-Vázquez *et al.* (2008), Zavala-Mendoza *et al.* (2013), Moreno-Peña *et al.* (2017), Hernández-Sánchez *et al.* (2018)
	Bidens pilosa L. (NAT)	Anti-inflammatory, diabetes, astringent, emmenagogue	Antibacterial, cytotoxicity, spasmolytic,	Murillo-Álvarez *et al.* (2001), Arroyo *et al.* (2004)
	Cosmos pringlei B.L. Rob. & Fernald (END)	Stomachaches, toothaches, headaches, dysentery, improving circulation	Phytochemical characterization	Mata *et al.* (2002)
EUPATORIEAE	*Ageratina pichinchensis* (Kunth) R.M. King & H. Rob (NAT) (*Eupatorium aschenbornianum* S.Schauer)	Dermatophytosis, skin infections, wounds, tumors, cancer sores, skin injuries, treat pain, gastric ulcers, skin wounds	Antimicrobial, antifungal, healing, genotoxicity phytochemical characterization, anti-inflammatory, anti-sores, antiulcer analgesic, gastroprotective	Navarro García *et al.* (2003), Ríos *et al.* (2003), Romero-Cerecero *et al.* (2006), Romero-Cerecero *et al.* (2008), Aguilar-Guadarrama *et al.* (2009), Romero-Cerecero *et al.* (2009), Sánchez-Mendoza *et al.* (2010), Romero-Cerecero *et al.* (2012a), Romero-Cerecero (2012b), Romero-Cerecero *et al.* (2013), Sánchez-Mendoza *et al.* (2013), Romero-Cerecero *et al.* (2014), Romero-Cerecero *et al.* (2015a,b), Romero-Cerecero *et al.* (2017), Sánchez-Ramos *et al.* (2018)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Brickellia cavanillesii (Cass.) A. Gray (END)	Diabetes, stomachache, liver diseases, diarrhea, cardiovascular diseases, treatment of ulcers, dyspepsia, analgesic, tapeworm, indigestion, colic, hypertension, anxiety	Vasorelaxing, anxiolytic, hypoglycemic	Aguirre-Crespo *et al.* (2005), Escandón-Rivera *et al.* (2012), Ávila-Villarreal *et al.* (2016)
	Brickellia paniculata (Mill.) B.L. Rob. (NAT)	Colic, abdominal pain, watery diarrhea	Anti-inflammatory, spasmolytic	Meckes *et al.* (2002), Meckes *et al.* (2004)
	Brickellia veronicifolia (Kunth) A. Gray (NAT)	Diabetes, gastroenteritis, diarrhea, pain, stomachache, biliary colic, dyspepsia, arthritis, topic inflammations, infectious diseases, gastritis	Hypoglycemic, antibacterial, analgesic, phytochemical characterization, anti-mutagenic, toxicity, spasmolytic, antioxidant	Pérez-Gutiérrez *et al.* (1998), Perez *et al.* (2000), Hernández *et al.* (2003), Pérez *et al.* (2004), Rivero-Cruz *et al.* (2006), Calzada *et al.* (2007), Palacios-Espinosa *et al.* (2008)
	Decachaeta incompta DC (NAT)	Diarrhea, dysentery	Antibacterial, antiprotozoal, trypanocidal	Calzada *et al.* (2009), Bautista *et al.* (2012), Velázquez-Domínguez *et al.* (2013), Sepúlveda-Robles *et al.* (2019)
	Hofmeisteria schaffneri (A. Gray) R.M. King & H. Rob (END)	Skin wounds, fevers, gastrointestinal ailments, stomach aches, dyspepsia, bleeding diarrhea, topic antiseptic agent	Toxicity, analgesic, antifungal, antimicrobial, phytochemical characterization, spasmolytic	Pérez-Vásquez *et al.* (2005), Pérez-Vásquez *et al.* (2008), Ángeles-López *et al.* (2010), Pérez-Vásquez *et al.* (2011), Pérez-Vásquez *et al.* (2017)
	Piqueria trinervia Cav. (NAT)	Typhus, fever, malaria, tetanus, diarrhea, antipyretic, abdominal pain	Antifungal, antibacterial, antiprotozoal, molluscicidal	Cruz-Reyes *et al.* (1989), Saad *et al.* (2000), Ruiz de Esparza *et al.* (2007), Rufino-González *et al.* (2017)
	Stevia salicifolia Cav. (NAT)	Gastrointestinal disorders	Phytochemical characterization	Mata *et al.* (1992), Meléndez-Rodríguez *et al.* (2002)
GNAPHALIEAE	*Anaphalis margaritacea* (L.) Benth. & Hook f. (NAT)	Cough, respiratory problems, colds, rheumatism.	Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Gamochaeta americana (Mill.) (NAT) (*Gnaphallium americanum*)	Cough, cold, bronchitis, angina ache	Antibacterial	Rojas *et al.* (2001)
	Gnaphalium purpureum L. (NAT) (Gamochaeta purpurea (L.) Cabrera)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Gnaphalium attenuatum (NAT) (*Pseudognaphalium attenuatum* (DC.) Anderb.)	Respiratory illnesses	Antibacterial	Enciso-Díaz *et al.* (2012)
	Pseudognaphalium conoideum (Kunth) Anderb. (END) (*Gnaphalium conoideum*)	Stomach diseases, swellings, wounds, prostatism, lumbago, neuritis, angina ache, blood pressure, diuretic, antipyretic, malarial	Spasmolytic	Campos-Bedolla *et al.* (2005)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Pseudognaphalium monticola (McVaugh) Villarreal, A.E. Estrada & Encina, stat. nov. (NAT) (*Gnaphallium liebmannii* var. montícola)	Respiratory diseases such as flu, fever, asthma, cough, cold, bronchitis, expectorating, and bronchial affections	Antibacterial, phytochemical characterization, muscle relaxant	Villagómez-Ibarra *et al.* (2001), Sánchez-Mendoza *et al.* (2007), Rodríguez-Ramos & Navarrete. (2009)
	Pseudognaphalium nataliae (F.J. Espinosa) Villarreal, A.E. Estrada & Encina, stat. nov. (NAT) (*Gnaphallium oxyphillum*)	Cough, bronchial affections, expectorating	Antibacterial	Rojas *et al.* (2001), Villagómez-Ibarra *et al.* (2001)
	Pseudognaphalium viscosum (Kunth) Anderb. (NAT) (*Gnaphalium viscosum*)	Flu, fever, asthma, bronchitis, cough	Antibacterial	Villagómez-Ibarra *et al.* (2001)
HELENIEAE	*Helenium mexicanum* Kunth (NAT)	Antiseptic, acaricide, sternutative	Antibacterial	Barrera-Figueroa *et al.* (2011)
HELIANTHEAE	*Aldama latibracteata* (Hemsl.) E.E. Schill. & Panero (END) (*Viguiera latibracteata* (Hemsl.) Blake)		Cytotoxicity, antimicrobial, phytochemical characterization	Villarreal *et al.* (1994)
	Ambrosia ambrosioides (Cav.) W.W. Payne (NAT)	Wounds, sores, placental expulsion, menstrual symptoms, hair diseases	Antibacterial	Robles-Zepeda *et al.* (2013)
	Ambrosia confertiflora DC. (NAT)	Intestinal parasites, stomachache, fever, lack of appetite, menstrual symptoms	Antibacterial, larvicidal, cytotoxic	de la Torre Rodríguez *et al.* (2013), Robles-Zepeda *et al.* (2013), Coronado-Aceves *et al.* (2016)
	Ambrosia monogyra (Torr. & A.Gray) Strother & B.G.Baldwin (NAT) (*Hymenoclea monogyra* Torr. & Gray)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Ambrosia psilostachya DC. (NAT)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Dendroviguiera quinqueradiata (Cav.) E.E. Schill. & Panero (END) (*Viguiera quinqueradiata* (Cav.) A. Gray)		Cytotoxicity, antibacterial, phytochemical characterization	Villarreal *et al.* (1994)
	Encelia laciniata Vasey & Rose (END)		Antibacterial, insecticide	Proksch *et al.* (1983)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Encelia palmeri Vasey & Rose (END)		Antibacterial, insecticide	Proksch *et al.* (1983)
	Encelia ventorum Brandegee (END)		Antibacterial, insecticide	Proksch *et al.* (1983)
	Flaveria trinervia (Spreng.) C. Mohr (NAT)	Diarrhea, dysentery	Antiprotozoal, antibacterial	Tapia-Pérez *et al.* (2003), Osuna *et al.* (2005)
	Flourensia cernua DC. (NAT)	Indigestion, expectorant, respiratory infections, tuberculosis	Antibacterial	Molina-Salinas *et al.* (2006), Molina-Salinas *et al.* (2011), Vásquez Rivera *et al.* (2014)
	Gonzalezia decurrens (A. Gray) E.E. Schill. & Panero (END) (*Viguiera decurrens* A. Gray)	Infections, wounds, boils, and to alleviate gastric ulcers	Phytochemical characterization, cytotoxicity, insecticide	Marquina *et al.* (2001)
	Gonzalezia hypargyrea (Greenm.) E.E. Schill. & Panero (END) (Viguiera hypargyrea Greenm.)	Gastrointestinal disorders	Cytotoxicity, anti-spasmodic, antibacterial, phytochemical characterization	Villarreal *et al.* (1994), Zamilpa *et al.* (2002)
	Helianthella quinquenervis (Hook.) A. Gray (NAT)	Deworming, gastrointestinal ailments, ulcers	Antibacterial, cytotoxicity, antifungal, antiprotozoal	Castañeda *et al.* (1996), Gutiérrez-Lugo *et al.* (1996), Calzada *et al.* (1998)
	Heliopsis longipes (A. Gray) S.F. Blake (END)	Muscle and toothaches, deworming, insecticide	Antibacterial, cytotoxicity, analgesic, antifungal, anti-inflammatory, genotoxic, spermicide, vasodilator, anti-arthritic, anti-mutagenic, herbal remedy/drug interaction	Gutiérrez-Lugo *et al.* (1996), Molina-Torres *et al.* (1999), Molina-Torres *et al.* (2004), Ríos *et al.* (2007), Damián-Badillo et al. (2008), Acosta-Madrid *et al.* (2009), Hernández *et al.* (2009), Ortiz *et al.* (2009), Rodeiro *et al.* (2009), Cariño-Cortés *et al.* (2010), Cilia-López *et al.* (2010), Déciga-Campos *et al.* (2010), Arriaga-Alba *et al.* (2013), Martínez-Loredo *et al.* (2016), Castro-Ruiz *et al.* (2017), Escobedo-Martínez *et al.* (2017), de la Rosa-Lugo *et al.* (2017), Buitimea-Cantúa *et al.* (2020)
	Iostephane heterophylla (Cav.) Hemsl. (END)	Arthritis, rheumatism, pain, diabetes, gastrointestinal ailments, dysentery, skin problems	Phytochemical characterization, antibacterial	Aguilar *et al.* (2001), Mata *et al.* (2001), Aguilar *et al.* (2007), Hernández *et al.* (2012), Ramírez *et al.* (2012), Rosas-Piñón *et al.* (2012)
	Montanoa frutescens (Mairet ex DC.) Hemsl. (END)	Aphrodisiac, anxiolytic, labor	Anxiolytic, ejaculatory	Carro-Juárez *et al.* (2012), Carro-Juárez *et al.* (2014), Rodríguez-Landa *et al.* (2014), Rodríguez-Landa *et al.* (2018)
	Montanoa grandiflora Alamán ex DC. (END)	Aphrodisiac, anxiolytic, labor	Anxiolytic, ejaculatory	Carro-Juárez *et al.* (2014), Rodríguez-Landa *et al.* (2014), Rodríguez-Landa *et al.* (2018)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Montanoa tomentosa Cerv. (NAT)	Aphrodisiac, anxiolytic, labor	Toxicity, aphrodisiac, anxiolytic, phytochemical characterization, ejaculatory	Gallegos (1983), Southam *et al.* (1983), Carro-Juárez *et al.* (2004), Sollozo-Dupont (2015), Carro-Juárez *et al.* (2014), Estrada-Camarena *et al.* (2019)
	12Neurolaena oaxacana B.L. Turner (END)		Phytochemical characterization	Passreiter *et al.* (1999)
	Parthenium hysterophorus L. (NAT)	Anti-inflammatory, insecticide, stomachache, fever, scabies, welts herpes	Antibacterial, trypanocidal activity	Sánchez-Medina *et al.* (2001), Sepúlveda-Robles *et al.* (2019)
	Parthenium tomentosum DC. (END)	Gastrointestinal disorders	Spasmolitic	Rojas *et al.* (1995)
	Perityle batopilensis A.M. Powell (END)		Antibacterial, cytotoxicity	Gutiérrez-Lugo *et al.* (1996)
	Ratibida latipalearis E.L. Richards (END)	Skin wounds, anti-inflammatory, headaches	Phytochemical characterization, bactericidal	Rojas *et al.* (1991), Rojas *et al.* (1992)
	Tithonia diversifolia (Hemsl.) A. Gray (NAT)	Diabetes, skin infections	Anti-inflammatory, antibacterial, phytochemical characterization, hypoglycemic	Bork *et al.* (1996), Villarreal-Ibarra *et al.* (2015)
	Verbesina abscondita Klatt (END)	Respiratory illness	Antibacterial	Rocha-Gracia *et al.* (2011)
	Viguiera dentata (Cav.) Spreng. (NAT)	Labor, baby rash, ant sting	Phytochemical characterization, antifungal, antimicrobial	Gao *et al.* (1985a), Peraza-Sánchez *et al.* (2005), Canales *et al.* (2008)
	Viguiera potosina S.F. Blake (END)		Phytochemical characterization	Gao *et al.* (1985b)
	Xanthium strumarium L. (NAT)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Zinnia grandiflora Nutt. (NAT)	Anti-inflammatory	Phytochemical characterization, analgesic	Reyes-Pérez *et al.* (2019)
INULEAE	*Epaltes mexicana* Less. (NAT)	Antibacterial	Phytochemical characterization, antibacterial	Kato *et al.* (1996)
MILLERIEAE	*Smallanthus maculatus* (Cav.) H Rob. (NAT)	Gastrointestinal diseases	Phytochemical characterization, cytotoxicity	Ríos & León (2006), Jacobo-Herrera *et al.* 2016
NASSAUVIEAE	*Acourtia cordata* (Cerv.) B. L. Turner (END)	Purge	Antibacterial	Rocha-Gracia *et al.* (2011)
	(*Perezia hebeclada* (DC.) A. Gray)			
	Acourtia humboldtii (Less.) B.L. Turner (END)	Pain, rheumatism, renal, hepatic, gastrointestinal ailments, diabetes	Hypoglycemic	Martínez *et al.* (2017)

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	(*Acourtia thurberi* (A. Gray) Reveal & R.M.King)			
	Trixis silvatica B.L. Rob. & Greenm. (END)	Cathartic, muscle pain, stomach illness	Antibacterial	Rocha-Gracia *et al.* (2011)
NEUROLAENEAE	*Calea ternifolia* Kunth (NAT)	Treating colic, fever, cough, diabetes	Phytochemical characterization, hypoglycemic	Fischer *et al.* (1984), Escandón-Rivera *et al.* (2017)
SENECIONEAE	*Barkleyanthus salicifolius* (Kunth) H. Rob. & Brettell (NAT)	Anti-inflammatory, migraine, liver and kidney disease	Antioxidant	Domínguez *et al.* (2005)
	Pittocaulon bombycophole (Bullock) H. Rob. & Brettell (END)	Anti-inflammatory, wound healing	Antioxidant, anti-inflammatory, antifungal, antibacterial	Marín-Loaiza *et al.* (2008), Marín-Loaiza (2013)
	Pittocaulon filare (McVaugh) H. Rob. & Brettell (END)	Anti-inflammatory	Antioxidant, anti-inflammatory, antifungal, antibacterial	Marín-Loaiza *et al.* (2008), Marín-Loaiza (2013)
	Pittocaulon hintonii H. Rob. & Brttell (END)	Anti-inflammatory	Antioxidant, anti-inflammatory, antifungal, antibacterial	Marín-Loaiza *et al.* (2008), Marín-Loaiza (2013)
	Pittocaulon praecox (Cav.) H. Rob. & Brettell (END)	Anti-inflammatory	Antioxidant, anti-inflammatory, antifungal, antibacterial	Marín-Loaiza *et al.* (2008), Marín-Loaiza (2013)
	Pittocaulon velatum (Greenm.) H. Rob. & Brettell (NAT)	Anti-inflammatory	Antioxidant, anti-inflammatory, antifungal, antibacterial	Marín-Loaiza *et al.* (2008), Marín-Loaiza (2013)
	Psacaliopsis purpusii (Greenm.) H. Rob. & Brettell (END)		Antibacterial	Rocha-Gracia *et al.* (2011)
	Psacalium peltatum (Kunth) Cass. (END)	Immunomodulatory agent, cancer	Anti-inflammatory, antioxidant, hypoglycemic, immunostimulant, cytotoxicity,	Alarcón-Aguilar *et al.* (2010), Juárez-Vázquez *et al.* (2013)
	(*Psacalium palladium* (H.B.K.) Cass.)			
	Psacalium radulifolium (Kunth) H. Rob. & Brettell (END)		Phytochemical characterization	Garduño-Ramírez *et al.* (2001)
	Robinsonecio gerberifolius (Sch. Bip.) T.M. Barkley & J.P. Janovec (NAT)		Phytochemical characterization	Arciniegas *et al.* (2003), Arciniegas *et al.* (2006b)
	Roldana angulifolia (DC.) H. Rob. & Brettell (NAT) (*Senecio angulifolius* DC., Senecio salignus DC.)	Dysentery, fever, rheumatism	Antibacterial, antifungal, anti-inflammatory phytochemical characterization	Hernández *et al.* (2003), Navarro García *et al.* (2003), Arciniegas *et al.* (2006a), Arciniegas *et al.* (2006b), Pérez-González *et al.* (2013)
	Roldana sessilifolia (Hook. & Arn.) H. Rob. & Brettel (END)	Fever, vaginal infections	Cytotoxicity, antibacterial, ejaculatory	Villarreal *et al.* (1994), Carro-Juárez *et al.* (2009), Rosas-Piñón *et al.* (2012)
	(*Senecio cardiophyllus* Hemsl, *Senecio sessilifolius* (H. et A.) Hemsley)			

Tribu	Species	Ethnomedicinal use	Tested activity/study	Studies
	Senecio bracteatus Klatt (END)		Phytochemical characterization	Pérez-Castorena *et al.* (1999)
	Senecio helodes Benth. (END)		Phytochemical characterization	Pérez-Castorena *et al.* (1997)
	Senecio iodanthus Greenm. (END)		Phytochemical characterization	Pérez-Castorena *et al.* (1999)
	Senecio mairetianus DC. (NAT)		Phytochemical characterization	Perez-Castorena *et al.* (2006)
	Senecio roseus Sch. Bip. (END)		Phytochemical characterization	Pérez-Castorena *et al.* (1997)
TAGETEAE	*Adenophyllum appendiculatum* (Lag.) Strother (NAT) (*Dyssodia appendiculata* Lag.)		Antibacterial	Frei *et al.* (1998)
	Chrysactinia mexicana A. Gray (NAT)		Antiprotozoal, antibacterial, phytochemical characterization, anti-spasmodic, antidepressant, toxicity	Calzada *et al.* (2007), Molina-Salinas *et al.* (2007), Guevara Campos *et al.* (2011), Salazar-Aranda *et al.* (2011), Cassani *et al.* (2015), Zavala-Mendoza *et al.* (2016)
	Dyssodia papposa (Vent.) Hitchc (NAT)		Antimicrobial, cytotoxicity	Gutiérrez-Lugo *et al.* (1996)
	Gymnolaena oaxacana (Greenm.) Rydb (END)	Diarrhea	Antibacterial	Hernández *et al.* (2003)
	Pectis hankeana (DC.) Sch. Bip. (END)		Antibacterial, cytotoxicity	Murillo-Álvarez *et al.* (2001)
	Porophyllum linaria (Cav.) DC (END)	Anti-inflammatory.	Insecticidal, phytochemical characterization	Hernández-Cruz *et al.* (2019)
	Tagetes erecta L. (NAT)		Antibacterial, spasmolytic, sedative	Hernández *et al.* (2003), Pérez-Ortega *et al.* (2017), Piña-Vázquez *et al.* (2017), Ventura-Martínez (2018)
	Tagetes lucida Cav. (NAT)		Antimicrobial, antifungal, antidepressant, sedative, anxiolytic, analgesic, anti-inflammatory	Céspedes *et al.* (2006), Damián *et al.* (2008), Guadarrama Cruz *et al.* (2008), Guadarrama-Cruz *et al.* (2012), Rosas-Piñón *et al.* (2012), Bonilla-Jaime *et al.* (2015), Pérez-Ortega *et al.* (2016), González-Trujano *et al.* (2019), Monterrosas-Brisson *et al.* (2019)
	Tagetes micrantha Cav. (NAT)		Spasmolytic	Arroyo *et al.* (2004)
VERNONIEAE	*Vernonia liatroides* DC., Prodr. (END)		Phytochemical characterization, muscle relaxant	Campos *et al.* (2003)
	Vernonia oaxacana Sch. Bip. ex Klatt (NAT)		Antibacterial	Rocha-Gracia *et al.* (2011)
	Vernonanthura patens (Kunth) H. Rob. (NAT) (*Vernonia patens* Kunth)		Cytotoxicity, antitumoral	Avelino-Flores *et al.* (2019)