



Traditional Medicine in the health systems of communities: A first exploring in Veracruz State, Mexico

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Received: 12 Sep 2022; Received in revised form: 26 Sep 2022; Accepted: 01 Oct 2022; Available online: 06 Oct 2022

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Abstract— Veracruz State has been described as one of the richest states in Mexico, in terms of its medicinal herbal diversity at a local and regional level, and its culture of utilization of such resources in traditional medicine. These resources are valued by their cultural and economic importance and by their usage in the healthcare system. In this study, we explore the value of Mexican traditional medicine knowledge registered in literature on this subject-books, thesis, and publications in ethnobotany scientific journals- from different localities in Veracruz State. We have found reports of a wide variety of plants used to heal different sufferings such as: cough, pain, healing, inflammation, gastrointestinal problems, cancer and diabetes of people who live in communities of Huasteca and Totonaca regions, Nautla, Capital or Central, Mountains, Los Tuxtlas and Olmeca in Veracruz, Mexico. The wide variety of plants found shows us a general scene of Veracruz State's great cultural richness. Some species commonly reported are *Bursera simaruba*, *Tithonia diversifolia*, *Oenothera rosea*, *Bidens pilosa*, *Heterotheca inulodes*. The formulations are tea, infusion, cataplasm or washings of the whole plant, root, blossom, bark, stem, leaves or fruits; they are essential to heal each attended illness by people in their communities. This review show that the traditional use of medicinal plants are of great importance due to their healing properties and contributes to an understanding of their biological activity. Furthermore, it will necessary to conduct further researches to evaluate these plants' effectiveness and safety, and to identify the compounds involved in them.

Keywords— Ethnobotany, Mexican traditional medicine, Medicinal Plants, Therapeutic uses.

I. INTRODUCTION

For many years, traditional medicine has been a valuable resource in the Mexican health system; particularly, in areas of great diversity of plant species and ethnic groups. According to old records, Mexico's herbal medicinal repertoire is one of the most diverse in the world. It contains numerous native plants, as well as species introduced from Europe, Asia and South Africa after the Spanish conquest in 1519 (García-Guerrero and Blanco-Dávila, 2004). The Mexican traditional medicine knowledge and the therapeutic uses of plants by the people of different regions in Mexico (in tea, infusions, decoctions, cataplasms, rubs, baths, macerations and

poultices, among others) is an ancient practice still used throughout the country to treat common infections and disorders (Aguilar et al., 1994). Currently, approximately 3,000 to 5,000 plants (both native and introduced species) are used for medicinal purposes by 62 different ethnic groups throughout Mexico (Aguilar, 1999; Lozoya, 1994; Aguilar et al., 1994).

In Veracruz State, the knowledge about the healing properties of plants has been passed on over many generations (de la Cruz, 1991, Chena, 2013). Several researchers, biologists, botanists, students, geographers and anthropologists have published different studies on traditional Mexican medicine contributing to the creation

of a rich ethnobotanical bibliographic collection (Frie et al., 1998; Benítez y Wels, 2010). Such studies describe the most frequently used species and their therapeutic use to treat gastrointestinal, respiratory, urinary and skin infections as well as stomachaches, cancer and diabetes (Martinez, 1984, 1992; Del Angel, 1995; Chena, 2013; Lozoya, 1987; Argueta, 1994), which are some of the main health problems in Mexico (Andrade-Cetto, 1995). This information has been gathered from interviews with healers (*curanderos*), midwives, specialists on medicinal plants and key informants in communities who know native plant species and their most frequent uses to treat different ailments.

This can only give us an idea of the importance of plants in the health systems, although there are no specific data to assess the extent of the global use of medicinal plants; the World Health Organization (WHO) estimates that more than 80% of the world's population routinely uses traditional medicine to meet the needs of primary health care and that much of the traditional treatments involve the use of plant extracts or their active ingredients. Since the late 70's, the WHO defined a *medicinal plant* as any plant species that contains substances which can be used for therapeutic purposes or which active principles can serve as precursors for the synthesis of new drugs (WHO, 1978) and therefore, within the framework of the "Health for all by the year 2000" program, it has promoted the study, documentation and kinetic evaluation of plants used in traditional medicine bridging the gap between traditional and modern medicine (Akerle, 1993; Tiwari 2008). Recently, researchers continue carrying out studies to discover and analyze the bioactive compounds and biological activity of medicinal plants, not only to preserve and record their traditional uses throughout the world but also to evaluate their biological and toxic activities in order to validate their use (Akerle, 1993). These validation and research studies could contribute to the development of new drugs and alternative methods to treat health problems as it has been registered in others studies (Heinrich, 2003; Akerle, 1993). For example, some drugs used nowadays were obtained and synthesized from medicinal plants used by the indigenous peoples of different countries.

In this article we present a specific review of different medicinal plants and their therapeutic uses, according to recent studies carried out in communities in Veracruz State, as well as some examples of phytochemical studies

about their possible specific biological activity. Also, we explore the value of Mexican traditional medicine knowledge based on the practices of key informants, herbalists ("*hierberas*") and healers ("*curanderos*") from different localities in Veracruz State, as it has been recorded in the literature on this subject -books, thesis, and publications in ethnobotany scientific journals-. Pharmacological reports available on Mexican medicinal plants were also briefly reviewed. This information provides the basis for future in-depth studies on pharmacology of medicinal plants of Veracruz State, Mexico.

1.1. Geographic background

Veracruz state is located in the South East of Mexico, along the Gulf of Mexico (see Figure 1). There are coastal plains along the coast of the Gulf of Mexico, and beyond the coastal plains, hills and canyons are found. Veracruz State covers an area of 72,815 square kilometers (28,114 square miles). Further inland there is Sierra Madre Oriental, which has different names according to the region it occupies: Sierra de Huayacocotla, Zomelahuacan, Chiconquiaco, Huatusco, and Zongolica. Otontepec or Tantima mountain range is located in the North. The mountain range of "Los Tuxtlas", which is not linked to Sierra Madre Oriental, is located in the South. The highest mountains in the State are El Pico de Orizaba (5,610 meters/18,500 feet above sea level) and Cofre de Perote (4,200 meters/13,860 feet). The ecosystem includes seven volcanoes and several lakes, lagoons, and marshlands. The average temperature is 24°C to 28°C (76°F to 82°F), and sometimes the temperature varies depending on the region.

The State is divided into 212 municipalities and it is the third most populated State in the country with a population of 7.1 million people. Veracruz has 10 regions: Huasteca alta, Huasteca baja, Totonaca, Nautla, Capital o Centro, Las Montañas, Sotavento, Papaloapan, Los Tuxtlas y Olmeca (OECD, 2010). The 212 municipalities are distributed along these regions (Figure 1, INEGI 2010). It also features the third largest indigenous population in Mexico. Veracruz has a huge diversity of flora and fauna, and many of these species are unique to Mexico and cannot be found anywhere else in the world. Veracruz is a place of enormous cultural diversity harboring indigenous traditional communities, such as: Popoluca, Totonaca, Nahuatl and Huasteca peoples (Toledo, 2001).

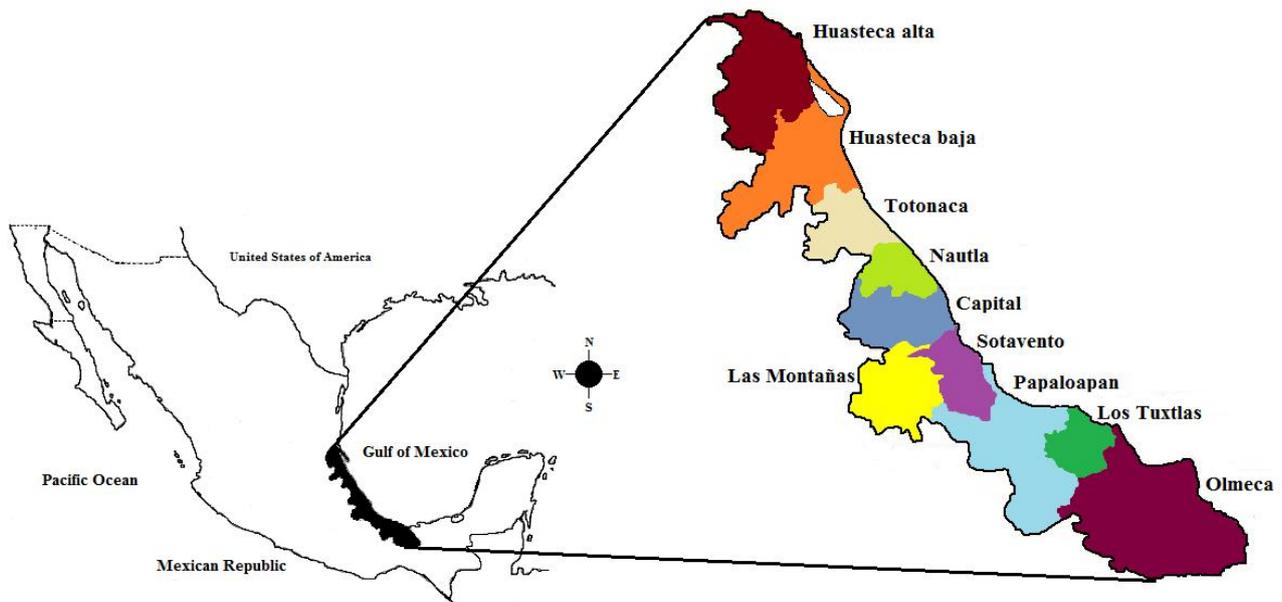


Fig. 1: Geographical location and ten regions of Veracruz State, México (INEGI, 2010).

II. THE VALUE OF MEDICINAL PLANTS IN VERACRUZ STATE

“Mexico is an appropriate place to examine the plant-human richness relationships because of the great degree of diversification of cultures and biota (the study of flora and fauna) in comparison to the rest of the Americas and the world” (Bye, 1993). There are over 5000 species of plants used medicinally by several indigenous groups in Mexico. There are specific records describing the customs and experiences in the preparation of home remedies using medicinal plants of some communities in the region of Veracruz (Cano, 1997a, 1997b). Some of these records were primarily compiled in the Zongolica mountains (Navarro and Avendaño, 2002), in a Galera Nahuatl community of Tantoyuca, Ver., (Del Angel, 1995), in communities of Coscomatepec and Orizaba (Gálvez y De Ita 1992); in four localities of Ixtaczoquitlán municipality (Hernández, 2006); in Tlalnehuayocan (Cabrera-Aguilar, 2010), in Tlalchy, in the municipality of Ixhuacán de los Reyes (Chena, 2013; Enriquez-Lopez et al., 2014), in “Los Tuxtlas” region (Leonti, 2002) and community of Nahua de la Sierra de Santa Marta, Los Tuxtlas (Calatayud, G.A., 1990). Also, there are registers of ethno-botanic studies where the value and importance of using medicinal plants are described. For example; “Algunas Plantas Conocidas como Tóxicas en la Planicie Costera del Norte de Veracruz” published in 1974 by UNAM. Del Amo’s study in 1979, where the book “Plantas Medicinales del Estado de Veracruz”, was published, registering about 544

medicinal plants used in different locations of Veracruz state.

Considering the distinct regions of Veracruz State, in the North zone called Huasteca Alta (21°22” North latitude, 97°44” West longitude); Bautista (1995) reported 82 plants of medicinal usage in the community of Chinampa de Gorostiza, Veracruz. Also, Del Ángel (1995) elaborated a work in a Nahuatl community of Galera’s congregation, which belongs to Tantoyuca’s municipality, Veracruz. Relevant information was compiled in here about the knowledge of herbal traditional medicine, getting ethnologic and botanical information of 112 species, related to 52 Families and 100 genuses. The most representative Families are Compositae, Lamiacea and Rutaceae. In this study, Del Ángel (1995) reported plants analgesic, anti-diarrheic, anti-inflammatory, healing, and dermatological properties, among others.

In Huasteca baja region, Smith-Oka (2007) reported a preliminary study of plants used by totonacos doctors, in this place they heal a variety of uneasiness, including; usual illnesses like flu, stomachache, gynecological pains, fractured or strained limbs, related syndromes to culture (including “fright” necaxantle, out of place organs, “malos aires” (when you feel full of air or dizzy, but you have not breathed so much or you are not sick. etc.) and ritual cleanings. Most of the plants were collected in specialist’s healing domestic gardens, around 150 specimens were collected, which include 33 Families among them are:

Asteraceae, Euphorbiaceae and Solanaceae. However, some of them such as: *Harpalyce arborescens*, *Adiantum tenerum*, *Cedrela mexicana*, *Croton soliman*, *Bursera simaruba* and *Protium copal*, were obtained from corn plants, from the grass areas destined to cattle or from the little spots of forest that still persist.

In Totonaca region, a plants catalogue used by traditional doctors of Pukuchin Healing House, a huge important herbarium can be seen (about 115 species) to different sufferings (Anemia, wounds, burns, blows, gastric ulcer, inflammation, infection, cough, parasites, diarrhea, muscular pains, diabetes, skin fungus, etc.) as well as their preparation: bathroom, tea, maceration, ointment, cataplasm, just to mention (De los Santos and Ruiz, 2009). Also, there is a study carried out by Olarte (1998) where a bibliographic investigation was done about ethnobotany and phytochemistry of medicinal plants of Filomeno Mata's municipality. (Papantla's mountain range). This research gathered information about 48 plants of medicinal use, documenting usual names, ethnobotanical description, anthropological data and medicinal uses.

To Nautla's region, Montoya (1996) reported 372 useful species, which belong to 286 genuses, in the municipality of Misantla, Veracruz. Each one of the registered species had information about its usual name, usage, section used and the way of preparation. 14 categories were registered, being the medicinal usage the most important aspect, followed by the edible and ornamental usage.

Veracruz state central region, Villamil and Avendaño (1992) presented an internal report called "Aspectos Generales del Uso de las Plantas en Xico, Veracruz". Also Bravo (1993) carried out an ethnobotanical study to the sellers of Naolinco, Veracruz., reporting 299 species, from these ones, 82 were informed to be as medicinal plants of great importance. The most representative Family was Compositae and the most representative uneasiness was the stomachache. On the other hand, Contreras (1996) reported around 350 species distributed in 83 Families were considered medicinal plants used in the central zone of the state of Veracruz. Beurregard (1996) found in his work "Las plantas útiles expedidas en el mercado de Coatepec, Ver." 112 species of medicinal plants, belonging to 57 Families and 100 genuses; the most representative Families were Asteraceae, Lamiaceae and Lauraceae; and he found the most sold plants are used to treat digestive problems. Santiago and Romero (1996) reported to the municipality of Jilotepec, Veracruz, 399 plant species, which 135 were plants of medicinal utilization. Compositae Family was the most representative and the intestinal infection was the most representative illness. As well, Grapain and Arcos (1999) carried out a study about

medicinal plants in the municipality of Jilotepec, Veracruz; registering around 130 genuses and y 63 Families of plants, from which 83 have multiple uses, 16 parts were used in 12 ways of use.

In the mountains region, Martínez-Bolaños (2012) reported about 70 medicinal plant species belonging to 20 Families; the most representative were Compositae, Solanaceae, Labiatae and Verbenaceae, in Barrio de Santa Cruz, Municipality of Tequila in the mountain range of Zongolica. He found 82 categories of multiple usages, among them are the medicinal plants used to heal stomachaches, cough, swelling, diarrhea, healing, skin ulcers and fungus, infections, etc.

While, Grapain López in 2020, reported medicinal plants of the Herbario XALU "Arturo Gómez-Pompa", realized by several authors. She Grapain collected data from the flora medicinal plant of the state of Veracruz, whose species are in the collection of the herbarium XALU "Arturo Gómez-Pompa", integrating 100% of the copies in a format of greater affordability and accessibility, so that people know the collection as well as the uses medicinal of it. Of the 2,205 records, 137 families, 544 genera and 919 species were counted. The 919 species were counted, 12% of the species correspond to the Compositae family, 8% to the leguminosae family, 5% to the Solanaceae family, 4% Lamiaceae family, 4% Euphorbiaceae family, 4% Malvaceae family, 3% Family Rubiaceae.

Henrich et al., (1998) reported culture importance about of medicinal plants in the Sierra de Zongolica of Veracruz State (is part of the Sierra Madre Oriental); where the medicinal plants most frequently mentioned serve toward the treatment of gastrointestinal and dermatological conditions. These two categories yielded the largest number of individual use-reports. For example, the principal species used to treat dermatological problems by Nahua are *Phyllanthus niruri*, *Lobelia laxiflora*, *Heterotheca inuloioides*, *Bryophyllum calcinum*, *Mercadonia procumbens*, *Stellaria nemorum* and *Tithonia diversifolia*. Particularly, Mexican "Arnica" or Mexican "sunflower" -*Tithonia diversifolia* is commonly used by different groups and also is known from various regions of Veracruz for treating dermatological conditions (Del Amo, 1979). This plant is native to the lowlands of southeastern Mexico and Central America but it is not well known in the ethnobotanical literature in Mexico (Heinrich, 1996).

In Tuxtla's region, Veracruz., Garrido (1997) carried out a study focused on vegetable species used as medicinal by the settlers of eight rural communities of Catemaco, Veracruz. In this research, it was reported about 104 species used by settlers have different medicinal usages and the most predominant illnesses were gastrointestinal.

The most representative Families were Compositae, Euphorbiaceae and Labiatae. Mendoza-Márquez (2000) reported in his ethnopharmacological-chemical study of the perennial high jungle of Los Tuxtlas, Veracruz, (Tropical Biology Station of los Tuxtlas Reserve) the knowledge and traditional use of medicinal plants. In here were found 309 species of 91 Families and 218 genres of medicinal use plants. The best representative Families are Asteraceae (34 species), Piperaceae (16 species), Euphorbiaceae (14 species), Rubiaceae (14 species) and Fabaceae (13 species). Some species of major representative in medicinal traditional use are *Sambucus mexicana*, *Bursera simaruba*, *Asclepias curassavica*, *Momordica charantia* and *Piper auritum* (for further information, look up details in these studies, quoted references and published articles).

In this ethno-botanical studies conducted in these communities it is possible to observe the different uses and the value or importance of medicinal plants in some regions in Veracruz State. Many of them are important medicinal resources which continue to be used nowadays and others are hardly ever used (Heinrich, 1989). Oftentimes some of these medicinal plants or parts of them (roots, leaves, etc.) are sold in popular markets, important easy-to-find places for their sale and distribution. These popular markets known as *mercados*, are widely known in Mexico and other Latin American countries (González-Stuart, 2010). In markets we can also find stalls known as *hierberías* where people sell a variety of herbal products. Here, herbs are usually sold by weight, dried or cut in small pieces or in small packets (Bellucci, 2002).

In general, popular markets have a larger selection of crude herbs as these products cannot be found in most of the more modern stores or supermarkets. Thus, popular markets in Mexico retain some of the cultural flavor regarding medicinal herbs traditionally used for healing and usually have herbal vendors who may also act as healers (Farnsworth et al., 1985; Taddei-Bringas et al., 1999; Gheno-Heredia et al., 2011; Bellucci, 2002).

Studies allowed investigators to conclude the existence of a basic group of 1,000 plants which have been used in Mexican traditional medicine almost throughout the whole country for nearly 400 years. Plant based treatments continue to play an essential role in primary health care (Aguilar et al., 1994; Balick and Cox, 2003), and it has been estimated that in Mexico, about 25% of the population still depends on the use of medicinal plants.

2.2. Medicinal plants and their properties in traditional healing practices

Historically all medicinal preparations derived from plants are different or similar among communities. In Veracruz state there are different sorts of preparations and the

therapeutic use of plants is a common practice; the different preparations of plants reported, using part of the plant (e.g. its fruit) or a combination of its parts (leaves, bark, roots, fruit and flowers), or combining plants of different species which suggests the presence of chemical agents that are effective against health problems. Thus, from a scientific point of view, it is essential to establish the relationship between the empirical use of plants and their real biological and therapeutic activities.

We analyzed the ethno-botanical literature available and we found common species as well as the traditional medicinal knowledge of some regions of Veracruz State. In Table 1 and 2 we can see a large amount of plants and their uses registered by some communities of Veracruz State. In this table it is important to observe that the people used the plants for treatment as well as anti-inflammatory, wounds and burns, pain, arthritis, rheumatism, antiseptic, respiratory problems, gastrointestinal and genital problems, cancer and diabetes. The formulation in tea, infusion and washings is more common in all communities evaluated in this paper.

For instance, we observed that the species *Thithonia diversifolia* is used to treat skin rashes and *Tagetes erecta* L., to treat wounds and pain, both are of the Family Asteraceae and were found in the community of Tlalchy, Ixhuacán de los Reyes, Ver., Totonacas, Ver., and San Pedro Soteapan, Veracruz, respectively. The species *Rhoeo discolor* L is used to treat wounds and washes, it belongs to Family Commelinaceae it was found in the community of Tlalnelhuayocan, Ver., and San Pedro Soteapan, Veracruz. *Oenothera rosea* L'Her. Ex Aiton was found in the communities Tlalnelhuayocan, Ver., Tlalchy, Ixhuacán de los Reyes, Ver., Barrio de Santa Cruz and Tequila, Ver., this species are used for wounds, bruises and burns, anti-inflammatory.

The *Sedum praealtum* and *Sedum purpurens* of the Family Crassulaceae are used for mouth sores and sores, respectively; and the species *Nicandra physaloides* and *Solanum nigrum* are used to treat wounds; they belong to Family Solanaceae they were found in the community of Tlalchy, Ixhuacán de los Reyes and Nahuatl Galera, Tantoyuca, Veracruz. Also, were found important different species of Family Gesneriaceae, Labiatae, Onagraceae and Rutaceae in this communities (see Table 1). This information on the therapeutic uses of medicinal plants is based on the species registered by each community and region (see Table 1 and 2, for some examples); which it shows that there are several plants with different uses and sometimes they are used for the same condition. Therefore, in the future, the species reported in Table 1 will require scientific studies to verify their biological effectiveness.

Also, it will be known their chemical composition and the effective dose for each ailment and treatment. Only a relatively small number of Mexican plants have been studied for their possible medical applications and even a

smaller number of them have been studied for their efficacy, safety, active ingredients and the type of extracts contained in them.

Table 1. Therapeutic uses, part (s) used and formulations of plants in three different localities of the State of Veracruz: Huasteca, central or capital and Los Tuxtlas, Ver.

Family ^b	Scientific name ^b	Local/Common name ^{a, b}	Therapeutic uses ^{a, c}	Part (s) used ^{a, b}	Formulation ^{a, b}	Region / Locality	Ref.
						Region: Huasteca Alta	
Aloeaceae	Aloe vera L.	Sábila	Burns	Leaves	Direct, macerated,	Galera Nahuatl Community, Tantoyuca, Ver.	Del Ángel, 1995.
Crassulaceae	Sedum purpurens L.	Balsámica	Sores	Leaves	Macerated and rubbed on skin		
Rubiaceae	Hamelia patens Jacq.	Maduro Zapote	Wounds	Leaves	Boiled for washes		
Solanaceae	Solanum nigrum	Hierba mora	Wounds	Leaves	Compresses with boiled leaves		
Sterculiaceae	Guazuma ulmifolia	Guacima	Wounds	Cambium	Applied on affected area		
						Region: Capital or Central	
Anacardiaceae	Amphipteryngium adstringens Schiede ex Schlecht.	Cuachalalate	Skin infections and swelling	Bark	Tea	Tlalnelhuayocan, Ver.	Cabrera-Aguilar, 2010
Chenopodiaceae	Chenopodium graveolens Willd.	Epazote zorrillo	Postpartum baths, cramps, abdominal cramping, dewormer, allergies, chickenpox, measles, diarrhea	Flowers, leaves and stems	Tea		
Commelinaceae	Rhoeo discolor (L'Hér.) Hance ex Walp	Magüey morado	Bruises and wounds. Used to stop bleeding	Leaves	Washes	Tlalnelhuayocan, Ver. San Pedro Soteapan, Ver. Zoque-Popoluca.	Cabrera-Aguilar, 2010. Muñoz, 2012.

Compositae	<i>Árnica montana</i> L.	“Árnica”	Vaginal douches, infections, swelling, wounds	Flowers, leaves and stems	Infusions and washes	Tlalnahuayocan, Ver.	Cabrera-Aguilar, 2010.
Compositae	<i>Artemisia cina</i> Berg ex Poljakov	Hierba maestra	Bile, hemorrhoids, itchy neck, stomachaches (adults), diarrhea	Leaves	Tea and washes		
Compositae	<i>Eupatorium pycnocephalum</i> Less	Hierba pico de pájaro”	Cancer, diarrhea	Flowers, leaves and stems	Tea		
Compositae	<i>Eupatorium</i> sp.	“Zacanene”	Labor induction	Leaves	Tea and washes		
Compositae	<i>Heterotheca inuloides</i> Cass	Árnica Arribeña	Wounds, swelling, infections	Flowers, leaves and stems	Tea and washes		
Compositae	<i>Taraxacum officinale</i> F.H. Wigg.	Diente de león	Wounds	Flowers, leaves and stems	Washes		
Compositae	<i>Verbesina turbacensis</i> H. B. & K	Árnica de árbol	Wounds	Leaves	Washes		
Equisetaceae	<i>Equisetum hyemale</i> L	Cola de caballo	Fever, constipation, kidney diseases, urinary tract infections	Leaves and stems	Tea		
Euphorbiaceae	<i>Acalypha alopecuroidea</i> Jacq	Chinaguatillo, hierba del cáncer, comalillo”	Bruises, sores, kidney diseases, wounds, pimples, sore throat, stomachaches	Flowers, leaves and stems	Washes and tea		
Gesneriaceae	<i>Kohleria deppeana</i> (Schltdl. & Cham.) Fritsch	Tlalchichinole, chinol	Mouth sores, cough, vaginal washes,	Leaves, stems and roots	Baths, washes, tea, chewed		

			gastritis				
Gramineae	<i>Cymbopogon citratus</i> (DC.) Stapf	Zacate limón	Bile, nerve diseases, influenza	Leaves	Tea, infusion	Tlalnahuayocan , Ver. Tlalchy, Ixhuacán de los Reyes, Ver.	Cabrera-Aguilar, 2010. Chena, 2013.
Labiatae	<i>Marrubium vulgare</i> L.	Hierba del vaporrub	Cough, asthma, stuffed nose, respiratory system (infections)	Leaves	Tea	Tlalnahuayocan , Ver.	Cabrera-Aguilar, 2010.
Labiatae	<i>Rosmarinus officinalis</i> L.	Romero	Anti-inflammatory, postpartum baths, relapses, magical-religious significance, wounds, disinfectant, labor induction, stomach lotion, fever	Leaves	Tea, baths, washes		
Labiatae	<i>Salvia microphylla</i> H. B. & K	Mirto	Magical-religious significance, postpartum baths, dewormer, hemorrhoids , worms in babies, headache, wounds, skin injuries, earache	Flowers, leaves and stems	Tea, baths, washes Ointment	Tlalnahuayocan , Ver. Tlalchy, Ixhuacán de los Reyes, Ver.	Cabrera-Aguilar, 2010. Chena, 2013.
Malvaceae	<i>Malva parviflora</i> L.	Malva	Vaginal discharges, postpartum baths, fever, vaginal douches	The whole plant	Tea, baths, washes	Tlalnahuayocan , Ver.	Cabrera-Aguilar, 2010.
Melastomataceae	<i>Arthrostemum Ruiz & Pav</i>	Mocachane de siembra	Relapses, postpartum baths, fever,	Flowers, leaves and	Tea, washes		

			wounds, influenza	stems			
Myrtaceae	<i>Psidium guajava</i> L.	guayaba	Stomachaches and diarrhea	Leaves and fruits	Tea	Tlalnahuayocan, Ver.	Hernández-Suárez, 2016.
Onagraceae	<i>Oenothera rosea</i> L'Hér. ex Aiton	Hierba del golpe	Wounds, bruises and burns (skin injuries), strains, anti-inflammatory, gastritis.	Leaves, stems and fruits	Tea, washes, infusion or plasters.	Tlalnahuayocan, Ver. Tlalch, Ixhuacán de los Reyes, Ver.	Cabrera-Aguilar, 2010. Chena, 2013.
Plantaginaceae	<i>Plantago australis</i> Lam.	Pata o manita de león, llantén	Wounds, venomous animal bites, eye pain	Flowers, leaves and stems	Baths, washes	Tlalnahuayocan, Ver.	Cabrera-Aguilar, 2010.
Rosaceae	<i>Rubus fagifolius</i> Schldl. & Cham	Mora de monte	Vaginal infection, blood purifier	Flowers, leaves and stems	Washes, tea		
Rutaceae	<i>Ruta graveolens</i> L.	Ruda	Stomachache, magical-religious significance, hemorrhoids, bile, postpartum baths, gastritis, abortive, swelling, blood circulation.	Leaves and flowers	Tea and baths		
Selaginellaceae	<i>Sellaginella</i> aff. <i>galeotti</i>	Doradilla, flor de piedra, garrapatilla	Epileptic seizures, kidney diseases.	Leaves	Tea		
Urticaceae	<i>Urtica chamaedryoides</i> Pursh	Ortiga, Chichicastle	Kidney diseases, anemia, arthritis, rheumatism	Leaves and flowers	Tea		
						Region: Capital or Central	
Asteraceae	<i>Brickellia</i>	Prodigiosa	Bile	Leaves and	Infusion	Tlalch, Ixhuacán de los	Chena,

	cavanillesii			stems		Reyes, Ver.	2013.
Asteraceae	Cebollina	Ageratum af. houstonianum	Wounds, scrapes, sores and burns, used as a healing agent	Flowers, leaves and stems	Direct application of infusion or washes		
Asteraceae	Tithonia diversifolia	Gigantón	Skin rashes	Leaves	Infusion		
Asteraceae	Aldama dentata	Mozote amarillo	Gastrointestinal problems	Flowers, leaves and stems	Infusion		
Asteraceae	Bidens pilosa	Mozote blanco	Gastrointestinal problems such as swelling	Flowers, leaves and stems	Infusion	Tlalch, Ixhuacán de los Reyes, Ver. Totonaca, Ver.	Chena, 2013. De los Santos and Ruiz, 2009.
Asteraceae	Eupatorium af. pichichense	Hierba negra	Skin injuries such as cuts, scrapes and bruises	Leaves and stems	Infusions and washes		
Caprifoliaceae	Sambucus nigra ssp. canadensis	Sauco	Cough	Flowers, leaves and stems	Infusion		
Clusiaceae	Hypericum sp.	Hierba del tapón	Diarrhea	Leaves and stems	Infusion		
Crassulaceae	Sedum praealtum	Siempreviva	Mouth sores	Leaves	Infusion		
Davalliaceae	Polypodium rivulare	Petatillo	Used to prevent influenza relapses	Flowers, leaves and stems	Infusion	Tlalch, Ixhuacán de los Reyes, Ver.	Chena, 2013.
Gesneriaceae	Moussonia sp.	Bayetilla	Gastrointestinal problems	Flowers, leaves and stems	Infusion		
Gesneriaceae	Moussonia sp.	Bayetilla	Gastrointestinal problems	Flowers, leaves and stems	Infusion		
Labiatae	Ocimum selloi	Hierba del zopilote	High blood sugar	Flowers, leaves and stems	Infusion		

Lauraceae	Litsea glaucescens	Laurel	Skin injuries	Leaves	Infusion or ointment		
Lythraceae	Cuphea nitidula	Hierba del ángel	Used to prevent influenza relapses	Flowers, leaves and stems	Infusion		
Magnoliaceae	Magnolia dealbata	Magnolia	Wounds	Leaves	Ointment		
Onagraceae	Lopezia racemosa	Hierba del sarampión	Measles	Flowers, leaves and stems	Direct application of infusion		
Papaveraceae	Bocconia frutescens	Gordolobo	Cough	Leaves and stems	Infusion		
Rutaceae	Casimiroa edulis	Zapote blanco	High pressure.	Leaves	Infusion		
Solanaceae	Nicandra physaloides	Belladora	Wounds	Flowers, leaves and stems	Ointment		
Umbelliferae	Foeniculum vulgare	Hinojo	Influenza	Leaves and stems	Infusion		
Rutaceae	Citrus limón	Limón	Influenza, sores and wounds.	Fruits	Infusion, diluted for washes.	Tlalchy, Ixhuacan de los Reyes, Ver. Comunidad Nahuatl Galera, Tantoyuca, Ver.	Chena, 2013. Del Ángel, 1995.
						Region: South Veracruz, Los Tuxtlas.	
Amaryllidaceae	Bauhinia divaricata	Lirio	Skin fungus	Flower and stems	Washes		
Aquifoliaceae	Ilex belizensis	Palito verde (Tsus kuy)	Wound healing	Leaves and stems	Washes		
Asclepiadaceae	Artemisa ludoviciana Nutt	Estafiate (Poma'ay)	Dewormer, cough, stomachaches, infections	Leaves	Tea and infusion.	San Pedro Soteapan, Ver. Zoque-Popoluca.	Muñoz, 2012.
Asteraceae	Tagetes erecta L.	Cempazuchil (Tsus mooya)	Wound healing, erysipelas, diarrhea,	Leaves	Washes and Braches		

			earaches. Magical- religious significance				
Bombaceae	Pachira aquatica	Apompo (Uakta)	Diabetes and cystitis	Leaves	Tea and infusion		
Bromeliaceae	Aechmea bracteata	Kardón (kardun)	Earaches and cystitis	Leaves	Tea and infusion		
Burseraceae	Bursera simaruba	Palo mulato (Ts_k)	Diarrhea, dysentery, fever, wounds and gastritis. Used as a living fence	Leaves and stems, braches	Tea and washes	San Pedro Soteapan, Ver. Zoque- Popoluca. Totonaca, Ver.	Muñoz, 2012. De los Santos and Ruiz, 2009.
Cactaceae	Epiphyllum crenatum	Pitahaya (Ñuchtyi)	Used to prevent miscarriages and to stop bleeding. Also used for food	Leaves and stems	Tea and infusion		
Cochlospermaceae	Cochlospermum vitifolium	Pongolote (Puts kuy)	Snake and black widow bites, anti- inflammator y and diabetes	Leaves	Tea	San Pedro Soteapan, Ver. Zoque- Popoluca.	Muñoz, 2012.
Curcubitaceae	Mormodica charantia L.	Bejuco condeamor (cundeamor)	Heals skin wounds, rashes, diabetes, scabies	Leaves and Braches	Wash wounds, decoction of leaves as a refreshing bath. Root decoction as tea		
Information gathered from key informants. ^a							
Information gathered from a literature review. ^b							
Information gathered from key informants but interpreted by the authors of this article. ^c							

Table 2. Example of some species of medicinal plants used by regions of Veracruz State.

Region	Scientific name (Family)	Local/Common name	Therapeutic uses	References
Huasteca Totonaca Mountains	Aloe vera	Sábila	Stomachache, cough, blows, healing.	Del Ángel, 1995. Martínez- Bolaños, 2012.

Huasteca Totonaca	Hamelia patens Jacq. (Rubiaceae) Hamelia erecta	hierba negra Bayetilla	Bath, wounds.	Del Ángel, 1995. De los Santos and Ruiz, 2009.
Totonaca Olmeca	Bursera simaruba (Burseraceae)	Palo mulato, Chaca (TAZUN)	Diarrhea, dysentery, fever, wounds and gastritis.	Muñoz, 2012. De los Santos and Ruiz, 2009.
Totonaca Mountains	Heterotheca sp (Compositae) Heterotheca inulodes (Compositae)	Árnica	Blows, healing, genital infections, gastritis, ulcer gastric.	De los Santos and Ruiz, 2009. Martínez-Bolaños 2012.
Capital or central, Mountains	Sambucus nigra var canadiensis (Caprifoliaceae)	Sauco	Cough, fright.	Chena, 2013. Martínez-Bolaños, 2012.
	Oenothera rosea (Onagraceae)	Hierba del golpe	Wounds, bruises and burns (skin injuries), strains, anti- inflammatory, gastritis, break down, kidney pain, blows, fractures, bruises.	Cabrera-Aguilar, 2010. Chena, 2013. Martínez-Bolaños, 2012.
Capital or Central, Totonaca	Titothonia diversifolia	Gigantón	Skin rashes, dandruff, scabies, and baldness.	Cabrera-Aguilar, 2010.
	Taraxacum officinale FH Wigg. (Compositae)	Diente de león	Wounds, kidney stones, intoxication, toothache, acne.	De los Santos and Ruiz, 2009.
	Bidens pilosa (Asteraceae)	Mozote blanco	Anemia, gastrointestinal problems such as swelling.	De los Santos and Ruiz, 2009. Tlalchy
Central or Capital, Olmeca	Rhoeo discolor (L'Her.) Hance ex Walp (Commelinaceae)	Maguey morado	Bruises and wounds. Used to stop bleeding.	Cabrera-Aguilar, 2010. Muñoz, 2012.
Mountains, Totonaca	Plantago mayor (Plantaginaceae)	Lanté	Kidney pain, organ inflammation and internal ulcers.	Martínez-Bolaños, 2012. De los Santos and Ruiz, 2009.
Mountains, Central or Capital	Solanum nigrescens (Solanaceae)	Hierba mora	Break down, wounds.	Del Ángel, 1995. Chena, 2013.

2.3 Phytochemical studies and biological activity of medicinal plants

Phytochemical studies are necessary to understand the pharmacological and biological activities of the different

species of plants used in traditional medicine, to gain an understanding of their mechanisms of action, and for quality control purposes. Currently, more than ever before, there is information available on the active principles of some plants. The reason is that modern detection

techniques and research have greatly expanded our knowledge about some of the possible medicinal and toxicological properties of plants (Awang, 2009). Some of these studies have shown that plants have a limitless ability to synthesize aromatic substances, mainly secondary metabolites, of which at least 12,000 have been isolated, a number estimated to be less than 10% of the total (Mallikharjuna, et al., 2007). Some secondary metabolites may be involved in plant odour (terpenoids), pigmentation (tannins and quinines), and flavor (Capsacin) (Mallikharjuna, et al., 2007). These molecules give plants their medicinal value which is appreciated by people, because of their vital role in human healthcare and for their economic value (Fazal et al., 2012). For example, diseases caused by microorganisms, the increasing resistance in many common pathogens to currently used therapeutic agents, such as antibiotics and antiviral agents, has led to a renewed interest in the discovery of novel anti-infective compounds (Fazal et al., 2012). Thus, the natural products derived from medicinal plants have proven to be an abundant source of biologically active compounds, many of which have been the basis for the development of new pharmaceuticals.

Therefore, the valuable medicinal properties of different plants are due to the presence of several constituents i.e. saponins, tannins, alkaloids, alkenyl phenols, glycoalkaloids, flavonoids, sesquiterpenes lactones, terpenoids and phorbol esters (Tiwari and Singh, 2004). These active compounds of interest present in the medicinal plants have continuously been of great concern to the scientists (Ahmad et al., 2012). Among them, some act as synergistic agents and enhance the bioactivity of other compounds. Thus, the presence of these phytochemicals in several medicinal plants could be responsible for the observed effects in traditional medicine.

Therefore, plants have shown to be a potential source new antimicrobial, antifungal, anti-inflammatory or analgesic agents (Clark and Hafford, 1993). Some species cited in the table 1 have been evaluated by other authors, John-Dewole and Oni, 2013 and Hinojosa-Dávalos et al., 2012, reported the presence of saponins in the leaves of species *Thitonia diversifolia* and *Tithonia tubaeformis*, and confirmed that they have anti-inflammatory, antifungal and antiparasitic properties; Owoyele et al., (2004) shown Antiinflammatory and analgesic properties of *Tithonia diversifolia* leaf extract.

The antioxidant and hepato-protective effects of *Heterotheca inuloids* have been reported too and this species have mutagenic/anti-mutagenic dual effect mediated by quercetin (Ruiz-Pérez et al., 2014). On the

other hand, *Rhoeo discolor* ethanolic crude extract evaluated in an *in vitro* system, showed anti-mutagenic, anti-genotoxic and anti-oxidative activities (González-Ávila et al., 2003) and anti-tumoral activity of aqueous crude extract of *Rhoeo discolor* (Rosales-Reyes et al., 2008). We could also confirm the reason why some medicinal plants are used to treat several treatments or affections. The presence of various active ingredients revealed by phytochemical screening and biological activity supports the resourcefulness of some plant extracts reported by researchers in other countries, and some of these medicinal plants are found in Veracruz state (Table 1 and 2). Therefore, all these natural agents (medicinal plants) reported in this paper, could to be a potential source for new compounds or drugs with diverse novel mechanisms of action and to treat infectious diseases, as have been recorded by others authors.

III. CONCLUSIONS

In this review, we show that Veracruz State has a wide variety of medicinal plants, which functions as a health care system for several communities. Also, it was observed that plants continue to be an important resource to treat different health problems in Veracruz State and all over Mexico. Furthermore, all the information collected in this review also shows that there is an important variety of plant species with different uses and applications. The formulation in tea and washes is more common in all communities evaluated in this paper. In addition, several of the species registered in different parts of Veracruz State are used for the same healing purposes or the same species can be used for various medicinal purposes. The phytochemical and ethno-pharmacological studies reviewed confirm the found properties in some plant species reported by the state of Veracruz. Therefore, the existing literature and experiments could be a successful step in the development of new drugs and be an alternative to cure certain diseases in Veracruz, Mexico. Also, from a scientific point of view, it is important to continue carrying out studies to confirm the efficacy and safety of medicinal plants, as well as to discover potential healing properties and to identify the compounds involved in the medicinal plants used by different communities of the ten regions in Veracruz, Mexico.

ACKNOWLEDGEMENTS

We would like to thank the National Council of Science and Technology (CONACYT) for its financial support during the 2012-2013 Postdoctoral research period (No. 186240). We also thank the School of Biology of the

University of Veracruz in Xalapa, for the information resources provided.

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