FACULTY OF TROPICAL AGRISCIENCES

Ethnomedicinal knowledge in the states of Chiapas, Veracruz and Zacatecas, Mexico.

Dissertation thesis

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Declaration of authorship

I, Eduardo A. Lara R., hereby declare that this thesis entitled "Ethnomedicinal knowledge in the states of Chiapas, Veracruz and Zacatecas, Mexico" submitted in partial fulfillment of the requirements for the degree of Ph.D., in Faculty of Tropical AgriSciences of the Czech University of Life Sciences Prague, and the work presented in it is entirely my own work. Information derived from the published or unpublished work has been acknowledged in the text and a list of references is given.

Prague, September, 2018

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List of abbreviationsAbbreviation	Description
CI	Cultural importance
CULS	Czech University of Life Sciences
IPNI	International Plant Name Index
m a. s. l.	Meters above sea level
TK	Traditional knowledge
MP	Medicinal Plants
UR	Uses Reportes
ICF	Informant concensus factor
FIV	Family importance Vaue
CI	Cultural importance
RI	Relative importance
RFC	Relative Frequency of citation
TM	Traditional Medicine
FIV	Familiar Importance Value
CIF	Consensus Index Factor.

Abstract

Nowadays, more than two thirds of the population in developing countries depend on the use of traditional plants as a first health resort. Despite the fact that Mexico has vast biocultural biodiversity, there are numerous regions where the traditional medicinal uses of plants have not yet been studied in-depth. This research aimed to document, to analyze quantitatively, and to preserve medicinal plant knowledge among local indigenous people living in three different states of Mexico (Chiapas, Veracruz and Zacatecas). The fieldwork was carried out from January to October 2016. In total 278 informants from 72 geographical points distributed in the studied areas, were interviewed. Data were analyzed using standard quantitative ethnobotany indices such as the relative frequency of citation, family importance value, cultural importance index, and informant consensus factor. The results indicate that the region with the highest biodiversity of medicinal plants was Zacatecas with 168 medicinal plants (151 genera, 69 families), followed by Veracruz with 102 (94 genera, 52 families), and the high lands of Chiapas with 59 medicinal plants (55 genera, 39 families). According to the results, women are the main users of medicinal plants for the treatment of reproductive discomforts (pre-postpartum, hormonal, gynecological, menstrual, inflammation of ovaries, hormonal problems, and overproduction of lactation), followed by gastrointestinal and respiratory problems. The Asteraceae family was the most representative botanical family in general. Generally, species with high cultural importance in our study were *Matricaria chamomilla*, *Mentha* x *verticillata*, *Ruta graveolens*, *Hamelia patens* and *Arnica montana*. Most of the informants gathered the plants from the wild (82 %). The leaves are the most important plant part for the preparation of herbal remedies in the highlands of Chiapas, Veracruz and Zacatecas. The results showed the persistence of rich traditional knowledge of medicinal plants in the different studied communities. The traditional medicine still plays an important role in the cultural and environmental aspects, the Mexican population from rural and urban areas are still recurring to the traditional medicine as strategy to solve health disorders.

Key words: Traditional medicinal uses, cultural importance, quantitative ethnobotany indices, medicinal plant knowledge, herbal remedy

RESUMEN

Hoy en dia, más de dos tercios de la poblacion en paises en desarrollo dependen del uso de plantas medicinales como primer recurso de salud. A pesar del hecho de que México tiene una gran biodiversidad biocultural, existen muchas regiones donde los usos tradicionales de plantas no han sido estudiados en profundidad. El objetivo de este trabajo fue documentar, analizar cuantitativamente y preservar el conocimiento de plantas medicinales entre los indígenas locales que viven en tres estados diferentes de México (Chiapas, Veracruz y Zacatecas). El trabajo en campo se realizo de Enero a Octubre del 2016. En total, se entrevistó a 278 informantes de 70 puntos geográficos distribuidos en las áreas estudiadas. Los datos se analizaron usando índices etnobotánicos cuantitativos estándar, como la frecuencia relativa de citación, el valor de importancia familiar, el índice de importancia cultural y el factor de consenso del informante. Los resultados indican que la región con mayor biodiversidad de plantas medicinales fue Zacatecas con 168 plantas medicinales (151 géneros, 69 familias), seguida por Veracruz con 102 (94 géneros, 52 familias), y las tierras altas de Chiapas con 59 plantas medicinales (55 géneros, 39 familias). Según los resultados las mujeres son las principales usuarias de plantas medicinales para el tratamiento de malestares reproductivos (preparto, hormonal, ginecológico, dolores menstruales, inflamación de ovarios, problemas hormonales y sobreproducción de lactancia), seguidos de problemas gastrointestinales y respiratorios. La familia Asteraceae fue la familia botánica más representativa. En general, las especies con alta importancia cultural en nuestro estudio fueron *Matricaria chamomilla*, *Mentha x verticillata*, *Ruta graveolens*, *Hamelia patens* y *Arnica montana*. La mayoría de los informantes collectan las plantas de forma silvestre (82%). Las hojas son la principal parte usada para la preparación de remedios a base de hierbas en las tierras altas de Chiapas, Veracruz y Zacatecas. Los resultados mostraron la persistencia de un rico conocimiento tradicional sobre plantas medicinales en las diferentes comunidades estudiadas. La medicina tradicional todavía juega un papel importante en los aspectos culturales y ambientales, la población mexicana de áreas rurales y urbanas siguen recurriendo a la medicina tradicional como estrategia para resolver los trastornos de salud.

Palabras clave: Usos medicinales tradicionales, importancia cultural, índices etnobotánicos cuantitativos, conocimiento de plantas medicinales, remedio herbal.

Abstrakt

V současné době více než dvě třetiny populace rozvojových zemí závisí na užívání léčivých rostlin při řešení zdravotních potíží. Navzdory rozsáhlé biologické a kulurní rozmanitosti Mexika, v zemi stále existuje mnoho oblastí kde tradiční užívání rostlin k léčebným účelům doposud nebylo podrobněji zkoumáno. Cílem tohoto výzkumu bylo zdokumentovat, kvantitativně analyzovat a uchovat tradiční znalosti domorodých obyvatel žijících na území tří různých států Mexika (Chiapas, Veracruz a Zacatecas) o užívaní léčivých rostlin. Terénní výzkum probíhal od ledna do října 2016. Celkem bylo dotázáno 278 informantů ze 72 geografických bodů v rámci zkoumaných oblastí. Data byla analyzována pomocí standardních kvantitativních etnobotanických ukazatelů jako například: relative frequency of citation, family importance value, cultural importance index, an informant consensus factor. Výsledky ukazují, že oblastí s nejvyšší biodiverzitou léčivých rostlin byl Zacatecas se 168 druhy léčivých rostlin (151 rodů, 69 čeledí), následoval Veracruz se 102 druhy (94 rodů, 52 čeledí) a vysočina v Chiapas s 59 druhy (55 rodů, 39 čeledí). Podle výsledků jsou hlavními uživateli léčivých rostlin ženy, které je užívají především k léčbě reprodukčních obtíží (hormonálního, gynekologického a menstruačního charakteru, v průběhu těhotenství a šestinedělí, při nadprodukci laktace či zánětu vaječníků) a dále při řešení trávicích a dýchacích obtíží. Rostlinná čeleď Asteraceae byla obecně nejvíce užívanou čeledí léčivých rostlin. Jako nejdůležitější druhy léčivých rostlin byly určeny: *Matricaria chamomilla*, *Mentha x verticillata*, *Ruta graveolens*, *Hamelia patens* a *Arnica montana*. Většina respondentů získávala rostlinná léčiva sběrem planě rostoucích druhů z volné přírody (82%). Listy jsou nejdůležitější rostlinnou částí užívanou pro přípravu bylinných léčiv v oblasti vysočiny v Chiapas, Veracruzu a Zacatecasu. Výsledky ukázaly, že studované komunity mají stále bohaté tradiční znalosti o léčivých rostlinách. Tradiční medicína stále hraje významnou roli v kulturní a environmentální sféře a studovaná populace z venkovských i městských oblastí se stále obrací k tradiční medicíně jako strategii řešení zdravotních obtíží.

Klíčová slova: Užití tradiční medicíny, cultural importance, ukazatele kvantitativní etnobotaniky, znalosti léčivých rostlin, rostlinná léčiva

1. INTRODUCTION

The practice of using plants in traditional medicine is recognized and included in the system of primary health care in developing countries (90 %) and developed countries (60 %) (Vandebroek et al. 2008). Mexico is a country with a rich heritage of ancestral knowledge passed from generation to generation; unfortunately, today there is a great loss of knowledge, biodiversity and management of these plants due to various reasons, one of which is the transfer of popular knowledge in closed groups, where there are no written records. Currently, the demand for use of traditional medicine has been increasing in the world. It is due to the high costs of new generation drugs and their ineffectiveness in resolving chronic diseases, these factors encourage people in developing countries to include traditional medicine in their primary health care system, moreover, they have 67 % of the plant species in the world (OMS 2013).It is estimated that there are about 30 000 species of plants in Mexico (Argueta et al. 1994), of which there are around 4 000 for medicinal use documented. This represents 15 % of the total botanical species in Mexico. However, only 5 % of them have been studied (Ocegueda & Koleff 2005) and there are still many unregistered plants in the central and southern part of the country. Currently more than two thirds of developing countries use ethnomedicine to combat their illnesses (Amri & Kisangau 2012). In Mexico, there are around 59 ethnic groups with a population around 12 000 000 inhabitants (CONAPO 2009). Chiapas has 11 different ethnic groups, this state hosts a great number of practitioners of the traditional medicine. In Veracruz there is a big concentration of indigenous communities who are handling a great amount of plants with therapeutic properties and Zacatecas presents an absence of ethnobotanical records. This kind of studies on the culture and processing of medicinal plants for therapeutic purposes is considered strategically important. Likewise, the transferring of indigenous knowledge is a fundamental part of the development of this sector. Plants as well as the associated indigenous knowledge of folk medicines can provide a comprehensive overview of the herbs employed in health care (Hassan et al. 2015). The importance of the uses that are given to medicinal plants in Mexico is not only for its wealth as part of culture, but also in the scientific knowledge generated by this study will enrich the international literature information of local sources.

2. LITERATURE REVIEW

2.1. Traditional medicine

The World Health Organization affirms that more than 80 % of the world population use Traditional medicine (TM), Complementary or alternative medicine to treat their ailments in first instance (Becoña et al. 2002; Caballero & Cortéz 2001). Traditional medicine, folk medicine or popular medicine have a holistic view of the human being and the so-called health-disease process (Hifa 2010).

Traditional medicine is the whole body of knowledge and skills based on theories, beliefs and indigenous experiences from different cultures, whether explicable or not, used for health maintenance and prevention practices, diagnosis, improvement or treatment of physical or mental illness (WHO 2013).

Traditional medicines include herbal medicines composed of herbs, this remedies could be mixed or accompanied of a mixture with different plants, animals or minerals (WHO 2002; Lira & Casas 2016; Maffi & Woodley 2010).

Traditional indigenous Mexican medicine is considered as a health system with its origins in knowledge about health and disease by indigenous and rural peoples of Mexico, in our country, this knowledge has accumulated throughout its history, based on an interpretation of the world (worldview), health and disease of pre-Hispanic origin. This practice has incorporated elements of other medicines, such as ancient Spanish medicine, African medicine and less measured by the interaction of Western medicine itself. According to the WHO, around 21,000 species of plants have the potential to be used as medicinal plants.

Currently, the effectiveness of such alternative therapies can not be fully tested; rather, we should return to the idea of what is the importance of the traditional media in society and its relation to the maintenance or improvement of public health, it as an element for the quality of life of people, as well as to understand the implication of the ethnomedicine in medical applications, in particular, the so-called traditional medicine.

In America, aleopathic or conventional medicine is one of the most widespread medical practices. This type of medicine has become a medical system of attention to health, but it was due to a series of sociopolitical and economic processes that has adjusted it under the guidelines of public health policies in each of the countries that make it official.

However, traditional medicine has not yet been adjusted to the political and scientific regulations (Villalobos 2001), therefore they could not be materialized as in a public health insurance system. Since the medicine emerged three main objectives were stablished: maintain health, cure or relieve diseases and prevent unnecessary death, improving the quality and health conditions in people (Pérez-tamayo 1989; Barquin 2009).

The annual expenditure of Traditional Medicine (TM) on the world is growing in a significant way every yeaar. It changes according to the economy in each population and culture, however, the limitation of a real in-depth knowledge of the effect and benefits caused by each plant should be more studied (Caballero & Cortéz 2001; Bacoña & Vázquez 2002). The high use of medicinal plants (MP) and the growing tendency are proves about the importance of MP in the world, it should be enough evidence to start developing more scientific studies on them.

2.2. Medicinal plants

The use of medicinal plants in large sectors of the population of Mexico expresses the permanence of this cultural practice and demonstrates the revaluation of traditional knowledge at the moment of solving health problems, in a country of permanent environmental destruction and where 70.6 % of the inhabitants live in poverty (Monroy-Ortiz & Castillo-España 2007).

The use of medicinal plants in the treatment of diseases by indigenous communities, is a practice that has been from ancestral times evolving in different cultural, social and ecological contexts. Currently, medicinal plants are in an industrialization process under the pharmaceutical companies, in many places the use of some plants have disappeared quickly and replaced by others (Caballero & Cotréz 2001; Maffi & Woodley 2010).

The medicinal plants are involved in a global process, traditional knowledge is affected by the scientific revolution, the low valuation towards medicinal plants by the authorities, governments and health centers affect the continuity of these ancestral practices. In addition to the loss of biodiversity due to the destruction of ecosystems decreases the availability of plants in the surroundings, the production of monocultures and the use of pesticides also plays an important role in biocultural loss (García 2015).

The prescription cost is higher for those uninsured individuals, the access to Mexican medicaments is higher and inadequate than other developed countries and it is not adjusted for the average. On the other hand, there is lack of important policies regarded to the access to a good pharmacosurveillance and rational use of medicines, these problems are affecting the effectiveness of the modern medicine to give a good treatment in chronical diseases (Wirtz et al. 2008).

2.3. Local knowledge

Local knowledge is defined as traditional ecological knowledge. Notable researchers such as Berkes (1999) and Toledo (2005) emphasized the value of local ecological knowledge, presenting it as a result and strategy of human adaptation to the environment. The role of local knowledge and healing practices are increasingly recognized as complementary for the biomedicine, its practice and the incorporation the public health care systems arround the world (Chaudhary & Singh 2011; Zank & Hanazaki 2012; Gruca et al. 2014). Local knowledge is one of the most important information we have from our ancestors regarding to the biodiversity and cultural diversity in each community. Local Traditional knowledge is a key in the management of natural resources, it also has the potential to contribute to human wellbeing and rural economic development. Authors describe that local knowledge systems contribute to the cultural diversity of each community, as well as create a sense of individual belonging for each group (Balee 1994; Maffi 2001; Chaudhary & Singh 2011).

2.4. Ethnobotany

Ethnobotany is considered a branch of ethnobiology, from "ethno" study of people and "botany" study of plants. Ethnobotany study is described as the relationship among uses of plants, traditional knowledge and cultures. The uses of the plants are not limited just for food, also clothing, shelter, cosmetics, dyeing, tools, currency, clothing, rituals, music, social life, ornamental and medicine (Choudhary et al. 2008). According to the World Health Organization, plant extracts or their active compounds are used as folk medicine in traditional therapies in 80 % of the world population. Over 50 % of all modern clinical drugs are from natural product origin (Kirbag et al. 2009). The most remarkable thing about this science is its dedication to the recovery the TK from the societies, ethnic-groups and cultures from all

over the world have had and have, recovering the knowledge about healing properties that the plants have and their use in all areas of life (Schultes 1990).

The concept of ethnobotany has undergone several modifications since that term began to be used. The matter studied by ethnobotany, for a long time, was studied by economic botany. The work of ethnobotany is not exercised by a single type of professional, but is a multidisciplinary work, exercised by: botanists, anthropologists, pharmacists, chemists, historians, architects, among others (Cásale 2007).

Ethnomedicine is the science that studies the connection between cultural groups, ethics and their plant environment. Medicinal plants are considered very important so that their effectiveness and efficiency are prepared by people, and to treat different ailments.

2.5. Mexican ethnography

The indigenous people of Mexico are those who assume an ethnic identity based on their culture, their institutions and a history that defines them as the native people of the country, descendants of Mesoamerican societies (CDI 2007). The Mexican State recognizes indigenous people by defining themselves in their Political Constitution as a multicultural nation founded on their indigenous peoples, according to the last census calculation done by National Indigenous Institute (NII) and the National Commission for the Development of Indigenous Peoples (CDI), in 2012 the indigenous population was approximately 15 million people, spread over 56 ethnic groups.

In contrast to other countries in Latin America, where the indigenous people are the majority belong to a single linguistic group, whose languages have been elevated to the category of official beside to the Spanish language, in Mexico there are around 65 indigenous groups who speak between sixty-two and more than a hundred different languages (CDI 2007). In Mexico, the indigenous population is distributed throughout the country but is especially concentrated in the Sierra Madre del Sur, the Yucatan Peninsula and in the most remote areas, such as the Sierra Madre Oriental, the Sierra Madre Occidental and surrounding areas.

In the north, center and the west of Mexico, there are a few concentration of indigenous groups living such as Tarahumaras, Huicholes, Mazahuas, Otomiés, Purépechas, Mexicas, Nahuas and the Yaquis. While in the southeast and south of the country, we can find bigger concentration of indigenous such as Tlapanecos, Totonacas, Tsotsil, Mixtecos, Mixes,

Triquis, Zapotecos and the Mayas, among others (INEGI 2009; CDI 2007). Ethnic groups such as the Zapotecs, Mayas, Nahuas, Purépecha, Mixtecs, Yaquis, Kikapúes and Otomíes have managed to improve their living conditions and have adapted easily to the culture of trade and globalization (CDI 2007).

Indigenous communities have a deep understanding of their environment (Caballero & Cortes 2001). They know a large number of uses of plants (Frei et al. 1998). The knowledge of medicinal plants constitutes a cultural heritage of global biodiversity (Frei et al. 1998; Ankli et al. 2002; Case et al. 2005). Traditional Mexican medicine has begun to be part of the strategy of health plans.

Some specialists consider that a part of the history of medicine is still present in marginalized populations and their sociopolitical systems, those communities have managed to maintain their practices based on their own beliefs, such as the Tsotsiles and Tzetales in Mexico (López & Teodoro 2006). Even health and illness, in some places, are still understood from the magical-religious approach, because it still prevails in societies.

The Mexican traditional medicine is divided by the diferent cultures and ecosystems presents in the country, but at the same time, these backrounds have determinated the current national cultural development.

2.5.1. Use of medicinal plants in Chiapas

The health panorama presented in Mexico inscribed in a social reality characterized by poverty, migration, social and enviromental fragmentation, which is more remarkable in the souther part. Elements such as the impact that formal education, new health care systems, religious practices, policies, malnutrition, lack of employment, low incomes, pollution, poverty, among other things, have led in the last decade to the transformation of healthy conditions of life, persistence of some diseases and change the profile of morbidity and mortality in the villages in the state of Chiapas.

In Chiapas, as in other states with indigenous predominance, many of the communities are governed by uses and customs. Although these traditions have been alive for centuries, the current context, which tends towards globalization, has generated important changes in the culture of indigenous peoples.

Many studies before recorded the most important epidemiological problems in highland, in which tuberculosis is registered, with severe cases of drug resistance (Sánchez 2000; Bencomo 2009). Problems came more frecuently such as: obesity; diabetes mellitus and the arterial hypertension; the constant and high morbidity and mortality mother and child, the malnutrition; the gradual increase of indices of HIV / AIDS, but particularly the low acces to information and receive a good treatment against sexually transmitted diseases, the human papilloma and consequently the indices of Cervical cancer in Mayan women and Zoques.

The majority of the inhabitants of the "Los Altos de Chiapas" region are women and are indigenous. These two conditions are factors that confront economic, social, cultural and even geographical marginalization (Sánchez 2014).

Despite the floristic richness of the state of Chiapas, result of the diversity of climates, soils, topography and complex geological structure, together with the presence of numerous groups ethnic who still have knowledge of the properties and uses of the plants, there have been few ethno-botanical explorations in the different zones of Chiapas.

During the past three decades many private companies tried to study the traditional knowledge from the local communities and many problems have started.These studies are getting more complicated in rural and isolated regions, that is the case of the high lands, where exist the largest Tsotsil and Tseltal population, here it is found the most representative number of people speaking ethnic languages coming from Maya Culture, some previous studies describes a big variety of medicnal animal uses still being carried by the locals (about 52 species), they use the animal in different ways as a food, artisanal purposes and religious, among others (Hunn 1977; Moscoso 1981; Sánchez 2000). Nowadays the studies in this area are just oriented towards into record symbolic information about medicinal biodiversity commonly used between the different Maya groups, Zoques and Mestizos that inhabit the region; anothers studies cover the processes of formation, initiation and practitioners' workers (chamanes), where we can understand the processes about the promotion of ethnomedical systems; and there are just a few ones to register the health processes, diseases, medical and social changes in the indigenous groups, care as anthropologists, doctors and psychologists (Holland 1963; Álvarez Del Toro 1993; Page 1996; Naranjo 1997; Sánchez 2000; Ventura 2000; Guerra 2001; CDI 2005).

However, there is still a big lack of information regarding to the use of wild life for medicinal pourpouses in this region, as well as the diseases treated with them. The use and commercialization of different medicinal plant species has caused overexploitation of the natural resources by communities or locals, the processes of deforestation and urbanization are damaging and transforming the habitat of these species, is causing many are threatened with extinction or of loss of genetic diversity (Berlin et al. 1990; Bye 1993; Berlin & Berlin 1996).

Between 1980 and 1990, the ethnomedicine´s field has decreased considerably, talking about Health and traditional medicine practices. The panorama is rapidly changing, it is characterized by the reduction of the Mayas and Zoques population in the Chiapas territory, and the TM practices.

Nowadays, the ethnomedicine practices are evolving in individual way in each community. There were many finding regarded to the number of combinations of plants, adding new uses and plants in the therapies. The TM presents in those groups have own characteristics, whose are based in the ancestral knowledge but with a certain social dynamic level of the modern needs, that makes incorporate new local and non-local plants to the biomedicine, as well as to the spiritualism (Heinrich et al. 1998; Kufer 2005; Hifa 2010).

2.5.2. Use of medicinal plants in Veracruz

The use of traditional medicine in the Totonac Region continues to be a central element in the preservation of health in the home and it is in the nuclear family where the parents are primarily responsible for teaching their children how to prepare herbal home remedies, considering the productive cycles of the plants, management intensities and harvesting techniques according to the capacity of regeneration of the phytogenetic resources available to them.

The transmission of consolidated knowledge through generations prevails, preserving the tradition of using medicinal plants as remedies in the primary care of diseases and is complemented by the conventional system generating a model of mixed attention in the study region. This mixed attention happens spontaneously, through an open dialogue between the doctors of the field clinic, patients, midwives and healers, which facilitates that the complex reality that looms in the practice of traditional medicine does not fragment and it is possible

to understand the interests, aspirations, needs and objectives of the individuals that constitute relevant social actors for the transference of knowledge and conservation and use of their natural resources. In this sense, another factor of persistence of traditional practice is the close relationship between midwives and patients such as treatment in their own language and trust, since there is a belief among women that if they go to the clinic they will operate to avoid having more children.

In the Totonaca region, their traditional doctors are midwives, healers and sorcerers, indigenous or mestizos, who know about medicinal plants to attend births, alleviate physical and soul ailments. They are people who acquire a privileged social position within their communities and are respected within the families that come to receive their services. Affective bonds are established between practitioners of traditional medicine and their patients and go beyond the cognitive aspect, The rural and rural communities have suffered a progressive abandonment of the development policies to improve the living conditions of the population of these areas, which has originated important negative impacts in the ersosión of their ancestral knowledge in the use and conservation of the environment. In this scenario, medicinal plants must be an instrument that helps to build new strategies for sustainable rural development.

Veracruz is one of the richest states in Mexico with regard to biological and cultural diversity. The flora in Veracruz accounts for 34 % of the 25,000 species that have been documented for the whole country (Rzedowski 1981). The Veracruzan biodiversity is due to the influence of two different plant kingdom (neotropical and holarctic) (Leonti et al. 2003; Leonti 2013). In Veracruz, there are a number of indigenous groups who are keen consumers and practitioners of traditional medicine, such as the Totonacs, Tepehuas, Nahuas, Otomies, Popurcas, Zocos, and the Popoluca Zaco, among others' (Cano et al. 1997). The Totonacs have a historical background with traditional medicine uses and are well-known for preserving a wide variety of plants.

Prevalence of some diseases in the indigenous population pushes the locals to treat their health problems with medicinal plants, adding and displacing many species into the daily life. It easily influences the traditional knowledge and used plants inside their communities (Pérez-Nicolás et al. 2017). This kind of studies shows how dynamic is the ethnomedicine to combat health disorders. Besides to preserve the ancestral knowledge, the tendency of

medicinal usage and herbal remedies by the community helps to proportionate more understanding about the role that the Mexican ethnomedicine has in the public health care system.

2.5.3. Use of medicinal plants in Zacatecas

Zacatecas has droughts concurrency along its history that affects the crops and yield production due to a low precipitation (Campos-Aranda 2016). Some record about the climate, agriculture and cycles of human occupation calculated the first land farming activities 500 years AD in similar aridity conditions in southern Zacatecas, it means the indigenous communities settled down and covered their requierements with the local flora till the Spanish conquest, where the erosion in the soil began and with that the decline of the ecosystems (Elliot et al. 2010) it could be the principal fault to the vanish of traditional knowledge in one of the biggest indigenous communities in the state. Many indigenous groups which existed in Zacatecas (Huicholes and caxcanes) left ruins where is easily distinguish the places used for rituals and ceremonies, in those groups the food may have been used as a marker to establish differences in social status.

Currently, Zacatecas population are forced by different circumstances such as low income and bad health care public system to use or depend more to the traditional medicine. Zacatecas is one states with less amount of records and studies regarding to Medicinal plants in Mexico (Dávila & Sosa 1994; Juaréz-Vazquez et al. 2013), the lack of research on the local medicinal plants do not stop the people to be actively using wild medicinal plant, develepod herbology activity (practicants- chamanes) and trade of medicinal plants. Nevertheless, the lack of control on the wild harvesting, the price that the plants reaches in the market and the demand from the users, push a human pressure on the local ecosystems, causing the degradation ad availability of plants (García et al. 2015).it is important to have deeper investigation about the Medicinal Plant effects in the semiarid regions and its chemical compounds.

Factors such as the uncontrol of the wild harvesting, the short incomes sources into the household and the lack of environmental education are causing an unsuitable activity, where the farmers in the form to solve the short needs of low incomes and cover the first needs, they make a trade off term of the plants and ecosystems in general not being aware about the

impacts caused through the illegal collection. Here the preservation of traditional local knowledge of plants has started to be affected and reduced due to historical migration process, modernization, new tendency of diseases, environmental degradation, the low incomes in the population, the level of poverty among the population absence of records and the new strategies in the new health care system.

Mexico presents has a mega biodiversity compared with others countries, where the compilation about the knowledge and uses of medicinal plants has just reached 15 % of its total biota but the lack of knowledge and register of medicinal plants is still present by the researchers, Zacatecas does not have relevant studies over its biota, but some studies registered the use over medicinal flora of Zacatecas is composed of 522 species distributed in 299 genera and 97 families (Davila & Sosa 1994; Balleza & Enriquez 2007; Ramos & Aguilera 2014) The market on medicinal plants keeps representing a part of sustenance of life into many local communities through the selling and these markets have become in essential place to discover the culture, history, society and the level of domestication of plants in each region (Martínez et al. 2006).

In the state of Zacatecas the medicinal plants of frequent use are chamomile (*Matricaria chamomilla*), mint (*Mentha spp*.), wolf's bane (*Arnica montana*), silver herb (*Artemisia ludoviciana*), mullein (*Gnaphalium viscosum*), eucalyptus (*Eucalyptus globulus*), aloe (*Aloe vera*), horsetail (*Equisetum arvense*), rue (*Ruta graveolens*), greasewood (*Larrea tridentata*) and skunkweed (*Chenopodium ambrosioides*), the most common sufferings for which they are used are gastrointestinal diseases and cough . 34 % of the population has combined the drugs with a medicinal plant, which resulted in an adverse effect among those who mentioned dizziness, stomach pain and stomach inflammation.

There are endemic species fragile in those ecosystems, despite the big importance as and variety of medicinal uses of the peyote (*lophophora williamsi*), it does not reach a big price in the region. The harvesting done without a real management has provoked that it becomes in a less accessible plant for much people. It has affected the status into its natural distribution. This plant plays an essential role in the dessert ecosystem. At the present *Lophophora williamsi* is considered in the current Mexican national red list of threatened plants "NOM-059-SEMARNAT- 2010″ (SEMARNAT 2010).

The New health care public system in the state did not take in count efficiently the health needs and the storage of pills. Moreover, they do not cover the real problems in the population (arthritis, diabetes, depression, overweight, hypertension, gastritis and urinary ailments). In fact, many analysis related to the poverty, high cost of medicaments, shortage of supplies of medicinal products, ineffectiveness in resolving chronic diseases, low rate of education, low incomes, and people in rural conditions are more likely to be Traditional Medicine- users (Oyinlola et al. 2016). Despite the considerable reduction of traditional knowledge and its biota, the traditional medicine is flexible and adaptable to new circumstances like the migration process (Gonzalez et al. 2016).

2.5.4. Market of medicinal plants

The use of plants has been connected with the human development in different ways, it started from those edible wild plants used by food, then as medicine evolving besides a culture inside of the communities and its religious festivals and in the production of some stuffs such as paint, textiles, fibers ,candies, handicrafts, cosmetics, etc. and during this process the monetary value of the trade was given but not appreciated by the people till recently years, where the monetary value for some specific plants are threatening against the status of many plants, and their own local ecosystem, the demand of medicinal plants in the world has raised from developed countries in the current times.

A big number of farmers in developing countries which still practice subsistence farming, having found the trade of medicinal plants as a strategy to create income and provide new resources to solve familiar problems, some of them have shown how factible and profitable would be growing medicinal plants for selling in small farms, moreover the how this process worked as alternative and enhanced the local livelihood , pushed the farmers´ willingness to in exploring new crops and reduced the pressure of the local harvesting (Sher et al. 2017).

Moreover, the pressure put by the population in developing countries rely in around 90 % over the use of medicinal plants to treat and control diseases (Mendoza & Mendoza 2005), the people which is more aware and worried about the use of healthier medicine, food, aromatic oils, use of natural spices or just the globalization which introduced some new products such a tropical fruits, grains or woods coming from a far away, where the people is willing to pay more or the trade-off is more profitable for the trade on those products, that

makes the demand come up joint the prices, production and the pressure over the vegetable resources will start to push the people look for overproduction. In lot of cases the plants are not cultivated, the medicinal plants are harvested in wild way, from the nature, and there is not control over a big variety of plants in the world.

The trade of plants has been becoming in a profitable market, in different scales, global, industrial, regional and local market. Unfortunately, some companies or middle men accumulate the medicinal plants are who control the prices in the market, the new generation in the small and rural communities do not appreciate the importance of this plants and its worth. In some indigenous communities the people give a different value to the plants, in this way they do not turn a profit over the plants, they respect and considerate the plants as part of a common heritage, as part of their own and local culture.

Concerning with the conservation of medicinal plants, some studies around the world have been done about it, since to register the traditional knowledge, the effects of some medicinal plant, Identification of biota and some policies to protect the plants in danger (García et al. 2007).Studies about the management and trade of plants, and some studies to analyze the current ailments inside of the communities. The problem starts due to many species are difficult to cultivate for many reasons, biological features, ecological requirements, specific climate, interaction with other pollinators and other species, problems with the germination of seeds, biological problems to break the pill, susceptibility to fungus, pest or altitude (Sher et al. 2017) as well as it could just be because the lack of land, experience or the activity would be less profitable in a controlled conditions.

The economic aspects into the gathering and trade on plants in the region plays an important role upon familiar livelihood, how it is mainly used by the people how live in a subsistence level and low incomes. It could represent advantage as a source of supplementary income, it due that some collected plants could reach a high market value, but the collectors keep selling the plants without any transformation, losing in this way an advantage to reach another kind of market in the herbolary. it either reflects how the markets is done in the region and compare the lack of a real system in harvesting and inbreeding use of medicinal plants is showed overloaded on the wild vegetation. The understanding of the tendency market can help to enhance local incomes (Sher et al. 2014).

3. RESEARCH QUESTIONS

- What is the cultural, social, economic, environmental roles that medicinal plants currently play in Mexico?
- What therapeutic application are the most common, how are they prepared and administered?
- What is the cultural strategy for the reproduction of medicinal plants? And what is the percentage of plants grown by consumers?
- Is there any strategy of reproducing medicinal plants by the same consumers?
- What are the main health problems treated with medicinal plants in the indigenous communities?
- Is there any relationship among the traditional knowledge of medicinal plants and gender, residence or age?

4. OBJECTIVES

4.1. The main objective

The main objective of this study was the documentation of medicinal plant knowledge, identification of the most culturally important medicinal plant species and botanical families in the states of Chiapas, Veracruz and Zacatecas de Mexico.

4.2. Specific objectives

1. To create an inventory of the medicinal plants used in the different ethnics present in each state of Mexico (Chiapas, Veracruz y Zacatecas)

    -Indigenous group “Tsotsil” in the high lands of Chiapas, Mexico.

    -Indigenous group “Totonacos” in Totonacapan, Veracruz, Mexico.

    -the Zacatecan population in rural and urban areas in Zacatecas state, Mexico.

2. To analyze the most important cultural species used in each area

5. MATERIALS AND METHODS

5.1. Data collection

The fieldwork data were collected during the periods Juanary-October 2016 at three studied Mexican States (Chiapas, Veracruz and Zacatecas). Then during the next year the data were processed. All of the informants were permanent residents of the respective communities and sampling were based on the methodology with a random sampling (Bernard 2002) in the states of Zacatecas and Veracruz, and the snowball method (Andrade 2002) was applied in Chiapas, it due to various reasons, such as: insecurity, difficulties to get information in the closed indigenous groups, and the last method was carried out to increase the willingness of the locals to participate and reply the interviews, once the informants knew we were accompanied by oficials members of the community, they explained the porpoise of this project and the informants were kindly asked to participate in the interviews. It is important to mention that in the states of Chiapas and Veracruz the indigenous people in first instance seemed afraid to share the knowledge and trust in the foreigners that were asking about traditional knowledge, it could affect in some way the number of cited plants.

A semi-structured questionnaire was applied through informal and formal interviews with the local's in each studied area. The questionnaire consisted of two parts, the first focused on gathering the general socioeconomic and demographic characteristics (age, sex, level of education and activities of the informants) and the second part focused on obtaining data on ethnomedicine knowledge (obtaining of knowledge, medicinal use, dosage of medicinal plants) (Table 1).

The descripcion of the data proccces were individually divided by each studied area and are described in the follow subthemes.due to we had two different methodologies to collect the information, the comparation will be just between the states of and Zacatecas.

Several visits were done to collect the plant specimens. All plant material was collected, pressed, dried, identified and deposited (with their vouchers) in the herbariums from each state. Moreover, the botanical names were verified with the aid of The Plant List (http://www.theplantlist.org) and *Biblioteca Digital de la Medicina Tradicional Mexicana* (www.medicinatradicionalmexicana.unam.mx/index.php).

5.2. Description of the studied areas

Mexico is mega-diverse country; it contains a wide variety of vascular plants which are not explored in their totality. The country also has a high number of endemic species (7,000) (Bye et al. 1995). In the next subthems there will be an individually description about the environmental, social and economical characteristics, describing the the language used to collect the information, process and faced problems.

5.2.1. Chiapas

Geography

Due to its mountain orography, the climate in the study region is temperate and semi-warm; predominantly subhumid temperate with rain in summer, the average annual rainfall is 1402 mm, with a minimum annual temperature of 14 ^{0}C and maximum 23 ^{0}C.

Soil conditions, local agriculture and Floweristic diversity

The main economic activity is tourism, agriculture and commerce (handicrafts, clothing, shoes, etc.). The agricultural activity is based on seasonal agriculture, agricultural diversity is based on the cultivation of corn, beans, potatoes, wheat, coffee and sugar cane. The sheep breeding predominates in the region, this mainly for wool. The vegetation is mainly composed of oak (*Quercus spp*.), Cypress (*Cupressus spp*.) And pine (*Pinus spp*.). Likewise, the vegetation cover is mainly composed of secondary vegetation (coniferous forest, mesophyll of mountains and oak) and induced vegetation (PRD 2014). The edaphological characteristics of the region show its great natural richness and diversity and it has soils of different types (acrisol, pheozem, lithosol, etc.) (INEGI 2010).

Ethnic group Tsotsil in Chiapas

The study was carried out in the State Chiapas, in the V region "Alto Tsotsil-Tseltal", State of Chiapas, Mexico (Figure 1). The highlands of Chiapas has 17 municipalities.
This region is inhabited by 67 % of the indigenous population and 33 % of mestizos (INEGI 2015). The predominant ethnic groups are Tsotsil and Tseltal, who are part of the ancient Mayan culture. 68 % of the population speaks an indigenous language and the illiteracy rate

is 26 % (INEGI 2015). In the highlands of Chiapas 60 % of the population lives in localities of less than 2 500 inhabitants and they are characterized by their very high marginalization, in accordance with the standards that are applied at the national level.

Description of the fieldwork in Chiapas

The study was conducted in 16 municipalities, out of a total of 17, of the V region "Alto Tsotsil-Tseltal", State of Chiapas, Mexico (Figure 1). The work was carried out from March to October 2016. The data was obtained from 61 informants who were visited in their homes and chosen in the snowball method. It is important to mentione that the problems with the insecurity, previous problems with robbing of traditional indigeous knowledge done by foreigner companies along the past three decades in this area, affected the collection of data, in this way we were forced to change the strategy to apply the interviews, we worked together with a Local Extension Agency and the Ing. Lehovy Edward Velazquez Diaz accompanied us to apply the interviews. In each village we visited, we were accompanied by the reprentator "comisario ejidal" or person incharge to represent the group of each village, the translators were members of each village and they accompanied us to visit the recommended people given by the first person accepted to answer the interview. Firstly, the consent for the application of the interview was asked and after that it the semi-structured questionnaire applied.

A total of 47 interviews were applied together with a translator of tsotsil language and 14 were in Spanish, the information was recorded in Spanish, only in some cases the vernacular name of the plants were noted with the indigenous name. Each interview lasted about 25 minnutes on average. For the application of the interviews, two translators of the local language (Tsotsil) were used. All informants interviewed were permanent residents of the municipalities under study (Figure 1), given that this was a requirement for inclusion in the sample.

For the identification of the medicinal species, samples of plants were collected, dried, pressed and taxonomically identified with periodic visits to different botanical gardens and to the herbarium of the South Frontier School (San Cristóbal de las Casas, Chiapas).

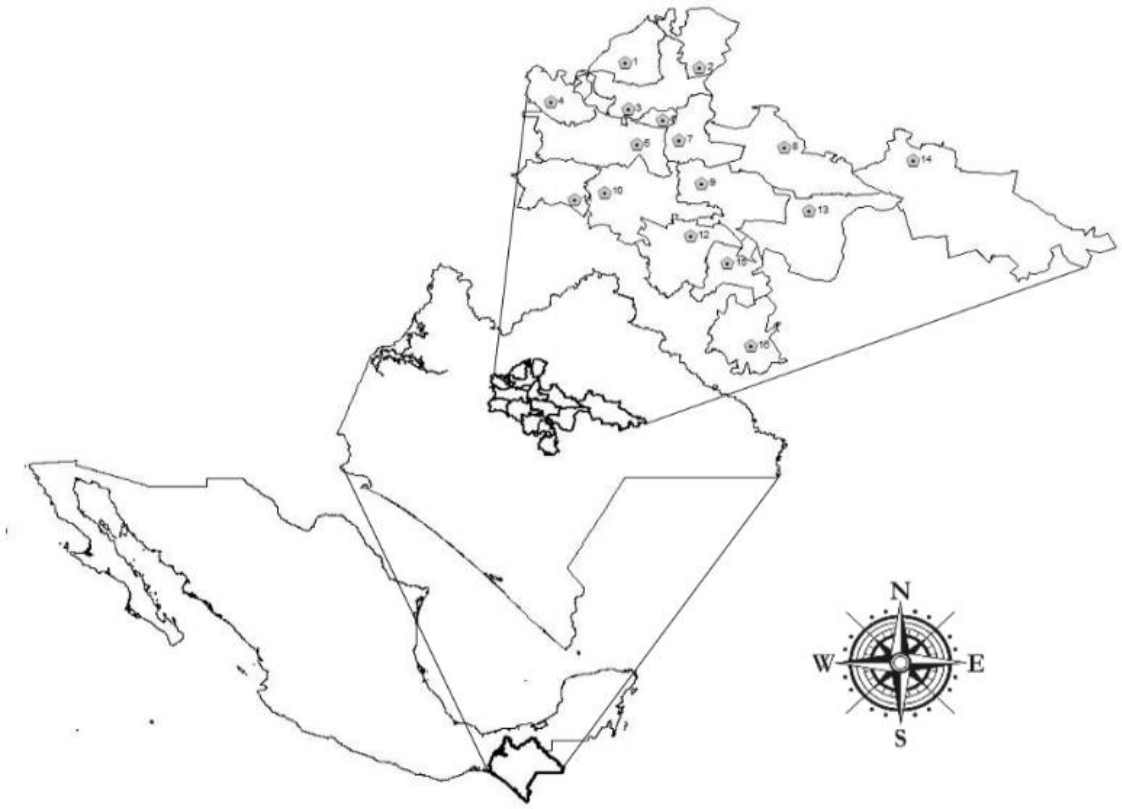

Figure 1. Study area: Chiapas Highlands "Region V"

5.2.2. Veracruz

Geography

The study area Totonacapan is located in the northern part of Veracruz, with an area of 4 300 km^2. This region represents some 5.97 % of the total area of the state of Veracruz. It has 15 municipalities and it's geographically known as Totonacapan. It is a part of the Northern Gulf Coastal Plain. The study area belongs to the municipality of Papantla known as Papanteca with coordinates 20° 27′ 39″ and 97° 19′ 39″, West and it lies at 180 m above sea level. It has an area of 1 458 km^2, representing 2.03 % of the state.

Geographically, the Totonacapan region is in northern Veracruz and it is part of the province of the Northern Gulf Coastal Plain, in the physiographic subprovince called "plains and low hills" due to the carved valleys and rivers running through it. The climate is humid-warm with an average annual temperature between 22 and 26 ° C.

Soil conditions, local agriculture and Floweristic diversity

The annual rainfall in the area varies between 1 000 and 1 500 mm per year. Totonacapan vegetation is, in most of its areas, humid warm and it has been recognized by various authors as median evergreen forest. Its soil is feozem type regosol and vertisol, whose main characteristics are their location in areas with temperate rain forest or acidity and the susceptibility to erosion. Concerning the Totonacapab surface, the 68 % of the municipal territory is devoted to agriculture, 11 % for livestock, 13 % to housing, trade 4 % and the remaining 4 % is earmarked for offices and public spaces.

The total population in the Totonacapan is 622 846 inhabitants, of which 204 934 people form the economically active population, which is the 32.9 % of its population. It is remarkable the fact that 32.5 % of totonacan people are involved in the primary sector (farming, agriculture, fisheries and forestry), and that 65 974 people in Papantla live in indigenous households.

Ethnic group Totonacas in Papantla, Veracruz.

Some 68 % of the municipal territory is devoted to agriculture, 11 % to livestock, 13 % to housing, the remaining 8 % are occupied by trade, public offices, and public spaces. The total population in the Totonacapan amounts to 622 846 inhabitants, of which 204 934 people form the economically active population (32.9 %). Nevertheless, it should be noted that 32.5 % of Totonac's population work in the primary sector (agriculture, fisheries, and forestry), and around 66000 people in Papantla have indigenous roots. According to Rivera and Ramírez (Rivera & Ruiz-Ramírez 2014), 77 of the 212 municipalities in the state have moderate poverty.

The ethnic composition of Veracruz is quite diverse, unique, and complex. Veracruz is the third state with a high number of indigenous people (1 037 424) in México (CDI: National Commission for the Development of Indigenous Peoples) (INEGI 2010) . The state is divided into seven ethnic regions and ethnic linguistic groups are located in the state of Veracruz. These groups still speak 14 different languages (Huasteco (Tenek), Popoluca, Mixe, Zoque, Chinanteco, Zapoteco, Mazateco, Mixteco, Otomí, Totonaca, Tepehua, Náhuatl from the Huasteca, Náhuatl from the Sierra de Zongolica, and Nahua from the south). The most

representative groups are Mazatecos, Totonacos, and Zapotecos (Rivera & Ruiz-Ramírez 2014) .

Totonacos group lives in the Papantla city and surround areas, the tourism in this area helps them to sale the handcrafts, more over the performance of the sky dancers (Papantla flayers), and shamans are the main reason for the tourism from whole Mexican territory. Is also remarkably has the high number of tourists who travels from different parts of the country to visit the shamans and buy the medicinal plants. All the high density is observed due to tourism sector in Papantla city and the ruins. The agriculture, livestock, forestry, traditional textile clothes, plants, fruits, practicing of traditional medicine, and informal employment are the base of the local economy. The corn, beans, coffee, vanilla, banana, citron, and orange are the main crops produced in the region (Burgos-Hernández et al. 2014; Srithi et al. 2009). Previous studies done in neighbor municipalities (Burgos-Hernández et al. 2014) show the number of farmers depending on the farm products, and talk about migration and lack of good opportunities cause a loss of interests to preserve the traditional knowledge in the new generation. The study area is highly interesting and represents a special combination of different factors to study the patterns of traditional medicine.

Description of the fieldwork in Veracruz

Fieldwork was carried out from May to June of 2017 in 16 communities (Adolfo López, Arroyo Grande, Carrizal, Cedros, Lahuas, Natividad, Panti, Papantla, Polutla, Poza Rica, Pozo Fresh, San Antonio Xital, Veracruz, Spoupat, Volador, and Zapotal)(Figure 2). Before initiating the survey, ethical approval for the study was obtained from the indigenous organized group “Consejo de Ancianos de la Sabiduria Ancestrat” likewise the president of indigenous Miss María Luisa Santes Santes supported and accompanied the visits to the interviewed people and explained the investigation purpose. . Ethnobotanical information was collected from local inhabitants by using semi-structured questionnaires. A total of 85 informants were selected by random sampling in the different villages. A total of 43 interviews were applied in Totonac language with the help of two local translators and 42 interviews in Spanish, information was recorded in Spanish.The participant observation was also part of the interview to have a better interpretation and analysis of the data reported by informants.On average each interview lasted 20 minuts.

The informants were asked to provide the knowledge about the plants uses (local names, indication of use, used plant parts, places/methods/rituals of harvesting, and administration mode). Many visits were done in order to collect, press, and identify the medicinal plants. The plant material was collected by the authors and taxonomically identified in the Herbarium of Universiy of the state Veracruz, and in cooperation of the indigenous organized group "Consejo de Ancianos de la Sabiduria Ancestrat".

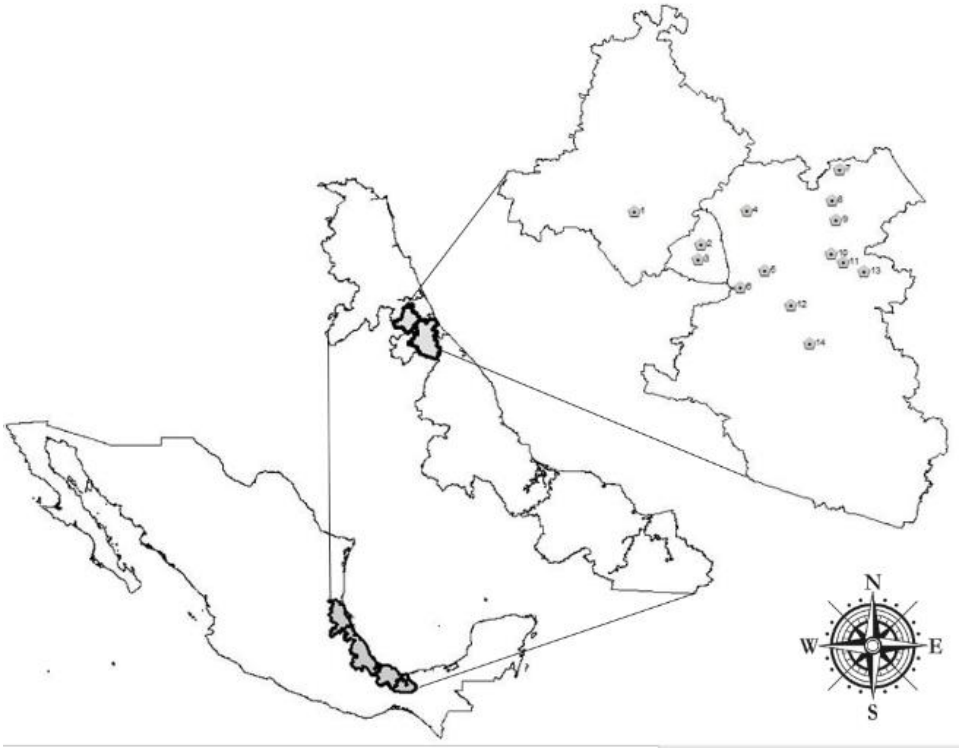

Figure 2. Study area: Totonacapan Veracruz

5.2.3. Zacatecas

Geography

Zacatecas is a landlocked state located in the north central region of Mexico and borders the states of Durango, Coahuila and Nuevo Leon to the north and Aguascalientes, Guanajuato and Jalisco to the south. The study area belongs to the Sierra Madre Occidental mountain range, Mesa del Centro and Eje Neovolcanico. The state is somewhat mountainous, being traversed in the west by lateral ranges of the Sierra Madre Occidental, with an average elevation of about 2 300 m.a.s.l.

Soil conditions, local agriculture and Floweristic diversity

Agricultural production is seasonal and irrigation is limited due to low precipitation in Zacatecas. The climate is characterized by dry and semi-dry (dry 73 %, temperate 17 %, very dry 6 % and warm sub-humid 4 %). The average annual temperature is 17 ºC. Average annual precipitation is approximately 510 mm (INEGI 2016; Gonzales-Trinidad et al. 2017).

Socio-economic description of the Zacatecan Population

The state of Zacatecas is divided into 58 municipalities. The majority of the population of Zacatecas state is concentrated in urban areas (59 % urban, 41 % rural). The main industries are tourism (47.2 %), mining and manufacturing (45.4 %), and agriculture (7.5 %). The number of inhabitants is 1 579 209 and the average life expectancy is 75 years. The percentage of the population in moderate to extreme poverty is 52.3 % (Salas-Luevano et al. 2016; INEGI 2016).

Small herbal stores and a variety of indigenous and introduced exotic plants are commonly found throughout the state. Hospitals and medical services are not readily available outside of urban areas and there is a shortage of specialists, clinics, and medicine in these remote areas (Geck et al. 2016).

Description of the fieldwork in Zacatecas

The fieldwork was carried out from January to October 2016 in 40 communities in the state of Zacatecas (12 urban and 28 rural) (Figure 3). All of the informants were permanent residents of the respective communities and sampling was based on the random method (Bernard 2002). Informants were asked for permission to participate in the study and were asked for the ethical approval of this research. After receiving oral informed consent, interview composed of general demographic and ethnobotanical parts was conducted. A total of 132 interviews were conducted and recorded in Spanish .A Demographic characteristics are presented in Table 6. The ethnobotanical information included: sources of traditional knowledge, uses of the plants, mode of administration, plant parts harvested and dosage for each remedy. The interview included open discussion about the status of traditional knowledge and the perception of current trends among the populations. Several visits were done to collect the plants in cooperation with the Department of Agronomy and the

Herbarium of the Autonomous University of Zacatecas. The voucher specimens were deposited in the aforementioned herbarium (SNIB-CONABIO).

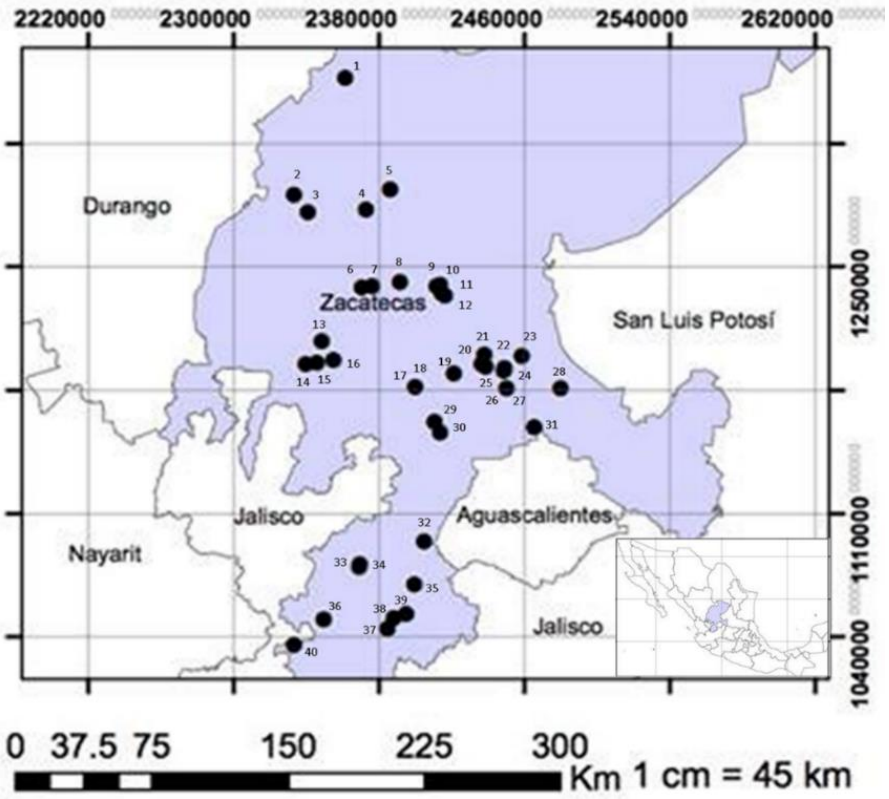

Figure 3. Study area: Zacatecas (1.Juan Aldama, 2.Loma de cruz, 3.Tapias de Sana Cruz, 4.Nuevo Sain Alto, 5.Cazaderos, 6.Refugio abrego, 7.Emiliano Zapata, 8.El Salto, 9.Fresnillo, 10.El Verguel, 11.San Rafael, 12.San Elena, 13.San Mateo, 14.Santa Potencia, 15.Valparaiso, 16.Mala noche, 17.Leobardo Reynoso, 18.El Capulin, 19.San Miguel, 20.San José, 21.Hacienda Nueva, 22.Zacatecas, 23.6 de Enero, 24.Guadalupe, 25.Sauceda de la Borda, 26.Tacoaleche, 27.San Jeronimo, 28.Pozo de Jarillas, 29.Cuenca Lechera, 30.Coyotes, 31.Cosio, 32.Tabasco, 33.Santa Ana, 34.Tlaltenango, 35.Jalpa, 36.Ortega, 37.Juchipila, 38.Palma Cuata, 39.Apozol, 40.Milpillas)

5.3. Traditional ethnobotanical knowledge

Plant uses were categorized according to Economic Botany Data Collection Standard (Cook 1995). For each species the following ethnobotanical elements were tabulated: botanical family, scientific name, vernacular name, plan part used, ailments, state of plant material, preparation mode and ethnomedicinal indices.

5.4. Quantitative Data Analysis (ethnomedicinal indices)

Each index specifically evaluates different parameters of the plants (accuracy of use, relative and cultural importance). The indices are calculated from the responses and degree of consensus among informants, and they set statistically different parameters that evaluate the knowledge, tendency and serve as qualitative reference.

At first, the medical information cited by the infomants was converted into uses report (UR) (Kufer et al. 2005). UR can be defined as the times that an informant mentioned the uses of a plants for the treatment of an ailment category (Chellapandian et al. 2012). Each given use was counted and tabulated in the ailments category. The informants cited in some cases in average seven plants and every plant had different treatments, uses, modes of administration, and the were considered for several categories, in this case one informant could give about many use reports. The data was then tabulated, and analyzed with the following quantitative ethnobotanical indices.

All the ailments described by the informants were organized in 14 main categories, based on the International Classification of Diseases used by the World Health Organization (ICD 2007). In rituals, spiritual and aromatic uses were added in a different group call “Rituals”. The study was aimed to organize the informant reported to give a right representation in the overall data, for example if an informant cited a plant that is used for stomachache and cholitis, they both ailments were counted as two UR, and summed to the corresponsal ailment category.

5.4.1. Relative Frequency of Citation (RFC)

Quantitative index Relative Frequency of Citation (RFC) was calculated to assess the local importance of particular plant species:

$$RFC_s = \frac{FC_s}{N} = \frac{\sum_{i=i_1}^{i_N} UR_i}{N} (0 < RFC < 1)$$

This index is representing the frequency of plant citations (FC, the number of informants mentioning the use of the species) divided by the total number of informants participating in the survey (N), without considering the use-categories (Bibi et al. 2015).

5.4.2. Cultural Importance Index (CI)

The cultural importance index (Reyes-García et al. 2006), reflects a measure of relative importance per plant use. This index considers not only the spread of the use (number of informants) for each species, but also its versatility, i.e., the diversity of its uses. The index is calculated by the following formula:

$$CI_s = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} UR_{ui}{}_{/N}$$

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

5.4.3. Family importance value index (FIV)

This index demonstrates the cultural significance of particular botanical families in the ethnobotanical context (Vitalini et al. 2013). It reflects the proportion of informants citing a particular family with respect to the total number of informants:

$$FIV = \frac{FC(Family)}{N} \; X \; 100$$

Where, FC is the number of informants mentioning the family while N is the total number of informants participating in the study.

5.4.4. Informant consensus factor (ICF)

Informant consensus factor (ICF) shows whether or not there is agreement among informants in the use of plant species in particular ailment categories (Heinrich et al. 1998):

$$ICF = \frac{n_{ur} - \quad n_t}{n_{ur} - \quad 1}$$

Where n_{ur} is the number of use reports for a particular ailment category, and n_t is the number of species used for that ailment category by all the informants. The range of the index is between 0 and 1, a higher number (close to 1) will reflect an agreement regarding which plants are used among the informants to cure a particular ailment category (Gazzaneo et al. 2005).

5.5. Statistical analysis

The statistical method will be linear regression for data analysis. After the constructs have been developed, regression analysis is used to test the established hypotheses. This statistical method will be briefly described.

5.5.1. Linear regression

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data. One variable is considered to be an explanatory variable, and the other is considered to be a dependent variable. For example, a modeler might want to relate the weights of individuals to their heights using a linear regression model.

Before attempting to fit a linear model to observed data, a modeler should first determine whether or not there is a relationship between the variables of interest. This does not necessarily imply that one variable causes the other (for example, higher SAT scores do not cause higher college grades), but that there is some significant association between the two variables (Peng & Luo, 2000; Musteen et al. 2010). A scatterplot can be a helpful tool in determining the strength of the relationship between two variables. If there appears to be no association between the proposed explanatory and dependent variables (i.e., the scatterplot does not indicate any increasing or decreasing trends), then fitting a linear regression model

to the data probably will not provide a useful model. A valuable numerical measure of association between two variables is the correlation coefficient, which is a value between -1 and 1 indicating the strength of the association of the observed data for the two variables.

A linear regression line has an equation of the form $Y = a + bX$, where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when $x = 0$).

6. RESULTS

6.1. Chiapas

6.1.1. Socio-economic data

Data were collected from 61 informants (61 % men, 39 % women) between 20 and 86 years old. The informants were categorized into 5 age groups (Table 1). The majority of respondents (34 %) were young people between 20-30 years of age (Table 1). The group that recorded a higher average of plants was 41-50 years old (48 plants described), followed by the group of young people between 20-30 years old (41 plants described). The informants cited an average of 8 plants. About 85 % of actively use medicinal plants for the treatment of diseases, the rest only consumed sporadically. Women resorted more frequently to medicinal plants.

The treatment of diseases with traditional medicine, which includes the use of medicinal plants, is considered by the informants as part of their family and cultural tradition, this was expressed by 55 % of the informants of all age categories, while about 45 % consider it as a strategy to lower costs, 27 % is to pay for the treatment of their diseases and 18 % value it for its effectiveness against diseases.

The promotion of traditional knowledge is given through the family (84 %), the community (11 %) and specialists (5 %). The men of rural communities in general cited on average two plants more than their counterparts in urban areas, expressing relatively that they are the main connoisseurs of traditional uses in the area studied, and in the urban area were the academics (students and teachers). The visit to the specialists (herbalists) is relatively low, and only 24 % of the informants visit regularly.

Table 1. Socio- demographic characteristics of the 61 informants in Chiapas Highlands.

Demographic vairables	Demographic category	No. informants	%	Mean number of plant species cited
Gender	Woman	37	61	6.2
	Man	24	39	5.5
Age	20-30	21	34	5.8
	31-40	11	18	5.8
	41-50	13	21	4.3
	51-60	6	10	8.2
	+61	11	18	17.5
Residence	Rural	39	63	6.6
	Sub-urban	23	37	5.6
Activity	House wife	15	24	4.3
	Farmer	24	39	4.7
	Public workers	5	8	7.8
	Merchants	4	7	11.3
	Students and profesors	3	5	12.3
	Midwife	1	2	19
	Others	7	12	4.7
Public health insurance	Insured	40	66	4
	Uninsured	21	34	6

6.1.2. Diversity of medicinal plant species and their cultural importance

The results indicate that the inhabitants of the region of the high lands of Chiapas use 59 species of medicinal plants belonging to 55 genera and 39 botanical families, for the treatment of diseases in traditional medicine (Appendix 4).

The Asteraceae family was the most cited, with 6 species (UR = 51). The medicinal species with the highest cultural index were: *Matricaria chamomilla* (CI = 0.42), *Mentha sativa* (CI = 0.36) and *Ruta graveolens* (CI = 0.31), Table 2.

6.1.3. Method of preparation, administration and parts of used plants

The leaves (51 %) were the most commonly used parts, followed by stems (20 %) and the whole plant (10 %) (Figure 4). 76 % of medicinal species are used fresh.

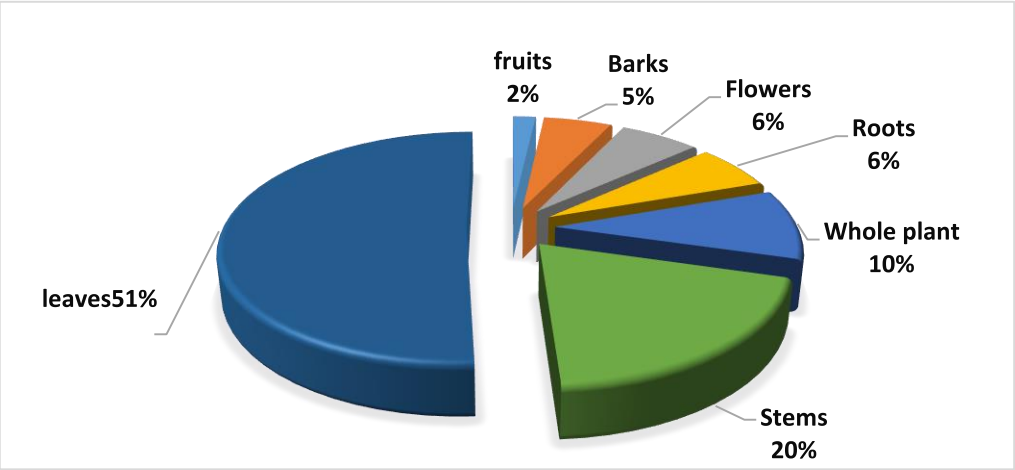

Figure 4. Used parts of the plants for the elaboration of traditional remedies in Chiapas Highlands

The method to prepare the traditional remedies was mainly through infusion and cooking (70.5 %), crushed (8.4 %), baths (5.3 %), latex or juice extraction (5.3 %), figure 5. Skin wounds and dermatological problems (pimples on the skin) were treated by baths and cataplasms in topical form.

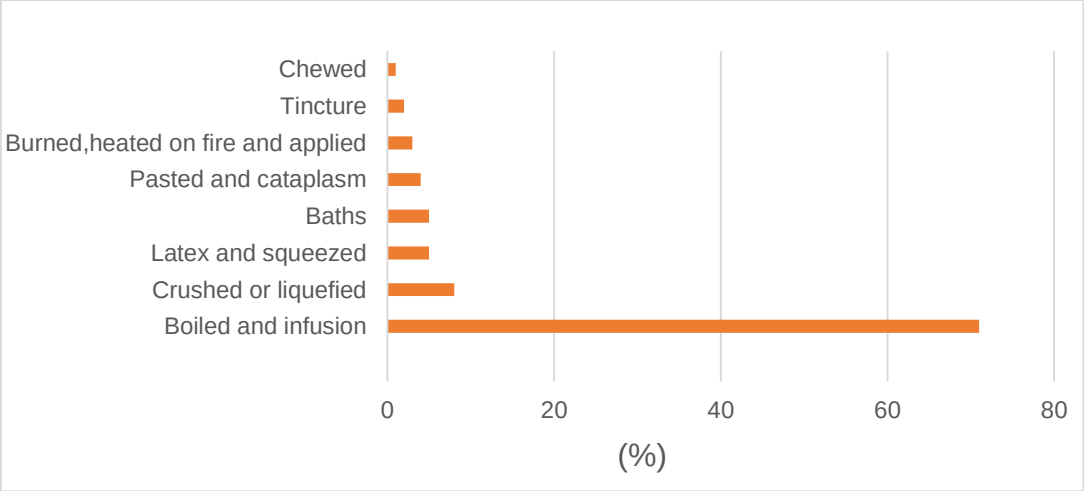

Figure 5. Preparation mode of medicinal species in traditional medicine in Chiapas Highlands

Informants for the use of medicinal plants, collect medicinal plants from wild areas and plains (46 %), buy in local markets (41 %) and grow it (13 %).

6.1.4. Consensus on the categories of diseases

A total of 47 human diseases were divided into 13 categories according to the International Classification of Diseases used by the World Health Organization (ICD 2017), Table 2. The category of the most common diseases with the highest ICF index were those related to the reproductive system (colic pains and prostate pain) with the highest CRF value (0.80); respiratory rate (0.75) and diseases of the digestive system (ICF = 0.70), Table 2.

According to the informants, there is also a high prevalence in the cardiovascular categories (CIF = 0.69) which usually manifests along with other diseases and triggers problems in the other chronic degenerative and autoimmune categories (each 0.67), this is because poor circulation increases the risk of developing diabetes, high blood pressure. On the other hand, the informants claimed to have relatives with rheumatic problems.

This index represents an agreement between the use that informants give to plants and the level of efficacy against the specific diseases treated. If the category has a high consensus value, this means, good management and mastery of traditional knowledge for the treatment of a certain disease. In this region women use more traditional knowledge to treat reproductive problems and men in general for the use and control of gastrointestinal disorders, while both genders resort to plants in the same way to treat respiratory problems.

Table 2. Number and percent of Use Reports (URs) and Important Consensus Factor (ICF) of the Mexican plant species for each ailment category in Chiapas Highlands

No.	Ailment category	No. of species	No. of UR	% of UR	ICF
1	Diseases of the reproductive system	3	11	3.94	0.80
2	Diseases of the respiratory system	15	56	20.07	0.75
3	Diseases of the digestive and gastrointestinal system	30	98	35.13	0.70
4	Diseases of the Cardiovascular system.	9	27	9.68	0,69
5	Diseases chronic–Degenerative	4	10	3.58	0.67
6	Autoimmune diseases	2	4	1.43	0.67
7	Diseases of the musculoskeletal	6	15	5.38	0.64
8	General symptoms and problems	13	34	12.19	0.64
9	Diseases of the nervous system.	2	3	1.08	0.50
10	Diseases of the urinary tract system	4	7	2.51	0.50
11	Diseases of the skin	8	11	3.94	0.30
12	Antidotes	2	2	0.72	0.00
13	Rituals	1	1	0.36	0.00

6.1.5. Significance of the families of medicinal plants in the region

The most common botanical family according to the FIV, was the Asteraceae with an FIV = 86.44 (51 RU), followed by the Laminaceae with an FIV = 62.71 (37 RU), Lauraceae with an FIV = 38.98 (23 RU), Chenopodiaceae with an FIV = 33.90 (20 RU), and the families of Poaceae and Rutaceae obtained an FIV = 10.51 (UR = 18) respectively.

6.1.6. Relationship of botanical families and Category of ailments

Figure 6 shows the 10 main botanical families and their common uses to treat the problems. The families Asteraceae, Laminaceae and Chenopodiaceae present a greater spectrum against gastrointestinal problems, while the families Laminaceae, Lauraceae and Poaceae are used for respiratory problems.

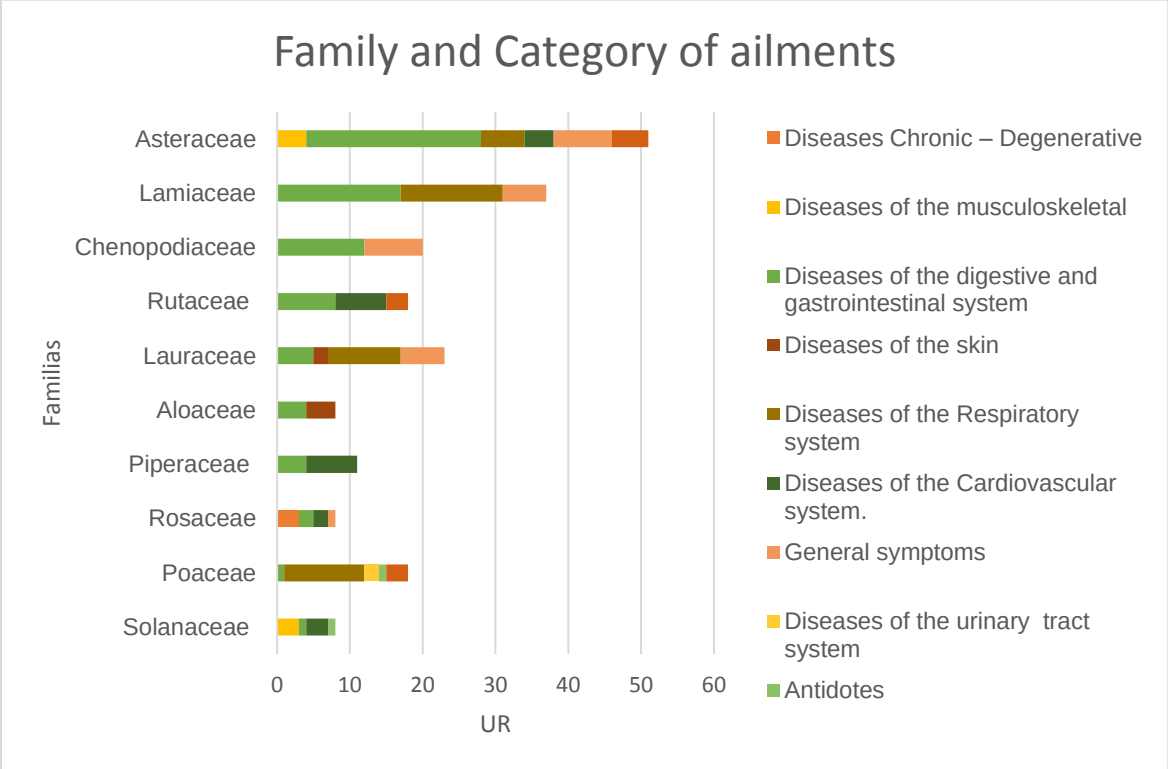

Figure 6. - Administration of plant use by family and disease category in Chiapas Highlands

6.2. Veracruz

6.2.1. Characteristics of participants

The table 3 provides the socio-demographic information as gender, residence, occupation, and annual expenditure in plants of 85 interviewed indigenous people of which 40 women (47 %) and 45 men (53 %). The age of informants varied from 19 to 85 years and they mainly live in urban area (69 %). The most of informants ranged from 51 to 60 years (24 %), whereas only two informants are less than 20 years. The informants are mainly workers (47 %) and housewives (25 %). But also farmers (11 %), sellers (5 %), and teachers (2 %) were interviewed; the rest of informants (11 %) have another occupation.

Table 3. Socio-demographic characteristics of 85 informants in Veracruz

Background characteristic		**No**	**%**	**Mean number of plant species cited**	**Annual expenditure (Mexican pesos, $)**
Gender	Female	40	47	15.7	174
	Male	45	53	13.8	200
Age	20–30	15	17	10.9	233
	31–40	12	14	15.75	183
	41–50	16	19	16.2	173
	51–60	20	24	13.9	210
	61–70	14	17	16.8	120
	71–85	8	9	18.2	225
Residence	Rural	26	31	19	160
	Urban	59	69	12.8	200
Occupation	Farmer	9	11	18.2	114
	Housewife	21	25	15.3	210
	Seller	4	5	16.7	50
	Teacher	2	2	21.5	200
	Worker	40	47	14.2	181
	Other	9	10	8	222
Public health insurance	Insured	45	58	12.9	159
	Uninsured	36	42	17.3	204

6.2.2. Relation between age, expenditure, and use of plants

People from 70 to 85 years (9 %) showed to have a higher knowledge in plants (17 plants) and women on average cited two more plants and spend more money (17 plants, expenditure: $200) than the male counterpart (15 plants, exp.: $176). The tendency of the informants

regarding the knowledge and the expenditure of plants seems to be proportionally opposite. Young people know only fewer plants but they spent more money to buy them, whereas the expenditure spent in plants by old people is lower, it could be due to the knowledge and identification of the used plants.

The origin of the traditional knowledge was given by the family (87 %) and the specialist "shamans" (13 %). More than half of the informants (58 %) claimed to perceive a decrease (medium and high loss) in the traditional knowledge during their youth, the rest (42 %) did not perceive some alarming decrease. The keepers of the traditional knowledge were found to be the teachers (average of 22 plants), followed by farmers (18 plants), and housewives (15 plants). The main reason why teachers have higher knowledge about plants is because they work with children of different ethnic groups and they are promoting the recording of ancestral knowledge in the primary schools. They have assumed responsibility for the conservation of this traditional knowledge.

Housewives spent more money for plants than compared to other occupations ($228 annual), the lowest expenditure was observed by the sellers ($66 annual). The expenditure in plants along the year is equivalent to 2 days of work for the farmers. It does not represent so much but the real value that the plants have in the family go beyond than some profitable or tangible resource.

Almost half part of the informants does not have public health insurance (42 %), even if they can obtain a governmental public insurance for free.These informants without insurance cited on average a higher number of medicinal plants (17 plants) compared with the insured people (13 plant). Seventy-eight (92 %) of informants are actively using medicinal plants in their dairy life, but 70 out of them (82 %) recurs to the plants in first instance to treat their ailments. Nevertheless, there are just 16 % (14 people) going to the specialist. The informants obtain the plants mostly from wild gathering (37 %), market (35 %), and familiar gardens (28 %). Some informants (29 %) expressed they do not have any expenditure in buying plants since they know the surrounded areas where they can find them. The informants (38 %) emphasized positively the usage of medicinal plants as part of their cultural uses (38 %), and they consider them as an effective and cheap resource (35 %) since their childhood to treat human disorders.

6.2.3. Treatment used to manage infection diseases

A total of 102 medicinal plants belonging to 52 families and 94 genera were recorded (Appendix 2). The study was carried out due to indigenous people of 14 communities in the Totonac area of Papantla, Veracruz. Results of the UR of each plant species were reported in table 2. Asteraceae (111 UR) and Rutaceae (99 UR) families have the highest number of species with eight plants each one, followed by Fabaceae (25 UR) with six plants, Euphorbaceae (38 UR), Malvaceae (45 UR), and Myrtaceae (41 UR) with fours each one. Lamiaceae (three plants, 60 UR), Piperaceae (three plants, 34 UR), and Poaceae (three plants, 33 UR).

The most common plant parts used by the informants to prepare the medicinal remedies were the leaves (55 %), followed by roots (12 %), bark (9 %), fruits (7 %), stems (6 %), whole plant (4 %), seed (3 %), latex (2 %), and flowers (2 %) (Figure 7). The plants are usually consumed fresh (83 %).

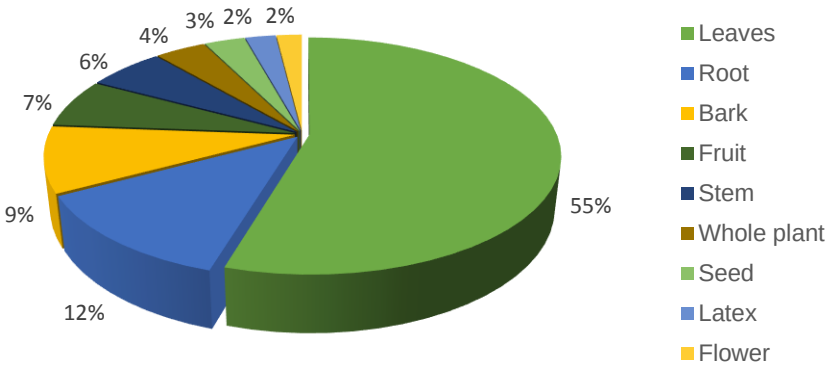

Figure 7. Used parts of the plants for the elaboration of traditional remedies in Veracruz

6.2.4. Herbal/botanical remedies

Two main routes of administration were reported: oral (72 %) and topical (28 %) administration. Herbal remedies were prepared in the form of decoctions (38 %) and infusions (29 %), but raw plant material (11 %) is eaten to combat gastric problems or used for injuries, cuts, bruises, or local pain (e.g., tooth pain). Some herbal parts were used also for the rituals (bad wind and evil eye). Bath and cataplasm (7 %) were applied to treat skin disorders such as chicken pox, grans, fungus herpes, or clean wounds; liquefied, crushed, smashed (5 %) remedies were used mainly to extract the latex from the plants and treat

herpes, wounds, bleeding of gums, and some inflammations; squeezed (4 %), tincture, microdosis (3 %), and burned (2 %) remedies were used to treat rheumatism, pain in the ears, wounds and it was used as part of the therapy to burn the leaves and apply them over the chest to promote the breastfeeding in the women's body, and fermented (2 %) (Figure 8).

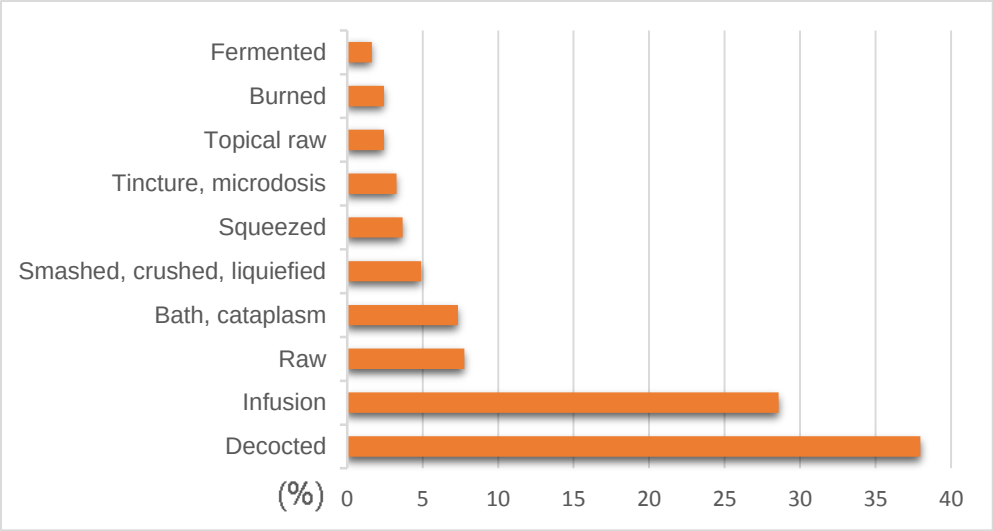

Figure 8 Preparation modeof medicinal species in traditional medicine inVeracruz

6.2.5. Quantitative ethnobotany

A total of 77 ailments were grouped into 14 categories according to World Health Organization (2013) (Table 4), the ICF values related aspects are associated with the ailments categorized, the ICF values in our study vary from 0.91 to 0.75, the highest ICF was calculated for the autoimmune diseases (ICF = 0.91) with an unique ailment of cancer, it was followed by diseases of the urinary tract system (ICF = 0.86) to combat mostly the stones in the kidneys, diseases of the nervous; antidotes are in third place (ICF = 0.85 each one) treating problems of anxiety, spasms, and bites of insects and snakes. The most cited categories were the diseases of the digestive and gastrointestinal system (251 UR), it showed the broadest spectrum with 47 species was used against diarrhea, anemia, and stomachache, with overall consensus relatively high (ICF = 0.82), followed by chronic–degenerative diseases, respectively (UR = 137, ICF = 0.83) with the unique problem of diabetes. It is important to remark the high prevalence of problems with tooth pain and bleeding gums by the informants presented in the area, which was grouped in the group of general symptoms

(UR = 127, ICF = 0.80), moreover, the prevalence of chinkungunya (UR = 4) and dengue (UR = 1) was grouped in the same category.

Table 4. Number and percent of Use Reports (URs) and Important Consensus Factor (ICF) of the Mexican plant species for each ailment category inVeracruz

No	Ailment category	No. of species	No. of UR	% of UR	ICF
1	Autoimmune diseases	5	44	4	0.91
2	Diseases of the urinary tract system	18	119	10	0.86
3	Diseases of the nervous system.	5	28	2	0.85
4	Antidotes	3	14	1	0.85
5	Diseases of the respiratory system	18	107	9	0.84
6	Diseases chronic–Degenerative	24	137	11	0.83
7	Diseases of the digestive and gastrointestinal system	47	251	20	0.82
8	Diseases of the musculoskeletal	7	33	3	0.81
9	General symptoms and problems	26	127	10	0.80
10	Diseases of the reproductive system	25	121	10	0.80
11	Aromatization and rituals and spiritual	7	31	3	0.80
12	Diseases of the Cardiovascular system.	23	104	8	0.79
13	Injury	10	40	3	0.77
14	Diseases of the skin	18	70	6	0.75

Regarding the cultural importance (see Table 5), *Hamelia patens* Jacq. obtained the highest IC = 0.91 (77 UR). This species presented the widest spectrum to treat problems related with the diabetes (UR = 18), gastritis, colitis, and ulcers (UR = 17), cancer (UR = 9), high pressure and blood circulation (UR = 8), respiratory problems (UR = 7), anemia (UR = 3), breastfeeding (UR = 6), menstruation (UR = 2), skin disorders and wounds (UR = 7). *Persea americana* Mill was ranked in the second place with IC = 0.68 (58 UR) and used to treat gastric problems with UR of 48, abortive (UR = 5), kidney problem (UR = 3), and nausea (UR = 2). In third place, *Bursera simaruba* (L.) Sarg. has CI = 0.53 with 45 UR to treat the fever. *Matriarcaria chamomilla* L. (IC = 0.40, 34 UR) was cited to treat colic pain (UR = 16), stomachache (UR = 14), and eyes problems (UR = 4). The rest of the families resulted with number below 0.39 (IC).

In the figure 9, a total of 52 families are in common use and the five most relevant families contribute to the medicinal flora used by the Totonac descendants. We can find Astereaceae

(47 UR), Rutaceae (39 UR), Rubiaceae (30 UR), Lauraceae (60 UR), and Lamiaceae (42 UR) are used commonly and mostly for digestive problems (Appendix 5).

Chronic and degenerative problems are mostly treated with Asteraceae (28 UR), Rubiaceae (28 UR), and Meliaceae (26 UR); the respiratory problems are treated majority with Rutaceae (24 UR) and Myrtaceae (20 UR). Burseraceae family (45 UR) presented the highest spectrum to treat general symptoms. The antidotes were represented mainly for two families (Apocynaceae with 13 UR; Amaryllidaceae with 1 UR). The rituals were represented by Malvaceaes (20 UR).

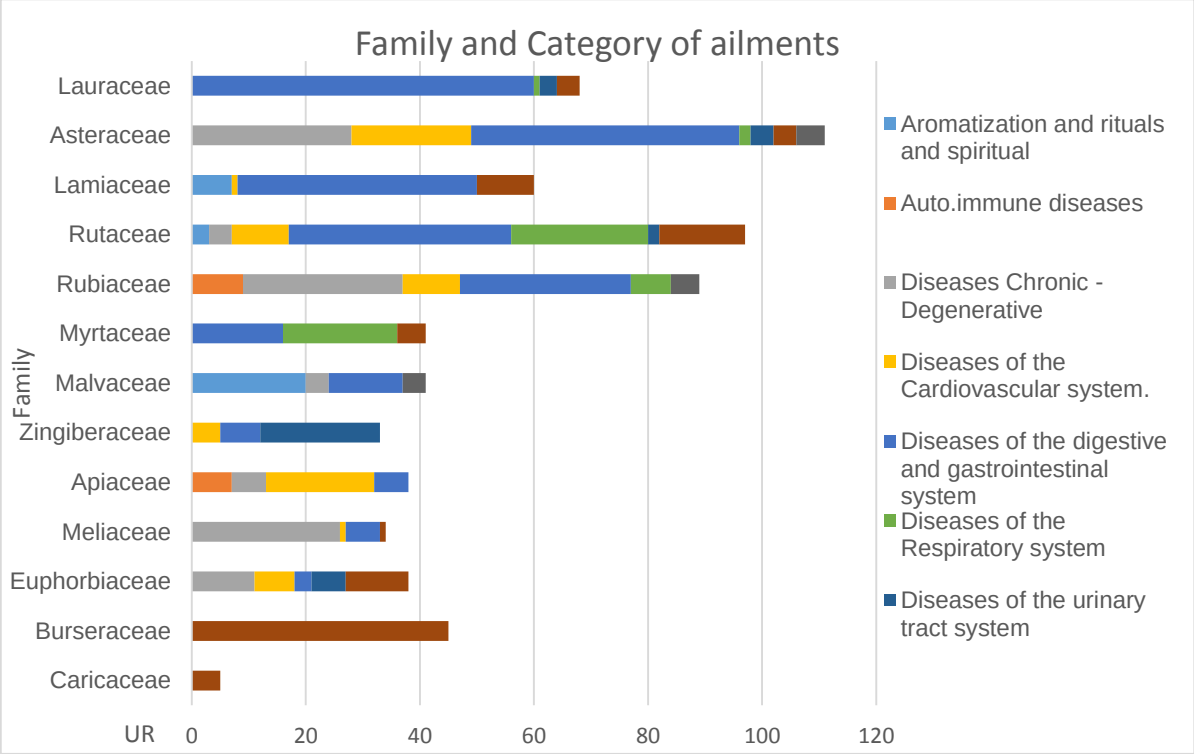

Figure 9. Administration of plant use by family and disease category in Veracruz.

6.2.6. Zootheraphy and other therapies

The use of therapeutics obtained or derived from animals to treat human diseases is the zootherapy. In the table 5, several animals are often consumed to treat some ailments by the locals, the animal mainly consumed was the buzzard (26 UR) with the highest CI = 0.23, this animal is known among the people as it helps to treat people with problems such as cancer (20 UR), followed by the skunk to treat problems of bronchitis and cough (5 UR) and diabetes

(3 UR) and the rest of animals are mainly used to combat problems such as cancer, rheumatism, and cough (viper, tuza, and terrapin).

These rituals are accompanied with modern medicine, some rituals are accompanied with the shamans and with a change in the diet.

Table 5. Zootheraphy uses in Totonac area

No	Common name	Scientific name	Used part	Ailment	Cita-tion	Cita-tion/ species	CI
1	Abeja (bee)	Anthopila	Bite	Rheumatism	1	1	0.01
2	Tlacuache	Didelphimorphia	Fat (soup)	Coff	3	3	0.03
3	Cucaracha	Blattodea	Whole(burned, crushed and applied)	Infection	3	3	0.03
4	Garlapago (turttle)	Kinosternon herrerai	Blood and meat (Burned)	Asthma	4	12	0.05
				Bronchitis	8		
5	Sapo barrigon (Frog)	Incilius nebulifer	Brushed	Rehumatism	1	1	0.01
6	Tejon	Nasua narica	Meat	Body strength	3	5	0.03
				Rehumatism	2		
7	Tuzita, insect	Not identified	The jaw	Take out the Spines	1	1	0.01
8	Tuza	Thomomys umbrinus		Rehumatism	4	4	0.05
9	Vivora de cascabel	Crotalus	Meat	Cancer	6	9	0.05
10	Zopilote	Cathartes aura	Meat	Cancer	20	26	0.23
				Rage	1		
				Liver problems	2		
				Cholesterol	3		
12	Zorrillo	Mephitis macroura	Meat and fat	Coff, bronchitis	5	9	0.06
				Bronchitis	3		
			Fat(applied)	Skin problems	1		
			Blood	Diabetes	3		

6.3. Zacatecas

6.3.1. The popularity of herbal medicine among the studied communities

A total of 132 informants between the ages of 20-86 years (mean age=49) participated in the study. Despite the high percentage of people holding health insurance (Table 6), 96.3 % of the total sample used traditional medicine to solve health problems. Due to high expenses and length of time required, 26.5 % do not typically access medical facilities as the first resource for treatment of diseases. Furthermore, 25.7 % use plants in a combined form with conventional medicine.

The dominant group of the survey participants was between the ages of 41-50 (29 %). Only 14 % of informants contacted traditional healers to treat illnesses. The medicinal plants were mostly used by women, with the exception of the youngest group (21-30 age) in which it was more the domain of the men than women. Age parameters did not display any significant differences in the number of plants and use reports cited (Table 6). The greatest knowledge on plant use demonstrated by a number of species cited was reached in age groups of 51-60 years (7.2), and 41-50 years (7.1). In case of gender, the women cited a slightly higher number of species (7.2) than men (6.5). Although the sample was not equal, we looked on the knowledge in different occupation types, the traders elicited the highest number of species (9.5). Remarkably, the informants in the sub-urban areas mentioned a significantly higher number of species (8.2) compared to their rural counterparts (5.8). This might be explained by the use of new natural products (often exotic species) commonly purchased in markets which people could sometimes assume as traditional knowledge.

Table 6. Socio- demographic characteristics of the 132 informants in Zacatecas

Demographic variable	Demographic category	Number of informants	%	Mean number of plant species cited
Gender	Female	73	55	7.2
	Male	59	45	6.5
Age	20-30	10	8	6.8
	31-40	19	14	6.6
	41-50	38	29	7.1
	51-60	36	27	7.2
	Above +61	29	22	6.6
Residence location	Rural	69	52	5.8
	Sub-urban	63	48	8.2
Occupation	House wives	54	41	6.9
	Farmers	21	16	5.2
	Public workers	9	7	6.3
	Traders	17	13	9.5
	Students and profesors	7	6	6.7
	Labourers and others	24	18	7.1
Public health insurance	Insured	139	83	7
	Uninsured	29	17	6

6.3.2. Medicinal plant species diversity and cultural importance

A total of 168 medicinal plant taxa were reported by their common names. From this total number of medicinal taxa, 163 were identified down to species level, and five taxa were identified only to the genus level (*Gnaphalium* sp. *Calendula* sp., *Rosa* sp., *Casimiroa* sp., *Agave* spp.), resulting in a list with 151 genera and 69 botanical families were documented (Appendix 6). The family Asteraceae was the most represented with 20 species (11 %) followed by Fabaceae and Lamiaceae with 12 species each (7.1 %). The Medicinal plan list of species in Zacatecas (Appendix 6) shows 10 of the most cited plants by informants and those that obtained the highest values of quantitative indices (CI, RFC, and RI). *Matricaria*

chamomilla L. ranked first, representing the highest number of all indices (CI=1.15, RFC=0.55, RI=0.73) and use reports (140 UR). This plant was cited by 59 % of the informants and has tremendous medicinal importance with multiple uses. The leaves and flowers are used for a wide range of conditions such as ailments of the respiratory system, digestive system, colic pains, fever, and eye problems. *Arnica montana* L. scored in the second place of CI (0.49) followed by *Mentha* x *verticillata* L. (0.48), *Aloe vera* (L.) Burm f. (0.46) and *Ruta chalepensis* L. (0.44).

Beside *Matricaria chamomile* reached the highest value, RFC results indicate different order of medicinal significance. In this index *Arnica montana* (0.39) with 62 UR scored high, followed by *Artemisia ludoviciana* (0.32) with just 48 UR. *Arnica montana* is predominantly used for skin infections, burns, stretch mark, vaginal infections, gastritis, stomachache, rheumatism, urinary tract infection, wounds and bruises, while *Artemisia ludoviciana* is used for flu, headache, nerves, stress and gastrointestinal problems. *Mentha* x *verticillata*, *Ruta chalepensis* and *Gnaphalium* sp. reached the same value (0.27), and all of them are commonly applied to combat gastrointestinal disorders by preparing infusion from leaves. Beside the previous index (RFC) which assessed the cultural importance of individual species, the RI index highlighted *Aloe vera* in second place (0.71) with 53 UR and *Arnica montana* (0.66) in third place with 55 UR, followed by *Ruta chalepensis* (0.62) with 51 UR and *Larrea tridentata* (Sessé & Moc. ex DC.) Coville (0.54) with 33 UR displacing *Mentha* x *verticillata* (0.51) with 55 UR.

6.3.3. Significance of plant families in the local medicine

The most common botanical families according to their FIV, were Asteraceae as the dominant family (FIV=15.2), followed by the Fabaceae and Lamiaceae (FIV=6.1). The 10 most frequently cited families were: Asteraceae (261 UR), Lauraceae (139 UR), Rutaceae (61 UR), Fabaceae (54 UR), Xanthorrhoeaceae (30 UR), Amaranthaceae (27 UR), Cactaceae (26 UR), Apiaceae (25 UR), Nyctaginaceae (22 UR), and Zygophyllaceae (20 UR) (Figure 10).

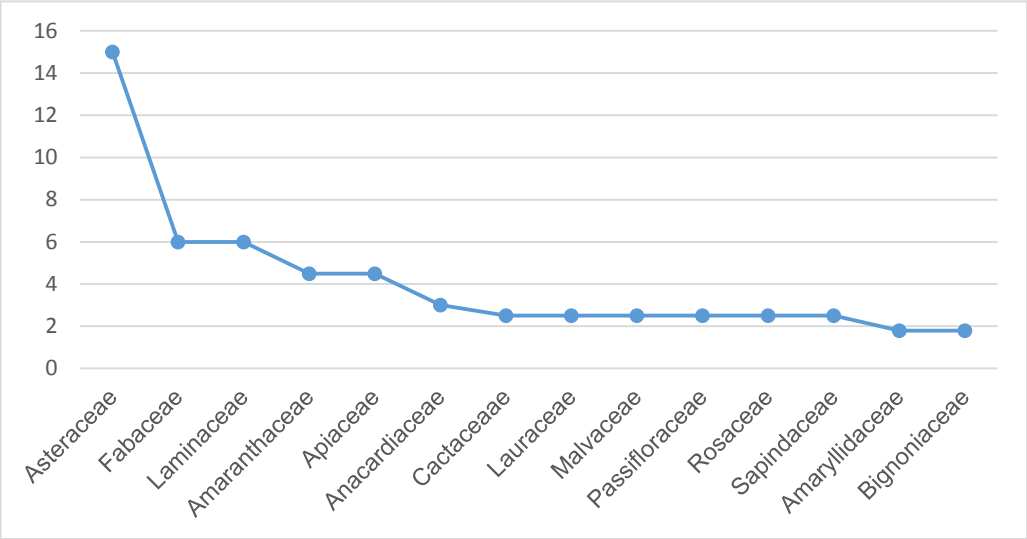

Figure 10. Family importance value (FIV) (Zacatecas)

6.3.4. Mode of preparation, Administration and plant parts used

Leaves (43 %) were the most commonly used plant part, followed by the whole plant (11 %) and stems (9 %) (Figure 11). Our study revealed that only 18 % of informants cultivated plants. Considering the preparation methods, freshly harvested and directly processed plant parts were used in 44 % of cases, dried plant material was used for remedy preparation in 27 % of the cases, and the remaining 29 % of the reported remedies were prepared from both dried and fresh plant material. Most plants parts (leaves, fruits, flowers and stems) are ingested raw, but, some plants (mainly roots, seed and barks) need to be boiled before consumption in order to degrade some toxic properties (alkaloids). Only a few of the plants were stored in order to increase availability of the herbal material.

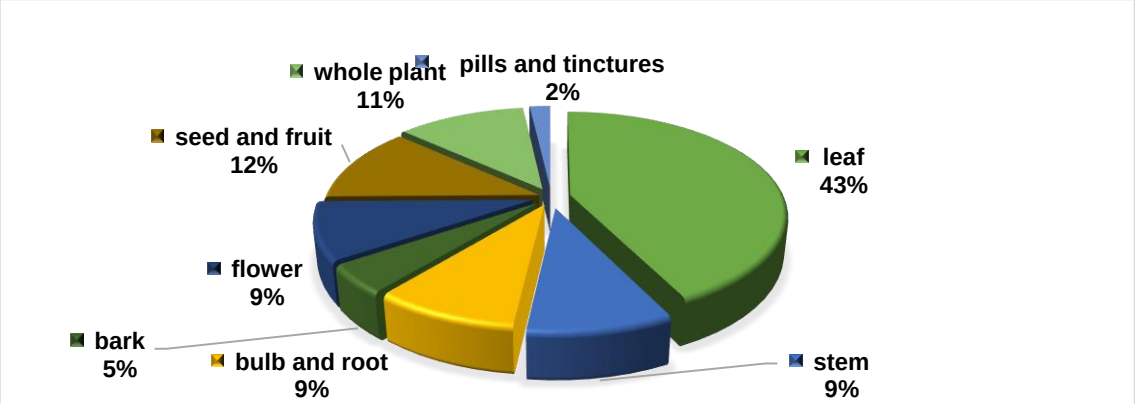

Figure 11. Used parts of the plants for the elaboration of traditional remedies in Zacatecas

Oral application (76.8 %) was used much more commonly than topical (24.2 %). Most of the plants are gathered and consumed the following day through herbal teas (infusion 52.2 %; decoction 10.2 %). Wounds were usually treated with a paste or cataplasm in topical form. Baths and tinctures were mostly used to control herpes and grains (Figure 12).

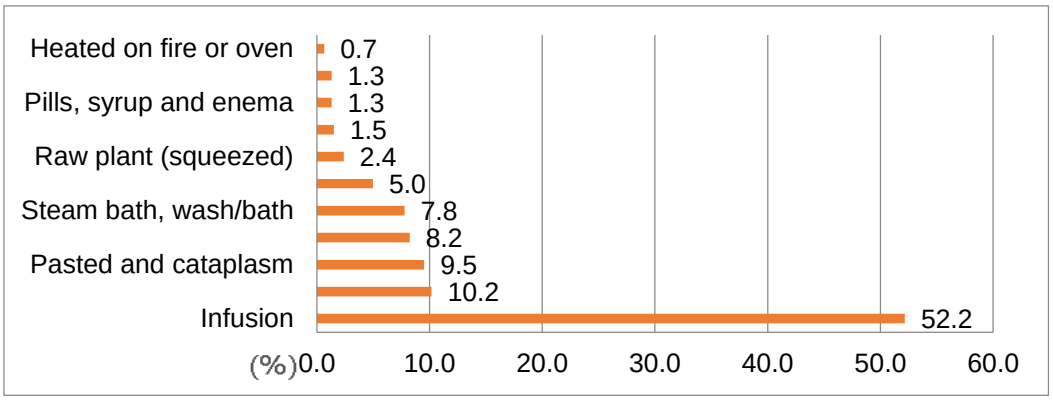

Figure 12. Preparation mode of medicinal species in traditional medicine in Zacatecas

6.3.5. Consensus on the treatment of ailment categories

A total of 99 ailments were divided into 12 categories (Table 7). Diseases of the reproductive system, represented by treatment of colic pain and the reduction of lactation, reached the highest ICF value (0.81) The second highest ICF value obtained gastrointestinal diseases (0.80), primarily represented by diarrhea, stomach ache, and intestinal worms. This category is followed by diseases of the respiratory system (0.79) combating coughs, sore throats, and bronchitis. Afterwards, still high consensus (0.78) reached diseases of the musculoskeletal system (0.78) treating mainly ailments such as rheumatism and pain in the muscles.

In general, the highest values of ICF represent a concordance among the informants about the use of certain plants for specific ailments. The high consensus on those categories indicates well-established and exchanged medicinal plant knowledge for their treatment. Yet, the most frequently treated ailment categories (diseases of the digestive and gastrointestinal system, diseases of the respiratory system, general symptoms and diseases of the musculoskeletal system, respectively), express a high incidence of those health disorders among the population. In Zacatecas, women primarily used traditional knowledge to solve reproductive and maternal problems.

Table 7. Number and percent of Use Reports (URs) and Important Consensus Factor (ICF) of the Mexican plant species for each ailment category) in Zacatecas

No	Ailments category	Description of ailments	ICF	No of species	No of UR	% of total UR
1	Diseases of the reproductive system	Sinus pain, contraceptive, reduction of breastfeeding, sexual impotence, colics, lactation suppression, childbirth preparation, vaginal infections.	0.81	17	86	6.53
2	Diseases of the digestive and gastrointestinal system	Anemia, bile, bitter mouth, bleeding ulcers, diarrhea, digestion, stomach ache, dysentery, gastric ulcer, gastritis, gastrointestinal problems, hemorrhoids, indigestion, intestinal parasites, amoebae, intestinal gases, liver problems	0.80	67	329	24.96
3	Diseases of the respiratory system	Asthma, bronchitis, chest pain, cough, flu, chest pain, pneumonia, laryngitis, respiratory system, sore throat	0.79	54	257	19.50
4	Diseases of the musculoskeletal system	Antibacterial, anti-inflammatory, arthralgia, back pain, general pain of the body, rheumatism, pain of muscles, body analgesic	0.78	29	130	9.86
5	Diseases of the nervous system	Anxiety, insomnia, epilepsy (spasm)	0.74	15	55	4.17
6	General symptoms	Colitis, ear ache, fever, headache, irritated eyes, lack of energy, migraine, motion sickness, ear problems, sight problems, body strength, stress, toothache, weak gums	0.69	52	168	12.75
7	Diseases of the urinary tract	Problems of urinary tract system, urinary tract infection, kidney stones, diuretic	0.67	30	89	6.75
8	Chronic – degenerative diseases	Diabetes, hormonal problems, cancer	0.63	15	39	2.96
9	Auto-immune diseases	Antibiotic, rheumatoid arthritis, hematopoietic, strengthening immunity defense	0.60	5	11	0.83
10	Diseases of the cardiovascular system	Blood cholesterol, circulatory system, hypertension, inflammation, weight-reduction, anginas	0.58	28	66	5.01
11	Diseases of the skin	Allergies, acne problems, baldness, external blows and bruises, burns, calluses, chickenpox (varicella), dry skin, foot fungus, sores, wounds, grains of the skin, genital herpes, injures in the mouth, gums, herpes, lice, rashes in the skin, measles, skin allergies, sore and wounds, skin blemishes, skin and hair problems, stretch marks, warts	0.58	36	85	6.45
12	Antidotes	Antidote for insect bite (arlomo) and snakebite	0.00	3	3	0.23

6.3.6. Socio-economic comparison of number of plants known by informants among Chiapas, Veracruz and Zacatecas

Linnear regression models for number of plants known by: size of localization (rural/urban), use of medicinal plants in first instance instead medicaments (yes/no) and insurance (yes/no). When analyzing the goodness of fit of the previous models, 'Chiapas' and 'Papantla' display r-squared values of 0.29 and 0.30 accordingly. Thus, it is posible to assert that 29 % of the variation in the number of plants known of Chiapas' dataset is explained by the model, whereas 30 % of the same variation is explained in Papantlas' dataset is explained by the model. The goodness of fit of 'Zacatecas' model is negligible.

In the case of Papantla's model, the results state that a person who uses plants as a first resort, has medical insurance and lives in a rural community, tends to know 28 plants approximately (p-value < 0.01). The number of plants known augment by approximately 3 when the person lacks medical insurance (p-value < 0.05). Whereas the number of plants drops by more than 5 plants if the person lives in an urban community and drops by more than 7 if the use of plants is not the first resort (p-value < 0.01 for both cases).

Table 8. Socio-economic comparison of number of plants known by informants in the three States.

	Dependent variable: number of cited plants by informants		
	Highlands in Chiapas	Papantla	Zacatecas
Localization	1.129	-5.636***	0.803
	(0.985)	(1.605)	(0.593)
Use of medicinal plants In first instance instead medicaments	-4.223***	-7.146***	-0.483
	(0.959)	(2.078)	(0.658)
Public insurance	1.177	3.067**	1.574*
	(0.986)	(1.533)	(0.798)
Constant	8.429***	28.263***	4.592***
	(2.152)	(4.503)	(1.690)
Observations	62	83	131
R^2	0.290	0.305	0.045
Adjusted R^2	0.253	0.278	0.022
Residual Std. Error	3.586 (df = 58)	6.692 (df = 79)	3.324 (df = 127)
F Statistic	7.887*** (df = 3; 58)	11.531*** (df = 3; 79)	1.994 (df = 3; 127)
Note:			*p<0.1; **p<0.05; ***p<0.01

7. DISCUSSION

7.1. Use of medicinal plants as a strategy for health

The use of medicinal plants has been increasing in recent years, as well as of all medicinal products of natural origin, which come in a variety of presentations, which respond to the cultural demands and economic needs of our time (Ocampo 2002). The results showed that the people are incorporating more tinctures, pills and the use of new herbal products in the daily treatments, however, the percentage is low, these methods have been started to be recorded in this study.

According to Mshana et al. (2008) the combination of traditional and modern medicine (multi-treatment) has become a strategy for people who live in places with less accessible modern healthcare systems. In fact, in Mexico the people can not afford to have a good treatment of their diseases, it due to many reason, some of them are related to the high cost of medicine, the shortage of supplies of medicinal products in the health institutions, and perceived ineffectiveness of resolving chronic diseases by modern medicaments (Romero-Cerecero 2007; Oyinlola 2016). The results are in line with Mshana, a high number of informants used both kind of medicine to treat their almeints due to different circunstances, the most cited reason by the informants were because they prefered a natural treatment, it due to the high numbers of besaide effects caused by the medicaments. Moreover, the use of TM has been seen as part of their culture use and tradition by their families for generations.

Analyzing that the Mexican health policies, they indicate that health clinics can not be established in localities of less than 2 500 inhabitants, it is understood that they do not respond to the reality of Mexico, particularly in the south region of the country (PRD 2014). The fact of living in conditions of high marginalization, with deficiency or lack of transportation, with long distances and lack of clinics or official medical services, this cituation could be an incentive for the inhabitants in marginalized and rural conditions to look for alternative strategies to solve their most common general ailments, the TM represents an available resource for the locals.

These factors drive the communities in the studied areas to continue using medicinal plants and to combine both medical systems as surviving strategy. The high acceptance of using the complementary medicine (traditional medicine) in combination with modern medicine in

public health care instirutions was demostrated by Romero-Cerecero and Tortoriello (Romero-Cerecero et al. 2007), where the record of acceptance by personnel (73 %) and patients (83 %) was carried out in the local Family Medical Care Unit of the Mexican Institute of Social Security and its patients in urbal cities in Mexico. In average more than 85 % of the sampled informants are actively using MP in the studied regions, it means a high acceptance of TM among the Mexican population either in urban or rural areas, if they have insurance and social status.

There is also a variety of factors such as age, gender, education, occupation and social status that can influence the use, management, knowledge of medicinal plants also important determinants of knowledge distribution. Factors such as low family income are related to a greater knowledge of uses of traditional plants (Ceuterick et al. 2008), this reaffirms the data obtained in this study. Due to the insecurity issues presented in Mexico, the informants were not willing to share data regarding to familiar incomes, however the linear regression done reaffirmed a positive tendency in knowing more number of medicinal plants with socioeconomical factors such as rural or urban areas, access to insurance, age and preference to use natural resources (Medicinal plants) in first instance.

According to Ceuterick et al. (2008), higher family incomes generally results in less knowledge about medicinal plants and less plant use for medicinal purposes (Ceuterick et al. 2008). On the other hand, the great knowledge of medicinal plants is related to rural communities, which, due to their very conditions of marginalization, do not have good health infrastructure, specialists or medicines, which encourages the use of a greater number of local herbal remedies to treat your ailments.

7.2. Current status of use and knowledge of medicinal plants in Chiapas, Veracruz and Zacatecas

Mexico has the 11th largest Grose Domestic Product (GDP) based on the Purchasin Power Parity (PPP). In 2009, the World Bank reported that Mexico´s GDP was the second highest in Latino America after Brazil. The poverty rate in Mexico stands at 44.2 % qand the wealth distribution in the country is a huge problem, as 10 % of the weathiest people control about 42.2 % of the country´s wealth, the studied areas belon to the list of the ten poorest states in Mexico based on poerty levels are Puebla, Guerrero, Chiapas, Oaxaca, Hidalgo, Zacatecas,

Tlaxcala, Veracruz, Michoacan and San Luis Potosi. In 2012, Chiapas had the the highest rate of poverty in the country, reaching 74.7 % , followed by Zacatecas in seventh-highest poverty place of any state wich stans at 54.2 % and Veracruz was rated in ninth place with a standing at 52.6 %.

Nowadays, poverty in Chiapas affects 88 %, which is located in extreme and moderate poverty. About 89 % of the population has an income below the line of well-being, and 42 %, with deficiencies of an educational nature (INEGI 2015), determines conditions that create a difficult environment of well-being, health, nutrition and education which translates into socioeconomic and intellectual poverty for the inhabitants. About 60 % of people live in small communities with less than 2 500 inhabitants (PRD 2014; INEGI 2015), so they do not have easy access to clinics, seeing the need to be transported to the municipal seat to receive medical consultation. Furthermore, 15 of the 17 municipalities have a lower than average human development index at the state level (PRD 2014).

Under these conditions, the use of traditional medicine to meet the high costs of medicines is a strategic pattern followed by low-income people that has also been used as a survival strategy in other countries, mainly in peasant regions (Seedhom et al. 2011; Hema & Fawsi, 2012; Alonso-Castro et al. 2017). The expenditure in medicinal plants in this region is very low compared with Veracruz and Zacatecas, the informants affirmed that almost all plants are recollected in the sourranded areas.

Although the public health system, called popular insurance, offers free care throughout the Mexican territory, the rate of people who do not have any type of health insurance in the sample in higher in Chiapas (35 %) than Veracruz (21 %) and Zacatecas (29 %), that can be explained by the lack of health services in the remote and isolated communities of the region. The Mexican Institute of Social Security only corvers 6.38 % of the inhabitants and the Institute of Social Security and Services for Workers of the state 6.7 % in the region of Los Altos of Chiapas (PHR 2006; Herce et al. 2009). The combination of traditional medicine and modern treatments has also been registered in groups of indigenous migrants (Mayas) in southern Mexico (Smith et al. 2009). Treatment with medicinal plants has also been used to treat mental pathologies in Tzeltal Maya communities in the highlands of Chiapas (Carod & Vázquez-Cabrera, 1996). The results showed that the people without insuraded cited in average a higher number of medicinal plants.

On average in Chiapas the people use 8.2 and 17.5 medicinal species, respectively, for the treatment of different therapies. The average number of medicinal plants used by informants in the other categories ranges between 4.3 and 5.8. According to gender, women make use of 6.2 medicinal plants on average, while men use 5.5 medicinal plants (Table 1).The annual expenditure of the insured people to buy plants reached $240 compared against the not insured people with $215.

These results are in line with what was described in other communities in Mexico and around the world (Thomson et al. 2012; Pérez-Nicolás et al. 2017) where women, specialists and vendors have registered a greater knowledge of traditional medicine and medicinal plants.

Women in Veracruz on average cited two more plants and spend more money (17 plants, expenditure: $200) than the male counterpart (15 plants, exp.: $176). Housewives ($210 annual) spent generally more money for plants than other occupations, the lowest expenditure was observed by the sellers. The expenditure in plants along the year is equivalent to 2 days of work for the farmers. The expenditure in medicinal plants might not reflect the impact in direct way on the public health, it means, it is imposible to measure the social benefits, economic savings and the positive effects in the society trhough a economic measure in the plants, however it could reflect the easy acces, cheap cost and the availability of the plants in their regions.

However, there are studies (Hassan et al. 2015; Burgos-Hernández et al. 2014) that have not found a significant difference between knowledge, medicinal plants and traditional medicine, with respect to gender. It is common that in many parts of the world the women always show a higher knowledge in the use of plants (Nunkoo & Mahomoodally 2012). It could also be described due to their roles in the family. Previous studies show that women usually have more knowledge on medicinal plants, and men know more about timber and handcrafts species. It happens due to sexual division of labor and external factors following the male migration in the young people inside the communities (Müller-Schwarze 2006; Brandt et al. 2013; Burgos-Hernández et al. 2014). Case et al. (2005) mentioned that local knowledge in plants increases with increasing geographical isolation; the people use intensively more plant species due to the scarcity of medical centers, specialist, or the medicines. Nevertheless, other studies are related to the familiar income (economic status) as main factor about the number and the uses of known plants (Ceuterick et al. 2008).

The results indicate that women are the main users of medicinal plants for the treatment of reproductive discomforts (colic, pre-postpartum, hormonal, gynecological, menstrual, inflammation of ovaries, hormonal problems, and overproduction of lactation). The results obtained agree with those described by Smith-Oka (2012) and Heinrich et al. (1998), who affirm that ovarian-uterine problems in women are a great problem to be solved in indigenous communities. According to the statistical data of the region (PRD, 2014), there are 80 000 young women between 19 and 24 years of age who begin to conceive children from an early age, and the use of medicinal plants could be related to this external factor, thus supporting the results of this study.

In Veracruz the keepers of the traditional knowledge are the teachers (average of 22 cited plants), followed by farmers (18 plants), and housewives (15 plants). Academic staff showed more knowledge in plants because they receive children from different communities, and the social engagement in those schools promote and apply different strategies to keep alive their costumes, languages, and traditions indoors of the classroom. Of the 85 indigenous people interviewed, men represented the highest number (53 %) and people from 70 to 85 years showed to have a higher knowledge in plants. In general, the gender is not significantly correlated to the age and to their knowledge (Burgos-Hernández et al. 2014; Sher et al. 2015). Seventy-eight of informants (92 %) are actively using medicinal plants in their dairy life, but 70 out of them (82 %) recurs to the plants in first instance to treat their ailments. Nevertheless, there are just 16 % (14 people) going to the specialist. The informants obtain the plants mostly from wild gathering (37 %), market (35 %), and familiar gardens (28 %). Some informants (29 %) expressed they do not have any expenditure in buying plants since they know the surrounded areas where they can find them. The informants (38 %) emphasized positively the usage of medicinal plants as part of their cultural uses (38 %), and they consider them as an effective and cheap resource (35 %) since their childhood to treat human disorders.

In fact, informants from Zacatecas declare that the origin of the traditional knowledge was given by the family (87 %) and the specialist “shamans” (13 %). More than half of the informants (58 %) claimed to perceive a decrease (medium and high loss) in the traditional knowledge during their youth, the rest (42 %) did not perceive some alarming decrease.

In Zacatecas, women are usually in charge of gardening, selling plants in local markets and child rearing. The reason for a slightly greater number of medicinal plants cited on average

by respondents in sub-urban areas might be explained by the use of a higher number of species (often exotic) and new natural products commonly purchased in markets. The impact of markets on accessibility of new plant resources is well known (Romero-Cerecero et al. 2007). The reason for a slightly greater number of medicinal plants cited on average by respondents in sub-urban areas might be explained by the use of a higher number of species (often exotic) and new natural products commonly purchased in markets. The impact of markets on accessibility of new plant resources is well known (Romero-Cerecero et al. 2007).

7.3. Diversity of medicinal families, species and treatment used to manage infections

In Chiapas, Informants recognized a total of 59 species of medicinal plants belonging to 55 genera and 37 botanical families were reported. The Asteraceae family was the most cited, with 6 species (UR=51, FIV=86.44), followed by Laminaceae (UR=37, FIV=62.71, Lauraceae (UR=23, FIV=38.98).

In Veracruz, Informants recognized a total of 101 ethnobotanical plants belonging to 51 families and distributed in 95 genera; they were commonly used by the most of indigenous people for the treatments of 77 ailments. The most represented family were Asteraceae and Rutaceae showing the 8 plant species each one, followed by Fabaceae (6 species), Myrtaceae, Malvaceae and Apocynaceae (4 species), and Euphorbiaceae, Lamiaceae, Meliaceae and Poaceae with 3 species. Other families reported two and one species each.

In Zacatecas, informants recognized a total of 168 medicinal plant taxa belonging to 151 genera and 69 botanical families were found to treat 99 health disorders. The most medicinally important plant families were Asteraceae (20 spp.; FIV=15.15), followed by Fabaceae and Lamiaceae (12 spp.; FIV=6.06) and Cactaceae (5 spp.; FIV=2.06).

Looking at the botanical families, the finding of Asteraceae as the most culturally important family in Chiapas, Veracruz and Zacatecas may indicate that the pharmacopoeia is not a random selection of flora but rather that some taxonomic groups are over-represented (Bennett et al. 2007).The botanical family Asteraceae represents a greater number of medicinal species in Mexico (Dominguez-Barradas et al. 2015) and in Latin America (Angulo et al. 2012; Cadena-Gonzales et al. 2013; Cussy-Poma et al. 2017). Amiguet et al. (2006) related the use of plants of the family Asteraceae and Rubiaceae to treat disorders in the nervous system, the digestive system and infections. Being the attacks of nerves and

scares one of the syndromes commonly treated in the Mayan ethnomedicine by Guatemalan refugees in Chiapas (Smith et al. 2009). Comparing four Mexican indigenous groups, Heinrich et al. (1998) suggested that there exist well-defined criteria how each culture select a plant to be used as a medicine.

Plant species of Asteraceae family were the most used also in Populoca, Veracruz (Leonti et al. 2003), not only in Papantla. Probably this can be due to the abundance and wide variety of Asteraceae species in ecosystems in the north and rainforest areas of Veracruz (Burgos-Hernández et al. 2014; Dominguez-Barradas et al. 2015) and to their relative cultural importance.

In Zacatecas, Balleza and Villaseñor (Balleza & Villaseñor 2002) found that the Asteraceae is the most widely distributed and diverse family among the flowering plants throughout the state. They recorded that 191 species (42 % of the total) are represented by weeds, with 59 species being endemic to Mexico. The Asteraceae family is apparently a crucial component of the floristic richness of the xeric environment in Central Mexico (Balleza & Villaseñor 2002; Balleza & Villaseñor 2011; Villareal-Quintanilla 2017).

The importance of the family Asteraceae is widely supported by different studies (Balleza & Villasenor 2016) with a rich number of species and their uses (medicinal, agricultural, and industrial). The phytochemical components given by the flavonoids, sapogenins, mucilage, essential oils and glucoalcohols are used in folk medicine to treat condition fever and rheumatism (Saslis-lagoudakis et al. 2011; Cassani et al. 2015). The phytochemical components are also used as a diuretic, an antispasmodic, a general tonic, a stimulating agent, and as an antidepressant (Cassani et al. 2015; Villarreal-Ibarra et al. 2014). Besides Asteraceae, also Fabaceae and Laminaceae has been found to be the most dominant families in the pharmacopoeias of Mexican communities (Alonso-Castro et al. 2012; Juárez-Vázqueza et al. 2013), but also e.g. in Ethiopia (Lukelal et al. 2013), and Pakistan (Bibi et al. 2015).

Piperaceae is the second most representative in family in Chiapas, the plant species of this family grow, mainly, in tropical areas such as those of Belize; where indigenous communities such as Qéqchi' use it commonly for having a high sedative effect, combating arthritis, malaria, somatic discomfort, digestive and musculoskeletal disorders (mainly species belonging to the genus Piper) (Tortoriello et al. 1995; Amiguet et al. 2006).

Families such as Asteraceae, Fabaceae, Rubiaceae, Euphorbiace, Bignoniaceae, Myrtaceae, Amaranthaceae and Solaneace have been registered in the use to treat diabetes in Central America, the first two families contains a wide variety of phytochemical. Similar plants were found in this study but not mainly oriented for diabetes and urinary problems in Mexico: *Tecoma stans* (L.), *Persea Americana* Mill, *Psidium guajava* L., *Carica papaya* L. in Belize, *Bursera simarruba* (L.) and *Anacardium occidentale* L. and *Hamelia patens* Jacq. (Giovannini et al. 2016).

Hamelia patens Jacq. Has been reported and recognized by its medicinal effects and anti-bacterial activity in the ethnopharmacolog in the medicnal plants from Mexico, Belize and Centro America (Camporese et al. 2003; Andrade-Cetto 2009).

7.4. Cultural important species for the informants

Generally, species with high cultural importance in our study can be characterized as species used frequently and having versatile uses. Numerous culturally important plants in our study such as *Matricaria chamomilla*, *Mentha* x *verticillata*, *Arnica montana*, *Citrus sinensis*, and *Bougainvillea glabra*, are used to cure the same ailments as in other parts of Mexico (Alonso-Castro et al. 2012). Moreover, there have been numerous pharmacological studies reporting that use of these species leads to a significant reduction of anxiety, depression, sedative effects, anti-inflammatory effects, and a reduction in colic-related pain, headaches, gastrointestinal disorders, diarrhea, and fright (Argueta et al. 1994; Amsterdam et al. 2009; Pérez-Nicolás 2017). *Matricaria* spp. are recommended and used by the health professionals in Mexico, due to the wide medicinal effect against many diseases in respiratory and gastrointestinal system (Alonso-Castro et al. 2012; Pérez-Nicoláset et al. 2017). The medicinal use of *A. montana* L. has been confirmed to be efficient particularly for the treatments of bruising, injuries, rheumatism, fractures, inflammation in the throat and muscles, insect bites, accelerated post-operative healing, and even skin fungus prevention (Klaas et al. 2002; Chaiet & Marcus 2016). The plant is also used to inhibit root rot fungi (*Fusarium oxyporum, Rhizoctonia solani and Macrophomina phaseolin*) in seeds (Hanif & Dawaar 2016). The significance of another important species *Aloe vera* could be explained by the trend of popular usage to cure the most common conditions. In Central America, *Aloe vera* is used for a wide range of conditions like diabetes, skin problems and kidney diseases

(Giovannini et al. 2016). The juice has long been used as a source of sugar substitution for patients with problems associated with triglycerides in the blood (Giovannini et al. 2016). It is evident that the culturally important medicinal plants in the communities are known to be effective pharmacologically, suggesting that the traditional knowledge is well-founded, and that use of medicinal plants is reasonable. This fact also shows a potential to investigate medicinal importance of neglected and underutilized species cited by a lower number of informants.

7.5. Mode of preparation, administration of different medicinal plant parts used by informants in Mexico

The current study showed as the plant parts are usually consumed fresh and leaves represent the most common plant parts used by the informants to prepare the medicinal remedies. Infusions and decoctions of the leaves are the most common preparation modes and plant parts used in different countries (León-Espinosa et al. 2008; Bibi et al. 2015; Lukelal et al. 2013; Khan et al.2015; Pawera et al. 2016). Research has shown that numerous plants stores highly active compounds in the leaves, the most important plant part in the present study, resulting in significant antibacterial and antioxidant effects (Camacho-Corona et al. 2015; Calzada et al. 2017; Penido et al. 2017). Teas in a form of infusion are among the most common medicinal preparations globally. The reasons of the use of the leaves is due to the easy way to collect them. Herbal medicines were either based on single species or mixed with other plant species.

In Mexico, it is also common to find a variety of traditional fermented beverages for religious/medicinal purposes made from maize (*atole, pozol* and *tesgüino*) or agave (*pulque*). This is due to a presence of beneficial microorganism that work as probiotics and reduce the gastrointestinal problems (Romero-Luna et al. 2017).

The mixture of two or more plants was seen in this study; and it is known that the use of more than two herbs could contain a range of different active compounds and can modify its effect, enhancing or reducing the healing effect. If we considered each mixture as one single remedy (Teklehaymanot et al. 2007; Mshana et al. 2008), the list of natural remedies could be multiplied.

Nonetheless, the toxic effects should be studied in depth, and many of the plants are used in minimum concentration by the locals but they are still unknown and unregistered. Two main routes of administration of herbal remedies were reported: oral and topical administration. Herbal remedies were prepared by using ten different ways. The main form used are decoction and infusion but raw plant material is eaten fresh to combat gastrointestinal disorders, for blood circulation and local pain (tooth pain). Raw material of leaves, whole plant or stems were used for the rituals as badwind and evil eye. Bath and cataplasm is applied to treat skin disorders (wounds) and to treat infective diseases as chicken pox, smallpox and measles; liquefied, crushed, smashed remedies were used fresh and extracted from different plant parts for the treatment of diabetes and kidney problems. Minor uses are Squeezed, tincture and microdosis and burned, these remedies were mainly used to treat rheumatism, pain in the ears and wounds. Leaves of *H. patens* was used as therapy to burn the leaves and apply them over the chest to promote the breastfeeding in the women's body. Bark, fruits and seeds are fermented to prepare alcoholic drinks.

According to Neves et al. (Neves & Matos 2009), raw materials such as roots and stems are not frequently applied on skin. In general, baths and tinctures applied externally are mostly used to control herpes and grains, and the use of this procedure is in correspondence of Garcia-Hernandez et al. (2015), who found that bathing (e.g. steam baths, foot baths, vaginal steam baths and sweat lodges) is commonly recommended by healers as they perceive that baths work more effectively than oral infusions (García-Hernández et al. 2015).

7.6. Origin of the medicinal plants used by the informants in Mexico

Most of the informants gathered the plants from the wild (82 %), as these plants are easily accessible, and have a high-perceived level of medical effectiveness with a high presence of alleophatic effects (Mshana et al. 2008). Yet, some informants have recently started cultivation to increase availability of important medicinal plants. According to a study in southern Mexico (Heinrich et al. 1998) cultivation of selected medicinal plants is spreading through the regions because they are perceived to be effective and they are grown close to the settlements. The cultivation of plants could also balance or homogenize the compounds in the plants, thus facilitating and adjusting the dose ingested by active users (Shi et al. 2008). The discussion about differences in nutritional and chemical composition between wild and

cultivated plants is still widely debated and deserves further investigation (Leonti & Casu 2013). It is important to mention that the most versatile plant species are often the exotic ones. These non-native plant species were brought, introduced, cultivated, spread and commercialized along the Spanish American territories, whereas nowadays the plants are commonly present in many ecosystems in the American continent (Gänger 2015).

The leaves are the main bioactive source for the preparation of herbal remedies in the highlands of Chiapas, Veracruz and Zacatecas (Tortoriello et al. 1995) as well because it is the easiest part to collect and transport. However, the excessive collection of these plants affects the status of these in their environment, being more vulnerable, those plants that are uprooted in their entirety, limiting with this their vegetative recovery or their sexual reproduction and causing the erosion of the soils, in tropical regions, where there is a great fragility of this natural resource.

The fact that people do not produce the plants in the backyard is a sign of the high accessibility and diversity of species of wild medicinal plants around their places and within their territories. The free access and lack of control of the wild collection of plants contributes to the high use of herbal remedies among the inhabitants of the localities (Hema & Fawsi 2012). However, these harms the status of the species, their future availability and harms the sustainability of the ecosystems (Neumann & Hirsch 2000). The lack of real management, in particular the cultivation of medicinal plants is also reflected in the supply and availability of medicinal plants in local and national markets (Neumann & Hirsch 2000). However Gasco (2008) has registered a great diversity of plants in backyard gardens by people from the region in the soconusco of the same state of Chiapas.

In general, the wild gathering and hunting is usually cheaper; and the locals avoid the cost production (Apaza et al. 2002; Baptiste et al. 2012).

This practice damages the ecosystems, availability, and quality and promotes the future poverty in all senses (Ford 2009). Even if the animals used for medicine were not included in the endangered list (Skunk, badger, buzzard, snake of cascabel, hummingbird, tortoise, cockroach, frog, and bee), their presence should be controlled by the government to avoid the changes of ecological equilibrium. Plants, insects and animals are the main ingredient of traditional medicine, and the use and consumption of these for therapeutic applications have been common among indigenous communities over the years (Adeola 1992; El-Kamali 2000;

Vázquez et al. 2006). The organoleptic properties of medicinal plants have a beneficial effect on mood quality when applied to therapies, and for this reason, they have been used by pharmaceutical companies in natural products, as a strategy to improve public health in the last years (Matthias et al. 2017).

There are many species that have stopped using such as tobacco (*Nicotiana tabacum*) which used to be of great importance within the Tsotsil and Tzeltal community, this used to be mixed to make plaster and medicinal infusions, being the fresh leaves used as protective agents and therapeutic, but its use has been significantly reduced in recent decades (Kevin 2010).

7.7. Uses reports and main diseases

The greatest number of use reports for gastrointestinal illnesses is often seen in ethnomedicinal studies, in Mexico for example in the Maya and Nahua communities (Heinrich et al. 1998). In the high lands of Chiapas, gastrointestinal category obtained one of the highest consensus, same as in our study. Diarrhea, stomachache and vomiting are symptoms frequently treated with homemade remedies in southern Mexico (Martinez et al. 1998). The use of medicinal plants to solve gastric problems in rural and suburban communities with access to public healthcare in Mexico may be caused by rapid exhaustion of pills in health centers (Wirts et al. 2008). Similar values of ICF in other regions of Mexico suggest a possible tendency of problems in the digestive, but also respiratory, musculoskeletar and integumentary systems (Alonso-Castro et al. 2012).

According to the medical consultations given by public institutions in each municipality of the state of Chiapas (PRD 2014), San Cristóbal de las Casas shows one of the highest number of consultations (459 553) to health institutions, where 341 904 they were general, the 46 949 specialized, 47 798 of urgency and the rest odontológica.

In the highlands of Chiapas, according to the statistical yearbook (PRD, 2014), the most treated diseases of the 1 304 427 cases recorded were: respiratory (664 703), intestinal infections (1 66 674), urinary tract (126 564), gastritis and ulcers (62 908), hypertension being one of the least present (14 489). These data agree with our results, but the important finding is that people treat their reproductive problems with traditional remedies.

The main cause of death in health centers in Chiapas is due to diseases of the digestive, circulatory and respiratory systems (Berlin & Berlin 1993; Herce et al. 2009; PRD 2014). These statements are in line with what was found by Alonso-Castro et al. (2017), where the main problems in Mexico are digestive. Herce et al. (2009) mention a synergistic effect between poverty, lack of hygiene and tuberculosis, which causes a high incidence of mortality among Chiapas communities for several decades. Due to the climatic and cold conditions of the region, problems such as colds, sore throat, flu, among others, are the health problems most commonly found in the region.

The results obtained (Table 4) are confirmed, in the sense that, the greater use of plants is given to treat gastric problems that prevail in the indigenous population of the highlands of Chiapas (Berlin et al. 1990; Berlin & Berlin 1993). Mayan traditional medicine promoters being the key component of family medicine in Chiapas villages, since they treat problems of pulmonary tuberculosis, respiratory infections, chronic cough and hemoptysis (Herce et al. 2009; Berlin & Berlin 1993).

The most commonly used species (*M. chamomill, M. sativa and R. Graveolens*), have been frequently recorded for their great use and effectiveness in the treatment of various diseases in Mexico (Alonso-Castro et al. 2012), these plants have been recommended for its high content of flavonoids and antioxidants to treat gastrointestinal problems, respiratory and pain (head, joints, throat), anti-inflammatory among others (Alonso-Castro et al. 2012; Kolodziejczyk-Czepas et al. 2015; Pérez-Nicolás et al. 2017; Cussy-Poma et al. 2017). *R. graveolis* is widely known for its essential oils, its properties with respect to human reproduction and its use in traditional medicine, particularly in the state of Chiapas (Tortoriello et al. 1995). Genders such as Mentha, Salvia and Rosmarinus present a wide diversity of species in the state of Chiapas, and have been used by mestizo and indigenous communities to alleviate various intestinal diseases and respiratory infections (Dominguez-Vázquez & Castro-Ramírez 2002).

It should be noted that the number of species reported (59 species in Chiapas) in the present investigation is lower compared to the 144 species reported in southern central Mexico, in the Zoque region (in Campeche and Chiapas) (Matthias et al. 2016).

Given the results of our observation, it is possible to say that the Veracruzan communities had a significant variety of traditional uses, with a specific frame of ailments. A total of 77

ailments were grouped into 17 use-categories in Veracruz (Table 3), based on the information gathered from the interviewed. The ICF was calculated for each ailment category and the highest value was calculated for poisonous animal bites (ICF = 0.92); roots of two plant species, *Pentalinon andrieuxii* (Müll.Arg.) B.F. Hansen & Amp; Wunderlin (13 UR) and *Allium sativum* L. (1 UR), were reported by informants to prepare the tincture for the treatment of snake bites. These species are the same used to treat snakebite in Central America (Giovannini & Howes 2017)

Cancer (oncology use-category) showed an ICF of 0.91 with 5 species and 44 UR, followed by gastro-intestinal disorders (ICF = 0.89) with 29 species and 247 URs, infective diseases and fever reported an ICF of 0.87 with 13 species and 93 URs, kidney disorders and genio-urinary disorders reported the similar ICF, with 17 species each one. The use-category of liver disorders showed the lowest degree of consensus; only three informants mentioned three plant species to treat ailments belonging to this category (cirrhosis, hepatitis and liver disorders); probably informants not exchanged their information. Malnutrition, poverty, and environmental conditions are main factors causing common ailments (digestive, respiratory and skin disorders) as previous reported (Frei et al. 1998; Alonso-Castro et al. 2017). This study also evidenced as cancer and diabetes cases are coming up recently and this problem could be related to the diet in the region. Decoction and infusion of leaves from *Asclepias curassavica* (16 URs), *Rauvolfia tetraphylla* (11 URs) and *Hamelia patens* (9 UR) were used to treat cancer, whereas plants such as *Tecoma stans*, *Psidium guajava, Persea americana* and *Anacardium occidentale* were registered in the treatment against diabetes (Giovannini et al. 2016). *Matricaria recutita, Mentha spicata, Psidium guajava, and Chenopodium ambrosioides,* are consumed in other nine Mexican States (Amsterdam et al. 2009; Arqueta-Villamar et al. 1994; Pérez-Nicolás et al. 2017*). Aloe vera, Piper auritum, Rutha chalepensis, Citrus limon, Annona reticulate,* and *Cocos nucifera* have been recorded a wide use by indigenous in the center South of Mexico (Frei et al. 1998; López & Teodoro 2006).

The most commonly used specie by the informants in Veracruz was *Hamelia patens* Jacq. with 77 UR. It is a large perennial small tree that has been used against a range of ailments by other indigenous communities in Mexico (Gomez-Rivera et al. 2016). Totonacs use *Hamelia patens* to treat problems related with the diabetes (UR = 18), gastrointestinal disorders (gastritis, colitis, and ulcers) (UR = 17), cancer (UR = 9), high pressure and blood

circulation, respiratory problems, anemia, breastfeeding, menstruation, skin disorders and wounds. Its medical effects has been proved in another countries, like India (Surana & Wagh 2017), in treatments of nervous shock for its antidepressant properties, athletes foot, skin lesions, insect bites, inflammation, rheumatism, headache, asthma, and dysentery. The leaves of *Persea americana* are commonly used by the Mexicans in infusion to treat gastrointestinal problems; nevertheless, the previous reports showed the higher use of bark and the seed against diabetes, cholesterol, and kidney problems in Central America (Balick et al. 1994; Imafidon & Amaechina 2010). Currently, Aloe vera plays an important role for its pharmacology effectiveness to treat a high number of ailments such as skin problems, gastrointestinal, blood circulation problems, kidney problems, and malnutrition but with a wide use by people with diabetes in Central America (Giovannini et al. 2016). The use of *Aloe vera* has been spread along Latin American; and the easy management on its reproduction provided a cheap option to the industry and people to grow it. Additionally, the prevalence of new health problems faced in tropical areas such as dengue and Chikungunya is getting more common around the world, and the way to combat them is a challenge for the people; the local people use as strategy the water of coco to reduce the impact of dehydration with the effects caused by Chikungunya, they boiled the mangosleaves and mixed with the coco to drink and manage the fever caused by the mosquito.

Our findings are in line with Alonso-Castro et al. (2017), where the main reason why the people use medicinal plants in Mexico are related to their effectiveness, the low cost of usage and acquisition, but they use traditional medicine as complementary alternative to the modern medicine which is getting more common to treat the diseases in Mexico in the lasts decades (Robles-Zepeda et al. 2011).

Diseases of the reproductive system obtained the highest ICF in Zacatecas. The reproductive health constraints is a current problem in indigenous communities in Mexico and locals are accustomed to apply traditional medicine (Balleza & Enríquez 2007; Amsterdam et al. 2009; Geck et al. 2016; Smith-Oka 2012). Smith-oka (2012) confirmed the wide use of plants by indigenous Mexican women to treat the disequilibrium of reproductive hormones, complications during labor, pre/post-partum problems (Gänger 2015). In Zacatecas, 17 species are used traditionally for those purposes, and there is a great consensus on their

selection. However, this study noticed that the problems with reproductive systems have a vast health consequence and are not controlled easily by the local communities.

Considering the persistence of spiritual treatments in the study area, *Schinus molle* L., *Ocimum basilicum* L., *Mentha* x *piperita* L., *Thymus vulgaris* L., and *Rosmarinus officinalis* L. are used in a traditional ritual for cleaning the spirit.

8. CONCLUSIONS

The results showed the persistence of rich traditional knowledge on medicinal plants in the different studied communities. The TM still plays an important role in the cultural and environmental aspects, the Mexican population from rural and urban areas sare still recurring to the TM to treat many diseaas part of a strategy to solve comun problems, it is seen the tendency to use the TM to treat problems regarded to pre-post partum problems by indigenous women.

The local traditional Medicine practices are evolving and incorporating non-locals plants into the herbal remedies and a lot of exotic plants right now are the most used plants by the loclas.

In terms of acquisition of plant resources, we found that majority of medicinal plants is obtained by collecting wild resources, which on the other hand might causes an exhaustion of certain plant species in the future, and culturally-sensitive development projects with sustainable cultivation of medicinal and aromatic plants might be considered to be developed in the region. It is necessary to develop new strategies for conservation of the medicnal plants, as well as to try to incorporate a harvesting program.

The gastrointestinal and respiratory problems are the most recurrent problems in the communities due to the bad hygienic. Moreover, the category of gastrointestinal disorders was one of the category most frequently treated by plants and include also the highest diversity of species. We did not find significant differences in traditional knowledge among different demographic groups, the knowledge and use of plants is not homogenous in the areas.

This study is the first report about the ethnobotanical inventory of medicinal plant used in the state of Zacatecas. The study found that the region still retains important reservoir of medicinal plant knowledge. Surprisingly, respondents from sub-urban areas showed to have richer plant knowledge than their rural counterparts. This is related to a better market access, where additional mostly exotic medicinal species are being purchased along with transfer of new plant knowledge. Women showed to be slightly more knowledgeable than men.

In Veracruz the promotion of medicinal plants is better conformed and carried by the own population. The locals are using more local species than the other two communities and the ehtnomedicine practices are established and well known, many tourist visit this place due to the known backgrounds regarded to the ethnomedicine practices.

In Chiapas the communities present a certain degree of isolation where the lack of health institutions is easealy seen, the problems for the locals in delivering children is moslty carried by midwifes. The ethnomedicine is promoted in closed groups and to get access to the traditional knowledge is more hermetic for the foreigners than the other two regions.

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10. APPENDICES

Appendix 1. Photodocumentation of ethnobotanical data collection in Chiapas

Photo 1.Tsotsil midwife in Chiapas

Photo 2. Interview to the Tsotsil midwife in Chiapas

Photo 3. Interview with translator to a Tsotsil family

Photo 4. Interview in Tsotsil language

Appendix 2. Photodocumentation of ethnobotanical data collection in Veracruz

Photo 5. Women in the market of Papantla selling medicinal plants

Photo 6. Medicinal plants in the local Totonacapan market in Papantla, Veracruz

Photo 7. Medicinal plants grown in the backyard by the Totonac families

Photo 8. Informant in the middle of the interview bringing the medicinal plants used

Appendix 3. Photodocumentation of ethnobotanical data collection in Zacatecas

Photo 9. Interview in the local market in Zacatecas to a seller of medicinal plants

Photo 10. Informant interviewed in Zacatecas

Photo 11. Women interviewed in Zacatecas

Photo 12. Informant interviewed from Zacateca

Appendix 4. List of the medicinal plant species used by the informants in the Highlands in Chiapas, Mexico (Tsotsil indigenous group)

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Alliaceae	*Allium sativum* L. ALL-001	Ajo	Bulb	Rehumatism	Fresh	Tincture	5	5	0.08
Aloaceae	*Alloe vera* (L.) Burm F. ALO-001	Sábila	Leaves	Stomachache	Fresh	Lequefied	4	8	0.16
Apiaceae	*Daucus carota* L. API-001	Zanahoria	Leaves	Burns	Fresh	Squeezed	3		
				Skin disorders	Fresh	Squeezed	1		
				Eyes infection	Fresh	Squeezed	1		
	Foeniculum vulgare Mill. API-002	Hinojo	Leaves, stem	Heart problems	Fresh	Smashed	2	2	0.03
Asclepiadaceae	*Asclepias similis* Hemsl. ASC-001	Aponal mamol	Leaves	Evil eye	Fresh	Bath	1	1	0.02
Asteraceae	*Baccharis vaccinioids* Gardner AST-001	Meste	Leaves	Stomachache	Fresh	Boiled	7	11	0.19
				Rheumatism	Fresh	Cataplasm	3		
				Stomachache	Fresh	Boiled	1		
	Helianthus annuus L. AST-002	Girasol		Eyes infection		Boiled	2	2	0.03
	Matricaria chamomilla L. AST-003	Manzanilla	Whole plant	Stomachache	Dried	Boiled	16	25	0.42
				Fever	Fresh	Boiled	4		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
				Colics	Fresh	Boiled	5		
	Tagets erecta L. AST-004	Flor de cempasuchil	Flower, stem	Coff	Fresh	Boiled	2	3	0.05
				Flu	Fresh	Boiled	1		
	Taraxacum officinale F.H.Wigg. AST-005	Diente de león	Whole plant	Gastritis	Fresh	Bolied	4	9	0.15
				Coff	Fresh	Bolied	1		
				Flu	Fresh	Bolied	2		
Bignoniaceae	*Tithonia diversifolia* A.Gray BIG-001	Árnica	Leaves	Fatigue	Fresh	Bolied	2		
	Pithecoctenium echinatum (Jacq.) Baill.	Lengua de vaca	Leaves, stem	Muscle pain	Fresh, dried	Bath	1	1	0.02
	BIG-002			Gastritis	Fresh	Burned	2	3	0.05
Brassicaceae	*Brassica alba* (L.) Boiss. BRA-001	Mostaza	Leaves	Skin disorders	Fresh	Bath	1		
				Problemas de piel	Fresh	Squeezed	1	1	0.02
Burseraceae	*Bursera jorullensis* Engl. BUR-001	Copal	Bark	Coff	Dried	Boiled	2	2	0.03
	Bursera simaruba (L.) Sarg. BUR-002	Palo de jiote	Bark	Measles	Fresh	Boiled	1	2	0.03
				Skin disorders	Fresh	Boiled	1		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Cactaceae	*Opuntia ficus-indica* (L.) Mill. CAC-001	Nopal	Leaves	Gastritis	Fresh	Smashed	3	3	0.05
Cannabaceae	*Cannabis sativa* L. CAN-001	Marihuana	Whole plant	Rehumatism	Dried	Cataplasm	1	3	0.05
				Anxiety	Dried	Burned	1		
				wounds	Dried	Tincture	1		
Caprifoliaceae	*Sambucus mexicana* C.Prsl ex DC. CAP-001	Chisite	whole plant	Coff	Fresh	Boiled	6	6	0.1
Celastraceae	*Semialarium mexicanum* (Miers) Mennega CEL-001	Cancerina	Leaves, stem	Gastritis	Fresh	Boiled	1	1	0.02
Chenopodiaceae	*Chenopodium ambrosioides* L. CHE-001	Épazote	Whole plant	Diarrea	Fresh	Boiled	2	11	0.19
				Intestinal Worns	Fresh	Boiled	1		
	Teloxys ambrosioides (L.) W.A.Weber CHE-002	Épazote	Leaves	toothache	Fresh	Masticado	8	3	0.05
				Stomachache	Fresh	Boiled	9	9	0.15
Commelinaceae	*Tradscantia spathacea* Sw. COM-001	Maguey morado	Leaves	Wounds	Fresh	Bath	2	2	0.03
Crassulaceae	*Sedum morganianum* E.Walther CRA-001	Cola de borrego	Leaves	Eyes infection	Fresh	Squeezed	2	2	0.03
Cucurbitaceae	*Cucurbita ficifolia* Bouché CUC-001	Chilacayote	Fruit	Diabetes	Fresh	Boiled	3	3	0.05
	Sicyos deppei G.Don CUC-002	Cipress	Leaves	Diabetes	Fresh	Smashed	3	3	0.05

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Cyperaceae	*Cyperus hermaphrodytus* (Jacq) Sandi CYP-001	Tule	Leaves	Ulcers	Fresh	Boiled con lengua de vaca	2	2	0.03
Cyatheaceae	*Cyathea divergens* Kunze CYA-001	Pata de vivora	Fruit	kidney problems	Fresh	Bolied	3	3	0.05
Equisetaceae	*Equisetum hyemale* L. EQU-001	Cola de caballo	Stem	Problemas de riñon	Fresh	Boiled	1	1	0.02
Oleaceae	*Fraxinus americana* L. OLA-001	Fresno	Leaves, bark	Typhoid	Dried	Smashed	2	2	0.03
Fagaceae	*Quercus peduncularis* Née FAG-001	Encino	Leaves, stem	Skin disorders in the tongue	Dried	Boiled	1	2	0.03
				Stomachache	Fresh	Boiled	1		
Lamiaceae	*Mentha sativa* L. LAM-001	Hierbuena	Whole plant	Flu	Fresh	Boiled	12	21	0.36
				Typhoid	Fresh	Boiled	4		
				Diarrea	Fresh	Boiled	5		
	Rosmarinus officinalis L. LAM-002	Romero	Leaves, stem	Stomachache	Fresh, dried	Boiled	6	7	0.12
				Colics	Fresh, dried	Boiled	1		
	Salvia lavanduloides Kunth LAM-003	Salvia	Leaves	Coff	Fresh	Boiled	2	2	0.03
Lauraceae	*Thymus vulgaris* Willk. LAU-001	Tomillo	Leaves	Stomachache	Fresh, dried	Smashed	7	7	0.12
	Cinnamomum camphora (L.) J.Prsl LAU-002	Alcanfor	Leaves, stem	Coff	Fresh	Boiled	2	3	0.05

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
				Fever	Fresh	Boiled	1		
	Cinnamomum zeylanicum Breyne LAU-003	Canela	Stem	Coff	Dried	Boiled	6	6	0.1
	Litsea glaucescens Kunth LAU-004	Laurel	Leaves	Stomachache	Fresh, dried	Boiled	5	12	0.2
				Fever	Fresh, dried	Boiled	2		
				Flu	Fresh, Dried	Boiled	2		
				Headache	Fresh	Smashed	3		
	Persea americana Mill. LAU-005	Aguacate	Leave	Burns	Fresh	Cataplasm	2	2	0.03
Leguminosae	*Haematoxylum brasiletto* H.Karst. LEG-001	Arbol de brazil	Bark	Gastritis	Dried	Boiled	1	2	0.03
	Mimosa albida Humb. & Bonpl. ex Willd. LEG-002	Mora	Fruit	kidney problems	Dried	Boiled	1		
				Fatigue	Fresh	Boiled	1	2	0.03
			Root	Corporal pain	Dried	Boiled	1		
Meliaceae	*Azadirachta indica* A.Juss. MEG-001	Neem	Leaves	Strengthen of body	Fresh	Boiled	3	3	0.05
Moringaceae	*Moringa oleifera* Lam. *MOR-001*	Moringa	Leaves, stem	Anxsiety	Fresh	Infusion	2	2	0.03
Myrtaceae	*Psidium guajava* L. MYR-001	Guayaba	Leaves, fruit	Ulceras	Fresh	Boiled	2	2	0.03
	Psidium guineense Sw. MYR-002	Manzanillo	Leaves, fruit	Problemas gastricos	Fresh	Boiled	2	2	0.03

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Nyctaginaceae	*Bougainvilliea glatra* Choisy NYC-001	Bugambilia	Flower	Gripa	Fresh	Boiled	1	1	0.02
Papaveraceae	*Bocconia frutescens* L. PAP-001	Drago amargo	Leaves, stem, flower	Stomachache	Fresh	Boiled	2	2	0.03
Passifloraceae	*Passiflora sexocellata* Schltdl PAS-001	Leaves de granadilla	Leaves	Colsterol	Fresh	Smashed	1	2	0.03
			Leaves	Fever	Fresh	Boiled	1		
Piperaceae	*Piper auritum* Kunth PIP-001	Santa maria	Leaves, stem	Malnutrition	Fresh	Boiled	7	11	0.19
				Hermorroids	Fresh	Boiled	4		
Poaceae	*Cymbopogon citratus* Stapf POA-001	Zacate	Leaves	Snake bite	Fresh	Boiled	1	12	0.21
		Te limon	Leaves	Flu	Fresh	Infusion	11		
	Zea maiz Vell. POA-002	Pelo de elote	Leaves, stem	Prostate	Fresh	Infusion	3	6	0.1
				kidney problems	Fresh	Infusion	2		
				Colitis	Fresh	Infusion	1		
Rosaceae	*Eriobotrya japonica* (Thunb.) Lindl. ROS-001	Nispero	Leaves	Diabetes	Fresh	Boiled	3	3	0.05
	Prunus avium L. ROS-002	Root de cerezo	Root	Toothache	Fresh, dried	Boiled	1	1	0.02
	Prunus persica (L.) Batsch ROS-003	Durazno	Leaves	Diarrhea	Fresh	Boiled	2	4	0.07

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
				Circulation problems in the feet	Fresh	Bath	2		
Rutaceae	*Ruta graveolens* L RUT-001	Ruda	Leaves, stem	Stomachache	Fresh	Boiled	8	18	0.31
				Low pressure	Fresh	Boiled	7		
				Menstruation problems	Fresh	Boiled	3		
Sapotaceae	*Achras zapota* L. SAP-001	Chico zapote	Leaves, stem	Diabetes	Fresh	Boiled	1	1	0.02
Solanaceae	*Nicotiana tabacum* L. SOL-001	Ajo with Tabaco	Leaves	sneak bite	Fresh	Smashed	1	5	0.08
				Reumas	Fresh	Burned	3		
				Stomachache	Fresh	Smashed	1		
	Solanum torvum Buch.-Ham. ex Wall.	Sosa blanca	Leaves, stem	Hypertension	Fresh, Dried	Boiled	2	3	0.05
	SOL-002			Colsterol	Fresh, Dried	Boiled	1		
Sterculiaceae	*Guazuma ulmifolia* Lam. STE-001	Caulote	Fruit	Stomachache	Fresh	Smashed	1	2	0.03
				Diarrhea	Dried	Boiled	1		
Zingiberaceae	*Zingiber officinale* Roscoe	Gengibre	Root	Flu	Fresh	Boiled	4	6	0.1
	ZIN-001			Flu	Fresh	Boiled	2		

* RU = Number of use report per disease

** RU = Total number of use reports per species cited

*** CI = Use report by species cited / Total number of informants

Appendix 5. List of the medicinal plant species used by the informants in Veracruz, Mexico (Totonac indigenous group)

Family	Scientific name	Vernacular name	Used Parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***IC
Amaranthaceae	*Beta vulgaris* L.	Betabel	Root	Intestinal worms	Fresh	Raw	1	2	0.024
	AMA-001			Stomachache	Fresh	Infusion	1		
Amaryllidaceae	*Allium cepa* L.	Cebolla morada	Root	Erection	Fresh	Crushed	1	6	0.071
	AMAR-001			Kidney problem	Fresh	Crushed	1		
				Veterinary fever in chicken	Fresh	Smashed	4		
	Allium sativum L.	Ajo	Root	Blood circulation	Fresh	Infusion	3	19	0.224
	AMAR-002			Cold	Fresh	Infusion	2		
				Grains in the skin	Fresh	Bath	2		
			Root	Liver problems	Fresh	Microdosis	1		
				Rehumatism	Fresh	Tincture	5		
				Snake bitten	Fresh	Tincture	1		
			Leaves	Stomachache	Fresh	Infusion	3		
				Tooth pain	Fresh	Raw	2		
Anacardiaceae	*Spondias mombin* L.	Jobo	Bark	Alcoholic drink	Dried	Fermented	1	9	0.106
	ANA-001			Flu	Dried	Decocted	6		
				Tooth pain	Dried	Decocted	2		
Annonaceae	*Annona glabra* L.	Anona	Leaves	Diarrea	Fresh	Infusion	7	19	0.224
	ANN-001		Fruit	Drink	Fresh	Infusion	3		
			Leaves	Stomachache	Fresh	Infusion	4		
			Fruit	To have children	Dried	Squeezed	3		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
			Leaves	To have children	Fresh	Infusion	2		
	Mangifera indica L ANN-002	Mango	Seed	Diarrea	Fresh	Decocted	4	4	0.047
Apiaceae	*Cuminum cyminum* L. API-001	Comino	Leaves	Diarrea	Dried	Boiled	6	6	0.071
	Apium graveolens L.	Guanabana	Leaves	Cancer	Fresh	Infusion	7	32	0.376
	API-002		Leaves	Diabetes	Fresh	Infusion	6		
			Leaves	High pressure	Fresh	Infusion	11		
		Apio and zanahoria	Stem	Cholesterol	Fresh	Liquiefied	8		
Apocynaceae	*Pentalinon andrieuxii* (Müll.Arg.) B.F.Hansen & Wunderlin	Guaco enredadera	Root	Snake bitten	Dried	Tincture	13	13	0.153
	APO-001								
	Rauvolfia tetraphylla L. APO-002	Cancerina	Leaves	Cancer	Fresh	Infusion	11	11	0.129
	Tradescantia spathacea Sw.	Maguey morado	Leaves	Skin inffection	Fresh	Bath	3		
	APO-003			Wounds and brusses	Fresh	Cataplasm	8		
	Ruta graveolens L. APO-004	Ruda	Leaves	Abortive	Fresh	Infusion	6		
Arecaceae	*Cocos nucifera* L.	Coco	Leaves	Blood Circulation	Fresh	Raw	3	16	0.188
	ARE-001			Chinkunguya	Fresh	Raw	5		
				Dengue	Fresh	Raw	6		
			Bark	Stop bleeding in the parthum	Fresh	Decocted	2		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Acrocomia aculeata (Jacq.) Lodd. ex Mart.	Coyol redondo Palma	Root	Diabetes	Dried	Infusion	3	6	0.071
	ARE-002		Bark	Eyes problem	Dried	Decocted	3		
Asclepiadaceae	*Asclepias curassavica* L.	Hierva del sapo	Leaves	Cancer	Fresh	Decocted	16	27	0.318
	ASC-001		Leaves	Diabetes	Dried	Infusion	5		
			Leaves	Kidney problem	Fresh	Decocted	6		
Asteraceae	*Artemisia ludoviciana* Nutt. AST-002	Estafiate	Stem	Cholesterol	Fresh	Infusion	12	12	0.141
	Calea ternifolia Oliv. ex Thurn ASC-003	Zacate chichi	Leaves stem, Flower	Bile	Fresh	Infusion	5	17	0.200
				Diabetes	Fresh	Infusion	12		
	Cyclolepis genistoides D. Don AST-004	Palo azul	Bark	Kidney problem	Dried	Decocted	4	4	0.047
	Gnaphalium viscosum Kunth AST-005	Gordolobo	Whole Plant	Coff	Fresh	Infusion	2	2	0.024
	Matricaria chamomilla L. AST-006	Manzanilla	Whole Plant	Colic pain	Fresh	Decocted	16	34	0.400
			Leaves	Eyes problem	Fresh	Bath	4		
			Whole Plant	Stomachache	Fresh	Decocted	14		
	Parthenium hysterophorus L.	Chuchullate con tres Hojitas	Stem	Anemy	Fresh	Decocted	1	13	0.153
	AST-007		Leaves	Diabetes	Fresh	Infusion	7		
			Leaves	Wounds	Fresh	Bath	2		
				Wounds	Fresh	Decocted	3		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Tagetes erecta L. AST-008	Flor de muerto	Root	Stomachache	Dried	Decocted	6	6	0.071
	Verbesina persicifolia D.C	Huichin	Leaves	Diabetes	Fresh	Infusion	9	23	0.271
	AST-009		Leaves	Gastritis	Fresh	Decocted	1		
			Root	High pressure	Fresh	Decocted	9		
			Root	Inflamation	Fresh	Bath	4		
Bignoniaceae	*Parmentiera aculeata* (Kunth) Seem.	Chote, Chiote	Flower	Veterinary uses	Fresh	Decocted	7	14	0.165
	BIG-001			Kidney problem	Fresh	Decocted	7		
	Tecoma stans (L.) Juss. ex Kunth BIG-002	Tronadora (Hoja de San Pedro)	Leaves	Infection in skin	Fresh	Burned	2	2	0.024
Brassicaceae	*Nasturtium officinale* R. Br. BRA-001	Berros	Leaves	Anemy	Fresh	Bath	3	3	0.035
Burseraceae	*Bursera simaruba* (L.) Sarg. BUR-001	Chaca	Leaves	Fever	Fresh	Cataplasm	45	45	0.529
Cactaceae	*Opuntia ficus-indica* (L.) Mill.	Nopal	Leaves	Cholesterol	Fresh	Liquiefied	2	12	0.141
	CAC-001			Clean stomach	Fresh	Liquiefied	8		
				Diabetes	Fresh	Decocted	2		
Cannabacea	*Cannabis sativa* L. CAN-001	Marihuana	Whole Plant	Rehumatism	Fresh	Tincture	9	9	0.106
	Trema micrantha (L) Blume	Puam	Leaves	Chicken Pox	Fresh	Bath	8	14	0.165
	CAN-002			Zarampion	Fresh	Bath	6		
Caricaceae	*Carica papaya* L. CAR-001	Papaya	Stem	Pain in ears	Fresh	Burned	5	5	0.059

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Chenopodiaceae	*Chenopodium ambrosioides*	Épazote	Leaves	Intestinal worms	Fresh	Infusion	13	25	0.294
	CHE-001			Stomachache	Fresh	Infusion	12		
Commelinaceae	*Tradescantia spathacea* Sw.	Barquilla	Leaves	Grains in the mouth	Fresh	Squeezed	3	31	0.365
	COM-001			Kidney Problem	Fresh	Infusion	8		
				Respiratory sistem	Fresh	Infusion	8		
				Wounds	Fresh	Burned	1		
Cucurbitaceae	*Cucurbita pepo* L. CUC-001	Calabaza	Latex	Scratches, wounds	Fresh	Squeezed	4	4	0.047
	Sechium edule (Jacq.) Sw. CUC-002	Chayote	Fruit	Cholesterol	Fresh	Decocted	12	12	0.141
Euphorbiaceae	*Cnidoscolus chayamansa* Mc Vaugh EUP-001	Chaya	Leaves	High pressure	Fresh	Boiled	7	7	0.082
	Cnidoscolus tubulosus (Müll.Arg.) I.M.Johnst.	Hortiga macho con espina	Root	Kidney problem	Dried	Decocted	5	18	0.212
	EUP-002		Stem	Kidney Problem	Fresh	Infusion	6		
			Latex	Tooth pain	Fresh	Raw	7		
	Euphorbia hirta L. EUP-003	Riñonina	Leaves	Kidney problem	Fresh	Infusion	6	6	0.071
	Jatropha curcas L.	Piñon	Latex	Bleeding of gums	Fresh	Topical raw	4	7	0.082
	EUP-004		Leaves	Acne	Fresh	Bath	1		
			Latex	Herpes	Fresh	Topical raw	2		
Fabaceae	*Bauhinia divaricata* L.	Pata de vaca	Leaves	Diabetes	Fresh	Infusion	4	9	0.106
	FAB-001			Diarrea	Fresh	Infusion	3		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
		Mixed with Crushed rice	Whole Plant	Disentery	Fresh	Decocted	1		
			Leaves	Grains in the skin	Fresh	Bath	1		
	Cassia fistula L. FAB-002	Hojasén	Leaves	Colitis	Fresh	Infusion	3	3	0.035
	Erythrina caribaea Krukoff & Barneby FAB-003	Pichoco	Bark	Push delivering in parthum	Fresh	Decocted	2	2	0.024
	Eysenhardtia polystachya (Ortega) Sarg FAB-004	Tarai (Palo azul)	Bark	Kidney problem	Dried	Infusion	5	5	0.059
	Gliricidia sepium (Jacq.) Walp FAB-005	Cocohuite	Leaves	Fever	Fresh	Tincture	2	2	0.024
	Leucaena leucocephala (Lam.) de Wit FAB-006	Guaje	Fruit	Intestinal orms	Fresh	Raw	4	4	0.047
Geraniaceae	*Pelargonium* spp. GER-001	Malva with hortiga	Leaves	Chicken pox	Fresh	Decocted	1	2	0.024
				Grains	Fresh	Decocted	1		
Lamiaceae	*Mentha spicata* L.	Hierva buena	Leaves	Colic pain	Fresh	Infusion	14	33	0.388
	LAM-002			Stomachache	Fresh	Decocted	19		
	Ocimum basilicum L.	Albacahar	Leaves	Anxiety	Fresh	Raw	7	25	0.294
	LAM-003			Bad wind	Fresh	Raw	3		
				Dizzy	Fresh	Infusion	9		
				Evil eye	Fresh	Bath	4		
				High pressure	Fresh	Infusion	1		
				Nausea	Fresh	Infusion	1		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Salvia spp. LAM-003	Salvia	Leaves	Spasm	Fresh	Decocted	2	2	0.024
	Cinnamomum verum J.Presl	Mango with canela	Leaves	Abortive	Fresh	Decocted	2	12	0.141
	LAM-004			Chinkunguya	Fresh	Decocted	2		
				Coff	Fresh	Decocted	1		
				Colic pain	Fresh	Decocted	5		
				Drink	Fresh	Decocted	2		
Lauraceae	*Persea americana* Mill.	Aguacate	Seed	Abortive	Fresh	Decocted	5	58	0.682
	LAU-001		Leaves	Diarrea	Fresh	Infusion	19		
			Seed	Kidney problem	Fresh	Liquiefied	3		
			Leaves	Nausea	Fresh	Infusion	2		
			Leaves	Stomachache	Fresh	Infusion	29		
Loranthaceae	*Struthanthus crassipes* (Oliver) Eichl.	Secapalo	Leaves	Skin disorders	Fresh	Decocted	7	15	0.176
	LOR-001			Kidney problem	Fresh	Decocted	7		
				Wounds	Fresh	Bath	1		
Malvaceae	*Guazum aulmifolia* Lam.	Guazima	Bark	Colitis	Dried	Decocted	5	21	0.247
	MAL-001		Bark	Diabetes	Dried	Decocted	4		
			Bark	Diarrea	Dried	Decocted	4		
			Fruit	Drink	Fresh	Squeezed	2		
			Bark	Stomachache	Dried	Decocted	4		
			Leaves	Veterinary	Fresh	Raw	2		
	Heliocarpus appendiculatus Turcz. MAL-002	Jonote	Latex	Wounds	Dried	Topical raw	4	4	0.047

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Sida rhombifolia L. MAL-003	Malva with albacahar	Leaves	Bad wind	Fresh	Raw	1	5	0.059
			Stem	Ritual	Fresh	Raw	4		
	Sphaeralcea angustifolia(Cav.) G.Don MAL-004	Hierva Del Negro	Whole Plant	Bad wind	Fresh	Raw	15	15	0.176
Meliaceae	*Azadirachta indica* A. Juss. MEL-001	Neem	Fruit	Diabetes	Fresh	Infusion	18	18	0.212
	Cedrela odorata L. MEL-002	Cedro	Bark	Abortive	Dried	Decocted	4	8	0.094
			Bark	Fever	Dried	Decocted	1		
			Leaves	Inflamation	Fresh	Decocted	1		
			Bark	Problem to have children	Dried	Decocted	2		
	Melia azedarach L. MEL-003	Piocha	Leaves	Diabetes	Fresh	Infusion	8	8	0.094
Monimiaceae	*Peumus boldus* Molina MON-001	Boldo	Leaves	Colitis	Fresh	Infusion	4	4	0.047
Moraceae	*Morus celtidifolia* Kunth MOR-001	Mora	Leaves	Chinkunguya	Fresh	Decocted	2	3	0.035
			Leaves	Tooth pain	Fresh	Raw	1		
Moringaceae	*Moringa oleifera* Lam. MORI-001	Moringa	Leaves	Cancer	Fresh	Decocted	1	7	0.082
			Leaves	Diabetes	Fresh	Decocted	6		
Musaceae	*Musa* spp. MUS-001	Platano	Bark	Respiratory sistem	Fresh	Decocted	2	9	0.106
			Bark	Tuberculosis	Fresh	Fermented	7		
Myrsinaceae	*Ardisia compressa* Kunth MYR-001	Capulin with nona	Leaves	Stomachache	Fresh	Infusion	5	8	0.094

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
			Leaves	Wounds	Fresh	Bath	3		
Myrtaceae	*Eucalyptus globulus* Labill MYR-001	Eucalipto	Leaves	Bronchitis	Fresh	Decocted	3	3	0.035
	Pimenta dioica (L.) Merr. MYR-002	Pimiento	Leaves	Flu	Fresh	Decocted	3	3	0.035
	Psidium guajava L.	Guayaba	Leaves	Diarrea	Dried	Decocted	16	30	0.353
	MYR-003		Bark	Flu	Dried	Decocted	14		
	Syzygium aromaticum (L.) Merr. & Perry MYR-004	Clavo	Seed	Tooth pain	Dried	Topical raw	5	5	0.059
Nyctaginaceae	*Bougainvillea glabra* Choisy NYC-001	Bugambilia	Flower	Coff	Fresh	Infusion	19	19	0.224
Orchidaceae	*Vanilla planifolia* Jacks. ex Andrews	Vainilla	Fruit	Drink	Fresh	Fermented	2	11	0.129
	ORC-001		Fruit	Drink	Fresh	Raw	6		
			Fruit	Menopause	Fresh	Tincture	1		
			Leaves	Menopause	Fresh	Decocted	2		
Papaveraceae	*Fumaria officinalis* L. PAP-001	Sangre de Cristo	Leaves	Wounds	Fresh	Bath	3	3	0.035
Passifloraceae	*Passiflora coriacea* Juss. PAS-001	Hierva del murcielago	Leaves	Kidney problem	Fresh	Decocted	6	6	0.071
Pedaliaceae	*Sesamum indicum* L. PED-001	Ajonjoli	Seed	Breastfeeding	Dried	Decocted	15	15	0.176
Piperaceae	*Peperomia granulosa* Trel.	Gordonzillo (Acoyo)	Root	Breastfeeding	Fresh	Decocted	5	17	0.200
	PIP-001		Stems	Menstruation	Fresh	Decocted	4		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
			Root	To Have children	Fresh	Decocted	8		
			Leaves	Cirrhosis	Fresh	Infusion	1	15	0.176
			Leaves	Rehumatism	Fresh	burned	9		
		Acoyo with ajo	Leaves	Respiratory sistem	Fresh	Infusion	5		
	Piper sanctum (Miq.) Schltdl. ex C.DC. PIP-001	Hierva Santa	Leaves	Clean baby and posparthum	Fresh	Decocted	2	2	0.024
Plantaginaceae	*Plantago major* L. PLA-001	Llanten	Leaves	Skin problems	Fresh	Decocted	15	15	0.176
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Zacate limon	Leaves	Drink	Fresh		7	7	0.082
	Pachystachys spicata (Rui z & Pav.) Wassh.	Mohuite	Stem	Bad wind	Fresh		1		
	POA-001		Leaves	Epilepsy	Fresh	Decocted	3		
				Kidney problem	Fresh	Decocted	12		
				Nausea	Fresh	Infusion	1		
	Phalaris canariensis L. POA-002	Alpistle	Seed	Diabetes	Fresh	Liquiefied	9	9	0.106
	Zea maiz L.	Maiz morado	Seed	Alcoholic drink	Fresh	fermented	3	17	0.200
	POA-003	Pelo de maiz	Fruit	Kidney problem	Fresh	Infusion	14		
Portulacaceae	*Portulaca oleraceae* L. POR-001	Verdolaga	Leaves	Blood circulation	Fresh	Burned	2	2	0.024
Rosaceae	*Eriobotrya japonica* (Thu nb.) Lindl. ROS-001	Nispero	Leaves	Kidney problem	Fresh	Decocted	2	2	0.024
	Prunus domestica L.	Ciruela	Leaves	Rush	Fresh	Smashed	4	6	0.071
	ROS-002			Smallpox	Fresh	Bath	2		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Rubiaceae	*Hamelia patens* Jacq.	Tres hojitas	Leaves	Anemy	Fresh	Infusion	3	77	0.906
	RUB-001			Blood circulation	Fresh	Decocted	7		
				Breastfeeding	Fresh	Burned	6		
				Cancer	Dried	Decocted	9		
				Colitis	Fresh	Decocted	4		
				Diabetes	Fresh	Decocted	7		
				Diabetes	Fresh	Infusion	11		
				Gastritis	Fresh	Infusion			
				Gastritis	Fresh	Decocted	8		
				High pressure	Fresh	Infusion	1		
				Menstruation	Fresh	Decocted	2		
			Root	Respiratory sistem	Dried	Decocted	7		
				Skin problems, fungus	Fresh	Squeezed	2		
				Ulcers	Fresh	Decocted	5		
				Wounds	Fresh	Bath	5		
	Morinda citrifolia L.	Noni	Fruit	Diabetes	Fresh	Liquiefied	10	12	0.141
	RUB-002			Heart problems	Fresh	Squeezed	2		
Rutaceae	*Casimiroa edulis* La Llave	Zapote blanco	Leaves	Cholesterol	Fresh	Infusion	3	10	0.118
	RUT-001		Latex	Chuin gum	Dried	Raw	2		
			Bark	Diabetes	Dried	Boiled	1		
			Leaves	Fever	Fresh	Infusion	2		
			Bark	Kidney problem	Dried	Decocted	2		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Citrus aurantiifolia (Christm.) Swingle RUT-002	Azares de naranjo	Leaves	Anxiety	Fresh	Decocted	3	3	0.035
	Citrus× aurantium L.	Naranja cucha	Leaves	Anxiety	Fresh	Decocted	9	14	0.165
	RUT-003			Coff	Fresh	Decocted	4		
			Fruit	Diabetes	Fresh	Liquiefied	1		
	Citrus limetta Risso	Lima chichi	Fruit	High pressure	Fresh	Decocted	3	12	0.141
	RUT-004			Infection in eyes	Fresh	Squeezed	9		
	Citrus medica L. RUT-005	Limón	Fruit	Coff	Fresh	Infusion	14	14	0.165
	Citrus sinensis (L.) Osbeck	Naranja	Leaves	Anxiety	Fresh	Infusion	6	11	0.129
	RUT-006			Flu	Fresh	Infusion	5		
	Murraya paniculata (L.) Jack	Limonaria	Leaves	Diabetes	Fresh	Squeezed	2	3	0.035
	RUT-007			Tooth pain	Fresh	Decocted	1		
	Ruta graveolens L.	Ruda	Leaves	Colitis	Fresh	Infusion	3	32	0.376
	RUT-008			Evil eye	Fresh	Raw	3		
				Gastritis	Fresh	Infusion	4		
				High pressure	Fresh	Infusion	4		
				Menstruation	Fresh	Infusion	8		
				Pain in ears	Fresh	Infusion	3		
				Pain in the chest	Fresh	Infusion	1		
Sapotaceae	*Manilkara chicle* (Pittier) Gilly SAP-001	Zapote chico and guia del chayote	Leaves	Cholesterol	Fresh	Infusion	4	7	0.082
				Diabetes	Fresh	Infusion	1		
				High pressure	Fresh	Infusion	2		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
	Pouteria sapota (Jacq.) H.E. Moore & Stearn.	Zapote rebentador	Bark	Diabetes	Dried	Decocted	4	7	0.082
	SAP-002		Fruit	Diarrea	Fresh	Squeezed	2		
			Leaves	Nausea	Fresh	Decocted	1		
Smilacaceae	*Smilax mollis* Humb. & Bonpl. ex Willd. SMI-001	Cocolmecate (Bejuco enredadera)	Root	Diabetes	Dried	Decocted	4	7	0.082
			Root	Gastritis	Dried	Decocted	1		
			Bark	Loss weight	Dried	Decocted	2		
Solanaceae	*Physalis ixocarpa* Brot. ex Hornem SOL-001	Tomate	Leaves	Kidney problem	Fresh	Infusion	4	4	0.047
Urticaceae	*Cecropia obtusifolia* Bertol. URT-001	Hormiguillo (Nihuiya)	Bark	Diabetes	Dried	Decocted	2	2	0.024
Verbenaceae	*Lippia duartei* Moldenke VER-001	Hierva dulce	Whole Plant	Diabetes	Dried	Decocted	1	2	0.024
			Leaves	Diarrea	Dried	Decocted	1		
	Lippia graveolens Kunth VER-002	Orégano	Leaves	Respiratory sistem	Dried	Infusion	4	4	0.047
Xanthorrhoeacea e	*Aloe vera* (L.) Burm.f. XAN-001	Sábila	Leaves	Gastritis	Fresh	Raw	7	33	0.388
				Hair problems	Fresh	Smashed	6		
				Inflamation	Fresh	topical raw	3		
			Whole plant	Ulcers	Fresh	Infusion	3		
				Wounds	Fresh	topical raw	11		
				Anemy	Fresh	Infusion	1		
				Chinkunguya	Fresh	Infusion	2		

Family	Scientific name, Voucher specimen	Vernacular name	Used parts	Diseases	State of plant material	Prepara-tion mode	*UR	**UR	***CI
Zingiberaceae	*Costus spicatus* (Jacq.) Sw.	Caña de jabali	Stem	Kidney problem	Dried	Infusion	21	22	0.259
	ZIG-001	Caña de jabali with root of Chiote	Root	Hepatitis	Dried	Decocted	1		
	Zingiber officinale Roscoe	Gengibre	Root	Anemy	Fresh	Decocted	1	11	0.129
	ZIG-002			Blood circulation	Fresh	Decocted	2		
				Clean the blood	Fresh	Raw	3		
				Colic Pain	Fresh	Decocted	1		
				Estomachache	Fresh	Decocted	1		
				Intestinal Worm	Fresh	Decocted	2		
				Inflamation	Fresh	Decocted	1		

* RU = Number of use report per disease

** RU = Total number of use reports per species cited

*** CI = Use report by species cited / Total number of informants

Appendix 6. List of the medicinal plant species used by the informants in Zacatecas State, Mexico

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Acanthaceae	*Justicia spicigera* Schltdl. ACA-001	Muicle	Leaves, stem	Urinary tract infections	Oral	Infusion	1	0.010
Amaranthaceae	*Beta vulgaris* L. AMA-001	Betabel	Stem, root	Hypertension, diabetes	Oral	Decocted	2	0.010
	Chenopodium graveolens Willd. AMA-002	Épazote	Whole plant, leaves, stem	Intestinal parasites, food, cough, respiratory system	Oral	Infusion	10	0.080
	Aerva sanguinolenta (L.) Blume AMA-003	Escancel	Leaves, stem	Respiratory system, pneumonia	Oral	Decocted	1	0.020
	Amaranthus hypochondriacus L. AMA-004	Amaranto	Leaves	Circulatory system, urinary problems	Oral	Liquefied	2	0.010
	Iresine diffusa Humb. & Bonpl. ex Willd. AMA-005	Hierba de arlomo	Leaves	Antidote, arlomo bite	Topical	Crushed	1	0.010
Amaryllidaceae	*Allium sativum* L. AMA-006	Ajo	Root	Intestinal parasites, antibacterial Rheumatism, skin problems	Oral Topical	Crushed, Tincture, Plasted	17	0.130

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Anacardiaceae	*Allium cepa* L. AMA-007	Cebolla	Root	Respiratory system	Oral	Infusion	2	0.020
	Mangifera indica L. ANA-001	Mango	Leaves	Bleeding gums	Oral	Infusion	2	0.020
	Amphipterygium adstringens (Schltdl.) Standl. ANA-002	Cuachala-late	Bark Leaves	Problems of urinary tract System Cough, flu, bronchitis, Fever Bronchitis	Oral	Decocted	5	0.050
	Schinus molle L. ANA-003	Pirul	Leaves	Rheumatism, ritual (clean the spirit), sore throat	Oral Topical	Decocted Tincture	8	0.140
Annonaceae	*Annona muricata* L. ANN-001	Guanabana	Leaves	Hematopoietic	Oral	Infusion	1	0.010
Apiaceae	*Coriandrum sativum* L. API-001	Cilantro	Leaves, stem	Sexual impotence, circulatory system	Oral	Oil	3	0.020
	Ligusticum porteri J.M. Coult. & Rose API-002	Hierva del cochino	Whole plant	General pain in the body	Oral	Infusion	1	0.010
	Petroselinum crispum (Mill.) Fuss API-003	Perejil	Leaves, stem	Hypertension	Oral	Infusion	1	0.010
	Eryngium heterophyllum Engelm. API-004	Hierva del sapo	Whole plant	Kidney problems, hemorrhoids, circulatory system, diabetes, cholesterol in the blood	Oral	Infusion	40	0.300

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Foeniculum vulgare Mill. API-005	Hinojo	Whole plant	Stomachache	Oral	Infusion	2	0.020
	Apium graveolens L. API-006	Apio	Leaves, stem	Stomachache	Oral	Infusion	2	0.010
Apocynaceae	*Vinca minor* L. APO-001	Pervinca	Flower, leaves	Stop lactation, hemorrhoids	Oral	Infusion	2	0.020
Arecaceae	*Cocos nucifera* L. ARE-001	Palma de coco	Fruit	Intestinal parasites, baldness	Oral, topical	Liquefied	3	0.020
Aristolochiaceae	*Aristolochia ringens* Vahl ARI-001	Guaco	Root	Antidote, snakebite	Topical	Paste	1	0.010
Agavaceae	*Agave spp*. Aga-001	Maguey	Leaves	Blows, bruises	Oral	Paste	4	0.030
Asteraceae	*Bidens pilosa* L. AST-001	Aceitilla	Leaves, flower	Urine tract infection, body pain, blows, food	Oral	Infusion	5	0.040
	Artemisia laciniata Willd. AST-002	Ajenjo, cenizo	Stem	Nerves, stomachache, bitter mouth, bile	Oral	Infusion	6	0.070
	Tagetes filifolia Lag. AST-003	Anis	Flower, seed	Bronchitis	Oral	Infusion	1	0.010
	Arnica montana L. AST-004	Árnica	Whole plant,	Gastritis, stomachache	Oral,	Decocted	62	0.490
			Flower, leaves	Body pain	Topical	Bath/wash		
	Cyclolepis genistoides D.Don AST-005	Baraduz	Leaves, steam	Kidney problems	Oral	Infusion	2	0.010
	Calendula sp. AST-006	Calendula	Flower, leaves	Sore and wounds	Topical	Cataplasm	2	0.020

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Flourensia cernua DC. AST-007	Leavesen	Leaves	Gastrointestinal problems, diarrhea	Oral	Crushed	6	0.060
	Brickellia cavanilesii (Cass.) A. Gray AST-008	Prodigiosa	Leaves	Bile, chest pain, gastrointestinal problems	Oral	Infusion	11	0.140
	Tanacetum parthenium (L.) Sch.Bip. AST-009	Altamisa	Leaves, stem	Nerves, stress	Oral	Infusion	1	0.020
	Senecio formosus Kunth AST-010	Arnica morada	Whole plant	Blows, wounds, stones in the kidneys and to wounds in animals	Oral, Topical	Paste, Bath/wash	9	0.050
	Taraxacum officinale F.H.Wigg. AST-011	Diente de León	Flower	Liver problems	Oral	Infusion	4	0.030
	Haplopappus veneta (Kunth) Greene AST-012	Escobilla de perro	Leaves, root	Reduction of breastfeeding and stomachache	Oral	Infusion	7	0.050
	Artemisia ludoviciana Nutt. AST-013	Estafiate	Leaves, stem	Flu, headache, nerves, stress, gastrointestinal problems	Oral	Infusion	48	0.360
	Gnaphalium sp. AST-014	Gordolobo	Leaves	Bronchitis, sore throat, cough, flu	Oral	Infusion	35	0.420
	Parthenium hysterophorus L. AST-015	Hierva amargosa	Whole plant	Rheumatism	Topical	Decocted Bath/wash	2	0.020
	Parthenium bipinnatifidum (Ortega) Rollins AST-016	Hierva del gusano	Leaves, stem	Diarrhea	Oral	Infusion	1	0.010
	Tagetes lucida Cav. AST-017	Hiervanis	Whole plant	Headache, insomnia, diarrhea, pain in the chest	Oral	Infusion	28	0.210

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Baccharis salicina Torr. & A.Gray AST-018	Jarilla	Whole plant	Muscle relaxant	Topical	Paste, bath/wash	1	0.010
	Matricaria chamomilla L. AST-019	Manzanilla	Whole plant	Gastrointestinal problems, colic pain, fever, respiratory system, respiratory system, dysentery	Oral	Infusion	140	1.150
	Parthenium incanum Kunth AST-020	Mariola	Whole plant	Diabetes, gastrointestinal problems	Oral	Infusion	2	0.020
Bignoniaceae	*Tecoma stans* (L.) Juss ex Kunth BIG-001	Retama	Leaves, flower	Kidney problems	Oral	Infusion	2	0.020
	Crescentia alata Kunth. BIG-002	Jicaro	Leaves, stem	Asthma, to prepare childbirth	Oral	Infusion	3	0.020
Bixaceae	*Bixa orellana* L. BIX-001	Achiote	Seed	Burns,measles, external blows, bruises, inflammation of anginas	Topical	Crushed, cataplasm	4	0.03
Boraginaceae	*Ehretia tinifolia* L. BOR-001	Pinguica	Fruit,	Kidney problems	Oral	Infusion	2	0.020
	Heliotropium curassavicum L. BOR-002	Alacranzillo	Root	Asthma	Oral	Decocted	2	0.020
Brassicaceae	*Matthiola incana* (L.) R.Br. BRA-001	Aile	Leaves	Fever, blows, bruises, wounds	Topical	Infusion	3	0.020
	Nasturtium officinale R.Br. BRA-002	Berro	Whole plant	Respiratory system	Oral	Infusion	1	0.010
	Raphanus raphanistrum L. BRA-003	Rabano	Root	Liver problems	Oral	Infusion	2	0.020
Bromeliaceae	*Ananas comosus* (L.) Merr. BRO-001	Piña	Fruit	Heartache	Oral	Infusion	2	0.020

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Burseraceae	*Bursera simaruba* (L.) Sarg. BUR-001	Mulato	Bark	Urinary tract infections	Oral	Decocted	2	0.020
Cactaceae	*Opuntia ficus-indica* (L) Mill. CAC-001	Nopal	Leaves	Diabetes, weight-reducing, weakness of the body	Oral	Liquefied	22	0.170
	Pachycereus marginatus (DC.) Backeb. CAC-002	Organo	-	To dye the hair	Topical	-	2	0.020
	Opuntia joconostle F.A.C.Weber CAC-003	Xoconoxtle	Fruit	Cough	Oral	Infusion	1	0.010
	Cylindropuntia imbricata (Haw.) F.M.Knuth CAC-004	Cardenche	Root	Kidney problems	Oral	Decocted	1	0.010
	Stenocereus thurberi (Engelm.) Buxb. CAC-005	Pitayo	Flower	Diabetes	Oral	Infusion	1	0.010
	Echinocactus platyacanthus Link & Otto CAC-006	Biznaga	Stem	Circulatory system	Oral	Infusion	2	0.020
	Lophophora williamsii (Lem. ex Salm-Dyck) J.M. Coult. CAC-007	Peyote	Stem	Rheumatism	Topical	Tincture Infusion Cataplasm	12	0.150
Cannabaceae	*Cannabis sativa* L. CAN-001	Marihuana	Flower, leaves	Rheumatism, epilepsy, gastrointestinal problems, cancer, analgesic	Oral, topical	Tincture	10	0.090
Caprifoliaceae	*Valeriana edulis* Nutt. CAP-001	Valeriana	Root	Insomnia, anxiety, colic pain Chest Body Pain, imsomnia	Oral	Infusion Tincture	7	0.080

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Caryophyllaceae	*Drymaria gracilis* Schltdl. & Cham. CAR-001	Candelilla	Whole plant	Wounds, grains	Topical	Bath/wash	1	0.010
Celastraceae	*Semialarium mexicanum* (Miers) Mennega CEL-001	Cancerina	Leaves, Whole plant	Gastrointestinal problems, diarrhea, Louses	Oral	Infusion Decocted	3	0.020
Cistaceae	*Helianthemum glomeratum* (Lag.) Lag. ex dunal CIS-001	Hierva de la gallina	Leaves, Root	Indigestion	Oral	Infusion	10	0.080
Commelinaceae	*Tradescantia spathacea* Sw. COM-001	Maguey morado	Leaves	Vaginal infections	Topical	Decocted Bath/wash	2	0.020
Convolvulaceae	*Convolvulus stans* Michx. CON-001	Tumba vaqueros	Stem	Contraceptive, cramps of body, cough,	Oral	Infusion	1	0.030
	Dichondra argentea Humb. & Bonpl. ex Willd. CON-002	Orejuela de ratón	Leaves, root	Toothache	Oral	Decocted	2	0.020
Crassulaceae	*Sedum praealtum* A.DC. CRAS-001	Siempreviva	Leaves	Irritated eyes	Topical	Infusion	1	0.010
Cucurbitaceae	*Cucurbita pepo* L. CUC-001	Calabaza	Flower	Insomnia	Oral	Infusion	1	0.010
	Ibervillea sonorae (S. Watson) Greene CUC-002	Werreque	Leaves, stem, root	Diabetes	Oral	Pills, syrup	5	0.040
	Sechium edule (Jacq.) Sw. CUC-003	Chayote	Sprout leaves	Headache	Oral	Tincture	1	0.010

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Ebenaceae	*Diospyros nigra* (J.F.Gmel.)Perr. EBE-001	Zapote Prieto	Leaves	Cholesterol in blood	Oral	Infusion	2	0.020
Equisetaceae	*Equisetum myriochaetum* Schltdl. & Cham. EQU-001	Cola de caballo	Whole plant	Kidney problems	Oral	Infusion	6	0.040
Euphorbiaceae	*Jatropha curcas* L. EUP-001	Pinon	Fruit, root,	Weak gums, herpes in the mouth	Oral	Infusion,	2	0.020
	Euphorbia anychioides Boiss. EUP-002	Hierva golondrina	Leaves, stem, root	Cracks in lips,	Topical	Paste	5	0.060
Fabaceaae	*Senna multiglandulosa* (Jacq.) H.S.Irwin & Barneby FAB-001	Cedron	Leaves	Mixed with Tecoma stans for kidney problems	Oral	Infusion	2	0.020
	Medicago sativa L. FAB-002	Alfalfa	Leaves	Kidney problems, food	Oral	Crushed	3	0.030
	Myroxylon balsamum (L.) Harms FAB-003	Balsamo	Leaves	Asthma, sore throat, Rheumatism	Oral, Topical	Infusion Paste	2	0.020
	Dalea bicolor Humb. & Bonpl.ex Willd. FAB-004	Engordacabr as	Leaves, stem	Gastrointestinal problems	Oral	Infusion	2	0.020
	Pithecellobium dulce (Rox) Benth. FAB-005	Guachichila	Fruit, leaves	Flu, food	Oral	Infusion	2	0.020
	Zornia thymifolia Kunth FAB-006	Hierva de la vivora	Leaves, stem	Stomachache Flu and fever	Oral Topical	Infusion Bath/wash	18	0.140

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Indigofera suffruticosa Mill. FAB-007	Platanillo	Fruit, leaves	Asthma and wounds	Oral, topical	Infusion, topical	4	0.030
	Mimosa tenuiflora (Willd.) Poir. FAB-008	Tepezcohuite	Leaves, stem	Cough, wounds	Topical	Infusion, bath	2	0.020
	Mimosa albida Willd. FAB-009	Vergonzosa	Leaves	Kidney problems	Oral	Infusion	2	0.020
	Eysenhardtia polystachya (Ortega) Sarg. FAB-010	Palo azul	Stem, root	Stones in the kidneys	Oral	Tincture	11	0.080
	Acacia farnesiana (L.) Willd. FAB-011	Huisache	Leaves, flower	Colic pains	Oral	Decocted Tincture	6	0.050
Fagaceae	*Quercus stellata* Wangenh. FAG-001	Palo colorado	Bark	Pain in gums and herpes labial	Topical	Decocted	2	0.020
Ginkgoaceae	*Ginkgo biloba* L. GIN-001	Ginko vilova	Leaves	Anxiety, diabetes	Oral	Infusion	2	0.020
Juglandaceae	*Juglans regia* L. JUG-001	Nuez	Fruit peel Leaves	Bile	Oral	Decocted	3	0.020
Lamiaceae	*Ocimum basilicum* L. LAM-001	Albacahar	Whole plant	Headache	Oral	Infusion	17	0.150

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Salvia hispanica L. LAM-002	Chia	Seed	Urinary tract infections	Oral	Liquefied	1	0.010
	Mentha x piperita L. LAM-003	Menta, hierbabuena	Whole plant	Epilepsy, stomachache, ritual (clean the spirit)	Oral	Infusion	21	0.160
	Cunila lythrifolia Benth. LAM-004	Poleo	Leaves	Cough, hypertension, colic pain, to prepare childbirth	Oral	Infusion	17	0.140
	Mentha x verticillata L. LAM-005	Hierva-buena	Leaves	Stomachache, intestinal problems, diarrhea, cholesterol in the blood	Oral	Infusion,	55	0.480
	Marrubium vulgare L. LAM-006	Marrubio	Whole plant	Liver problems	Oral	Infusion	1	0.010
	Origanum majorana L. LAM-007	Mejorana	Whole plant	Headache, gastrointestinal problems, ough	Oral	Decocted	5	0.040
	Origanum vulgare L. LAM-008	Oregano	Leaves	Stomachache, colic pain, cough	Oral	Infusion	31	0.230
	Rosmarinus officinalis L. LAM-009	Romero	Leaves	To strengthen blood	Oral	Infusion	19	0.140
	Salvia microphylla Kunth LAM-010	Hierva del Indio	Leaves	Sight problems	Oral	Infusion	1	0.010
	Thymus vulgaris L. LAM-011	Tomillo	Leaves	Intestinal parasites, cough, diarrhea, gastrointestinal problems	Oral	Infusion	7	0.080
	Agastache mexicana (Kunth) Lint & Epling LAM-012	Toronjil	Whole plant	Insomnia	Oral	Infusion	2	0.020

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Lauraceae	*Persea americana* Mill. LAU-001	Aguacate	Leaves	Colic pains	Topical	Raw	3	0.020
	Cinnamomum verum J.Presl LAU-002	Canela	Stem	Colic pain, cough, flu and headache	Oral	Infusion	15	0.110
	Laurus nobilis L. LAU-003	Laurel	Leaves	Chest pain and headache	Oral	Infusion	12	0.090
Linaceae	*Linum usitatissimum* L. LAU-003	Linaza	Seed	Arthralgia	Oral	Crushed	1	0.010
Malvaceae	*Guazuma ulmifolia* Lam. MAL-001	Guasima	Root	Kidney problems	Oral	Infusion	1	0.010
	Hibiscus sabdariffa L. MAL-002	Jamaica	Flower	Circulatory system	Oral	Infusion	1	0.010
	Sida rhombifolia L. MAL-003	Malva	Leaves	Hormonal problems	Oral	Decocted	3	0.020
	Malva parviflora L. MAL-004	Malva de campo	Leaves, Stem	Gastrointestinal problems, acne, bronchitis, diarrhea, urinary tract infections	Oral	Infusion	12	0.070
	Ceiba acuminata (S. Watson) Rose MAL-005	Pochote (injerto)	Whole plant	Migraine	Oral	Infusion	1	0.010
Meliaceae	*Azadirachta indica* A.Juss. MEL-001	Neem	Leaves	Diabetes and body weak	Oral	Infusion	4	0.030
	Cedrela odorata L. MEL-002	Cedro	Bark	Allergies and pain of anginas	Oral	Decocted	2	0.020
Monimiaceae	*Peumus boldus* Molina MON-001	Boldo	Leaves	Bile and stomachache	Oral	Infusion	4	0.050

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Moraceae	*Brosimum alicastrum* Sw. MOR-001	El ramón	Aerial plant	Gastrointestinal problems	Oral	Decocted	1	0.010
	Ficus carica L. MOR-002	Higuera	Leaves	Diabetes	Oral	Decocted	1	0.010
Moringaceae	*Moringa oleifera* Lam. MORI-001	Moringa	Seed	Anemia, lack of energy and diabetes	Oral	Raw plant	8	0.060
Musaceae	*Musa x paradisiaca* L. MUS-001	Platano	Fruit	Callus in the skin	Topical	Paste, crushed	1	0.010
Myrtaceae	*Eucalyptus globulus* Labill. MYR-001	Eucalipto	Leaves, root	Respiratory system	Oral	Infusion	14	0.160
	Psidium guajava L. MYR-002	Guayabo	Leaves	Cancer, intestinal parasites and gastric ulcers	Oral	Infusion	4	0.050
Nyctaginaceae	*Bougainvillea glabra* Choisy NYC-001	Bugambilia	Flower	Cough, sore throat	Oral	Infusion	9	0.090
Oleaceae	*Fraxinus americana* L. OLE-001	Fresno	Leaves, stem	Weight-reducing, atiflamatory	Oral	Infusion,	4	0.030
			Topical	Antibiotic Warts	Topical	Bath/wash		
	Olea europaea L. OLE-002	Olivo	Leaves	Gastrointestinal problems, hypertension	Oral	Infusion	2	0.020
Onagraceae	*Epilobium mexicanum* Moc. & Sessé ex DC. ONA-001	San Antonio	Leaves, stem	Flu	Oral	Infusion	1	0.010

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Orobanchaceae	*Castilleja scorzonerfolia* Kunth ORO-002	Garañona	Leaves, stem	Circulatory system	Oral	Infusion	1	0.010
Papaveraceae	*Argemone mexicana* L. PAP-001	Chicalote	Leaves	Rashes in the skin and chickenpox	Topical	Bath/wash	4	0.030
	Fumaria officinalis L. PAP-002	Sangre de Cristo	Leaves	Grains of the skin and genital herpes	Topical	Paste	1	0.010
Passiforaceae	Turnera diffusa Willd. ex Schult. PAS-001	Damiana	Leaves	Kidney problems	Oral	Infusion	3	0.020
	Passiflora edulis Sims PAS-002	Maracuya	Leaves	Insomnia	Oral	Infusion	1	0.010
	Passiflora suberosa L. PAS-003	PasiFlowera	Leaves	Insomnia, anxiety, headache, nerves, hypertension	Oral	Infusion	12	0.110
Pentaphylacaceae	*Ternstroemia lineata* DC. PEN-001	Tila	Flower	Insomnia	Oral	Infusion	2	0.020
Phytolaccaceae	*Phytolacca icosandra* L. PHY-001	Congoja	Leaves	Problem of ears, ulcers	Topical	Infusion	4	0.030
	Petiveria alliacea L. PHY-002	Hierva del zorrillo	Root	Flu	Oral	Crushed	1	0.010
Poaceae	*Coix lacryma*-jobi L. POA-001	Lagrimas de San Pedro	Leaves, stem	Diabetes	Oral	Infusion, pills	1	0.010
	Zea mays L. POA-002	Pelo de elote	Fruit	Kidney problems	Oral	Infusion	5	0.040
	Phalaris canariensis L. POA-003	Alpiste	Seed	Stomachache, cholesterol in blood, hypertension	Oral	Liquefied	4	0.050

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Polemoniaceae	*Loeselia mexicana* (Lam.) Brand POL-004	Huachichile	Whole plant	Flu and fever	Oral	Infusion	2	0.020
Polypodiaceae	*Pleopeltis polylepis* (Roem. ex Kunze) T. Moore POLY-003	Lengua de ciervo	Leaves	Stomachache	Oral	Infusion	1	0.010
Rosaceae	*Eriobotrya japonica* (Thunb.) Lindl. ROS-004	Nispero	Leaves	Back pain	Oral	Infusion	4	0.030
	Rosa sp. ROS-002	Rosa de castilla	Flower	Eyes problems (infections)	Topical	Crushed	2	0.070
	Crataegus pubescens (C. Presl) C. Presl ROS-003	Tejococte	Leaves	Weight reducing	Oral	Infusion	2	0.020
	Prunus persica Stokes ROS-004	Durazno	Leaves	Gastrointestinal problems	Oral	Infusion	1	0.010
Rubiaceae	*Coffea arabica* L. RUB-001	Café	Seed	Liver problems	Oral	Enema	1	0.010
	Hintonia latiflora (Sessé & Moc. Ex DC) Bullock RUB-002	Palo amargo, canelilla	Bark	Wounds	Oral	Decocted	1	0.010
	Morinda citrifolia L. RUB-003	Noni	Fruit	Body weak	Oral	Raw plant(squeezed)	2	0.020
Rutaceae	*Citrus sinensis* (L.) Osbeck RUT-001	Hoja de naranjo	Flower	Nerves	Oral	Infusion	1	0.010

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
	Citrus x aurantium L. RUT-002	Naranja Cucha	Flower	Sore throat	Oral	Decocted	3	0.020
				Raw plant(squeezed)	Fruit	Topical		
	Ruta chalepensis L. RUT-003	Ruda	Leaves	Chickenpox	Topical	Infusion Bath/wash	51	0.440
	Casimiroa sp. RUT-004	Sapote	Leaves	Anti-inflammatory	Oral	Infusion	1	0.010
	Citrus limon (L.) Osbeck RUT-005	Limon	Bark	Sore throat and colds	Oral	Infusion	7	0.100
			Flower, fruit, leaves	Colds	Oral	Infusion		
Salicaceae	*Salix taxifolia* Kunth SAL-001	Taray	Leaves, stem	Stones in kidneys	Oral	Infusion	1	0.010
Sapindaceae	*Aesculus hippocastanum* L. SAP-001	Castaña de indias	Seed	Circulatory system	Oral	Infusion	2	0.020
	Serjania triquetra Radlk. SAP-002	Palo de tres costillas	Stem	Kidney problems	Oral	Infusion	1	0.010
	Dodonaea viscosa (L.) Jacq. SAP-003	Varachile	Leaves	Kidney problems	Oral	Infusion	1	0.010
Scrophulariaceae	*Buddleja scordioides* Kunth SCR-001	Copal	Bark	Diarrhea, cough, flu and indigestion	Oral	Infusion	3	0.030
Smilacaceae	*Smilax moranensis* M.Martens & Galeotti SMI-001	Zarzaparilla	Whole plant	Anemia and kidney problems	Oral	Infusion	4	0.030
Solanaceae	*Solanum rostratum* Dunal SOL-001	Mancamula	Leaves	Animals	Oral	Decocted	2	0.020
	Solanum tuberosum L. SOL-002	Papa	Root	Blood cholesterol	Oral	Infusion	2	0.020

Family	Scientific name	Vernacular name	Used parts	Diseases	Admin. mode	Prepara-tion mode	**UR	***CI
Theaceae	*Camellia sinensis* (L.) Kuntze THE-003	Té negro	Leaves	Blood cholesterol	Oral	Infusion	2	0.020
Verbenaceae	*Lippia graveolens* Kunth VER-001	Oreganillo del cerro	Leaves	Stomachache	Oral	Infusion,	1	0.010
	Aloysia citriodora Palau VER-002	Cedron	Leaves	Gastrointestinal problems, hipertension and muscle	Oral	Infusion	25	0.190
Vitaceae	*Cissus sicyoides* L. VIT-001	Tripas de judas	Leaves, stem	Arthralgia	Topical	Tincture	1	0.010
Xanthorrhoeaceae	*Aloe vera* (L.) Burm.f. XAN-001	Savila	Leaves, whole plant	Wounds, skin blemishes, cough, bronchitis, gastritis, irritated eyes headache, dry skin, hair problems, gastrointestinal problems, mouth sores, muscle relaxant, blows, bruises	Topical	Paste, crushed, syrup, raw (squeezed)	53	0.460
Zingiberaceae	*Zingiber officinale* Roscoe ZIN-002	Gengibre	Root	Rheumatoid arthritis, to strength body defenses, lack of energy, food	Oral,	Infusion,	12	0.110
Zygophyllaceae	*Larrea tridentata* (Sessé & Moc. ex DC.) Coville ZYG-001	Goberna-dora	Leaves, stem	Kidney stones, retention of urine, foot fungus, gastric ulcers, rheumatism, body pain, anemia, flu, bile, diabetes	Oral, topical	Decocted bath	33	0.260
	Tribulus terrestris L. ZYG-002	Abrojo	Root	Kidney problems	Oral	Decocted	1	0.010

** RU = Total number of use reports per species cited

*** CI = Use report by species cited / Total number of informants

11. AUTHOR´S LIST OF PUBLICATIONS

Articles published in journals with impact factor:

1. **Lara REA,** Fernández CE, Lara REA, Zepeda VJM, Polesny Z, Pawera L. 2018. An ethnobotany study of medicinal plants used in the Zacatecas state, Mexico. Acta societatis Botanicorum Poloniae. Vol **87(2). DOI: https://doi.org/10.5586/asbp.3581.**

2. Lara REA, Fernández CE, Zepeda-del-Valle JM, Lara RDJ, Aguilar A, Van Damme P. 2018. Ethnomedicine in the Highlands of Chiapas, Mexico. Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas**.** ISSN07177917 [Article in press]

Articles ready to be submitted:

Lara REA, Fernández CE, Zepeda VJM, Lara RDJ, Chaloupkova PMilella L, Russo D. 2018. An ethnobotanical study of medicinal plants used in Papantla, Veracruz, Mexico.

Conferences and congress:

1. **Lara REA,** Dvorakova A, Fernández CE, 2016. Ethnobotanical inventory of medicinal plants in the province of Orellana, Ecuador. ELLS CONFERENCE 17-18 November, 2017. Copenhagen, Denmark.

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