

**CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE**

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**Bachelor Thesis**

**Ethnobotany: Traditional plants used in Mexico**

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Declaration

I declare, that I have written the Bachelor thesis "Ethnobotany: Traditional plants used in Mexico" on my own and used only the sources presented in the list of references.

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date

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signature of the student

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## **Abstract:**

An ethnobotanical study in Mexico, including the Cumbres de Monterrey National Park in Nuevo León, Sierra de Oaxaca foothills, Zapotitlán de las Salinas and San Rafael, Valley de Tehuacán-Cuicatlán in Puebla, Chiapas and Lacandon Rain Forest Region in Chiapas, Baja California and Sonora. In total, 540 species belonging about to 115 families were found. A list of species with concentration to medicinal plant, local names, plant parts used, localization, ailments treated and other uses is included in this study. The families with the highest number of medicinal plants were found out *Asteraceae* (75 spp.), *Leguminosae* (38 spp.), *Euphorbiaceae* (29 spp.), *Solanaceae* (26 spp.), *Lamiaceae* (23 spp.) and *Cactaceae* (21 spp.). We recorded also that 45 species are cultivated in homegardens for various purposes.

**Key words:** ethnobotany, Mexico, medicinal plants, Chiapas, Nuevo León, Oaxaca, Sonora, Baja California, Puebla

## **Abstrakt:**

Ethnobotanická studie v Mexiku, zahrnující oblasti Cumbres de Monterrey Národní park v Nuevo León, podhůří Sierra Oaxaca, Zapotitlán de las Salina a San Rafael, údolí Tehuacán-Cuicatlánu v Puebla, Chiapas a oblast Lacadonského deštného pralesa v Chiapas, Baja Kalifornie a Sonora. Celkem bylo zjištěno 540 druhů patřících do přibližně 115 čeledí. Seznam druhů, se zaměřením na léčivé rostliny, místní název, část použité rostliny, oblast, léčenou nemoc a další využití, je součástí této studie. Čeledi *Asteraceae* (75 spp.), *Leguminosae* (38 spp.), *Euphorbiaceae* (29 spp.), *Solanaceae* (26 spp.), *Lamiaceae* (23 spp.) a *Cactaceae* (21 spp.) byly zjištěny s nejvyšším počtem léčivých druhů. Zaznamenali jsme také, že 45 druhů je pěstováno v zahradách za rozličným účelem.

**Klíčová slova:** etnobotanika, Mexiko, léčivé rostliny, Chiapas, Nuevo León, Oaxaca, Sonora, Baja California, Puebla

## **Preface**

Ethnobotany plays a very important role considering that Mexico is presented with a high diversity of plants. A lack of medicinal care, malnutrition and poverty contribute to people's need to use knowledge about traditional use of plants. Many of these plants are used by people for different purposes: as food, medicine, ornamental and other uses. One of the biggest groups of traditional plant uses is medicinal plants, which is given this study.

In Mexico, traditional medicine is the first alternative in health care because high cost of medicines or cultural barriers. It is practised frequently in the urban areas, where it is most frequent the rituals and ceremonies.

The most frequent health problems of Mexican people are gastrointestinal diseases, cancer, problems with heart, diabetes and others, but Mexican people use medicinal plants also as an ingredient to bath for woman labour, after childbed, diabetes, colic, shock, jaundice, dandruff, and laxative or to increase the appetite of children.

To preparation of herbal medicament, people use the whole plants or some parts of plants, which have the necessary medicinal compound as flowers, leaves, stem, root, fruit, seeds, but also sap of the root, parenchyma, latex, styles and stigmas or turpentine. These parts are used in baths, teas, ointments, compress and inhalation.

Mexican people do not use only the plants in nature, but also they used the homegardens to cultivation of the useful plants. The homegardens are not only rich in biodiversity, but also preserve much of local cultural traditions and can reveal about plant management of these plants.

In this work the using of plants in different domains is described, especially the medicinal plants and their utilization in traditional medicine. The part of this study is also the database from representative states of Mexico, which will include family, botanical name, local name, localization, plant parts used and ailments treated. It solves also which of these plants are grown in homegardens for many kinds of utilization, which can sometimes differ.

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# **1 MEXICO**

## **1.1 General information**

Mexico is known by its very large cultural diversity, which is deeply connected with the eventful Mexican history. The name of United Mexican States has its root in Aztecs word „Mexitli”, which mean God of the war. The capital of Mexico is Mexico (Distrito Federal). The official language is Spanish, but there are also various Mayan, Nahuatl and other regional indigenous languages. With a population of 109 955 400, Mexico is the most populous Spanish-speaking country and it is the 11th most populous country in the world (CIA, 2008).

## **1.2 Situation**

Mexico situated in America within 14° 30' and 32° 42' N and 86° 46' and 117° 7' W, comprise the big part of southern North America, but it is also described as the greatest state of Middle America. It is bounded on the north by the United States; on the south and west by the North Pacific Ocean; on the southeast by Guatemala, Belize, and the Caribbean Sea; and on the east by the Gulf of Mexico. Including islands in the Pacific Ocean (including the Guadalupe Island and the Islas Revillagigedo), Gulf of Mexico, Caribbean Sea, and Gulf of California, total area of Mexico is 1 972 550 km<sup>2</sup>. Mexico is by this surface the fifth-largest country in the Americas (CIA, 2008).

## **1.3 Geography and climate**

### **1.3.1 Geography**

In the majority of Mexican territory reigns the mountains and plateau, which are the extensions of the systems of Cordillera from North America. It crosses the Mexican territory from north to south by two mountain ranges known as Sierra Madre Oriental and Sierra Madre Occidental. Mexico is also crossed by the Trans-Mexican Volcanic Belt known as the Sierra Nevada from east to west at the centre. The last mountain range is the Sierra Madre del Sur, which runs from Michoacán to Oaxaca.

The Trans-Mexican Volcanic Belt dominates by the highest elevations in the Mexican northern and central territories: Pico de Orizaba (5,700 m), Popocatepetl (5,462 m), Iztaccíhuatl



(5,286 m) and the Nevado de Toluca (4,577 m). This part of territory is known by frequent earthquake, based on the tectonic origin.

Mexico has two large peninsula (Fig. 1); in the Northwest of Mexico the peninsula of California with length 1250 km and in the Southeast the peninsula of Yucatán.



**Fig. 1** Satellite image of Mexico. Source: GOOGLE- Imagery, 2008; MYGEO, 2008.

### **1.3.2 Climate**

#### **1.3.2.1 Rainfall**

Climate in Mexico depends on the latitude and on the altitude. The minimum rainfall and high temperatures created the deserts with the typical vegetation adapted on the rainfalls up to 100 mm. These areas are mainly located in the north west of Mexico, especially on the peninsula of Baja California, the west of the state of Sonora and the north of the state of Chihuahua. The rainfall arrives in the direction of south. The maximum rainfalls about 1500 mm include the states of Chiapas, Tabasco, Veracruz and Oaxaca. It is raining mainly from May to August. The high rainfalls are also near the highest mountains of Mexico (Fig. 7 in Annexe).

#### **1.3.2.2 Climate**

According to the climate, Mexico is divided into four parts; tierra caliente, tierra templada, tierra fría and tierra helada.

The warmest climate with the lowest altitude up to 1000 m is called tierra caliente where sugarcane, cocoa and rice can be grown. There are many hurricanes from August to October, which have direction mainly from Gulf of Mexico (Otta et al., 1901; Gardner et al., 1993).

At the elevation of from 1000 m to 2000 m above sea level, there reigns a perpetual spring, a temperature which never varies more and with annual temperature between 20°- 25°C. The natives gave to this region the name of tierra templada. In this area can be planted coffee and citrus, but from the 1500 m there is a risk of frosts (Otta et al., 1901; Gardner et al., 1993).

The principal part of Mesa Central is in the zone of tierra fría. It is cold climate with elevation from 2000 m above sea level with the annual temperature up to 20°C. In the highest elevation there are also mild frosts, especially in the north of country (Otta et al., 1901; Gardner et al., 1993). The summers are wet on the other hand the winters are dry. In this region there is the possibility to grow wheat, potatoes and temperate fruits (Améndola et al., 2006).

From 4000 m above sea level there are tierra helada, where it is freezing during all year (Otta et al., 1901; Gardner et al., 1993).

#### **1.4 Mexican History**

Human presence in Mexico was dated back 40 000 years based upon discovery of ancient human footprints in the Valley of Mexico in the region, we now know as Mesoamerica, which includes central and southern Mexico, Guatemala, Belize, El Salvador, Honduras and northern Nicaragua (Macvean et al., 2003). In this region there were civilizations which arose and ceased to exist and which had a lot of the same traits. The most frequently trait was growing of maize, construction of pyramids and others.

The first most developed civilization on this area was a culture of Olmec, living in the tropical lowlands of south-central Mexico from 900 BCE to about 400 BCE (Gardner et al., 1993). The Olmec people plant maize, squash, manioc, sweet potato and cotton (Wikipedia, 2008). They were first civilization, which used the hieroglyphic writing and complicated calendar.

Other civilization, which was formed near the present Ciudad de México in central Mexico, was culture of Teotihuacan. People of Teotihuacan plant intensively maize, cotton and beans. By the development of trade and cultural prowess, Teotihuacan had become in 500 AD, one of the largest city in the world with diverse and cosmopolitan population (Wikipedia, 2008).

In the south part of Mexico, especially in the rain forests of Chiapas and Yucatan peninsula was noted other Mesoamerican civilization, called Maya civilization. Maya culture can be detected more than 1000 km from the Maya area. Mayan used the most advanced phonetic and hieroglyphic writing in all Mesoamerica and many different Mayan languages continue to be spoken today (Klápšťová et al., 2001). The Mayan people had diverse and sophisticated methods of agricultural production. They cultivated corn, manioc, sunflowers, cotton and others crops (Wikipedia, 2008). In the 10<sup>th</sup> century the Mayan area was influenced with the arrival of other ethnic group, called Toltecs. It caused the modification, shifting of Maya culture towards the Yucatan peninsula and in several centuries the decline (Klápšťová et al., 2001).

In Mexico, there were many other civilizations, like Toltecs, Mixtecs, Totonacs, Huastecs, Chichimecs or Aztecs (Klápšťová et al., 2001). The Aztecs were formed in central Mexico. They spoke the Nahuatl language. Aztecs used for food especially maize, beans, squash, chillies and tomatoes (Wikipedia, 2008). They drunk fermented beverages with alcoholic content or they used also the food additives as “honey water” (aguamiel). They had the developed the militarism, which made possible the expansion of Aztecs culture, subjugation of other ethnic groups and assimilation of their culture by Aztecs. But they also changed the historical documents, where they emphasized their role in Mexican history (Klápšťová et al., 2001).

In 1519 Hernán Cortéz landed near the present Veracruz. It was the total turn in history of Mesoamerican civilizations (Klápšťová et al., 2001). Spanish defeat of Aztecs led to beginning of colonial period in 1535, called New Spain. There were many military campaigns against the native civilizations. During the wars, many monuments, towns, historical documents and artworks were destroyed. It is the reason, why there is a lack of information about living of Mesoamerican civilizations. After the Spanish conquest, some foods were also outlawed, because its role in religious rituals (Gardner et al., 1993).

Finally, all tense situations led to beginning of fight for freedom, which was declared in 1821 and in 1824 was the establishment of the Federative republic. There were many wars to present situation, for example with the United States of America, the civil war, The Cristero War or the Mexican revolution.

The revolutionary groups formed in 1929, the National Mexican Party (PNM) and later become the Partido Revolucionario Institucional (PRI) that accomplished many important reforms and stayed ruling political party to present days (Gardner et al., 1993).

## 1.5 Political divisions of United Mexican States

Mexico is federated union of thirty-one free sovereign states and one federal district Table 1, which are located on the map in Fig. 2.

**Table 1. State names in Mexico**

1	Aguascalientes	9	Durango	17	Nayarit	25	Sonora
2	Baja California	10	Guanajuato	18	Nuevo León	26	Tabasco
3	Baja California Sur	11	Guerrero	19	Oaxaca	27	Tamaulipas
4	Campeche	12	Hidalgo	20	Puebla	28	Tlaxcala
5	Chiapas	13	Jalisco	21	Querétaro	29	Veracruz
6	Chihuahua	14	Mexico	22	Quintana Roo	30	Yucatán
7	Coahuila	15	Michoacán	23	San Luis Potosí	31	Zacatecas
8	Colima	16	Morelos	24	Sinaloa	■	Distrito Federal

Source: Wikipedia, 2008.



**Fig. 2 Location of the Mexican states and the Federal District.** Source: MYGEO, 2008

The head of Mexico is president elected for six-year term. The 31 states and the Federal District are collectively called "federal entities". There are equally represented in the Congress of the Union, where each state has its governor (gobernador) elected for six-year term and representatives (diputados locales) to their respective state congresses for three-year terms. In federal district the governor is elected by the president. Each state has as well as its own constitution, congress, judiciary and its citizens elect by direct voting.

## **1.6 Agriculture**

Mexican food is known for its colourful decoration, flavours and a variety of spice. The majority of Mexican food is based on pre-hispanic traditions, including the Aztecs and Maya, combined with culinary methods introduced by Spanish colonists (Wikipedia, 2008). With the native pre-Columbian food, including chocolate, maize, tomato, vanilla, avocado, papaya, pineapple, chilli pepper, beans, squash, sweet potato, peanut and turkey, during the history it was eventually combined by importation of rice, beef, pork, chicken, wine, garlic and onion.

With about 12 % of arable soil, agriculture contributes about 8% of the GDP and employs about 27% of the working population (Bonnal, 2001).

Mexican agriculture is characterized by a large number of small farming units and smaller number of modern farms. Only 15% of the farms are highly modernized, but they contribute 85% of agricultural production (Bonnal, 2001). In the north reigns the cattle farms. Due to irrigation systems the typical plant which is cultivated in the north of Mexico is cotton, particularly in the region of the river Colorado delta and Rio Grande delta. The south of Mexico with its situation is a typical tropical country. In the south, there is mainly farming of pig. There is a breeding of oil palm, coconut palm, cacao, coffee, maize, pulses, sorgo, soja bean, tomatoes, sugar cane and sisal. But in the mountain region the most cultivated plants are sugar cane, coffee, millet and wheat. The characteristic plant for Mexico is cactus, but there is also the exploitation of wood, using in industry or for colouring (Wikipedia, 2008).

Mexico exports especially sugar cane, fruits (citrus fruit, mango, avocado, pineapple fruit), cotton, coffee, sisal, sardine, prawn and tunny (Wikipedia, 2008).

## 2 ETHNOBOTANY

The very first ancient European document about plants was “De Materia Medica” by Pedanios Dioscorides. The work described about 600 medicinal plants with using illustrations of plants. This work began the basis of medicinal knowledge for 1500 years (Castleman, 2004).

The discovery of the New World initiated the interest in plants, especially with economic value. New knowledge was based mainly on the observations of native people. There were a lot of botanists, which had written the studies about relationship between aboriginal people and plants (Plant Interactions, 2008). But ethnobotany as the term is coined in the end of 19<sup>th</sup> century by American botanist named J. W. Harshberger. He first defined ethnobotany as “the studies of plants used by primitive and aboriginal people” (Balick, 1996).

The general definition of ethnobotany is the study of the relationships and interactions between plants and people (Balick, 1996). It includes the collaboration with other disciplines, especially with chemistry, ecology, anthropology, economics and botany (Prance, 1991). Plants in ethnobotany are used as beverage, alcoholic liquor, ceremonial, food, commercial, fodder, insecticide, construction material, live fences, fibre or as medicinal plants. In many cases one plant can be used in diverse utilizations.

For example, the very important plant of American origin maize (*Zea mays*) from family *Poaceae*, was planted in Mexico about 3000 B.C. (Bushnell, 1976). This cereal was taken to Europe, where it domesticated and began the very important crop not only in all Europe. However, *zea mays* were not only for food, it was an important plant connected with the religious significance. Maize was represented by many gods. The Aztecs soothsaid by using grains of maize. In some Mayan myths are the mentions of humans shaped the corn dough (Klápšťová et al., 2001). But this plant has also the medicinal properties. Corn "hairs" (styles and stigmas) are the treatment of cough, dysentery, bladder inflammations, diabetes and menstrual colic (Estrada et al., 2007).

The commodity of medicinal and aromatic plants including teas, products for pharmacology, cosmetics, dietary supplements, beverages or herbal remedies are very important in the international trade. The list of 12 leading countries of import and export (Table 5 in Annexe) shows that Mexico with its exportation of 37 600 tones of medicinal and aromatic plants

is the fourth followed by Germany and USA. China exported annually on average about 150 600 tones, which is fourth times as high as the exportation of Mexico.

## **2.1 Ethnobotany in Mexico**

Mexico, presented by a high diversity of plant, is one of the regions we know as Mesoamerica. It has been the source of genetic resources not only for crops, but also for fruit and vegetable.

The indigenous Americans started to use plants more than 10 000 years ago. Olmecs, Mayas and Aztecs had very developed knowledge about plants, which they used as medicinal, instrumental, ornamental, fodder and others (Pöll, 2005). After discovery of Mexico, many people were interested in ethnobotany and it became the part of world literature. Bernardino de Sahagún was the first, who examine the plant use of the Nahua (Aguirre et al., 2008).

### **3 USEFUL PLANTS OF MEXICO**

#### **3.1 Medicinal plants**

Medicinal plants are plants with medicinal properties. In certain quantity, the plants can cure, but using considerable or reduced quantity these plants can be toxic or can wasting the healing powers. These plants can be used in an ointment, infusion or tincture for herbal remedies to burns, treatment of diabetes or for example laxative.

Using of plants in traditional medicine is known and well-developed long before Spanish conquest (Macvean et al., 2003). In 1552 The Badianus manuscript, the first herbal from the Americas, was written by Martín de la Cruz in native Aztec language and by Joannes Badianus translated into Latin language. The manuscript contain up to 200 medicinal coloured plants, involved purely Indian medicine (Zirkle, 1941). Many of these plants are used still today.

Now, the medicinal plants are used by pharmacologists, microbiologists and natural-products chemists to develop the medicament for diseases. Unfortunately, there are also many drugs which were derived from plants.

##### **3.1.1 Traditional health system in Mexico**

A lack of medicinal care, malnutrition and poverty contribute to people's need to use knowledge about traditional use of medicinal plants. In Mexico, traditional medicine is the first alternative in health care practised especially in the urban areas, where the rituals or ceremonies and the high cost of medicines are the most frequent. There are not also problems with the need to stick of timetables, because traditional medicine is practiced in the home of the healer, in the home of the sick person or other place in the town or country.

The states with the highest prevalence of healers are Chiapas, Morelos, Oaxaca and Veracruz. The development of traditional medicine is promoted by Mexican public and private institutions, such as National Indian Institute or the National Council of Traditional Indigenous Medicine Men.

It exists also a registry of traditional healers in Mexico, but the exact number is not know. The healers have its specialities, which are focused on certain part of traditional medicine. The Table 2 shows the principal healing specialities in the state of Chiapas in Mexico. The most



frequent specialities are midwives (392) and healers (330) from total number of 887, but in Mexico there are also bone-setters (huesero), snake healers (culebreros) and others.

**Table 2. The principal healing specialities in Chiapas in Mexico**

<b>Specialities</b>	<b>Number</b>	<b>Percentage</b>
Midwives (partera)	392	44,2
Healer (curanderos)	330	37,2
Herbalists (hierbero)	65	7,3
Bone-setters (huesero)	57	6,4
Prayers (rezador)	13	1,5
Medium (medium)	10	1,1
Rubbers (sobadores)	9	1,0
Magician (brujo)	8	0,9
Healer (remeador)	2	0,2
Hallucinogenic healer (hechicero)	1	0,1
<b>Total</b>	<b>887</b>	<b>100,0</b>

Source: Lozoya et al., 1992

Mexican people use medicinal plants as an ingredient to bath for woman labour, after childbed, diabetes, colic, shock, jaundice, dandruff, and laxative or to increase the appetite of children, but there are also differences between the demand for healthcare from traditional healers in urban and rural areas. People in the country demand especially the treatments of diarrhoea, fever, skin problems, heavy cough, nerves, evil eyes or indigestion. In contrast to people living in towns demand mainly remedy to envy, sorcery, fright, high fever, acute skin problems, indigestion or insomnia.

To preparation of herbal medicament, people use the whole plants or some parts of plants, which have the necessary medicinal compound as flowers, leaves, stem, root, fruit, seeds, but also sap of the root, parenchyma, latex, styles and stigmas or turpentine. These parts are used in baths, teas, ointments, compress and inhalation.

On occasion, traditional medicine is mixed with therapies from other cultures or combined with allopathic medicine. In addition there are other resources or techniques used in traditional

medicine, such as gems, animals, candles, incense, beverages, alcohol and flowers (Anonymous, 1999).

### **3.2 Ornamental**

The other utilization of many plants is as ornamental ones. Many of plants from family *Orchideaceae*, *Asteraceae*, *Fabaceae*, *Arecaceae* and others are used ornamentally not only in parks, homegardens, but also as a house plants. The common ornamental feature includes leaves, scent, bark, stem, fruit and flowers for which they are grown and display. These plants are cutting for flowers or drying, than people make the decoration for example on tables, in the window and so on.

### **3.3 Food**

Mexican food is known for its flavours, colourful decoration and variety of spices. The majority of Mexican food is based on pre-hispanic traditions, including the Aztecs and Maya, combined with culinary methods introduced by Spanish colonists (Wikipedia, 2008). Mexican people used for food the fruits, leaves, stems, roots or seeds.

Many of plants utilized for food, were taken not only to Europe, where they domesticated. For example, maize, vanilla, chilli pepper, beans, sweet potato and others began the very important crop in the world (Wikipedia, 2008).

*Theobroma cacao*, for example, is in the present time important plant, known in the whole world. Cacao was cultivated by Mayas over 1500 years ago (Motamayor et al., 2002). Aztecs and Mayas prepared a chocolate drink by pounding cacao beans, especially with addition of maize kernels and boiling water with hot pepper chilli. After Spanish conquest, cacao wasn't well received in Europe, but its popularity increased dramatically. There were developed many techniques to create chocolate, cocoa and chocolate liquor. Cacao contains theobromine, which is alkaloid used in medicine (Macvean et al., 2003).

### **3.4 Other Uses**

Except of medicinal, ornamental and alimentary utilization of plants, Mexican people use plants also as insecticide, firewood, commercial, fodder, stimulator, toy, construction material, ceremonial, making besom, industrial, aromatic, shade, toxic, technical, live fences, alcoholic

liquor, fibre, resin, latex, spice, beverage, narcotics, dye, parts of shampoo, to protect the soil and many other uses. Plant utilization depends on the tradition and can differ in utilization of plant in each locality.

Many of plants are used in several utilizations. Aloe vera, for example, is used as medicinal plants, but also as ornamental, aromatical and medicinal. Other example is *Cyrtocarpa procera*, which is used as food, medicinal plant, firewood, commercial, fodder and as construction material.

Plants used as fodder are commonly aerial parts of herbs or leaves of shrubs and trees. Animals can graze freely in the nature or people bring the land under cultivation. The most frequent plants for feeding animals belong to family *Poaceae* and *Fabaceae*.

Some plants can be used as toy or musical instrument by for example its fruit. It is for example of kinds of pumpkin, which is hollowed out and filled up by the gravel or grit. It is used as percussion instrument.

Traditional use of plants can depend on the location and tradition. The reed is used as material for production of typical Mexican hats, as railings or as roofing materials. Many kinds of bags are made from fibre of *agave*. Species of *Agave* made also a part of alcoholic traditional alcoholic liquor as well as *Prunus serotina* (Estrada et al., 2007; Dávila et al., 2002; Paredes et al., 2007).

Other utilization of plants can be to make many kinds of construction material or for making shade, firewood or live fences. These plants are usually shrubs or trees, like *Prosopis laevigata*, *Schinus molle*, et cetera. We used them for wood, but also for fruit and sometimes as fodder for animals (Hernández et al., 2005; Canales et al., 2006; Dávila et al., 2002; Paredes et al., 2007; Hernández et al., 2003).

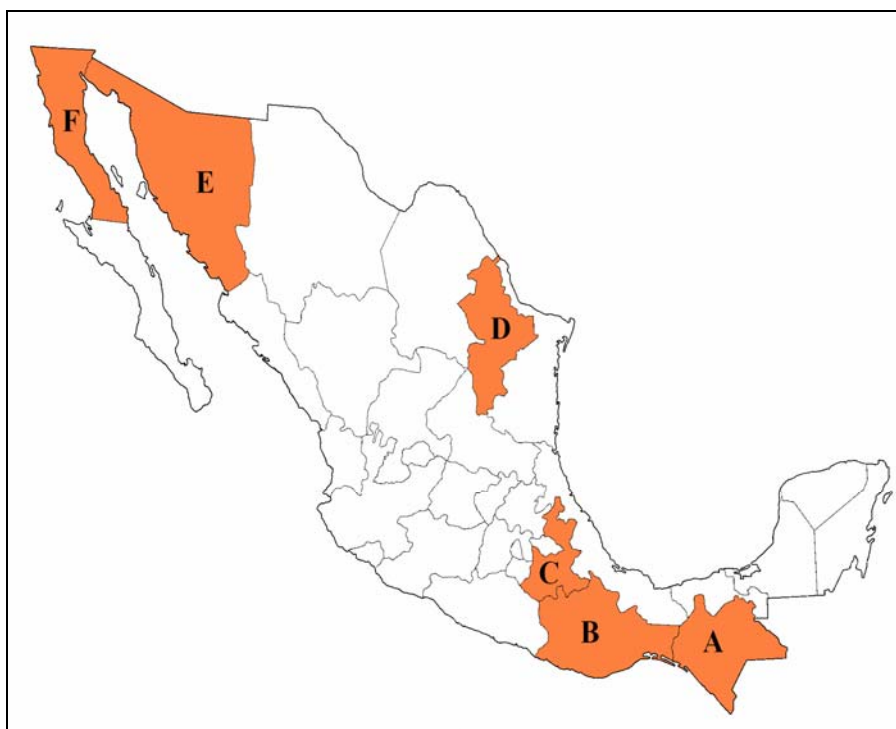
## **4 OBJECTIVE**

The objective of this study is the ethnobotanical research of traditional use of plants in Mexico, country rich in history and high diversity of plants. This study is concentrated on the medicinal plants, which are connected with long cultural tradition in the representative areas in Mexico, including the Cumbres de Monterrey National Park in Nuevo León, Sierra de Oaxaca foothills (Isthmus of Tehuantepec), Zapotitlán de las Salinas and San Rafael, Coxcatlán, Valley de Tehuacán-Cuicatlán in Puebla, Lacandon Rain Forest Region in Chiapas, Sonora and Baja California.

## 5 MATERIALS AND METHODS

### 5.1 Site description

Considering that Mexico is presented with a high diversity of plants, this work is concentrated on the ethnobotanical studying of medicinal plants in the representative areas in Mexico, including the Cumbres de Monterrey National Park in Nuevo León, Sierra de Oaxaca foothills (Isthmus of Tehuantepec), Zapotitlán de las Salinas and San Rafael, Coxcatlán, Valley de Tehuacán-Cuicatlán in Puebla, Lacandon Rain Forest Region in Chiapas, Chiapas as the state, Sonora and Baja California (Fig. 3).



**Fig. 3 Representative states in Mexico.** (A) Chiapas, (B) Oaxaca, (C) Puebla, (D) Nuevo León, (E) Sonora, (F) Baja California

#### 5.1.1 Description of Chiapas

Chiapas is the state of Mexico (Fig. 3/A) located towards the southeast of the country. In general Chiapas has a humid and tropical climate. For this area the average annual rainfall are up to 2000 mm (CONAUGA, 2007).

Lacandon Rain Forest Region is situated in eastern Chiapas between the Usumacinta River, the Perlas and Lacantún rivers. In this area dominate tropical and montane rain forests, cloud forest, semi-deciduous tropical forest, savannah, pine-oak forest, seasonally flooded forest, gallery forest and open wetlands. The climate is warm and humid (Smithsonian National Museum of Natural History, Department of Botany, 2008).

### **5.1.2 Description of Puebla**

Zapotitlán de las Salinas and San Rafael are situated in Valley de Tehuacán-Cuicatlán in Puebla (Fig. 3/C) south central part of Mexico, became in 1998 one of Mexico's 18 Biosphere Reserves. Typical vegetation is several dry land scrub formations with many species succulent, spiny or thorny, or forming rosettes and low, early deciduous forest. The average annual rainfalls are about 1200 mm (CONAUGA, 2007; Smithsonian National Museum of Natural History, Department of Botany, 2008).

### **5.1.3 Description of Nuevo León**

The Cumbres de Monterrey National Park in Nuevo León (Fig. 3/D) was established in 1939 and by its area of 1 773,7 km<sup>2</sup> it is the largest national park in Mexico. It is one of the most visited areas in central part of Nuevo León where peoples can do hiking, camping or other recreational activities. Typical vegetation is a chaparral, mixed pine-oak forest, conifer forest, halophytic grasslands and alpine meadows. The average annual rainfall varies area about 600 mm (Estrada et al., 2007; CONAUGA, 2007).

### **5.1.4 Description of Oaxaca**

The Isthmus of Tehuantepec is situated in the southern part of the State of Oaxaca (Fig. 3/B). The studying area is located in the foothills of the Sierra Madre de Oaxaca. Typical vegetation includes humid forests, subhumid forests and dry deciduous lowland and submontane forest. The average rainfalls are about 1500 mm (Frei et al., 1998; CONAUGA, 2007).

### **5.1.5 Description of Sonora**

Sonora (Fig. 3/E), Mexico's second largest state is located in the northwest of the Mexico. The average rainfalls are about 400 mm (CONAUGA, 2007). Sonora has an extensive plain in

the western part, the mountain ranges in the south and in the east. The typical vegetation is Madrean montane coniferous forest, oak-coniferous woodland, barrancan oak woodland, oak savannah, Madrean chaparral, short-grass prairie, tropical deciduous forest, subtropical thorn scrub and subtropical desert fringe (Encyclopedia of Mexican States, 2007; Smithsonian National Museum of Natural History, Department of Botany, 2008).

### **5.1.6 Description of Baja California**

Baja California (Fig. 3/F) is located in the North West region of the Mexico, in the northern part of the Baja California peninsula. It is bordered on the north by California and on the west by the Pacific Ocean. The typical vegetation includes montane coniferous and mixed evergreen forests, oak woodlands, chaparral, coastal scrubs and annual grassland. The average rainfalls are about 200 mm (CONAUGA, 2007; Encyclopedia of Mexican States, 2007; Smithsonian National Museum of Natural History, Department of Botany, 2008).

## **5.2 Methods**

The ethnobotanical studying of medicinal plants is divided on the two parts. In the first part the selected group of medicinal plants was formed in database regarding plant family, species, local names, part uses, localization,) and The Index Filicum (IF). By the limitations of the data originating from these indexes, in ailment treated and their other uses. Taxonomic identification was performed by The International Plant Name Index (IPNI) using three sources: The Index Kewensis (IK), The Gray Card Index (GCI) all formed database was used to combination data set.

In the second part the studied data was taken for analysis. Using the Microsoft office the data was arranged in alphabetical order and formed in the graphs and diagrams.

## **5.3 Materials**

After an exhaustive search in ethnobotanical studies, we constructed a database with over 500 Mexican plants. The data was taken from 10 bibliographical sources (Hernández et al., 2005; Estrada et al., 2007; Canales et al., 2006; Dávila et al., 2002; Frei et al., 1998; Lozoya et al., 1992; Paredes et al., 2007; Hernández et al., 2003; González et al., 1984; Levy et al., 2002).

## 6 RESULTS

We recorded 540 plants, 332 genus and 115 families of plants having at least medicinal use in the local folk culture from the ethnobotanical literature (Hernández et al., 2005; Estrada et al., 2007; Canales et al., 2006; Dávila et al., 2002; Frei et al., 1998; Lozoya et al., 1992; Paredes et al., 2007; Hernández et al., 2003; González et al., 1984; Levy et al., 2002). All plants were formed in the database of Table 6 in Annexe.

### 6.1 Plant taxa

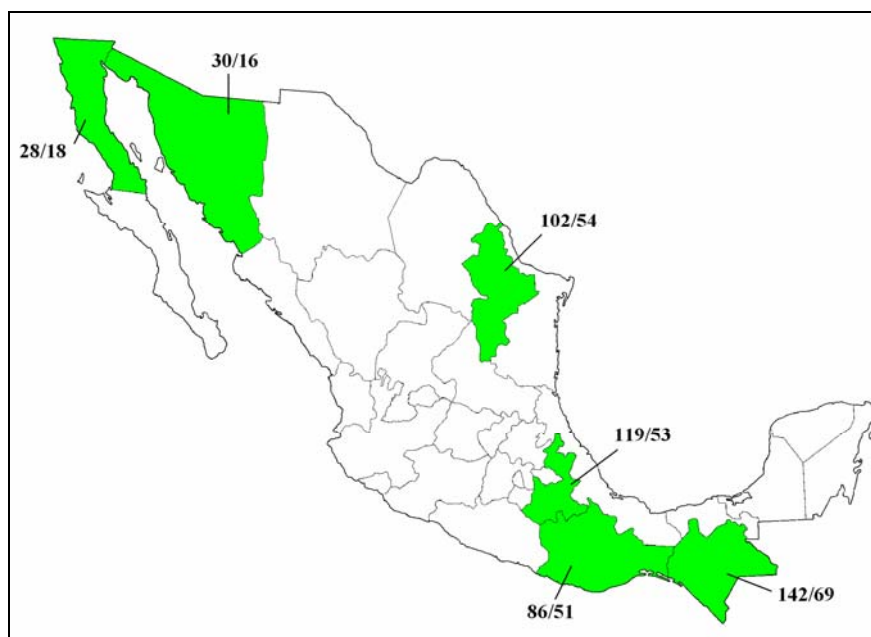
From 540 medicinal plants we recorded 30 plants in Baja California, 38 in Sonora, 149 in Puebla, 181 in Chiapas, 104 in Oaxaca and 128 in Nuevo León. Table 3 shows the incidence of medicinal plants in six studying states of Mexico by genus, family, total plants and the authors, which wrote these studies. The Fig. 4 shows the distribution of plants by genus and family in each state of Mexico. The greatest occurrence of using medicinal plants is in the states of Nuevo León, Chiapas, Oaxaca and Puebla with tropical and humid climate, where the diversification is most common, and long tradition connected with Maya, Aztec and Olmec people. In these areas there is also the most frequent ethnobotanical research.

**Table 3. Incidence of medicinal plants in representative states in Mexico**

Name of state	Genus	Family	Total plants	Number of authors
Baja California	28	18 *	30	1
Sonora	30	16 *	38	1
Puebla	119	53	149	5
Chiapas	142	69 *	181	2
Oaxaca	86	51	104	1
Nuevo León	102	54	128	1

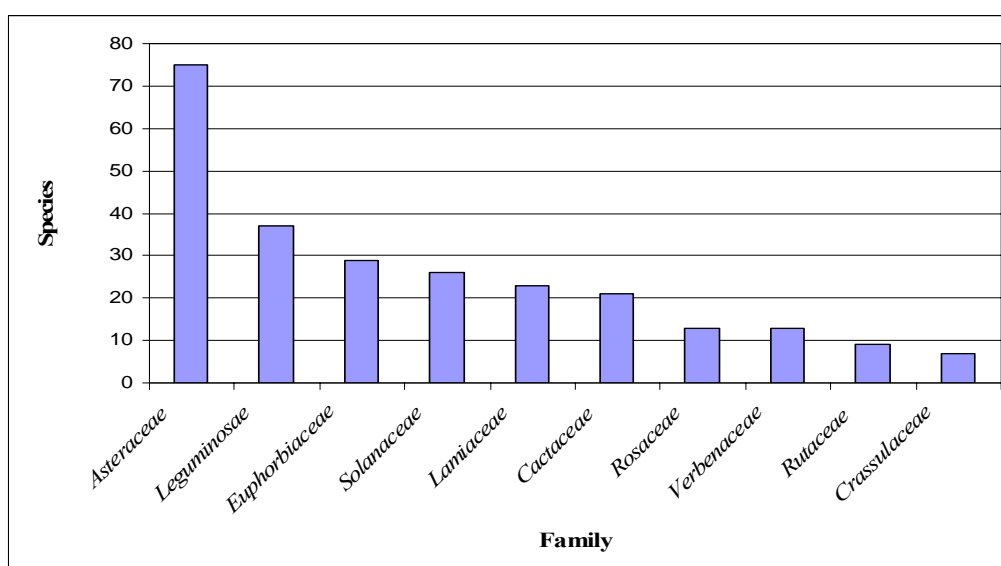
\* Without of not verified medicinal plants





**Fig. 4 Incidence of genus and family in the representative states of Mexico (genus/family)**

Fig. 5 of families shown the highest number of genera used in the folk culture as medicine plants are the *Asteraceae* (75), *Leguminosae* (38), *Euphorbiaceae* (29), *Solanaceae* (26), *Lamiaceae* (23), *Cactaceae* (21), *Rosaceae* (13), *Verbenaceae* (13), *Rutaceae* (9) and *Crassulaceae* (7).

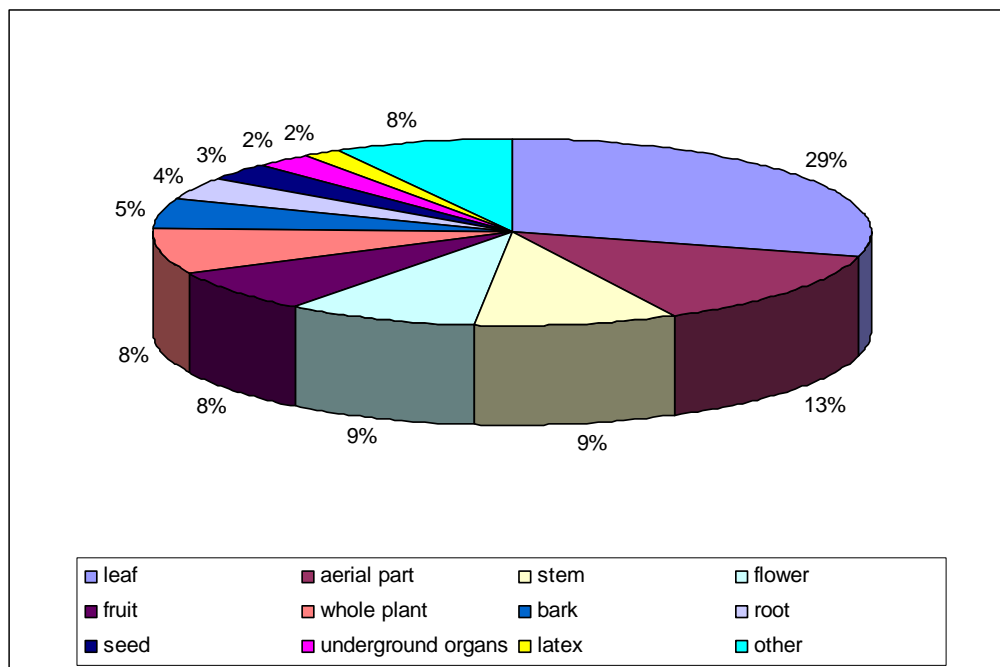


**Fig. 5 Major medicinal plant families**

## 6.2 Type of use

Five hundred and forty of the plants listed in Appendix were reported as medicinal plants, although sometimes the parts of plants of uses were different. *Cyrtocarpa procera*, for instant, mentioned for the bark as remedy for renal problems, is eaten for its fruits, used its wood as firewood or as construction material and its leaves are used as fodder for animals (Canales et al., 2006; Dávila et al., 2002; Paredes et al., 2007).

In general, there are many plant parts, which are harvested. To preparation of herbal medicament, people use the whole plants or some parts of plants, which have the necessary medicinal compound. The greatest plant parts used are leaves with occurrence of 196 plants, than aerial part (88 plants), stem (63 plants), flower (57 plants), fruit and whole plant (51 plants), bark (36 plants), root (26 plants), seed (20 plants), underground organs (16 plants), latex (12 plants) and other as fruit husk, bract, sap of the root, turpentine, inflorescence or resin (Hernández et al., 2005; Estrada et al., 2007; Canales et al., 2006; Dávila et al., 2002; Frei et al., 1998; Lozoya et al., 1992; Paredes et al., 2007; Hernández et al., 2003; González et al., 1984; Levy et al., 2002). The major plant parts used are also given in the Fig. 6 in percentage.



**Fig. 6 Major plant parts used**

### 6.3 Homegardens

We recorded that 45 species (Blanckaert et al., 2004) are also cultivated in homegardens for various purposes. The homegardens are not only rich in biodiversity, but also preserve much of local cultural traditions and can reveal about plant management of these plants.

Table 4 shows that the most common plants uses are ornamental (16), edible (24), medicinal (16), shade (10), commercial (3), toy (1), firewood (1), animal fodder (2), ceremonial (1) and shampoo (2) (Blanckaert et al., 2004).

**Table 4. List of plants found in the homegardens**

Family	Botanical name	Local names	Uses
<i>Agavaceae</i>	<i>Agave marmorata</i> Roezl	Pitchomel	2, 3
<i>Aloaceae</i>	<i>Aloe vera</i> L.	Sábila	1, 3, 10
<i>Anacardiaceae</i>	<i>Cyrtocarpa procera</i> H. B. & K.	Chupandia, Chupandilla	2
	<i>Mangifera indica</i> L.	Mango	2
	<i>Schinus molle</i> L.	Cohuino, Pirul	3, 4
	<i>Spondias mombin</i> L.	Ciruela	2
<i>Araceae</i>	<i>Xanthosoma robustum</i> Schott	Hoja de serra	1
<i>Asteraceae</i>	<i>Artemisia ludoviciana</i> subsp. <i>mexicana</i> (Willd. ex Spreng.) D.D.Keck	Istafiate, Estafiate, Hierba maestra	3
	<i>Tagetes erecta</i> L.	Flor de muerto	9, 5
<i>Bromeliaceae</i>	<i>Tillandsia recurvata</i> L.	Pastle, Paxtle, Gallinitas	8
<i>Burseraceae</i>	<i>Bursera simaruba</i> Sarg.	Mulato	4
<i>Cactaceae</i>	<i>Hylocereus undatus</i> Britton & Rose	Pitajaya	1, 2
	<i>Opuntia ficus-indica</i> Mill.	Nopal de Castilla	2
	<i>Opuntia</i> Mill.	Nopal	2
<i>Caricaceae</i>	<i>Carica papaya</i> L.	Papayo	2, 4
<i>Commelinaceae</i>	<i>Commelina</i> Plum. ex L.	Aliento de niño	1
	<i>Zebrina pendula</i> Schnizl.	Barquito	1
<i>Cucurbitaceae</i>	<i>Sechium edule</i> Sw.	Ch'umate, Chayote	2

Family	Botanical name	Local names	Uses
<i>Euphorbiaceae</i>	<i>Cnidoscolus chayamansa</i> McVaugh	Chaya	1, 2, 3
	<i>Jatropha dioica</i> Cerv.	Sangre de grado	3
	<i>Jatropha curcas</i> L.	Piñón	1, 2, 4
<i>Geraniaceae</i>	<i>Pelargonium hortorum</i> L. H. Bailey	Geranio	1
<i>Lamiaceae</i>	<i>Marrubium vulgare</i> L.	Marrubio	1, 3
	<i>Mentha</i> L.	Hierbabuena	1, 2, 3
	<i>Ocimum basilicum</i> L.	Albahácar, Albahaca	1, 3
<i>Lauraceae</i>	<i>Persea americana</i> Mill.	Aguacate, Aguacatl	2
<i>Leguminosae</i>	<i>Prosopis laevigata</i> (Humb. & Bonpl. ex Willd.) M. C. Johnston	Mezquite	3, 4, 7, 8
	<i>Leucaena esculenta</i> Benth.	Huaje, Huaje rojo	2, 4, 5
	<i>Tamarindus indica</i> L.	Tamarindo	2, 4, 5
<i>Malvaceae</i>	<i>Gossypium hirsutum</i> L.	Algodón cimarrón	1, 3, 4
	<i>Malva parviflora</i> L.	Malva	3
<i>Myrtaceae</i>	<i>Psidium guajava</i> L.	Guayaba	2
<i>Nyctaginaceae</i>	<i>Bougainvillea spectabilis</i> Willd.	Bugambilia	1
	<i>Mirabilis jalapa</i> L.	Maravilla	1
<i>Piperaceae</i>	<i>Piper auritum</i> H.B. & K.	Hoja santa	2, 4
<i>Poaceae</i>	<i>Zea mays</i> L.	Elote, Maíz	2
<i>Portulacaceae</i>	<i>Portulaca oleracea</i> L.	Verdolaga	1
<i>Rhamnaceae</i>	<i>Ziziphus amole</i> (Sessé & Moc.) M.C.Johnst.	Coesquite, Cholulo de monte, Cholulo	3, 6, 10
<i>Rosaceae</i>	<i>Rosa centifolia</i> L.	Rosa de Castilla	1
<i>Rutaceae</i>	<i>Citrus aurantifolia</i> Swingle	Limón, Azahares	2, 3, 4
	<i>Citrus maxima</i> (Burm.) Merr.	Toronja	2, 3
	<i>Citrus aurantium</i> L.	Naranja	2
<i>Solanaceae</i>	<i>Physalis philadelphica</i> Lam.	Tomate de cascara	2
<i>Ulmaceae</i>	<i>Celtis pallida</i> Torr.	Frutita	2
<i>Verbenaceae</i>	<i>Lippia</i> Houst. ex L.	Mukta homo	2, 3

Plant uses: 1=ornamental, 2=edible, 3=medicinal, 4=shade, 5=commercial, 6=toy, 7=firewood, 8=animal fodder, 9=ceremonial, 10=shampoo. Source: Blanckaert et al., 2004.

#### **6.4 Ethnobotanical use of medicinal plants**

Digestive disorders, dermatological illnesses and culture bound syndromes were the most frequently cited medical problems. On the contrary, Mexican people used medicinal plants as remedy for shock, concussions, dandruff, rabidness, hair loss, vomiting, urticaria, temperature, sterility, rheumatism or for example as treatment to jaundice.

One of the plants used as remedy for digestive disorders is *Lippia graveolens* (“Orégano”) in Table 6 in Annexe. The leaves, aerial parts and stems are used as the treatment of diarrhoea, stomach-aches or colic (Hernández et al., 2005; Canales et al., 2006; Dávila et al., 2002; Paredes et al., 2007; Hernández et al., 2003). The Fig. 8 shows the plant habitus with flowers.

*Tagetes lucida*, *Hedeoma costatum*, *Hedeoma drummondii*, *Hedeoma plicata* and *Marrubium vulgare* (Fig. 9 in Annexe) are plants used against insomnia. Mexican people used to cure aerial part of *Hedeoma* genus and *Marrubium vulgare*, or leaves of *Tagetes lucida*. *Marrubium vulgare* (Kathuchjeekunia, Concha or Marrubio de monte) has also influence to stimulation of appetite, sinus infection, to colic or for example “fright” illness (mal de susto) (Hernández et al., 2005; Estrada et al., 2007; Canales et al., 2006; Dávila et al., 2002; Frei et al., 1998; Lozoya et al., 1992; Paredes et al., 2007; Hernández et al., 2003; González et al., 1984).

Other interesting plant is *Sechium edule* (Fig. 10, Table 6 in Annexe). This plant, known by Mexican people as Chayote or Ch´umate, is used by Mayan people as a food, especially the starchy root, fruit, stems, young leaves as a vegetable or it is used as an ingredient of stews, fruit, for juices and sauces (Lubin, 1994). *Sechium edule*, used mainly for human consumption, has also medicinal uses. The leaves are used for dissolving kidney stones and as part of the treatments of arteriosclerosis and hypertension. Leaves, fruit and shoot are also used as remedy for dermatological illnesses and as the treatment of culture bound syndromes (Frei et al., 1998).

It seems strange that Mexican people also used plants for no conventional curing. *Asclepias linaria* (Fig. 11, Table 6 in Annexe), for instant, is used as remedy for shock and in bath for woman in labour making the infusion from the aerial parts (Canales et al., 2006). Using the aerial part of *Gypsacanthus nelsonii* and *Ruta chalepensis* (Fig. 12, Table 6 in Annexe) they can cure jaundice (Canales et al., 2006).

## 7 CONCLUSION

This study is interested in ethnobotanical research in Mexico, including the states Chiapas, Puebla, Oaxaca, Nuevo León, Sonora and Baja California. Considering that Mexico is presented with a high diversity of plants, in this work was studying the using of plants in different domains, especially the medicinal plants and their utilization in traditional medicine. Medicinal plants form most important group in ethnobotanical use of plants, because in Mexico there is undeveloped and expensive medicinal care, which is frequently compensated by alternative medicine.

This study presents plants in traditional medicinal use of Mexican people. It created the database of 540 medicinal plants, where we were interested in localization, local name, botanical name and uses. The highest number of genera used in the folk culture as medicine plants are the *Asteraceae*, *Leguminosae*, *Euphorbiaceae* and *Solanaceae*. We recorded that the greatest plant parts used are leaves with occurrence of plants, than aerial part, stem, flower, fruit and whole plant. We recorded that 45 species are cultivated in homegardens for various purposes.

We shows in this study that except the usual illnesses the plants are also used for no conventional curing, including the treatment of shock, jaundice, snake or ant bite or for example earache.

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# **ANNEXE**

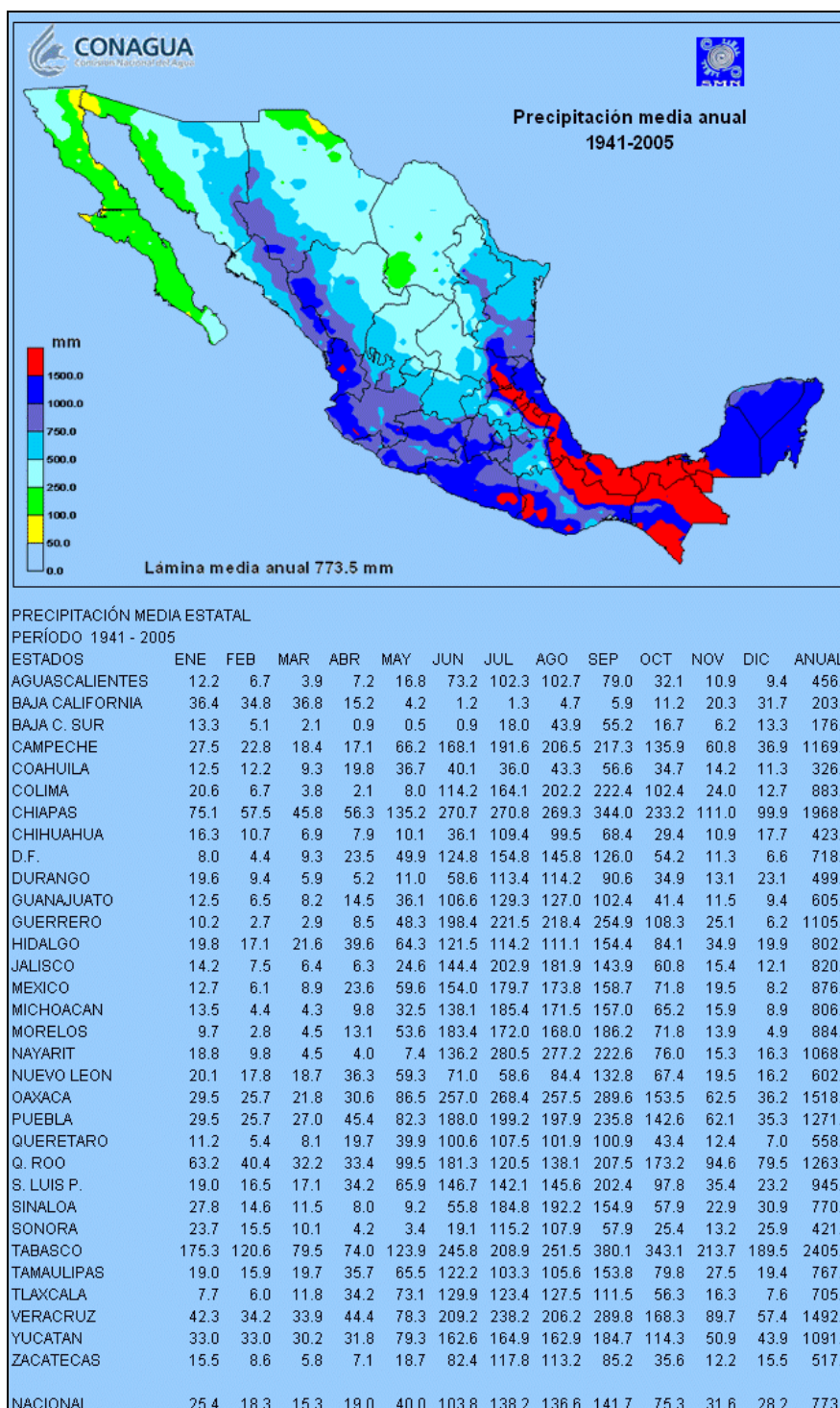


Fig. 7 Average Annual Rainfall. Source: CONAGUA, 2008.

**Table 5. The 12 leading countries of import and export of medicinal and aromatic plants (SITC.3: 292.4 = commodity group HS 1211).** The countries are listed according to descending order of average trade volumes, 1991-2003.

<b>Country of import</b>	<b>Quantity (tonnes)</b>	<b>Value (US\$)</b>	<b>Country of export</b>	<b>Quantity (tonnes)</b>	<b>Value (US\$)</b>
Hong Kong	59,950	263,484,200	China	150,600	266,038,500
USA	51,200	139,379,500	Hong Kong	55,000	201,021,200
Japan	46,450	131,031,500	India	40,400	61,665,500
Germany	44,750	104,457,200	Mexico	37,600	14,257,500
Rep. Korea	33,500	49,889,200	Germany	15,100	68,243,200
France	21,800	51,975,00	USA	13,050	104,572,000
China	15,550	41,602,800	Egypt	11,800	13,476,000
Italy	11,950	43,006,600	Bulgaria	10,300	14,355,500
Pakistan	10,650	9,813,800	Chile	9,850	26,352,000
Spain	9,850	27,648,300	Morocco	8,500	13,685,400
UK	7,950	29,551,000	Albania	8,050	11,693,300
Malaysia	7,050	38,685,400	Singapore	7,950	52,620,700
<b>Total</b>	<b>320,550</b>	<b>930,524,400</b>	<b>Total</b>	<b>368,100</b>	<b>847,980,800</b>

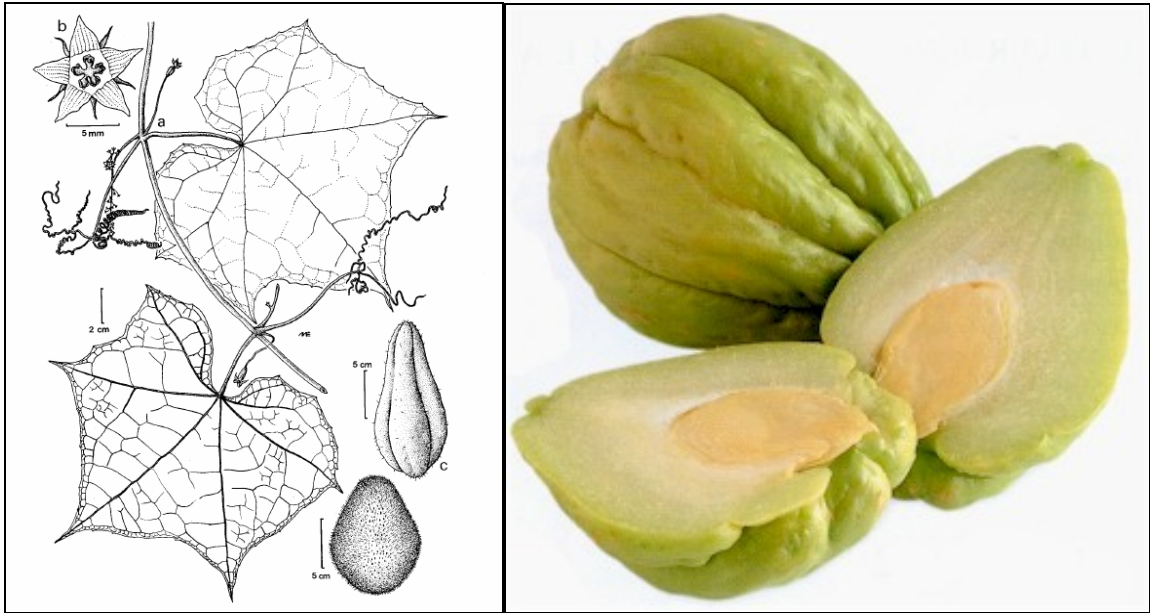
Source: COMTRADE database, United Nation Statistics Division, New York, 2008.



**Fig. 8** *Lippia graveolens* (*Verbenaceae*). Source: Database on Important Medicinal and Aromatic plants, 2008.



**Fig. 9** *Marrubium vulgare* (*Lamiaceae*). Source: Royal College of Physicians, 2007; Hughes, 2007.



**Fig. 10** *Sechium edule*. Source: The gourmet food and cooking resource, 2008; Lira, 1996.



**Fig. 11** *Asclepias linaria*. Source: ARIZONA-SONORA DESERT MUSEUM, 2005.



**Fig. 12** *Ruta chalepensis*. Source: Les senteurs du Quercy, 2008.



**Table 6. List of medicinal plants in representative states of Mexico**



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