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Czech University of Life Sciences Prague  
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**Ethnobotanical study of medicinal plants used by  
Mocho community in the state of Chiapas,  
Mexico**

BACHELOR'S THESIS

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## **Declaration**

I hereby declare that I have done this thesis entitled Ethnobotanical study of medicinal plants used by Mocho community in the state of Chiapas, Mexico independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague, 19.04.2019

.....  
Ainura Seitmuratova

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## Abstract

The State of Chiapas is inhabited by 11 ethnic groups with valuable ancestral knowledge in the management, and use of medicinal plants that are transmitted orally from generation to generation. The aim of this thesis was the documentation of traditional knowledge about medical plants and its usage in traditional medicine by the locals of the Mocho community, located in the state of Chiapas.

Ethnobotanical and socio-demographical data were collected in the form of the questionnaire from 43 local informants from Motozintla municipality, the state of Chiapas. In addition, quantitative approaches were used to determine medicinal use value (MUV), use report (UR), frequency of citation (FC), the relative frequency of citation (RFC) and informant consensus factor (ICF).

A total of 83 medicinal plant species belonging to the 44 botanical families were documented. Asteraceae was the most dominant family by number of species (6 species) followed by Lamiaceae and Rutaceae (5 species each). The most often used parts are leaves (46 %) and the decoction is the most common method of preparation. Diseases of the digestive and gastrointestinal system were dominated with 102 use-reports (27.57 %) and diseases of the reproductive system had the highest ICF index (0.76) among other ailment categories. According to RFC and MUV index, the most important species were *Verbena litoralis* Kunth, *Matricaria chamomilla* L., *Bursera simaruba* (L.) Sarg., *Dysphania ambrosioides* (L.) Mosyakin & Clemants and *Ruta graveolens* L.

At present, there is a great loss of knowledge due to different problems. The information may be forgotten this way, so it is important to maintain traditional knowledge for the next generations before it pours out into a huge loss.

**Key words:** Asteraceae, Ethnobotany, Lamiaceae, Traditional medicine, *Verbena litoralis* Kunth.

## Abstrakt

Tradiční medicína byla používána stovky, tisíce let lidmi po celém světě. Téměř 5000 až 7000 rostlinných druhů jsou používány domorodými skupinami v Mexiku. Stát Chiapas je obýván 11 etnickými skupinami s cennými znalostmi v používání léčivých rostlin, které jsou přenášeny ústně z generace na generaci.

Etnobotanické a socio-demografické údaje byly shromážděny formou dotazníku od 43 místních informátorů z obce Motozintla, státu Chiapas. Získaná data byla zpracována do tabulek a analyzována kvantitativními etnobotanickými indexy (UR, FC, RFC, MUV, ICF).

Celkem bylo použito 83 druhů léčivých rostlin patřících do 44 botanických čeledí. Asteraceae byla nejčastěji zmiňovaná čeleď (6 druhů), pak Lamiaceae a Rutaceae (5 druhů každý). Nejčastěji používanými částmi rostlin byly listy (46 %) a nejčastější metodou přípravy byl odvar. Převládajícími potížemi jsou onemocnění zažívacího systému (27.57 %) a onemocnění reprodukčního systému měly mezi ostatními kategoriemi nejvyšší index ICF (0,76). Podle RFC a MUV indexu byly nejdůležitějšími druhy *Verbena litoralis* Kunth, *Matricaria chamomilla* L., *Bursera simaruba* (L.) Sarg., *Dysphania ambrosiodes* (L.) Mosyakin & Clemants a *Ruta graveolens* L.

V současné době dochází k velkým ztrátám znalostí v důsledku různých problémů, jako je migrace, absence dokumentace a nezájem mladší generace v tradiční medicíně. Informace může být ztracena, takže je důležité zachovat tradiční znalosti pro příští generace, než se dostane do obrovské ztráty. Práce je proto zaměřena na dokumentaci tradičních znalostí.

**Klíčová slova:** Asteraceae, Ethnobotanika, Lamiaceae, Tradiční medicína, *Verbena litoralis* Kunth.

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# 1. Introduction

Traditional medicine has been used for hundreds, thousands of years by people all over the world. Medicinal plants play an important role in it and rewarded as a part of a culture's traditional knowledge. Traditional medicine includes various techniques and beliefs that combine traditional methods of treatment, based on the use of the healing properties of plants, animals and/or mineral sources, as well as spiritual therapy and physical exercise (Casas et al. 2016).

Globally, about 80 % of the population in developing, and 60 % in developed countries still use traditional medicine as their primary health care to treat a wide range of diseases. Nowadays, the role of traditional medicine in the national health care system is increasingly recognized and defined, so more and more countries are adopting the national policy and promoting the development of specific legal regulations, especially in the field of herbal medicine (WHO 2007). More than 50,000 plant species are being used in different human cultures not only for treating health problems but also as food, spices, fuel, fodder, materials for construction and in shamans' rituals (Casas et al. 2014). The statistic shows that non-communicable diseases are estimated to account for 80 % of all deaths in Mexico: cardiovascular diseases (24 %), diabetes (injuriesancers (12 %), injures (10 %), communicable, maternal, perinatal and nutritional conditions (10 %), chronic respiratory diseases (6 %) and other non-communicable diseases (22 %) (WHO 2018).

The poorest countries in the world need cheap and effective treatment of infectious disease the most. According to WHO, one third of the world's population still does not have regular access to essential drugs, and in the poorest regions of Africa and Asia, this figure exceeds 50 %. In these regions, some forms of traditional medicine are often more affordable and cheaper sources of medical care. Traditional medicine is also very important for developed counties, because any products used in pharmaceutical industry are based on, or consists of biological materials, founded through references to traditional medicine.

To the negative aspects of the use of medical plants is changing their chemical composition depending on various growing conditions, up to the complete loss of their



medicinal properties. Poor drying or excessively long storage can be the reason of losing their medicinal quality. A significant drawback is the presence of toxic substances in some of the plants, that are harmful to human body and can cause undesirable phenomena (Nasri, Hamid Shirzad 2013). So, it is important to know if the uses of the plant are proven scientifically and how effective these methods are.

Mexico is made up of 32 States, inhabited by 12,000,000 indigenous people divided into 59 ethnic groups (CONAPO 2009). Nearly 5,000 to 7,000 plant species are being used by indigenous groups in Mexico. The State of Chiapas is inhabited by 11 ethnic groups with valuable ancestral knowledge in the management and use of medicinal plants that are transmitted orally from generation to generation. At present, there is a great loss of knowledge due to different problems, such as the transfer of knowledge in closed groups, with is no documentation, migration to other areas, disinterest among the younger generation in traditional medicine, and the loss of biodiversity of medicinal plants. The information may be forgotten this way, so it is important to maintain traditional knowledge for the next generations before it pours out into a huge loss (Turner et al. 2006). Therefore, this work is focused on documentation of traditional knowledge.

## **2. The aim of study**

The main purpose of this study was the documentation of traditional knowledge about medical plants and its usage in traditional medicine by the locals of the Mocho community, located in the state of the Chiapas.

The aim of study was based following research questions:

- Which plant families and species are the most common for treating health problems?
- What is the main ailment category treated with medicinal plants in the Mocho community?
- What therapeutic application are the most common, how are they prepared and administered?

### **3. Methodology**

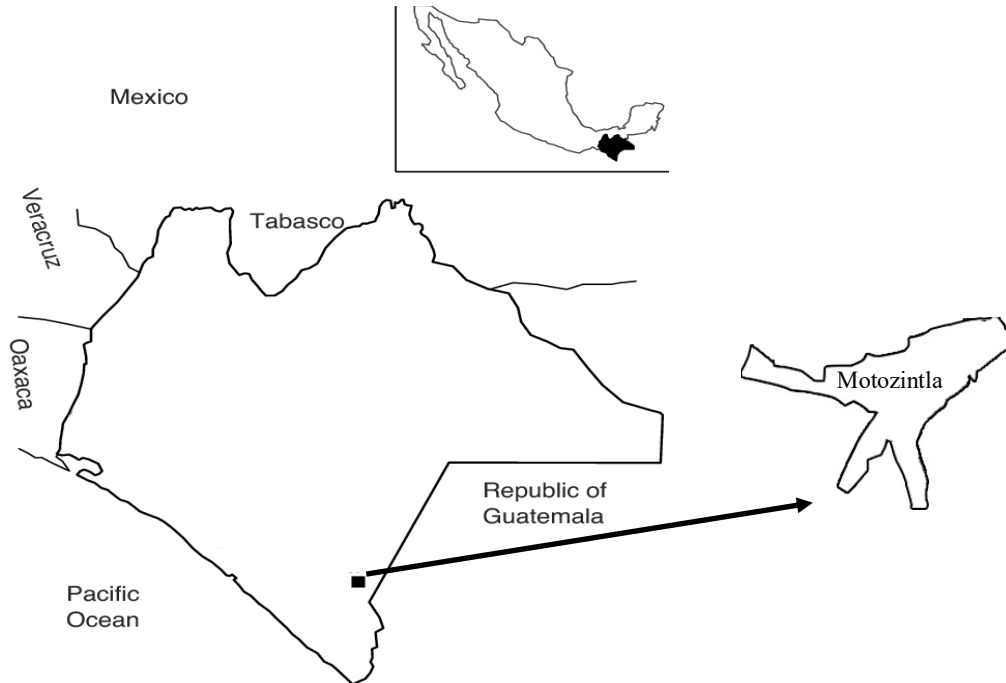
#### **3.1 Geographical and Demographical data of study area**

Mexico or officially the United Mexican States is a federal republic located in the continent of North America. According to the National Institute of Statistics and Geography, Mexico is the 13th largest independent state in the world with its area (1,964,375 km<sup>2</sup>). Mexico shares land borders with three countries: United States of America, Guatemala and Belize. Washed by the Pacific Ocean to the south and west, by the Caribbean Sea to the southeast and by the Gulf of Mexico to the east (Figure 1). According to estimations made by Mexico's National Geography and Statistics Institute, in 2017 Mexico had a population of 123.5 million inhabitants, making it the largest Spanish-speaking country in the world.

Mexico is a federation comprising 31 states and Mexico City, a special federal entity that is also the capital city and its most populous city. Other metropolises in the state include Guadalajara, Monterrey, Puebla, Toluca, Tijuana and León. The state of Chiapas is one of the states that make up Mexico. It is the southern state and it borders with Oaxaca to the west, Veracruz to the northwest and Tabasco to the north, and by the Petén, Quiché, Huehuetenango and San Marcos departments of Guatemala to the east and southeast. Washed from the south by the waters of the Pacific Ocean. The state consists of 118 municipalities organized into nine political regions called Center, Altos, Fronteriza, Frailesca, Norte, Selva, Sierra, Soconusco and Istmo-Costa. It is inhabited by 11 ethnic groups and has about 13.5 % of all of Mexico's indigenous population with valuable ancestral knowledge in the management and use of medicinal plants (Encuesta Intercensal 2015).

The survey was made in Motozintla municipality where lives the majority of Mocho community. The members of this town call themselves mochós or motozintlecos, as the linguists also call them regionally. The municipality of Motozintla is located in southeast of the state, at an altitude of 1,300 meters above sea level. It borders with Guatemala in the east, and its territorial extension is 782 square kilometers. The motozintleco language (mochó) is spoken approximately by 400 people in Chiapas and it is almost extinct. The tongue is classified within the Mayan language. In the region where

the Mochós live, there is also the Mam and the Kaqchikel pearele which languages is also belonging to the Maya and the first one is the predominant language in this region (González 2009).



**Figure 1:** Map of Mexico, state of Chiapas and Motozintla municipality

From the economic point of view, the mochós depend fundamentally on agriculture (57.7 %), which is the main activity of the family group. They plant corn, beans, chili and tomat, es. Coffee, potatoes and cocoa are grown for sale. Avocados, oranges and bananas are of a secondary importance. The raising of livestock and poultry, particularly chicken and turkey, to a lesser extent beef, and farming fish are also major economic activities. In the second place is tourism and services (29.2 %). Many indigenous people are employed in the production of traditional clothing and fabrics, and producing wood items and traditional goods. Thus, manufacturing industry takes the third place (11.2 %) (Schmal 2012). The climate is mostly tropical and humid. The rainfall average can more than 3,000 mm per year. In the past, natural vegetation in this region was lowland with tall perennial rainforest, but it has been completely cleared out to agriculture and ranching (González 2009).

### 3.2 Data collection and identification of plant species

The information is represented by semi-structured interviews with randomly selected people in different age categories, gender or education. The interviews were made in the official language – Spanish. The questionnaire was mainly focused on ethnobotanical information – which plants do respondents use, for what reason, allow to prepare them,; as well as including demographic characteristics. All plant material was identified taxonomically with the aid of Biblioteca Digital de la Medicina Tradicional Mexicana ([www.medicinatradicionalmexicana.unam.mx/indehp](http://www.medicinatradicionalmexicana.unam.mx/indehp)) and with an expert Autonomosom Chapingo Autonomus university. The botanical names of species were verified with The Plant List (<http://www.theplantlist.org>).

### 3.3 Quantitative anawereis

Collected data was put into and analyzed by quantitative ethnobotanical indices: use report (UR), frequency of citation (FC), relative frequency of citation (RFC), medicinal use value (MUV) and informant consensus factor (ICF).

#### Use report (UR)

The UR stands for the number of uses for each plant species.

#### Frequenthe cy of citation (FC), relative frequency of citation (RFC)

The RFC is important for quantitative determining of well-known and most useful species in the area. This index could be calculated using formula, proposed by Tardio and Santayana (2008)

$$RFC = FC / N$$

while FC is the number of informants, which represent species, the N means the number of all people participating in the survey.

### Medicinal use value (MUV)

The MUV is modification of UV (is calculated to demonstrate the relative importance of the species for medicinal purposes. MUV was calculated using following formula suggested by Šavikina et al. (2013)

$$\text{MUV} = \sum a \text{ MU} / \text{N}$$

where MU is the number of medicinal uses mentioned by each informant for a given plant, and the N is the number of all people participating in the survey.

### Informant Consensus Factor (ICF)

The ICF is calculated for each category of medicinal uses to show the homogeneity of knowledge about using the species in each disease's category among the populations. The ICF the was calculated using following formula proposed by Heinrich et al. (1998).

$$\text{ICF} = (\text{nur} - \text{nt}) / (\text{nur} - 1)$$

where “nusers is the number of use reported in each category of diseases, and "nt” is the number of species used for particular category by all informants.

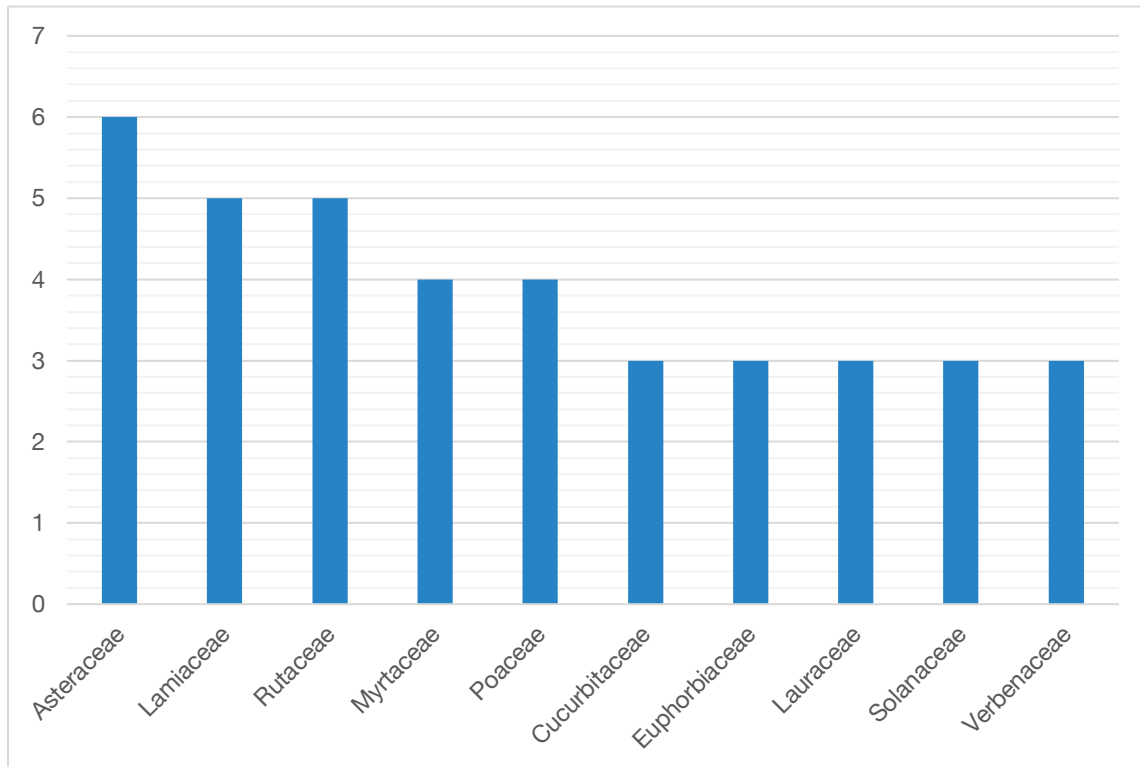
## 4. Results and discussion

### 4.1 Taxonomic classification

In total 83 medicinal plant species, belonging to the 44 families were documented (Table 1). Asteraceae was the most dominant family (6 species), followed by Lamiaceae and Rutaceae (5 species each), Myrtaceae and Poaceae (4 species each), Verbenaceae, Solanaceae, Lauraceae, Euphorbiaceae, Cucurbitaceae (3 species each), while other families were represented by two or one species only (Figure 2).

The Asteraceae family is apparently a crucial component of the floristic richness of the environment in Central Mexico and rainforest areas (of the family Asteraceae is widely supported by different studies (Balleza & Villasenor, 2016), with rich number of species and their uses (medicinal, agricultural, and industrial) (Burgos-Hernández et al. 2014; Dominguez-Barradas et al. 2015).

The worldwide number of species found in this family (19,085) could be the reason of predominance of plants from Asteraceae family (Voeks 1996). That agrees with other study provided in Mexico. The study showed that several states in the country such as Chiapas, Oaxaca, Veracruz Jalisco and Chihuahua are outstanding and rich in genera of Asteraceae family (Luis et al. 2013). The similar results are shown in the study of Bennett and Prance (2000), which presents Asteraceae and Lamiaceae as the most dominant plant families. The study of de la Torre *et al.* (2008), where those two families represent 21 % of the 216 species according to the survey taken in the north of South America.



**Figure 2:** The most cited botanical plant families in study area

## 4.2 Demographic features of the informants

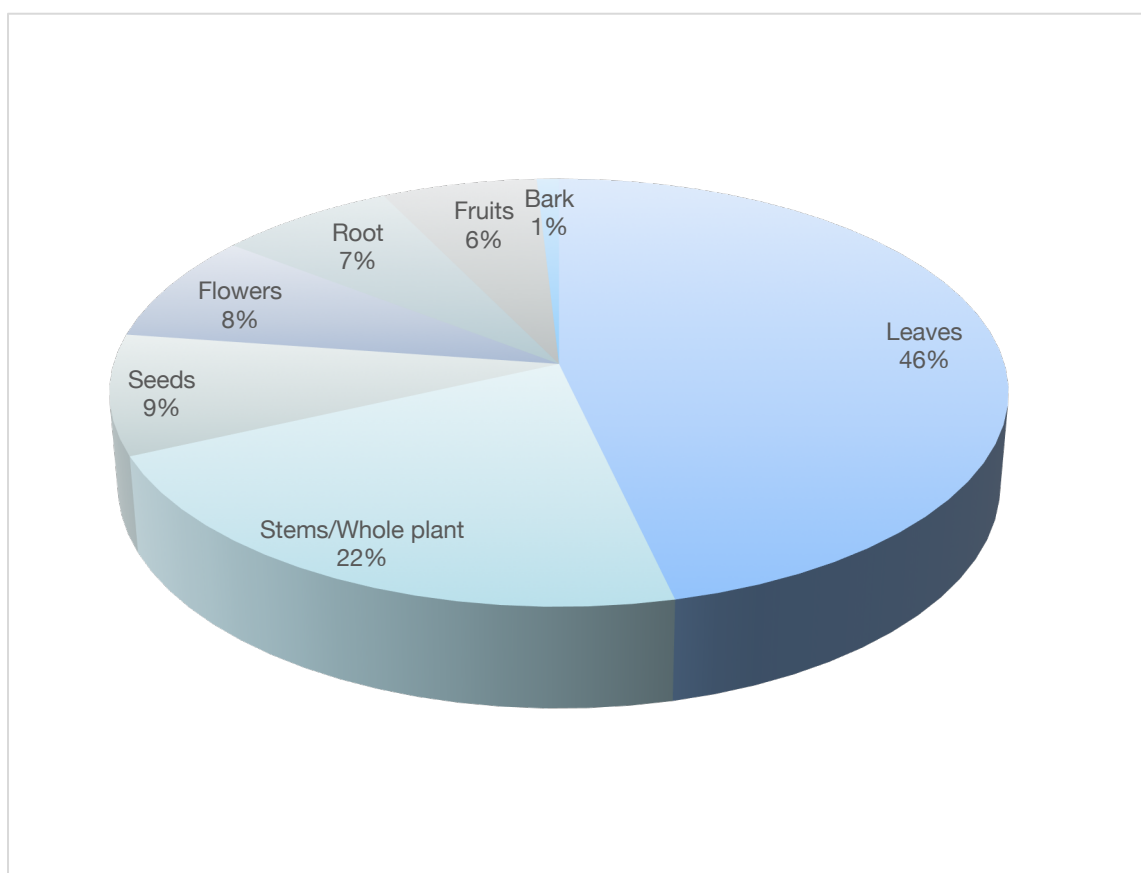
A total of 43 local informants (72 % male, 28 % female) participated in survey. The large number of respondents were in the age group between '31-40 years' (30 %), followed by 'above 61 years' (23 %), then '41-50 years' (16 %), '51-60 years' (14 %), '21-30 years' (12%) and the last one is group 'less than 20 years' (5 %).



### 4.3 Plant part(s) used

Even though all plant parts have important roles in the treatment of different illnesses, the present study shows that leaves were the most common part of plant with 46 % applications in traditional recipes, followed by whole plant/stem (22 %), seed (9 %), flower (8 %), root (6 %), fruit (6 %) and bark (1 %) (Figure 3).

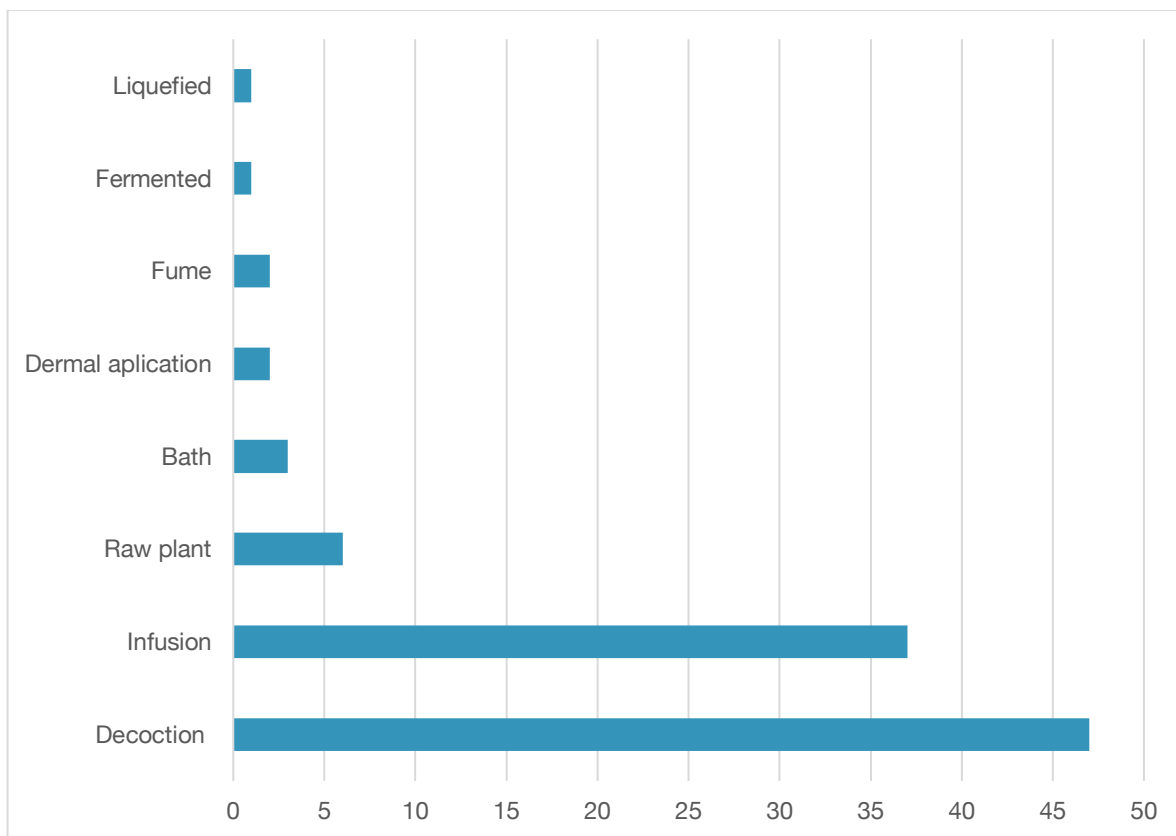
The reason is that comparing to roots, flowers and fruits, it is easier to use the leaves as a medicine, and they are constantly available in the tropical area (Telefo et al. 2011). Removal of up to 50% of tree leaves does not pose a great danger to the plant existence, compared with the collection of stems, bark, whole or underground parts (Campbell 2010). Also, leaves store most of the chemical compounds in the form of secondary metabolites with biological activity (Turner et al. 2006).



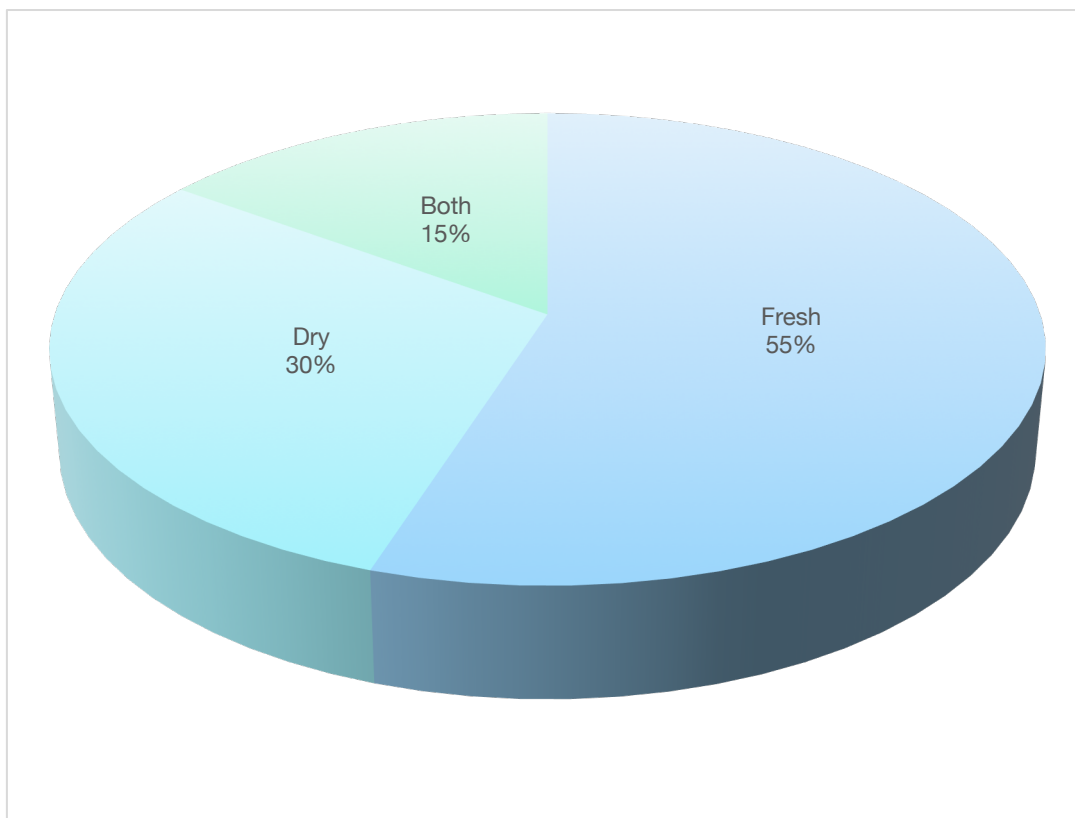
**Figure 3:** Plant part used

#### 4.4 Methods of preparation

Local inhabitants of the study area use different methods to prepare recopies for the treatment of ailments. The most common methods are decoction (47 %), followed by the infusion (37 %), raw plants (6 %), bath (3 %), fume and dermal application (2 % each), fermented and liquefied (1 % each) (Figure 4). Most of the plants are applied or consumed fresh (55 %), dry (30 %) and some of could be used in the both ways (15 %) (Figure 5).



**Figure 4:** Preparation mode (%)



**Figure 5:** Percentage of preparing plants (fresh/dry)

Similar result appeared in other studies, where the decoction was the most common method of treatment (Joshi & Joshi 2000). Decoction is used commonly in traditional medicine, because it is easy to prepare the medicine by mixing it with tea or water , and it can be also be consumed with meat and vegetable, or used to prepare bouillons or soups (Ssegawa & Kasenene 2007). Also, a study form Pakistan showed that the most popular methods of preparation were decoction and infusion (Umair et al. 2017).

**Table 1: Inventory of medicinal plants used by Mocho community in the state of Chiapas, Mexico**

Species name	Common name	Family	Used parts	Ailment category	Fresh/dry	Preparation mode
<i>Allium sativum</i> L.	ajo	Amaryllidaceae	bulb	2,4	fresh	decocted
<i>Aloe vera</i> (L.) Burm f.	savila	Xanthorrhoeaceae	leaves	2,11	dry	raw plant
<i>Ananas comosus</i> (L.) Merr.	piña	Bromeliaceae	fruit, leaves	2,6,7,8	fresh,dry	fermented, decocted
<i>Annona muricata</i> L.	guanabana	Annonaceae	leaves, fruits	6,8	fresh	infusion
<i>Annona</i> sp.	anona	Annonaceae	leaves	2	fresh	crushed
<i>Apium graveolens</i> L.	apio	Apiaceae	stems,leaves	1,2	fresh	crushed, infusion
<i>Artemisia absinthium</i> L.	ajenjo	Asteraceae	leaves, branches	1,2	dry	decocted
<i>Artemisia ludoviciana subsp. mexicana</i> (Willd. ex Spreng.) D.D.Keck	estafiate	Asteraceae	leaves, stems	1,2,6	fresh,dry	decocted
<i>Avena sativa</i> L.	avena	Poaceae	seeds	2,3,11	dry	decocted
<i>Beta vulgaris</i> L.	betabel	Amaranthaceae	root	10	fresh	raw plant
<i>Borago officinalis</i> L.	borraja	Boraginaceae	stem	2	fresh,dry	infusion
<i>Bougainvillea spectabilis</i> Willd.	bugambilia	Nyctaginaceae	flowers	3,6	fresh	infusion
<i>Bursera copallifera</i> (Sessé & Moc. ex DC.) Bullock	copal	Burseraceae	leaves, stems	5,6	dry	fume
<i>Bursera simaruba</i> (L.) Sarg.	mulato	Burseraceae	bark, branches, leaves	2,6,11	fresh	bath, decocted
<i>Cannabis sativa</i> L.	marihuana	Cannabaceae	leaves, stems, flowers	4	fresh	raw plant
<i>Capsicum</i> spp.	chile mecate	Solanaceae	leaves, stems	6	dry	decocted
<i>Cecropia obtusifolia</i> Bertol.	palo guarumbo	Urticaceae	leaves	3	fresh	decocted, bath
<i>Cecropia peltata</i> L.	guarumbo	Urticaceae	leaves	3	fresh	infusion
<i>Cinnamomum verum</i> J.Presl	canela	Lauraceae	stems	3,5	dry	infusion

<i>Citrus × aurantium</i> L.	naranja	Rutaceae	leaves,fruits	3	fresh	decocted
<i>Citrus aurantiifolia</i> (Christm.) Swingle	limón	Rutaceae	leaves, fruits	2,3,6	fresh	infusion
<i>Citrus limon</i> (L.) Osbeck	limón criollo	Rutaceae	seeds	5,6	dry	decocted
<i>Citrus medica</i> L.	lima chichi	Rutaceae	fruits	6	fresh	decocted
<i>Coffea arabica</i> L.	café	Rubiaceae	seeds	2,5	dry	decocted
<i>Crotalaria pumila</i> Ortega	chepi 1	Leguminosae	leaves,stems	2,6	fresh	decocted
<i>Cucurbita ficifolia</i> Bouché	calabacilla	Cucurbitaceae	root	8	fresh	decocted
<i>Cucurbita pepo</i> L.	calabaza	Cucurbitaceae	seeds	2	dry	decocted
<i>Cupressus sempervirens</i> L.	cipres	Cupressaceae	leaves,stems	6,8	fresh	decocted
<i>Cymbopogon citratus</i> (DC.) Stapf	zacate limon	Poaceae	leaves	3	fresh	decocted, infusion
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	epazote	Amaranthaceae	whole plant	2,11	fresh,dry	infusion
<i>Equisetum hyemale</i> L.	cola de caballo	Equisetaceae	branches	7	fresh	infusion
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	nispero	Rosaceae	leaves	2,6	fresh	infusion
<i>Eucalyptus globulus</i> Labill.	eucalipto	Myrtaceae	leaves, flower	3	fresh	infusion
<i>Euphorbia maculata</i> L.	hierba de la golondrina	Euphorbiaceae	stems	7,11	fresh,dry	decocted
<i>Foeniculum vulgare</i> Mill.	hinojo	Apiaceae	whole plant	1,3,5	fresh	infusion
<i>Hibiscus sabdariffa</i> L.	Jamaica	Malvaceae	flowers	10	fresh	infusion
<i>Hymenaea courbaril</i> L.	guapinol	Leguminosae	fruit	1,2	dry	decocted
<i>Jatropha curcas</i> L.	piñon	Euphorbiaceae	seeds	6,11	fresh	decocted
<i>Lantana camara</i> L.	riñonin a	Verbenaceae	leaves,stems	7	fresh,dry	infusion
<i>Lantana hirta</i> Graham	oro zus	Verbenaceae	root,flowers	3	dry	decocted
<i>Litsea glaucescens</i> Kunth	laurel	Lauraceae	leaves	6	dry	decocted
<i>Luffa cylindrica</i> (L.) M.Roem.	estropajo	Cucurbitaceae	leaves, fruit	11	dry	decocted
<i>Mangifera indica</i> L.	mango de coche	Anacardiaceae	leaves	2	fresh	decocted
<i>Matricaria chamomila</i> L.	manzanil la	Asteraceae	leaves,stems, flowers	1,2,5,6	fresh,dry	infusion
<i>Mentha × piperita</i> L.	hierbabuena	Lamiaceae	leaves, stems	2,3,5	fresh	infusion

<i>Mirabilis jalapa</i> L.	maravilla	Nyctaginaceae	leaves	11	fresh	crushed
<i>Moringa oleifera</i> Lam.	moringa	Moringaceae	leaves	5	fresh	decocted
<i>Musa</i> spp.	platano	Musaceae	leaves	2	fresh	crushed
<i>Nasturtium officinale</i> R. Br.	berro	Brassicaceae	leaves	2	fresh	raw plant
<i>Ocimum basilicum</i> L.	albahaca	Lamiaceae	leaves, stems	1,2	fresh	infusion
<i>Opuntia</i> sp.	no pal	Cactaceae	leaves, fruit	1,2	fresh	crushed, infusion
<i>Origanum vulgare</i> L.	oregano	Lamiaceae	leaves, stems	2	fresh, dry	infusion
<i>Pachycereus pecten-aboriginum</i> (Engelm. ex S. Watson) Britton & Rose	cardon	Cactaceae	stem	8	fresh, dry	raw plant
<i>Passiflora suberosa</i> L.	pasiflora	Passifloraceae	leaves	5	fresh	infusion
<i>Persea americana</i> Mill.	aguacate oloroso	Lauraceae	seed, leaves	2	fresh	decocted
<i>Peumus boldus</i> Molina	boloc	Monimiaceae	seeds	2	fresh	decocted
<i>Phalaris canariensis</i> L.	alpistle	Poaceae	seeds	6	dry	decocted
<i>Pimenta dioica</i> (L.) Merr.	pimienta	Myrtaceae	seeds	6	dry	bath
<i>Pinus oocarpa</i> Schiede	ocote	Pinaceae	stems, cortex	2	dry	decocted
<i>Pinus</i> spp.	pino	Pinaceae	branches	2	dry	decocted
<i>Piper auritum</i> Kunth	acoyo	Piperaceae	leaves	2	fresh	crushed
<i>Psidium guajava</i> L.	guayaba	Myrtaceae	branches	2	dry	decocted
<i>Psidium guineense</i> Sw.	guayaba agrio	Myrtaceae	leaves, fruits	2	fresh	infusion
<i>Quassia amara</i> L.	quina	Simaroubaceae	cortex	3,8	dry	decocted
<i>Ricinus communis</i> L.	higuerilla	Euphorbiaceae	leaves	6	fresh	burned, decocted
<i>Ruta graveolens</i> L.	ruda	Rutaceae	leaves, stems, flowers	2.5	fresh, dry	infusion
<i>Salvia polystachya</i> Cav.	chia	Lamiaceae	seeds, leaves	10	dry	decocted
<i>Sambucus mexicana</i> C. Presl ex DC.	sa uco	Adoxaceae	flower, leaves, fruits	3,6	fresh, dry	infusion
<i>Sedum praealtum</i> A. DC.	siempre viva	Crassulaceae	leaves	6	fresh	Infusion
<i>Semialarium mexicanum</i> (Miers) Mennega	cancerina	Celastraceae	root	8	dry	Infusion, decocted
<i>Sida rhombifolia</i> L.	Malva	Malvaceae	leaves	6	fresh	decocted

<i>Smilax spinosa</i> Mill.	zarzaparrilla	Liliaceae	stems, leaves	7,1	fresh	infusion
<i>Solanum americanum</i> L.	hierba mora	Solanaceae	leaves, stems	2	fresh	decocted
<i>Solanum torvum</i> Sw.	lavaplató	Solanaceae	leaves	6,11	fresh	infusion
<i>Tagetes lucida</i> Cav.	peri cón	Asteraceae	stems,leaves	2	dry	decocted
<i>Taraxacum officinale</i> (L.) Weber ex F.H.Wigg.	diente de león	Asteraceae	whole plant	10	fresh,dry	decocted
<i>Thevetia ovata</i> (Cab.) A.DC.	yoyote	Apocynaceae	leaves, root	6	dry	decocted
<i>Thymus vulgaris</i> L.	tomillo	Lamiaceae	leaves, flower, stems	6	dry	decocted
<i>Tithonia diversifolia</i> (Hemsl.) A.Gray	arnica	Asteraceae	leaves	3,9,11	fresh,dry	infusion
<i>Valeriana</i> sp.	valeriana	Caprifoliaceae	branches,root	5,6	dry	decocted
<i>Verbena litoralis</i> Kunth	verbena	Verbenaceae	leaves	2,3,11	fresh	decocted, liquefied
<i>Zea mays</i> L.	maiz	Poaceae	seeds, fruits,root	2,7	fresh	infusion
<i>Zingiber officinale</i> Roscoe	gengibre	Zingiberaceae	root	3	fresh	infusion

Category of diseases: 1-Diseases of the reproductive system; 2-Diseases of the digestive and gastrointestinal system; 3- Diseases of the respiratory system; 4-Diseases of the musculoskeletal system; 5-Diseases of the nervous system; 6-General symptoms; 7-Diseases of the urinary tract; 8-Chronic – degenerative diseases; 9-Auto-immune diseases; 10-Diseases of the cardiovascular system; 11-Diseases of the skin.

#### 4.5 Informant consensus factor (ICF)

To calculate ICF, the reported ailments were classified to 11 different disease categories (Table 1). The highest ICF index had diseases of the reproductive system (0.76). Medicinal plants are used to treat reproductive discomforts, such as menstrual pain, gynecological and hormonal problems. Among three major categories, diseases of the digestive and gastrointestinal system were dominated with 102 use-reports, followed by general symptoms and diseases of the respiratory system (69 and 52 use-reports, respectively). Similar results had appeared in other study, conducted in Mexico, where Maya and Nahua communities had mentioned diseases of the gastrointestinal system as a category with the largest number of use-report (de la Torre et al. 2008).

#### 4.6 Relative frequency of citation (RFC) and Medicinal use value (MUV)

The relative frequency of citation index authenticates the frequency of a medicinal plant species used for various ailments. The highest RFC was calculated for *Verbena litoralis* (0.581), followed by *Matricaria chamomilla* (0.395), *Dysphania ambrosioides* and *Bursera simaruba* (0.372 each), *Persea americana* (0.349) and *Ruta graveolens* (0.326) (Table 2). Medicinal use values of recorded plant species have been calculated with the highest number of values for *Verbena litoralis* – 0,186 MUV, *Matricaria chamomilla* – 0,163 MUV, *Foeniculum vulgare*, *Bursera simaruba*, *Ananas comosus*, *Ruta graveolens*, *Dysphania ambrosioides*, *Mentha × piperita* – 0,140 MUV each. The most important medicinal plants will be described in detail.



**Table 2: Informant consensus factor (ICF) of reported plant species**

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, lactation suppression, childbirth preparation, vaginal infections.	0.76	6	22	5.95
2	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	0.75	11	41	11.08
3	Diseases of the musculoskeletal system	Antibacterial, anti-inflammatory, arthralgia, back pain, general pain of the body, rheumatism, pain of muscles, body analgesic	0.75	2	5	1.35
4	Diseases of the respiratory system	Asthma, bronchitis, chest pain, cough, flu, chest pain, pneumonia, laryngitis, respiratory system, sore throat	0.69	17	52	14.05
5	Diseases of the nervous system	Anxiety, insomnia, epilepsy (spasm)	0.67	11	31	8.38

6	Auto-immune diseases	Antibiotic, rheumatoid arthritis, hematopoietic, strengthening immunity defense	0.67	2	4	1.08
7	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	0.65	36	102	27.57
8	Diseases of the urinary tract	Problems of urinary tract system, urinary tract infection, kidney stones, diuretic	0.64	6	15	4.05
9	Generearacheoms	Colitis, ear ache, fever, headache, irritated eyes, lack of energy, migraine, motion sickness, ear problems, sight problems, body strength, stress, toothache, weak gums	0.63	26	69	18.65
10	Chronic – degenerative diseases	Diabetes, hormonal problems, cancer	0.6	7	16	4.32
11	Diseases of the cardiovascular system	Blood cholesterol, circulatory system, hypertension, inflammation, weight-reduction, anginas	0.4	7	11	2.97

**Table 3: Quantitative analysis of data**

<b>Species name</b>	<b>UR</b>	<b>FC</b>	<b>RFC</b>	<b>MUV</b>
<i>Allium sativum</i> L.	4	12	0.279	0.093
<i>Aloe vera</i> (L.) Burm f.	4	5	0.116	0.093
<i>Ananas comosus</i> (L.) Merr.	6	5	0.116	0.140
<i>Annona muricata</i> L.	3	4	0.093	0.070
<i>Annona</i> sp.	1	2	0.047	0.023
<i>Apium graveolens</i> L.	2	1	0.023	0.047
<i>Artemisia absinthium</i> L.	2	1	0.023	0.047
<i>Artemisia ludoviciana subsp. mexicana</i> (Willd. ex Spreng.) D.D.Keck	4	3	0.070	0.093
<i>Avena sativa</i> L.	3	12	0.279	0.070
<i>Beta vulgaris</i> L.	1	3	0.070	0.023
<i>Borago officinalis</i> L.	1	5	0.116	0.023
<i>Bougainvillea spectabilis</i> Willd.	3	11	0.256	0.070
<i>Bursera copallifera</i> (Sessé & Moc. ex DC.) Bullock	3	5	0.116	0.070
<i>Bursera simaruba</i> (L.) Sarg.	6	16	0.372	0.140
<i>Cannabis sativa</i> L.	1	2	0.047	0.023
<i>Capsicum</i> spp.	1	3	0.070	0.023
<i>Cecropia obtusifolia</i> Bertol.	1	1	0.023	0.023
<i>Cecropia peltata</i> L.	1	2	0.047	0.023
<i>Cinnamomum verum</i> J.Presl	2	3	0.070	0.047
<i>Citrus × aurantium</i> L.	2	3	0.070	0.047
<i>Citrus aurantiifolia</i> (Christm.) Swingle	3	11	0.256	0.070
<i>Citrus limon</i> (L.) Osbeck	2	5	0.116	0.047
<i>Citrus medica</i> L.	3	4	0.093	0.070
<i>Coffea arabica</i> L.	1	1	0.023	0.023
<i>Crotalaria pumila</i> Ortega	2	2	0.047	0.047
<i>Cucurbita ficifolia</i> Bouché	1	1	0.023	0.023
<i>Cucurbita pepo</i> L.	1	3	0.070	0.023
<i>Cupressus sempervirens</i> L.	2	2	0.047	0.047
<i>Cymbopogon citratus</i> (DC.) Stapf	1	7	0.163	0.023
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	6	16	0.372	0.140
<i>Equisetum hyemale</i> L.	1	3	0.070	0.023
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	2	3	0.070	0.047
<i>Eucalyptus globulus</i> Labill.	2	5	0.116	0.047
<i>Euphorbia maculata</i> L.	3	4	0.093	0.070
<i>Foeniculum vulgare</i> Mill.	6	13	0.302	0.140
<i>Hibiscus sabdariffa</i> L.	1	1	0.023	0.023
<i>Hymenaea courbaril</i> L.	2	1	0.023	0.047
<i>Jatropha curcas</i> L.	2	2	0.047	0.047
<i>Lantana camara</i> L.	1	1	0.023	0.023
<i>Lantana hirta</i> Graham	1	1	0.023	0.023
<i>Litsea glaucescens</i> Kunth	2	3	0.070	0.047
<i>Luffa cylindrica</i> (L.) M.Roem.	1	1	0.023	0.023

<i>Mangifera indica</i> L.	1	2	0.047	0.023
<i>Matricaria chamomilla</i> L.	7	17	0.395	0.163
<i>Mentha</i> × <i>piperita</i> L.	6	9	0.209	0.140
<i>Mirabilis jalapa</i> L.	2	4	0.093	0.047
<i>Moringa oleifera</i> Lam.	2	1	0.023	0.047
<i>Musa</i> spp.	2	2	0.047	0.047
<i>Nasturtium officinale</i> R. Br.	1	1	0.023	0.023
<i>Ocimum basilicum</i> L.	3	4	0.093	0.070
<i>Opuntia</i> sp.	3	3	0.070	0.070
<i>Origanum vulgare</i> L.	1	3	0.070	0.023
<i>Pachycereus pecten-aboriginum</i> (Engelm. ex S.Watson) Britton & Rose	1	1	0.023	0.023
<i>Passiflora suberosa</i> L.	1	1	0.023	0.023
<i>Persea americana</i> Mill.	4	15	0.349	0.093
<i>Peumus boldus</i> Molina	1	2	0.047	0.023
<i>Phalaris canariensis</i> L.	1	2	0.047	0.023
<i>Pimenta dioica</i> (L.) Merr.	1	2	0.047	0.023
<i>Pinus oocarpa</i> Schiede	1	1	0.023	0.023
<i>Pinus</i> spp.	2	2	0.047	0.047
<i>Piper auritum</i> Kunth	2	4	0.093	0.047
<i>Psidium guajava</i> L.	1	1	0.023	0.023
<i>Psidium guineense</i> Sw.	2	3	0.070	0.047
<i>Quassia amara</i> L.	2	3	0.070	0.047
<i>Ricinus communis</i> L.	1	1	0.023	0.023
<i>Ruta graveolens</i> L.	6	14	0.326	0.140
<i>Salvia polystachya</i> Cav.	1	1	0.023	0.023
<i>Sambucus mexicana</i> C.Presl ex DC.	4	7	0.163	0.093
<i>Sedum praealtum</i> A.DC.	1	1	0.023	0.023
<i>Semialarium mexicanum</i> (Miers) Mennega	1	2	0.047	0.023
<i>Sida rhombifolia</i> L.	3	2	0.047	0.070
<i>Smilax spinosa</i> Mill.	2	4	0.093	0.047
<i>Solanum americanum</i> L.	3	8	0.186	0.070
<i>Solanum torvum</i> Sw.	4	8	0.186	0.093
<i>Tagetes lucida</i> Cav.	2	1	0.023	0.047
<i>Taraxacum officinale</i> (L.) Weber ex F.H.Wigg.	1	1	0.023	0.023
<i>Thevetia ovata</i> (Cab.) A.DC.	1	1	0.023	0.023
<i>Thymus vulgaris</i> L.	2	5	0.116	0.047
<i>Tithonia diversifolia</i> (Hemsl.) A.Gray	5	6	0.140	0.116
<i>Valeriana</i> sp.	3	3	0.070	0.070
<i>Verbena litoralis</i> Kunth	8	25	0.581	0.186
<i>Zea mays</i> L.	2	4	0.093	0.047
<i>Zingiber officinale</i> Roscoe	2	5	0.116	0.047

## **4.7 Description of the most important the medicinal plants in study area**

### **4.7.1 *Verbena litoralis* Kunth**

South American verbena, also known as seashore vervain, is an aromatic plant from *Verbenaceae* family. It is native to the Americas from Mexico to the south and through Central and South America to Argentina and Chile. It is present throughout the world as an introduced plant, and in some areas, it is considered a noxious weed. Verbena is currently used in traditional South and Central American folk medicine against diarrhea, fever, gastrointestinal disorders and some sexually transmitted diseases (Pérez-Arbeláez 1978, Ocampo and Maffioli 1987). Due to its content of vitamins A, B and C, the verbena has various medicinal properties. In Chiapas, this verbena is commonly used in the treatment of stomach pain, vomiting and cough. The plant is crushed and boiled in water and then the decoction is taken orally. Preliminary ethnobotanical and phytochemical information *Verbena litoralis* have been published and various constituents were obtained. It is used in case of infections and stomach cramps, typhoid, bronchitis, dermatitis, malaria, ulcers and diabetes. It is also an effective expectorant, laxative, antitussive, anthelmintic, vulnerary, febrifuge and blood purifier. (Umaña and Castro 1990a, b, Li et al. 2001a, b). The interest in this plant increased after the isolation of the substances with nerve growth factor-potentiating activity. The aerial parts of this plant produce an extract that revealed an interesting preliminary antibacterial potential (Castro-GambA similar Castro 2004). Similar study was provided in Ecuador and verbena was the spices with the highest number of medicinal uses, among all the medicinal plants (de la Torre et al. 2008).

### **4.7.2 *Matricaria chamomilla* L.**

Commonly known as chamomile, it is an annual plant from the Asteraceae family. The plant is widespread and actively cultivated in North America and Eurasia. As invasive species, found in almost all extratropical regions of both hemispheres, the chamomile is used in traditional medicine from the ancient times and still is one of the

most demanded medicinal plants. 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. Infusions and decoctions of the chamomile flower and its essential oil are used in modern scientific medicine (Singh et al. 2011). Chamomile flowers are used in the composition of gastric, diaphoretic and emollient charges, taken inside and outwardly. The most valuable substance in essential oil is chamazulene - an aromatic chemical compound, which has anti-inflammatory, sedative and local anesthetic properties (Pereira et al. 2009). Chamomile oil is used in aromatherapy for insomnia, migraine, inflammation of the skin, as well as burns and eczema. It is recommended for asthma, bronchitis, cough, flu, cystitis, irritability, useful for children and the elderly. The oil is applied externally with vegetable oil, taken internally with honey, as well as in the form of inhalations, baths, applications and compresses (Bhaskaran et al. 2010). Infusion of chamomile flower has anti-inflammatory, hemostatic, antiseptic, weak astringent, analgesic, sedative, anticonvulsant, diaphoretic, choleric effect (Pérez-Nicolás et al. 2017). It is also common to use chamomile flowers combining with other medicinal herbs to prepare tea, which has sedative effect and reduces the manifestation of flatulence. Even the health professionals in Mexico recommend using *Matricaria* spp. the against diseases of gastrointestinal and respiratory systems, because of the wide medicinal effectiveness (Lara Reimers et al. 2018). Chamomilla - *Matricaria chamomila* L. had the highest relative frequency of citation and use reports in the study provided in Zacatecas, Mexico. This plant was cited by 59 % of the informants to treat wide range of condition such as ailments of the respiratory system, digestive system, colic pains, fever, and eye problems (Sosa et al. 2002).

#### **4.7.3 *Bursera simaruba* (L.) Sarg.**

This plant is commonly known as a palo mulato or chaca is a tropical tree, that grows up to 30 meters from *Bursera* family. It is also known as almacigo, naked Indian, jiote, palo colorado, etc. In Maya it is called chakaj and in English - copper wood tree, Indian limbo or west indian birch. This tree is native to tropical America and is found in warm regions from Florida and Mexico, to Venezuela and Brazil. This tree adapts very well to different habitats, saline or calcareous soils. That is why it is used as a street tree

in coastal areas. Leaves, and especially the bark of this tree contain sticky and aromatic resin, that has many medicinal virtues. Many ethnobotanical studies indicate that the bark is a common topical remedy for skin affections like sores, measles, sunburns, insect bites and rashes (Essential et al. 2007). Bark infusions are consumed in form of tea to treat urinary diseases, fevers, colds and purify the blood. Also, it was found out that the chemical composition of plant leaf essential oil has anticancer activity. (Ketzis et al. 2002; Palareti et al. 2016)

#### **4.7.4 *Dysphania ambrosioides* (L.) Mosyakin & Clemants**

Epazote is a perennial aromatic plant from *Amaranthaceae* family. This plant is native to America and has been used in traditional medicine since Mayan civilization. Nowadays, it is used as a medicinal plant and as a condiment in many countries of Latin America. In Mexico it is also called acahualillo or tea milpa. Infusion and decoction made from the leaves are useful in cure of colds, asthma, flu and pneumonia. This herb has been used in traditional medicine for centuries to treat intestinal parasites of humans and domestic animals. Many studies have indicated antifungal and anthelmintic activity against different microorganisms and intestinal parasites (Nascimento et al. 2006). The herb is an excellent remedy for stomach and intestinal ailments like indigestion, cramps, and ulcers. An epazote tea is made from the plant's leaves and flowers and ingested in moderate amounts. Some research has shown it to have strong antioxidant and soothing qualities (Pollio et al. 2008).

#### **4.7.5 *Ruta graveolens* L.**

*Ruta graveolens* commonly called ruda is a species of the *Rutaceae* family and native to Southern Europe. Due to its medicinal properties, this plant has been introduced to and cultivated in many parts of the world. In the study area it is used to treat various problems such as menstrual pain, anxiety, stress, stomach ache and cold. The major number of therapeutic uses in Latin American traditional medicine is in the field of gynecology (Ravindran et al. 2012). It is also widely used to treat gastrointestinal

complains such as colic and flatulence. Fresh stems and/or leaves are used as an infusion or applied directly. Decoctions prepared from the leaves and applied on the chest, this way helps in treating persistent bronchitis (Raghav et al. 2006). Fresh leaves are placed on forehead and meant to cure headaches. From current studies revealed antioxidant, anti-inflammatory properties were revealed (Toserkani et al. 2012), as well as antidiabetic (Meepagala et al. 2005), antibacterial, antifungal (Jinous Asgarpanah 2012) effects. Also, epidemiological studies pointed out a big potential of this plant in preventing cardiovascular diseases and cancer .



## **5. Conclusion**

This study was the first documentation of medicinal plants usage by Mocho community in Chiapas, Mexico. Traditional medicine play an important role in primary every day heath care. For treating 11 categories of diseases, 83 species of medicinal plants were registered. Among all the categories, diseases of gastrointestinal and gastroimtestinal systems had the highest number of references and use-reports.

In Chiapas, the ethnomedicine is promoted in close groups and the knowledge are transmited from generation to generations. Despite the floristic richness of the state, species of traditional knowledges about medicinal plants could be forgotten. It is necessary to carry out more ethnobotanical studies and inventories to preserve this knowledge for future generations, then traditional medicine could be a good source of information for the developing new drugs in pharmaceuticandustry.

Thanks to the knowledges about the use of medicinal plants in the state of Chiapas by Mocho community were recorded. Mexico biodiversity is very rich, so it is important to protect it and carry out more studies in order to exploit potential of the medicinal plants.

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