CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

Department of Crop Sciences and Agroforestry

Ethnobotanical inventory of medicinal plants used in Salamá, Baja Verapaz, Guatemala

Bachelor thesis

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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BACHELOR THESIS ASSIGNMENT

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Agriculture in Tropics and Subtropics

Thesis title

Ethnobotanical inventory of medicinal plants used in Salamá, Baja Verapaz, Guatemala

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Objectives of thesis

Ethnobotanical inventory of medicinal plants in Salamá, Baja Verapaz, Guatemala is the main purpose of this thesis.

Methodology

Ethnobotanical data will be collected in fields, through semi – open interview. The informants will be local residents. The questions will be about knowledge of utilization medicinal plants in traditional medicine. Minor issues will then focus on age, gender and other specifics. The scientific names will be identified according to The International Plant Names Index and with help of Universidad de San Carlos de Guatemala and Czech University of Life Sciences Prague. The general information will be found on web page Web of Science, other accessible web pages and books. Results, as a family, genus and species of plants will be presented in the form of tables and graphs.

The proposed extent of the thesis

30

Keywords

Ethnobotany, ethnopharmacy, Guatemala, medicinal plants, traditional medicine

Recommended information sources

Ana Lucrecia de MacVean. 2006. Guatemala. Plantas Útiles de Sololá. ISBN 99922-2-279-4

Cáceres. A. 2009. Vademécum Nacional de Plantas Medicinales. Universidad de San Carlos de Guatemala. Editorial Universataria. 313 p.

Gary J. Martin. 2004. Ethnobotany: A Methods Manual. ISBN-10: 1844070840

Pavel Valíček a kolektiv. 2002. Užitkové rostliny tropů a subtropů. 2. vydání. Praha: Academia. ISBN 80-200-0939-6

Expected date of thesis defence

2016/17 SS – FTA

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Dean

Prague on 19. 04. 2017

Declaration:

I declare that I elaborated this bachelor thesis "Ethnobotanical inventory of medical plants used in Salamá, Baja Verapaz, Guatemala" alone, and that I have used only literature, web resources and other resources mentioned in references at the end of the thesis.

I agree with placing this work in the library of CULS Prague and make it accessible for study purposes.

Prague   …………………

21st April 2017   Barbora Fišerová

Acknowledgement

Abstract

This work contain study about ethnobotany, which is part of botany which deals with the relationship between community of people and medicinal plants which are used by them and its specific usage in traditional medicine. Using medicinal plants for curing is important for local people of Guatemala, from whom the information was obtained. Medicinal plants are still commonly used for medicinal purposes by local people in their daily lives.

Aims: Aim of the thesis is inventarization of medicinal plants in Salamá district, Baja Verapaz department of Guatemala.

Methodology: This study first documented the information about the medicinal uses of species of Salamá, Baja Verapaz in Guatemala. Data was collected through semi – opened questionnaire and fields observations during the time of study with 50 informants (56 % women, 44 % men). Following indexes were calculated for the medicinal plants: Use reports (UR), Medicinal use value (MUV), Frequency of citation (FC), Relative frequency of citation (RFC) and Fidelity level (FL).

Results: Total number of species is 44 which belong to 41 genera. Number of botanical families is 26, where the most dominant families are Lamiaceae (8 species; 16 %), Asteraceae (5 species; 10 %), Rutaceae (3 species; 6 %), used by local inhabitants to treat 21 categories of various diseases, where the largest representation are of gastrointestinal disorders (76 %) and breathing system problems (47 %) category. Mostly used parts were leaves (55 %). Used preparation modes were decoction, raw leaves or raw fruits.

Highest calculated indexes: UR: *Matricaria chamomilla* L. and *Aloe vera* L.; RFC: *Matricaria chamomilla* L., *Eucalyptus gunnii* F. Muell., *Aloe vera* L.; MUV: *Matricaria chamomilla* L., *Aloe vera* L.; FC: *Matricaria chamomilla L.*, *Eucalyptus gunnii F. Muell.* and *Aloe vera L.*

Majority of people are used to using plants for curing themselves for more than 10 years. They use them because of family traditions and started to using them because of the same reason – the family traditions. People mostly buy those plants on the local market and they are easily available.

Conclusions: People in middle age living in rural zone carry important knowledge about usage of medicinal plants in traditonal medicine. Thanks to this study, knowledge about the use of medicinal plants in traditional medicine in department Baja Verapaz, Salamá district, Guatemala, is recorded.

Keywords: Baja Verapaz, ethnobotany, Guatemala, medicinal plants, Salamá, traditional medicine

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1. Introduction

Since human race is on the planet Earth, it has been gathering plants and fruits. Men started collecting them, generally as useful materials. People also looked for plants with nutritious fruits in nature to feed themselves. Men have been using their extracts and substances ever since the ancient times. Ancestors were using them as a treatment when they were ill or for healing purposes etc. Everywhere around the world we can find people using traditional medicine. Besides, modern medicine is based on the traditional one. Nature itself has always been source of usefull and unreplaceable medicaments. According to WHO 65 % people around the world use traditional medicine and for 90 % in developing countries this is a primary healthcare (World Health Organization, 2015).

It was John William Harshberger who first started doing research in this part of botany in 20th century (Press, 2016). Even more later a man appears there, who named this part of science which covers relationships between plants and human, as a ethnobotany. It was Richard Evans Schulters who travelled to Amazon for visiting local people, to collect plants and to get information from them (Ponman & Bussmann, 2012).

Medicinal plants in traditional medicine were used much more in the past, in comparison to today, but still we have to save their great potential because of their specifications and irreplaceableness. Medicinal plants are a huge source full of secondary metabolities and for those specific effects are in category plants called special plants.

Traditional medicine is very common in Guatemala, because the majority of the rural population and a considerable number of the urban population, depends on it. In Guatemala exists many ethnic groups, who still use plants to cure diseases. In the first place because they believe that it is more effective than modern medicine, that is biomedicine, and also has the advantage of having fewer side effects, and in certain place, prices are much lower. But a large number of society, which has a formal education, is against traditional medicine because they feel it is difficult to distinguish between beneficial and superstitious aspects, and only adopts traditional medicine when biomedicine has failed. Lots of Guatemalan people depend on traditional medicine because it is cheaper in comparison with buying drugs in pharmacy. Or just because of

plants are more available or people just trust in traditional medicine because of their family traditions and because synthetic drugs can caused many side effect and problems, therefore people in Guatemala do not trust them. The population of rural areas of Guatemala and many migrants from the countryside to the city use many plants in their daily life, but the specific knowledge of their healing benefits is restricted to healers, the elder people, or residents who have lived in these areas for a long time (Pöll & Álvarez, 2015).

2. Literature review

2.1. Ethnobotany

Ethnobotany is defined as the science that deal with relationships between plants and humans. We can say that most of the time in context of ethnobotanical studies, we talk about indigenous uses of medicinal plants. Modern medicine is based on the traditional medicine (Diksha & Amla, 2011). In general traditional medicine is an amorphous concept that comprises a range of long-standing and still evolving practices based on diverse beliefs and theories (Xue, 2008). Many people especially in poorer countries trust and even could rely on wild growing plants and collecting them and the knowledge of these people of usage plants as a source of different materials is tremendous. The problem is that much of this knowledge is becoming to be lost. So the role of ethnobotanists is important for conservations information for future generations in these communities. There are six disciplines that contribute to an ethnobotanical study: Botany, ethnopharmacology, anthropology, ecology, economics and linguistics (Martin, 2004).

2.2. Medicinal ethnobotany

Medicinal ethnobotany is the study of the medicinal use of the flora of a region, area or ecosystem that includes collection, documentation and preservation of popular culture (Cáceres, 1998).

Already native american healers used to be using a wide range of natural substances for curing diseases, pain relief or healing wounds. Certain medical information is commonly known among all cultures, while other knowledge have been used only among members of local tribes. For example, indigenous people partly experimented with medicinal material so that, if they found in another territory, plants like plants that commonly used, it has become part of their pharmacology (Binvillain, 1999).

However in Guatemala are only several studies that could explore the use of flora in country, and much less is the number of studies of floristic diversity here. Knowledge of the uses of plants is about to diminish or disappear in many areas. Then it is evident, it is necessary to study this flora before these traditions disappear or are altered. In general the indigenous people of Guatemala continue to use plants for food, medicine, ornaments and for religious rites (McVean, 2006).

In Guatemala still plenty of people use medicinal plants as a first option to cure themselves. It is possible go to the street market or shop to buy them. Basically, they are reachable everywhere. By the way some kind of bennefit is that these products have healing potencial which we did not even expected. And mostly they are cheaper than regural drugs they can get in pharmacy. Two thirds of respondents of this research said they have reachable resource of medicinal plants with no difficulty and the vast majority answered that they use medicinal plants for a treatment.

2.3. Medicinal plants

Plants' compounds had always been a part of diverse types of therapeutic system. Medicinal plants we use for their active substances which are product of metabolism, which in case of its own metabolism are produced and stored. The most important active substances and their healing properties are: Etheric oils, glycosides and alkaloids, bitter substances, tannins, saponins, mucilages, minerals, vitamins and flavonoids (Pöll & Álvarez, 2015).

2.4. Guatemala

Guatemala is a maritime country in northern part of Central America. From west is surrounded by Pacific ocean and its eastern part, on the oposite side, by the Atlantic ocean. Coastline is 400km. Its bordering countries are Maxico, with bordering line with 958 km of lenght, from the north and from its restante part are El Salvador with 199 km, Belize 266 km and Honduras with 244 km. With its 108,889 sq km, is the 107th biggest country in the world. Climate is generally tropical and hot, humid in lowlands and cooler in highlands, mainly because of its terrain, what is composed by mountains with narrow coastal plains and coastal lowlands what creates microclimates through the whole country. Lowest point is Pacific Ocean and the highest Volcan Tajumulco with 4,211 m. Mean elevation is 759 m. When it comes to questione of land use, 41.2 % is agricultural, where 14.2 % is arable, 8.8 % with pemanent crops and 18.2 % is permanent pasture. Forest takes 33.6 % of the land. 25.5 % pertains to others. Irrigated land is 3,375 sq km (The World Factbook, 2015).

2.4.1. Demographic

Amount of habitants, according to Instituto National de Estadística, in 2013 was 15,438,383, what makes Guatemala the 71th most populated country. 2.918 million (2015) lives in Capital city – Guatemala City. According to World Bank the amount of people living in Guatemala in 2015 was 16,342,897. Population growth since 1997 to 2015 is on Graph 1. (The World DataBank, 2016).

In total, there is 48.8 % men and 51.2 % women. When it comes to question of ethnicity, it is 39.8 % Native Americans and the remaining 60.2 % belongs to others ethnicities as a Mestizo (mixed Amerindian-Spanish, in local Spanish called Ladino) and European 59.4 %, K'iche 9.1 %, Kaqchikel 8.4 %, Mam 7.9 %, Q'eqchi 6.3 %, other Mayan 8.6 %, indigenous non-Mayan 0.2 % and 0.1 % of other (2001 census). Republic of Guatemala is segmented half and half into people who live in cities and in rural zones (Instituto Nacional de Estadística, 2013).
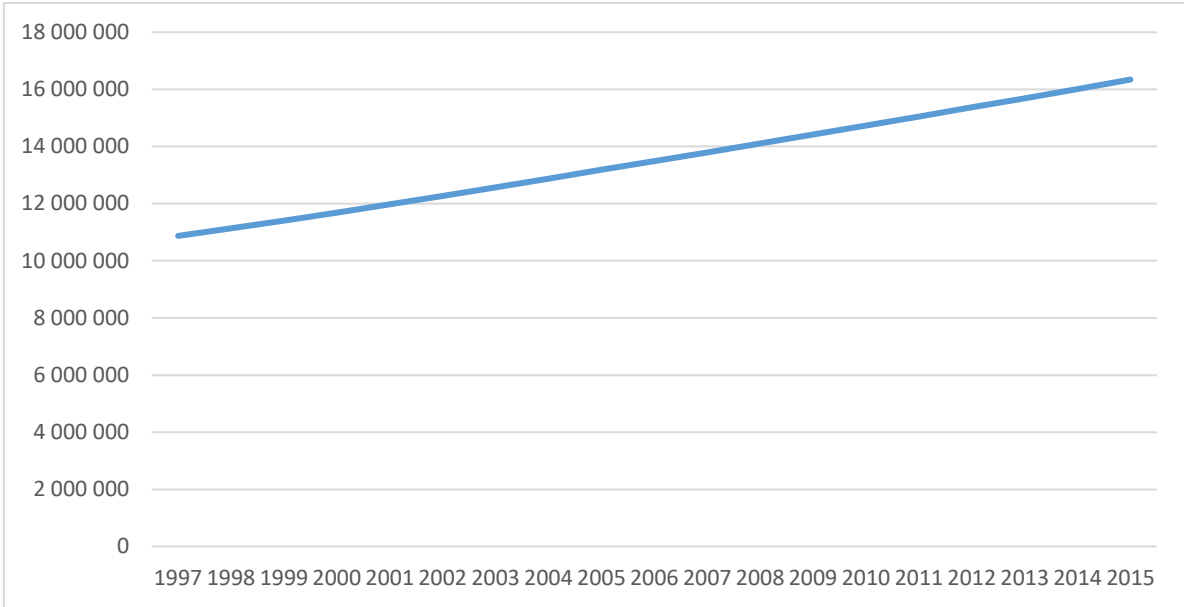
Graph 1. Total growth of population, 1997 – 2015

Source: The World DataBank

Sixty percent of population speaks Spanish and the rest Amerindian languages, where 23 are officially recognized Amerindian languages, including Quiche, Cakchiquel, Kekchi, Mam, Garifuna, and Xinca. One part of religion belongs to Roman Catholic, another to Protestant and the remainig to indigenous Mayan beliefs. Guatemala is the most populous country in Central America and has the highest fertility rate in Latin America. The highest population growth rate in Latin America also belongs to Guatemala, which is likely to continue because of its large reproductive-age population and high birth rate. Almost half of Guatemala's population is under age 19, making it the youngest population in Latin America (The World Factbook, 2015).

3. Aims of the thesis

Aim of the thesis is inventarization of medicinal plant in Salamá district, department Baja Verapaz, Guatemala.

The aim was based on hypotheses:

I.   Young generation is less interested in carrying information of knowledge of medicinal plants which are used in traditional medicine.

II.   Knowledge about the use of medicinal plants in traditional medicine in Salamá is not recorded.

4. Material and methods

4.1. Study area

Guatemala is segmented into 22 administrative departments. On Fig. 2. is map of country with particular departments. Highlighted is one, where data have been collected. The region is officially called Baja Verapaz. Region is in the middle of the whole country of Guatemala. It has a 7 following districts: Cubulco, Granados, El Chol, Rabinal, San Miguel Chicaj, San Jerónimo, Purulhá and Salamá. Individual regions are on Fig. 2. as well.

In 2013 the number of population was 284,530 people living in this department, which is 1.8 % of total amount of people living in Guatemala. The population grew 2.58 % between 2012 and 2013, a percentage higher than the national growth rate, which was 2.32 %. According to the projections of population of the department of Baja Verapaz for 2013 on Figure 1. the two municipalities with greater amount of population are Cubulco and Salamá; while the municipality with smaller population is Granados. Of the total population, 47.9 % are men and 52.1 % are women. At the national level the percentage of the population that identifies itself as indigenous is 40 %, while for the department of Baja Verapaz is 55.8 % (Sergio *et al*., 2014). Its main sources of economy are agriculture, breeding cattle, horses, pigs and other animals. Its most important crops are: coffee, maize, beans, tomato, pea and cut flowers.

- 9,296 - 16,183
- 16,183 - 27,703
- 27,703 - 40,108
- 40,108 - 55,696
- 55,696 - 64,303
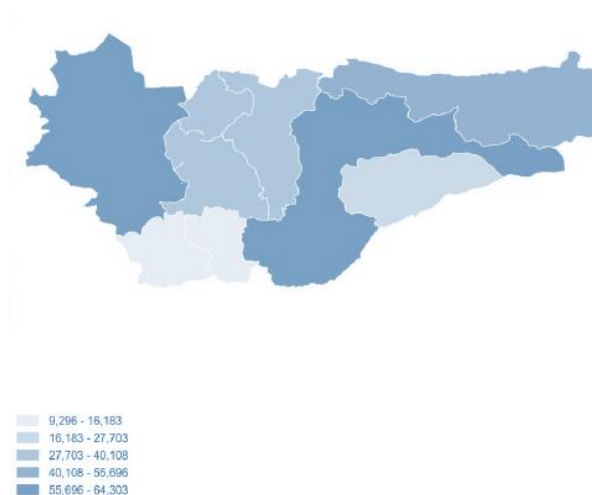
Figure 1. Population density in Baja Verapaz

Source: Instituto de Nation de Estadística de Guatemala (Sergio *et al*., 2014)

Whole research was done in district called Salamá (Fig. 2). It laids on the east side of Baja Verapaz. It's high above the sea leves is 940, covers 776 sq km of surface and 40,000 people live here. Further Salamá is segmented into 146 settlements with tropical savanna climate. Official language is Spanish in here, people also speaks Poqomchí, Achí, Kakchiquel, Quekchi and 2 % Xinca. Salamá is one of two parts of Baja Verapaz which has greater amount of population. The second one is Cubulco (Fig. 1).

Guatemala   Baja Verapaz, Salamá
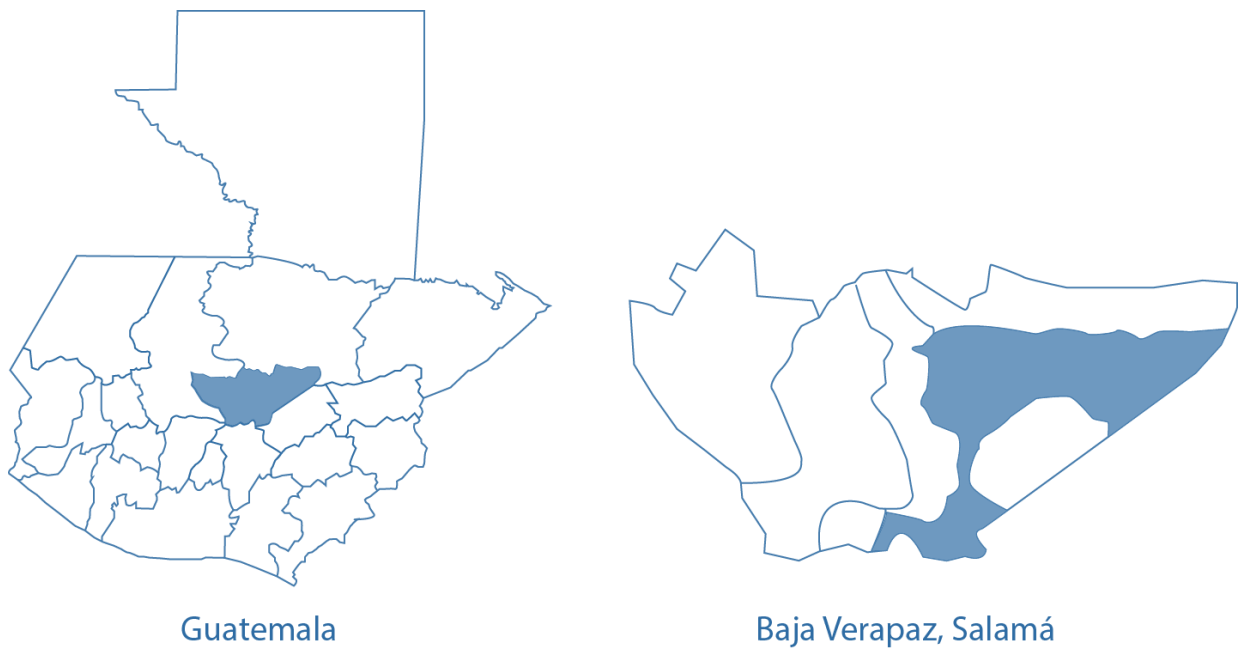
Figure 2. Map of Guatemala with department Baja Verapaz and District Salamá

4.2. Collecting of data

Ethnobotanical data were collected through semi – open interview, which is presented in annexes of this thesis, and by observations in fields and speaking with local inhabitants (Fig. 3.). The study area was visited from 15th of June till 15th of July 2016. The information was collected from 50 respondents through whole district Salamá, which were randomly selected. The age of asked people was from 20 to 60+ years, who were willing to participate in the survey, where 3 of them are from urban zone, the remaining 47 are from rural zone and than 22 of them are men, 28 women. In Guatemala, 66% of the current total population is indigenous, the majority of which live in rural areas (McVean, 2006). All the respondents speaks spanish. Data collection also included observation by our study in fields or in local Botanical garden of University (Fig. 4).
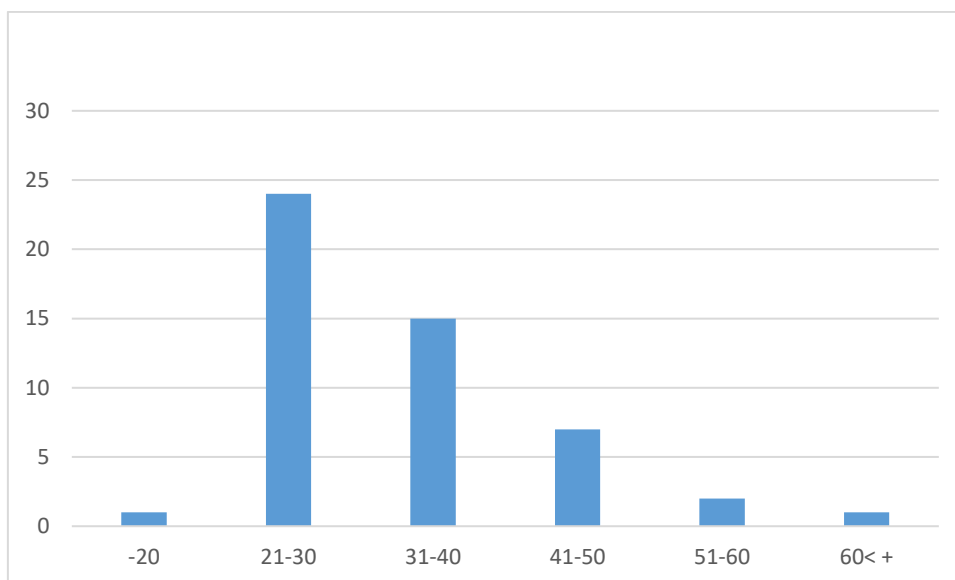
Graph 2. Distribution of age of respondents

The biggest part of respondents is aged from 21 to 30 years and represent 48 % of the total (Graph 2.). Next category is 31-40 years of age and this group is represented by 30 % of people. The third most commonly occurring age was 41-50 years of age and that forms 14 % of the total number of respondents. Thus, the 78 % of asked people, which makes the majority, are in middle age, from 20 to 40 years of age and they are acquainted with knowledge of medicinal plants and its usage in traditional medicine.

Figure 3. Field data collection from local people

Figure 4. Observation of medicinal plants in local University Botanic Garden

4.3. Methodology

The study was carried out from people living in Salamá district, which is situated on north of Baja Verapaz department which is in central Guatemala. In Guatemala exists 27 individual languages, where 1 of them is extinct. Inhabitants of whole country speak Spanish (Simons *et al.*, 2017). The questionnaire is presented in Annexe 1. First page includes general information about age, gender or place of living and knowledge of using medicinal plants as a medicaments. The second one is focused on research about medicinal plants itself.

The scientific names were identified according to The International Plant Names Index and with help of scientists from Universidad de San Carlos de Guatemala and Czech University of Life Sciences Prague. The general information was found on web page Web of Science and in accessible web pages and books.

Used key words were: Baja Verapaz, ethnobotany, Guatemala, medicinal plants, Salamá, traditional medicine.

For each species, the following ethnobotanical and pharmacologistic elements are provided: *scientific name; local name; family; part used; therapeutic use; preparation modes; voucher number*; and quantitive analysis which is composed of *Use reports (UR), Relative frequency of citation (RFC), Medicinal use value (MUV), Frequency of citation (FC),* and *Fidelity level (FL).*

4.3.1. Quantitive analysis of data

The data and analyzed using 5 quantitive ethnobotanical indices: Use reports (UR), Medicinal use value (MUV), Frequency of citation (FC), Relative frequency of citation (RFC) and Fidelity level (FL).

4.3.1.1. Use report (UR)

UR is the use recorded for every species. It means how many utilizations certain plant has.

4.3.1.2. Medicinal use value (MUV)

MUV is actually modification of the Use Value. The formula was obtained by (Tardío & Pardo-De-Santayana, 2008). The medicinal use value was calculated with little modification. It is good a good measure to estimate all the possible uses of a plant

without considering its RFC. It gives us relative importance of a species, considering the number of uses mentioned by an informant for a particular wild medicinal plant species. It was calculated using the the following formula:

$$MUV = \sum Mu_i/N$$

Where 'MU' is the number of mentioned medicinal uses cited by each informant for a given plant species and 'N' is the total number if informants included in the survey. In this case N = 50. Muv does not provide any information on the single or multiple uses of species.

4.3.1.3. Frequency of citation (FC)

FC is number of people who mention plant.

4.3.1.4. Relative frequency of citation (RFC)

RFC were calculated to quantitatively determine the consensus between the informants on the use of endemic medicinal plants in the region. It was calculated using the following formula proposed by (Vitalini *et al*., 2013).

$$RFC = FC/ N \ (0 < RFC < 1)$$

4.3.1.5. Fidelity level (FL)

Fidelity level (FL) index is used to determine the most preferred species used in the treatment of a particular ailment as more than one plant species are used in the treatment in the same category. High FL value indicates high frequency of use of the plant species for treating a particular ailment category by the informants of the study area.

Fidelity level is calculated by using the following formula (Pushpangadan & Atal, 1986):

$$FL = Ip/ FC \times 100$$

where **Ip** is the number of informants who independently indicated the use of a species for the same major ailment and FC is the total number of informants who mentioned the plant for any major ailment (Bibi *et al*., 2015).

5. Results and discussion

The results of the survey are presented in tables and graphs. Processed questionnaires are presented in Table 5. and Table 6. and Graphs 5 – 10. Results are presented in Tables 1 – 4. and Graphs 3 – 4. Plants species are arranged in alphabetical synopsis.

5.1. Diversity of reported medicinal plant

Botanical families of monitored medicinal plants: Amarathaceae (2 %), Apiaceae (4 %), Asteraceae (10 %), Araliaceae (2 %), Bignoniaceae (2 %), Caprifoliaceae (2 %), Cupresaceae (2 %), Chenopodiaceae (2 %), Iridaceae (2 %), Lamiaceae (16 %), Lauraceae (4 %), Liliaceae (4 %), Linaceae (2 %), Malvaceae (4 %), Monimiaceae (2 %), Moraceae (4 %), Moringaceae (2 %), Myrthaceae (4 %), Nyctaginaceae (2 %), Poaceae (2 %), Rubiaceae (2 %), Rutaceae (6 %), Salicaeae (2 %), Theaceae (2 %), Zingiberaceae (4 %) (Graph 3.). All the families are known from book: Amazonian Ethnobotanical Dictionary (Duke *et al*, 2009).
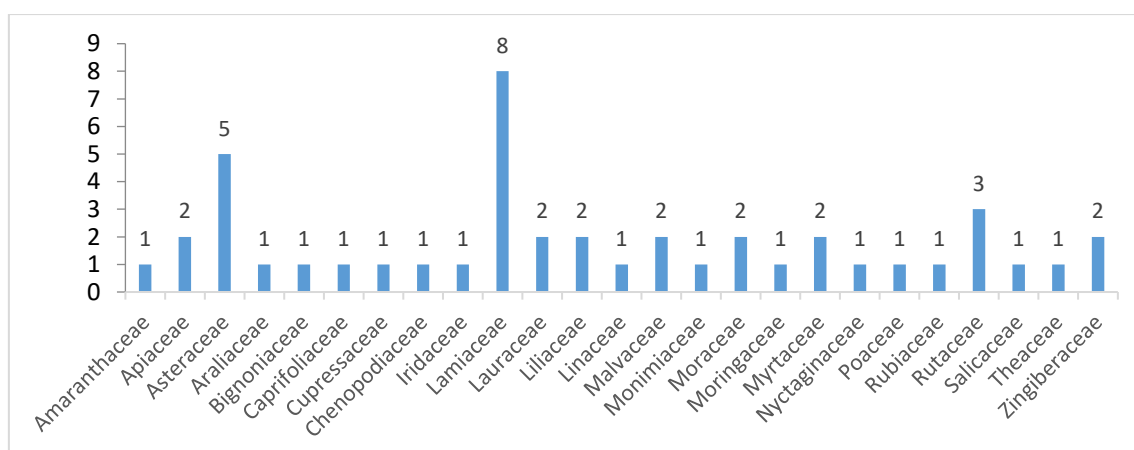
Graph 3. Botanical families medicinal plants which are used in Salamá, Baja Verapaz, Guatemala

Total number of botanical plant families is 26 and number of species is 44. Number of plants on the planet is 250,000 (Fabricant & Farnsworth, 2001) and in Guatemala is about 8.000 species (Sawe, 2016). The most dominant medicinal plant families are Lamiaceae (8 species; 16 %), Asteraceae (5 species; 10 %), Rutaceae (3 species; 6 %) and others families are represented by number 2 or 1 of amount of species (Graph 3.). In different studies of ethnobotany of medicinal plants we can find results about Lamiaceae, Asteraceae, Rutaceae or Apiaceae are dominant as well (Bibi *et al*., 2015; Clement, 2010), so that medicinal plants are mostly represented by those families.

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In study from island Trinidad, which is located in nearby area, by author Clement, most dominant species were also Asteraceae and Lamiaceae.

5.2. Used parts of plants
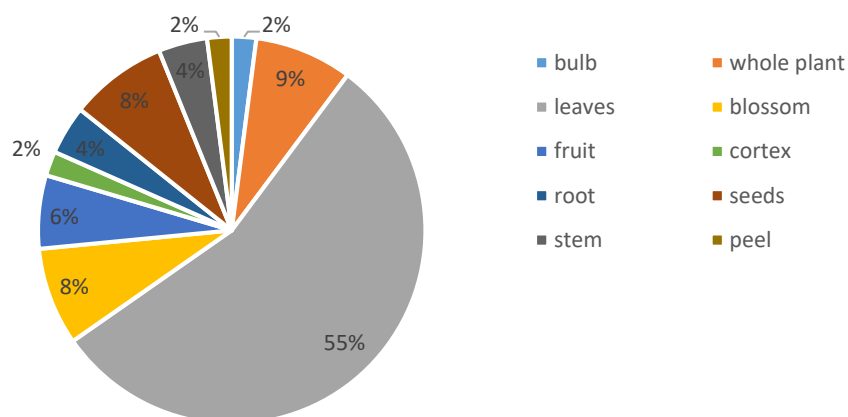
Graph 4. Used parts of plants

Used parts of plants: Leaves; Seeds; Whole plant; Root; Fruit; Blossom; Stem, where most dominant was leave as a part with the highest frequency of citations (55 %), second was whole plant (9 %) and then seeds and blossom (both 8 %) (Graph 4.). Common results we can find in study about endemic medicinal plants in Northern Belochistan (Bibi *et al.*, 2015), where the results are: Whole plant (50%), leaves (30%) and seeds (10%).

Preparation modes: Powder; Decoction; Paste; Raw leaves, Seeds; Juice; Fume. Methods are further described in detail in Chapter 5.4. of this study. Most frequently decoction, raw leves or fruit and then powder or paste. In different study we can find results: The most commonly applied methods of preparation are powder (48.2 %), decoction (14.3 %), which are same, and infusion (11.6 %) (Bibi *et al.*, 2015).

According to Graph 4., most often used part is leave, and the most commonly occurring therapeutic uses are deseases belonging to gastrointestinal disorders (76 %) and problems with breathing system (47 %) categories. Preparation modes are decoction, raw leves or fruit and powder or paste.

5.3. Indigenous knowledge of the community

This part of thesis is focused on graphs and tables with results of the research. Graphs 5 – 10. are elaborated first page questionnaire with information about how many years respondent use medicinal plants, how did he or she started to usse them, reason why respondent started with usage, how does he/ she get them and if buy, then where and the last graph is about availability of medicinal plants.
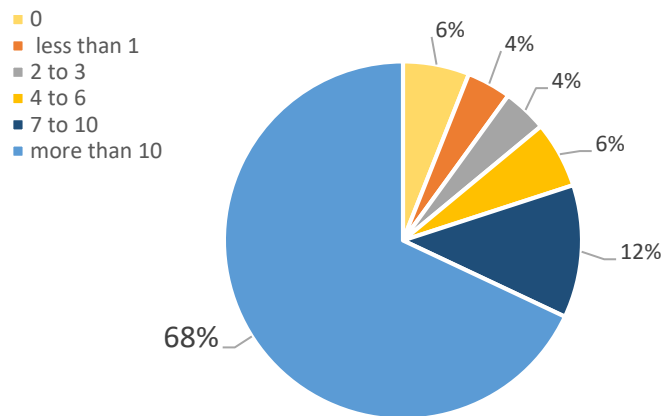
Graph 5. Distribution of how many years respondent use medicinal plants

According to Graph 5., 68 % of respondents use traditional medicine longer than 10 years of time, 3 of 50 said, they never use plants to cure they health problems and the rest of years' categorization is between 4 – 6 %. Medicinal plants are found throughout Central America and indigenous peoples have used them in traditional healing for many thousands of years (Pesek *et al*., 2006).
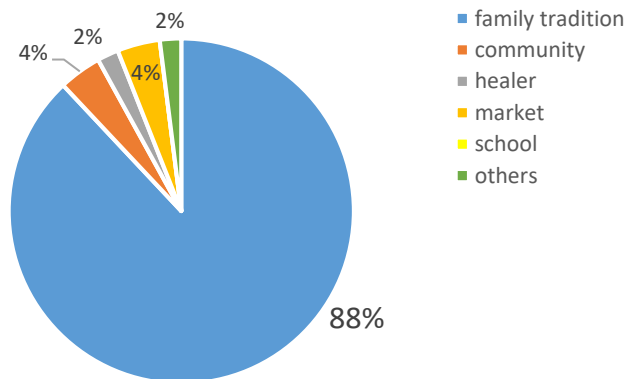
Graph 6. Method of obtaining knowledge about meditional plants

Majority of people (88 %) responded to question of how did they start to use traditional medicine was that they started because of their family traditions (Graph 6.). Some of them said it was because of the community where they live or that is possible to purchase medicaments at local market. One of respondets marked healer as a source of his medicinal plants and in category of others is one answer, namely that he needed to start to use plants for curing himself.
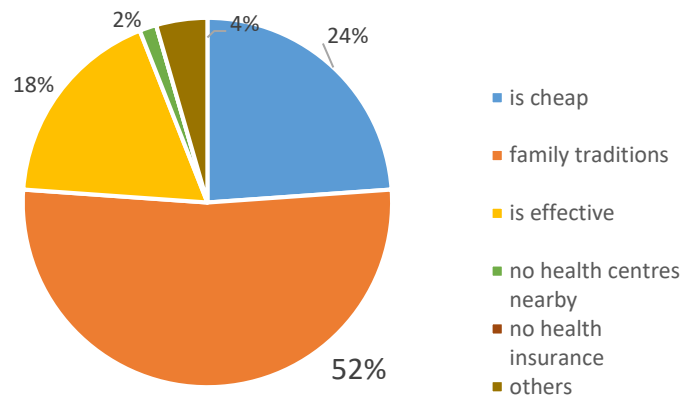
Graph 7. Reason for using natural medicine
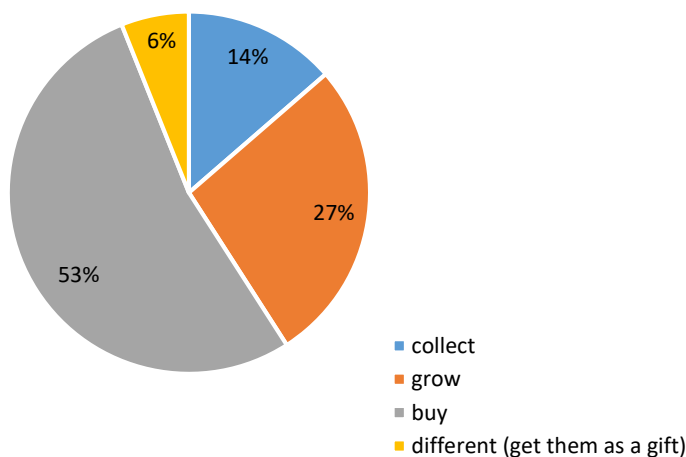
Graph 8. Ways of getting plants
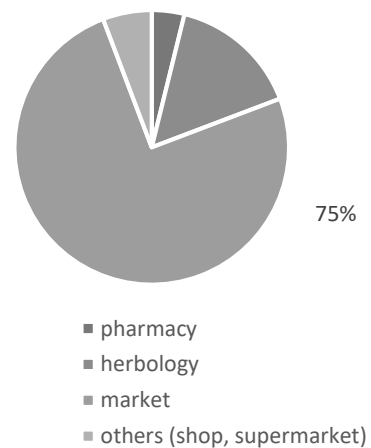
Graph 9. If buy, where

Number of informants is 50, 3 (6 %) of them responded that they never use medicinal plants to solve health problems. Next questione is if they use medicinal plants as a first option to cure themselves. For 42 % of them, using medicinal plants, is not a primar option for treatment, for the rest 58 %, is.
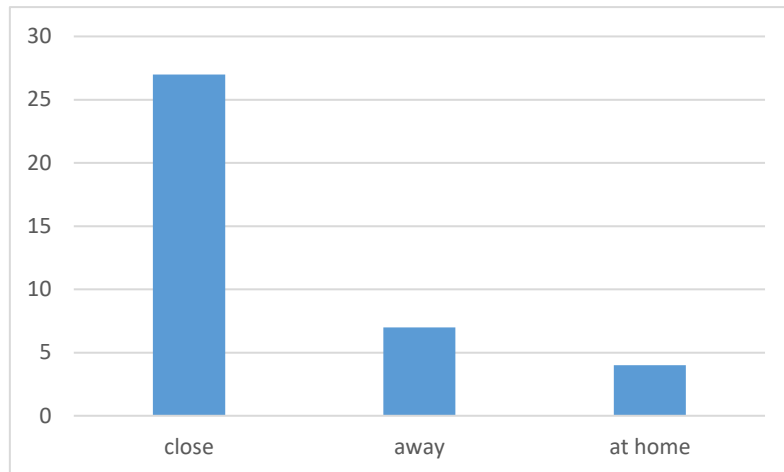
Graph 10. Availability of obtaining medicinal plants

As a reason of using medicinal plants as medicaments, 52 % said, they use them because of family traditions. Second most common answer to this questione was that is cheap and third because is effective (Graph 7.). A recent analysis of human development and poverty in Latin America shows that although poverty rates overall have been declining in Latin America, the poverty rate in indigenous communities has remained the same (Hall, *et al.,* 2006) so that could be reason why respondents reported as the second most common advantage, that it is cheap in meaning of cheaper than medicament purchased in pharmacy. First one is because for people in Guatemala and in whole Latin America family is crucial. If we asked how they get plants, more than half, 53 % of respondents said, that they usually buy them. They are reacheble on every market. Second most important way of getting them is growing on their own (Graph 8.) because, again, is cheaper, 75 % of informants mostly buy them (Graph 9.). And last question concerns availability of plants (Graph 10.), where 27 out of 50 people said, is not problem to get them because the place of getting them is close to place they live. In question about preparation modes, 38 of 45, which is 84 % are used oral way and 16 % topically (Table 5.). In different study, vast majority (98 %) of plants is used oral way (Clement, 2010).

Table 1. Use reports (UR)

Aloe vera L.	5
Matricaria chamomilla L.	5
Eucalyptus gunnii F. Muell.	3
Moringa oleifera Lam.	3
Rosmarinus officinalis L.	3
Tilia tomentosa Moench	3

Table 2. Relative frequency of citation (RFC)

Matricaria chamomilla L.	0.5
Eucalyptus gunnii F. Muell.	0.3
Aloe vera L.	0.18
Tagetes lucida Cav.	0.16
Dysphania ambrosioides (L.) Mosyakin & Clemants	0.12
Mentha spicata L.	0.12
Tilia tomentosa Moench	0.1
Thymus vulgaris L.	0.1
Ficus carica L.	0.08

Table 3. Medicinal use value (MUV)

Matricaria chamomilla L.	0.12
Aloe vera L.	0.1
Eucalyptus gunnii F. Muell.	0.06
Tagetes lucida Cav.	0.06
Tilia tomentosa Moench	0.06
Thymus vulgaris L.	0.06
Rosmarinus officinalis L.	0.06
Mentha piperata L.	0.06
Moringa oleifera Lam.	0.06
Litsea glaucescens Kunth	0.06
Pimpinella anisum L.	0.06

Table 4. Frequency of citation (FC)

Matricaria chamomilla L.	26
Eucalyptus gunnii F. Muell.	15
Aloe vera L.	9
Tagetes lucida Cav.	8
Dysphania ambrosioides (L.) Mosyakin & Clemants	6
Mentha spicata L.	6
Tilia tomentosa Moench	5
Thymus vulgaris L.	5
Ficus carica L.	4

Highest use report were calculated for *Matricaria chamomilla* L. and *Aloe vera* L., (5 UR each), *Eucalyptus gunnii* F. Muell., *Moringa oleifera* Lam., *Rosmarinus officinalis* L., *Tilia tomentosa* Moench (3 UR each) (**Table 1.**).

In case of relative frequency of citation the highest index has *Matricaria chamomilla* L. (RFC 0.5), than *Eucalyptus gunnii* F. Muell. (RFC 0.3), *Aloe vera* L. (RFC 0.18), *Tagetes lucida* Cav. (RFC 0.16), *Dysphania ambrosioides* (L.) Mosyakin & Clemants and *Mentha spicata* L. had both (RFC 0.12), *Tilia tomentosa* Moench and *Thymus vulgaris* L. (RFC 0.1 each) (**Table 2.**).

Medicinal use value, highest indexes were for following medicinal plants, *Matricaria chamomilla* L. (MUV 0.12), *Aloe vera* L. (MUV 0.1) and *Eucalyptus gunnii* F. Muell., *Tagetes lucida* Cav., *Tilia tomentosa* Moench, *Thymus vulgaris* L., *Rosmarinus officinalis* L., *Mentha piperata* L., *Moringa oleifera* Lam., *Litsea glaucescens* Kunth, *Pimpinella anisum* L. had (MUV 0.06 for each) (**Table 3.**).

Frequency of citaton, highest nubmers of index got *Matricaria chamomilla L.* (FC 26), *Eucalyptus gunnii F. Muell.* (FC 15) and *Aloe vera L.* (FC 9) (**Table 4.**).

Fidelity level index did not show any differences between individual plants because 56 % of monitored plants reach a number of fidelity level 100 %.

Matricaria chamomilla L. is a well-known medicinal plant species from the Asteraceae family often referred to as the "star among medicinal species." Nowadays it is a highly favored and much used medicinal plant in folk and traditional medicine. Its multitherapeutic, cosmetic, and nutritional values have been established through years of traditional and scientific use and research. Chamomile has an established domestic (Indian) and international market, which is increasing day by day. The plant available in the market many a times is adulterated and substituted by close relatives of chamomile. True chamomile is an annual plant with thin spindle-shaped roots only penetrating flatly into the soil. The branched stem is erect, heavily ramified, and grows to a height of 10-80 cm. Chamomile is a well-known old time drug and belongs to a major group of cultivated medicinal plants. It contains a large group of therapeutically interesting and active compound classes as a sesquiterpenes, flavonoids, coumarins, and polyacetylenes (Singh *et al*., 20011). It gives blue color essential oil. Some scientific studies confirm using Manzanilla as plant medicament against diarrhoea and stomach aches

(de la Motte *et al.,* 1997; Mehmood *et al*., 2015) which my study approved. It also has positive effect on prevention of hyperglycemia and diabetes (Kato *et al.*, 2008).

Aloe vera L. improves wound healing and inhibits inflammation. Mannose-6-phosphate is the major sugar in the Aloe gel and authors think this is reason of its being an active growth substance (Davis *et al.,* 1994). In a different study of twenty-seven patients with partial thickness burn wound, they were treated with Aloe vera gel compared with vaseline gauze. It revealed the Aloe vera gel treated lesion healed faster than the vaseline gause area (Visuthikosol *et al.,* 1995). Another study where author did a test with mice, seemed that the glycoside, gibberellin, might indeed hold the key to the healing plant's anti-inflammatory powers (Davis R, 1988). *Aloe vera L.* can be used by oral (Clement, 2010) or topical way of use.

According to author MacVean, *Eucalyptus gunnii* F. Muell. can beused in traditional medicine for various diseases, which is true. According to my research it can cure gastrointestinal disorders, problems breathing system and flu. Leaves are used in decoction to relieve cold. The steam from the boiled leaves is also widely used, what my research confirms (McVean, 2006). *Eucalyptus gunnii* F. is widely used as a source of ethnomedicines in tropical regions of the world (Gbenou *et al*., 2013).

As a research showed plant *Tagetes lucida* Cav. has high indexes and it should serve as a medicament for curing gastrointestinal disorders and study of author Cáceres about Plants used in Guatemala for the treatment of gastrointestinal disorders agree with plants' usage (Cáceres, *et al*., 1990). Book Plantas Útiles de Sololá by MacVean said that could serve for stomach pain, menstrual problems. The mixture of leaves becomes an infusion mixed with myrtle *(Salvia microphylla)* and basil (*Ocimum basilicum*). The whole plant is used to make clean of the evil spirits. Has nematicidal, fungic and antibacterial properties. Used as an antidote for scorpion bites (McVean, 2006).

5.4. Ways of processing of plants

Preparation is process by which adjust the plant so that the healing substances are quickly and easily accessible. Exists many ways how plants can be prepared. In research from Guatemala the main ways that was filled into questionnaire, were decoction, tea, paste, bath, powder, raw plant, raw fruit, raw seeds, juice or fume.

Decoction – in product in the end of process, which includes mashing of material and boiling to extract oils and organic compounds.

Tea - herbal teas are not only medicinally active, but also tasty. They have a positive impact on health and alleviate various problems. Tea is prepared so that they pour a dried or fresh herbs and let leach (Górnicka, 2014).

Paste - the preparation of plant as a paste consistency is achieved so that the milled herb is mixed with water and the whole mix is heated over a fire or on a stove

Bath - bath with herbal additives not only have a positive effect on our health, but also beauty. It must take 15-30 minutes in water having a temperature of about 40 ° C. Herbs usually do not give directly into the bath, but first to a smaller container with hot water, which is leached and then the contents to pour into the bath. (Górnicka, 2014)

Powder - this means drying and milling herbs into powder. It can be mixed with water and eaten (Górnicka, 2014). When we mix the herb with fat we can get a cream or pouring a little bit of water and heating it we get a paste.

Raw parts of plant – using raw form of plants is method without any preparation

Juice – to get juice from plant is necessary to squeez out the liquid content ot of a plant

Fume – when we inhale vapor, which is consist of mixture of liquid part of plant and hot water it usually helps us with respiration problems. To effect the process of inhalation we can cover our head with fabric and so that prevent leakage of vapor

Table 5. Table of inventory of medicinal plants used in Salamá, Baja Verapaz, Guatemala

Spicies	Local name	Family	Part use	Therapeutic use	Preparation mode(s); Oral/ topical	(Voucher no.)
Allium sativum L.	Ajo	**Liliaceae**	bulb	3, 17	Raw plant; oral	Gu.Lil02
Aloe vera L.	Sábila	**Liliaceae**	whole plant, juice	3, 4, 6, 16, 19	Whole leaves, juice; topical,	Gu.Lil01
Arnica montana L.	Arnica	**Asteraceae**	whole plant	10	Paste; topical	Gu.As02
Artemisia absinthum L.	Ajenjo	**Asteraceae**	leaves	3, 5	Decoction; oral	Gu.As01
Beta vulgaris L.	Acelga	**Amaranthaceae**	leaves	17	Decoction; oral	Gu.Am01
Bougainvillea spectabilis Willd.	Buganvilla	**Nyctaginaceae**	blossom	3	Decoction; oral	Gu.Nyc01
Brosimum alicastrum Sw.	Mayan nut	**Moraceae**	fruit	18	Powder; oral	Gu.Mora02
Camellia sinensis (L.) Kuntze	Té verde	**Theaceae**	leaves	21	Powder; Decoction, oral	Gu.The01
Cinnamomum verum J. Presl	Canela	**Lauraceae**	cortex	3, 15	Decoction; oral	Gu.Lau01
Citrus paradisi Macfad.	Toronja	**Rutaceae**	fruit	19	Juice	Gu.Rut01
Citrus sinensis (L.) Osbeck	Hoja de Naranja	**Rutaceae**	leaves	3	Decoction; oral	Gu.Rut02
Cumpressus sempervirens L.	Ciprés	**Cupressaceae**	leaves	5, 9	Decoction;	Gu.Cu01

Spicies	Local name	Family	Part use	Therapeutic use	Preparation mode(s); Oral/ topical	(Voucher no.)
Curcuma longa L.	Curcúma	**Zingiberaceae**	root	5	Decoction, powder; oral	Gu.Zi01
Cymbopogon citratus Stapf	Té de Limon	**Poaceae**	leaves	5	Decoction; oral	Gu.Po01
Dysphania ambrosioides (L.) Mosyakin & Clemants	Apazote	**Chenopodiaceae**	leaves	10, 16	Decoction, oral; Paste, topical	Gu.Che01
Eucalyptus gunnii F. Muell.	Eucalipto	**Myrtaceae**	leaves	3, 5, 8	Decoction, fume; oral	Gu.Myr01
Ficus carica L.	Hoja de Hijo	**Moraceae**	leaves	5	Decoction	Gu.Mora01
Hedera helix L.	Hiedra	**Araliaceae**	leaves	10	Paste; topical	Gu.Ar06
Hibiscus sabdariffa L.	Rosa de Jamaica	**Malvaceae**	blossom	1	Decoction; oral	Gu.Mal01
Chaptalia nutans (L.) Pol. / *Valeriana officinalis* L.	Valeriana	**Asteraceae/ Caprifoliaceae**	leaves	13	Decoction; oral	Gu.As03
Jacaranda mimosifolia D.Don	Flores Jacaranda	**Bignoniaceae**	leaves	13	Decoction; oral	Gu.Bi01
Lavandula angustifolia Mill.	Lavanda	**Lamiaceae**	whole plant	13	Bath; topical	Gu.Lam04
Linum usitatissimum Griseb.	Linaza	**Linaceae**	leaves, seeds	3	Decoction, raw seeds; oral	Gu.Lin01
Litsea glaucescens Kunth	Laurel	**Lauraceae**	leaves	7, 17	Decoction; oral	Gu.Lau02

Spicies	Local name	Family	Part use	Therapeutic use	Preparation mode(s); Oral/ topical	(Voucher no.)
Matricaria chamomilla L.	Manzanilla	**Asteraceae**	leaves, blossom, stem	3, 7, 8, 9, 10	Decoction; oral	Gu.As04
Mentha piperata L.	Menta	**Lamiaceae**	leaves	3, 4	Raw leaves, decoction; oral	Gu.Lam05
Mentha spicata L.	Hierba Buena	**Lamiaceae**	leaves	5	Decoction; oral	Gu.Lam01
Morinda citrifolia L.	Noni	**Rubiaceae**	leaves, fruit	12	Raw fruit; oral	Gu.Rub01
Moringa oleifera Lam.	Moringa	**Moringaceae**	leaves, seeds	15, 17, 19	Paste, topical; Decoction, raw seeds, oral	Gu.Mori01
Ocimum basilicum L.	Albahaca	**Lamiaceae**	leaves	3, 10	Raw leaves, decoction; oral	Gu.Lam06
Origanum vulgare L.	Oregano	**Lamiaceae**	leaves	3	Decoction; oral	Gu.Lam07
Petroselinum crispum (Mill.) Fuss	Perenjil	**Apiaceae**	leaves, stem	17	Decoction; oral	Gu.Ap01
Peumus boldus Molina.	Boldo	**Monimiaceae**	leaves	3, 12	Decoction, oral	Gu.Mon01
Pimpinella anisum L.	Anís	**Apiaceae**	seeds	3	Decoction; oral	Gu.Ap02
Psidium guajava L.	Guayaba	**Myrtaceae**	fruit	8	Raw fruit, oral	Gu.Myr02
Rosmarinus officinalis L.	Romero	**Iridaceae**	leaves	4, 15, 18	Decoction; oral	Gu.Ir01

Spicies	Local name	Family	Part use	Therapeutic use	Preparation mode(s); Oral/ topical	(Voucher no.)
Ruta chalepensis Wall.	Ruda	**Rutaceae**	whole plant	7, 15	Decoction; oral	Gu.Rut03
Salix humboldtiana Willd.	Sauce	**Salicaceae**	peel	4, 8	Decoction; oral	Gu.Sa01
Salvia hispanica L.	Chía	**Lamiaceae**	seeds	8	Decoction; oral	Gu.Lam08
Salvia officinalis Pall.	Salvia Santa	**Lamiaceae**	leaves	3, 5	Decoction; oral	Gu.Lam02
Tagetes lucida Cav.	Pericón	**Asteraceae**	leaves	3, 7	Decoction; oral	Gu.As05
Thymus vulgaris L.	Tomillo	**Lamiaceae**	leaves	5, 9	Decoction; oral	Gu.Lam03
Tilia tomentosa Moench	Tilo	**Malvaceae**	leaves, blossom	4, 5, 13	Decoction, oral	Gu.Mal02
Zingiber officinale Roscoe	Jengibre	**Zingiberaceae**	root	8, 17	Decoction; oral	Gu.Zi02

Explanation:

Numbers of therapeutic use in treatment: **1** – Infection (cystitits), **2** Fever, **3** - Gastrointestinal disorders (Stomach problems, gastritis, colic, colon, diarrhea, ulcers, constipation), **4** – Headache, **5** - Breathing system problems (Cought, lung and respiration problems, bronchitis), **6** - Problems of skin (Scars, itchy skin, burns), **7** - Female probems (Menstruation pain, ovarian pain), **8** – Flu, **9** - Tonsillitis (Sorethroat, angina), **10** - Inflammation (infection, edema, swelling, insect bites), **11** - Problems of bones (Bone pain, joints pain), **12** - Detoxification (Body detoxification, liver detoxification, kidneys cleaning), **13** - Psychological problems (Stress, sleepig problems),

14 - Antibactericide, antialergic, desinfection, **15** - Pain (Muscule pain, eye pain, analgesic), **16** - Light alcohol intoxication caus, **17** - Dizziness, faint, bloodpressure control, **18** - Energy, regeneration, **19** – Vitamins, **20** – Diabetes, **21** – Weight reduction.

Table 6. Quantitive analysis of collected data

(Voucher no.)	UR*	RFC*	MUV*	Ip	FC*	FL* [%]
Gu.Am01	1	0.02	0.02	1	1	100.00
Gu.Ap01	1	0.02	0.02	1	1	100.00
Gu.Ap02	1	0.04	0.06	1	2	50.00
Gu.As01	2	0.02	0.04	1	1	100.00
Gu.As02	1	0.02	0.02	1	1	100.00
Gu.As03	1	0.02	0.02	2	2	100.00
Gu.As04	5	0.5	0.12	17	26	65.38
Gu.As05	2	0.16	0.06	4	8	50.00
Gu.Ar06	1	0.02	0.02	1	1	100.00
Gu.Bi01	1	0.02	0.02	1	1	100.00
Gu.Cu01	2	0.04	0.04	2	2	100.00
Gu.Che01	2	0.12	0.04	2	6	33.33

(Voucher no.)	UR*	RFC*	MUV*	Ip	FC*	FL* [%]
Gu.Ir01	3	0.06	0.06	2	3	66.67
Gu.Lam01	1	0.12	0.04	3	6	50.00
Gu.Lam02	2	0.02	0.04	1	1	100.00
Gu.Lam03	2	0.1	0.06	2	5	40.00
Gu.Lam04	1	0.02	0.02	1	1	100.00
Gu.Lam05	2	0.06	0.06	2	3	66.67
Gu.Lam06	2	0.06	0.04	1	3	33.33
Gu.Lam07	1	0.02	0.04	1	1	100.00
Gu.Lam08	1	0.02	0.02	1	1	100.00
Gu.Lau01	2	0.04	0.02	1	2	50.00
Gu.Lau02	2	0.04	0.06	2	2	100.00
Gu.Lil01	5	0.18	0.1	5	9	55.56
Gu.Lil02	2	0.06	0.04	1	3	33.33
Gu.Lin01	1	0.02	0.02	1	1	100.00
Gu.Mal01	1	0.02	0.02	1	1	100.00
Gu.Mal02	3	0.1	0.06	2	5	40.00
Gu.Mon01	2	0.06	0.04	2	3	66.67

(Voucher no.)	UR*	RFC*	MUV*	Ip	FC*	FL* [%]
Gu.Mora01	1	0.08	0.04	4	4	100.00
Gu.Mora02	1	0.02	0.02	1	1	100.00
Gu.Mori01	3	0.04	0.06	1	2	50.00
Gu.Myr01	3	0.3	0.06	12	15	80.00
Gu.Myr02	1	0.02	0.02	1	1	100.00
Gu.Nyc01	1	0.02	0.02	1	1	100.00
Gu.Po01	1	0.02	0.02	1	1	100.00
Gu.Rub01	1	0.02	0.02	1	1	100.00
Gu.Rut01	1	0.02	0.02	1	1	100.00
Gu.Rut02	1	0.04	0.02	2	2	100.00
Gu.Rut03	2	0.02	0.02	1	1	100.00
Gu.Sa01	2	0.02	0.04	1	1	100.00
Gu.The01	1	0.02	0.02	1	1	100.00
Gu.Zi01	1	0.02	0.02	1	1	100.00
Gu.Zi02	2	0.06	0.04	3	3	100.00

6. Conclusion

Traditional medicine in Guatemala is still really important in these days for inhabitants of Guatemala in indigeous department Baja Verapaz, Salamá discrict. Local population, mostly in rural areas use traditional medicine as a source of medicaments, where 96 % of respondets said, they use medicinal plants for curing themselves. These medicinal plants have been used as alternative solutions for ages and stil are. Because of that is important to preserve information and collect data from local people about usage of medicinal plants. They are reacheable practically everywhere, on every market or they can be collected in nature.

Younger generation is not maybe interested in carrying this information, but middle age generation from 20 to 40 years of age, which was our mostly asked category (78 %), still have and carry a good resource of important and usefull information. So that information are still retained by the younger generation, but it threatens to disappear over time.

Thanks to this study, knowledge about the use of medicinal plants in traditional medicine in Salamá is recorded.

During the research was found out 44 known medicinal plants, which heal about 50 diseases in 21 categories. As a medicaments can be used in various ways, mostly as a decoction in oral way. Most respondents use traditional medicine because of family traditions and they know the usage and dosis from theis family members as well and mostly they are using them than ten years.

Guatemala biodiversity is very rich and we may need in the future. It is important to protect it and held expeditions for the purpose of exploring the flora and the possibilities of utilization.

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8. Annexes 1.: Questionnaire

Universidad Checa de Ciencias de la Vida   Encuesta a Usuarios de Plantas Medicinales

Favor de responder a las siguientes preguntas, que servirán para conocer en que medida se conservan las tradiciones de las comunidades indígenas, en especial en lo que se refiere al uso de las plantas medicinales.

    I.   Datos Generales

    1.   Localidad: _____   2. zona: __urbana __rural   3. Ocupación principal: _____ _____
Sexo: Masculino __   Femenino___   5. Edad: ->20   21-30   31-40   41-50   51-60   61<+

    II.   Uso de Plantas medicinales:
1.-¿Utiliza plantas medicinales para resolver problemas de salud?:   si_____ no_____
2.- ¿Usted utiliza plantas medicinales como primera medida para tratar las enfermedades?   si_____ no_____
3.- ¿Por qué razón utiliza la medicina tradicional? Marcar una o mas

a) es barato   b) es tradición familiar   c) tiene alta efectividad   d) no cuenta con centros de salud cercano   e) no tiene seguro médico   f) otro_____

_____
5.- ¿Cuánto tiempo tiene consumiendo plantas medicinales o haciendo uso de ellas?

>1 año   2-3 años   4-6 años   7-10 años   +10 años

6.- ¿Cuál fue la principal forma de obtención del conocimiento?   Tradición familiar ___   comunidad ___   curandero ___   mercado ____   escuela ____ otro _____

7.-¿según su conocimiento o percepción cree que existe una reducción del número de plantas usadas actualmente?   Si____ no____

7.1.- si es sí, ¿Qué porcentaje considera que se ha perdido?   * 0 es nada   100 es mucho: _____%

8.- ¿visita al curandero para determinar el uso de las plantas? si_____ no____ , en este último caso,   ¿Cómo determinó el uso?_____
_____

8.- ¿Cómo consigue las plantas?   las recolecta_____   autoproducción en su huerta de traspatio_____   las compra_____   Otra forma_____

8.1.- ¿Si las compra en qué lugar lo hace?:   farmacia _____   herbolaria _____   Mercados _____   otros (tiendas, súper) _____

Universidad Checa de Ciencias de la Vida   Encuesta a Usuarios de Plantas Medicinales

9.-¿Qué tan lejos y accesible se encuentra el lugar de recolección de las plantas de su comunidad?_____

10. Mencione las plantas medicinales que utiliza regularmente:

Número	Nombre común	Nombre científico	Parte usada	Verde o seca	Problema a resolver (¿Para que la usa?)	Forma de uso (Tintura, te, tizania, emplasto, otra forma) ¿Cómo se usa?	Dosis del tratamiento (Cantidad de planta medicinal por día y como se mide esa cantidad)	Tiempo de tratamiento (duración en días, semanas o meses)	¿Cómo determinó la dosis?	Combinaciones con otras plantas (o usos para otras enfermedades de la misma planta)	Contradicción o recomendaciones de uso
1											
2											
3											
4											
5											