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Czech University of Life Sciences Prague
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**Ethnobotanical inventory of medicinal plants used in the village
of Qampaya,
Potosí, Bolivia**

Bachelor thesis

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Declaration

I declare that I elaborated this bachelor thesis "Ethnobotanical inventory of medicinal plants used in the village of Qampaya, Potosí, Bolivia" alone, and that I have used only literature quoted and mentioned in references. The study could not arise without the cooperation between the Faculty of Tropical AgriSciences and the Universidad Nacional Siglo "XX". The Universidad Nacional Siglo "XX". gave me the resources and help with filling out the questionnaire.

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

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Hana Foffová

I wish to express my special gratitude to my supervisor for the cooperation, valuable suggestions and advice.

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Abstract

A survey of medicinal plants used by rural communities in the Indigenous Qampaya District, Province of the Potosí Department, Bolivia is reported in this thesis. Fifty - nine medical plants species belonging to 30 families have been identified as medicinal. The plants were separated by vernacular, as well as scientific names, families, used part, way of use and modes of preparation. The most dominant medicinal plant families are Asteraceae (13) and Laminaceae (7), often repeated preparation is infusion and poultice. Predominant diseases, which are treated by medical plants, are rheumatism, fever and problems with digestive system. The most known medical plants are *Calendula officinalis*, L., *Nicotiana glauca*, Graham, *Artemisia vulgaris*, L., *Mentha piperita*, L., *Matricaria chamomilla*, L., *Eucalyptus sp.*, L'Her, *Plantago hirtella*, Kunth and *Chenopodium ambrosoides*, L..The most frequently used parts were leaves. Knowledge of using medicinal plants plays important role in life of Bolivian rural people, which use medicinal plants as cure for all disease. The inventory of medicinal plants allows partially knowledge retain about the meaning and use of traditional healing plants for future generations.

Keywords: Ethnobotany, Medicinal plants, Bolivia, Potosi Department, nature health

Abstract

Práce se zabývá inventarizací léčivých rostlin ve venkovské oblasti Qampaya District, Province of the Potosi Department v Bolívii. Ve výzkumu bylo provedena inventarizace 59 léčivých rostlin, které patří do 30 čeledí. Rostliny byly seřazeny do tabulky a pro každou z nich byl přidán latinský název, tradiční název, číslo vouchery, elevace, způsob použití, část rostliny využívaná k terapii a nemoci, které léčí. Nejpočetněji zastoupenou čeledí je *Asteraceae* (13) a *Lamiaceae* (7). Nejčastěji se pro léčebnou účinnost používají výluhy a obklady. Nejvíce zmíněnou nemocí, která se dá léčit těmito rostlinami, je revmatismus, horečka a problémy s trávicím traktem. Mezi nejvíce zmíněnými rostlinami patří *Calendula officinalis*, L., *Nicotiana glauca*, Graham, *Artemisia vulgaris*, L., *Mentha piperita*, L., *Matricaria chamomilla*, L., *Eucalyptus* sp., L'Her, *Plantago hirtella*, Kunth a *Chenopodium ambrosoides*, L. Znalost léčivých rostlin hraje v současné době velký vliv, neboť většina obyvatel stále využívá více tradiční léčitelství než západní medicínu. Inventarizace léčivých rostlin umožňuje lépe zachovat znalosti o významu a využití těchto rostlin tradičního léčitelství pro budoucí generace.

Klíčová slova: Ethnobotanika, léčivé rostliny, Bolívie, Potosí Department, přírodní léčitelství

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1. Introduction

People have collected plants and their fruits for centuries. From the outset, they collected these plants only for their livelihood, but later they have found their healing abilities. The use of plants by human is interested in science called Ethnobotany. Medicinal plants have today a great potential, since they contain some substances that can be used as a natural medicine. In the past, medicinal plants were used much more, however today the world is gradually returning to them. Plants can cure us to heal from many diseases, or help us with prevention of these diseases.

In Bolivia, people still use a lot of medicinal plants. Mainly it is for their availability. Medicinal plants can be bought at markets or in some trade with pharmaceutical goods. Shamans and healers play major role in everyday life of the population in Bolivia. They help people from birth to death with their health and psychological problems. Plants accompany people all their life in Bolivia.

The inventory of medicinal plants allows us to determine what plants are medicinal and how these plants can be used for our benefit. Unfortunately, nowadays knowledge about medicinal plants gradually fallen into decline due to lack of interest of young people, confidence in Western medicine, migration to the cities, and ultimately the destruction of the original environment of the plants.

Therefore, this thesis aims at the inventory of medicinal plants and their uses. The aim is to help document and reserve these medicinal plants for future generations and if possible introduce such plants in to other markets or countries.

2. Literature review

2.1. Ethnobotany

Ethnobotany is defined as the study of the relationship between people and plants and most commonly refers to the study of indigenous uses of plants. We can also say that it is the alliance between cultural anthropology and botany, a study that investigates the role of plants as medicine, nourishment and natural resources (Diksha & Amla, 2011).

The term ethnobotany was first used by William Harshberger to present the uses of plants by aboriginals. There are three main ways in which plants have been found useful in medicine. Firstly, plants may be used directly for their natural chemical constituents. Secondly, plants may be used as agents in synthesis of drugs. Finally, the organic molecules found in plants may be used as models for synthetic drugs. Second and third statements are studied under a science named ethnopharmacology. Ethnopharmacology is exploring new and scarce plant species for development of phytomedicine. Although, Ethnomedicine and Ethnopharmacology includes indigenous beliefs, concepts, knowledge and practices among ethnic group, folk people or race for preventing, lessening, curing disease or pain. Moreover, information on these branches of science can provide some basic data regarding the medicinal uses of some locally available plants. The World Health Organization has estimated that 80 percent of people in the world rely on traditional medicine for primary healthcare. And of the 119 plants based drugs used today by modern medicine, about 74% are from plants origin. Although, the 1978 technical report of the World Health Organization discusses the role of traditional medicine in treating the masses in traditional ways (Farnsworth et al., 1985). Scientists are focused on the development of new drugs for huge markets and potentially, highly profitable pharmaceutical products are developed, based on the biological and chemical diversity of the various ecosystems of the earth. The search begins with the collection of biogenic samples (fungi, other micro-organisms, plants and animals), progresses through analysis of the chemical, biological and pharmacological activities to the development of drugs. A key process in this search is high throughput screening systems such as those that have been established by major international pharmaceutical companies. Huge libraries of compounds (extracts) are screened for biological activity against specific targets. Active natural products are only one of the many sources of material for these batteries of tests

but serve as a starting point for drug development (Ghorbani et al., 2006). Therefore, it needs a close cooperation and multidisciplinary teams of researchers of different professionals from anthropology, botany, pharmacology and medicine. It is clear that inter- and multidisciplinary approaches can lead to more thorough, fruitful and systematic approximations in the study of plant-people interactions (Alexiades & Sheldon, 1996).

Ethnobotany is the scientific investigations of plants or fungi which are used by indigenous culture for rituals, household implements, food, medicine, building, musical instruments, firewood, pesticides, clothing, shelter or other purposes (Ugulu & Aydin, 2011).

In this time ethnobotany knowledge (planting, using, preservation and others) are lost by lack of interest, migrations to the cities, propagation crops, destruction of the original landscape and many other reasons. It is necessary to provide inventorying of medical plants before we waste all knowledge about them.

2.2. Bolivia

Bolivia is a landlocked South American country of 1 098 581 km² in size. Its population amounts 10 027 262 inhabitants. Land uses include 33 % agricultural land, of which 5 % is arable, 93 % pastures, and a negligible percentage is irrigated. Bolivia is divided into three distinct eco - zones: a vast semi-arid Altiplano plateau between the western range (Cordillera Occidental) and the eastern range (Cordillera Oriental) ; semi-tropical Yungas and temperate valleys of the Cordillera Oriental; and eastern lowlands, including the semi-arid Chaco.

Agriculture is an extremely important sector, with 60 % of farmers in the highlands. The arable land was estimated at 2.3 ha per person in 1993 (Dirven, 1999). Of the total area, 51 % is covered by forests. It employed about half of the official labour force in 1986. Coca growing, a long standing customary crop, has become a major social problems in Bolivia.

Bolivia has the second largest population of South American llamas and alpacas, after Peru, and a large number of cattle and sheep.

Bolivian soils are extremely varied and reflect the variable topography and slopes of the landscape.

Temperatures depend on elevation and show little seasonal variation. In most places rainfall is heaviest in summer, and yearly amounts tend to decrease from north to south.

2.2.1. Altiplano

The Altiplano, which is also swept by strong and cold winds, has an arid and chilly climate, with sharp differences in daily temperatures. Average temperatures during the day range from 15⁰C to 20⁰C, but in the summer tropical sun, temperatures may exceed 27⁰ C. After nightfall, however, temperatures decrease rapidly.

Although the Altiplano covers only 12 % of Bolivia's land area, it has 35 % of its population. The Altiplano is a high altitude basin, which includes a plain known as Puna. It is covered with sediments of disappeared lakes, partially dried lakes (e.g. lake Titicaca) and residues of other salty lakes. Humidity in the Altiplano decreases from north to south, and salinity of the existing lakes increases in the same direction. Livestock systems in the highlands include pastoral and agro-pastoral systems. Although animals are not necessarily the main source of family income, their role is crucial to survival, since it is a far less risky enterprise than cropping and other agricultural activities.

Sheep are kept in the Altiplano for meat and wool. Originally introduced by colonizers, breeds such as Churra, Manchega Merino and some others are widespread.

Alpacas, llamas and vicuñas provide efficient pack animals, wool, meat, fibre, leather, manure and fuel. Their habitat is generally above 3 800 m.

The natural vegetation is dominated by semi-arid Puna formations characterized by grasses, and less frequently shrubs, of low nutritive value. Soils tend to be low in nitrogen and phosphorus, high in sodium chloride, and moderate to low organic matter. Altiplano soils are affected by erosion in various degrees. In fact, in some areas sand dunes have evolved through soil overuse. The erratic rainfall ranges between 300-600 mm per year, and is supplemented by scarce irrigation when water is available.

Communal crop and grazing lands are interspersed with privately - owned farms and all of them are grazed by mixtures of alpacas, llamas, sheep and cattle in varying proportions depending upon the location and altitude. Main crops are potatoes (*Solanum tuberosum L.*), quinoa (*Chenopodium quinoa Willd.*), various beans and others. The climax vegetation

of the Altiplano or Puna is considered to include the following species: *Stipa ichu* (Ruiz & Pav), *Calamagrostis* spp. (Adanson), *Baccharis incarum* (Wedd.), *Baccharis boliviensis* (Wedd.), and *Parastrephia lepidophylla* (Wedd.) (Vera, 2000).

Table 1. Eco-regions and their main genera and species of Puna and Altiplano (Vera, 2000)

Eco-region	Local names	Characteristic genera and species
Subhumid Puna (N Altiplano)	Bofedal	<i>Distichlis humilis</i> Phil., <i>Carex</i> sp. L., <i>Oxychloe andina</i> Phil., <i>Calamagrostis</i> spp.(Michx.) P.Beauv
	Chilliguares (=Chillihuares)	<i>Festuca dolichophylla</i> J.Presl, <i>Lachemilla</i> spp. Rothm., <i>Trifolium amabile</i> Kunth.
	Totalal	<i>Scirpus</i> L., <i>Juncus</i> L.
Arid-semiarid0 Puna (Central Altiplano)	Bofedal	<i>Oxychloe andina</i> Phil.
	Pajonal	<i>Stipa</i> spp. L., <i>Calamagrostis</i> spp., Adans.
	Pajonal de Ichu	<i>Stipa ichu</i> Kunth,., <i>Stipa</i> sp. L., <i>Erodium cicutarium</i> L'Her., <i>Aristida</i> sp. L.
	Chilliguares	<i>Festuca dolichophylla</i> , J. Presl
	Tolar (=Tholar)	<i>Parastrephia lepidophylla</i> (Wedd.) Cabrera, <i>Baccharis microphylla</i> Kunth, <i>Adesmia</i> spp. DC
	Tolar-pajonal	<i>Parastrephia lepidophylla</i> (Wedd.)Cabrera, <i>Baccharis</i> L., <i>Festuca</i> L., <i>Stipa</i> L.
	Gramadal	<i>Distichlis humilis</i> Phil., <i>Muhlenbergia fastigiata</i> Henrard, <i>Muhlenbergia peruviana</i> Steud.
	Arbustal de Cauchi	<i>Suaeda fruticosa</i> Delile, <i>Atriplex cristata</i> B.Heyne ex Moq.
Arid-semi-arid high Puna (S &W Altiplano)	Bofedal	<i>Oxychloe andina</i> Phil., <i>Ranunculus</i> sp. L.
	Tolar	<i>Psila boliviensis</i> (Wedd.) Cabrera, <i>Fabiana densa</i> J. Rémy
	Gramadal	<i>Distichlis</i> Raf., <i>Werneria</i> Kunth
	Matorral de polylepis	<i>Polylepis tomentella</i> Wedd, <i>Polylepis tarapacana</i> Phil., <i>Stipa ichu</i> Kunth
	Pajonal	<i>Festuca</i> sp. L.
Subhumid high Puna (E Altiplano)	Bofedal	<i>Distichlis</i> Raf., <i>Plantago</i> L.
	Pajonal de ladera	<i>Festuca</i> L., <i>Stipa</i> L., <i>Paspalum</i> L.
	Gramadal	<i>Geranium</i> L., <i>Werneria</i> Kunth
	Arbustales de satureja	<i>Satureja</i> L., <i>Chuquiraga</i> Juss.

2.2.2. Population of Bolivia

The population increased from 8 274 325 inhabitants (2001 census) to 10 027 262 (2012 census). 3% of the inhabitants are Catholics, 5% are Protestants (2012 census) in entire Bolivia. The people are predominantly indigenous citizens of Quechua descent. They have a preference for traditional medicine modern medicine.

In Bolivia the impact of hospitals and health posts only became important for the general population after 1975, when the government increased their number by over 80 %. Nevertheless, rural communities in Bolivia are still relying on traditional medicine to treat illnesses and make prevention. The use of medicinal plants to treat a wide variety of diseases has been often noted. According to the World Health Organization, up to 90 % of the population in developing countries relies on traditional medicine (such as medicinal plants) to meet primary health care which is needed. In Bolivia traditional medicine is still a part of daily life in many areas. Therefore, research on traditional forms of medicine and the exploration of the possible use of medicinal plants in primary health care is required to understand the extent of use and effectiveness of these practices. Previous research has shown that 80 % of people in developing countries use traditional medicine to meet their primary healthcare needs, and about 85 % of a traditional medicine involves the use of plant extracts (Quiroga et al., 2012).

Bolivian people use a variety of healing elements, such as medical plants, animal and human products, minerals, manufactured products to prevent and cure various diseases. In Qampaya it is difficult to have freely available pharmaceutical drugs, because of the high cost and the geographical features of this place. People use medicinal plants as curatives or soothing products of main health problems according to their cultural background. Plants were and still are a recognized traditional way to treat ailments and diseases (Kokoska & Fernández, 2008).

A typical aspects of the therapy is that some of the inhabitants distinguish õhotö and õcoldö diseases, in the same manner as also õhotö and õcoldö plants, which can treat only illnesses having the same õtemperatureö, so the õhotö diseases can be treated only with õhotö plants. This belief may have arrived together with the Chiquitano mestizos, because the similar categorization was observed in a Bolivian Chiquitano community (Hajdu & Hohman, 2011).

2.3. Shamans and Healers in Bolivia

The herbalists develop their skills by learning from their ancestor, other herbalists and through practice. When they treat a disease with an experimental herb, they give the patient small doses to observe its effects over several weeks. If a patient dies in treatment, they are held responsible. Bolivians practice retributive justice, and a herbalist may be killed by relatives of the deceased. Herbalists usually refuse to treat anyone they are unsure about curing; and this apparently works against the terminally ill patient.

2.3.1. Healers

In many cultures there are healers who practice the arts of physical healing which methods such as herbal medicines, massage, or acupuncture. These healers are not shamans. Any number of these healing arts may be practiced by particular shamans. For the example, most Amazonian shamans have a vast knowledge of the medical and hallucinogenic uses of rainforest plants (Pratt, 2007).

2.3.2. Yatiris

Yatiris are diviners of coca leaves among the ethnic group of Aymara. They are also named kallaway or jampiris. They are an elite group of indigenous healer whose knowledge inherits from father to son. The yatiri can be woman or man, who has usually received the soft of divination through surviving an auspicious event such as being stuck by lightening. Through the divination of coca leave the yatiri is able to bring luck or good fortune as well as cure illnesses of a supernatural causation (International Labour Organization, 2000).

Yatiri also performs a ceremony in which coca (*Erythroxylum coca* Lam.) is the instrument of communicating with spiritual world. Yatiris can help with lost souls and he knows how the soul can return to the body of patient. The patient will begin to recover (Tremayne, 2001).

Patients usually have to pay for treatments. Sometimes they also have to pay for medicinal plants, although the poor patients do not have to pay at all and can collect the required medicinal plants themselves. Healers state the payment according to each patient.

In Apillapampa, payment is usually in cash, but other means, e.g. by labour exchange, animal, crops or products are also possible. Exchange of goods or labour is in agreement with traditional Bolivian principles of reciprocity. Alternatively, they might agree that the patient has to pay after the desired effect of treatment has been demonstrated (Vandebroek et al., 2008).

2.4. Medicinal plants

Definition of medicinal plants is a plant which has been used for medical purposes at one time or another, and which, although not necessarily a product or available for marketing, is the original material of herbal medicines (World Health Organization, 1998).

The medicinal plants have some extracts that can help people such as inulin, vitamins, alkaloids, phytoncids, tannins, bitters, glycosides, alkaloids and others.

Inulin is carbohydrate, which is located in the sweet potato tuberous or chicory. Inulin is used for nutrition and diabetes diagnostic purposes.

Mucilages are storage substances in plant vacuoles ribwort or mullein flowered. Counteracts inflammation of the mucous membranes and have the ability to reduce irritation.

Vitamins, a diverse group of substances which are necessary for human organisms. They can be part of biocatalysts, enzymes or regulatory proteins.

Glycosides, botanical agents, which have effects against bacteria and fungi. In physiological doses are beneficial to human body. Includes salicin, arbutin, coumarin, hydrogen cyanide, and thioglycosides.

Bitters are diverse group of substances is characterized by its bitter taste. They have a stimulating effect on the digestive tract, the formation of gastric juice or bile and increase appetite.

Tannins, substances that have a common characteristic, which is mucosal protein precipitation. Tannins are effective for gastrointestinal disease and skin disease. Are also

used for treatment of frostbite, inflammatory bowel and gastric catarrh and diarrhoea.

Phytoncids are chemically heterogeneous group of substances that have the ability to inhibit bacterial growth, therefore they are popularly called natural antibiotics.

Alkaloids are a large group that affects the human body. These substances act on the nervous system. The repeated administration of humans may exhibit addiction. Medical uses a wide range of beneficial physiological effects of alkaloids. Alkaloids must be administered at certain concentrations.

Among the alkaloids include: Ephedrine, which narrows blood vessels, increases blood pressure, stimulates the central nervous system, as is used in the treatment of rhinitis, and edema. Mescaline has hallucinogenic and intoxicating effects. Colchicine is used in the treatment of leukaemia, and bottom hinge rheumatism. Lobeline, which serves people with asthma to reduce their seizures. Atropine and hyoscyamine inhibits the secretion of sweat, salivary and intestinal glands. It is also used in ophthalmology and in asthma. Chitin is administered to patients as an antimalarial, antipyretic and need to reduce cardiac activity. Morphine and codeine are buffering substances for nervous system. Ergotamine is an alkaloid, which is located in ergot. Today it has grown to have effect against migraines and gynaecological problems. Psilocybin is a hallucinogenic substance that is used in psychiatry (Bulánková, 2005).

2.5. Types of preparations of medicinal plants

There are several types of preparations of medicinal plants, for example decoctions, infusions, tinctures, ointments, creams, poultices, syrups and oils.

Decoctions can be prepared by the chopped plant parts (roots, twigs, bark and fruits). The plant parts are cooked in hot water about half an hour.

Infusions are the same as teas. It is suitable for flowers and leaves. The plant parts are poured by 100°C water. Medicinal plants were allowed 10 minutes to stand in water. Then removed the medical plants and infusion can be drunk.

The tincture is obtained by dipping medicinal plants in alcohol. We will achieve stronger effect of herbs. After 4 weeks, the mixture of herbs and alcohol pressed out. The finished tincture will last up two years.

Creams are produced by mixing the fat, water and herbs. Creams are well absorbed into the skin, and the skin can breathe better. Their disadvantage is their decay. They should be kept for three months in a cool place.

Ointments unlike creams do not contain water. Their preparation is suitable soft paraffin or petroleum jelly. It is heated and mixed with herbs. It has greater durability than cream.

Poultice of herbs directly attach to the skin. Herbs are simmered for two minutes before attaching to the desired area. Then rub the affected area with oil and put on it herbs that are well-breathable fabric. Let causing up to 3 hours.

Lotion is a preparation of herbal infusions, decoctions or diluted tinctures. Pressure herb dressing fabric is soaked lotion that is applied to the affected area and let it causing about an hour.

Syrup is made from infusion and preservatives, which may be raw sugar or honey. Mix in the same ratio and allowed to boil for about half an hour. Syrups best to help relieve sore throat and cough. For their sweet taste children love them.

Healing wine is made by mixing medicinal herbs and wine. This mixture was allowed to stand for 2-6 weeks. It is good for indigestion. The dosage should not exceed 70 ml before the main meal.

Hot infusion oils are produced by mixing the oil and medicinal plants. The mixture is boiled 2-3 hours. Oil can be used for 1 year.

Cold infusion oil is produced from medicinal plants laden with in plant oil, which leaves 2 ó 6 weeks to rest in a sunny spot (Chevallier, 2001).

3. Aims of the thesis

The main aim of this work was the inventory of medicinal plants in Qampaya, Potosí Department, Bolivia.

These medical plants were identified. The botanical name, family, local name, used part, preparation for the application and treatment were found. The plants were deposited in Universidad Nacional Siglo öXXö.

The inventory of the medicinal plants is necessary in this time, because we are losing information about medical plants every day. It is because of migration, lack of interest, losing the traditional way of healing and losing of tradition location to medical plants.

Another aim was to provide study of other medicinal aids which are used in Qampaya, Potosí Department, Bolivia.

4. Materials and methods

4.1. Study Area

Bolivia is located in South America. The country is divided in to 9 administrative departments. For this research was used the indigenous Qampaya District which is situated in the north of the Potosí Department. It is located between 18° 75' South and 19° ' South and 66° 3' West. The soils of the region are dry and loosely consolidated clays, sands and gravel. Climate is cold and dry with one rainy season from December to February. It belongs to the Andean Plant Geography Region.

The Qampaya community is situated in the agro - ecological region Altiplano, characterized by an average elevation of 3900 m above sea level, annual average temperature 15-20°C and annual average rainfall 350 mm.

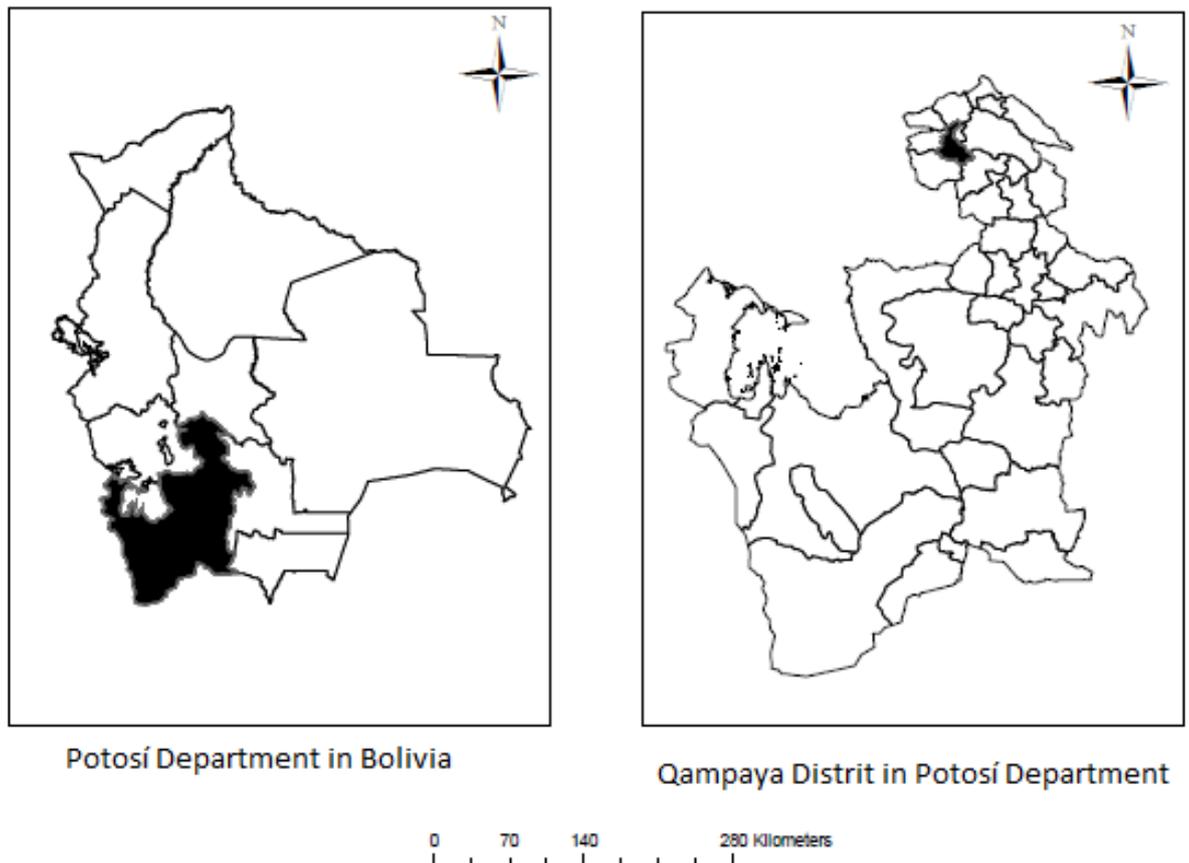


Figure 1. Maps of Potosí Department in Bolivia and Qampaya in Potosí Department

4.2. Population of Qampaya

This study is from three different ecological communities in indigenous Qampaya which belongs to Quechua ethnic group. The traditional agricultural system is focused on potatoes (*Solanum tuberosum* L.), oca (*Oxalis tuberosa* Molina), goosefoot (*Chenopodium quinoa* Willd), maize (*Zea mays* L.) and isaño (*Tropaeolum tuberosum* Ruiz & Pav.). There are few extensive flat spaces; the topography is for the most part precipitous, with many narrow valleys and ravines between high ridges. They breed cattle (*Bos*), sheep (*Ovis*), alpacas (*Lama guanicoe*) and llamas (*Lama glama*). This is the typical way of life in the studied population (De Lucca & Zalles, 1998). The householders are the basic economic unit, and at times of intensive work people rely on extended kinship networks. Main language is Quechua, spoken by 86 %, while 74 % of the population speak Spanish. This people have learned to survive by keeping llamas and marketing with medical plants.

4.3. Methodology

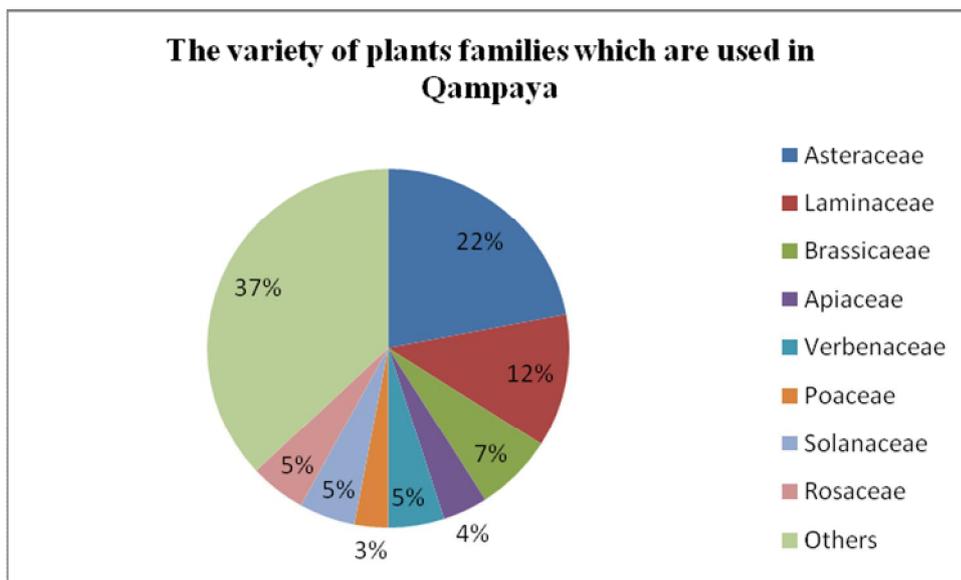
Ethnobotanical data were collected through semi ó open interview which was wrote in Spanish, because inhabitants of Qampaya can speak just Spanish or Quechua. The questionnaire is presented in Annexe 1. The information was collected from 60 respondents. The age of asked were from 18 to 60 years, who spent most of their lives in studied area and who were willing to participate in the survey. The scientific names were identified according to The International Plant Names Index.

The general information was found on web page Web of Science and in accessible books. I used key words: Ethnobotany, Bolivia, medical plants, nature medicine, healing. For the citation I decided to use the Ecosystems system of citations. This study was created in partnership with Carrera de Ingeniería Agropecuaria, Universidad Nacional Siglo XX, LLallagua, Bolivia.

5. Results and Discussion

The results of the survey are presented in Table 4., in which the plants are arranged in alphabetical synopsis. For each species, the following ethnobotanical and pharmacologic elements are provided: scientific name; local name; family, parts used; preparations; use/treatment, voucher number and numbers of reports.

The most dominant medicinal plant families are Asteraceae (13), Laminaceae (7), Brassicaeaceae (4), and other. That can be seen at Graph 1.



Graph 1. The variety of plants families which are used in Qampaya

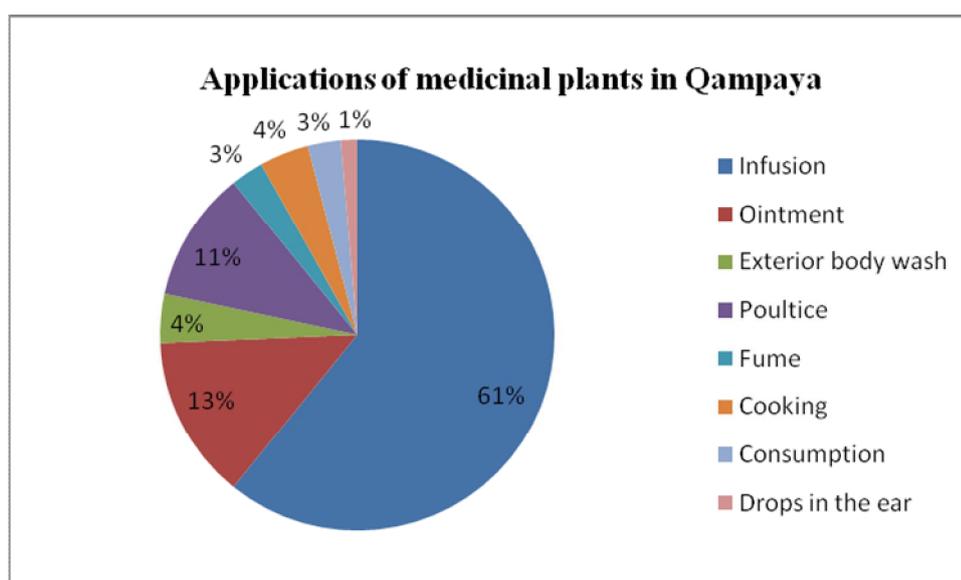
In this area they have ever used medicinal plant to prevent or cure the diseases 75 % and 25 % have never used medical plant. This 25 % were young people between 18 and 25 years, which were not willing to promote the use of the traditional medicine of their communities. 75 % of the respondents know from 2 to 8 medical plants at least. This can be seen in Table 2.

Table 2. Numbers of medicinal plants which people of Qampaya know

Variability	Respondents	%
8 Medicinal plants	11	18
6 Medicinal plants	7	12
5 Medicinal plants	5	8
3 Medicinal plants	12	20
2 Medicinal plants	10	17
None	15	25
TOTAL	60	100

Respondents made identification of 60 plants species (herbs or trees). The frequency of using medicinal plants like alternative cure were 'always' 45 %, 'almost' 30 %, 'almost never' 5 % and 'never' 20 %.

The application of medicinal plants is used in different application such as infusion, poultice, fiction ect. It can be observed in Graph 2.



Graph 2. Applications of medicinal plants in Qampaya

The highest percentage of the way of using is an infusion (61 %). The respondents believe that the using of medical plants in their community is good, because it is accessible and free.

The respondents have learned mostly from their grandparents, parents, healers or in workshops. In the community there are 2 - 5 healers called yatiris, aysiris, jampiris, paqøuiris. They have virtue for providing welfare services to the community. The transfer of knowledge from the ancestors to today was from the generation to generation, but not only in medicinal aspect, but also in the areas such as agriculture, technology, art, language and many others aspects (Zalles & De Luca, 1993)

The respondents know many traditional medicines as medicinal plants, animals and humans products, processed products and mineral products (using of these medicine can be seen in Table 3). The responders indicated medical plants and besides them such are huayrurus (fruits of *Ormosia coccinea* (Aubl.)Jacks.), nutmeg (*Myristica fragrans* Houtt.), copal, incense, cuti cuti (*Asplenium lunulatum* SW.), skull, coca (*Erythroxylum coca* Lam.) and carnation (*Dianthus caryophyllus* L.). They also responded animal and human products such as hair, nails, feathers, embryos, dry meat, fats, eggs, urine and milk. Between the mineral products responders mentioned clay, lodestone (magnetite), halite (rock salt) and safura.

Table 3. Types of healing which is known in Qampaya

Variability	Respondents	%
Medicinal plants	39	65
Products of animals	4	7
Products manufactured	3	5
Minerals products	2	3
Healing by yatiris	7	12
Not known	5	8
TOTAL	60	100

The processed products mentioned by 5 % we can cite candies, pills, crackers, gold, black molasses, tin foil and other. Number of respondents corresponding 8% did not know any traditional medicine, 97% agreed to continue practicing traditional medicine, but 3% of respondents disagreed. They do not think that the alternative medicine can help them.

The most known medical plants are *Calendula officinalis* L., *Nicotiana glauca* Graham, *Artemisia vulgaris* L., *Mentha piperita* L., *Matricaria chamomilla* L., *Eucalyptus* sp. L'Her, *Plantago hirtella* Kunth and *Chenopodium ambrosoides* L.

Calendula officinalis L. have antioxidant, antibacterial, anti-inflammatory, and wound healing properties when used to treat skin burns (Aro et al., 2015).

Calendula officinalis L. is widely used for presenting activities, anti-inflammatory antibacterial and antioxidant. However the therapeutic action is linked to the amount of assets of the extracted raw material (Martins et al., 2014).

Calendula officinalis L. cures abrasions, sunburn and skin rashes. It helps in the treatment of fungal foot and thrush. Further reduces pain during menstruation (Chevallier, 2001).

Nicotiana glauca Graham is used for tooth pains (Silva K.N., 2007).

Nicotiana glauca Graham has strong antibacterial activity against Gram positive and negative pathogenic bacteria (Rahman S. M. A., 2011).

Nicotiana glauca Gram is often used of antioxidante effect. *Nicotiana glauca* Gram can be used to cure the oxidative stress and paraneoplastic symptoms caused by the cancer (Hassan L. E. A., 2014).

Infusions of *Anthemis wiedemanniana* L. are used to treat urinary tract infections. Scientists in Turkey also showed antioxidant, antimicrobial and hepato - protective activity. It is also used as sedative, antiseptic, for urinary inflammations and diabetes (Cakilciogluet al., 2011).

Anthemis wiedemanniana L. is traditionally used for the treatment of cold and flu, stomach-ache and diabetes disease. Also showed antimicrobial, antioxidant and hepato - protective activity (Polat, 2013).

In Southeast Asia it is used to treat menstrual conditions, pregnancy disorders, and severe pain during labour. It is also used as uterine sedative and postpartum tonic (De Boer, 2014).

Mentha piperita L. cures headache, diarrhoea, rheumatism, stomach ache, dizziness, Bronchitis and cough (Juárez-Vázquez, 2013).

Mentha piperita L. is traditionally used in treatment of various conditions including flatulence, carminative and as a local antiseptic. In addition, *M. piperita* is reported to have analgesic activity and its leaves are used to reduce tooth and abdominal pains. Besides, this plant has been indicated to relieve inflammatory disorders. Topically *M. piperita* essential oil is employed as an analgesic compound for diseases of the pharynx and in the relief of tension headache and migraines. In mouthwashes, it is utilized for oral hygiene, possibly due to its antimicrobial activities. *M. piperita* has antibacterial effects, strong antioxidant and antitumor action, and anti-allergenic potential (Taher, 2011).

Mentha piperita L. showed some antibiofilm activity against pathogens such as *Pseudomonas aeruginosa* and *Candida albicans* (Sandasi, 2011).

Infusion of *Mentha piperita* L. has anti-viral and anti-bacterial properties and also has antioxidant effects (Romero-Jiménez, 2005).

Peppermint product of *Mentha piperita* L. is usually taken after a meal for its ability to reduce indigestion and colonic spasms (Spirling, 2001).

Matricaria chamomilla L. cures cold, insomnia, stomach ache, anxiety and inflammation of skin (Mati et al., 2013).

Matricaria chamomilla L. is a plant of Asteraceae family. Its flowers have different substances with therapeutic properties for healing and prevention of various ailments, among them, gastrointestinal upset, stress, inflammation and hypertension (Delarmelina et al., 2012).

Matricaria chamomilla L. is an important medical plant known for its anti-inflammatory, wound healing and antiseptic actions since long time (Ashnagar et al., 2009).

Eucalyptus L'Her. leaves have been used to heal wounds and fungal infections. Essential oils and extracts possess antimicrobial and antitumor properties. We sought to determine antimicrobial and cytotoxic activities of oils and extracts of stems, leaves and flowers (Ashour, 2008).

Eucalyptus L'Her. has strong antimicrobial activity against human and food borne pathogens. The antimicrobial nanoemulsions are oil in water type with nanosized droplets having a broad spectrum activity against enveloped bacteria, fungi and virus (Sugumar, 2014).

Local communities have used leaves, as well as other parts of the plant for various diseases, including cancer. Recently, a variety of *Eucalyptus* L'Her. species have shown potential cytotoxic properties in addition to antimicrobial activities (Bardaweel, 2014).

The World Health Organization has approved the use of *Plantago* L. as laxative agent, to treat hypercholesterolemia and to reduce the blood glucose. *Plantago* has different compounds such as alkaloids, antioxidants, flavonoids, phenolic compounds, terpenoids and vitamin C (Haddadian & Zahmatkash, 2014).

Plantago L. cures diabetes, ear pain and kidney problems (Andrade-Cetto, 2009).

Plantago L. has been used in Slovak folk medicine to treat cough, gastric ulcers, respiratory infections and tonsillitis as well as to improve wound healing and draining abscesses. It has analgesic, anti-inflammatory, antioxidant and antiviral properties (Ková et al., 2015).

Aqueous leaves extracts and essential oils of *Chenopodium ambrosoides* L. are used traditionally as dietary condiments and in traditional medicine against menses disorders, fibroids, uterine haemorrhage, parasitic diseases and inhibits the Ehrlich tumor growth (Ortega ó Ramirez et al., 2014).

Chenopodium ambrosoides L. proved to be a good source of natural antioxidants and other bioactive compounds, which may have industrial use. Relevant diseases such as cancer, cirrhosis, diabetes, heart disease and dementia disorders, as well as ageing process have been associated with the uncontrolled production of free radicals. It also cures influenza,

cold or gastrointestinal and respiratory ailments, as well as vomiting or healing of skin ulceration (Barros, 2013).

Chenopodium ambrosoides L. is used in folk medicine in the form of teas, poultices and infusions for inflammatory problems, contusions and lung infections, and as an anthelmintic and anti-fungal. It acts as a diuretic and it is used to treat wounds, respiratory problems, inflammatory and painful processes, bronchitis, tuberculosis and rheumatism (Grassi, 2013).

Table 4. Table of inventory of medicinal plants used in Qampaya, Potosí Department, Bolivia

Local Name	Voucher number	Scientific name	Family	Used part	Use / Treatment	Preparation	Number of report
Vira vira	Bo.As05	<i>Achyrocline saturejoides</i> Lam.	Asteraceae	Leaves	15	Infusion	2
Ajo	Bo.AI261	<i>Allium sativum</i> L.	Alliaceae	Bulb	4	Infusion	6
Altamisa	Bo.As11	<i>Artemisia vulgaris</i> L.	Asteraceae	Leaves	2	Infusion, ointment	9
Yareta	Bo.Ap162	<i>Azorella glabra</i> Wedd.	Apiaceae	Leaves	1	Infusion, fume	2
Qinsa loma	Bo. As0	<i>Baccharis genistelloides</i> Pers.	Asteraceae	Leaves	1, 14	Infusion	1
Saru saru	Bo.As10	<i>Baccharis salicifolia</i> (Ruiz & Pav.) Pers.	Asteraceae	Leaves	8	Infusion	2
Misicu	Bo.As02	<i>Bidens andicola</i> Kunth	Asteraceae	Leaves, thon	15	Infusion	1
Mostaza	Bo.Br31	<i>Brassica hirt</i> Moench	Brassicaceae	Leaves	3	Exterior body wash	2
Kiswara	Bo.Bu101	<i>Buddleja coriaceae</i> Rusby	Budleiaceae	Leaves	15	Infusion	1
Tusuwaya	Bo.La84	<i>Bystropogon glabrescen</i> Benth.	Laminaceae	Leaves	2, 18	Infusion, ointment	1
Tara	Bo.Le191	<i>Caesalpinia tinctoria</i> Domb.	Leguminosae	Leaves, fruit	7, 9	Ointment	1
Itapallu	Bo.Loa181	<i>Cajophora horrida</i> Urb. & Gilg.	Loasaceae	Flower	12	Infusion	1

Local Name	Voucher number	Scientific name	Family	Used part	Use / Treatment	Preparation	Number of report
Zapatilla	Bo.Sc241	<i>Calceolaria</i> sp. L.	Scrophulariaceae	Leaves	6	Infusion	1
Caléndula	Bo.As13	<i>Calendula officinalis</i> L.	Asteraceae	Flower	2	Ointment	8
Bolsa bolsa	Bo.Br33	<i>Capsella bursa pastoris</i> L.	Brassicaceae	Leaves	1	Infusion	2
Andrés huaylla	Bo.So92	<i>Cestrum parqui</i> L'Her	Solanaceae	Leaves	4, 15	Infusion, ointment	1
Sewenq'a	Bo.Po281	<i>Cortaderia quila</i> Stapf	Poaceae	Leaves	14	Consumption	3
Chak'atia	Bo.Sa231	<i>Dodonea viscosa</i> Jacq.	Sapindaceae	Leaves	1, 15, 17	Infusion	1
Sanu sanu	Bo.Ep201	<i>Ephedra american</i> Humb. & Bonpl.	Ephedraceae	Leaves	1	Infusion	2
Cola de caballo	Bo.Eq211	<i>Equisetum arvense</i> L.	Equisetaceae	Leaves	1, 14, 19	Cooking, infusion	4
Sulta	Bo.Ge41	<i>Erodium cicutarium</i> L'Her.	Geraniaceae	Leaves, stalk	1, 3	Infusion	1
Chachacoma	Bo.Es151	<i>Escallonia resinosa</i> Pers	Escalloniaceae	Leaves	14	Infusion	1
Eucalipto	Bo.My141	<i>Eucalyptus</i> sp. L'Her	Myrtaceae	Leaves	15	Infusion	9
Hinojo	Bo.Ap163	<i>Foeniculum vulgare</i> Mill.	Apiaceae	Leaves	14	Infusion	6
Pampa orégano	Bo.La85	<i>Hedeoma mandoniana</i> Wedd.	Laminaceae	Leaves	4	Infusion	3
Cebada	Bo.Po282	<i>Hordeum vulgare</i> L.	Poaceae	Seeds	1	Cooking	4
Payqu	Bo.Ch41	<i>Chenopodium ambrosoides</i> L.	Chenopodiaceae	Leaves	2, 3, 5	Infusion, poultice	8

Local Name	Voucher number	Scientific name	Family	Used part	Use / Treatment	Preparation	Number of report
Sillu sillu	Bo.Ro111	<i>Lachemilla pinnata</i> (Ruiz & Pav)Rothm.	Rosaceae	Leaves	3	Infusion	6
Lampaya	Bo.Ve13	<i>Lampaya medicinalis</i> F. Phil.	Verbenaceae	Leaves	1, 2	Infusion	3
Januk´ara	Bo.Br32	<i>Lepidium bipinnatifidum</i> Desv.	Brassicaceae	Leaves	4, 7	Infusion	3
T´ola	Bo.As14	<i>Lepidophyllum quadrangulare</i> Benth.	Asteraceae	Leaves	15	Ointment	5
Cedrón	Bo.Ve132	<i>Lippia citriodora</i> Royle	Verbenaceae	Leaves	4	Infusion	6
Manzanilla	Bo.As06	<i>Matricaria chamomilla</i> L.	Asteraceae	Leaves	4, 16	Infusion	13
Toronjil	Bo.La87	<i>Melissa officinalis</i> L.	Laminaceae	Leaves	10, 18	Infusion	4
Hierba buena	Bo.La83	<i>Mentha piperita</i> L.	Laminaceae	Leaves	4, 14	Infusion, external washing	11
Oqururu	Bo.Br43	<i>Nasturtium officinale</i> W.T. Aiton	Brassicaceae	Leaves	9, 3	Consumption	1
K´aralawa	Bo.So93	<i>Nicotiana glauca</i> Graham	Solanaceae	Leaves	4	Ointment	8
Ayrampu	Bo.Ca271	<i>Opuntia sulphurea</i> G. Donex Loudon	Cactaceae	Fruit	3, 10, 13	Infusion	5
Perejil	Bo.Ap161	<i>Petroselinum hortense</i> Hoffm.	Apiaceae	Leaves	19	Ointment	5
Matico	Bo.Pi251	<i>Piper angustifolium</i> Lam.	Piperaceae	Leaves	14	Infusion, poultice	2
Ch´uku ch´uku	Bo.PI51	<i>Plantago hirtella</i> Kunth	Plantaginaceae	Leaves	1, 11, 12	Infusion, poultice	6
Keñua	Bo.Ro112	<i>Polylepis incana</i> Kunth	Rosaceae	Leaves	15	Infusion	3

Local Name	Voucher number	Scientific name	Family	Used part	Use / Treatment	Preparation	Number of report
Jamillo	Bo.Lor171	<i>Psittacanthus cuneifolius</i> Blume	Loranthaceae	Fruit	17	Poultice	1
Romero	Bo.La86	<i>Rosmarinus officinalis</i> L.	Laminaceae	Leaves	14	Infusion, fume	6
Sarasara	Bo.Po51	<i>Rumex crispus</i> L.	Polygonaceae	Terminal bud	10	Poultice	1
Ruda	Bo.Ru121	<i>Ruta graveolen</i> L.	Rutaceae	Leaves	14	Infusion	3
Salvía	Bo.La82	<i>Salvia officinalis</i> L.	Laminaceae	Leaves	2	Infusion, poultice	7
Muña	Bo.La81	<i>Satureja ovata</i> R.Br.	Laminaceae	Leaves	6, 14	Infusion	4
Jinchu jinchu	Bo.Cr71	<i>Sedum</i> sp. L.	Crasulaceae	Leaves	13	Drops in the ear	1
Waych´a	Bo.As09	<i>Senecio brasiliensis</i> Less.	Asteraceae	Leaves	8	Infusion	1
Molle	Bo.An21	<i>Schinus molle</i> L.	Anacardiaceae	Leaves, fruit	2, 6	Poultice, ointment	3
uñumaya	Bo.So91	<i>Solanum calygnaphalum</i> Ruiz & Pav	Solanaceae	Leaves	11	Ointment	1
Retama	Bo.Fa151	<i>Spartium junceum</i> L.	Fabaceae	Flower, leaves	10	Infusion, external washing	2
Suyku	Bo.As03	<i>Tagetes graveolens</i> L´Hér	Asteraceae	Leaves	4, 9	Infusion	2
Pampa anís	Bo.As12	<i>Tagetes pusilla</i> Kunth.	Asteraceae	Leaves	4	Infusion	5
Warakaya	Bo.As04	<i>Taraxacum officinale</i> F.H. Wigg	Asteraceae	Leaves	1, 5	Infusion	3
Insaño	Bo.Tr291	<i>Tropaeolum tuberosum</i> Ruiz & Pav.	Tropaeolaceae	Tuber	1	Cooking	2

Local Name	Voucher number	Scientific name	Family	Used part	Use / Treatment	Preparation	Number of report
Verbena	Bo.Ve131	<i>Verbena</i> sp. L.	Verbenaceae	Leaves, flower	4	Infusion	2
Pupusa	Bo.As07	<i>Werneria popos</i> Phil.	Asteraceae	Leaves	10	Infusion, poultice	2
Ulu ulu	Bo.As01	<i>Xanthium spinosum</i> L.	Asteraceae	Leaves, branch	3	Infusion	1

Explanation:

Numbers in used and treatment: 1 - Problems of kidney (kidney stones, chronic renal insufficiency), 2 - Rheumatism (joint pain), 3 - Fever (temperature higher than 37 °C), 4 - Gastrointestinal disorders (pain in the stomach and intestines, vomiting, upset stomach, diarrhoea), 5 - Hepatitis (liver therapy), 6 - Insecticide, disinfectant, antiseptic; 7 - Children impaired concentration (calming effect), 8 ó Angina, 9 ó Headache, 10 - Psychological problems (sedatives, refreshing, weakness), 11 - Problems of skin (ulcers, scars, burns, eczema, rashes), 12 - Problems with urinary tract (bladder inflammation, promote the formation of urine), 13 ó Inflammation, 14 - Female trouble (menstruation, childbirth, labour pains), 15 - Problems breathing system (pneumonia, cough, phlegm, bronchitis), 16 ó Cold, 17 - Problems of bones (fractures, bone pain, joint sprains), 18 - Heart problems (calming effect, supporting the proper functioning of the heart), 19 - Problems with the liver (cirrhosis, liver steatosis)

6. Conclusions

The practice of traditional medicine in the North Potosi communities, especially in indigenous Qampaya District, we can see that families use this natural resource as health centre and medicinal facilities. These medicinal plants have been used as alternative solutions for thousands of years.

In indigenous communities Qampaya District 75 % of households are using from 2 to 8 medical plants mainly for cure or prevent diseases. These medical plants were identified and classified in species with different therapeutic properties. These various medicinal plants are applied in the various ways of using. Mostly consumed in teas, poultices, friction, patches, incense, cooking and as a preparation of ointments.

The knowledge of using medical plants and traditional medicine is carried from generation to generation, from grandparents, parents to children. However young people (18-25 years) did not already know the healing properties of medicinal plants. They migrate to the other cities and do not value their cultural identity. Finally respondents indicated that they know other types of drugs such as human and animal products and minerals products.

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4. ¿Cómo preparan estas plantas medicinales para su aplicación?

a) í í í í í í í í í í ..í í í í í í í í í í ..í í ..

b) í ..í í í í í í .

c) í ..í í í í í í í í

d) í .í í í í í í í í í .

5. ¿Cómo considera Ud. la utilización de las plantas medicinales en su comunidad?

Excelente Bueno Regular Malo No sabe

6. ¿En qué medida Ud. difunde en su comunidad la utilización de plantas medicinales?

No difunde Poco Regular Mucho

7. ¿Cómo Ud. aprendió el empleo de estas plantas medicinales en su comunidad?

a) í ..í í í .

b) í ..í í í í

c) í .í í í í í í .

d) í .í í í í í í .

8. ¿Qué tipo de medicamentos caseros más aplicables conoce Ud.?

a) í ..í í í í

b) í ...í ...

c) í ...

d) í .

9. ¿Ud. está de acuerdo en continuar practicando la medicina tradicional en su comunidad?

Si

No