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Ethnobotanical inventory of medicinal plants used in the Qampaya District, Bolivia

[Inventario etnobotánico de plantas medicinales usadas en el Distrito Qampaya, Bolivia]

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Abstract: Herbal medicine therapy is traditionally practiced by indigenous healers in Bolivia for hundreds years. Due to the great geographical and ecological diversity, there are thousands of native plants, which are utilized against diverse types of diseases. Nowadays, there is a worldwide problem connected with possible loss of ethnobotany knowledge because of the lack of the interest of young people. In present study, survey focused on medicinal plants used by rural people in Qampaya District, Potosí Department, Bolivia has been done. The data were collected from 60 respondents by semi-structured interviews. The results showed that 60 plant species belonging to 30 families are known as curative plants in this area. The mostly named families were Asteraceae (14 species) followed by Lamiaceae (7 species) and Brassicaceae (4 species). Predominant health problems treated by these plants are urological problems and gastro-intestinal disorders. The most frequently used plant parts were leaves and the preparation is mostly done as infusion. Even though the knowledge of using medical plants plays important role in life of Bolivian rural people, which use plants as medicines against various types of diseases, this study showed that 25% of respondents didn't know any medicinal plants. On the other hand 40% of asked people have known 6 or more medicinal plant species.

Keywords: *Chenopodium ambrosioides*, Ethnobotanical survey, *Matricaria chamomilla*, *Mentha piperita*, *Nicotiana glauca*, Potosí Department

Resumen: La terapia de la medicina herbolaria es practicada, tradicionalmente, por los curanderos indígenas en Bolivia, desde hace cientos de años. Gracias a la gran diversidad geográfica y ecológica, hay miles de plantas nativas, que se utilizan para el tratamiento de diferentes tipos de enfermedades. Hoy en día, hay un problema mundial relacionado con la posible pérdida del conocimiento etnobotánico, esto debido a la falta de interés de las nuevas generaciones. El presente estudio descriptivo, mediante una encuesta, fue enfocado a las plantas medicinales utilizadas por la población rural del Distrito Qampaya, Departamento de Potosí, Bolivia. Los datos se obtuvieron de 60 informantes mediante una encuesta semiestructurada. Los resultados mostraron que 60 especies de plantas medicinales, pertenecientes a 30 familias botánicas, son conocidas en el área de intervención. Las familias botánicas, más importantes de uso medicinal son Asteraceae (14 especies), seguido de Lamiaceae (7 especies) y Brassicaceae (4 especies). Los problemas predominantes de salud, tratados con estas especies, son los urológicos y trastornos gastrointestinales. La parte de la planta más utilizada son las hojas y la forma más común de uso es en infusión. A pesar de que el conocimiento sobre la utilización de las plantas medicinales, juega un papel importante en la vida de la población rural de Bolivia, quienes utilizan las plantas medicinales para el tratamiento de diversos tipos de enfermedades, este estudio mostró que el 25% de los encuestados no tienen conocimiento sobre la utilidad medicinal de ninguna especie vegetal. Por otro lado, el 40% de los informantes conocen 6 o más especies de plantas medicinales.

Palabras clave: *Chenopodium ambrosioides*, Estudio etnobotánico, *Matricaria chamomilla*, *Mentha piperita*, *Nicotiana glauca*, Departamento de Potosí

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INTRODUCTION

Ethnobotany is defined as the study of the relationships between peoples and plants. In general, it is a scientific investigation of the indigenous knowledge about plants that is unique to the culture or society (Diksha & Amla, 2011). This knowledge is traditionally passed orally from generation to generation and it has high value not only for the indigenous cultures in which occurs, but also for the scientific world. However, nowadays traditional knowledge is very often lost due to the lack of interest by young people, and thus the ethnobotanical documentation has a great importance for the conservation and utilization of biological resources (Muthu *et al.* 2006).

Plants are used in different ways, mostly as a food and fodder, medicines, fuel, dying agents, construction and tool materials, as well as for rituals purposes (Ugulu & Aydin, 2011). As medicines, they are utilized for thousands of years, mostly by the traditional healers and shamans as treatment against many diseases. According to the World Health Organization around 65% of people in the world and up to 90% of the population in developing countries rely on traditional medicine for primary healthcare (Vandebroek *et al.*, 2008). Medicinal plants also serve as a big source of secondary metabolites which are valuable for pharmaceutical industry and drug discovery. In developed countries, 25% of drugs are based on plants and their derivatives (Bodeker & Burford, 2007). Moreover in recent time, people from developed countries increased their interest on drugs of plant origin as alternative therapies, because conventional medicine is often ineffective and use of synthetic drugs can caused many side effects and other problems (Rates, 2001).

Bolivia is land locked country in the tropical zone, with big differences in climatic conditions which together with dramatic variations in topography resulted in a wide range of ecosystems with extreme plant biodiversity. The geography of Bolivia includes three main zones: Altiplano and Andes, the Gran Chaco, and the Amazon Rainforest. Bolivian population is about 10 million from which more than 60% are native Bolivians belonging to 36 ethnic groups. The largest groups are predominantly indigenous Quechua, into which traditional healers Kallawayaya belong, and Aymara people. Main language is Quechua, spoken by 86%, while 74% of

the population speaks Spanish. Their 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.). They breed cattle (*Bos*), sheep (*Ovis*), alpacas (*Lama guanicoe*), llamas (*Lama glama*) (De Lucca & Zalles, 1992). This is the typical way of life in the studied population. The householders are the basic economic unit, and at times of intensive work people rely on extended kinship networks. Bolivians have a preference for traditional medicine before modern medicine (Fernandez *et al.*, 2003).

Even though the traditional knowledge of medicinal plants has in Bolivia deep roots, there are only several studies focused on ethnobotanical inventory of these plants (Bourdy *et al.*, 2000; Fernandez *et al.*, 2003; Macía *et al.*, 2005). Therefore we decided to make ethnobotanical inventory of plants collected for medicinal purposes by local people of Qampaya, Potosí Department, Bolivia and to document the local names, botanical names, families, plant parts used, type of preparation and use of these plants.

METHODOLOGY

Study area

The ethnobotanical study was carried out from three rural communities (Kea Kea, Pampoyo and Tuyo Tuyo) of Qampaya District situated in the north of the Potosí Department, which is located in southern Bolivia (Figure 1) between 19°04 '54" south latitude and 66°3'05" west longitude. The Qampaya District comprised from 14 communities, but the research was conducted only in three of them, in which we obtained the authorization for this research. The Qampaya communities are situated in the agro ecological region Altiplano Central, characterized by an average elevation of 3900 m above sea level. The climate is cold and dry with annual average temperature 15-20° C and annual average rainfall 350 mm with one rainy season from December to February. The soils of the region are dry and loosely consolidated clays, sands and gravel. It belongs to the Andean Plant Geography Region.

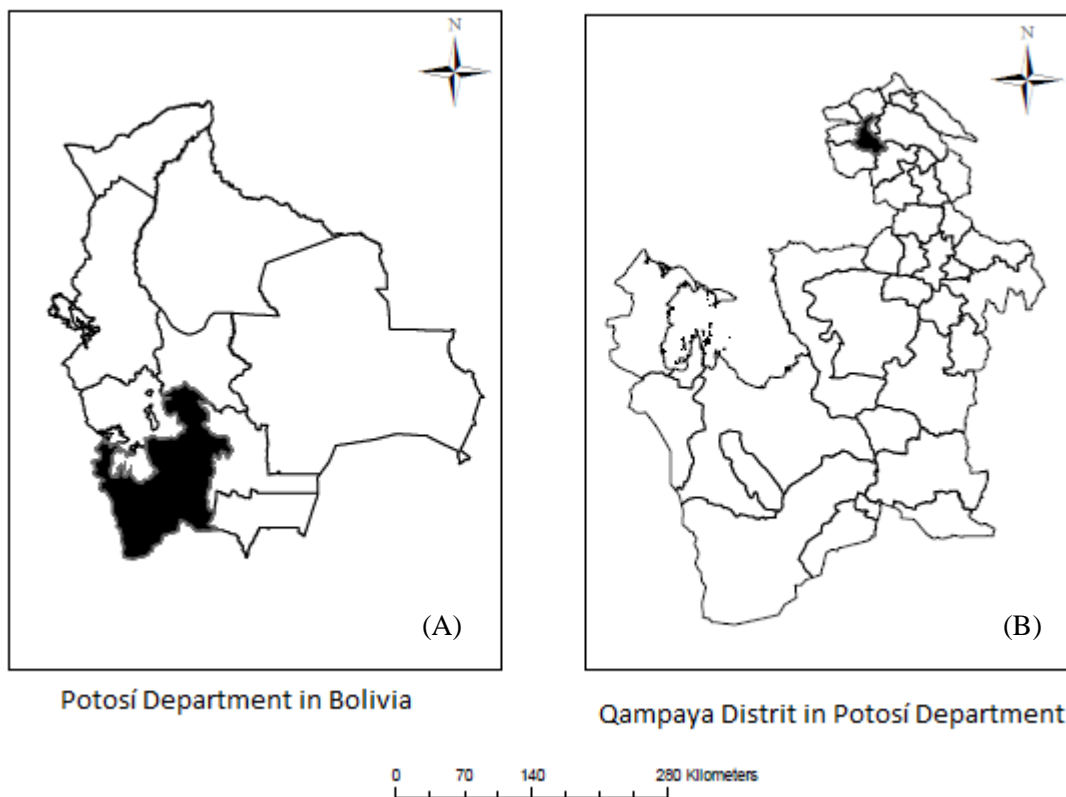
Data collection

The data were collected in year 2013 through semi-structured face to face interview. The total of 60

respondents (24 women, 36 men) belonging to the Quechua ethnic group were interviewed at homes as well as at busy places such markets, fields, home gardens. The approximate population in the three studied communities is 600 habitants, approximately 200 habitans per community. The survey was conducted in 20 habitans per community, which represents 16.6% (older than 18 years). The

interviews were in Spanish and questions were focused on utilizing of medicinal plants (e.g. which medicinal plants do they know, how often they used them, how they prepare the plants for medicinal application). The age of asked people was from 18 to 60 years, who spent most of their lives in studied area and who were willing to participate in the survey.

Figure 1
Location of Potosí Department in Bolivia (A) and Qampaya District in Potosí Department (B)



The plant material was collected by the authors and identified following 'Bolivian Flora of Medicinal Plants' (De Lucca & Zalles. 1992). Voucher specimens were deposited in the herbarium of the Carrera de Ingeniería Agrómica, Universidad Nacional Siglo XX, Llallagua, Bolivia. The scientific names were identified according to The International Plant Names Index.

RESULTS

The results showed that respondents known 60 plant species which used as medicine against various types of diseases. The data including scientific name, local

plant name, botanical family, voucher number, plant parts used, type of health problem treated by plant, way of preparation and number of reports are summarized in Table 1. The most dominant families with the highest number of medicinal plants used were Asteraceae (14 species), Lamiaceae (7 species), and Brassicaceae (4 species) (Figure 2). The mostly named medicinal plants were *Matricaria chamomilla* L. (13 reports), *Mentha piperita* L. (11 reports), *Eucalyptus* sp. (9 reports), and *Artemisia vulgaris* L. (9 reports). The most mentioned health problems treated by named medicinal plants were urological problems (kidney stones, chronic renal insufficiency,

and bladder inflammation, to promote the formation of urine) and gastro-intestinal disorders (such as pain in the stomach and intestines, vomiting, diarrhea).

Our survey also revealed that 75% of respondents commonly utilize medicinal plant to prevent or cure the diseases and are able to identified at least 2 medicinal plants. On the other hand, 25% of interviewed did not use medicinal 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. The frequency of using medicinal plants like alternative cure were “always” 45%, “almost” 30%, “almost never” 5% and “never” 20%. The respondents have learned their knowledge mostly from their grandparents, parents, traditional healers or in workshops. In the community

there are between 2 to 5 healers called yataris, aysiris, jampiris, or paq' uiris, who provide welfare services to the community. The application of medicinal plants is used in different ways (Figure 3). The highest percentage of preparation is in form of infusion/tea (61%) followed by ointment (13%) and poultice (11%). Besides the medicinal plants, respondents also identified some animals and human products (hair, nails, feathers, embryos, dry meat, fats, eggs, urine and milk) and minerals (clay, magnetite, halite rock salt and sulfur) as type of traditional remedies used in their communities. The processed products mentioned by 5% of interviewed were candies, pills, crackers, gold, black molasses, or tin foil. Only 8% of asked people did not know any traditional medicine.

Table 1
Medicinal plants used in Qampaya, Potosí Department, Bolivia

Scientific name	Local Name	Family	Voucher number	Used part	Uses	Preparation	Number of reports
<i>Achyrocline saturejoides</i> Lam.	Vira vira	Asteraceae	Bo.As05	Leaves	15	Infusion	2
<i>Allium sativum</i> L.	Ajo	Alliaceae	Bo.A1261	Bulbs	4	Infusion	6
<i>Artemisia vulgaris</i> L.	Altamisa	Asteraceae	Bo.As11	Leaves	2	Infusion, ointment	9
<i>Azorella glabra</i> Wedd.	Yareta	Apiaceae	Bo.Ap162	Leaves	1	Infusion, fume	2
<i>Baccharis genistelloides</i> Pers.	Qinsa loma	Asteraceae	Bo. As0	Leaves	1, 14	Infusion	1
<i>Baccharis salicifolia</i> (Ruiz & Pav.) Pers.	Saru saru	Asteraceae	Bo.As10	Leaves	8	Infusion	2
<i>Bidens andicola</i> Kunth	Misicu	Asteraceae	Bo.As02	Leaves	15	Infusion	1
<i>Brassica hirta</i> Moench	Mostaza	Brassicaceae	Bo.Br31	Leaves	3	External washing	2
<i>Buddleja coroicense</i> Rusby	Kiswara	Buddlejaceae	Bo.Bu101	Leaves	15	Infusion	1
<i>Bystropogon glabrescens</i> Benth.	Tusuwaya	Lamiaceae	Bo.La84	Leaves	2, 18	Infusion, ointment	1
<i>Caesalpinia tinctoria</i> Domb.	Tara	Fabaceae	Bo.Le191	Leaves, fruit	7, 9	Ointment	1
<i>Cajophora horrida</i> Urb. & Gilg.	Itapallu	Loasaceae	Bo.Loa181	Flower	12	Infusion	1
<i>Calceolaria</i> sp.	Zapatilla	Scrophulariaceae	Bo.Sc241	Leaves	6	Infusion	1
<i>Calendula officinalis</i> L.	Caléndula	Asteraceae	Bo.As13	Flower	2	Ointment	8

Scientific name	Local Name	Family	Voucher number	Used part	Uses	Preparation	Number of reports
<i>Capsella bursa pastoris</i> L.	Bolsa bolsa	Brassicaceae	Bo.Br33	Leaves	1	Infusion	2
<i>Cestrum parqui</i> L'Her	Andrés huaylla	Solanaceae	Bo.So92	Leaves	4, 15	Infusion, ointment	1
<i>Cortaderia quila</i> Stapf	Sewenq´a	Poaceae	Bo.Po281	Leaves	14	Consumption	3
<i>Dodonea viscosa</i> Jacq.	Chak´atia	Sapindaceae	Bo.Sa231	Leaves	1, 15, 17	Infusion	1
<i>Ephedra americana</i> Humb. & Bonpl.	Sanu sanu	Ephedraceae	Bo.Ep201	Leaves	1	Infusion	2
<i>Equisetum arvense</i> L.	Cola de caballo	Equisetaceae	Bo.Eq211	Leaves	1, 14, 19	Cooking, infusion	4
<i>Erodium cicutarium</i> L'Hér.	Sulta	Geraniaceae	Bo.Ge41	Leaves, stalk	1, 3	Infusion	1
<i>Escallonia resinosa</i> Pers	Chachacoma	Escalloniaceae	Bo.Es151	Leaves	14	Infusion	1
<i>Eucalyptus</i> sp.	Eucalipto	Myrtaceae	Bo.My141	Leaves	15	Infusion	9
<i>Foeniculum vulgare</i> Mill.	Hinojo	Apiaceae	Bo.Ap163	Leaves	14	Infusion	6
<i>Hedeoma mandoniana</i> Wedd.	Pampa orégano	Lamiaceae	Bo.La85	Leaves	4	Infusion	3
<i>Hordeum vulgare</i> L.	Cebada	Poaceae	Bo.Po282	Seeds	1	Cooking	4
<i>Chenopodium ambrosioides</i> L.	Payqu	Chenopodiaceae	Bo.Ch41	Leaves	2, 3, 5	Infusion, poultice	8
<i>Lachemilla pinnata</i> (Ruiz & Pav) Rothm.	Sillu sillu	Rosaceae	Bo.Ro111	Leaves	3	Infusion	6
<i>Lampaya medicinalis</i> F. Phil.	Lampaya	Verbenaceae	Bo.Ve13	Leaves	1, 2	Infusion	3
<i>Lepidium bipinnatifidum</i> Desv.	Januk´ara	Brassicaceae	Bo.Br32	Leaves	4, 7	Infusion	3
<i>Lepidophyllum quadrangulare</i> Benth.	T´ola	Asteraceae	Bo.As14	Leaves	15	Ointment	5
<i>Lippia citriodora</i> Royle	Cedrón	Verbenaceae	Bo.Ve132	Leaves	4	Infusion	6
<i>Matricaria chamomilla</i> L.	Manzanilla	Asteraceae	Bo.As06	Leaves, flowers	4, 16	Infusion	13
<i>Melissa officinalis</i> L.	Toronjil	Lamiaceae	Bo.La87	Leaves	10, 18	Infusion	4
<i>Mentha piperita</i> L.	Hierba buena	Lamiaceae	Bo.La83	Leaves	4, 14	Infusion, external washing	11
<i>Nasturtium officinale</i> W.T. Aiton	Oqururu	Brassicaceae	Bo.Br43	Leaves	9, 3	Consumption	1
<i>Nicotiana glauca</i> Graham	K´aralawa	Solanaceae	Bo.So93	Leaves	4	Ointment	8

Scientific name	Local Name	Family	Voucher number	Used part	Uses	Preparation	Number of reports
<i>Opuntia sulphurea</i> G. Donex Loudon	Ayrampu	Cactaceae	Bo.Ca271	Fruit	3, 10, 13	Infusion	5
<i>Petroselinum hortense</i> Hoffm.	Perejil	Apiaceae	Bo.Ap161	Leaves	19	Ointment	5
<i>Piper angustifolium</i> Lam.	Matico	Piperaceae	Bo.Pi251	Leaves	14	Infusion, poultice	2
<i>Plantago hirtella</i> Kunth	Ch`uku ch`uku	Plantaginaceae	Bo.PI51	Leaves	1, 11, 12	Infusion, poultice	6
<i>Polylepis incana</i> Kunth	Keñua	Rosaceae	Bo.Ro112	Leaves	15	Infusion	3
<i>Psittacanthus cuneifolius</i> Blume	Jamillo	Loranthaceae	Bo.Lor171	Fruit	17	Poultice	1
<i>Rosmarinus officinalis</i> L.	Romero	Lamiaceae	Bo.La86	Leaves	14	Infusion, fume	6
<i>Rumex crispus</i> L.	Sarasara	Polygonaceae	Bo.Po51	Terminal bud	10	Poultice	1
<i>Ruta graveolens</i> L.	Ruda	Rutaceae	Bo.Ru121	Leaves	14	Infusion	3
<i>Salvia officinalis</i> L.	Salvía	Lamiaceae	Bo.La82	Leaves	2	Infusion, poultice	7
<i>Satureja ovata</i> R.Br.	Muña	Lamiaceae	Bo.La81	Leaves	6, 14	Infusion	4
<i>Sedum</i> sp. L.	Jinchu jinchu	Crasulaceae	Bo.Cr71	Leaves	13	Drops in the ear	1
<i>Senecio brasiliensis</i> Less.	Waych`a	Asteraceae	Bo.As09	Leaves	8	Infusion	1
<i>Schinus molle</i> L.	Molle	Anacardiaceae	Bo.An21	Leaves, fruit	2, 6	Poultice, ointment	3
<i>Solanum calygnaphalum</i> Ruiz & Pav	Ñuñumaya	Solanaceae	Bo.So91	Leaves	11	Ointment	1
<i>Spartium junceum</i> L.	Retama	Fabaceae	Bo.Fa151	Flower, leaves	10	Infusion, external washing	2
<i>Tagetes graveolens</i> L`Hér	Suyku	Asteraceae	Bo.As03	Leaves	4, 9	Infusion	2
<i>Tagetes pusilla</i> Kunth.	Pampa anís	Asteraceae	Bo.As12	Leaves	4	Infusion	5
<i>Taraxacum officinale</i> F.H. Wigg	Warakaya	Asteraceae	Bo.As04	Leaves	1, 5	Infusion	3
<i>Tropaeolum tuberosum</i> Ruiz & Pav.	Isaño	Tropaeolaceae	Bo.Tr291	Tuber	1	Cooking	2
<i>Verbena</i> sp.	Verbena	Verbenaceae	Bo.Ve131	Leaves, flower	4	Infusion	2
<i>Werneria poposa</i> Phil.	Pupusa	Asteraceae	Bo.As07	Leaves	10	Infusion, poultice	2
<i>Xanthium spinosum</i> L.	Ulu ulu	Asteraceae	Bo.As01	Leaves, branch	3	Infusion	1

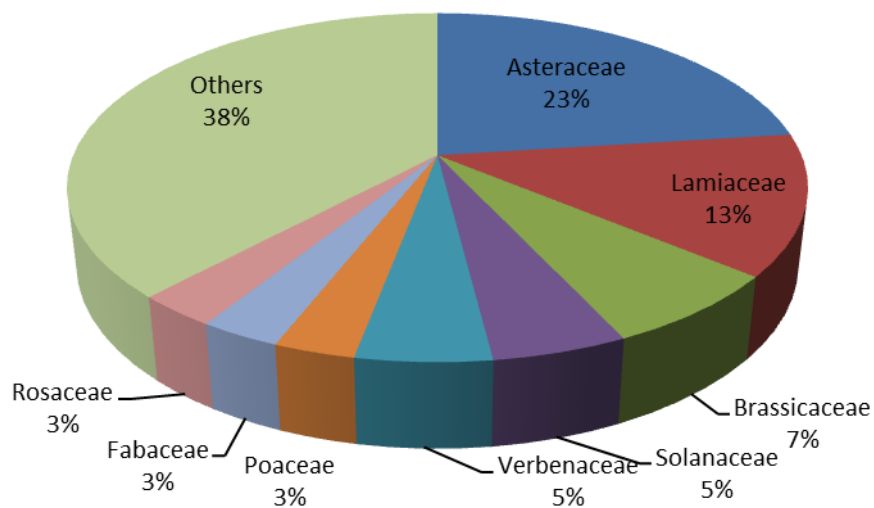
Footnote: Type of use: 1 - Problems of kidney , 2 - Rheumatism, 3 - Fever, 4 - Gastrointestinal disorders and diarrhoea, 5 -Hepatitis, 6 - Insecticide, disinfectant, antiseptic; 7 - Children impaired concentration (calming effect), 8 – Angina, 9 – Headache, 10 - Psychological problems, 11 - Problems of skin (ulcers, scars, burns, eczema, rashes), 12 - Problems with urinary tract, 13 – Inflammation, 14 – “Female troubles”, 15 – Problems with breathing system, 16 – Cold, 17 - Problems of bones, 18 - Heart problems, 19 - Problems with the liver.

DISCUSSION

The use of four most often mentioned medicinal plants in this study (more than 9 reports) can be supported by previous reports focused not only on traditional use of plants as natural remedies (Fernandez et al., 2003; Macía et al., 2005) but also by *in vitro* studies showing their biological activities. However these plants are not originated from this region. *M. chamomilla* is worldwide well-known medicinal plant very often called as the “star among medicinal species”. This plant is widely cultivated mostly in Europe, because it possesses variety of beneficial compounds in its essential oils. More than 120 chemical constituents have been identified in chamomile as secondary metabolites, including terpenoids, flavonoids and additional compounds with potential pharmacological activity. E.g. α -bisabolol, chamazulene and umbelliferone showed antimicrobial activity against broad spectrum of pathogenic microorganisms (Singh et al., 2011). *M.*

piperita is traditionally used in treatment of various disorders such diarrhea, flatuance, rheumatism, dizziness, bronchitis and cough (Juárez-Vázquez et al., 2013). Its essential oil has been reported for its analgesic activity which is in accordance with the use of this plant against various types of pains (headache or tooth pains). In mouthwashes, it is utilized for oral hygiene, possibly due to its antimicrobial activities (Taher, 2011). Due to these beneficial properties the peppermint products of *M. piperita* are often taken after a meal for its ability to reduce indigestion and colonic spasms (Spirling & Daniels, 2001). The leaves of *Eucalyptus* species are used by many indigenous communities to heal wounds and infections due to its huge antimicrobial effect against many human pathogenic fungi, viruses and bacteria (Ashour & Hossam, 2008). Recently, a variety of *Eucalyptus* species have shown potential cytotoxic properties in addition to antimicrobial activities (Bardaweel et al., 2014).

Figure 2
Most dominant plant families of medicinal plants used in Qampaya, Potosí Department, Bolivia



On the other hand, respondents also mentioned many times plants which are native in this area. The most often used indigenous medicinal plant in this study was *Chenopodium ambrosioides* (8

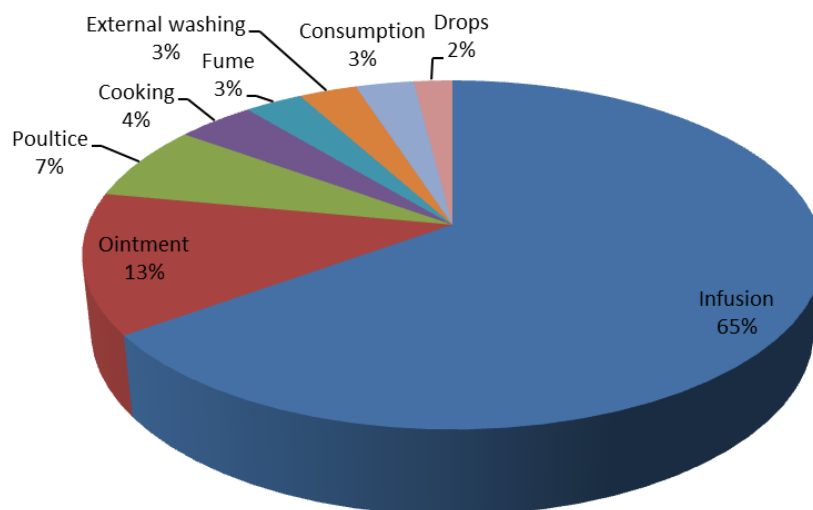
reports). This plant is traditionally used in South American countries against many diseases such as microbial and viral infections (including oral and skin diseases), gastrointestinal disorders, and respiratory

ailments (Vieira *et al.*, 2014; Bieski *et al.*, 2015) and its health beneficial activities were also described by many experiments *in vitro* (Calado *et al.*, 2015; Degenhardt *et al.*, 2016). Moreover this plant is traditionally used also as repellent and its anti-insect activity has been proven (Pandey *et al.*, 2014). Another often reported South American medicinal plant was *Nicotiana glauca*, used against gastrointestinal disorders and diarrhea. This plant was many times described by ethnobotanist for its medicinal purposes (Moerman, 1998). On the other side, *N. glauca* contains in all plant parts harmful substances (e.g. nicotine related pyridine alkaloid called anabasin), which have been reported to cause serious and often fatal intoxication in human (Ntelios

et al., 2013). In this study we showed, that three quarters of respondents are used to use medicinal plants as a prevention or for the treatment of different diseases which is in correspondence with WHO (2003) reported that traditional, complementary and alternative medicines are in developing countries more practices than modern medical systems. We also found that 25

of interviewed which did not use any medicinal plant are young people, that is in correspondence with study of Silva *et al.* (2011) who proofed that number of plants mentioned by each respondent is related with age and it is possible to say that the greater the age, the greater the number of plants known.

Figure 3
Types of application of medicinal plants used in Qampaya, Potosí Department, Bolivia



The biological or therapeutic activity of medicinal plant is closely related to the plant chemicals. Each compound (or group of compounds) preferred effective method of extraction which facilitates getting the chemicals out of the plant and transfer into the herbal remedy that is being prepared. For example, some active plant chemicals are not soluble in water, therefore just preparing of hot tea, or even boiling the herb in hot water won't extract these chemicals into the resulting water extract or tea remedy. These same chemicals may however be more soluble in alcohol which is why some plants should be prepared as a tincture or alcohol extract (Aibinu & Adelowotan, 2008).

CONCLUSION

In conclusion we can say that the practice of traditional medicine in the indigenous Qampaya District people is still common. Communities use for thousands years natural resources as medicinal remedies and mostly they utilize medicinal plants. The knowledge of using traditional remedies is carried out from generation to generation however young people are nowadays not so familiar with the healing properties of medicinal plants as a result of the lack of interest about the traditions. The study of people's indigenous knowledge of medicinal plants can contribute information about the use by local people and also can explain the people-plant relationships. Moreover, information about medicinal

plants is important source for pharmaceutical industry focused on the development of new drugs.

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