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Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquirá, Boyacá, Colombia

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Abstract

Background: Medicinal plant species contribute significantly to folk medicine in Colombia. However, few local studies have investigated whether species used are introduced or native and whether there is a difference in importance of native and introduced medicinal plant species. The aim of the present study was to describe the use of medicinal plants within two municipalities, Campo Hermoso and Zetaquirá, both in the department of Boyacá, Colombia and to assess the importance of native and introduced plants to healers, amateur healers and local people. As local healers including amateur healers have no history of introduced species our working hypotheses (H_{1-2}) were that H_1 : native and introduced medicinal plant species are of equal importance and H_2 : healers and amateur healers do not differentiate in their preferences between native and introduced medicinal plant species.

Methods: Ten villages were included in the study. A combination of quantitative and qualitative methods was used including questionnaires, semi-structured interviews, in-depth interviews, and open talks. Voucher specimens were collected in home gardens and during field walks. For data analysis, we calculated use value indices and Jaccard index and tested for the above hypothesis using Spearman rank-correlation coefficients and Wilcoxon-Mann-Whitney tests.

Results: Eighty medicinal plant species were described by locals as the most frequently used. Of these, 78 species were taxonomically identified, distributed within 41 families and 74 genera, which included 35 native species and 43 introduced. The highest valued families were: Asteraceae, Lamiaceae, Apiaceae, Rutaceae and Verbenaceae. The species ranked highest according to their Use Values, in both municipalities, were *Mentha suaveolens* Ehrh., *Ambrosia cumanensis* Kunth, and *Verbena littoralis* Kunth. Introduced species were more important than native ones in Zetaquirá, while there was no difference in importance in Campo Hermoso. While healers relied most on the uses of native species, amateur healers were inclined to rely on introduced species. Medicinal plant administration in both municipalities follow the usual pattern: Leaves are used most commonly prepared by decoction or infusion and administered orally.

Conclusions: The high proportion of introduced plant species used in the local traditional medicines is similar to the results of a number of other ethnobotanical studies and emphasise the need for efforts to record and maintain traditional knowledge on native species.

Keywords: Acculturation, Ethnobotany, Trained healers, Amateur healers, Introduced medicinal plants, Traditional knowledge

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Background

Medicinal plant species constitute important alternatives to conventional medicine in a large number of developing countries, especially within poor communities that inhabit rural areas and lack access to health services [1,2]. A number of native medicinal plants of both the palaeotropics and neotropics have traditionally had a high value for indigenous communities, not only because of their healing properties, but also due to other uses [3]. An example of such multi-use plants is the neotropical species *Crescentia cujete* L., a source of both timber and traditional medicine. Recently, this species has reached the United States and European pharmaceutical markets demonstrating that traditional medicinal plants used by indigenous communities may be of high economic value [3].

However, knowledge, cultivation and maintenance of these native species within rural communities is decreasing, due to modernization processes, such as acculturation [1-3]. In addition, a tendency to consider all plant resources as native by local people has been directly or indirectly documented in several studies [4-6]; in other words, numerous introduced plant species with healing properties have become popularly considered as 'native'. Consequently, a number of native medicinal plant species have been replaced by introduced species. Thus, they use the terms 'native' and 'introduced' indiscriminately so that many introduced species with healing properties have become popularly known as native. For these reasons, the uses of a number of native species have been replaced by introduced species, incorrectly perceived as native.

When faced with the rapid decline in traditional knowledge it is relevant to identify medicinal species and to record their uses within local communities. This is especially important in regions that currently are affected by land-use change and modernisation. Documentation and awareness of ethnobotanical knowledge within these regions may facilitate the maintenance of medicinal plant resources and uses.

Furthermore, ethnobotanical studies may support implementation of strategies that integrate native medicinal plant uses with sustainable management of natural resources. The municipalities of Campo Hermoso and Zetaquirá in the department of Boyacá, Colombia, are examples where conversion of forest areas into agriculture land and reforestation with exotic species have destroyed large areas of natural forest including high plateau, upland, and montane forest. Furthermore, many multiple-use plants have been overexploited [7,8]. This situation has caused loss of a number of native species (pers. comm. local key informants 2009). Studies on medicinal plant use have been conducted in different localities within Boyacá [9,10], but none in the regions of

Campo Hermoso and Zetaquirá. Therefore, the present study was carried out within these municipalities. The aims of this study were to identify the medicinal plant species, to determine their origin (native or introduced to Colombia), to record their medicinal uses (targeted illnesses, ways of administration), and based on personal observations and inspired by previous studies [4-6] to assess the value of native and introduced plant species to members of local communities. The latter objective was evaluated by the null hypotheses ($H_{1,2}$) H_1 : native and introduced medicinal plant species are of equal importance and H_2 : healers and amateur healers do not differentiate in their preferences between native and introduced medicinal plant species.

Methods

Study areas

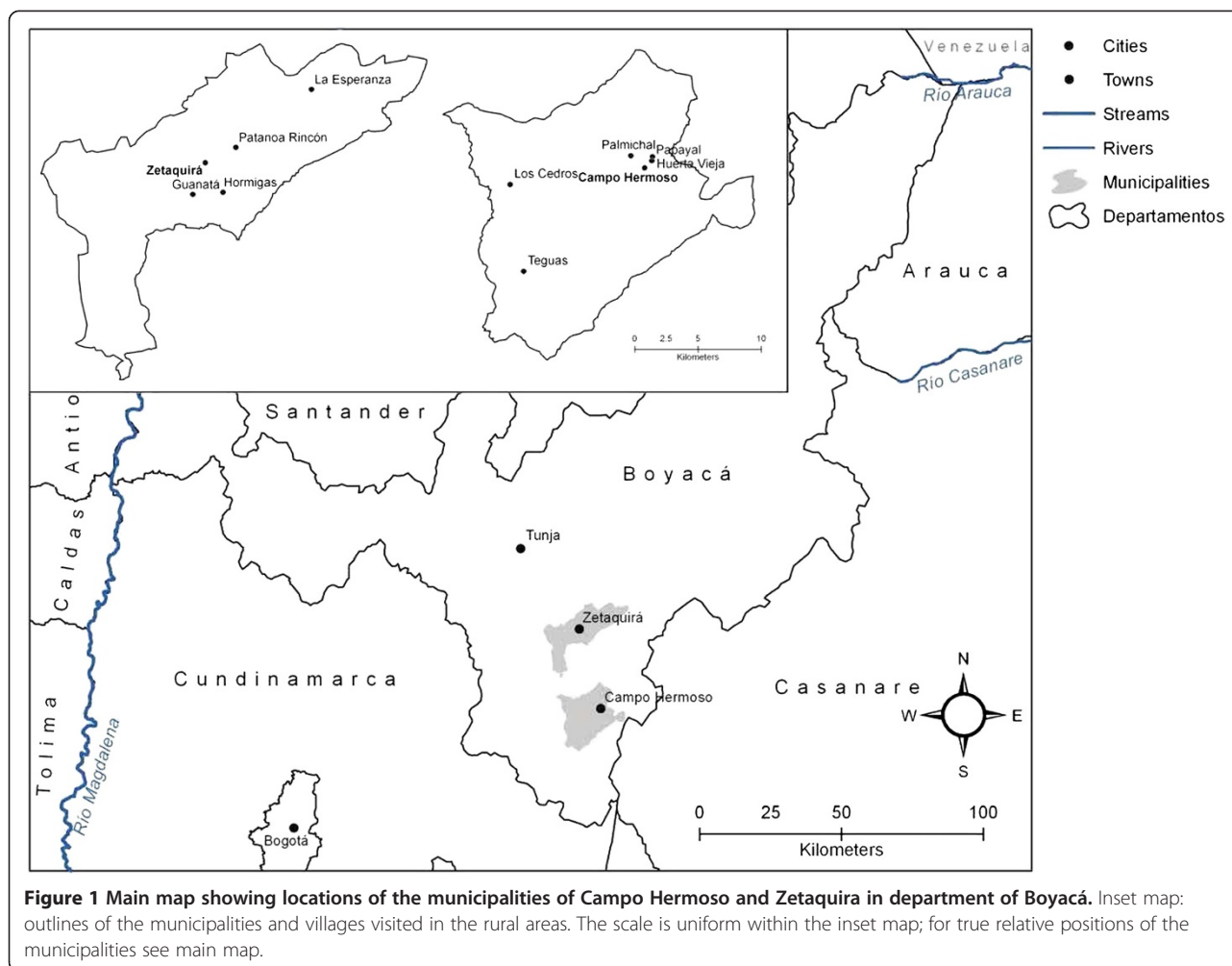
The study took place in the municipalities of Campo Hermoso and Zetaquirá in department of Boyacá, Colombia (Figure 1). The municipalities are located on the Eastern slope of the Cordillera Oriental (Eastern Andean range) and their terrain comprises rugged areas with peaks, steep canyons, and valleys. Both study areas belong to the humid subtropical zone [7,8]. The altitude range from 500–2500 m a.s.l. in Campo Hermoso and 1875–3600 m a.s.l. in Zetaquirá. Temperatures range between 12–35°C.

Climatic differences and mountainous topography lead to a diversity of natural vegetation, livestock pastures, and crops within the study areas [7,8]. Campo Hermoso is located at 132 km from Tunja the capital of the department and 143 km from Bogotá. Zetaquirá is located at 69 km away from Tunja, and at 126 km away from Bogotá.

The economy of the municipalities is based on cattle ranching and agriculture; the latter often by smallholders practicing subsistence economy. The main products in Zetaquirá are coffee, beans, sugarcane, maize, plantain, manioc and 'arracacha' (*Arracacia xanthorrhiza* Bancr.) [11]. The coffee production is located near the villages at intermediate altitudes. Until 2008, coffee was a main crop in Zetaquirá. However, climate change has decreased feasibility of coffee production in recent years (pers. comm.: Domingo Mendoza, responsible of the Federación Nacional de Cafeteros de Colombia, office in Zetaquirá). Campo Hermoso is basically a cattle ranching region with large areas of pastures [7]. Besides, maize, beans, manioc and vegetables and, at smaller scale, sugarcane is cultivated for subsistence. There are no conspicuous economic differences between the two municipalities [7,8].

Data collection and free, prior informed consent (FPIC)

The field work was conducted from October 2008 to January 2009. Data collection included a combination of



quantitative and qualitative methods in order to allow for triangulating and cross-checking [12]. Applied and complementary ethnobotanical methods [13] were used to acquire information on how local people related to the medicinal plant resources in the two municipalities. The project was presented to the local authorities and to the communities during initial meetings. Objectives and methods were approved in both municipalities.

Selection of villages and identification of informants

Within each municipality representative villages were visited. Ten villages were chosen according to distance to the main urban centre, the presence of a representative flora, and residential areas of the healers and herbalists, who were purposefully included in the sampling. In Zetaquirá the villages studied were: La Esperanza, Guanata, Centro Rural and Hormigas; and in Campo Hermoso: Papayal, Huerta Vieja, Palmichal, Los Cedros, Macanalito and Teguás.

Participation of local people was essential to several stages of the research process [12]. Thus, key informants

in the municipalities were contacted in the first stage. Their collaboration was crucial for selecting and planning the visits to the villages.

Each municipality was visited three times during the study in order to establish and maintain communication with the local informants, to identify additional informants, and later to apply quantitative and qualitative tools. The informants from the villages were selected using stratified random sampling. Interviewees in the study all belonged to farmers' communities.

Application of questionnaires, in-depth interviews and semi-structured interviews

Questionnaires were designed to collect information on the main local medicinal plant uses. The questions were answered by a selected group ($n=9$) of old women in Patanoa Rincon in Zetaquirá. Interviews were structured in two groups: in depth interviews and semi-structured interviews, which were done with individual informants in order to maintain data independence [13]. In depth interviews were answered by healers^a and amateur

healers^b. In-depth interviews were carried out in order to collect information on their knowledge on plant use and their services offered to locals. Semi-structured interviews addressed farmers (n = 41). Their distribution across age and sex is shown in Table 1. Semi-structured interviews helped to collect data on traditional plant knowledge and use. For all interviews, vouchers of local medicinal plant species was used as a stimulus for interviewees to elaborate on known and used plants [14].

Homegardens, gardens and solares^c were visited during the interviews. Plant specimens were collected together with the informants when obtainable. From the list of mentioned plants, those that were not cultivated at home were grouped in a separate list.

Disease was defined by interviewees as a period of disequilibrium in the body due to deterioration of organs and functions. Disequilibrium could also be caused by bacteria and viral infection. The diseases described during the study were grouped into categories as it is shown in Table 2.

Field walks

A field walk with key informants was conducted in each municipality in order to identify environmental characteristics of medicinal plant species. The field walk in Campo Hermoso took place along a 5 km transect. In Zetaquirá, it was conducted along a 4.5 km transect. Both transects traversed hills and sloping terrain, agricultural lands, and pastures for cattle ranching with some spots of secondary forests.

Systematics of plant species

Taxonomic identification was mainly conducted by experts at the Colombian National Herbarium (COL) and at the herbarium of Universidad Tecnológica de Tunja and, the Colombian Amazonian Herbarium (COAH) [15]. Collected specimens were deposited at COL, at the non-profit organization Alexander von Humboldt Biological Resources Research Institute Villa de Leyva branch, Colombia (FMB), and at the Herbarium, Botany Group, Department of Plant and Environmental Sciences, Faculty of Science, University of Copenhagen (CP), for future references. Additionally, specimens were

deposited with the local authorities of each municipality, for reference and further studies at the local level.

Data analysis

Different measures of knowledge described by interviewees can be seen in ethnobotanical research. Therefore, it was decided to carefully evaluate the measure of knowledge to be used in the data analysis of the present study.

Table 2 Categories of diseases with the respective descriptions recorded in the municipalities of Zetaquirá and Campo Hermoso

Category	Diseases
Digestive system	Inflamations of intestine, intestinal obstipation, intestinal obstipation in newborns, diarrhoea, apendicitis, stomach aches, enhance stomach function, gastritis, stomach ulcer, against stomach acids, liver cleanser, hepatitis, against bad breath, againsts umbilical, hernia, diabetes, high bilirubin in new born, tooth pain, mouth driedness, sensitive gums
Bacterial, parasitic and mycotic infections	Inflamations and skin infections, erisipela, againsts acne and feet's fungus, against warts, infections in throat, gripe, intestinal parasites, eye inflamations and infections, eye dust, mouth infections, againsts hair lice, typhus, denge
Musculoskeletal system	Rheumatism, colds and spasms in muscles and tendons, fractures in bones, back pain
Nervous system	Memory loss, nervous system tonics, nervous tension, children with problems to fall asleep, tiredness and weakness, body dryness
Immune system	Fevers, yellow fever
Integumentary system	External and internal inflamations, allergies, infected wounds, excema, spots, rashes in adults, diaper rash
Reproductive system	Prostata complaints, weak uterus, cramps in uterus and menstrual pains, uterus cleanser, menstrual disorders, healing of uterus after giving birth, to prevent extra bleeding during child delivery, to enhance lactation
Circulatory system	Cardiac problems as hypertrophy, hipertension complaints, blood cleanser and tonic, antihemorrhagic, to stop nose bleeding in children
Respiratory system	Sinusitis, to enhance lungs function, asthma, coughs
Urinary system	Children bladder complaints, kidney and bladder complaints in adults
Cancer	Stomach cancer, skin cancer, cancer in general
Accidents	Ofidic accidents
Specific conditions	Headaches, general indisposition, againsts flies, to lose weight, hidropisy, againsts hair loss, hair treatments
Other	Food, condiment herb

Table 1 Distribution of informants who answered semi-structured interviews in the municipalities of Campo Hermoso and Zetaquirá, including totals, percentage of interviewees native to the municipality, and age classes

Municipality	Total	% native	Age class		
			20 to 40	41 to 60	>60
Campo Hermoso	16	81	1	7	8
Zetaquirá	25	80	6	11	8

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics

Species, family, voucher ID, and vernacular names	Life form, Habitat/ place of collection	Status, place of Origin	Index Use Values (estim./ actual)		Part Used	Use	Preparation, mode of administration
			Zeta- quira	Campo Herm.			
<i>Justicia filibracteolata</i> Lindau Acanthaceae ALCG 62 Chuchuhuaza	shrub cultivated in homegarden	native Colombian Andes ³	0.48/ 0.04	0.06/ 0.00	bark and leaves (B)	rheumatism (B)	concoction with <i>Allium sativum</i> and <i>Aristolochia ringens</i> in extract in alcohol/ oral -U1- (Z), concoction with <i>Cannabis sativa</i> in extract in alcohol -U2-/ oral (B), decoction/ oral (C)
<i>Trichanthera gigantea</i> (Bonpl.) Nees (s) Acanthaceae ALCG 125 Cafetero, Quiebrabarrigo	small tree wild in edge of route	native to Northern South America ⁸	0.32/ 0.20	0.19/ 0.00	leaves and stems (B)	inflammations and skin infections (B) fevers (Z) to lose weight (Z)	decoction/ topical-baths (B) decoction/ topical-baths (Z); fresh extract by maceration/ oral (Z) infusion/ oral (Z)
<i>Sambucus nigra</i> L.* ° Adoxaceae-Caprifoliaceae ++ ALCG 68 Sauco Elder or Elderberry	tree cultivated in solar	introduced Europe-West Siberia-North Africa ⁵	0.72/ 0.24	0.56/ 0.25	leaves and flowers (B)* ² flowers (B) ^o 2 leaves and branches (B) flowers and shoots (Z) leaves and branches (B)	gripe (B) eye inflammations and infections (B) fevers (B) tiredness and weakness (Z) respiratory complaints (B) respiratory complaints (Z) headache (Z) against hair lice (C)	concoction with <i>Citrus limon</i> juice in decoction/ oral (B) extract in decoction or distillation (in a glass bottle)/ topical- eye baths (B) decoction/ topical in baths (B) decoction/ topical, baths (Z) decoction/ oral (B) concoction with milk in decoction/ oral (Z) decoction/ oral (B) decoction/ oral (Z) fresh extract from maceration/ topical on the head before the sunrise starts (Z) fresh extract from maceration/ topical for washing the hair (C)
<i>Furcraea macrophylla</i> Baker, Hook (e-CH) Agavaceae Fique,cabuya Fique	succulent rosette forming tall herb cultivated in a farmland	native Boyaca-Colombia ⁷	0.00/ 0.00	0.25/ 0.13	root (C) leaves (C)	rheumatism (C) muscles and tendons complaints (C) Hidropisy (C)	decoction/ oral (C) use of fibres of leaves to tie them on the affected part/ topical (C) decoction of a piece of leaf/ oral (C)
<i>Chenopodium ambrosioides</i> L. (s) Amaranthaceae ALCG 80 Paico Epazote Wormseed	herb ascendent cultivated in small garden	native Central Andean range and south of western range in Colombia ⁷	0.40/ 0.12	0.44/ 0.38	leaves (B) leaves and stems (B)	stomach complaints (B) intestinal parasites (B)	infusion or decoction/ oral (B) fresh extract by maceration in water/ oral (B)
<i>Althernanthera lanceolata</i> (Benth.) Schinz Amaranthaceae ALCG 113 Planta del cáncer or Sanguinaria	herb cultivated in small garden	introduced American tropics and subtropics, Asia, Africa and Australia ¹²	0.16/ 0.16	0.48/ 0.25	leaves and branches (B) leaves (C) leaves (Z)	healing of wounds (B) skin cancer (C) stomach ulcer (C) cancer in general (C) cancer in general (Z) fevers (Z)	decoction/ oral and decoction/ topical-baths (B) decoction/ topical baths (C) decoction in milk/ oral (C) decoction / oral (C) fresh extract by maceration in water/ oral (Z)
<i>Eryngium foetidum</i> L.*	herb cultivated in homegarden	native South Mexico to Bolivia Colombian	0.00/ 0.00	0.06/ 0.06	root (C)	hepatitis (C) condiment herb (C)	decoction/ oral (C) combination with food/ oral (C)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

Apiaceae		Andeans and Orinoquia ⁵			leaves (C)*2		
ALCG 167							
Cilantrón,cilantro cimarrón							
Mexican coriander, shadow beni							
<i>Apium graveolens</i> L. *	herb cultivated in homegarden	introduced Europe and West Asia ¹³ , Europe ⁵	0.20/0.24	0.25/0.19	leaves and stems (B)*2	intestinal obstipation (B)	decoction/oral(B)
Apiaceae							infusion/oral(B)
Apio						stomach ache (B)	combination with food/oral(B)
Celery,celeriac						condiment herb (B)	infusion/oral(B)
						relaxant (B)	decoction/oral(Z)
						to regulate menstruation (Z)	
<i>Foeniculum vulgare</i> Mill.* °	herb cultivated in homegarden	introduced Mediterranean Europe ⁵	0.16/0.16	0.06/0.06	leaves and stems (B)	to enhance lactation (B)	decoction in milk or "aguadepanela"-U3-/oral (B)
Apiaceae							
ALCG 89						condiment herb (B)	combination with food/ oral (B)
Hinojo							
Fennel, Bronze Fennel, Sweet cumin ¹²							
<i>Petroselinum crispum</i> (Mill.) Nyman ex A.W. Hill*	herb cultivated in homegarden	introduced Eastern Mediterranean Western Asia Mediterranean Europe ⁸	0.44/0.36	0.50/0.25	leaves (B)*2	cardiovascular complaints as high blood pressure (B)	infusion/ oral (B)
Apiaceae							to chew leaves/ oral (B)
ALCG 87							combined with food/ oral (B)
Perejil						enhance stomach function (B)	infusion/ oral (C)
Parsley							infusion/ oral (Z)
						againts bad breath (B)	
						condiment herb (B)	
						kidney complaints (C)	
						intestinal pain (C)	
						againts menstrual pain (Z)	
<i>Catharanthus roseus</i> (L.) G. Don.	short lived herb cultivated in pod	introduced Madagaskar ⁸	0.00/0.00	0.06/0.06	flowers (C)	againts eye infections and irritations (C)	infusion/ topical-baths (C)
Apocynaceae							
ALCG 158							
Vicaria							
Madagascar periwinkle							

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Philodendron</i> sp.	sufrutex wild in edges of secondary forest	unknown Africa and Asia and America around the equador ⁷	0.04/0.04	0.00/0.00	leaves and stem (Z)	skin infections and inflamations (Z)	fresh extract by maceration/ topical-rub part affected
Araceae							
ALCG 103							
Hidra or Yedra							
<i>Colocasia esculenta</i> (L.) Schott	herb cultivated in homegarden	introduced South East Asia, Australia ^{8,13}	0.20/0.16	0.31/0.25	tuberous root (B)	gastritis (B)	concoction of blended root with milk/ oral (B)
Araceae						stomach ulcer (B)	
ALCG 106						food (B)	carbohydrate source food/ oral (B)
Malanga							
Taro							
<i>Aristolochia ringens</i> Vahl.	Twiner/climber Wild in river bank	introduced native to Brazil ¹⁵	0.64/0.04	0.75/0.00	leaves and stems (B)	rheumatism (B)	concoction with Cannabis sativa, Erythroxylum coca and Justicia filibracteolata in extract in alcohol/ topical and oral (B), maceration in extract in alcohol/ topical and oral (Z)-U2- maceration/ topical in emplast (B)
Aristolochiaceae						ofidic accidents (B)	
ALCG 78							
Bejuco de Guaco							
Gaping Dutchman`s Pipe							
<i>Aloe vera</i> (L.) Burman f. * °	Short stem-med succulent plant cultivated in pods	introduced arabic peninsula ⁸	0.64/0.60	0.63/0.63	gel from leaves (B) * 2 ° 2	asthma (B)	fresh gel is blended single or in concoction with egg or with honey and juice of Citrus limon/ oral (B)
Asphodelaceae						caugh (B)	
Zábila						fever (B)	
						headache (B)	fresh gel/ topical-emplast over head-front (Z)
						healing wounds and	fresh gel/ topical-emplast over head-front (B)
						skin spots (B)	fresh gel/ topical-emplast over head-front (Z)
Aloe						external inflamations (B)	
						hair treatment (B)	massaging (B)
						stomach cancer (Z)	fresh gel in concoction with honey/ oral (Z)
<i>Bidens pilosa</i> L. *	herb wild in pastures with bushes composition	native\ From the centrum to the south of the Andeans of Colombia ³	0.00/0.04	0.00/0.00	leaves (Z)*2	skin infections (Z) rashes (Z)	maceration/ topical-emplast (Z)
Asteraceae							decoction/ topical-baths (Z)
ALCG 144							
Chipaca							
Spanish needle,black jack							
<i>Onoseris onoseroides</i> (Kunth) Robins	tall herb wild in slope hills and between bushes on open pastures	introduced Central America and naturalized in Colombia ³	0.00/0.00	0.13/0.00	leaves (B)	against bleedings (C)	fresh leaves directly on the wound/ topical (C)
Asteraceae						against uterus complaints (C)	infusion/ oral (C)
ALCG 139							
Santa María						pains in muscles (Z)	maceration/ topical-emplast (Z)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Conyza filaginoides</i> (DC.) Hieron Asteraceae ALCG 110 Venadillo	herb spontaneous in solar with some cultivated trees	native Central Colombian Andean ³	0.04/ 0.00	0.00/ 0.00	leaves and stems (Z)	skin infections and rash (Z)	fresh extract by maceration/ topical-massage (Z)
<i>Pyrethrum parthenium</i> (L.) Sw. * o	herb cultivated in small garden	introduced Eurasian, meridional-boreal ³	0.36/ 0.28	0.00/ 0.00	leaves 2*2 and stems (Z)*2	intestinal complaints (Z) relaxant (Z)	infusion/ oral (Z) fresh maceration/ emplast (Z)
Asteraceae ALCG 75 Manzanilla Feverfew Wild chamomille					flowers (Z)	uterus cramps (Z)	
<i>Galinsoga parviflora</i> Cav. Asteraceae ALCG 90 Guacas	herb cultivated in homegarden	native Colombia, South America ^{3,8}	0.08/ 0.04	0.19/ 0.06	leaves (B) leaves and stems (C)	against excess of stomach acids (B) condiment herb (B) against white plaques in mouth (C) intestinal parasites (C)	decoction/ oral (B) decoction/ oral (B) fresh extract by maceration in water/ oral (C)
<i>Matricaria chamomilla</i> L. * o	herb cultivated in homegarden	introduced Iran and Europe ^{3,8,17}	0.32/ 0.32	0.38/ 0.38	leaves and flowers (B)	stomach complaints (B) relaxant (B) rheumatism (Z)	decoction or infusion (B) infusion/ oral (B) fresh extract by maceration/ topical-massage (Z)
Asteraceae ALCG 96 Manzanilla dulce Roman chamomile, German chamomile					leaves, stems and flowers (B)	colds, spasms and cramps in muscles (C)	decoction/ oral and fresh extract by maceration/ topical-massage (C)
<i>Taraxacum officinale</i> F.H. Wigg. * o	herb spontaneous in a farm with a large patch of secondary forest	introduced Europe ³	0.16/ 0.12	0.25/ 0.06	leaves (B) * 2	cardiovascular complaints (B)	infusion/ oral (B)
Asteraceae ALCG 104 Diente de león Dandelion						kidney complaints (C) enhance lungs function (Z) rheumatism (Z) liver cleanse (Z)	infusion/ oral (C) infusion/ oral (Z) decoction/ oral (Z) maceration/ topical-emplast (Z)
<i>Artemisia absinthium</i> L. * (e-CH)	herb cultivated in homegarden	introduced Europe ³ and West Asia	0.32/ 0.16	0.19/ 0.13	leaves (B) leaves (Z)	stomach ache (B) liver cleanser (C)	infusion/ oral (B) infusion/ oral (C)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

Asteraceae						to prevent extra blood flow during child delivery (Z)	infusion/ oral (Z)
Ajenjo					leaves and stems (Z)		infusion/ oral (Z)
Absinthe wormwood, grand wormwood						against inflammations and infections (Z)	decoction/ topical-baths (Z)
<i>Calendula officinalis</i> L. * °	short-lived plant cultivated in pod	introduced South and East Europe ³	0.60/0.24	0.31/0.19	flowers (B)	external-internal inflammations (B)	Decoction / topical, baths (B)
Asteraceae					*2 ° 2	gastritis (C)	decoction / oral (B)
ALCG 57					leaves and flowers (C)	skin infections (Z)	infusion of leaves and flowers in concoction with drops of Crotons' sage/ oral (C)
Caléndula							
Pot Marigold, Scotch Marigold					leaves and stems (Z)	menstrual cramps (Z)	maceration of leaves/ topical (Z) decoction/ topical,baths (Z)
<i>Ambrosia cumanensis</i> Kunth	herb cultivated in homegarden	native Colombian Andeans ³	0.88/0.40	1.12/0.81	leaves and stems (B)	gripe (B)	infusion/ oral (B)
Asteraceae						rheumatism (B)	fresh plant in maceration / topical in cataplasm (B)
ALCG 63					branches (Z)	children bladder complaints (B)	
Altamisa							concoction with <i>Mentha suaveolens</i> and <i>Ruta graveolens</i> in infusion/ oral (Z)
Western Ragweed or Perennial Ragweed						menstrual cramps (Z) colds and spasms in muscles (C) stomach ache (C) intestinal complaints (C) against flies (Z)	fresh extract by maceration/ topical to rub body (C) decoction/ oral (C)
<i>Anredera cordifolia</i> Tenore	Vine wild in edges of secondary forest with enough shadow and moisture	native South America (Colombia, Ecuad, Argentina, Paraguay, Uruguay, Bolivia, Brasil, Salvador) ¹³	0.24/0.16	0.12/0.13	leaves and stems (B)	fevers (B) respiratory complaints (C)	decoction or infusion/ oral (B) fresh extract by maceration in water/ topical-baths (Z)
Basellaceae							
ALCG 109						skin infections (Z)	decoction/ oral (C)
Rubacá						muscles and tendons inflammations, edemas (Z)	fresh extract by maceration/ topical-emplast or massage (Z)
<i>Crescentia cujete</i> L. ³ ; *	tree cultivated in homegarden	native North Central America, Mexico and Belice, Colombian Andes, Amazons and Caribbean ³	0.00/0.00	0.06/0.06	young fruit (C)*2	caugh (C) asthma (C)	fresh extract or juice/ oral (C)
Bignoniaceae							
Totumo							
Calabash tree							
<i>Jacaranda cf. copaia</i> (Aubl.) D. Don	tree cultivated in solar	native Colombian Andeans and Orinoquia ³	0.20/0.12	0.94/0.69	bark (B)	Intestinal complaints (B)	decoction/ oral (B)
Bignoniaceae					leaves (Z)		infusion/ oral (Z)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

					leaves (C)	Kidney complaints (Z)	infusion/ oral (C)
ALCG 69					branches (C)	rheumatism (C)	concoction with fresh maceration-Eucalyptus globulus and Allium sativum in extract in alcohol ^{U2} / oral topical (C)
Gualanday						gripe (C)	
						fevers (C)	
						denge (C)	decoction/ oral (C)
						skin infections (C)	see concoction with Urtica dioica and Rosmarinus officinalis (C)
						circulatory complaints (C)	
						mouth dryness (C)	
<i>Symphytum officinale</i> L.	herb cultivated in garden	introduced Europe, West Asia ⁹	0.12/ 0.12	0.06/ 0.13	leaves (B)	rheumatism (C)	infusion/ oral (C)
Boraginaceae						headache (C)	concoction with Rosmarinus officinalis in decoction/ oral (Z)
ALCG 173						prostate complaints (Z)	
Comfrey							
Quaker Comfrey, boneset							
<i>Cannabis sativa</i> L.	herb cultivated	introduced North West of Himalayan mountains, Asia ⁷	0.12/ 0.00	0.19/ 0.06	leaves (B)	rheumatism (B)	concoction with Justicia filibracteolata in extract in alcohol ^{U2} / oral (B),
Cannabaceae							
ALCG 172							concoction with Aristolochia ringens, Erythroxylum coca and Justicia filibracteolata in extract in alcohol/ topical and oral (B)
Marihuana							maceration in extract in alcohol/ topical and oral (Z) ^{U2}
Marijuana,Hemp,Cannabis							fresh fruit juice/ topical directly on skin (C)
<i>Clusia aff. ellipticifolia</i> Cuatr.	small tree cultivated in an edge of pastures plot	native Colombian Andes and Amazons ⁵	0.08/ 0.00	0.13/ 0.00	fruits (C)	against warts (C)	
Clusiaceae or Guttiferae					leaves (Z)	back pain (Z)	heated leaves/ topical directly on the back (Z)
ALCG 122							
Gaque							
<i>Tradescantia zebrina</i> Heynh.	herb cultivated in small garden	introduced Neotropical Guatemala and Mexico ¹³ probably Panama ⁸	0.04/ 0.08	0.00/ 0.00	leaves and flowers (Z)	diabetes (Z)	decoction/ oral (Z)
Commelinaceae						rheumatism (Z)	maceration/ topical-emplast (Z)
ALCG 115							
Suelda con suelda roja or cinta							
Wandering jew							

Table 4 List of medicinal plant species reported in Zetaquirá and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Callisia monandra</i> (Sw.) Schult. & Schult f.	herb wild in edge of secondary forest with enough shadow and moisture	native to Caribbean territories ²⁰ including Colombia	0.12/0.00	0.19/0.13	leaves and stems (B)	fracture bones (B) rheumatism (Z)	maceration/ topical-emplast (B) maceration/ topical-emplast (Z) decoction/ topical-baths (Z)
Commelinaceae ALCG 118							
Suelda con suelda blanca Cojite morado							
<i>Sechium edule</i> (Jacq.) Sw.	climbing vine plant cultivated in homegarden	introduced Central America and Mexico ⁸	0.08/0.08	0.06/0.00	fruit (B)	hipertension complaints (B)	decoction/ oral (B)
Cucurbitaceae ALCG 151							
Guatilla Alligator pear,pear squash							
<i>Cupressus lusitanica</i> Mill.	tree cultivated in small garden	introduced Europe ⁷ naturalized in Mexico ²⁴	0.28/0.04	0.13/0.00	branches (B)	rheumatism (B) caughs and asthma (B) against bladder complaints in children (C)	decoction/ topical-baths (B) concoction with <i>Eucalyptus globulus</i> and <i>Solanum nigrum</i> in concentrated extract by decoction/ oral (B)
Cupressaceae ALCG 129							
Pino ciprés Mexican cypress,Cedar of Goa						tiredness and weakness (Z) kidney complaints (Z)	maceration/ topical-emplast (C) concoction with <i>Eucalyptus globulus</i> in decoction/ topical-baths (Z) decoction/ oral (Z)
<i>Equisetum giganteum</i> L.*	herb wild in strem edge	native Central and South America Central part of Colombian Andeans ⁷	0.28/0.00	0.19/0.00	leaves and stem (B)*2 root (C)	skin infections and inflamations (B) kidney complaints (B)	decoction/ topical-baths (B) decoction/ oral (Z) decoction/ oral (B)
Equisetaceae ALCG 156							
Cola de caballo horsetail						againts rheumatism and osteoporosis (C)	concoction with <i>Furcraea macrophylla</i> in decoction/ baths (C)
<i>Erythroxylum coca</i> Lam.	Shrub or small tree Cultivated in solar	native Colombia and South America ⁵	0.08/0.08	0.44/0.25	leaves and branches (B) leaves (C) leaves (B) leaves (Z)	rheumatism (B) rheumatism (C) tiredness and weakness (B) relaxant (B) tooth pain (Z)	concoction with <i>Cannabis sativa</i> , <i>Aristolochia ringens</i> and <i>Justicia filibracteolata</i> in extract in alcohol/ topical and oral (B) decoction/ oral (C) infusion/ oral (B) fresh maceration/ topical on the tooth (Z)
Erythroxylaceae ALCG 73							
Coca							

Table 4 List of medicinal plant species reported in Zetaquirá and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Croton Funckianus</i> Muell. Arg.	tree wild in edge of route	native Colombian Andes ⁵	0.00/0.00	0.06/0.06	leaves (C)	tooth pain (C)	maceration/ topical-emplast (B)
Euphorbiaceae							
ALCG 120							
Sangregado							
<i>Mimosa pudica</i> L.	herb wild in open pastures	native South and Central America ⁷	0.12/0.12	0.56/0.00	leaves (B)	tooth pain (B) rheumatism (C)	fresh maceration/ topical-emplast (B) decoction/ topical-bath (C)
Fabaceae							
ALCG 175							
Dormidera							
Sensitive Plant, Mimosa							
<i>Senna obtusifolia</i> (L.) Irwin & Barnaby	shrub spontaneous in a sideroad	introduced 48 lower states, Virgin Islands, Puerto Rico ²³	0.12/0.08	0.50/0.06	branches (B)	fever (B)	decoction/ topical-bath (C)
Fabaceae							
ALCG 161							
Alcaparro							
Sicklepod							
					branches (B)	to stop noise bleeding in children (Z)	maceration/ topical-massage or bath (C) decoction/ topical-bath (C)
<i>Juglans neotropica</i> Diels (e-CH/Z)	tree cultivated in solar within a secondary forests well drened	native Amazonas, Orinoquia Central Andes Range ⁷	0.40/0.20	0.00/0.00	leaves (Z) leaves and branches (Z)	allergies (Z) diaper rash and other skin complaints as acne and feet's fungus (Z)	decoction in milk/ topical-bath (Z) infusion/ oral (Z) decoction/ topical in baths (Z)
Juglandaceae							
ALCG 67							
Cedro Nogal							
Colombian walnut							
<i>Melissa officinalis</i> L.* °	herb cultivated in homegarden	introduced Europe and Asia ³	0.88/0.72	0.75/0.62	leaves°2 and stems (B)*2	gripe (B) fevers (B) relaxant (B) stomach ache (B)	decoction/ oral (B) or fresh extract by maceration in water/ oral (B) or infusion/ oral (B)
Lamiaceae							
ALCG 92							
Toronjil							
Common balm							
<i>Ocimum campechianum</i> Mill.	herb cultivated in homegarden	native North, Central and Northern South America ²³	0.28/0.16	0.63/0.31	leaves (B)	Intestinal complaints (B)	infusion/ oral (B)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

Lamiaceae					seeds (B)	eye dust (B)	one seed is placed in the eye/ topical (B)
ALCG 74						gripe (Z)	infusion/ oral (Z)
Albahaca					leaves (Z)		
Basil, Wild mosquito plant							
<i>Mentha viridis</i> L.	herb cultivated in homegarden	introduced Europe ³	0.36/ 0.20	0.50/ 0.38	leaves (B)	gripe (B)	infusion/ oral (B)
Lamiaceae						stomach ache (B)	infusion or decoction/ oral (B)
ALCG 91 Menta						inflammations of intestine (B)	fresh extract by maceration in water/ oral (C)
Spearmint							infusion/ oral (B)
<i>Satureja brownei</i> (Sw.) Briq.	herb cultivated in small garden	native South America, Colombian Andean Ranges ³	0.60/ 0.20	0.19/ 0.06	leaves and stems (B)	against bladder complaints in children (B)	maceration/ topical-emplast (B)
Lamiaceae						condiment herb (B)	combination with food/ oral (B)
ALCG 130						stomach ache (Z)	infusion/ oral (Z)
Poleo						enhance blood cleaning (Z)	infusion/ oral (Z)
<i>Origanum majorana</i> L.*	herb cultivated in solar	introduced Asia menor ¹³	0.36/ 0.28	0.06/ 0.00	leaves (Z)*2	stomach aches and	infusion or decoction/
Lamiaceae							
ALCG 76						intestine complaints (Z)	oral (Z)
Mejorana						prostata complaints (Z)	infusion/ oral (Z)
knotted marjoram, sweet marjoram						kidney complaints (Z)	infusion/ oral (Z)
<i>Rosmarinus officinalis</i> L.* °	woody herb cultivated in homegarden	introduced Península Ibérica, Western Mediterranean ³	0.44/ 0.44	0.31/ 0.19	leaves (B) * 2 ° 2	lungs complaints (B)	infusion/ oral (C)
(e-Z)						tooth pain (B)	decoction in milk/ oral (Z)
Lamiaceae						hipertension complaints (B)	maceration/ topical-emplast on tooth (B)
ALCG 149						against hair loss (B)	infusion/ oral (B)
Romero					leaves and stems (B)	muscles pain (C)	fresh extract by maceration/ topical-massage (C)
Rosemary						rheumatism (C)	decoction/ topical-baths (Z)
						stomach ache (Z)	fresh extract by maceration/ topical-massage (C)
						tiredness (Z)	infusion/ oral (Z)
<i>Mentha suaveolens</i> Ehrh.	herb cultivated in homegarden	introduced Europe ³	1.20/ 1.04	0.94/ 0.94	leaves (B)	stomach ache (B)	infusion or decoction/ oral (B)
Lamiaceae					shoots (Z)		fresh extract by maceration/ oral (B)
ALCG 127					leaves and stems (Z)		infusion or fresh extract by maceration/ oral (B)
Yerbabuena blanca					leaves (Z)	headaches (B)	concoction with <i>Allium sativum</i> cloves, in concentrated extract by decoction/ oral (Z)
Round leaved mint					leaves and stems (Z)	intestinal inflamations (B)	

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

					intestinal parasites (Z)	concoction with Piper cf. bogotense, Trichanthera gigantea and Phytolacca rivinoides decoction/ topical-baths (Z)
					against infections and inflammations (Z)	
					fevers (Z)	infusion/ oral (Z)
					menstrual cramps (Z)	concoction with Ambrosia cumanensis and Ruta graveolens in decoction/ oral (Z)
					diaper rash (Z)	decoction/ topical-baths (Z)
<i>Persea americana</i> Mill.	tree cultivated in solar	native Central and South America ⁷	0.04/0.04	0.25/0.13	shoots (C)	gripe (C)
						apendicitis (C)
Lauraceae					shoots (Z)	sensitive gums (Z)
ALCG 100					fruit (C)	against dry hair (C)
Aguacate					fruit (Z)	regulator of digestion (Z)
Avocado, butter pear						maceration/ topical-massage (C)
<i>Allium fistulosum</i> L.	gregarious herb cultivated in homegarden	introduced Siberia ; Altai montains in Siberia ⁷	0.12/0.08	0.31/0.19	roots (B)	intestinal obstipation (B)
						decoction/ oral (B)
Liliaceae					leaves (B)	stomach ache (B)
Cebolla larga					leaves (B)	condiment herb (B)
Scallion, green onion					young leaf (C)	against intestinal obstipation in newborns (C)
					roots (C)	lost of memory (C)
					leaves (B)	fever (Z)
						decoction/ oral (C)
						maceration/ topical-emplast on head-front (Z)
<i>Allium sativum</i> L. * °	herb cultivated in pod	introduced Southwestern Asia; Central Asia ⁷	0.32/0.04	0.12/0.06	bulbus (B) *2 ° 2	gripe (C)
						concoction with alcohol-Aguardiente ^{U2} / oral (C)
Liliaceae						fevers (C)
Ajo						againsts intestinal worms (C)
						concoction with alcohol-Aguardiente ^{U2} / oral (Z)
Garlic						againsts amebiasis (Z)
						concoction with shoots of Menta suaveolens in concentrated extract by decoction/ oral (Z)
						rheumatism (Z)
						concoction with Justicia filibracteolata and Aristolochia ringens in extract in alcohol ^{U1} - (Z)
<i>Althaea officinalis</i> L. °	herb cultivated in pod	introduced Mediterranean ⁵	0.08/0.04	0.38/0.00	leaves (C)	kidney complaints (C)
Malvaceae					flowers (C)	caugh (C)
						fresh extract by maceration/ oral (Z)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

Malva						stomach	infusion/ oral (Z)
Marsh mallow				leaves (B)		ache (Z) fever (Z)	
<i>Anoda cristata</i> (L.) Schl.	herb wild in open pastures	introduced Mexico and part of Central America ⁵	0.00/0.00	0.19/0.13	leaves and stems (C)	fever (C)	concoction with <i>Senna obtusifolia</i> in extract from maceration/ topical-bath or rub body (C)
Malvaceae						healing wounds and againts spots (C)	fresh extract by maceration/ topical-rub skin (C)
ALCG 170							
Patechula (Campo Hermoso)							
Escobo (Zetaquira)							decoction/ topical-bath (C)
Spuded anoda, crested anoda							
<i>Hibiscus rosa-sinensis</i> L.	shrub and groundcover	introduced China ^{11,13}	0.12/0.08	0.31/0.19	leaves (C)	intestinal obstipation (C)	fresh extract by maceration/ oral (C)
Malvaceae	cultivated in small garden				leaves and flowers (C)	fever (C)	concoction with <i>Cestrum mariquitense</i> in decoction/ topical-bath (C)
ALCG 164					leaves (Z)	againts hair loss (C)	decoction/ topical-bath (C)
Rosado					flowers (Z)	nervous system tonic (Z)	fresh extract by blending/ oral (Z)
Hibiscus						eye inflamations (Z)	fresh extract in water/ topical-eye-bath (Z)
<i>Psidium guineense</i> Sw.	small tree spontaneous in a private pastures plot	native Tropical America, native to Colombia ⁵	0.12/0.08	0.44/0.31	leaves and branches (B)	skin infections and recover wounds (B)	decoction/ topical-baths (C) maceration/ topical-emplast (Z) decoction or infusion/ oral (B) infusion/ oral and decoction/ topical-baths (C)
Myrtaceae						intestinal complaints (B)	decoction/ topical-baths (C)
ALCG 121						against umbilical hernia (C)	concoction with other eight bitter plants in decoction/ topical-steam baths (C)
Guayabo Zapatero or Cimarrón						rheumatism (C)	
Brazilian guava, wild guava						against colds and cramps in uterus (C)	
<i>Eucalyptus cf. globulus</i> Labill. * °	tall tree wild in edge of secondary forest	introduced South East of Australia and Tasmania ^{6,10}	0.56/0.00	0.44/0.19	leaves (B)* 2	gripe (B) fevers (C)	infusion/ oral (B) concoction with <i>Jacaranda copaia</i> and <i>Allium sativum</i> in decoction/ topical-baths (C)
						caughs and asthma (B)	concoction with fresh maceration- <i>Jaccaranda copaia</i> and <i>Allium sativum</i> in cloves extract in alcohol ^{U2} / oral (C)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

						rheumatism (B) tiredness and weakness (Z)	concoction with <i>Solanum nigrum</i> and <i>Cupresus lusitanica</i> in concentrated extract by decoction/ oral (Z) decoction/ topical-baths (B) concoction with <i>Cupresus lusitanica</i> in decoction/ topical-baths (Z)
				° 2			
				branches (C)			
				leaves (B)			
				branches (B)			
Myrtaceae				leaves (Z)			
ALCG 128							
Eucalipto							
Gum tree, Silver-leaved							
mountain gum							
<i>Cattleya schroederiae</i> Rchb. F.	Epiphytic herb cultivated in solar	native Colombia ⁸	0.00/ 0.00	0.69/ 0.63	leaves (C)	typhus (C) denga (C) fever (C) intestinal complaints (C)	fresh extract by maceration of one leafe/ oral (C) extract by blending in concoction with water/ oral (C) fresh extract by maceration of a piece of leafe in concoction with water/ oral (C)
Orchidaceae							
ALCG 165							
Lirio							
Easter orchid, Baron schroeder's cattleya							
<i>Petiveria alliacea</i> L. *	herb cultivated in small garden	native Andean (specially Peruvian Amazonas), Caribbean and South east of Colombia ⁷	0.00/ 0.00	0.25/ 0.25	leaves (C)*2	stomach cancer (C) against lacerations in mouth (C) headache (C)	infusion/ oral (C) decoction/ oral (C) extract by maceration/ topical-rinsing mouth out/ (C) infusion/ oral (C)
Phytolaccaceae							
ALCG 136							
Anamú							
Anamú plant							

Table 4 List of medicinal plant species reported in Zetaquirá and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Phytolacca rivinoides</i> Kunth & C.D.Bouché	shrub spontaneous in a solar	native Central and South America, Colombian Andeans ⁷	0.08/ 0.00	0.38/ 0.25	leaves and branches (B)	rheumatism (C) erisipela (C) inflammations and skin infections (C) inflammations and skin infections (Z)	decoction/ topical-baths (C) concoction with <i>Mentha suaveolens</i> , <i>Piper bogotense</i> and <i>Trichanthera gigantea</i> decoction/ topical-baths (Z)
Phytolaccaceae							
ALCG 146							
Guaba, Cargamanto							
<i>Piper hispidum</i> Sw.	shrub cultivated in solar/it can also occur in wild	native Central and South America and native to Caribbean territories ²⁰	0.00/ 0.00	0.44/ 0.38	leaves and stems (C)	high blood pressure (C) fevers (C) tiredness and weakness (C) rheumatism (C)	fresh extract by maceration in water/ oral (C) concoction with <i>Verbena littoralis</i> in decoction/ topical-bath (C) decoction / topical-bath (C), steam baths/ topical(C)
Piperaceae							
ALCG 85							
Cordoncillo negro							
Jamaican pepper							
<i>Piper cf. bogotense</i> C.DC.	shrub cultivated in solar/it can also occur in wild	native North of South America ¹²	0.08/ 0.00	0.50/ 0.25	leaves (C) leaves and stems (Z)	high blood pressure (C) fevers (C) mouth dryness (C) skin infections and inflammations (Z)	fresh extract by maceration in water/ oral (C) extract in water/ oral (C) concoction with <i>Mentha suaveolens</i> and <i>Phytolacca rivinoides</i> in decoction/ topical- bath (Z)
Piperaceae							
ALCG 81							
Cordoncillo blanco							
<i>Plantago major</i> L.*	herb spontaneous in homegarden	introduced Europe and Asia ³	0.32/ 0.16	0.81/ 0.31	leaves (B)*2	eye dust and infections (B) gastritis (B) liver cleanser (B) kidney complaints (C) fever (C) eczema (C)	decoction/ topical eye bath (C) fresh extract by distillation in glass bottle/ topical-eye drops (Z) fresh extract by maceration/ oral (B) decoction/ oral (C) fresh extract by maceration/ oral (Z) decoction/ oral (C) decoction/ oral (C) fresh maceration in concoction with honey/ topical-emplast (C) concoction with <i>Calendula officinalis</i> and <i>Solanum nigrum</i> in decoction/ topical-baths (Z)
Plantaginaceae							

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

ALCG 374						healing wounds (Z)	
Llantén							
Common plantain							
<i>Cymbopogon citratus</i> (DC.) Stapf.*	herb cultivated in solar	introduced India ²	0.56/0.60	0.44/0.50	leaves (B)*2	stomach aches (B)	infusion or decoction/ oral (B)
Poaceae							infusion/ oral (Z) decoction/ oral (Z) decoction/ oral (C)
						intestine complaints (Z) gripe (Z) prostate complaints (C)	
ALCG 77							
Limonaria or limoncillo							
West Indian, Lemon grass, oil grass						fevers (C)	
<i>Rumex crispus</i> L.	herb wild in open pastures	introduced Europe ⁷ , West Asia ²⁰	0.08/0.04	0.19/0.00	leaves (B)	fevers (B)	fresh extract by maceration/ oral (C) fresh extract by maceration/ topical-baths (Z) fresh extract by maceration/ oral (C) heated leaves/ topical directly on the lower belly (Z)
Polygonaceae						kidney complaints (C) liver cleanser (C) intestinal inflammations (Z)	
ALCG 148							
Romaza, Lengua de vaca							
Curled dock							
<i>Rubus glaucus</i> Benth.	sub-shrub cultivated in homegarden	native from Mexico to Ecuador and from center to south of Colombian Andeans ⁷	0.28/0.00	0.50/0.13	shoots and fruits (B)	rheumatism (B)	decoction/ oral and decoction/ topical-baths (B)
						against skin infections and inflammations (C)	decoction/ topical-baths and infusion/ oral (C) decoction/ topical-baths (C)
Rosaceae					shoots (Z)	against rashes (C) against spots (C) caughs (Z)	decoction/ oral (Z)
ALCG 126							
Moras							
Andean blackberry							
<i>Citrus aurantium</i> var. Amara L.	small tree cultivated in homegarden	introduced Southern Vietnam ¹³ , Southeast Asia ⁵	0.20/0.20	0.69/0.25	fruit (B)	relaxant (B)	steam baths/ topical (B) infusion/ oral (C) decoction/ topical-for rinsing mouth (B)
						headache (C)	steam baths/ topical (C)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

									decoction/ topical-baths (Z)
								mouth infections (B)	decoction/ oral (Z)
								rheumatism (B)	
Rutaceae					leaves (Z)			body dryness (Z)	
Naranjo agrio									
Bitter orange, Seville orange									
<i>Citrus maxima</i> (Burm. ex Rumph.) Merr.	small tree cultivated in homegarden	introduced South East Asia ^{5,13}	0.36/0.24	0.25/0.19	fruits (B)			gripe (B)	juice, alone or in combination with aguadepanela-U3-/ oral (B)
								stomach ache (B)	decoction of shoots/ oral (C)
									juice in combination with water / oral (B)
								inflammations because infections (C)	decoction / topical-baths (C)
					shoots (C)				juice in combination with water/ oral (Z)
								headache (Z)	decoction/ topical-baths (Z)
								fevers (Z)	
					fruits (B)			rheumatism (Z)	
					fruits and branches (C)				
Rutaceae					fruits (Z)				
ALCG 98					fruits and branches (Z)				
Limón mandarin									
Pommelo, Pumelo									
<i>Ruta graveolens</i> L.*	herb cultivated in small garden	introduced Canary Islands Europe meridional ⁵	1.24/1.08	0.75/0.50	leaves (B)			to strengthen uterus (B)	fresh chopped leaves combined with boiled egg/ oral (B)
									decoction/ oral (B)
									decoction/ topical-bath (Z)
									fresh extract by maceration in water/ oral (C)
Rutaceae					leaves, flowers and stems (B)*2			against cramps in uterus and menstrual pains (B)	infusion/ oral (Z)
								rheumatism (Z)	
								intestinal parasites (C)	
					leaves and stems (C)			cardioregulator (Z)	
ALCG 86					leaves (Z)				
Ruda									
<i>Citrus limon</i> (L.) Burm. F. (e-Z)	small tree cultivated in homegarden	introduced Himalaya and Indochina ⁵	0.52/0.20	1.00/0.63	fruits (B)			gripe (B)	juice alone or in combination with water or aguadepanela/ oral (B)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

						fevers (B)	juice in combination with water/ oral (B)
						against infections in throat (B)	juice/ to gargle-topical (B)
Rutaceae						stomach complaints (B)	juice in combination with water/ oral (B) a fresh hitted-hot fruit/ to massage-topical (C)
ALCG 93						intestine complaints (B)	fruit pieces mixed with salt in water/ to do baths-topical (C)
Limón ácido						rheumatism (C)	fresh fruit pulp/ to rub the head-topical (C)
						against excema (C)	juice in combination with water/ oral (Z)
Lemon,Citrus						headache (C)	
						to prevent high blood presure (Z)	
<i>Physalis peruviana</i> L.	shrub cultivated in homegarden	introduced Northern South America-Peru ³	0.16/0.04	0.19/0.00	fruits (B)	eye dust and infections (B)	fresh extract from maceration/ topical-eye drops (B)
Solanaceae							a variation is a concoction with honey (C)
ALCG 163							
Uchuba,Guchuba							
Cape gooseberry							
<i>Solanum nigrum</i> L. *	sub shrub spontaneous in solar	introduced Eurasia ^{13,23}	0.20/0.04	0.19/0.00	fruits and leaves (B)*2	diabetes (C)	infusion/ oral (C)
							decoction/ topical-baths (Z)
Solanaceae						inflammations and skin infections (Z)	concentrated extract by decoction/ oral (Z)
						respiratory complaints (Z)	
ALCG 157							
Yerbamora(Zetaquira)							
Almoraduz(Campo Hermoso)							
black night shade							
<i>Cestrum mariquitense</i> Kunth	shrub cultivated in solar	native Tropical America ¹³ Boyacá and Cundinamarca-Colombia ³	0.08/0.08	0.50/0.25	leaves (B)	sinucitis (B)	fresh extract by maceration/ topical-noise drops (B)
						fevers (B)	fresh extract by maceration/ oral (B)
						headache (C)	concoction with Hibiscus rosa sinensis in decoction/ topical-baths (C)
Solanaceae							fresh extract by maceration/ oral (C)

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

ALCG 102							
Tinto							
<i>Cecropia</i> sp.	tree wild in secondary forest	native Colombian Andes ⁷	0.08/0.00	0.06/0.00	leaves (Z)*2	cardiac complaints as hypertrophy (B)	concoction with alcohol-dye/ oral (B)
Urticaceae •							
Cecropiaceae ++							
Yarumo							
Pumpwood, trumpet tree							
<i>Urera baccifera</i> (L.)	herb spontaneous in a farm with a large patch of secondary forest	native Central and South America Central Andeans and Orinoquia in Colombia ⁷	0.20/0.08	0.25/0.06	leaves and branches (B)	rheumatism (B) allergies (B)	decoction/ topical baths (B) infusion/ oral (C)
Gaudich ex Wedd. Urticaceae					leaves (C)	blood circulation tonic (C)	
ALCG 99							
Ortiga mayor, Pringamoza							
<i>Urtica dioica</i> L.* °	herb spontaneous in a farm with a large patch of secondary forest	introduced eurasian, meridional-boreal, native of Britain ¹⁸	0.44/0.32	1.12/0.63	leaves and stems (B)	rheumatism (B) allergies (B)	fresh-maceration/ topical in cataplasm (B) decoction / topical in baths (B) Infusion/ oral (B)
						blood cleaner and tonic (B)	fresh extract by maceration/ topical to rub skin (C) infusion/ oral (C)
Urticaceae							
					leaves (B)*2	antihemoragic (B) skin infection and inflamations (C)	concoction with Jacaranda copaia and Rosmarinus officinalis in decotion/ oral (C)
					leaves and stems (C)	gripe (C)	
ALCG 66							
Ortiga Blanca or Ortiga menor							
Great Nettle or Stinging Nettle							
<i>Lippia alba</i> (Mill.) N.E. Brown*	shrub cultivated in homegarden	native to Colombia ^{5,25}	0.68/0.56	0.75/0.56	leaves (B)*2	stomach complaints (B), diarrhoea (B) tiredness and weakness (C), (Z)	decoction / oral (B) decoction/oral (C),infusion/oral (Z) infusion/oral (Z)
Verbenaceae							
ALCG 72							
Pronto alivio							
Bushy,Matgrass							

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

<i>Lippia citriodora</i> (Lam.) Kunth*	shrub cultivated in homegarden	native Colombian Andean range ⁸	0.48/ 0.36	0.25/ 0.13	leaves (B)*2	stomach and intestinal complaints (B)	infusion/ oral (B) decoction/ oral (B) infusion/ oral (Z)
Verbenaceae						relaxant (B) general indisposicion (Z)	
ALCG 70							
Cidrón							
Lemon Scented Verbena							
<i>Lantana camara</i> L.	herb wild in open pastures	native to Caribbean territories including Colombia, Continental US and Hawai ²⁰	0.20/ 0.08	0.25/ 0.25	leaves and stems (B)	high bilirubin in newborns (B)	decoction/ topical-baths (B) infusion/ oral (C) decoction in milk/ oral and decoction/ topical-baths (C) decoction/ topical-baths (Z)
Verbenaceae					flowers (C) flowers, stems and leaves (C) leaves and stems (Z)	hepatitis (C) yellow fever (C) hepatitis (Z)	
ALCG 117							
Florota							
Cambara de Espinto or Pricky Lantana							
<i>Verbena littoralis</i> Kunth *	herb cultivated in solar	native western and central Andean ranges ⁵	0.96/ 0.40	0.88/ 0.63	leaves and stems (B)	fevers (B) gripe (B)	decoction/ topical baths (B) fresh extract by maceration in water/ oral (Z) concoction with Calendula officinalis and Piper hispidum in decoction/ topical baths (C) concoction with Piper hispidum in decoction/ topical in baths (C) infusion/ oral (Z)
Verbenaceae						rheumatism (Z) rheumatism (C) tiredness and weakness (C)	
ALCG 79							
Verbena blanca							
Vervain, owi							
<i>Viola odorata</i> L.*	Acaule herb Cultivated in small garden	introduced Europe, Austral Asia and Boreal Africa ⁵	0.04/ 0.00	0.00/ 0.00	leaves*2 and stems (Z)	cough (Z) asthma (Z)	infusion/oral (Z)
Violaceae							

Table 4 List of medicinal plant species reported in Zetaquira and Campo Hermoso including ethnobotanical characteristics (Continued)

ALCG 111

Violeta

Sweet violet/common

violet

B: Both municipalities; C: Campo Hermoso; Z: Zetaquira.

^{U1} A glass bottle is filled with plant(s) parts, red grape wine usually and, it is buried under the ground during a month.

^{U2} A similar process as it is described in U1, with the variation of the use of aguardiente, which is the introduced alcoholic drink similar to spirit (snaps).

^{U3} Aguadepanela is a traditional colombian homemade drink. The ingredients are water and panela, that is an unrefined food product of which the main component is sugarcane juice.

* Reported in Colombian Vademecum, 2008; * ² Plant material of interest reported in Colombian Vademecum, 2008.

° Reported in WHO, 2009; ° ² Plant material of interest reported in WHO, 2009.

• www.tropicos.org.

++ www.ipni.org/ipni/plantnamesearchpage.do.

(e-CH/Z) Endangered plant species according to the perceptions of the locals in Campo Hermoso (CH) and/or Zetaquira (Z).

¹ Rothmaler Werner, 1994.

² Antolinez González J. C. et.al., 2008.

³ Garcia Barriga Tomo III 1992.

⁴ De Fraume Melida, 1988.

⁵ Garcia Barriga Tomo II, 1992.

⁶ Fonnegra, 2007.

⁷ Garcia Barriga Tomo I 1992.

⁸ Perez-Arbelaez 1978.

⁹ Centro de Educacion No Formal FUNIBA.

¹⁰ Carlos Paez Perez, 1964.

¹¹ www.Botanical.com.

¹² www.zipcodezoo.com/plants/.

¹³ www.en.wikipedia.org.

¹⁴ www.mansfeld.ipk-gatersleben.de.

¹⁵ www.flowersofindia.net.

¹⁶ www.mobot.org.

¹⁷ Soloiki M et al., 2008.

¹⁸ www.botanicus.org (Missouri Botanical Garden).

¹⁹ www.issg.org (global invasive species database).

²⁰ www.cbif.gc.ca/itis (Integr. Taxonomi Inf. Sys.).

²¹ Missouri Bot. Garden 2007 in Colomb. Vademecum.

²² a.o. (tropicalforages.info).

²³ <http://plants.usda.gov/java/profile?symbol=SEOB4#>.

²⁴ <http://www.conifers.org/cu/cup/lusitanica.htm>.

²⁵ Vera et. al. in Revista Cubana de plantas medicinales 2010.

²⁶ http://zipcodezoo.com/Key/Plantae/Cecropia_Genus.asp.

²⁷ <http://plants.jstor.org/flora/flos003208>.

Table 5 Plant species reported as disappeared or endangered within the municipalities of Campo Hermoso and Zetaquirá

	Campo Hermoso	Zetaquirá
Disappeared species	<i>Brownea ariza</i>	<i>Fraxinus udhei</i>
	<i>Ananas comosus</i>	<i>Schizolobium parahybum</i>
	<i>Parietaria officinalis</i>	<i>Chrysophyllum colombianum</i>
	<i>Furcraea</i> sp.	'Alma negra'
	<i>Malva</i> sp.	
	'Gualola'	
	'Mano de León'	
Endangered Species	'Bejuco de roca'	
	<i>Furcraea macrophylla</i>	<i>Citrus limon</i>
	<i>Artemisia absinthium</i>	<i>Saccharum officinarum</i>
	<i>Ocimum campechianum</i>	<i>Juglans neotropica</i>
	<i>Juglans neotropica</i>	<i>Rosmarinus officinalis</i>
	<i>Ceroxylum quindiuense</i>	
	<i>Cedrela</i> spp.	

Wilcoxon-Mann-Whitney tests [16,17] were used to test for differences between introduced and native medicinal plant species in their estimated and actual UV within the two municipalities.

Finally, similarities of use of introduced and native medicinal plant species between the municipalities were calculated using the Jaccard Index [21,22].

Results

Medicinal plant species and plant characteristics

Interviews and questionnaires supplied a list of a total of 80 medicinal plant species used in the treatments of ailments within the municipalities of Campo Hermoso and Zetaquirá. Of these, 78 species were taxonomically identified. Results are based on the 78 identified species of which 35 were native species and 43 introduced (Table 4), belonging to 74 genera and 41 floristic families. The families with the highest numbers of species reported as medicinal were: Asteraceae (10 species), Lamiaceae (7), Apiaceae, Rutaceae and Verbenaceae (each 4), and Malvaceae, Solanaceae and Urticaceae (each 3).

Twenty-nine of the identified species and the genus *Cecropia* Loefl. were included in the list of medicinal plants evaluated and accepted in the Colombian pharmacopeia [23]. Thirteen species were reported in the World Health Organization's (WHO) monographs on selected medicinal plants [24] (Table 4).

During interviews and meetings interviewees were able to reflect about the local resources of medicinal plant species, their importance and, additionally, to discuss

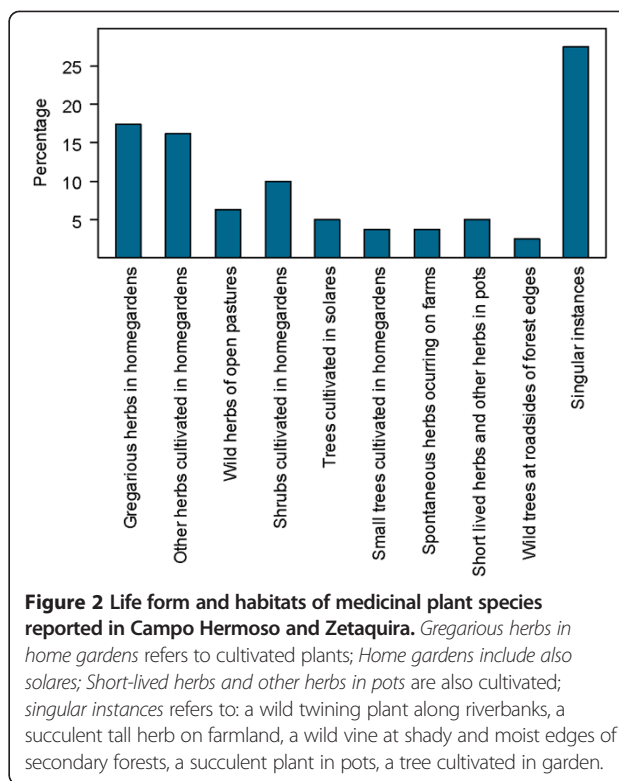


Figure 2 Life form and habitats of medicinal plant species reported in Campo Hermoso and Zetaquirá. Gregarious herbs in home gardens refers to cultivated plants; Home gardens include also solares; Short-lived herbs and other herbs in pots are also cultivated; singular instances refers to: a wild twining plant along riverbanks, a succulent tall herb on farmland, a wild vine at shady and moist edges of secondary forests, a succulent plant in pots, a tree cultivated in garden.

factors that may have increased or reduced plant diversity, such as logging, over-exploitation and difficulties of cultivation. Some interviewees reported that they found it difficult to treat certain diseases because they failed to find the plant species needed. An example is *Brownea ariza* Benth., a native species, which locals consider

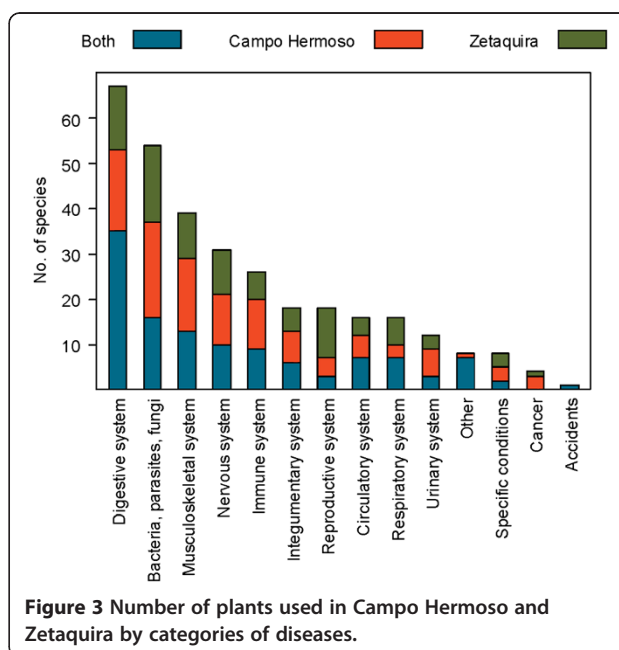


Figure 3 Number of plants used in Campo Hermoso and Zetaquirá by categories of diseases.

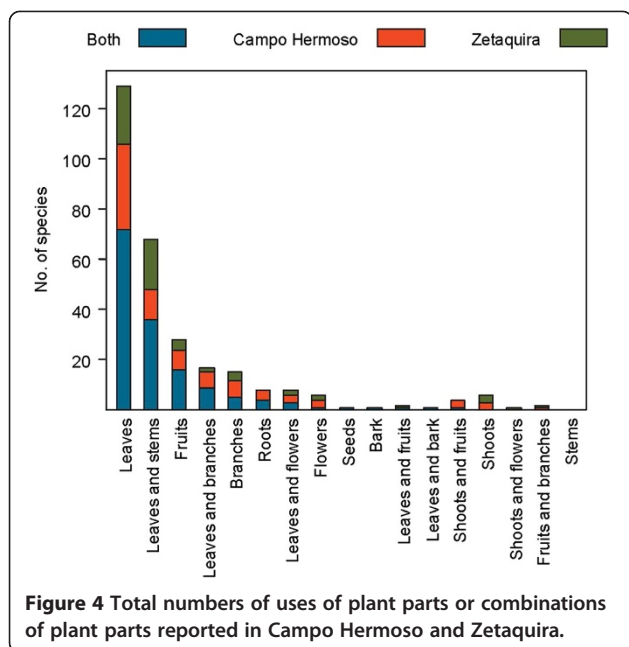


Figure 4 Total numbers of uses of plant parts or combinations of plant parts reported in Campo Hermoso and Zetaquira.

extinct in the Campo Hermoso area. This species was used as a haemostat, i.e. to stop bleeding, and as laxative. Another example is *Juglans neotropica* Diels., a native species, used as fungicide and bactericide, which was reported to be endangered in both municipalities (Table 4 and 5). Due to the lack of samples it was not possible to scientifically identify all the species reported as threatened and disappearing by the interviewees.

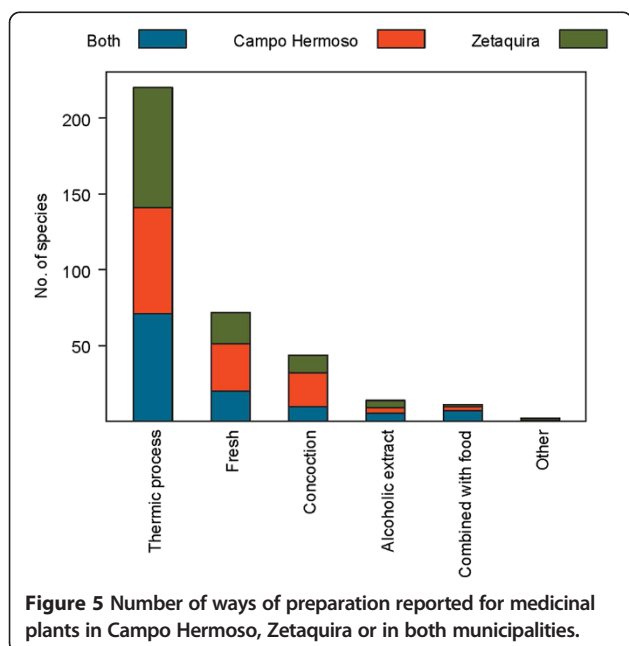


Figure 5 Number of ways of preparation reported for medicinal plants in Campo Hermoso, Zetaquira or in both municipalities.

According to informants' reports and the subsequent calculations of average UVs the most popular medicinal species, in the municipality of Campo Hermoso were *Urtica dioica* (0.88), *Jaccaranda copaia* (0.81) and *Citrus limon* (0.81) while in Zetaquira the most popular species were *Ruta graveolens* (average UV = 1.16), *Melissa officinalis* (0.8), and *Aloe vera* (0.6). Across both municipalities, the most common and popular medicinal plant species were *Mentha suaveolens*, *Ambrosia cumanensis* Kunth, and *Verbena littoralis* (Table 4).

In relation to life form and habitat, the collected plant species could be assigned to 10 categories shown in the Figure 2 (Table 4). Of the native species 40% were found in natural habitats whereas 27% of the introduced species were found as naturalised in the wild.

The naturally occurring and naturalised species were distributed widely within families. For example, Asteraceae (2 herbs), Acanthaceae (1 tree), Aristolochiaceae (1 twiner) and Commelinaceae (2 vines) (Table 4).

Traditional plant use in Campo Hermoso and Zetaquira

Traditional plant uses in the municipalities of Campo Hermoso and Zetaquira are represented in Figures 3, 4, 5, 6. The total number of medicinal plants uses described by informants was higher in more remote Campo Hermoso than in Zetaquira.

Common diseases, such as colds, but also a small number of difficult or complicated diseases, such as cancer, were reported to be treated. The majority of plants mentioned by the informants were reported to be effective in curing the diseases they were applied to. Additionally, most of the informants mentioned the importance

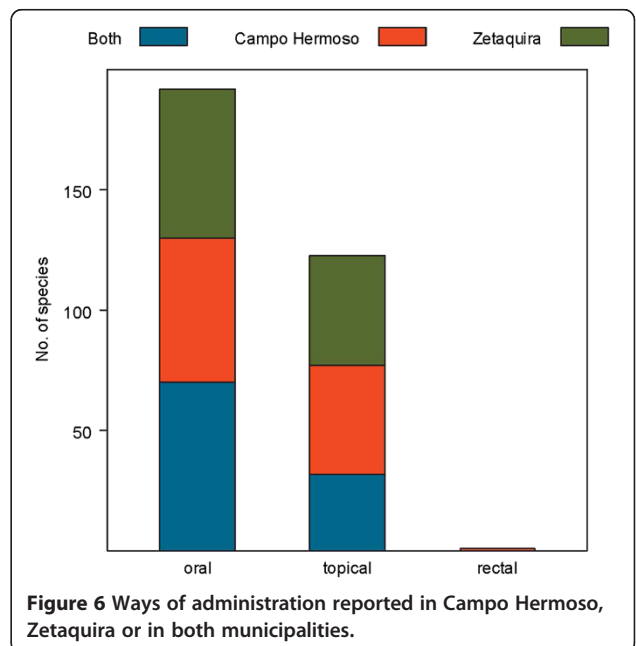


Figure 6 Ways of administration reported in Campo Hermoso, Zetaquira or in both municipalities.

of using folk traditions, e.g. prayers, during treatments in order to ensure the effect of the medicinal plant.

The diseases described by interviewees were grouped in 14 categories (Table 2). The five categories of ailments/diseases with the highest numbers of plants reported in both municipalities were associated with: the digestive system, infections, musculoskeletal, the nervous system, and the immune system. The corresponding most popular medicinal plant species are shown in Table 6. Significant dissimilarities between municipalities occurred in treatments of musculoskeletal, immune and urinary systems, and cancer where the total numbers of plants mentioned in more remote Campo Hermoso was almost double the number of Zetaquira. The category with the highest number of medicinal plant species reported from Zetaquira was 'reproductive system' with 11 plants. There were no plant species specifically reported for the treatment of the two parasitic, epidemic, local diseases of Chagas (caused by *Trypanosoma cruzi*) and Malaria (Paludism). Only two species, *Cattleya schroederiae* Rchb.f. and *Jaccaranda cf. copaia*, were reported for the treatment of Dengue, a viral, epidemic mosquito transmitted disease also affecting these populations (Table 4).

Regarding the plant parts used, leaves were the plant part most frequently reported for remedy preparations, in both municipalities. Other commonly used plant parts were, in descending order of total counts in both municipalities: combination of leaves with stems (36), fruits (16), combination of leaves with branches (9), branches (5), roots (4),

Table 6 Most commonly treated categories of diseases with the most popular plant species used for their treatments

Disease category	No. of plants reported in both municipalities	Popular plant species used in treatments
Digestive system	35	<i>Melissa officinalis</i> <i>Cymbopogon citratus</i> <i>Apium graveolens</i>
Infections from bacteria, parasites or fungi	16	<i>Mentha suaveolens</i> <i>Citrus limon</i> <i>Jaccaranda copaia</i>
Muskuloskeletal system	13	<i>Verbena littoralis</i> <i>Urtica dioica</i> <i>Aristolochia ringens</i>
Nervous system	10	<i>Melissa officinalis</i> <i>Matricaria chamomilla</i> <i>Lippia citriodora</i>
Immune system	9	<i>Aloe vera</i> <i>Melissa officinalis</i> <i>Verbena littoralis</i>

and combination of leaves with flowers (3). Other combinations of different plant parts were mentioned only rarely. The use of seeds was not popular in either of the municipalities (Figure 4).

In both municipalities, similar numbers of applications were reported for *Cymbopogon citratus*, *Plantago major*, *Petroselinum crispum* and *Lippia alba* (Mill.) N.E.Br. These species received the highest scores for application of leaves. Most popular species with the highest applications of leaves were: *Cattleya schroederiae* (4) and *Piper cf. bogotense* C.DC. (3), in Campo Hermoso, and *Origanum majorana* L. (3) in Zetaquira (Table 4).

Eighty different ways of preparation of remedies with medicinal plant species were described. They were grouped according to the type of processing: thermic methods, alcoholic extracts or fresh use. Other ways of preparation of the remedies, such as the combination with food and with other plants (concoction) were also mentioned and thus counted. Practices according to beliefs included the effect of moon or sunlight, esoteric ways and specific ways to treat pets. These additional ways of preparing traditional remedies were included in one group named 'other' (Figure 5).

The most popular way of administration remedies was oral followed by the topical in both municipalities (Figure 6). Among the most popular topical ways of administration, 'baths' yielded the highest scores (13 counts) in both municipalities, 26 in Campo Hermoso and 25 in Zetaquira. Massage was the second most popular in Campo Hermoso, while 'emplast' was the second most popular in Zetaquira.

Healers and amateur healers unanimously reported that bitter plants were denominated 'hot plants' ('plantas calientes', in Spanish), while plants with sweet flavour were denominated 'cold plants' ('plantas frias'). These terms suggested the level of caution with which the medicinal plants should be used. Bitter plants should be used in small doses at low frequency because most of them can produce eye or heart problems. Bitter plants should be used orally only in situations caused by musculoskeletal complaints. Further, they recommended to initially use topical treatments and, in the most general sense, to follow a diet when using medicinal plants. Popular plants used for the purposes outlined above in the localities are described in Table 4.

Table 7 shows the plant species with the highest values obtained in aUV according to the sum of the values from both municipalities. In addition, eUV are also included.

Differences and similarities among plant groups and families

UVs of introduced plant species were significantly higher than native species in the more accessible municipality of Zetaquira (Table 8), while there were no significant

Table 7 Plant species according to the highest actual index use values obtained in both municipalities

Scientific name (Voucher number)	aIUV all	aIUV Zq	aIUV CH	eIUV all	eIUV Zq	eIUV CH	Medicinal uses
<i>Mentha suaveolens</i> Ehrh. * (ALCG 127)	1	1.04	0.94	1.10	1.20	0.94	stomach ache(B), headaches(B), intestinal inflammations(B), intestinal parasites(Z), fevers(Z), menstrual cramps(Z), diaper rash(Z)
<i>Ruta graveolens</i> L. *(ALCG 86)	0.85	1.08	0.50	1.05	1.24	0.75	against cramps in uterus and menstrual pains(B), rheumatism(Z), intestinal parasites(C), cardio-regulator(Z)
<i>Melissa officinalis</i> L. * (ALCG 92)	0.68	0.72	0.63	0.83	0.88	0.75	gripe(B), fevers(B), relaxant(B), stomach ache(B), intestine complaints(B)
<i>Aloe vera</i> (L.) Burman f. **	0.6	0.63	0.63	0.64	0.64	0.63	asthma (B), cough(B), fever(B), headache(B), healing wounds and skin spots(B), external inflammations(B), hair treatment (B), stomach cancer(Z)
<i>Ambrosia cumanensis</i> Kunth (ALCG 63)	0.4	0.81	0.98	0.88	0.88	1.13	gripe(B), rheumatism(B), children bladder complaints(B), menstrual cramps(Z), colds and spasms in muscles(C), stomach ache(C), intestinal complaints(C), against flies(Z)
<i>Lippia alba</i> (Mill.) N.E.Br. (ALCG 72)	0.56	0.56	0.71	0.68	0.68	0.75	stomach complaints(B), diarrhoea(B), tiredness and weakness(C)/(Z), childbirth(Z)
<i>Cymbopogon citratus</i> (DC.) Stapf. * (ALCG 77)	0.6	0.50	0.51	0.56	0.56	0.44	stomach aches(B), intestine complaints(Z), gripe(Z), prostate complaints(C), fevers(C)
<i>Verbena littoralis</i> Kunth (ALCG 79)	0.4	0.63	0.93	0.96	0.96	0.88	fevers(B), gripe(B), rheumatism(Z)/ (C), tiredness and weakness(C)
<i>Urtica dioica</i> L. * (ALCG 66)	0.32	0.63	0.71	0.44	0.44	1.13	rheumatism(B), allergies(B), blood cleaner and tonic (B), anti-haemorrhagic(B), skin infection and inflammations(C), gripe(C), mouth dryness(C)
<i>Citrus limon</i> (L.) Burm. F. * (ALCG 93)	0.2	0.63	0.71	0.52	0.52	1.00	gripe(B), fevers(B), infections in throat(B), stomach and intestine complaints(B), rheumatism(C), eczema (C), headache(C), to prevent high blood pressure(Z)
<i>Jacaranda cf. copaia</i> (Aubl.) D.Don (ALCG 69)	0.12	0.69	0.49	0.2	0.2	0.94	Intestinal complaints(B), Kidney complaints(Z), rheumatism (C), gripe(C), fevers(C), dengue(C), skin infections(C), circulatory complaints(C), mouth dryness(C)
<i>Matricaria chamomilla</i> L. *(ALCG 96)	0.32	0.38	0.34	0.32	0.32	0.38	stomach-complaints(B), relaxant(B), rheumatism(Z), colds, spasms and cramps in muscles (C)
<i>Rosmarinus officinalis</i> L. *(ALCG 149)	0.44	0.19	0.39	0.44	0.44	0.31	lungs complaints(B), tooth ache(B), hypertension complaints(B), against hair loss(B), muscles pain (C) rheumatism(C), stomach ache(Z), tiredness(Z)
<i>Petroselinum crispum</i> (Mill. Nyman ex A. W. Hill)*(ALCG 87)	0.36	0.25	0.46	0.44	0.44	0.50	cardiovascular complaints as high blood pressure(B), enhance stomach function(B), halitosis(B), condiment herb (B), kidney complaints(C), intestinal pain(C), against menstrual pain(Z)
<i>Lippia citriodora</i> (Lam.) Kunth (ALCG70)	0.36	0.13	0.39	0.48	0.48	0.25	stomach and intestinal complaints(B), relaxant(B), general indisposition(Z)
<i>Mentha viridis</i> L. * (ALCG 91)	0.2	0.38	0.41	0.36	0.36	0.50	gripe(B), stomach ache(B), inflammations of intestine(B)
<i>Sambucus nigra</i> L. *(ALCG 68)	0.24	0.25	0.66	0.72	0.72	0.56	gripe(B), eye inflammations and infections(B), fevers(B), tiredness and weakness(Z), respiratory, complaints(B), head ache(Z), against hair lice(C)
<i>Cattleya schroederiae</i> Rchb.f. (ALCG 165)	0	0.63	0.27	0	0	0.69	typhoid(C), dengue(C), fever(C), intestinal complaints(C)
<i>Calendula officinalis</i> L. * (ALCG 57)	0.24	0.19	0.49	0.6	0.6	0.31	external-internal inflammations(B), gastritis(C), skin infections (Z), menstrual cramps(Z)
<i>Ocimum campechianum</i> Mill. (ALCG 74)	0.16	0.31	0.41	0.28	0.28	0.63	intestinal complaints(B), eye dust (B), gripe(Z)
<i>Chenopodium ambrosioides</i> L. (ALCG 80)	0.12	0.38	0.41	0.4	0.4	0.44	stomach complaints(B), intestinal parasites(B)
<i>Citrus maxima</i> (Burm. ex Rumph.) Merr. *(ALCG 98)	0.24	0.19	0.32	0.36	0.36	0.25	gripe(B), stomach ache(B), inflammations because infections (C), headache(Z), fevers(Z), rheumatism(Z)
<i>Apium graveolens</i> L. * °	0.24	0.19	0.22	0.2	0.2	0.25	intestinal obstipation(B), stomach ache(B), condiment herb (B), relaxant(B), to regulate menstruation(Z)

Table 7 Plant species according to the highest actual index use values obtained in both municipalities (Continued)

<i>Plantago major</i> L*(ALCG 374)	0.16	0.31	0.51	0.32	0.32	0.81	eye dust and infections(B), gastritis(B), liver cleanser(B), kidney complaints(C), fever(C), eczema(C), healing wounds (Z)
<i>Citrus aurantium</i> var. <i>amara</i> L. **	0.2	0.25	0.39	0.2	0.2	0.69	relaxant(B), headache(C), mouth infections(B), rheumatism (B), body dryness(Z)

Includes also estimated index use values.

*Introduced plant species; **No specimen collected; (C) Campo Hermoso; (Z) Zetaquira; aIUUV Actual Index Use Value; eIUUV Estimated Index Use Value; all-aIUUV/eIUUV Sum of all values corresponding to actual or estimated uses.

differences between the two groups in the more remote municipality of Campo Hermoso and nor in the two municipalities combined.

Numbers of plant species for which estimated and actual UVs could be calculated did not differ greatly between the two municipalities (Table 9). Nevertheless, totals of actual UV of introduced species were higher in Zetaquira than in Campo Hermoso. Totals of actual UV of native species were higher in Campo Hermoso than in Zetaquira. Totals of common plant species including introduced and native ones were very high in both municipalities.

There were many similarities in the use of both introduced and native plant species between the municipalities (Table 10).

Estimated Family Use Values (FUV) were higher than actual family use values in almost all cases (Table 11). Estimated and actual FUV were commonly higher for Campo Hermoso than for Zetaquira. Plant families represented by high numbers of plant species did not always have high FUVs, i.e. Asteraceae and Apiaceae. Some families, of which only one plant species was reported, surprisingly obtained high values, e.g. Aristolochiaceae which had the highest estimated use value. Another interesting case was the Asphodelaceae which yielded high actual use values. Furthermore, Asphodelaceae and Poaceae coincided in having high actual use values in both municipalities.

The list of the most popular medicinal plant species based on median of actual and estimated Use Values, among amateur healers and healers is shown in Table 12.

From the amateur healers' list, 87% species were introduced including six herbs and one shrub, while only 13%, i.e. one herb, was native. In the case of healers, 57% in the list of preferred species were native, which included two trees and two shrubs, while the remaining 43% were introduced, i.e. two herbs and one vine (Table 4).

Discussion

Significance of the use of medicinal plants within the municipalities

The patterns in traditional knowledge and medicinal plant use described in this study is in accordance with other studies [25-27] in the high number of introduced species mostly herbs. Especially for the more accessible municipality of Zetaquira the use of native species was rarely reported.

Rapid adoption of introduced species in traditional medicine can be understood as a response to new opportunities arising with globalisation. Inefficacy of native species may lead to experimentation with introduced species. Introduced species enrich the arsenal of species used in treatments and are often seen as very powerful [28-30]. Adoption of introduced species may be seen as a way to reshape and re-vitalise traditional practices, which in many places provide an important alternative to the official health care services within developing countries.

The effectiveness of treatments with popular introduced plant species that are used world-wide indicates the need to promote and further the studies on the use and effectiveness of these plant species [23,24]. In the Colombian pharmacopoeia list of officially accepted plants for medicinal use 44% of the total of 149 species are introduced [23,31].

The flip-side of the coin is that with the adoption of introduced medicinal plant species peoples' interest in cultivating native species decreases. In this study most of the popular medicinal plant species (UV >0.5) were introduced with the exception of *Verbena littoralis* and *Ambrosia cumanensis* (Table 4 and 7). Furthermore, a number of native species with multiple uses, e.g. timber but also medicinally, are currently endangered or have disappeared from the regions indicating that over-exploitation has taken place [27].

Table 8 Results of Mann-Whitney-Wilcoxon tests of differences in Index Use Values (IUUV) among native and introduced medicinal plants. Med. = Median; Nat. = Native; Int. = Introduced

Index	Campo Hermoso			Zetaquira			Both Municipalities		
	Med. Nat.	Med. Int.	P	Med. Nat.	Med. Int.	P	Med. Nat.	Med. Int.	P
Actual IUUV	0.13	0.13	0.677	0.04	0.14	0.005	0.09	0.12	0.095
Estimated IUUV	0.25	0.25	0.750	0.12	0.20	0.047	0.22	0.23	0.237

Table 9 Numbers of introduced and native medicinal plant species for which estimated and actual Index Use Values could be calculated

Origin	Index Use Value	Campo Hermoso	Zetaquira	Both
Introduced	Actual	4	10	25
	Estimated	2	3	38
Native	Actual	11	5	18
	Estimated	7	2	26

The high similarities between estimated and/or actual UV (> 50%) for introduced and native plant species showed little difference in the lists of medicinal plants between the municipalities. For introduced species, similarity values were the highest (Table 10). These results are comparable to the findings of De Almeida et al. [28] who worked with rural communities in the Northeast Brazil.

Overexploitation of medicinal plant species, including a large number of native species, has been discussed extensively. Njoroge et al. [32] found that *Carissa edulis* (Forssk.) Vahl, a native wild species of Ethiopia [33], is a priority species used in the treatment of several ailments, especially for stomach pains, a common disorder in the Mwingi District, Kenya. Presently, this species is threatened by overuse. Similarly, other scholars have reported that plant species most popularly used by communities depend on the kind of local diseases that people face [2], which could be a parameter to identify possible species that could become endangered by overexploitation in combination with knowledge on plant parts used, harvest techniques, demand and prices.

The most frequent diseases in the study sites according to local reports from the health centre service [34] were related to the digestive system and infections caused by bacteria, parasites or fungi. The present study shows that the highest valued species were related to exactly these diseases. Of these, the top five were all introduced (Tables 4 and Table 7) confirming that communities make use of specific plant species including introduced ones.

The large number of plant species used in the treatment of complaints of the digestive system, infections and nervous system in both municipalities, is comparable to other findings from studies involving farmer communities in other localities in department of Boyacá.

Table 10 Jaccard-index similarity (%) between Campo Hermoso and Zetaquira municipalities for medicinal plant species with estimated and actual Index Use Values

Index Use Value	Introduced	Native
Estimated	88	74
Actual	64	53

For example, Lagos [9] found that stomach-complaints occupy the category of illnesses which is treated with the highest number of medicinal plant species, followed by complaints of the nervous system. At the same time, these results are comparable to findings from other places. In the municipalities of the city of Imbituba, Santa Catarina, Brazil Zank and Hanazaki [35] found, that digestive complaints were the disease category with the highest therapeutic applications of medicinal plants. Furthermore, Neves et al. [36], who studied various groups of the community of Trás-os-Montes, Portugal, including farmers, reported that illnesses related to the digestive system were most popularly treated with medicinal plants.

Life form, habitat and proximity to cities facilitate popularity of introduced species

It has been demonstrated in several studies [28,37,38], that life form and habitat specification determine the use of medicinal plant species. The reason usually mentioned is that herbs, of which a large number are introduced, are easy to cultivate and maintain in small gardens or pots near to or in the houses. Examples of species whose popularity can be related to life form and the ease of cultivation are *Ruta graveolens* that has a high medicinal value in Zetaquira, and *Urtica dioica* that is a highly valuable herb in Campo Hermoso. Opposed to the introduction of easily cultivated herbs, a number of ecological factors diminish advantages of cultivation and maintenance of some native plant species.

Among the most popular species of amateur healers (eight species), seven species (87.5%) were introduced, of which six were herbs and only one a shrub (Table 12). In contrast, among healers the tendency to use native species, usually trees or shrubs, is higher: 57% of their most popular species was native and included two herbs and one vine. Since healers are specialised in the use of medicinal plants, they are in most cases willing to cultivate a diversity of species, including trees and shrubs with medicinal values, in their home gardens and on other cultivated lands. Hence, cultivation could explain the popularity of native woody species within the group of healers.

The high significance of introduced plant species according to UV (Table 8) in Zetaquira closer to the capital of the department, Tunja, could be an indication of the influence of distance to modern cities and acculturation upon the adoption of new medicinal plant species. These findings are comparable to results obtained by other studies, e.g. in Brazil, Argentina and Manus Island (Papua New Guinea) [28,39,40]. Inhabitants of Campo Hermoso, which is more remote and follows rural traditions, have higher knowledge on medicinal plant use. Furthermore, there are more healers in Campo Hermoso. Hence, the null

Table 11 Family Use Values (FUV) of most popular plant families calculated from estimated and actual Index Use Values of species and number of native and introduced species per family

Family	Native	Introd.	FUV est. CH	FUV est. Zq	FUV est. Both	FUV act. CH	FUV act. Zq	FUV act. Both
Asteraceae	4	6	0.26	0.28	0.27	0.16	0.16	0.16
Lamiaceae	2	5	0.48	0.59	0.55	0.36	0.43	0.40
Apiaceae	1	3	0.22	0.20	0.21	0.14	0.19	0.17
Rutaceae	0	4	0.67	0.58	0.62	0.39	0.43	0.41
Verbenaceae	4	0	0.53	0.58	0.56	0.39	0.35	0.37
Malvaceae	0	3	0.29	0.07	0.15	0.10	0.04	0.07
Solanaceae	1	2	0.29	0.15	0.20	0.08	0.05	0.07
Urticaceae	2	1	0.48	0.24	0.33	0.23	0.13	0.17
Acanthaceae	2	0	0.13	0.40	0.30	0.00	0.12	0.08
Alliaceae	0	2	0.22	0.22	0.22	0.13	0.06	0.09
Amaranthaceae	1	1	0.44	0.28	0.34	0.31	0.14	0.21
Bignoniaceae	2	0	0.50	0.10	0.26	0.38	0.06	0.18
Commelinaceae	1	1	0.09	0.08	0.09	0.06	0.04	0.05
Myrtaceae	1	1	0.44	0.34	0.38	0.25	0.04	0.12
Phytolaccaceae	2	0	0.31	0.04	0.15	0.25	0.00	0.10
Piperaceae	2	0	0.47	0.04	0.21	0.31	0.00	0.12
<u>Adoxaceae</u>	0	1	0.56	0.72	0.66	0.25	0.24	0.24
<u>Aristolochiaceae</u>	0	1	0.75	0.64	0.68	0.00	0.04	0.02
<u>Asphodelaceae</u>	0	1	0.63	0.64	0.63	0.63	0.60	0.61
<u>Plantaginaceae</u>	0	1	0.81	0.32	0.51	0.31	0.16	0.22
<u>Poaceae</u>	0	1	0.44	0.56	0.51	0.50	0.60	0.56

Bold = plant families with higher number of species (>2); italics = plant families with two plant species; underlined = plant families with one species but high FUV. Est. = estimated; act. = actual; CH = Campo Hermoso; Zq = Zetaquira; both = both municipalities together.

hypothesis of similarity between plant knowledge and use between municipalities is falsified.

High presence of pharmacologic components in herbs and popularity of genera

The high presence of pharmacologic components in herbs makes them attractive for treatments of different diseases [27]. Specifically the high composition of alkaloids in leaves facilitates medicinal uses as has been indicated by the popularity of these plant parts within

Table 12 Most popular species among healers and amateur healers

Amateur healers	Healers
<i>Calendula officinalis</i> L.	<i>Jacaranda copaia</i> (Aubl.) D.Don
<i>Citrus Limon</i> (L.) Burm.F	<i>Aristolochia ringens</i> Vahl.
<i>Petroselinum crispum</i> (Mill.) Nyman ex A.W. Hill	<i>Ruta graveolens</i> L.
<i>Chenopodium ambrosioides</i> L.	<i>Lippia alba</i> (Mill) N.E. Brown
<i>Ruta graveolens</i> L.	<i>Althernanthera lanceolata</i> Benth.
<i>Cymbopogon citratus</i> (DC.) Stapf	<i>Psidium guinense</i> Sw.
<i>Mentha suaveolens</i> Ehrh.	<i>Rubus glaucus</i> Benth.
<i>Allium sativum</i> L.	

several communities [9,25,27,36] and also in the present study. Furthermore, a number of phytochemical studies have proven remarkable alkaloid and oil content in herbal leaves [41-43] which may provide alternatives for the pharmaceutical industry. Taxa with large numbers of useful herbs contribute to the tendency of using leaves and introduced plant species. For example, the genus *Mentha*, one of the most popular taxa in Campo Hermoso and Zetaquira and, was reported to be used in treatments of digestive complaints, colds, fevers, skin infections, inflammations and headaches (Table 4). *Mentha ssp.*, introduced to the American continent, is widely popular in folk medicine [9,35,44] and contribute to the popularity of introduced plant species.

Popularity of plant families

Popularity may also reflect world-wide presence of large plant families, such as the Lamiaceae. Contrary, Schippmann et al. [1], suggest that popularity of plant families is related to the local availability of the species. Studies in diverse localities as for example in Loja province, Ecuador [45], Imbituba, Santa Catarina, Brazil [35], Sierras de Córdoba, Argentina [46], and Banbungo, Cameroon [27] have found Asteraceae and Lamiaceae with high

numbers of plant species used locally. These findings are comparatively similar to the results obtained by ethnobotanical studies carried out in the department of Boyacá, e.g. the studies of Lagos [9] in five municipalities in the central part of Boyacá, and a study carried out in the municipality of San José de Pará by Toscano [10]. The results indicate a large availability of species belonging to the Asteraceae and Lamiaceae in this region. At the same time, these results are comparable to the global pattern suggested by Moerman [47] who considered that Asteraceae and Lamiaceae are among the most used plant families in traditional medicine world-wide.

In relation to the popularity of Asteraceae, Garcia Barriga [48] reported that this family is the taxonomic group of plant species with the highest use in traditional medicine in Colombia. Nevertheless, the large range of distribution of this family may explain part of the popularity of this taxonomic group in folk medicine [27].

Furthermore, plant families, such as the Apiaceae, Apocynaceae and Guttiferae, of which there are examples of species with medicinal use in Campo Hermoso and Zetaquirá, are part of the list of plant families with high numbers of traditionally used species worldwide [1].

However, 85% of the medicinal species identified in this study have been described and reported as medicinal in Colombia [11,48-50]. Of these species, 54% are introduced. This indicates that transmission of knowledge on introduced medicinal species has been successful in Colombia and in the studied municipalities. Similar situations have been observed and discussed in other countries as Brazil [28] where it was observed that knowledge of introduced plant species within farmers communities has been well established.

Promotion, conservation and sustainable use of native medicinal plant species may be facilitated by including shrubs and trees into local agroforestry systems. A number of these species, apart from being medicinal, offer also other kind of uses, e.g. as food, source of wood and shade. Such multiuse plants are often valuable to locals [31].

Conclusions

A total of 80 medicinal plant species were recorded. Of these, 78 species were taxonomically identified of which 35 were native species and 43 were introduced belonging to 74 genera and 41 floristic families. Among the native species 40% were found in natural habitats while twenty-seven per cent of introduced species were found as naturalised in the wild. The families with the highest numbers of species reported as medicinal were: Asteraceae, Lamiaceae, Apiaceae, Rutaceae, Verbenaceae, Malvaceae, Solanaceae and Urticaceae. Most applications of medicinal plants are related to diseases of the digestive and respiratory systems, and infections. Leaves are the most popular plant part

used. Decoctions and oral administration are the most common practices.

The total of medicinal plants uses described by informants was higher in the more remote Campo Hermoso than in the more accessible Zetaquirá. UVs of introduced plant species were significantly higher than native species in the more accessible municipality of Zetaquirá, while there were no significant differences between the two groups in the more remote municipality of Campo Hermoso and nor in the two municipalities combined.

The list of the most popular medicinal plant species for healers and amateur healers respectively showed that 87% of the species from the amateur healers' list were introduced including mainly herbs while in the case of healers, 57% of the species of mainly trees and shrubs. Conversion of forests for agriculture and cattle ranching is depleting local forest resources and a number of medicinal plants were reported as disappearing or locally extinct. Only about 50% of the native medicinal species were found in cultivation. Agroforestry may provide an option for integrating agriculture with cultivation of native trees, shrubs and lianas, not otherwise cultivated. Educational programs could raise awareness in relation to conservation and maintaining use of native species.

Consent

Written informed consent was obtained from the patient for publication of this report and any accompanying images.

Endnotes

^a Group of experts on the use of local medicinal plant species who offer local people treatments using medicinal plants.

^b Group of people who are interested in the use of medicinal plants, but do not work as professional healers.

^c Local term to refer to large home gardens with inclusion of a variety of trees and shrubs.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Ana Lucía Cadena-González was the main responsible for study design, data analysis, interpretation, and writing. She conducted the field work in Campo Hermoso and Zetaquirá between October 2008 and February 2009, collected the plant specimens, and identified the specimens in cooperation with the herbaria. Marten Sørensen and Ida Theilade contributed to the concept and design of the study, interpretation of the findings and preparation of the manuscript. All authors read and approved the final manuscript.

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