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Minimum inhibitory concentrations of medicinal plants used in Northern Peru as antibacterial remedies

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Abstract

Aim—The plant species reported here are traditionally used in Northern Peru to treat bacterial infections, often addressed by the local healers as “inflammation”. The aim of this study was to evaluate the Minimum Inhibitory Concentration (MIC) of their antibacterial properties against Gram-positive and Gram-negative bacteria.

Materials and methods—The antimicrobial activity of ethanolic and water extracts of 141 plant species was determined using a deep-well broth microdilution method on commercially available bacterial strains.

Results—The ethanolic extracts of 51 species inhibited *Escherichia coli*, and 114 ethanolic extracts inhibited *Staphylococcus aureus.* In contrast, only 30 aqueous extracts showed activity against *E. coli* and 38 extracts against *S. aureus.* The MIC concentrations were mostly very high and ranged from 0.008 to 256mg/ml, with only 36 species showing inhibitory concentrations of <4mg/ml. The ethanolic extracts exhibited stronger activity and a much broader spectrum of action than the aqueous extracts. *Hypericum laricifolium*, *Hura crepitans*, *Caesalpinia paipai*, *Cassia fistula*, *Hyptis sidifolia*, *Salvia* sp., *Banisteriopsis caapi*, *Miconia salicifolia* and *Polygonum hydropiperoides* showed the lowest MIC values and would be interesting candidates for future research.

Conclusions—The presence of antibacterial activity could be confirmed in most species used in traditional medicine in Peru which were assayed in this study. However, the MIC for the species employed showed a very large range, and were mostly very high. Nevertheless, traditional knowledge might provide some leads to elucidate potential candidates for future development of new antibiotic agents.

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Keywords

South America; Medicinal Plants; ethnobotany; Minimum Inhibitory Concentration (MIC); antibacterial; *Escherichia coli*; *Staphylococcus aureus*

1. Introduction

In developing countries, Traditional Medicine (TM) is often the only accessible and affordable treatment available. In Latin America, the World Health Organization (WHO) Regional Office for the Americas (AMRO/PAHO) reports that 71% of the population in Chile and 40% of the population in Colombia have used TM. In many Asian countries TM is widely used, even though Western Medicine is often readily available. In the US the number of visits to providers of Complementary Alternative Medicine (CAM) now exceeds by far the number of visits to all primary care physicians (WHO 1999a,b; 2002), and CAM is becoming increasingly popular in many developed countries (WHO 1998), and a US survey reported the use of at least one of 16 alternative therapies increased from 34% in 1990 to 42% in 1997 (UNCCD 2000).

The expense for the use of TM and CAM is growing exponentially in many parts of the world. The 1997 out-of-pocket CAM expenditure was estimated at $ 2.7 billion in the USA. The world market for herbal medicines based on traditional knowledge is now estimated at US$ 60 billion (Breevort 1998).

Peru is a country rich in biodiversity. For millennia, traditional healers have used the rich flora to cure ailments. The same plants are still being used today. TM continues to be very popular since a large part of the population has either no access to, or no resources to afford Western Medicine. Bacterial infections and inflammation are among the ailments treated by traditional healers. Northern Peru is believed to be the center of the Central Andean Health Axis (Camino 1992), and TM practices in this region remain an important component of everyday life (Bussmann and Sharon 2006; De Feo 1992; Joralemon and Sharon 1993; Polia 1988; Revene et al. 2008; Sharon 1978, 1980, 1994, 2000; Sharon and Bussmann 2006). TM is also gaining more and more respect by national governments and health providers. Peru's National Program in Complementary Medicine and the Pan American Health Organization recently compared Complementary Medicine to allopathic medicine in clinics and hospitals operating within the Peruvian Social Security System (EsSalud 2000). The WHO has expressed high interest in TM. It is important to demonstrate scientifically that the remedies employed in folk medicine are indeed therapeutically active (Baker et al. 1995; Cox and Balick 1994; Elisabetsky and Castilhos 1990; Farnsworth et al. 1985; Muñoz and Sauvain 2002).

Plants with potential medicinal activity have recently come to the attention of Western scientists, and studies have reported that some are bioactive (e.g. Perumal Samy and Ignacimuthu 2000). Potentially active compounds have been isolated from a few of the plants tested (D'Agostino et al. 1995a,b; Okuyama et al. 1994; Rodriguez et al. 1994; Umana and Castro 1990). Plant species from the Cordillera Blanca in Peru, demonstrated antimicrobial, anti-cancer, and wound-healing activities (Bussmann et al. 2008, 2009a,b; Hammond et al. 1998;, Lee at al. 1999; Neto et al. 2002; Villegas et al. 1997). However, despite the fact that the center of healing traditions in Northern Peru is located in the Trujillo/Chiclayo coastal region, no in-depth studies had been undertaken.

In this communication we report on antibacterial assays for 141 plant species with a wide range of traditional uses.

2. Materials and Methods

2.1. Plant Material

Plants were collected in Northern Peru (Fig. 1) in the field, in markets, and at the homes of traditional healers (*curanderos*) during August-September 2001, July-August 2002, July-August 2003, June-August 2004, July-August 2005, July-August 2006, June-August 2007, June-August 2008, March-April 2009 and June-August 2009. The specimens are registered under the collection series "JULS," "ISA," "GER," "EHCHL," "RBU/PL," "ACR," "KMM," and AKT," depending on the year of fieldwork and collection location. Surveys were conducted in Spanish by fluent speakers. Surveyors would approach healers, collectors and market vendors and explain the premise for the study, including the goal of conservation of medicinal plants in the area. All were asked to participate, but due to expected resistance information could not be recorded from everybody. From those who gave their prior informed consent, information was collected regarding their knowledge and inventory of medicinal plants.

Vouchers of all specimens were deposited at the Herbarium Truxillense (HUT, Universidad Nacional de Trujillo), and Herbario Antenor Orrego (HAO, Universidad Privada Antenor Orrego, Trujillo). In recognition of Peru's rights under the Convention on Biological Diversity, most notably with regard to the conservation of genetic resources in the framework of a study treating medicinal plants, the identification of the plant material was conducted entirely in Peru. No plant material was exported in any form whatsoever.

2.2. Nomenclature

The nomenclature of plant families, genera, and species follows the *Catalogue of the Flowering Plants and Gymnosperms of Peru* (Brako and Zarucchi 1993) and the *Catalogue of the Vascular Plants of Ecuador* (Jørgensen and León-Yanez 1999). The nomenclature was compared to the TROPICOS database (Tropicos, 2010). Species were identified using the available volumes of the *Flora of Peru* (McBride 1936–1981), as well as Jørgensen and Ulloa Ulloa (1994), Pestalozzi (1998) and Ulloa Ulloa and Jørgensen (1993), and the available volumes of the *Flora of Ecuador* (Sparre and Harling 1978–2009), and reference material in the herbaria HUT, HAO, QCA, LOJA and QCNE.

2.3. Preparation of Extracts

For each species tested, above ground material (in case of trees leaves or bark as indicated by the collaborating healers) was collected, and the entire material used for extract preparation. This corroborates with the traditional preparation (Bussmann and Sharon 2006). Plant material was dried at 35°C for three days. After drying, the material was ground with an industrial grinder, and 2 samples of 5g. of plant material each were weighted out. One sample was submerged in 100ml of 96% ethanol and left to macerate for 7 days, while another sample was submerged in 100ml of boiling distilled water and left to macerate for 24h. After maceration the plant material was filtered and 100 ml 96% ethanol was added to the water extracts to allow faster solvent removal. The solvent was then evaporated to complete dryness using a standard Buchi rotary-evaporator. The resulting dry extracts were re-suspended in 5 ml distilled water. In order to determine the real concentration of each extract, 1ml of previous homogenization of the respective extracts was removed and again completely oven-dried and then weighed to determine amount of extract per ml of final solution. The remaining extract was used for MIC assays.

2.4. Antimicrobial assays

2.4.1. Bacteria and culture media—*Staphylococcus aureus* ATCC 25923 (Gram-positive) and *Escherichia coli* ATCC 25922 (Gram-negative) were used for the current study. Bacterial cultures were grown on 5% sheep red blood agar (SBA). Following the initial incubation, organisms were suspended in 10ml of physiological saline solution and optical density readings were compared to a 0.5 McFarland standard. For the MIC determination bacterial solutions of 5×10^5 colony-forming units (cfu) ml were employed.

2.4.2. Minimal inhibitory concentration (MIC) determination—The antibacterial activity of the plant extracts was determined using sterile 2ml 96-well plates (Wiegand et al. 2008). The 12 wells of each row were filled with 0.5 ml sterilized Mueller Hinton agar. Sequentially, wells 2–11 received an additional 0.5 ml of a mixture of culture medium and plant extract serially diluted to create a concentration sequence from 0.512 ml to 0.008 ml. Well 1 served as growth control, well 12 as antibiotic control. Tetracycline Hydrochloride (0.1mg/ml) and Amoxicillin (0.1mg/ml) were used as controls for the *S. aureus* and *E. coli* assays respectively. The respective antibiotics were chosen because they are often employed as first line antibiotics in the respective bacterial infections. The MIC of Tetracycline Hydrochloride (for *S. aureus* assays) was 0.25 μg/ml and the MIC of Amoxicillin (for *E. coli* assays) was 8 μg/ml. The deep-wells were incubated for 24h at 37°C. The resulting turbidity was observed, and after 24h MIC was determined to be where growth was no longer visible by assessment of turbidity by optical density readings at 600nm with a Beckman DU-70 UV-Vis Spectrophotometer. At least three repetitions were run for each assay. Strong activity was defined as MIC < 5 mg/ml.

3. Results and Discussion

The selection of plant material for this study was based on ethnobotanical data on the traditional use of the plants in treatment of bacterial diseases, and conditions classified by the traditional healers as “infection” and “inflammation,” the latter characterized by reddening (e.g. in wounds), or internal afflictions causing gastric discomfort (Table 1). The plant species were initially tested in simple agar-bioassays, which included plants that are used or other purposes by the local population (Bussmann et al. 2007,2008,2009a,b). The initial testing yielded 141 species with antibacterial activities which were chosen for this study to establish their MIC values. Because many traditional preparations are prepared by maceration in ethanol or water, we tried to use both extraction methods to prepare the starting extracts for this study.

Table 1 shows the antibacterial activity of Northern Peruvian medicinal plants against Gram-positive and Gram-negative bacteria. The extracts were subjected to the determination of MIC values. The ethanolic extracts of 51 species inhibited *Escherichia coli*, and 114 ethanolic extracts inhibited *Staphylococcus aureus.* In contrast, only 30 water extracts showed activity against *E. coli* and 38 extracts against *S. aureus.* The MIC concentrations ranged from 0.008 to 256mg/ml. The very high values in many species indicate only a very limited antibacterial efficacy. The ethanolic extracts exhibited stronger activity and a much broader spectrum of action than the water extracts. The most interesting activity on *E. coli* was obtained from ethanolic extracts of *Baccaris* sp., *Ochroma pyramidale*, *Croton lechleri*, *Banisteriopsis caapii*, *Miconia salicifolia*, and *Eugenia obtusifolia*. Only the latter species also showed strong activity in the aqueous extract. A much wider range of species, including most species active against *E. coli* showed inhibition of *S. aureus. Poropohyllum ruderale, Senecio* sp., *Corynaeae crassa*, *Dioscorea trifida*, *Senna monilifera*, *Spartium junceum*, *Pelargonium odoratissimum*, *Satureja pulchella*, *Cuphea* sp., *Malva parviflora*, *Brosmium rufescens*, *Syzygium aromaticum*, *Sanguisorba minor*, *Citrus limetta*, *Verbesine* sp. and 2

unidentified species all showed MIC values between 1–4mg/ml. Most of them however did not portray any efficacy in aqueous extract. *Hypericum laricifolium*, *Hura crepitans*, *Caesalpinia paipai*, *Cassia fistula*, *Hyptis sidifolia*, *Salvia* sp., *Banisteriopsis caapi*, *Miconia salicifolia* and *Polygonum hydropiperoides* showed the lowest MIC values and would be interesting candidates for future research. Most MIC values reported in this work were largely higher than those obtained for South American species (Bastos et al. 2009;Jimenez et al. 2001;Meléndez et al. 2006;Zampini et al. 2009) and African studies (Kirira et al. 2006). However, they were in range or lower than concentrations reported by Kloucek et al. (2007),Nascimento et al. (2000) and Psewu et al. (2008).

Most species effective against *S. aureus* are traditionally used to treat wound infection, throat infections, serious inflammations, or are post partum infections. Interestingly many species used in cleansing baths also showed high activity against this bacterium. Many of these species are either employed topically, or in synergistic mixtures, so that possible toxicity seems not to be an issue. The species effective against *E. coli* were mostly employed in indications that traditional healers identified as “inflammation”.

Most of the plants used by the healers have antibacterial activity, but only 8 of the 141 plants (5.6%) examined in this study show any MIC values of 200 or less mg/ml of extract. Of these 8 plants 5 are used to treat diseases believed to be in bacterial origin by TM, one is a disease not believed to be caused by bacteria and one is used for undefined treatment purposes.

Nine out of 141 plants (6.3%) tested that were not used for diseases believed to be bacterial in origin by TM, 5 showed high antibacterial activity with MIC values below 16 mg/ml. Four of these were among the most potent plants tested with MIC values of 2 or less mg/ml including the hallucinogen and extracts used to treat diabetes and epilepsy. Diseases such as diabetes often compromise the health of the individual and antibacterial treatments can be warranted for secondary complications of the disease. In addition, TM does determine sometimes that diseases not originally believed to be bacterial in origin, such as ulcers, are actually caused by bacteria. Currently TM is seriously looking the role of inflammation (which can certainly be bacterial in origin) in heart disease.

The results presented in this paper demonstrate that most of the plants used by the healers in Peru to treat disease of bacterial origin do show limited antibacterial activity and that some treatments for diseases not currently believed to be of bacterial origin also show antibacterial activity. These facts support the medicinal value of traditional Peruvian remedies and suggest that those plants widely used by the curanderos could be new sources of antibacterial therapies.

4. Conclusions

The antibacterial activity of 141 ethanolic and aqueous extracts belonging to 140 plant species used in TM in Northern Peru was demonstrated. Most species tested showed limited antibacterial activity. It is important to note however, that most species are not employed as single plant extracts in the traditional context. The results indicate that the often very elaborate traditional knowledge can serve as guideline to provide leads for further testing of potentially interesting plants that can serve for further studies that would allow the clinical validation of the traditional uses and the application of the species in modern treatment forms. Further studies on the toxicity of the species employed, as well as their application in often complex traditional mixtures would allow to elucidate possible candidates for future development of antimicrobial agents.

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Figure 1.
Study area: Peruvian Departments of Amazonas, Piura, Lambayeque, La Libertad, Cajamarca, San Martin, and the Ecuadorian Province of Loja.

Table 1

Minimum Inhibitory Concentration (MIC) for plants tested

Family	Scientific name	Common name	MIC *E. coli* (ethanol extract) mg/ml	MIC *S. aureus* (ethanol extract) mg/ml	MIC *E. coli* (H_2O extract) mg/ml	MIC *S. aureus* (H_2O extract) mg/ml	Traditional antibacterial use?	Collection #
Adiantaceae	*Adiantum concinnum* Willd.	Culantrillo		8			Blood purification	ACR91
Amaranthaceae	*Alternanthera porrigens* (Jacq.) Kuntze	Moradillo Blanco		16			Inflammation	ACR149
Amaranthaceae	*Gomphrena globosa* L.	Siempre viva (corta)		16			Inflammation	ACR191
Amaranthaceae	*Iresine herbstii* Hook.	Colores	256				Inflammation	ACR162
Amaryllidaceae	*Eustephia coccinea* Cav.	Pumapara		32			Inflammation	ACR119
Annonaceae	*Annona muricata*L.	Guanabana		128			Inflammation	ACR81
Apiaceae	*Apium graveolens* L.	Apio del Campo	32	256			Inflammation	KMM439
Apocynaceae	*Nerium oleander* L.	Laurel		128		64	Wounds	ACR34
Apocynaceae	*Vallesia glabra* (Cav.) Link	Cuncuno	64	16	32		Snake bite	ACR192
Aquifoliaceae	*Ilex guayusa* Loes.	Gauyusa		16	128		Inflammation	KMM513
Asteraceae	*Achyrocline alata* (Kunth) DC	Hierba de Ishpingo		8	32	32	Spiritual cleansing	AKT1199
Asteraceae	*Baccharis vaccinioides* Kunth	Sigueme Sigueme		64	64		Spiritual cleansing	KMM565
Asteraceae	*Baccharis* sp	Chilca Chica	2	4	8	8	Inflammation	KMM562
Asteraceae	*Bidens pilosa* L.	Amor seco		16		32	Inflammation kidneys	KMM427
Asteraceae	*Diplostephium sagasteguii* Cuatrec.	Gato Cimuro	8	8	8	8	Spiritual cleansing	AKT1192
Asteraceae	*Eupatorium* cf. *gayanum* Wedd.	Asma chilca		32		32	Bronchitis	KMM555
Asteraceae	*Gamochaeta* sp.	Lechuguilla		8			Spiritual cleansing	ACR41
Asteraceae	*Matricaria recutita* L.	Manzanilla	16	32			Wounds	ACR6
Asteraceae	*Munnozia lyrata* (A. Gray) Rob. & Brett.	Caniahuanga				16	Spiritual cleansing	KMM519
Asteraceae	*Munnozia* sp.	Salvia Blanca		128			Spiritual cleansing	ACR148
Asteraceae	*Porophyllum ruderale* Less.	Hierba de Gallinazo		4			Spiritual Cleansing	KMM515
Asteraceae	*Pseudogynoxys cordifolia* (Cass.) Cabrera	San Juan	32	16			Spiritual Cleansing	AKT1168
Asteraceae	*Schkuhria pinnata* (Lam.) Kuntze	Encanchallacha	64	128			Inflammation kidneys	ACR17
Asteraceae	*Senecio* cf. *tephrosioides* Turcz.	Huamanripa	64	64	32	32	Bronchitis	ACR65

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Asteraceae	*Senecio* sp.	Huamanripa	64				Inflammation	KMM449
Asteraceae	*Senecio* sp.	Ornamo	8	2		64	Inflammation	KMM480
Asteraceae	*Tagetes erecta* L.	Flor de Muerto	16	16	64	64	Inflammation	JULS156
Asteraceae	*Tagetes filifolia* Lag.	Anis	16	16			Diarrhea	KMM524
Asteraceae cf.		Chunguez					Inflammation	KMM405
Asteraceae		Hierba del Amor				8	Inflammation	KMM522
Balanophoraceae	*Corynaea crassa* Hook.f.	Huanarpo		2			Impotence	KMM474
Berberidaceae	*Berberis buceronis* J.F. Macbr.	Palo Amarillo	16				Hepatitis	KMM573
Bignoniaceae	*Jacaranda acutifolia* Humb. & Bonpl.	Arabisco	32	16			Bronchitis	ACR89
Bombacaceae	*Ochroma pyramidale* (Cav. ex Lam.) Urb.	Balsa	1					ACR206
Boraginaceae	*Borago officinalis* L.	Borraja	16	8	32	8	Bronchitis	ACR9
Brassicaceae	*Rorippa nasturtium-aquaticum* (L.) Hayek	Berros	64	64			Bronchitis	AKT1163
Bromeliaceae	*Tillandsia cacticola* L.B. Sm.	Siempre viva		16			Spiritual cleansing	ACR183
Cactaceae	*Opuntia ficus-indica* (L.) Mill.	Tuna	128				Diabetes	AKT1220
Campanulaceae cf.	*Centropogon* sp.	Trinoso	16	16	8	4	Liver	KMM545
Capparidaceae	*Capparis scabrida* Kunth	Zapote	16	8	64		Inflammation	KMM554
Caprifoliaceae	*Sambucus peruviana* Kunth	Flor de Novia	32	32		32	Bronchitis	KMM539
Chenopodiaceae	*Chenopodium ambrosioides* L.	Paico		8			Parasites	ACR31
Chloranthaceae	*Hedyosmum racemosum* (Ruiz. & Pav.) G. Don.	Asarsito		8			Bronchitis	KMM505
Clethraceae	*Clethra castaneifolia* Meiss.	Hierba del Olvido		16			Spiritual cleansing	KMM549
Clethraceae	*Clethra castaneifolia* cf. Meiss.	Olvido	32	64			Spiritual cleansing	ACR109
Clusiaceae	*Hypericum laricifolium* Juss.	Pachuli		0.16		16	Spiritual cleansing	AKT1172
Cucurbitaceae	*Sicana odorifera* Naudin	Sicana		128			Spiritual cleansing	ACR96
Dioscoreaceae	*Dioscorea tambillensis* Kunth	Papa Semitona		16			Inflammation	KMM583
Dioscoreaceae	*Dioscorea trifida* L.f.	Papa Madre		4			Wounds	KMM503
Dipsaceae	*Scabiosa atropurpurea* L.	Ambarina		32			Bronchitis	ACR158

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Ephedraceae	*Ephedra americana* Engl.	Diego Lopez	64	32	32	32	Wounds	KMM511
Equisetaceae	*Equisetum bogotense* Kunth	Cola de Caballo		64			Wounds	ACR1
Ericaceae	*Bejaria aestuans* L.	Hierba de la Postema		16			Inflammation	KMM527
Ericaceae	*Gaultheria reticulata* Vent.	Maique		128			Spiritual cleansing	KMM531
Euphorbiaceae	*Croton lechleri* Müll. Arg.	Sangre de Grado	4	2		4	Wounds	KMM546
Euphorbiaceae	*Hura crepitans* L.	Habilla		1			Wounds	AKT1225
Euphorbiaceae	*Jatropha macrantha* L.	Hoja de piñon				32	Wounds	KMM487
Fabaceae	*Caesalpinia paipai* Ruiz. & Pav.	Pai Pai		1			Wounds	KMM581
Fabaceae	*Caesalpinia spinosa* (Molina) Kuntze	Tara	64	16			Wounds	ACR111
Fabaceae	*Cassia fistula* L.	Caña fistula		1			Epilepsy	ACR88
Fabaceae	*Medicago sativa* L.	Trebol de aqua	64				Bronchitis	KMM463
Fabaceae	*Senna bicapsularis* (L.) Roxb.	Alcaparilla	0.016	256	16		Blood purification	ACR194
Fabaceae	*Senna monilifera* H.S. Irwin & Barnaby	Sen		4			Cleansing stomach	KMM470
Fabaceae	*Spartium junceum*L.	Ratania		4			Blood purification	AKT1222
Gentianaceae	*Gentianella bicolor* (Wedd.) J.S. Pringle	Corpus Way	8	8		16	Blood purification	KMM526
Gentianaceae	*Gentianella dianthoides* (Kunth) Fabris ex J.S. Pringle	Chagape		64			Blood purification	ACR155
Geraniaceae	*Erodium cicutarium* (L.) L'Her.	Agujilla		64	16	4	Inflammation	AKT1171
Geraniaceae	*Geranium sessiliflorum* Cavanilles	Pasuchaca		64		8	Inflammation	ACR38
Geraniaceae	*Geranium sessiliflorum* Cavanilles	Pasuchaca		32			Inflammation	KMM400
Geraniaceae	*Pelargonium odoratissimum* Soland. cf.	Malva de Olor		2			Inflammation womb	ACR26
Krameriaceae	*Krameria lappacea* (Dombey) H.M. Burdet & B.B. Simpson	Ratamia		128			Inflammation	ACR48
Lamiaceae	*Hyptis sidifolia* (L'Her.) Briq.	Pedorera		1			Gastritis	ACR69
Lamiaceae	*Hyptis* sp.	Albaca Serrana		256			Gastritis	ACR18
Lamiaceae	*Mentha x piperita* L.	Poleo		16		64	Inflammation	ACR68
Lamiaceae	*Mentha spicata* L.	Menta			32		Parasites	KMM453
Lamiaceae	*Minthostachys mollis* (Kunth) Griseb.	Chancas del muerto	16				Inflammation	AKT1142

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Lamiaceae	*Ocimum basilicum* L.	Albaca		16			Inflammation	KMM437
Lamiaceae	*Origanum vulgare* L.	Oregano		128			Inflammation	KMM509
Lamiaceae	*Otholobium mexicanum* (L.f.) Grimes	Culen		8			Diarrhea	ACR67
Lamiaceae	*Salvia* sp.	Alamo Silvestre		8	16	8	Inflammation	ACR184
Lamiaceae	*Salvia* sp.	Paja Amargoza		1			Inflammation	KMM567
Lamiaceae	*Satureja pulchella* (Kunth.) Briq.	Panizara	16	2	32		Bronchitis	KMM543
Lamiaceae	*Satureja sericea* (C. Presl. & Benth.) Briq.	Romerillo	16	16	8		Inflammation	KMM397
Lauraceae	*Cinnamomum verum* J. Presl.	Canela					Bronchitis	KMM575
Lauraceae	*Persea americana* Mill.	Palta		16			Diarrhea	AKT1120
Lycopodiaceae	*Huperzia* sp.	Condor Misha			16		Spiritual cleansing	KMM479
Lycopodiaceae	*Lycopodium* sp.	Guamingo	64				Spiritual cleansing	AKT1206
Lythraceae	*Cuphea* sp.	Hierba del Toro		32			Blood purification	AKT1102
Lythraceae	*Cuphea* sp.	Hierba del Toro	8	8		4	Blood purification	KMM448
Malvaceae	*Malva parviflora* L.	Malva Rosa		2			Wounds	AKT1200
Malvaceae	*Malva* cf. *sylvestris* L.	Malva Blanca	16	8			Wounds	ACR8
Malpighiaceae	*Banisteriopsis caapi* (Spruce ex Grieseb.) Morton	Ayahuasca	0.0625	1			Hallucinogen	ACR135
Maranthaceae	*Monotagma plurispicatum* (Koern.) Schum.	Patiquina						ACR114
Melastomataceae	*Brachyotum naudinii* Triana	Carcilleja	16	8	16	8	Blood circulation	ACR140
Melastomataceae	*Micronia salicifolia* (Bonpl. ex Naud.) Naud.	Porontillo	2	0.0625	16	8	Blood purification	KMM544
Menispermaceae	*Abuta grandifolia* (Mard.) Sandwith.	Abuta		8			Inflammation	ACR136
Monimiaceae	*Peumus boldus* Molina cf.	Boldo					Inflammation kidneys	AKT1132
Moraceae	*Brosimum rubescens* Taub.	Palo Sangre		4		2	Inflammation	KMM570
Myrtaceae	*Eucalyptus globulus* Labill	Eucalipto		8			Bronchitis	AKT1110
Myrtaceae	*Eugenia obtusifolia* Cambess.	Limoncillo/Arra yan	16	2	2	2	Inflammation	ACR19
Myrtaceae	*Eugenia obtusifolia* Cambess.	Limoncillo/Arra yan	8	4	32	0.008	Inflammation	ACR180
Myrtaceae	*Psidium guajava* L.	Guanabana		16			Liver	KMM399

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Myrtaceae	*Scutia spicata* Weberb. in J.F. Macbr.	Pus		512			Spiritual cleansing	ACR207
Myrtaceae	*Syzygium aromaticum* (L) Merr. & L.M. Perry	Clavo de olor	8	2	32		Inflammation	ACR188
Myrtaceae	*Syzygium jambos* (L.) Alston	Poma Rosa		8			Diarrhea	ACR174
Olacaceae	*Heisteria acuminata* (Humb. & Bonpl.) Engl.	Chuchu Wasi	32				Cough	KMM507
Onagraceae	*Fuchsia* sp.	Añasquero	8			64	Colds	AKT1187
Orchidaceae	*Epidendrum* sp.	Hierba de la Espada		64			Spiritual cleansing	AKT1177
Passifloraceae	*Passiflora punctata* L.	Norgo	16	16			Inflammation	KMM510
Piperaceae	*Piper aduncum* L.	Matico		16		32	Wounds	ACR12
Plantaginaceae	*Plantago sericea* Ruiz. & Pav.var. *lanuginosa* Grieseb.	Paja Blanca		16			Vaginal discharge	AKT1182
Poaceae	*Arundo donax* L.	Carrizo		16			Hemorrhoids	KMM389
Polygonaceae	*Polygonum hydropiperoides* Michaux cf.	Pica Pica		1			Wounds	ACR80
Polypodiaceae	*Cheilanthes myriophylla* Desv.	Cuti Cuti		32			Spiritual cleansing	KMM461
Polypodiaceae	*Cheilanthes myriophylla* Desv.	Cuti Cuti	32	32			Spiritual cleansing	AKT1108
Proteaceae	*Oreocallis grandiflora* R. Br.	Chucharilla		2			Inflammation uterus	ACR176
Ranunculaceae	*Laccopetalum giganteum* (Wedd.) Ulbrich	Pacra	16	32	64	32	Bronchitis	AKT1119
Rosaceae	*Cydonia oblonga* Mill.	Membrillo		15			Heart problems	ACR56
Rosaceae	*Margyricarpus pinnatus* (Lam.) Kuntze	China Linda						ACR146
Rosaceae	*Polylepis racemosa* Ruiz. & Pav.	Quinal		8			After birth	ACR3
Rosaceae	*Rubus robustus* C. Presl.	Zarzamora		32			Wounds	ACR70
Rosaceae	*Sanguisorba minor* Scop.	Pimpinella		4			Blood purification	ACR23
Rubiaceae	*Cinchona officinalis* L.	Cascarilla		16			Cough	ACR123
Rubiaceae	*Morinda citrifolia* L.	Noni	32	32		64	Inflammation	ACR160
Rutaceae	*Citrus limetta* Risso	Lima		2			Inflammation	KMM425
Scrophulariaceae	*Capraria peruviana* Bentham	Te de Indio				32	Inflammation of kidneys	KMM574
Scrophulariaceae		Chiciricoma		32				KMM440
Smilacaceae	*Smilax* sp.	Palo China		32			Cancer	KMM516

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Solanaceae	*Cestrum auriculatum* L'Her.	Hierba Santa			32	32	Typhoid	ACR36
Solanaceae	*Cestrum* sp.	Agrasejo			64		Inflammation	AKT1121
Solanaceae	*Solanum americanum* Mill.	Hierba Mora	128				Flu	ACR37
Valerianaceae	*Valeriana* cf. *bonplandiana* Wedd.	Fortuna	8		32		Spiritual cleansing	ACR181
Valeriana	*Valeriana plantaginea* Kunth	Ornamo Caballero		32			Purgative	ACR120
Valerianaceae	*Valeriana* sp. cf.	Ornamo		8			Spiritual cleansing	AKT1141
Verbenaceae	*Verbena litoralis* Kunth.	Bervena				64	Inflammation	ACR13
Verbenaceae	*Verbesine* sp.	Sabadilla	8	2	64	4	Spiritual cleansing	ACR154
Viscaceae	*Phoradendron* cf.	Suelda con suelda					Inflammation	ACR189
		Ajo Caspi	128	32				ACR133
		Arnica		128			Inflammation	ACR193
		Beldaco		2	32	2		KMM501
		Huarate		2			Diabetes	AKT1209