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Preliminary Ethnopharmacological Survey of Plants Used in Mexico for the Treatment of Hypertension

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ABSTRACT

Traditional Mexican medicine is one of the most important health systems in the world, among Chinese and Indian systems. Furthermore, medicinal plants play an important role in these systems. Investigation of medicinal plants allowed the isolation of several active compounds that have been used as leads for the developing of several therapeutic agents. In this context, from our continuous effort for the investigation of Mexican medicinal plants from different point of views, in this opportunity we are reporting a preliminary ethnopharmacologic, chemical and pharmacological survey of 186 plant species used in Mexico for the treatment of hypertension. From these, it was registered a total of 163 genera and 76 families and is important to mention that the most abundant were Asteraceae (17), Lamiaceae (12), Solanaceae (11), Fabaceae (10) and Rutaceae (8). Moreover, 85 were wild type. To the best of our knowledge, 47% of the total was studied at least once from phytochemical point of view and 74% were subjected to investigation of *in vitro* and *in vivo* pharmacological assays. These last investigations were carried out in order to validate their medicinal uses as antihypertensive agents in the Mexican traditional medicine.

Keywords: antihypertensive, ethnomedicinal knowledge, Mexican medicinal plants, vasorelaxant effect.

INTRODUCTION

The ancestral model of traditional medicine (TM) is a real choice as an alternative treatment of different diseases. The vast majority of people on this planet still rely on their traditional *materia medica* (medicinal plants and other materials) for their everyday health care needs. It is also a fact that one quarter of all medical prescriptions are formulations based on substances derived from plants or plant-derived synthetic analogs, and according to the World Health Organization (WHO), 80% of the world's population primarily those of developing countries rely on plant-derived medicines for their health care. Plants have formed the basis of sophisticated traditional medicine systems that have been in existence for thousands of years and continue to provide mankind with new remedies. Although some of the therapeutic properties attributed to plants have proven to be erroneous, medicinal plant therapy is based on the empirical findings of hundreds and thousands of years (1).

The interest in Nature as a source of potential chemotherapeutic agents continues. Natural products and their derivatives represent more than 50% of all drugs in clinical use in the world. Higher plants contribute no less than 25% of the total. During the last 40 years, at least a dozen potent drugs have been derived from flowering plants including *Dioscorea* species derived diosgenin from which all anovulatory contraceptive agents have been derived; reserpine and other anti-hypertensive and tranquilizing alkaloids from *Rauwolfia* species; pilocarpine to treat glaucoma and "dry mouth", derived from a group of South American trees (*Pilocarpus* species) in the Citrus family; two powerful anti-cancer agents from the Rosy Periwinkle (*Catharanthus roseus L.*); laxative agents from *Cassia* sp. and as a cardiotonic agent to treat heart failure from *Digitalis* species (1).

Hypertension, defined as an elevation of systolic and/or diastolic blood pressure to above 140/90 mm Hg, is the most common cardiovascular disease. Hypertension is a major risk factor for endothelial dysfunction, metabolic syndrome, diabetes, renal dysfunction, congestive heart failure, coronary artery disease and stroke (2). These diseases are the most important causes of death in the world. Almost 15% of the world population has been diagnosed with hypertension. On the other hand, the most highly used drugs for hypertension therapies are generally expensive and they have adverse effects; consequently, patients show low adherence and difficulty of the treatment (3). In Mexico, hypertension is one of the most important public health problems. In the year 2005, 5,14,246 deaths were registered in people between 15 to 65 years old and, 99,893 were provoked by hypertension-related diseases, becoming the first cause of death (4). Although there is availability of low-cost therapy, the Mexican folk medicine policies promote the use of medicinal plants for the treatment of different diseases (5), and some herbal medicines are real choices for treatment of hypertension (6, 7). In this framework, in the present study we are reporting a preliminary ethnopharmacologic, chemical and pharmacological survey of 186 plant species used in Mexico for the treatment of hypertension.

DATA BANK ELABORATION AND SYSTEMATIZATION OF THE ETHNO-BOTANIC INFORMATION

This section was elaborated with the purpose of to obtain a floristic list of several species used in Mexican folk medicine for the treatment of hypertension. In this context, it was generated a data bank from various bibliographic fonts as several valuable national or stately reviews (7-14) and catalogs or inventories (15-21). In addition, other data were found it in many of the ethnobotanical thesis, monographs and/or poster presentation in several national and international meetings on specific regions (22-28). Scientific names were corroborated with The International Plant Names Index (IPNI) database and the reports on phytochemical investigation was obtained from the Dictionary of Natural Products on CD-ROM Version 11.2 (1982-2003), as well as from the direct examination of Chemical abstract (2003-2005) and Pubmed data base.

GENERAL DISCUSSION

In this paper we are reporting 186 plant species that are used in Mexican folk medicine as antihypertensive agents (Table 1). All of these plants are belonging to 163 genera and 76 families. In this context, the most frequent is the Asteraceae family representing the 9.13% of the total (17 plant species), following by Lamiaceae (12 plant species, 6.45%), Solanaceae (11 plant species, 5.91%), Fabaceae (10 plant species, 5.37%) and Rutaceae (8 plant species, 4.30%).

It is important to mention that the major amount information about plants species described here, were obtained from records of medicinal plants databanks stated by "Instituto Nacional Indigenista" (7), as well as by described regional studies in professional thesis, technical reports, or those that only appear in scientific meetings of national or international issue. Thus, the number of medicinal plants which could be used for the treatment of the hypertension increase drastically, and that is the reason why we considered that the Mexican population uses about 300 vegetal species to treat this suffering. However, is this opportunity we decide to report most used plants for Mexican people in folk medicine.

With respect to the origin of the reported species, we confirmed the contributions from other continents to the Mexican ethnomedicine, with the registry of 89 (48%) species from Europe, Asia or Africa origin, whereas 97 (52%) are endemic species from Mexico or from the American continent. From their biological status, 89 (47.84%) are wild, 75 (40%) cultivated and 22 (12%) could be in wild state or cultivated.

In elderly Mexico, there was a tradition in the culture of medicinal plants, through establishment of gardens that worked like research centres and education, in where botanical and zoological investigations were made, nevertheless, that tradition was disappeared, and in current time it is known that more than 90% of the medicinal plants that are consumed come from wild populations without some type of sustainable handling (29). Today, the culture of medicinal plants is an activity that is made in the familiar orchards and most of plants described in this work are exotic.

About 60% of cultivated plants with antihypertensive effect (59) came from other continents unlike America, being most common *Allium cepa* L, *Anethum graveolens L.*, *Cannabis sativa* L., *Citrus limetta* Risso, *Cinnamomun verum* J. Presl, *Cymbopogon citratus* Stapf, *Ficus carica* L., *Lactuca sativa* L., *Musa paradisiaca* L., *Pimpinella anisum* L. and *Saccharum officinarum* L. On the other hand, from the total of medicinal plants reported in this revision, 139 of them have been subject to chemical studies to identify the components into themselves. Additionally, 47% of them have been studied from pharmacological point of view in order to demonstrate and validate the medicinal use as antihypertensive agents. Instead, we reviewed current information about some commonly known plants used in Mexico to treat hypertension and summarize the ethnobotanical, pharmacognostical, phytochemical and pharmacological data of main species reported as antihypertensive agent in Mexico (Table 1).

Without doubt, large number of plants is used in Mexico for the treatment of hypertension and its complications. Nevertheless, there are poorly pharmacological studies reported in order to determine the antihypertensive activity of these species, and this fact allows establishing these plants as potential sources of active agents with antihypertensive properties. On the other hand, species that have previous studies related to an antihypertensive effect only describe vasorelaxant, hypotensive or antihypertensive effects on *in vitro* or *in vivo* animals model, however they do not reveal the mode of action either and other deep studies about its antihypertensive effect (Table 1). Therefore, many of these medicinal plants are suitable candidates for their chemical and pharmacological investigation. In this context, with this work we are offering a wide list of medicinal plant that are using in Mexico for the treatment of hypertension.

Finally, the use of plants in traditional medicine systems of many cultures has been extensively documented. These plant-based systems continue to play an essential role in health care and the World Health Organization estimates that 80% or the world's population continues to rely mainly on traditional medicines systems for their health care. Plant products also play an important role in health care systems of the remaining 20% of the population, mainly residing in developed countries. From these 119 drugs, 74% were discovered as a result of chemical studies directed to the isolation of the active substances from plants used in traditional medicine. In addition, the use of so-called complementary or alternative herbal products has expanded in recent decades (1).

Ethnobotany and Ethnopharmacology are interdisciplinary fields of research that look specifically at the empirical knowledge of indigenous peoples concerning medicinal substances, their potential health benefits and their health risks associated with such remedies. As can be seen, many of the plant-derived pharmaceuticals and phytomedicines currently in use were used by native people around the world. Some of this knowledge has been documented and codified or studied scientifically. Although there exits hundreds of thousands of living plants species, only a fraction has been investigated in laboratory. Thus, it can be seen that the investigation of plants

Table 1: Plants used in Mexican Folk medicine for the treatment of hypertension

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Achyranthes aspera L.	Amaranthaceae	Zorro	Tropical region of the world	Wild herb	Aerial parts infusion	Triterpenes glycosides		
Adiantum capillus Sw.	Pteridaceae	Culantrillo		Cultivated herb	Aerial part decoction	Triterpenes, aromatic acids, flavonoids		
Agastache mexicana (Kunth) Lint & Epling	Lamiaceae	Toronjil	Mexico	Wild herb	Flowers and stem infusion, mixed with others plants	Essential oils		
Allium cepa L.	Liliaceae	Cebolla	Asia	Cultivated herb	Crude or boil fruit	Sulfuric compounds	Hypotensive action	9
Allium sativum L.	Liliaceae	Ajo	Asia	Cultivated herb	Fruit infusion	Sulfuric compounds	Hypotensive action	9
Anethum graveolens L.	Apiaceae	Eneldo	Europe	Cultivated herb		Phenolics, monoterpenes, phenylpropanoids, flavonoids	Hypotensive action	9
Annona reticulata L.	Annonaceae	Anona	The Antilles	Cultivated tree		Diacetates Acetogenins		
Apium graveolens L.	Apiaceae	Apio	Central America	Cultivated herb	Leaves and stem infusion	Coumarins, terpenes, benzofurans, flavonoids	Vasorelaxant action of isolated apigenin from plant	30
Arachis hypogaea *L.*	Fabaceae	Cacahuate	South America	Cultivated herb		sterols, flavonoids	Hypotensive action	9
Arceuthobium vaginatum J. Presl	Viscaceae	Injerto	Mexico	Parasite shrub	Plant (aerial) infusion			
Argemone mexicana L.	Papaveraceae	Chicalote	The Antilles	Wild herb	Plant (aerial) infusion toxic fruits and seeds	Alkaloids, flavonoids	Hypotensive action	9, 29

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Bellis perennis L.	Asteraceae	Margarita enana	Europe	Wild herb (naturalized)		Acetylenes, flavonoids, triterpenes		
Bidens pilosa L.	Asteraceae	Aceitilla	South America	Wild herb		Flavonoids, triterpenes, alkaloids	Hypotensive action (anestethized rats) Antihypertensive action (SHR rats) Fructose-hypertensive rats Vasorelaxant action	31-33
Bixa orellana L.	Bixaceae	Achiote	America	Wild or cultivatedshrub or tree		Insaturated esters, flavonoids, monoterpenes, triterpenes	Hypotensive action	9
Boerhaavia diffusa L.	Nyctaginaceae	Mata de pavo	Pantropical	Wild herb	Root boil	Rotenoids		34
Borago officinalis L.	Boraginaceae	Borraja	Africa	Wild or cultivated herb	Plant (aerial) mixed with others plants infusion			
Brickellia veronicifolia (Kunth) A.Gray	Asteraceae	Peisto	Africa	Wild herb (naturalized)	Plant (aerial) infusion	Flavonoids, polysaccharides		
Bromelia pinguin L.	Bromeliaceae	Piñuela	Tropical America	Wild herb		Diterpenes	Hypotensive action	9
Budleia perfoliata Kunth.	Loganiaceae	Salvia de bolita	Mexico	Wild shrub	Plant (aerial) boil			
Bursera simaruba Sarg.	Burceraceae	Palo mulato	Mexico	Wild tree	Resin mixed with others plants infusion	Tanins Monoterpenes		35

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Cajanus cajan (L.) Millsp.	Fabaceae	frijolillo	Western Africa and India	Cultivated shrub		Flavonoids, polyalcohols, phenylpropanoids, Quinones	Hypotensive action	9
Calendula officinalis L.	Asteraceae	Mercadela	Mediterranean region	Cultivated herb	Plant (aerial), Flowers boil	Sesquiterpenes, triterpenes, flavonoids, fat acids		
Cannabis sativa L.	Cannabaceae	Mariguana	Asia	Cultivated herb		Alkaloids, cromenes, phenolics, aromatic acids, phenylpropanoids, essential oils monoterpenes, sesquiterpenes, flavonoids	Hypotensive action	9
Capsicum annuum L.	Solanaceae	Chile chocolate	South America	Cultivated herb	fruit	Carotenes, polysaccharids, fat acids, phenolics, peptids, sesquiterpenes, alkaloids, sterols, triterpenes	Hypotensive action	9
Cardiospermum halicacabum L.	Sapindaceae	Alfombrilla	America	Cultivated herb	Plant (aerial) boil	Alcaloids	Hypotensive action	9
Carica papaya L.	Caricaceae	Papaya	America	Cultivated tree		Monoterpenes	Vasorelaxant activity Antihypertensive action (Normotensive rats Renal and DOCA-hypertensive rats) and vasorelaxant activity	36,37
Carum carvi L.	Apiaceae	Alcaravea	Asia	Wild herb		Cromones, polyalcohols, monoterpenes, phenolic, acetylenes, coumarines,		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Casimiroa edulis La Llave	Rutaceae	Zapote blanco	South America	Wild or cultivated tree	Fruit, leaves alone or mixed with others plants infusion or boil	Flavonoids, coumarins, alkaloids,	Hypotensive action Hypotensive action (Anesthetized rats and Anesthetized guinea pigs) Vasorelaxant action	9, 29,38,39
Cayaponia racemosa Cogn.	Cucurbitaceae	Xtaab keej	Africa	Wild herb			Hypotensive action	9
Ceanothus caeruleus Lag.	Rhamnaceae	Cuaicuastle	Mexico and Central America	Wild shrub	Plant boil			
Cecropia obtusifolia Bertol.	Cecropiaceae	Guarumbo	Central America	Wild tree	Root infusion	Flavonoids, phenolics	Hypotensive action Antihypertensive (SHR rats)	40,41
Cedrela odorata L.	Meliaceae	Cedro	The Antilles	Wild or cultivated tree		Terpenes, fat acids, phenolics	Hypotensive action	9
Cereus senilis Salm-Dyck	Cactaceae	Cabeza de viejo	Mexico	Herbaceous. Wild or cultivated				
Cestrum nocturnum L.	Solanaceae	Huele de noche	México	Wild or cultivated shrub		Phenolics, triterpenes, spirostanols, flavonoids,	Hypotensive action	9
Chelidonium majus L.	Papaveraceae	Amapola amarilla	Europe	Wild herb (naturalized)	Plant (aerial) boil	Alkaloids, aminoacid, phenolics, alifatic compounds		
Chenopodium ambrosioides L.	Chenopodiaceae	Epazote	Central America	Wild herb		Sesquiterpenes, furanoids, inosytol, monoterpenes, flavonoids		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Chiranthodendron pentadactylon Larreat	Sterculiaceae	Flor de manita	Mexico and Guatemala	Wild tree	Flowers alone or mixed with others plants infusion	Flavonoids	Vaxorelaxant effect	42
Chrysantemum partthenium (L.) Bernh.	Asteraceae	Santamaría		Cultivated Herb or shrub	Plant (aerial) and flowers infusion	sesquiterpenes	Hypotensive action	29
Cichorium intybus L.	Asteraceae	Achicoria	America and África	Wild herb		Lignans, coumarines, sesquiterpenes	Vasorelaxant activity	42,43
Cinnamomum verum J.Presl	Lauraceae	Canela	India and Asia	Cultivated tree	Bark infusion	Aromatic compounds		
Cirsium ehrenbergii Sch.Bip.	Asteraceae	Cardo	Mexico	Wild herb	Flowers and root boil			
Cissus sicyoides L.	Vitaceae	Abrojo rojo	Central Asia	Wild herb	Stem mixed with others plants infusion	Phenolic compound		44
Citrullus lanatus (Thunb.) Matsumara & Nakai	Cucurbitaceae	Sandia	Africa	Prostrate Cultivated plant		Triterpenes, glycosidated saponins	Hypotensive action	9
Citrus aurantifolia Swingle	Rutaceae	Limon	China	Cultivated shrub		Essencial oils, sesquiterpenes	Hypotensive action	9
Citrus aurantium L.	Rutaceae	Naranjo agrio	China	Cultivated tree	Leaves and flowers infusion	Flavonoids, coumarins, sesquiterpenes, diterpenes, aromatics, aminoacids	Hypotensive action	9
Citrus limetta Risso	Rutaceae	Lima	Southwest of Asia	Cultivated tree	Flowers mixed with others plants infusion			

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Citrus limon (L.) Burm.f.	Rutaceae	Limon	Southeast of Asia	Cultivated shrub	Fruit	Flavonoids, coumarines, fat acids, phenolics, diterpenes,	Hypotensive action	9
Citrus medica L.	Rutaceae	Limon grande	Southeast of Asia	Cultivated shrub	Flowers mixed with others plants infusion	Coumarines, flavonoids		
Citrus sinensis Osbeck	Rutaceae	Naranjo	South of China	Cultivated tree	Flowers mixed with others plants infusion	Essential oils, flavonoids, aminoacids, carotenoides, phenolics, monoterpenes, sulfuric compounds, diterpenes, furanoides, coumarines, alifatics, alkaloids,		
Cnidoscolus chayamansa McVaugh	Euphorbiaceae	Chaya	Mexico and Central America	Cultivated shrub	Leaves boil	Glycosidated flavonoids		
Cnidoscolus multilobus I.M.Johnst.	Euphorbiaceae	Mala mujer	North America	Wild tree or shrub	Flowers infusion	Triterpenes, flavonoids, tanins		
Cocos nucifera L.	Arecaceae	Coco	Islands of the Pacific	Cultivated palm		Alifatics, pyranosides, adenin derivated	Hypotensive action	9
Convolvulus arvensis L.	Convolvulaceae	Correhuela	Europe , Asia and America	Wild herb		Flavonoids		
Coriandrum sativum L.	Apiaceae	Cilantro	The Eastern Mediterranean	Cultivated herb		Benzopiranes, triterpenes, phenolics, alifatics, Flavanol-*O*-glucoside	Hypotensive action Anaesthetized rats	9
Crataegus monogyna Jacq.	Rosaceae	Espino blanco	Europe, North of Africa and Asia	Cultivated tree		Flavonoids		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Crateva tapia L.	Capparaceae	Coscorron	America	Wild tree			Hypotensive action	9
Crotalaria incana L.	Fabaceae	Cascabelillo	Mexico	Wild herb		Alkaloids	Hypotensive action	9
Croton glabellus L.	Euphorbiaceae	Cascarillo	America	Wild shrub			Hypotensive action	9
Crusea calocephala DC.	Rubiaceae	Zorrilla	Mexico	Cultivated herb	Plant boil			
Curatella americana L.	Dilleniaceae	Cacaito	America	Wild tree		Phenolic derivatives	Antihypertensive and vasorelaxant activities	45,46
Cymbopogon citratus Stapf	Poaceae	Zacate limon	Asia and Equatorial Africa	Cultivated herb	Plant (aerial) infusion	Monoterpenes, diterpenes, triterpenes	Vasorelaxant activity Hypotensive action Antihypertensive activity	29,47,48
Cynara scolymus L.	Asteraceae	Alcachofa	The Mediterranean and the Northeast of Africa	Cultivated herb		Flavonoids, phenolics acids, sesquiterpenes	Vasomodulating activity	49
Cynodon dactylon Pers.	Poaceae	Grama	Asia and south of Europe	Wild herb (naturalized)				
Datura inoxia Mill.	Solanaceae	Toloache	America	Wild herb		Alkaloids, triterpenes, flavonoids,	Hypotensive action	9
Datura stramonium L.	Solanaceae	Hierba del diablo	South America	Wild herb		Alkaloids, monoterpenes		
Dianthus caryophyllus L.	Caryophyllaceae	Clavel	The Mediterranean	Cultivated herb	Flowers infusion	Alkaloids, flavonoids, phenylpropanoids, aminoacids, fat acids		
Digitales purpurea L.	Scrophulariaceae	Digital	Europe	Wild or cultivated ligneous herb	Leaves infusion	Glycoside terpenoids		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Dodonaea viscosa Jacq.	Sapindaceae	Ocotillo	Tropical regions of the world	Wild shrub		Diterpenes, inosytol, flavonoids	Hypotensive action	9
Ehretia tinifolia L.	Boraginaceae	Pinguica	Mexico	Wild or cultivated tree				
Eriobotrya japonica Lindl.	Rosaceae	Nispero	China	Cultivated tree	Leaves boil	Sesquiterpenes, flavonoids, Triperpenos, flavonoids		
Eryngium foetidum L.	Apiaceae	Cilantro cimarron	Islands of the Caribbean	Wild herb		Aromatic acids, phenolics, nitrogenated aromatics	Hypotensive action	9
Eugenia uniflora L.	Myrtaceae	Pitanga	South America	Cultivated shrub		Sesquiterpenes, tanins	Antihypertensive action	50
Euphorbia hirta L.	Euphorbiaceae	Golondrina	America	Wild herb		Tanins, flavonoids	Hypotensive action	9
Exostema caribaeum Roem. & Schult.	Rubiaceae	Cascara sagrada roja	America	Wild tree	Bark mixed with others plants infusion	Benzopirone, xantones 4-phenylcoumarins		
Ficus carica L.	Moraceae	Higo	Asia and Mediterranean	Cultivated tree	Plant (aerial) boil	Alkaloids, peptides, coumarines	Hypotensive action	9
Ficus sp.	Moraceae	Higo		Cultivated tree	Leaves infusion	Proteolitic enzyme, peptides, flavonoids		
Foeniculum vulgare Mill.	Apiaceae	Anis, hinojo	Mediterranean	Cultivated herb	Plant (aerial) and flowers boil	Flavonoids, glycosides, monoterpenes glycosilads, phenolics, benzopyranes, essential oils	Hypotensive action Antihypertensive and hypotensive actions (SHR and normotensive rats) Hypotensive action (Pentobarbital-anaesthetised rats)	29,51-53
Galphimia glauca Cav.	Malpighiaceae	Hierba del venado	Mexico and Guatemala	Wild shrub		triterpenes	Vasorelaxant activity	42

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Gelsemium sempervirens Ait.	Loganiaceae	Retama	The United States	Wild shrub		Alkaloids, iridoids, coumarines, sterols	Hypotensive action	9
Gossypium herbaceum L.	Malvaceae	Algodón	South Africa r	Cultivated herb		Flavonoids		
Gossypium hirsutum L.	Malvaceae	Algodón	Central America and The Caribbean	Wild or cultivated shrub	Infusion	Aminoacid, monoterpenes, phenolics, naftoquinones, quinones, alkaloids, coumarines, flavonoids		
Guazuma ulmifolia Lam.	Sterculiaceae	Guazima	Mexico, Central and South America	Wild tree		Alkaloids, tanins	Hypotensive action	9
Haematoxylon brasiletto H.Karst.	Fabaceae	Palo de brasil	Mexico	Wild tree	Wood of the stem mixed with others plants infusion			
Hedera helix L.	Araliaceae	Hiedra	Europe	Wild shrub (naturalized)	Leaves infusion	Alkaloids, polyalcohols, triterpenes, acetylenes, coumarines		
Heimia salicifolia Link & Otto	Lythraceae	Hierba de Sn Fco.	Mexico	Wild shrub		alkaloids		
Helianthus annuus L.	Asteraceae	Girasol	America	Cultivated herb		Phenolics, alkaloids, sesquiterpenes, triterpenes, diterpenes, fat acids, monoterpenes, polysaccharides, sterols, aromatics, peptide, flavonoids		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Hibiscus sabdariffa L.	Malvaceae	Jamaica	Africa	Cultivated shrub	Flowers infusion	Alkaloids	Hypotensive action Antihypertensive action (SHR rats) Clinical study Antihypertensive effect Patients with moderate hypertension Patients with secondary hypertension Clinical study Antihypertensive effectiveness and tolerability Patients with hypertension, 30-80 years old	9,54-56
Hippocratea excelsa H.B. & K.	Hippocrateaceae	Cancerina	America	Wild tree	Root mixed with others plants infusion	Sesquiterpenes, triterpenes, alkaloids		
Indigofera suffruticosa Mill.	Fabaceae	Añil	America	Wild shrub	Wood of the stem	Pyranosides nitropropanoids, flavonoids	Hypotensive action	9
Inula helenium L.	Asteraceae	Helenio	Southeast of Europe and west of Asia	Cultivated herb		Sterols, sesquiterpenes		
Ipomoea purga Hayne	Convolvulaceae	Raiz de jalapa	México	Wild herb		Fat acids, resin glycosides		57
Iresine calea Standl.	Amaranthaceae	Atlancuayo	América	Wild herb	Stem mixed with others plants infusion			

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Jacaranda mimosifolia D.Don	Bignoniaceae	Jacaranda	South America (Brasil)	Cultivated tree	Flowers infusion	Fat acids		
Juglans regia L.	Juglandaceae	Nogal	Europe and Asia	Cultivated tree	Leaves, bark infusion or boil	Flavonoids, quinones, monoterpenes, fat acids	Vasorelaxant effect Hypotensive action	9,42,58
Justicia spicigera Schltdl.	Acanthaceae	Muicle	Mexico and South America	Cultivated ligneous herb	Plant (aerial) and flowers infusion or boil	Flavonoids	Hypotensive action	29
Lactuca sativa L.	Asteraceae	Lechuga	Asia	Cultivated herb	Juice of the leaves	Alifatics, Sesquiterpenes, diterpenes	Hypotensive action	9
Lantana camara L.	Verbenaceae	Cinco negritos	Tropical America	Wild or cultivated shrub		Monoterpenes, flavonoids, triterpenes, quinones, polysaccharides	Hypotensive action	9
Larrea tridentata Coult.	Zygophyllaceae	Gobernadora	North America	Wild shrub	Root, plant (aerial) or bark boil	Terpenes, lignanes		
Lavandula spica Loisel.	Lamiaceae	Espliego	The Mediterranean	Cultivated ligneous herb		triterpenes		
Leonorus sibiricus L.	Lamiaceae	Altamisa	Liberia and China	Cultivated ligneous herb			Hypotensive action	9
Leonotis nepetaefolia Schimp. ex Benth.	Lamiaceae	Bola del rey	Cosmopolitan	Wild shrub		Diterpenes, phenylpropanoids, sesquiterpenes, fat acids, coumarines	Hypotensive action	9

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Linum usitatissimum L.	Linaceae	Linaza	The Mediterranean	Cultivated herb		Alkaloids, aminoacids, phenolics, lignans, polysaccharides, alifatic acid, flavonoids		
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	Verbenaceae	Te de castilla	America	Cultivated shrub		Essential oils	Antihypertensive and vasorelaxant activity (SHR and Wistar rats)	45,59
Lobelia laxiflora H.B. & K.	Campanulaceae	Chilpanxochitl	America	Wild ligneous herb	Flowers and leaves infusion			
Lochnera rosea (L.) Rchb.	Apocynaceae	Vicaria	Madagascar	Cultivated herb			Hypotensive action	9
Magnolia dealbata Zucc.	Magnoliaceae	Magnolia	Mexico	Wild tree	Flowers infusion			
Magnolia grandiflora L.	Magnoliaceae	Flor de magnolia	The United States	Cultivated tree	Flowers mixed with others plants infusion	Phenolics, sesquiterpenes, alkaloids		
Manilkara zapota (L.) P.Royen	Sapotaceae	Chicozapote	Mesoamerica	Wild or cultivated tree	Seeds, leaves and bark infusión			
Marrubium vulgare L.	Lamiaceae	Marrubio	Europe, North of Africa and Asia	Wild herb	Plant (aerial) infusion or boil	Terpenes, flavonoids	Hypotensive action Antihypertensive and hypotensive activities (SHR and normotensive rats) Vasorelaxant activity	9,29,51,52
Matricaria chamomilla L.	Asteraceae	Manzanilla alemana	The Mediterranean	Cultivated herb		Monoterpenes, flavonoids, sesquiterpenes, acetylenes		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Matricaria recutita L.	Asteraceae	Manzanilla	The Mediterranean	Wild or cultivated herb		monoterpenes	Hypotensive action	9
Melilotus indica (L.) All.	Fabaceae	Trébol amarillo	Europe and Asia	Cultivated herb	Infusion	Benzofurans, flavonoids		
Mentha citrata Ehrh.	Lamiaceae	Hierbabuena	Europe	Cultivated herb	Plant (aerial) and leaves infusion			
Mentha pulegium L.	Lamiaceae	Poleo	South Africa and Australian	Wild herb		Monoterpenes, hidrocarburos cyclic hydrocarbures		
Musa acuminata Colla	Musaceae	Platano	Australian and Asia	Cultivated herb		Phenolics		
Musa paradisiaca L.	Musaceae	Platano	Asia	Cultivated herb		Sterols, alkaloids, polysaccharides, flavonoids	Hypotensive action	9
Musa sapientum L.	Musaceae	Platano	Asia	Cultivated herb		Sterols, alifatic alcohol, dopamine, phenolics, alifatic ester, flavonoids	Hypotensive action	9
Nerium oleander L.	Apocynaceae	Rasa laurel	The Mediterranean and China	Cultivated shrub		Flavonoids Sterols, triterpenes, inosytol		
Nicotiana tabacum L.	Solanaceae	Tabaco	America	Wild herb		Alkaloids, phenolics, quinones, alifatics, aromatics, monoterepenes, sesquiterpenes, sterols, flavonoids, polysaccharides	Hypotensive action	9

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Ocimum micranthum Willd.	Lamiaceae	Albahacar del monte	America	Wild or cultivated herb			Hypotensive action	9
Ocimum selloi Benth.	Lamiaceae	Albahacar	America	Wild or cultivated herb	Leaves, boil or infusion	Monoterpenes		
Oenothera rosea *Aiton*	Onagraceae	Hierba del golpe	America	Wild or cultivated herb			Hypotensive action	9
Olea europaea L.	Oleaceae	Olivo	The Mediterranean	Cultivated tree or shrub	Fruit, leaves infusion	Terpenes, flavonoids, alkaloids	Hypotensive action Smooth vascular muscle endothelium Decoction of leaf Oleuropeoside, active component	9, 60
Origanum vulgare L.	Lamiaceae	Orégano	Asia and Europe	Wild or cultivated herb		Essential oils, flavonoids		
Oryza sativa L.	Poaceae	Arroz	Asia	Cultivated herb		Aminoacids, sesquiterpenes, sterols, furanoids, diterpenes, alkaloids, fat acids, flavonoids		
Parkinsonia aculeata L.	Fabaceae	Bagote	America	Wild shrub		Triterpenes, flavonoids	Hypotensive action	9
Paronychia argentea Lam.	Caryophyllaceae	Nevadilla	The Mediterranean	Wild herb				
Passiflora exsudans Zucc.	Passifloraceae	Puid ngoy	Mexico	Wild herb	Root boil			

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Passiflora subpeltata Orteg.	Passifloraceae	Pasiflora	Mexico and Guatemala	Wild or cultivated herb	Plant (aerial) mixed with others plants infusion			
Persea americana Mill.	Lauraceae	Aguacate	Mexico, Central America	Cultivated tree	Leaves, seeds infusion or boil	Sterols, flavonoids	Hypotensive action	2,29
Petiveria alliacea L.	Phytolaccaceae	Epazote de zorrillo	Central and South America	Wild herb	Plant boil	Aminoacids, aromatics sulfur-containing compounds, flavonoids, triterpenes, alkaloids		
Petroselinum crispum (Mill.) A.W. Hill	Apiaceae	Perejil	The Mediterranean	Cultivated herb	Fresh leaves	Iridoids, flavonoids, sesquiterpenes, diterpenes, monoterpenes, phenolics essential oils, tanins y triterpenes	Hypotensive action	9
Phalaris canariensis L.	Poaceae	Alpiste	The Mediterranean	Cultivated herb	Fruit infusion	Triterpenes		
Phoradendron velutinum Nutt.	Viscaceae	Injerto	Mexico	Parasite shrub	Leaves infusion			
Phyllanthus niruri L.	Euphorbiaceae	Rosillo	Peru and Brasil	Wild herb		Phenolics, sterols, flavonoids, lignans	Hypotensive action Vasorelaxant activity Clinical study Diuretic, hypotensive and hypoglycaemic effects (syn. *P.amarus*) Patients with hypertension, and patients with hypertension and suffering from diabetes mellitus Whole plant	9, 61,62

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Physalis gracilis Miers	Solanaceae	Chipil	Mexico	Wild herb	Leaves boil			
Physalis philadelphica Lam.	Solanaceae	Tomatillo	Mesoamerica	Cultivated herb		Triterpenes, alkaloids		
Physalis pubescens L.	Solanaceae	Cascara de tomate	Cosmopolitan	Wild herb		Alkaloids, esterol,	Hypotensive action	9
Pimenta dioica (L.) Merr.	Myrtaceae	Pimienta	Mexico and Central America	Cultivated tree			Hypotensive action	63
Pimpinella anisum L.	Apiaceae	Anis	Asia	Cultivated herb		Phenolics, acetylenes	Hypotensive action	9
Pinaropappus roseus Less.	Asteraceae	Chapulillo	Mexico	Wild herb	Leaves infusion			
Pinusspp. L.	Pinaceae	Ocote negro		Wild tree	Leaves infusion	Diterpenes, aromatics, monoterpenes, essential oils, flavonoids, glanidin derivated, alcohols alifatics, fat acids, triterpenes, sterols		
Piper aduncum L.	Piperaceae	Cordoncillo	America	Shrub		Flavonoids, phenolics, chromenes	Hypotensive action	9
Plantago major L.	Plantaginaceae	Cancerina	Cosmopolitan	Wild herb	Plant (aerial) boil	Polysaccharides, lipids, caffeic acid derivatives, flavonoids, iridoid glycosides, terpenoids, alkaloids and some organic acids	Hypotensive action	9,64

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Portulaca oleracea L.	Portulacaceae	Verdolaga	America	Wild herb		Alkaloids, terpenes Flavonoids	Hypotensive action	9
Psittacanthus calyculatus G.Don	Loranthaceae	Injerto de huizache	Mexico	Parasite shrub	Stem and root mixed with others plants infusion		Vasorelaxant action	65,66
Psoralea pentaphylla L.	Fabaceae	Contra yerba	America	Wild herb	Plant boil			
Pteridium aquilinum (L.) Kuhn	Deenstaedtiaceae	Helecho hembra	Cosmopolitan	Wild herb		Flavonoids, phenolics, sulfuric compounds, sesquiterpenes, alkaloids, sterols, aromatics		
Rauvolfia canescens L.	Apocynaceae	Venenillo	America	Cultivated tree		Alkaloids	Antihypertensive activity	67
Rosmarinus officinalis L.	Lamiaceae	Romero	The Mediterranean	Wild or cultivated shrub	Plant (aerial) and flowers Infusion or boil	Phenylpropanoids, terpenes, quinones, glycosidated flavonoids		
Ruta chalepensis L.	Rutaceae	Ruda	Spain	Wild or cultivated herb	Plant (aerial) infusion	Phenylpropanoids, alkaloids, flavonoids		
Saccharum officinarum L.	Poaceae	Caña	Southeast of Asia	Cultivated herb		Triterpenes, sterols, flavonoids	Hypotensive action	9
Schinus molle L.	Anacardiaceae	Pirul	South America	Wild tree		Sesquiterpenes, sterols, monoterpenes, flavonoids, triterpenes	Hypotensive action	9
Sechium edule Sw.	Cucurbitaceae	Chayote	Mexico	Cultivated herb	Fruit boil, fruit mixed with others plants infusion		Hypotensive action Anaesthetised rats Aqueous extract Fruit (pulp and the peel)	29,68

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Selaginella lepidophylla (Hook. & Grev.) Spring	Selaginellaceae	Doradilla	Mexico	Wild herb		Essential oils		
Senna occidentalis (L.) Link	Fabaceae	Frijol del monte	Tropical America	Wild shrub		Sterols, flavonoids	Hypotensive action	9
Sida acuta Burm.f.	Malvaceae	Malva	America	Wild herb	Root boil			
Sida cordifolia L.	Malvaceae	Malva	Tropical America	Wild herb		Alkaloids	Hypotensión and bradycardia effects (Normotensive non-anaesthetized rats Normotensive anaesthetized and vagotomized rats) Vasorelaxant activity	69,70
Silene laciniata Cav.	Caryophyllaceae	Clavel de monte	The United States	Wild herb				
Solanum marginatum Linn.f.	Solanaceae	Sosa	Etiopía	Wild shrub		Sterol	Hypotensive action	9,71
Solanum melongena L.	Solanaceae	Berenjena	Asia	Cultivated shrub	Pericarpio boil	Alkaloids, sesquiterpenes, sterols, flavonoids, insaturated alcohols, acetylenes		
Solanum nigrum L.	Solanaceae	Hierba mora	South America	Wild herb		Alkaloids, antibiotics, sterol, flavonoids	Hypotensive action	9,72
Sorghum halepense Pers.	Poaceae	Zacate nilo	Southeast of Europe	Wild herb				
Spartium junceum L.	Fabaceae	Retama	Spain	Cultivated shrub		Alkaloids, flavonoids, fat acids, triterpenes		

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Sphaeralcea angustifolia G.Don	Malvaceae	Hierba del negro	America	Wild ligneous herb	Plant (aerial) boil			
Tagetes lucida Cav.	Asteraceae	Pericon	Mexico and United States	Wild herb			Hypotensive action	9
Talauma mexicana G.Don	Magnoliaceae	Yoloxochitl	Mesoamerica	Wild or cultivated tree	Flowers mixed with others plants boil	Aromatics acids, sesquiterpenes, phenolics, alkaloids	Hypotensive action	29
Tanacetum parthenium Sch.Bip.	Asteraceae	Santa Maria	Europe	Cultivated shrub		Phenolics, sesquiterpenes, acetylenes, coumarines y flavonoids	Hypotensive action	9
Taraxacum officinale F.H.Wigg.	Asteraceae	Diente de leon	North hemisphere of the Old World	Wild herb	Plant infusion	Terpenes, phenolic acids, flavonoids, cinamic acid, coumarines		
Taxodium mucronatum Ten.	Taxodiaceae	Ahuehuete	Mexico	Wild tree	Leaves, fruit, Stem, wood of the stem, bark and tar boil	Flavonoids	Vasorelaxant effect	42
Ternstroemia lineata DC.	Theaceae	Flor de tila	America	Wild tree	Flowers mixed with plants infusion			
Thevetia peruviana K.Schum.	Apocynaceae	Trompetilla	Mexico and Tropical America	Wild or cultivated shrub		Sterols, alifatics, flavonoids, triterpenes, iridoids	Hypotensive action	9
Thunbergia alata Bojer ex Sims	Acanthaceae	Trompillo	Tropical Africa	Climbing Plant		Iridoids, fat acids	Hypotensive action	9

Table 1: (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Thymus vulgaris L.	Lamiaceae	Tomillo	The Mediterranean	Cultivated herb		Phenolics, fat acids, monoterpenes, essential oils, flavonoids		
Tilia mexicana Schltdl.	Tiliaceae	Tila	Mexico	Wild tree	Leaves and flowers infusion			
Tilia platyphyllos Scop.	Tiliaceae	Tilo	Europe	Cultivated tree				
Tribulus cistoides L.	Zygophyllaceae	Abrojo amarillo	Europe	Prostrate wild plant		Sterols, sulfuric compounds, esteroids	Hypotensive action	9,73
Tribulus terrestris L.	Zygophyllaceae	Abrojo	Europe	Wild herb		Alkaloids, sterols, flavonoids	Antihypertensive and vasorelaxant activities	74, 75
Urtica chamaedryoides Pursh	Urticaceae	Ortiga	America	Wild herb	Leaves infusion			
Urtica dioica L.	Urticaceae	Ortiga	Asia	Wild herb		Coumarines, flavonoids, sterols	Hypotensive action Anaesthetized rats Aqueous extract, aerial parts Toxic effect at the higher dose Hypotensive and vasorelaxant activities	9,76-78
Valeriana edulis subp. *procera* Nutt.	Valerianaceae	Valeriana	Mexico	Wild herb	Root mixed with others plants infusion	Valepotriates		
Vernonia arctioides Less.	Asteraceae	Lineacordial	Mexico	Wild shrub				

Table 1 (Continued)

Scientific name	Family	Common name	Distribution	Biological form	Plant part used and preparation	Chemical type compounds*	Pharmacological studies related with antihypertensive action	Pharmacological References
Vinca minor L.	Apocynaceae	Cielo raso	Mediterranean region	Climbing Cultivated shrub Prostrate cultivated shrub	Plant boil	Alkaloids, phenolics, flavonoids	Hypotensive action	9,79
Viscum album L.	Viscaceae	Muerdago	Europe	Wild Parasite herb	Plant macerated	Aminoacids, flavonoids, inosytols, alkaloids, sesquiterpenes		
Vitis vinifera L.	Vitaceae	Uva	The Mediterranean	Cultivated herb		Flavonoids, phenolics, aromatics,triterpenes, glycolipids, polyalcohols alifatics, sterols, poliphenolics, monoterpenes, fat acids	Antihyertensive and vasorelaxant activities	80
Zea mays L.	Poaceae	Pelos de elote	Mexico	Cultivated herb	Fruit infusion	Alkaloide, carotenoides, sterols, phenolics, flavonoids, alifatics	Hypotensive action	9
Zingiber officinale Rosc.	Zingiberaceae	Jengibre	South of Asia	Cultivated herb	Root boil	Benzofuranos, monoterpenes, phenolics, glicolipidos, sulfuric compounds, alifatics, aromatics, diterpenes	Hypotensive action	9,29

* The phytochemical information, refers about the reports for the plant no the active compounds and was obtaind from the Dictionary of Natural Products on CD-ROM Version 11.2 (1982-2003) (81)

used for medicinal purposes by unsophisticated peoples can provide us with new biodynamic compounds that may have important applications in our society (1).

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