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Alternanthera repens and *Bidens odorata*, Resilience Medicinal Plants in Mexico City

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Abstract

In Mexico, the use of medicinal plants to treat health disorders has been practiced since pre-Columbian times. Unfortunately, this knowledge has been lost over time, mainly in highly urbanized areas. We conduct an ethnobotanical survey about *Alternanthera repens,* Kuntze (Amaranthaceae) and *Bidens odorata* Cav. (Asteraceae) in Mexico City. A total of 500 people were interviewed, 250 of them were questioned about *B. odorata* and 250 in relation to *A. repens*, the questions included: common names, medicinal uses, part of the plant used, mode of preparation, route of administration and duration of treatment. This study revealed that both plant species are currently used in top diseases, in the study area, mostly to treat gastrointestinal disorders, specifically diarrhea; *A. repens* is also recommended to treat fever and renal diseases, whereas *B. odorata* is used for treating diabetes, renal disorders and less frequently for fever and as forage. The results allow us to ensure that these plants are used today and are potentially important to continue with the determination of their pharmacological effects and other aspects.

Keywords: *Alternanthera repens; Bidens odorata; Ethnobotanic*; Mexican Traditional Medicine.

1 Introduction

The World Health Organization has acknowledged the importance of traditional medicine – with medicinal plants as the major resource – and has set forth strategies for research and use at a global level (OMS, 2002). Ethnobotanical studies are essential to identify the bioactive compounds of medicinal plants, which are currently used for the treatment of many diseases (Pieroni et al., 2004; Cameron et al., 2005; Bermúdez et al., (2005). Medicinal plants, within the Mexican traditional medicine, represent an important alternative to solve health problems in the country. The use of medicinal plants for the treatment of diseases is a common practice in Mexico as well as in other countries. These resources are usually regarded as part of a culture's "traditional" knowledge (Leonti et al., 2003; Heinrich et al., 2014).

Alternanthera repens Kuntze (Amaranthaceae) (Tianguis) and *Bidens odorata* Cav. *(Asteraceae) (Acahualillo)*, both herbaceous plants are abundant in the country and they

are included among the species that are used in the treatment of gastrointestinal disorders (Argueta, 1994).

A. repens is a medicinal plant that has been used since prehispanic times to treat a number of illnesses like typhus (matlazahuatl from Nahuatl language), and also as a diaphoretic, diuretic, astringent agent and for other purposes (Hernández, 1946). This species contains alkaloids, saponins, tannins and reducing sugars (Astudillo-Vázquez et al., 2008). In particular, it contains triterpene saponins (Sanoko et al., 1999). In vitro investigations, *A. repens* presented spasmolytic effect of methanol extract and fractions, on isolated rat ileum (Garín-Aguilar et al., 2014).

Bidens odorata contain alkaloids, flavonoids, saponins, tannins and reducing sugars (Astudillo-Vázquez et al., 2008). *B. odorata* showed antidiarrheal activity on castor oil induced diarrhea on mice (Zavala-Mendoza et al., 2013).

Pharmacological tests showed that both aqueous and ethanol extracts from *A. repens* and *B. odorata* inhibited the advance of the gastrointestinal content using charcoal meal, in mice. Also, the lethal media doses in mice were estimated in order to examine the plants' safety founding that extracts can be regarded as slightly toxic; nevertheless none of these plants showed any toxic activity in the pharmacological proofs (Astudillo-Vázquez et al., 2008).

These investigations indicate a promissory pharmacological profile.

Therefore, it is important to know if *A. repens* and *B. odorata* are currently use by the population. Both plants are widely distributed around the world. Today, preserving the popular knowledge about the Mexican traditional medicine is crucial, especially in big cities like Mexico City. The purpose of this study was to carry out an ethnobotanical survey of *A. repens* and *B. odorata* in Mexico City.

2. Materials and Methods

2.1 Plant Material

Aerial parts of *A. repens* and *B. odorata* were collected from a number of urban environments in Mexico City, between July and September 2013 and 2014, including sidewalks, parking lots and streets.

2.2 Ethnobotanical Survey

Mexico City is the most populous entity and one of the most populated in the world, in 2010 it was inhabited by 8.851 million people, distributed in 16 delegations (Álvaro Obregón, Azcapotzalco, Benito Juárez, Coyoacán, Cuajimalpa, Cuauhtémoc, Gustavo A. Madero, Iztacalco, Iztapalapa, Magdalena Contreras, Miguel Hidalgo, Milpa Alta, Tláhuac, Tlalpan, Venustiano Carranza and Xochimilco) (INEGI, 2014).

In Mexico, markets have been fertile sources for ethnobotanical studies (Bye and Linares 1983; Taylor and Bogdan, 1994). In Mexico City markets, 250 persons were interviewed about their knowledge of *A. repens* (in 2013), and 250 about *B. odorata* (in 2014); a specimen of both plant species was always shown to them in order to avoid a potential misidentification. The information so gathered was processed to obtain the percentage of users, hierberos (specialists in medicinal plants, people who advise members of the community on how to use them), healers, merchants, etc., from the pool of persons interviewed. Also, diseases for which *A. repens* and *B. odorata* are currently used in the study area were recorded, as well as plant parts used, preparation, and mode of use for each species (Taylor and Bogdan, 1994; Souza-Brito, 1996; Bermúdez et al., 2005). The questionnaire was validated through its previous administration to 40 persons, adapting it as needed according to the results found. The resulting instrument is included in Table 1.

Table 1. *Ethnobotanical Information Questionnaire.*

1. Activity of the interviewee.
   ( ) Healer ( ) Medicinal Herb Dealer ( ) User ( ) Rural Doctor ( ) Other _____
2. Age of the interviewee (years).
   ( )15 a < 20 ( )20 a < 30 ( )30 a < 40 ( ) 40 a < 50 ( )50 a < 60 ( )60 a < 70 ( )
   70 a <80 ( )80 a < 90 ( ) > 90
3. Name of the interviewee _____
4. Place of the interview _____
5. Are you familiar with this herb?(specimen is shown) _____
6. Under what name do you know it? _____
7. Where have you seen it growing?
   ( ) Roadside ( ) Fields ( ) Irrigation channels ( ) Orchards ( ) River banks ( ) Arid zones
8. What is this plant used for? ( ) Drug ( ) Fodder ( ) Edible ( ) Other _____
9. Which uses do you know for this plant as a drug? _____
10. Part of the plant used? ( ) Leaves, stem, flowers ( ) Leaves ( ) Stem ( ) Flowers ( ) Root
11. How is it used? ( ) Dried ( ) Fresh ( ) Both
12. Amount used? _____
13. How do you prepare it for use? (Mention the health disorder involved)
    ( ) Tea to treat:_____ ( ) Topical application, to treat: _____
    ( ) Infusion to treat: _____ ( ) Dye extract, to treat: _____
    ( ) Syrup, to treat: _____( ) Other _____
14. Please describe in detail how you prepare and use it (for each disorder) _____
15. Amount used/administered of this preparation per day? (for each disorder) _____
16. ¿how many days? (for each disorder) _____
17. Who passed this knowledge to you? _____
18. Have you recommended anyone to use this plant? _____
19. Observations: _____

3 Results

To establish the size of the population sample to be interviewed in Mexico City, it was considered that only a few people possess the knowledge of interest, so those "privileged informants" (Harris, 1979; Taylor and Borgdan, 1994; López-Gutiérrez et al., 2014) were located and interviewed, most of them sell plants in markets. The markets of choice were representative of the diverse geographical areas of Mexico City. The most important among them is the Sonora market, Mexico's largest warehouse and supply center for medicinal plants (Bye and Linares, 1983) (Table 2).

Table 2. *Markets Visited in Mexico City*

	Market Name	Delegation
1.	*San Ángel*	*Álvaro Obregón*
2.	*Azcapotzalco*	*Azcapotzalco*
3.	*Clavería*	*Azcapotzalco*
4.	*Mixcoac*	*Benito Juárez*
5.	*San Pedro de los Pinos*	*Benito Juárez*
6.	*De la Bola*	*Coyoacán*
7.	*Pescadito*	*Coyoacán*
8.	*De la Cruz*	*Coyoacán*
9.	*Del Reloj*	*Coyoacán*
10.	*Xotepingo*	*Coyoacán*
11.	*Portales*	*Coyoacán*
12.	*Juárez*	*Cuauhtémoc*
13.	*Hidalgo*	*Cuauhtémoc*
14.	*San Cosme*	*Cuauhtémoc*
15.	*Contadero*	*Cuajimalpa*
16.	*Cuajimalpa*	*Cuajimalpa*
17.	*Rosa Torres*	*Cuajimalpa*
18.	*Unidad Habitacional Huizachito*	*Cuajimalpa*
19.	*San Mateo*	*Cuajimalpa*
20.	*San Juan de Aragón Sección 7*	*Gustavo A. Madero*
21.	*Zona Escolar*	*Gustavo A. Madero*
22.	*Del Carmen*	*Gustavo A. Madero*
23.	*San Juan*	*Iztacalco*
24.	*López Portillo*	*Iztacalco*
25.	*Pantitlán*	*Iztacalco*
26.	*Santiago Acahualtepec*	*Iztapalapa*
27.	*San Sebastián*	*Iztapalapa*
28.	*Santa Marta Acatitla*	*Iztapalapa*
29.	*Constitución de 1917*	*Iztapalapa*
30.	*De las Espinitas*	*Iztapalapa*
31.	*Los Ángeles*	*Iztapalapa*
32.	*La Purisima*	*Iztapalapa*
33.	*Progresista*	*Iztapalapa*
34.	*Tacuba*	*Miguel Hidalgo*
35.	*Lago Gascasonica*	*Miguel Hidalgo*
36.	*San Antonio Tecomitl*	*Milpa Alta*
37.	*El Mirador*	*Tlalpan*
38.	*Mercado de la Colonia*	*Tlalpan*
39.	*López Portillo*	*Tlalpan*
40.	*Mi mercado*	*Tlahuac*
41.	*Mixquic*	*Tlahuac*
42.	*Federal*	*Venustiano Carranza*
43.	*Sonora*	*Venustiano Carranza*
44.	*La Merced*	*Venustiano Carranza*
45.	*Moctezuma*	*Venustiano Carranza*
46.	*Arenal*	*Venustiano Carranza*
47.	*López Mateos*	*Venustiano Carranza*
48.	*Palacio de la Flor*	*Xochimilco*
49.	*San Luis*	*Xochimilco*
50.	*Madre Selva*	*Xochimilco*
51.	*Plantas, flores y hortalizas*	*Xochimilco*

It is significant that a plant species used in prehispanic times *(Alternanthera repens, Tianguis)* continues to be used and that a plant used as forage *(Bidens odorata, Acahualillo)* also has a medicinal use.

Main common names for the plants in the study area are:

Alternanthera repens: Tianguis, Tianguispepetla, Tianquizpepetla, Verdolaga del puerco and Tumina. *Tianguispepetla* and *Tianquizpepetla* are derived of tianquiztli (market) and pepetle (mat and grass) from the Nahuatl language, given to the plant because it was very abundant in Mexican markets in prehispanic times, exposed as green carpets (Hernández, 1946).

Bidens odorata: Acahualillo, Aceitilla and Mosote blanco.

The persons interviewed pointed out that both plants are used today in Mexico City; Tianguis is more frequently used, 69 % of persons in the sample use it (users), despite the fact that this plant was not sold in the markets surveyed.

The ethnobotanical survey showed that both plants are used for a variety of ailments, mainly in gastrointestinal disorders (Table 3), chiefly as an antidiarrheal agent (Table 4).

Table 3. *Frequency Medicinal Uses for A. repens and B. odorata, According to the People Interviewed*

Disease	*A. repens* %	*B. odorata* %
	(n=169 mentions of use)	(n=225 mentions of use)
Gastrointestinal disorders[a]	56.2	39.1
Fever associated with gastrointestinal disorders	18.4	9.0
Kidney disorders	4.7	10.2
Diabetes	1.8	30.0
Twists	3.5	-
Blows	6.5	-
Wounds	2.9	-
Throat	-	2.0
Liver inflammation	-	2.6
Forage	-	5.3
Other disorders like *espanto* (fright), *nervios* (nervous alterations), *coraje* (anger), infections	6.0	1.3

[a]Gastrointestinal disorders are shown in Table 4.

Table 4. *Frecuency Gastrointestinal Uses for A. repens and B. odorata, According to the People Interviewed*

Disease	*A. repens* %	*B. odorata* %
	(n=95 mentions of use)	(n=88 mentions of use)
Diarrhea	42.1	39.8
Stomach ache	35.7	22.8
Vomit	11.6	13.6
Empacho (indigestion)	7.4	17.0
Flatulence	-	6.8
Gastritis	2.1	-
Dysentery	1.1	-

Tianguis is also indicated to diminish fever caused by gastrointestinal diseases and kidney disorders.

Acahualillo is indicated as a treatment for diabetes and, in a lower degree, for kidneys disorders and to diminish fever (Table 3).

Statements about the plant's different uses, parts used, mode of preparation and application, doses and time of application recorded from the persons interviewed are shown in Tables 5 and 6. The most popular form of treatment, in both cases, is as a tea to treat gastrointestinal disorders, diabetes and kidney diseases.

Table 5. *Ethnobotanic Information About Alternanthera repens, Obtained from People Interviewed.*

Disease	Parts used	Preparation (in water)	Mode of use	It is used ...
Diarrhea	AP	tea	ADW	1 or 2 days
Intestinal	WP WP	tea decoction	ADW enema	USC USC
Fever	AP WP	tea mashed plant	ADW cataplasm in the stomach	USC 1 or 2 times a day
Diabetes	AP	tea	ADW	USC
Kidney	WP	tea	ADW	permanently
Stomach	AP WP, R	tea roots and plant mashed in fresh water	ADW cataplasm in the stomach	USC 1 or 2 times a day
Buccal	WP	boiled and strained	buccal wash	USC
Parasitosis	AP	tea	ADW	USC
"Heat in the stomach"	AP R	tea decoction	ADW rectal wash	1 or 2 days 1 or 2 days
Vaginal infections	B	decoction	vaginal wash	a single time
Cleaning of the digestive system	B	tea decoction	ADW rectal wash	1-3 days 1-3 days
Susto (fright)	B	tea	a cup/day	USC
Prostate	WP	tea	ADW	USC
Wounds	WP	decoction	wash in the affected part	Once a day to USC

B: branch; WP: whole plant; AP: aerial part, R: root, ADW: as drinking water, USC: until symptoms are controlled

Table 6. *Ethnobotanic Information About Bidens odorata, Obtained from People Interviewed.*

Disease	Parts used	Preparation (in water)	Mode of use	It is used ...
Diabetes	B/F, WP (alone or combined)	tea	ADW	USC
Kidney	B/ F	tea	ADW	permanently
Throat	F	tea	A glass at night	USC
Diarrhea	AP	tea	3 cups/day	USC
Fever	B	tea	3 cups/day	USC
Stomach ache	F (alone or combined)	tea	ADW	2 o 3 days
Empacho	AP	tea	ADW	2 days
Liver	AP	infusion	ADW	USC
Vomiting	F, S	tea	ADW	USC
Forage	WP			

B: branch; F: flower, WP: whole plant; AP: aerial parts, S: shaft, ADW: as drinking water, USC: until symptoms are controlled

4 Discussion and Conclusion

It is relevant to mention that *Bidens odorata* Cav. belongs to *B. pilosa L. complex,* however according to Melchert (1976) and Ballard (1975, 1986), it's important to recognize it like an independent specie. Both taxa are part of a complex of species that are similar, but genetically and ecologically different.

The two species belong to a group of closely related taxa, which systematic and taxonomy used to be confused for a long time. Ballard (1975, 1986) left it partially clear. This author found three species (with varieties each one): the diploid one (n = 12) *Bidens odorata* Cav., the tetraploid one *B. alba* (l.) DC (n = 24) and finally, the hexaploid one *B. pilosa L.* (n = 36). Different ploidy levels were associated with certain morphological features. Its classification was accepted by Melchert (1976), McVaugh (1984) and Rzedowski & Rzedowski (2001). Unfortunately, Ballard (1986) just treats the *Bidens odorata* varieties with codes and descriptions, whereas that the *B. pilosa* varieties are just mentioned superficially (Vibrans, 1995).

Under the high morphological variability that present *Bidens odorata* Cav. population and often confused with *B. pilosa* (sensu Sherff in part) it should be noted that in this study we worked under the criteria mentioned by Rzedowski and Rzedowski (2001). So, *Bidens odorata* Cav. (*B. pilosa* L. sensu Sherff, in part) is one of the most common and widespread species in the Mexico Valley, which grows in fields, waysides, disturbed places, and secondary communities in general, and it is distributed from New Mexico and Nuevo León to Guatemala.

Ethnobotanical research has increased considerably in the last few years, and is presently considered a subject of great interest (Macía et al., 2005; Libman et al., 2006, López-Gutiérrez et al., 2014). Of particular interest are the plants used in Mexican traditional medicine (Leonti et al., 2003, Canales et al., 2005, Heinrich et al., 2014). Mexico is a country with a vast empiric ancestral knowledge on medicinal plants (Viesca, 2010), which has been transmitted verbally from generation to generation. Over time, this traditional knowledge is being lost so his rescue is imperative. This work attempts to rescue and validate the empiric popular knowledge of medicinal plants that Mexicans who live in highly urbanized cities still possess. In this research, the most valuable information was provided by people at least 50 years old.

It is surprising that both Tianguis and Acahualillo are grown in such inhospitable environments such as sidewalks, parking lots and streets; it was from these places that plants specimens were collected and where people who use the plants obtain them. Both Tianguis and Acahualillo are regarded as crop weeds and hence destroyed, but nevertheless they have managed to resist. All this shows the enormous natural resilience that these resources have.

The results of the ethnobotanical survey showed that both plant species are currently used as medicine, mainly to treat gastrointestinal disorders and especially for diarrhea, a disease with a high priority in Mexico and other countries (WHO, 2013); in Mexico, both gastrointestinal diseases such as diabetes mellitus are among the 20 leading causes of

disease (SS, 2013); in 2012, diabetes caused 1.5 million deaths (WHO 2014); in the period of 1990-2013, mortality from diabetes and chronic kidney diseases, increased in Mexico and in the world (GBD, 2015); diarrheal diseases and diabetes mellitus are listed as causes of premature death worldwide (OMS, 2014). These facts pointed to the need to investigate the role of these medicinal plants in the mentioned diseases in experimental models.

Rescuing ethnobotanic information about plants used in the treatment of diarrheal disorders, diabetes and kidney diseases, in a high urbanized area is of great importance. In this work, the information obtained about the current use of *A. repens* and *B. odorata* set the basis for the experimental study of both species. Therefore, we aimed to find out whether there is a pharmacological support which validates the popular use of these plants.

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