Reprinted from: Issues in new crops and new uses. 2007. J. Janick
and A. Whipkey (eds.). ASHS Press, Alexandria, VA.

The Production of Native and Exotic Herbs, Medicinal and Aromatic Plants in Argentina

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Herbs, medicinal, and aromatic plants (HMAPs) are a diverse group of plants with potential to contribute to economic development. South America has a long history of using and producing HMAPs, thus Argentina and other South American countries have been the source of genetic material that is now growing world wide, typical examples are *Tagetes* (*T. minuta* L., Asteraceae) (Guenther 1952) and "cedron" or lemon verbena [*Aloysia citriodora* (Cav.) Ort., syn. *Lippia citriodora* (Ort.) HBK, Verbenaceae].

Argentina has a long and rich history in the use of HMAPs in folk medicine and commercial products (Fester et al. 1961; Ratera and Ratera 1980; Retamar 1986). In 1998, a survey showed that there were over 60 species of HMAPs commonly used (either collected from the wild or cultivated) that produced different types of raw and finished products such as fresh, dried, or ground flowers, leaves and roots and their extractable essential oils, and oleoresins (Zygadlo and Juliani 2003).

In the past years, the interest and consumption of native and cultivated HMAPs have notably increased. Since few of the native plants have been successfully introduced into cultivation, they are still gathered directly from the wild to meet the increasing demand of the marketplace (Lopez 1993). Consequently, natural populations of those in highest demand have been harvested more heavily and continually over time with the native stand of many declining and the genetic diversity is being lost (Zygadlo and Juliani 2003). The objective of this work is to provide an overview of the HMAPs, both exotic and native, that are used in Mid-Western Argentina.

MATERIAL AND METHODS

In 2006, a study was conducted to determine the potentially important HMAPs that are cultivated or wild grown in Central/Mid-Western Argentina. This work also assessed the native, cultivated or imported HMAPs that are used in different commercial products that are sold in supermarkets, herbal shops, and drug stores. Only herbal teas, nonprescription drugs, non-alcoholic beverages, and composite yerba mate were considered for this study. This study was not designed to be an extensive survey of all the HMAP derived products commercialized in Central/Mid-western Argentina, but to provide a comparison with a similar survey conducted in 1998 (Zygadlo and Juliani 2003).

RESULTS AND DISCUSSIONS

Although official information on the cultivation of HMAPs in Argentina is scarce, some reports have shown that many species are cultivated throughout the country in seven regions (Berzins and Romagnoli 2003). The Central and Mid-Western regions are important areas for production of both cultivated and wild HMAPs. Spices, like local hybrid oreganos (*Origanum* × *aplii*, Lamiaceae), rosemary, and mint are cultivated in both regions. Basil, lemon balm, and sage are cultivated in the central region, while thyme, tarragon, absinthium, hyssop, anise, and lavender are mostly cultivated in the Mid-Western region known also as "cuyo."

This survey conducted in 2006, showed that over 140 plant species are used to prepare around 160 different products that include, but are not limited to, herbal teas, nonprescription drugs, non-alcoholic beverages, and composite yerba mate (Table 1). In contrast, the earlier survey conducted in 1998 showed that 65 species were mainly used to produce around 82 commercial products (Zygadlo and Juliani 2003). These results clearly showed an increment not only in the number of products that are commercialized, but also a diversification in HMAPs that are used in the different commercial products. The present study has also shown that a higher number of exotic plants were found to be used in products compared to 1998. Binomials and families are presented in Table 1.

*We thank the New Jersey Agricultural Experiment Station and Cook College for their support, the New Use Agriculture and Natural Plant Products Program and the Instituto Nacional de Tecnologia Agropecuaria, EEA (La Rioja). We also acknowledge support from the National Council for Scientific and Technical Research from Argentina (CONICET).

Table 1. Percent use of HMAP in different types of commercial products.

Common name	Botanical name	Family	Non-alcoholic beverage[z]	Non-prescription drug[z]	Herbal tea[z]	Composite yerba mate	Total[y]
Artichoke (alcachofa)	*Cynara scolymus* L.	Compositae		19			6
Boldo	*Peumus boldus* Mol.	Monimiaceae			12	40	12
Carqueja	*Baccharis* spp.	Asteraceae	70	9	6	20	12
Canchalagua	*Schkuhria pinnata* (Lam.) Thell.	Asteraceae	40				
Ceibo	*Erythrina crista-galli* L.	Fabaceae		9			
Lemon verbena, cedron	*Aloysia citriodora* (L'Her.) Britt.	Verbenaceae			8	50	9
Cardo santo	*Argemone mexicana* L.	Papaveraceae	30				
Cola de caballo	*Equisetum* spp.	Equisetaceae			5		6
Quassia	*Quassia amara* L.	Simaroubaceae	30				
Dulcamara	*Solanum dulcamara* L.	Solanaceae		19			
Enebro	*Juniperus communis* L.	Cupressaceae	30				
Fucus	*Fucus vesiculosus*	Fucaceae		9			
Sweet fennel, (hinojo)	*Foeniculum vulgare* Mill.	Apiaceae				20	
Incayuyo	*Lippia integrifolia* (Gris.) Hier.	Verbenaceae	70				7
Marcela	*Achyrocline satureoides* DC	Asteraceae	50				
Chamomile (manzanilla)	*Matricaria chamomilla* L.	Asteraceae	30		18		15
Lemon balm	*Melissa officinalis* L.	Lamiaceae			5		6
Mint	*Mentha* spp.	Lamiaceae			15	80	15
Peperina	*Minthostachys mollis* (Kunth.)	Lamiaceae			5	50	7
Passion flower (Pasionaria)	*Passiflora* spp.	Passifloraceae		13			
Poleo	*Lippia turbinata* Griseb.	Verbenaceae	50		6	60	11
Linden (tilo)	*Tilia* spp.	Malvaceae			7		
Tomillo	*Hedeoma multiflorum* Benth.	Lamiaceae	40				
Vira vira	*Achyrocline tomentosa* Rusby	Asteraceae	30				

[z]The percentage that an HMAP is present in a given group of product or,
[y]in the whole set (162)

The 2006 market survey showed that 11 species are used in more than 5% of commercial products, of which both cultivated and native plants play an important role. The most significant cultivated species, chamomile and mint, were found in 15% of commercial products. Boldo and lemon verbena "cedron" were found in 12% and 9% of the products, respectively, while artichoke and lemon balm are used in 6% of the products (Table 1).

The species extracted from the native flora include "carqueja" found in 12% of the products (Fig. 1), "poleo" (11%), and "incayuyo" (7%). In our last survey (Table 1), "poleo" was found in 38%, "incayuyo" in 23% and "carqueja" in 33% of the products (Zygadlo and Juliani 2003) (Table 1).

Noteworthy is the presence of a native fern known as "cola de caballo" (horse tail) that was used in 6% of the products (Table 1). Another important native plant is "peperina" that is used in 7% of the products, mainly as herbal teas alone in blends with other species (Table 1).

The non-alcoholic beverages include the bitters "amargos," in which "carqueja" and "incayuyo" were found in 70% of the products, other major used native species included "marcela" and "poleo" that were found in 50% of the non-alcoholic beverages. Other native species frequently used were "canchalagua," "tomillo" (or wild thyme), and "vira vira." The introduced species include chamomile, "cardo santo," quassia, and "enebro" (Table 1).

The non-prescription drugs include extracts/tinctures that were used as digestives, among other medicinal uses (Table 1). In this group the most important species were artichoke and dulcamara that were found in 19% of the products. Passion flower was found in 13% of the products while other native species are frequently used such as "carqueja" (9%) and "ceibo" (9%) (Argentina's national flower). *Fucus* (algae) is also commonly used (9%) in this group of products (Table 1).

Herbal teas (either as blends or single species) represented by far the most important group of products. The most important species were chamomile, mint and "boldo" that were found in 12%–18% of the products. Other minor cultivated species include lemon balm and linden (5%–7%), the latter locally know as "tilo" (Table 1). The native species were also well represented, lemon verbena the most used species (8%), followed by "carqueja" (6%), "poleo" (6%), *Equisetum* spp. (5%), and "peperina" (5%).

"Yerba mate" is a product obtained from the dried leaves of *Ilex paraguariensis* St.-Hil. (Aquifoliaceae), to prepare the popular infusion "mate" that is widely used in South American countries, such as Argentina, Brazil, Chile, and Uruguay. Yerba mate is blended with different HMAPs (1%–15%) to produce composite yerba mate that is another important group of commercial products (Table 1). Aromatic plant species like mint (80%), "poleo" (60%), lemon verbena (50%), and "peperina" (50%) were the most used species in this group, others minor species included boldo, carqueja and fennel (20%–40%) (Table 1).

Other conspicuous native species such as a native tree used mainly for ornamental purposes "lapacho" (*Tabebuia* spp., Bignoniaceae) was found in commercial products, while agronomic crops, such as alfalfa (*Medicago sativa*, Fabaceae) was also used. Other minor species, include the aromatic and native fern "doradilla" [*Anemia tomentosa* Sw. (Sav.) Sw., Schiazeaceae], which fronds are utilized as crude drugs in the form of infusion against menstrual complaints and menstrual cycle control.

Species that represent a potential health hazard has also been found in less than 0.6% of the products (1 out of 162 products), this species include *Chenopodium ambrosioides* L. (Chenopodiaceae), locally know as "paico" (Gadano et al. 2002) and *Heliotropium curassavicum* var. *argentinumn* (Boraginaceae). This latter species is employed in gout, rheumatism, neuralgias, arteriosclerotic disorders, muscular algias, phlebitis, varix, and other illnesses. The *in vitro* genotoxic effect of this species could be associated with pyrrolizidine alkaloids and their N-oxides (Carballo et al. 1992).

The present study has shown that cultivated species were mostly used, while less native species were used in commercial products. For Argentina, the regulation of plant collection from the wild does not seem to be a viable option (Lopez 1993). The cultivation of HMAPs has been considered as a vehicle to contribute to their conservation (Foster 1993). However, only a few native species are cultivated and the majority of the native species are still collected from the wild, with a few being cultivated for commercial production.

Lemon verbena now comes from cultivated fields in Argentina, with almost no wild species found. Recently, "peperina" has been introduced into cultivation by farmers of the central region and is beginning to be offered in the local markets. Since the last decades, there has been a significant demand of HMAPs to sustain the increasing need of raw materials (Lopez 1993), suggesting that the industrial consumers have switched to

cultivated sources to guarantee a sustain supply of raw materials.

Many of the medicinal uses of HMAPs could be accounted for the presence of secondary metabolites, that are responsible, at least in part, for the biological activities of this group of plants, these metabolites include volatile (essential oils) and non-volatiles components (e.g. polyphenols among others).

The essential oil of "doradilla" was dominated by α-bisabolol (50%) (Juliani et al. 2004), α-bisabolol was found to display antiinflammatory and local analgesic activities (Sheridan et al. 1999), suggesting that the use of "doradilla" for menstrual complaints may be due, at least in part, to this sesquiterpene alcohol.

The genus *Lippia* (Verbenaceae) is widely distributed in West of Argentina and it includes many shrubs. The plants are collected directly from the wild, since the natural populations of this species are very high. The species was found to exhibit antimicrobial (Hernandez et al. 2000) and antitubercular activity (Watcher et al. 2001). *L. intergrifolia*, locally known as "incayuyo" is used largely because of its digestive and diuretic properties. *L. turbinata* and *L. integrifolia* are the most employed species among the genus *Lippia* for different therapeutic activities including as tonic, nervine, and emenagoge (Bassols and Gurni 2000). Although some studies have been done on the essential oil composition (Frike et al. 1999), other components such as non-volatiles polyphenols has been less studied.

Lemon verbena is a perennial shrub that is broadly used both as a spice and as a medicinal. The plants are 1 to 3 m height with narrow leaves and small white flowers with a lemon-smelling fragrance. Traditionally, the infusion of the leaves is used as a digestive and antispasmodic, antipyretic, sedative, and for indigestion. Recently, it has been reported as a potent antioxidant (Valentao et al. 2002) and antimicrobial (Ohno et al. 2003). This species is widely used in teas and composite yerba mate, and its essential oil rich in citral gives the plants the characteristic lemon flavor (Santos-Gomes et al. 2005).

The genus *Baccharis* (Asteraceae) is commonly known as "carqueja" and is a perennial shrub (Fig. 1). In Argentina, *Baccharis articulata* (Lam.) Pers. and *B. crispa* Sprengel are one of the most uses species in commercial products. *B. articulata* is used as diuretic and as digestive in folk medicine in South America. Aerial parts of the plants are used to prepare extracts to treat gastrointestinal, inflammatory and liver problems, and poor blood circulation (Verdi et al. 2005). Recently it has been reported also its antioxidant activities of ethanol and aqueous extracts, antiviral activity (Abad et al. 1999), anti arthritic therapeutic effect (Coelho et al. 2004), spasmolytic (Weimann et al. 2002), potential antidiabetic activity (Oliveira et al. 2005) and antimicrobial activity (Feresin et al. 2003), thus supporting its traditional use in folk medicine.

Flavonoids and other polyphenols were the most common components found in the genus *Baccharis*. Flavonoids, and caffeic acid derivatives have been identified in many species (Sharp et al. 2001, Weimann et al. 2002). In *B. articulata,* a component (glucopyranosyl dimethoxybenzylalcohol) showed similar or higher antioxidant activity (depending on the antioxidant assay) when compared with vitamin E analogues (Oliveira et al. 2003).

These studies have shown that the genus *Baccharis* is a rich source of polyphenols and considering the diversity of species of the genus *Baccharis* (500 species) (Verdi et al. 2005), the genus could be a new source of components and bioactivities, with great potential to generate new HMAPs products.

Different species of the genus *Tagetes* and *Eupatorium* have been reported to present antiviral activity against herpes virus simple 1, vesicular stomatitis virus and poliovirus type 1 (Abad et al. 1999). Species of the genus *Baccharis*, *Lippia*, *Eupatorium*, and *Satureja* have been reported to be effective against epimastigote forms of *Trypanosoma cruzi* (protozoan parasite which causes an endemic disease) (Sulsen et al. 2006).

The studies conducted in 1998 and to a lesser extent in 2006, have shown that in fact only a limited number of the potential native HMAPs available in Argentina are used in commercial products. In the provinces of La Rioja and Cordoba (Central and Mid-western regions), we were able to identify approximately 160 species that could be used as HMAPs

Fig. 1. Carqueja (*Baccharis* spp.) is one of the most used native plants in Argentina mainly for digestive complaints.

(Table 2). Asteraceae is the most important family, with many significant members such as *Baccharis*, *Eupatorium*, *Senecio*, *Tagetes*, and *Stevia*, among others. Verbenaceae is also important with many members being used commercially. Other conspicuous species have received less attention, such as the genus *Aloysia* and *Accontholippia*.

CONCLUSIONS

This study demonstrated that more than 140 species of HMAPs in Central/Mid-Western Argentina are used today. There has been a diversification in the species used to generate new and increased commercial products as we found an increasing number of HMAPs from 1998 to 2006. This diversification of species and products suggests that the current market demand creates opportunities for both the collectors and commercial growers of these specialty crops and plant products, and may offer niche products for mainly small land holders. Although some of the components of the diverse local flora have been extensively used in commercial products, the Argentinean medicinal flora still remains relatively untapped and has the potential to continue to contribute to economic development. However, strategies for the sustainable collection from the wild are needed to preserve the native stands of HMAPs.

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Table 2. List of species with potential as HMAPs in La Rioja and Cordoba provinces (Argentina).

Genus	No. species	Family	Genus	No. species	Family
Acantholippia	2	Verbenaceae	*Lepechinia*	2	Lamiaceae
Achyrocline	3	Asteraceae	*Lippia*	7	Verbenaceae
Aloysia	5	Verbenaceae	*Lithrea*	1	Anacardiaceae
Aristolochia	1	Aristoloquiaceae	*Mulinum*	2	Apiaceae
Artemisia	3	Asteraceae	*Mutisia*	4	Asteraceae
Baccharis	22	Asteraceae	*Ophryosporus*	2	Asteraceae
Chenopodium	8	Chenopodiaceae	*Pluchea*	1	Asteraceae
Coronopus	1	Cornaceae	*Porophyllum*	2	Asteraceae
Eryngium	2	Apiaceae	*Salvia*	1	Lamiaceae
Eupatorium	10	Asteraceae	*Satureja*	1	Lamiaceae
Flourensia	6	Asteraceae	*Schinus*	5	Anacardiaceae
Gaillardia	3	Asteraceae	*Senecio*	38	Asteraceae
Grindelia	2	Asteraceae	*Stevia*	9	Asteraceae
Helenium	1	Asteraceae	*Tagetes*	6	Asteraceae
Lantana	3	Verbenaceae	*Tessaria*	3	Asteraceae

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