Fabiana imbricata Ruiz & Pav.

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Fabiana imbricata Ruiz & Pav**.** flowers. (Photo by the author)

Abstract *Fabiana imbricata* Ruiz & Pav. (Solanaceae), is popularly known as "palo piche", "palo pichi", "romero-pichi", etc. The infusion and decoction obtained from the bark and stems of this shrub has gastroprotective, liver stimulant, antiseptic and diuretic effects. This infusion is also used to treat *Fasciola hepatica* infections in goats and sheep, in Chilean folk medicine. The aerial parts of *Fabiana imbricata* have yielded a great variety of non-polar and polar compounds, as n-alkanes, mono, sesqui and triterpenes, alkaloids, anthraquinones, flavonoids and sugars. The plant displays several biological activities including diuretic effect, inhibition of the enzyme β-glucuronidase, antifeedant activity and gastroprotective effect in animal models. It is recommended to domesticate this species by elaborating appropriate

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propagation, cultivation and agronomic practices that would ultimately ensure the good pharmaceutical quality of this valuable medicinal plant.

Keywords *Fabiana imbricata* · "Palo piche" · Diuretic · Gastroprotective

1 Introduction

Fabiana imbricata has a long history as medicinal plant in the South American traditional medicine and presently, it is still widely used. Hipólito Ruiz and José Pavón (1798) were the first botanists who identified and described it in the XVIII century. The common name "pichi", given by local people, refers to its urination increasing effect after consumption.

2 Taxonomic Characteristics

The Solanaceae Family comprises about 96 genera and 3000 species. They show a cosmopolitan distribution with the main center of taxonomic diversity and endemism in South America. *Fabiana* is a genus of flowering plants native to dry slopes in western South America, it comprises 15 species usually growing in South American Andes Mountains. *Fabiana imbricata* Ruiz & Pav. (Solanaceae), is popularly known as "palo piche", "palo pichi", "romero-pichi and "tola" in the North of Chile (de Mösbach 1992; Hoffmann et al. 1992; Barboza et al. 2009; Guerra et al. 2012).

Synonyms
Fabiana biflora J. Rémy, *Fabiana imbricata* Ruiz & Pav. var. *biflora* (J. Rémy) Reiche, *Fabiana araucana* Phil., *Fabiana lutescens* Phil. (The Plant List 2019).

3 Crude Drug Used

Fabiana imbricata is a species widely known both in the Argentinean Patagonia and throughout Chile. Several chroniclers from the colonial era cited it. Murillo (1889) appointed it for effective treatment of urinary problems and lithiasis.

The bark and stems of this shrub (Photo 1) are used as infusion, decoction or added to the "mate", a traditional drink of the region mainly composed by *Ilex paraguariensis* (Casamiquela et al. 2002). The fruits, in a dehydrated form, are used in desserts as sweeter (Cordero et al. 2017). In Chile, wild plants are harvested and sold to flower shops. In other countries, this shrub is used as an ornamental plant in gardens or as a pot flower (Fischer et al. 2011). Zin (1930) described that the plants

Photo 1 Stems with flowers, twigs, and bark of *F. imbricata*. (Photos by the author)

from the South of Chile have more resin than those from the North, so they are more active.

F. imbricata was an official drug in the Farmacopea Argentina, until the 3th edition (Bandoni 2001) and in the Farmacopea Chilena II ed. (Imbessi 1964). Presently, it is official in the Homeopathic Pharmacopeia from India (Tiwari et al. 2013) and German (German Homeopathic Pharmacopoeia, 2000/2005) and it is registered as skin conditioner and tonic, in cosmetic products in Europe, with the INCI: *Fabiana imbricata* extract. In a French patent it was registered as skin smoothing agent, for irritation and inflammations (Pegeon and Pelletier 2010).

4 Major Chemical Constituents and Bioactive Compounds

In the family Solanaceae some alkaloids are frequently unique to one or only a few species: this is the case also with: fabianine (volatile tetrahydroquinoline alkaloid) in *F. imbricata* (Barboza et al. 2016). Fabianine is - almost certainly - synthesized in nature from two isoprene units, linked head to tail, and a C_4N unit, probably derived from aceto-acetate (Edwars and Elmore 1962).

The aqueous extract of *F. imbricata* tops has yielded D-manno-heptulose, the closely related perseitol (D-glycero-D-galactoheptitol), and D-glycero-D-manno-octulose; D-arabinitol, D-mannitol, galactitol, myo-inositol, D-xylose, D-galactose, and primeverose (6-*O*-β-D-xylopyranosyl-D-glucose) were also obtained (Richtmyer 1970).

Knapp et al. (1972) found in the ethanolic extracts of aerial parts the following compounds: n-alkanes, fatty acids, 6-methoxyanthraquinones: erythroglaucin and physcion; and acetovanillone.

Flavonoids as quercetin, kaempferol and quercetin-3-*O*-rhamnoglucosid (rutin) were reported by Hörhammer et al. (1973). Silva et al. (1962) isolated from the leaves and stalks phytosterol.

Fourteen sesquiterpenes with muurolane and amorphane skeletons were isolated from the petroleum ether extract of the aerial parts of *F. imbricata* by Brown (1994a; Brown and Shill 1994). They seem to fit into two biogenetic classes: a 7-oxygenated muurolane and an 11-oxygenated amorphane. The norcadinane, α-muurolene and γ-amorphene derivatives were identified in samples from Chile (Schmeda-Hirschmann and Papastergiou 1994).

A novel seco-amorphane sesquiterpene incorporating a fully saturated furo[2,3-d]-l,3-dioxole system was isolated from the aerial parts of *F. imbricata* and was named fabianane. Such functionality is unique within the sesquiterpene family (Brown 1994a, b).

F. imbricata yielded coumarin-derivatives, such as scopoletin and its 7-prenyl-derivative in its exudates, differing from the other studied Solanaceae (Wollenweber et al. 2005). Also, fabiatrin after identified as the *O*-β-D-glucoside of scopoletin and a probable saponin (Edwards and Rogerson, 1927; Chaudhury et al. 1947).

Chlorogenic acid is one of the major components of the polar extracts of *F. imbricata* (Quispe et al. 2012) and also has been demonstrated the presence of oleanolic acid and *p*-hydroxyacetophenone (Schmeda-Hirschman and Papastergiou 1994).

Some secondary metabolites of *F. imbricata* seem to show toxicity towards the greenbug *Rhopalosiphum pudi*: fabiaimbricatan-15-oic acid, oleanolic acid, rutin, scopoletin and *p*-hydroxyacetophenone may protect from aphid infestation by acting as toxicants or feeding deterrents depending on the doses (Schmeda-Hirschman et al. 1995).

The essential oils that were analyzed in a population from Argentina (Guerra et al. 2012) contained the following main compounds: tricyclene, α-pinene, camphene, *p*-cymene, limonene and terpinen-4-ol.

5 Morphological Description

F. imbricata plants are chamaephytes or microphyllous shrubs, of homoblastic or heteroblastic growth; stems and leaves with dense resiniferous indumentum (Photo 1). Leaves sessile, imbricate, fasciculate or rosulate. Flowers solitary, 5-merous, actinomorphic; calyx lobes shorter than tube; corolla whitish, rarely lilac or bluish, funnel-shaped or salverform, aestivation contorted-conduplicate (Alaria and Peralta 2013). *Fabiana* is the only genus where the stomata are placed on projections of the epidermis (Barboza et al. 2016). Leaves emitting when crushed an aromatic and resinous odor. *F. imbricata* is a non-resprouting long-lived woody shrub that reaches sexual maturity in approximately 6 years.

The flowering period extends from September to January. Seed production was estimated at 200,000 seeds per adult forming persistent banks. Very longlived individuals were found up to 140 years old (de Torrres Curth et al. 2012). The drug comprises leaves and parts of stems, with or without bark. Luján and Barboza (1999) published the macroscopic and microscopic characters for the identification of this plant.

6 Geographical Distribution

The species of the South American plant genus *Fabiana* grow along arid mountainous area between 16° S and 51° S latitude, between 1000 and 4900 m.a.s.l. There are 15 species, ten are present in Argentina, seven in Chile, four in Bolivia and one in Peru (Cuello et al. 2011). *Fabiana imbricata* occurs from Mendoza to Chubut Provinces in Argentina, including the Patagonia steppe where it forms shrublands. In Chile, it can be found from Atacama to the Región de los Ríos, covering a wide range of dry, Mediterranean landscapes reaching down to the rainier places in Southern Chile (de Torrres Curth et al. 2012). Also occurs in Brazil, Bolivia and Peru (Rätsch 2005).

7 Ecological Requirements

F. imbricata grows in soils with varying chemical and physical properties, such as sandy, loamy sand and loam soils. Most of natural populations of "palo pichi" are adapted to grow in the foothills or in the valleys. *F. imbricata* is a long-lived shrub distributed via seeds. Fire and wind, followed by post-fire high precipitation in the early spring are requirements for successful propagation of the species (Ghermandi et al. 2013). Germination rate of the very tiny seeds is very low, therefore, the effect of gibberellic acid soaking on the germination percentage should be studied (Fischer et al. 2011). The species is a seeder shrub that forms conspicuous monospecific

shrublands providing a degree of landscape heterogeneity within a grassland matrix (Ghermandi et al. 2013).

8 Traditional Use (Part(s) Used) and Common Knowledge

It has been used to treat kidney and bladder infections, liver flukes of goats and sheep (Kunz Krauze 1899). Infusion of flowers is diuretic, and infusion of stems is used to treat kidney stones, cystitis, hepatic abscesses and bronchial infections. As plant infusion it is consumed for kidney and urinary duct problems. (San Martín 1983; Houghton and Manby 1985). It is recommended as a diuretic, digestive and to treat kidney complaints (Razmilic et al. 1994; Muñoz et al. 1991). *F. imbricata* is reported for renal and respiratory diseases in Mapuche rural and semi-rural populations in Argentina (Eyssartier et al. 2013). It is used as diuretic, blood depurative, for liver ailments and for hair washing (Schmeda-Hirschmann and Theodoluz 2019). The tips of the branches are dried and sometimes chopped into little pieces. This herbage is then burned as incense or thrown over burning charcoal. This causes the plant to give off resinous smoke that can easily be inhaled. It has a sweetish scent like that of pine (Rätsch 2005).

9 Modern Medicine Based on Its Traditional Medicine Uses

The plant displays several biological activities including diuretic effect, inhibition of the enzyme β-glucuronidase (IC_{50} 6.2–10μg/ml) and antifeedant activity (Schmeda-Hirschmann et al. 1992, 1993, 1994, 1995). The diuretic effect was assessed at 250 mg/kg in rats and resulted in a 47.8% increase in urine output, compared with untreated animals. Hydrochlorothiazide (25 mg/kg) was used as a reference compound (Schmeda-Hirschmann et al. 1994).

In a homoeopathic journal, Mehnert (1989) describes the drug as sovereign for the treatment of migraine and sciatica, as a muscle relaxant and pain reliever in cervical root syndrome, to resolve spasms and thus relieve pain after trauma and in neuropathies.

The main terpenes of the *F. imbricata* exudate were evaluated for gastroprotective effect in animal models reducing the gastric lesions (Reyes et al. 2005). According to the pharmacological evidence from the Chilean collections of the plant, *F. imbricata* is a safe crude drug in the amounts used in traditional medicine. (Schmeda-Hirschmann and Theodoluz 2019).

According to Gastaldi (2012) aerial parts of *F. imbricata* infusion has a high ARP (antiradical power) value and then it would be an important source of antioxidants.

10 Conclusions

Fabiana imbricata has a long history of use in folk medicine, it is abundant in the Argentinean Patagonia; most chemical and bioactivity studies were performed in Chile (Schmeda-Hirschmann and Theodoluz 2019). *F. imbricata* shows activity as a diuretic, while in animal models, its main constituents demonstrated gastroprotective effects. This species possesses a wide diversity of chemical constituents, ranging from non-polar hydrocarbons and terpenes to highly polar compounds such as phenolics and sugars. In view its possible domestication, it seems important to refer micropropagation experiments suggesting that it might be possible to obtain large number of clonal plants in a short time by this procedure (Razmilic et al. 1994; Schmeda-Hirschmann et al. 2004). Further information about the domestication, propagation, cultivation and agronomic practices are needed to ensure good pharmaceutical quality.

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