

CONTRIBUTION TO THE STUDY OF SOME ARGENTINIAN MEDICINAL PLANTS AND COMMERCIAL QUALITY CONTROL

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Abstract

A morpho-anatomical study of 5 Argentinean non-official medicinal plants (*Bauhinia forficata* subsp. *pruinosa* (Vog.) Fortunato et Wunderlin, *Coronopus didymus* (L.) Smith, *Cuphea glutinosa* Cham. et Schlecht., *Euphorbia serpens* Kunth and *Fabiana imbricata* Ruiz et Pav.) was carried out in order to determine the diagnostic characteristics for an adequate quality control. The article includes a monograph with illustrations for each species. The quality control of a set of commercial samples puts in evidence that only a 60% of them deserves to be commercialised.

1. Introduction

According to the World Health Organization, the use of medicinal plants remedies is increasing in both developed and developing countries (Akerle, 1991). Argentina has many medicinal plants, which are used in folk medicine (Sorarú and Bandoni, 1978; Ratera and Ratera, 1980) or are used by pharmaceutical, cosmetic or food industries.

Since the anatomical features of many popular herbs are yet unknown, they are difficult to identify in vegetative stage or when the material is very fragmented. For this reason, this investigation deals with 2 main objectives: 1) to contribute to the knowledge of the anatomical diagnostic characteristics of some species used as herbal remedies and, 2) to verify the legality of commercial samples of these species through a quality control. Diagnostic descriptions of the plants and drugs including original observations, as well as information about the local uses and chemical composition are also included.

2. Materials and methods

Fresh or fixed in Formalin-Aceto-Alcohol (5:5:90) material of the organs used was analysed. Sections for study with light microscope were prepared after dehydrating the material in an ethyl alcohol/xylene series and then included in an embedding medium ("paraplast"). Sections were cut 10-15 µm thick and stained with brilliant Cresyl blue.

In order to observe stomata and trichomes in surface view, epidermal peels were made and then mounted in a drop of diluted glycerine. Differential histochemical staining put in evidence the different cellular contents. In some cases, leaves were submerged in a bleaching reagent for a few minutes before peeling.

Drawings are original and were made using a camera lucida. The different tissues were represented following the symbols proposed by Metcalfe and Chalk (1950). In the microscopical diagnosis, the type of stoma is described in surface view.

Quality control of a total of 25 commercial samples (5 samples of each of the 5 species) has also been carried out. Four aspects were considered: 1) Label verification, that is, if

the scientific name indicated on the label fits well with the content of the sample. 2) Botanical quality control, that is, the legality verification of the commercial species through a comparison with the respective diagnosis; as a result of this verification, the samples were classified in authentic, substitute, adulterated and falsified according to the Código Alimentario Argentino (1989) definitions. 3) The purity degree: in order to determine the purity degree, both organic foreign matter (such as dead or alive insects in their different stages of development, remains of insects, excrements of insects and/or mammals, fungus spores and hyphae and remains of other plants) and inorganic foreign matter (dust, grit, other minerals) were taken into account; in the samples of the 5 species analysed the amount of foreign matter present in 50 gr. of each commercial sample was weighted. 4) Categorisation of the analysed samples: according to the results obtained in 2 and 3, the samples were classified in a) excellent: samples that proved to be the authentic species stipulated on the label and were in excellent sanitary conditions (high purity degree), b) good: samples which are fit for commercialisation because they are authentic and in acceptable hygienic conditions (standard purity degree), and c) bad: samples which are not fit to be commercialised due to the fact that they are adulterated or falsified and in unacceptable sanitary conditions (low purity degree).

The identification of foreign matter of animal origin was performed by the Catedra de Entomología and Diversidad Animal II (UNC) and the respective voucher specimens are deposited at Cátedra de Botánica (Fac. Cs. Químicas, UNC).

Voucher specimens and commercial samples of the 5 species studied are deposited at the herbarium of Museo Botánico de Córdoba, Argentina (CORD).

3. Results

3.1. Monographs

Bauhinia forficata subsp. *pruinosa* (Vog.) Fortunato et Wunderlin (Fam. *Fabaceae*)

Synonym: *Bauhinia candicans* Benth.

Common names: "pezuña de vaca", "pata de vaca", "pata de buey", "falsa caoba".

The plant (Fig. 1 D, I): Tree or shrubs, up to 10 m tall. Branches densely minute pubescent with 2 axillary glabrescent spines. Petiole up to 3 cm; blades uniform in colour, deeply two-lobed, base cordate with a pulvinus in the adaxial surface. Flowers 1-3 in extra-axillary racemes; calyx spathaceous in anthesis; corolla white, 8-10 cm long., 5 spathulate clawed petals; stamens fertile 10, unequal: 5 short (4-5 cm), 5 long (6-7 cm), filaments curved in the apex and connate at the base, with an additional glabrous ligular appendix; gynoecium glabrescent with gynophore. Pod 10-20 cm long. Seeds dark brown, glabrescent; sporoderm smooth. Native to eastern Paraguay, southern Brazil, NO Uruguay and NE Argentina (Fortunato, 1986).

The drug includes entire or partly broken dried leaves; occasional pieces of woody stems with spines.

Macroscopical diagnosis. LEAVES (Fig. 1 D). Blades lobed in the 2/3 superior, 4-10 cm long. x 2,5 cm lat., each lobe obtuse in the apex.; adaxial surface glabrous, abaxial surface tomentose or strigose; veining campylodromus (8-10 main nerves, the 3 central ones straight and the remaining slightly curved); dark brown pulvinus in dried leaves. Broken leaf pieces up to about 5,5 cm long in maximum dimension. Petioles pubescent, manifestly 2-ridged in the adaxial surface and broadened in the proximal and distal end.

Microscopical diagnosis. LEAVES (Fig. A-C, E, F-H, J). Epidermis uniseriate; adaxial surface with rectangular cells, glabrous; abaxial surface with more or less flask-shaped cells; hypostomatic, anomocytic stomata; abundant pluricellular eglandular trichomes slightly verrucate. In surface view, many prismatic crystals are observed along the nerves.

Cuticle striate and thicker in the abaxial surface. Mesophyll: Homogeneous consisting wholly of 4-5 compact layers of palisade parenchyma; rows of 2-4 cells with calcium oxalate druses among them. Main vascular strands protruding considerably to the abaxial surface, with some unequal projections in the epidermis due to a proliferation of collenchymatous cells; bicollateral bundles with 2-4 parenchymatous layers contiguous to the sieve elements and a nearly continuous sclerenchymatous ring around the bundles; to adaxial surface, 2-3 (5) layers of tangential and angular collenchyma are observed. Secondary and tertiary bundles immersed in the mesophyll. Abundant prismatic crystals and druses in all tissues.

Exsicc. - Ariza Espinar 3378 (CORD); Luján s.n. (CORD 379).

Chemical composition: Leaves contain tannins and peroxidases (Ratera *et al.*, 1980). A preliminary analysis revealed β -sitosterol (Lemus *et al.*, 1997).

Uses: Leaves are traditionally used as a hypoglycemic, in infusions (Sorarú and Bandoni, 1978; López *et al.*, 1987). They also have an antitussive activity (Burkart, 1967).

Coronopus didymus (L.) Smith (Fam. *Brassicaceae*)

Common names: "quimpe", "mastuerzo", "mastuerzo falso".

The plant (Fig. 2 A, C, F, I): Annual or biennial; fetid herbs, decumbent, profusely branched in the base, up to 50 cm tall. Lower leaves shortly petiolate, the upper ones sessile. Flowers small, 0,8-1,5 mm long.; pedicels glabrescent. Sepals 4, oval, glabrous or pubescent; petals 4, white, elliptic; stamens 2, rare 4, anthers globose; ovary broad, ovate, stigma subsessile, capitate. Silicle indehiscent, dorsiventrally compressed, emarginate in the apex and base, valve reticulate. Seeds yellow; sporoderm smooth. South American, widespread as weed and ruderal (Boelcke, 1987).

The drug includes dried aerial parts, especially fragments of stem (0,5-3 cm long.) and entire ripe fruits or just one of their valves with its unique seed; in less proportion fragmented leaves. Odour fetid.

Macroscopical diagnosis. STEM green, striate, with patent long white trichomes. LEAVES. Petiole pubescent, blades opaque when dried, pinnatisect, glabrous or glabrescent, each segment pinnately cleft ending in a peculiar trichomatic mucro. FRUIT. Ripe silicle and the one-seeded valve easily recognised by the reticulate ornamentation of pericarp.

Microscopical diagnosis. STEM (Fig. 2 H, J, L). With an early and incipient secondary growth. Epidermis uniseriate, rectangular cells, anisocytic stomata, long unicellular verrucate trichomes. Cuticle thick and striate. Cortex partly photosynthetic, tangential collenchyma 1-2 layered and 4-7 parenchymatous layers with scarce intercellular air-spaces. Groups of pericyclic fibers above each vascular bundle. Vascular system: Eustele, with interfascicular cambium (5-6 layers) and interfascicular xylematic fibers (2-3 layers). Abundant pith.

LEAVES (Fig. 2 B, D, K, M). Epidermis uniseriate, glabrous or glabrescent; isodiametric or rectangular cells in both surfaces; amphistomatic, anomocytic and anisocytic stomata. The foliar mucro bears an unicellular, verrucate, unbranched or bifurcate eglandular trichome. Cuticle thin and smooth. Mesophyll: Dorsiventral, 2 (rare 3) layers of palisade tissue and 4-5 spongy tissue with large intercellular spaces. Main and secondary vascular bundles collateral, wholly immersed in the mesophyll and surrounded by a sheath with chloroplasts.

FRUIT (Fig. 2 E, N). Cuticle striate and very thin. Pericarp differentiated in 2 well defined zones: the outer one consists of the uniseriate epidermis (with large rectangular thin-walled cells and many anisocytic stomata) followed by 4-6 layers of parenchyma

(cells with many chloroplasts); the inner zone consists in the mechanical tissue (5-6 layers of fibers arranged in a palisade structure).

Exsicc. - Filipina 5 (CORD); Barboza 162 (CORD).

Chemical composition: The essence of this species contains benzyl cyanure (Fester *et al.*, 1961).

Uses: Vulnerary (healing agent for wounds), among other uses (Sorarú and Bandoni, 1978; La Porte, 1980).

Cuphea glutinosa Cham. et Schlecht. (Fam. *Lythraceae*)

Common names: "siete sangrías".

The plant (Fig. 3 A-D, F-H): Pubescent herbs, up to 50 cm tall, profusely branched in the base; horizontal rhizome (0,5 cm diam.), reddish; aerial stems erect to decumbent, reddish. General indument consisting of eglandular and glandular trichomes. Leaves simples, decussate, oblong-ovoid, base attenuate, margin ciliate. Flowers solitary, zygomorphic, hexamerous; pedicels sometimes bibracteolate; calyx tubular, viscid, with a small spur, outside densely glandular-pubescent and inside with eglandular trichomes on the nerves, in its upper end with 2 small cushion-like structures just above the 2 shortest stamens; petals lilac or rose, oblong elliptic; stamens 11 inserted to the tube calyx, heterodynamous: 2 short, 4 medium, 5 long, filaments geniculate, pilosulous (the longest ones, glabrous), anthers articulate; ovary glabrous, convex and with a receptacular nectary on its dorsal face, style curved and pubescent; stigma capitate. Capsule multi-seeded, wholly covered by the calyx. Seeds cinnamon, subglobose-compressed; sporoderm foveolate. From South America: Brasil, Uruguay, Paraguay and Argentina (Lourteig, 1943).

The drug includes small pieces of stem and leaves, sometimes pedicels with persistent calyx.

Macroscopical diagnosis. Small pieces of reddish stems. LEAVES subsessile, entire. Calyx purple with its characteristic spur. All of them with glandular pubescence.

Microscopical diagnosis. STEM (Fig. 3 E, J). Epidermis uniseriate, rectangular cells; stomata, trichomes and cuticle the same as the foliar epidermis. Primary cortex consisting of a conspicuous subepidermic layer with starch, 2-3 parenchymatous layers with druses, an endodermis and, a continuous ring 2-3 layered of sclerenchyma. Deep periderm bistratified that crushes the primary cortex in older stems. Vascular system: Amphiphloic siphonostele. Pith with starch and large druses.

LEAVES (Fig. 3 I, K, L-O). Epidermis uniseriate; globose and rectangular cells of different size in both surfaces; some cells with mucilagous; amphistomatic, anomocytic stomata, guard cells with many and large chloroplasts; abundant uncinulate (unicellular) or erect or curved (uni-tetracellulular) eglandular trichomes; scarce glandular bristles-like trichomes provided with a wide pluriseriate body ending in 2 or 3 cells, the secretory cells are in the base of the trichomes and produce a mucilagous exudation confined below the cuticle (these trichomes are abundant in the calyx). Cuticle thick and striate. Mesophyll: Dorsiventral, 1 (rare 2) layers of palisade tissue and 6-8 layers of lax spongy tissue, abundant druses. Main vascular bundle bicollateral, 3-4 layers of tangential collenchyma to the adaxial surface and 1 (rare 2) layers of fibers to the abaxial surface. Smaller bundles wholly immersed in the mesophyll.

Exsicc. - Ariza Espinar 3329 (CORD).

Chemical composition: Unknown.

Uses: Diuretic and hypotensive (Ratera and Ratera, 1980).

Euphorbia serpens Kunth (Fam. *Euphorbiaceae*)

This species comprises 2 varieties (*E. serpens* var. *serpens* and *E. serpens* var.

microphylla Muell. Arg.); both taxa are indistinctly used in folk medicine.

Common names: “yerba meona”, “rompepiedra”, “yerba de la paloma”, “lechera”.

The plant (Fig. 4 A-E): Perennis, monoecious, glabrous and reptans herbs, abundantly branched and leafy, green or green-purple in colour; radicant nodes, white latex. Entire leaves brevipecciolate, blades ovate, slightly asymmetrical, with base and apex truncate, 4-6 mm long. x 3-4 mm lat.; stipules membranaceous, connate, entire or toothed, glabrous. Involucrum urceolate (var. *serpens*) or tubular (var. *microphylla*) ending in 5 lobes, each lobe alternates with 4 green nectaries joined to petaloid appendices. Imperfect flowers in terminal and solitary cyathia. Female flower on a pedicel, protogynous, naked (var. *serpens*), or with a trimerous perianth (var. *microphylla*), surrounded by 5 male flowers (each single stamen on a pedicel); ovary with 3 bifid styles. Capsule globose, glabrous, three celled. Seeds ovoid; sporoderm smooth without caruncule. *Euphorbia serpens* var *serpens*: widespread in America from United States to Argentina (Buenos Aires); var. *microphylla* grows from southern Paraguay to Argentina (Buenos Aires). Both very common in disturbed areas (Subils, 1977).

The drug includes aerial dried plant chopped into small pieces.

Macroscopical diagnosis - Small pieces of stem (ca. 3-5 mm long.) easily recognizable by its radicant nodes or its green purple colour; sometimes fragments of leafy stems or leaves with their peculiar stipules.

Microscopical diagnosis. - STEM (Fig. 4 G, I). Epidermis uniseriate, isodiametric cells, anisocytic stomata, it is no replaced by a periderm in the secondary growth. Cuticle smooth and thick. Cortex: 4-6 parenchymatous layers, thick walled cells with abundant starch; in the innermost layers, groups of fibers alternate with laticifers. Vascular system: Eustele with collateral bundles in primary growth. Laticifers also in primary xylem. Pith parenchymatous.

LEAVES (Fig. 4 F, H). Epidermis uniseriate, glabrous; rectangular cells in both surfaces; amphistomatic, anomocytic and paracytic stomata. Cuticle thick, smooth, with epicuticular waxes. Mesophyll: Laticifers subepidermic non-articulated and branched; Kranz structure, a conspicuous sheath with large chloroplasts surrounds the collateral vascular bundles; palisade tissue radially arranged around the bundles. Main and secondary vascular bundles separated by small spongy mesophyll cells.

Exsicc. - Subils 4598 (CORD).

Chemical composition: Nothing is known for var. *serpens*. However, saturated linear C₂₄ to C₃₆ hydrocarbons, flavonoids (luteolin 7-0-glucoside, quercetin 3-0-galactoside, vitexin, isovitexin, quercetin, luteolin and apigenin) and anthocyanins (cyanidin 3-0-glucoside) have been isolated from var. *microphylla* (Galarza *et al.*, 1983).

Uses: Diuretic (Ratera *et al.*, 1980; Sorarú *et al.*, 1978).

Fabiana imbricata Ruiz et Pav. (Fam. *Solanaceae*)

Common names: “palo pichi”, “palo piche”, “pichi”, “piche”, “tola”, “pipi”, “romero” “ciprés”.

The plant (Fig. 5 A-C): Shrub, up to 3,5 m tall. Branches pubescent, resinous, with homoblastic growth. Young stems wholly covered with imbricate, scale-shaped and sessile leaves (ca. 1-1,5 mm long). Flowers subsessile; calyx urceolate with 5 obtuse segments; corolla whitish, lilac or bluish, infundibuliformis, 15-20 mm long.; androecium heterodynamous; ovary 2-carpellar, notorious annular nectary. Capsule ovoid, pluri-seeded, with a persistent calyx slightly accrescent. Seeds small, prismatic; sporoderm foveolate. From Chile (Prov. Atacama to Valdivia) and Argentina (Prov. San Juan to Río Negro), predominantly in high altitudes (Barboza and Hunziker, 1993).

The drug includes especially fragments of stems (1-3 cm) without bark, 2-3-aged; sometimes leaves or small pieces of stem with bark; occasionally bark alone.

Macroscopical diagnosis.- Brown or deep brown periderm; cork of older stems with notorious scars of leafy younger branches; wood yellowish, rough to the touch, hard consistency but separated easily into threads when dried. Leaves glabrescent or glabrous, fleshy, green turning into yellowish green when dried, resinous, ovoid with obtuse or acute apex, deeply concave to the adaxial surface (Fig. 3 B).

Microscopical diagnosis.- STEM (Fig. 3 D, F). Since early with secondary growth. Epidermis crushed and replaced by a periderm consisting of 1-6 layers of cork and the phellogen (1-2 layers). Abundant glandular trichomes with elongate unicellular head producing resin and 3-7-celled stalk. Cortex: Young stems with 4-5 layers of tangential collenchyma followed by 4-6 parenchymatous layers with numerous druses and isolated brachysclereids (cortex completely crushed in older stem). Vascular system: Amphiphloic siphonostele with a perivascular disrupted sclerenchyma in young stems. Secondary xylem and phloem with conspicuous groups of fibers among the conducting cells; diffuse-porous wood; axial parenchyma scanty paratracheal sometimes vasicentric; rays homogeneous uni-multiseriate (up to 4 cells wide); 2 or 3 growth-rings are present. Pith parenchymatous with brachysclereids and druses.

LEAVES (Fig. 3 E, G, H). Epidermis uniseriate; isodiametric cells with chloroplasts in both surfaces, secondary cell walls right or slightly sinuate with many pits; hypostomatic, with different kind of raised stomata covered by a thick and curved cuticular peak. Cuticle very thick and smooth. Mesophyll: Dorsiventral, palisade and spongy parenchyma inversely arranged; some druses. Main and secondary vascular bundles collateral, completely immersed in the mesophyll and surrounded by a conspicuous parenchymatous sheath with starch and chloroplasts.

Exsicc. - Subils 4593 (CORD); A. T. Hunziker 20151 (CORD).

Chemical composition: Many secondary metabolites were isolated from twigs, leaves or terminal branches such as volatile alkaloids (fabianine, Edwards *et al.*, 1962), various sugars (Richtmayer, 1970), anthraquinones (Knapp *et al.*, 1972), catechols (Dzhemukhadze *et al.*, 1972), many sesquiterpenes (Brown, 1994 a, b, c; Schmeda-Hirschmann *et al.*, 1994 a), rutin and scopoletin (Razmilic *et al.*, 1994) and other related compounds (Schmeda-Hirschmann *et al.*, 1995).

Uses: An herbal remedy for centuries; it is reputed to have curative properties as diuretic and against urinary afflictions (Sorarú and Bandoni, 1978; San Martín, 1983).

3.2. Quality control

The analysis of the 25 commercial samples revealed the following percentage:

A. Botanical quality control:

- Authentic samples: 72%
- Substitute samples: 0%
- Adulterated samples: 16%
- Falsified samples: 12%.

B. Purity degree:

- Samples with high purity degree: 36%
- Samples with standard purity degree: 32%
- Samples with low purity degree: 32%

C. Categorisation of the commercial samples:

- Excellent samples: 32%
- Good samples: 28%
- Bad samples: 40%.

4. Discussion and conclusions

One of the most important problems to solve when working on plant quality control is the verification of the identity of a sample. Although chemical methods of analysis, especially chromatographic techniques (TLC, GC, and HPLC), are now accepted as standard techniques for the identification of many vegetable materials (Jackson *et al.*, 1990; Bruneton, 1995), a careful morphologic and anatomical examination of the plant provides an easy and reliable criterion to detect possible falsifications or adulterations.

From an anatomical point of view, only *F. imbricata* (Cosa de Gastiazoro, 1991) and *E. serpens* (Subils, 1977) have already been studied but in both cases they were considered in a taxonomic context. Our results agree with the observations of the mentioned authors; however, some comments are needed. In *F. imbricata*, Cosa de Gastiazoro (1991) cited fibers only in the secondary outer phloem; we could observe them also in the xylem. The presence of these fibers in-groups within the vascular tissues is a conspicuous feature to take into account to identify the wood of this species in the commercial samples, especially when bark is lacking.

The leaf anatomy of *E. serpens* was described in detail by Subils (1977). She did not study the stem anatomy of this species in particular but, instead, she analysed that of Sect. *Anisophyllum* (Haw.) Roesler in general, where *E. serpens* is included. As the drug consists mainly in small pieces of stem, they can be recognised by its anisocytic stomata, the parenchymatous cortex consisting of 4-6 layers with thick walled cells and abundant starch, the groups of fibers alternating with laticifers and the ectophloic siphonostele in secondary growth.

Concerning *Bauhinia forficata* subsp. *pruinosa*, the endomorphology of the leaf was described by Amat (1989). Our data differs from the results of the mentioned author regarding the trichomes ornamentation (smooth trichomes vs. verrucate trichomes) and in the denomination of the mesophyll structure. In fact, Amat defines it as dorsiventral but he clearly schematises it as a palisade homogeneous structure; this last case is what we could confirm. The druses observed in large quantities by Amat in the petiole are also present in the palisade cells of the mesophyll.

Before this study was made, nothing was known about the anatomy of the other 2 species.

Cuticle (thickness and ornamentation), epidermal cells shape, trichomes (types and ornamentation), stomata (types and distribution), crystals of calcium oxalate (type, abundance, distribution), foliar structure, features of primary cortex when it is present, type of stele, periderm origin and peculiarities of the secondary vascular tissues, were the most relevant diagnostic features that allow us to characterise each species.

This information could be useful to the elaboration of official regulations; to this respect, in Córdoba province, the Provincial Act N° 8302 (sect. 23) "de Farmacias, Droguerías, Laboratorios y Herboristerías" (1993) demands a list of medicinal herbs including, apart from the scientific and vernacular name of the species, the main morphological and histologic characteristics for an appropriate quality control.

Concerning the phytochemical data, it is noteworthy the scarce information existing about these species with the exception of *F. imbricata*. In fact, this is the only species whose secondary metabolites have intensively been studied (cfr. supra). A recent bioassay has demonstrated that the main active constituent of this species is scopoletin which produces a significant increase in the urine output of rats (Schmeda-Hirschmann *et al.*, 1994 b), but nothing is yet known about its effects on human beings.

The hypoglycemic effect of *Bauhinia forficata* has recently been tested by Lemus *et al.* (1997) in induced rats with different diabetogenic agents, this experiment being the only report about its potential pharmacological action.

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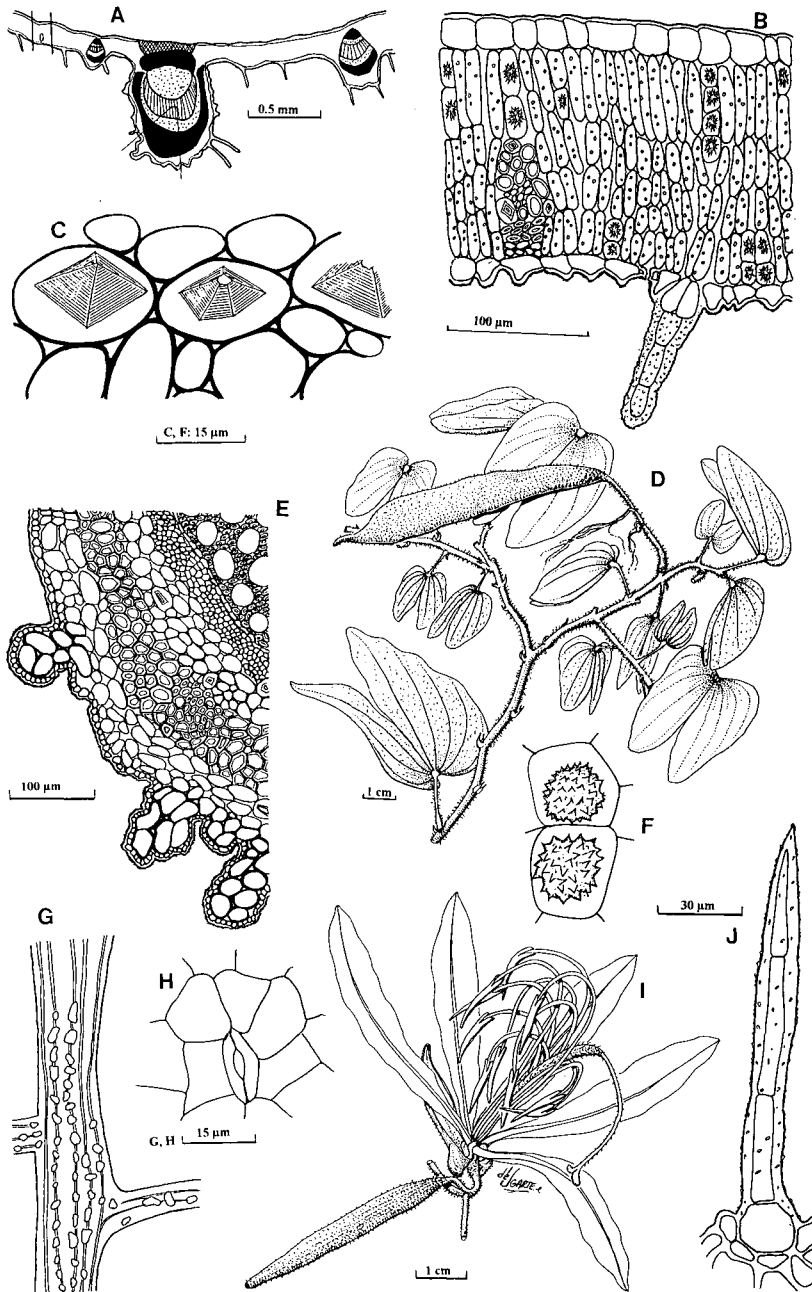


Fig. 1 - *Bauhinia forficata* subsp. *pruinosa* (CORD 379). A: transverse section through leaf; B: detail of the blade sector indicated in A; C: prismatic crystals; D: fruiting branch; E: detail of the main nerve of the leaf showing the protuberances toward the abaxial surface; F: druses; G: surface view of the nerves showing the distribution of the crystals; H: anomocytic stoma in surface view; I: flower; J: glandular trichome.

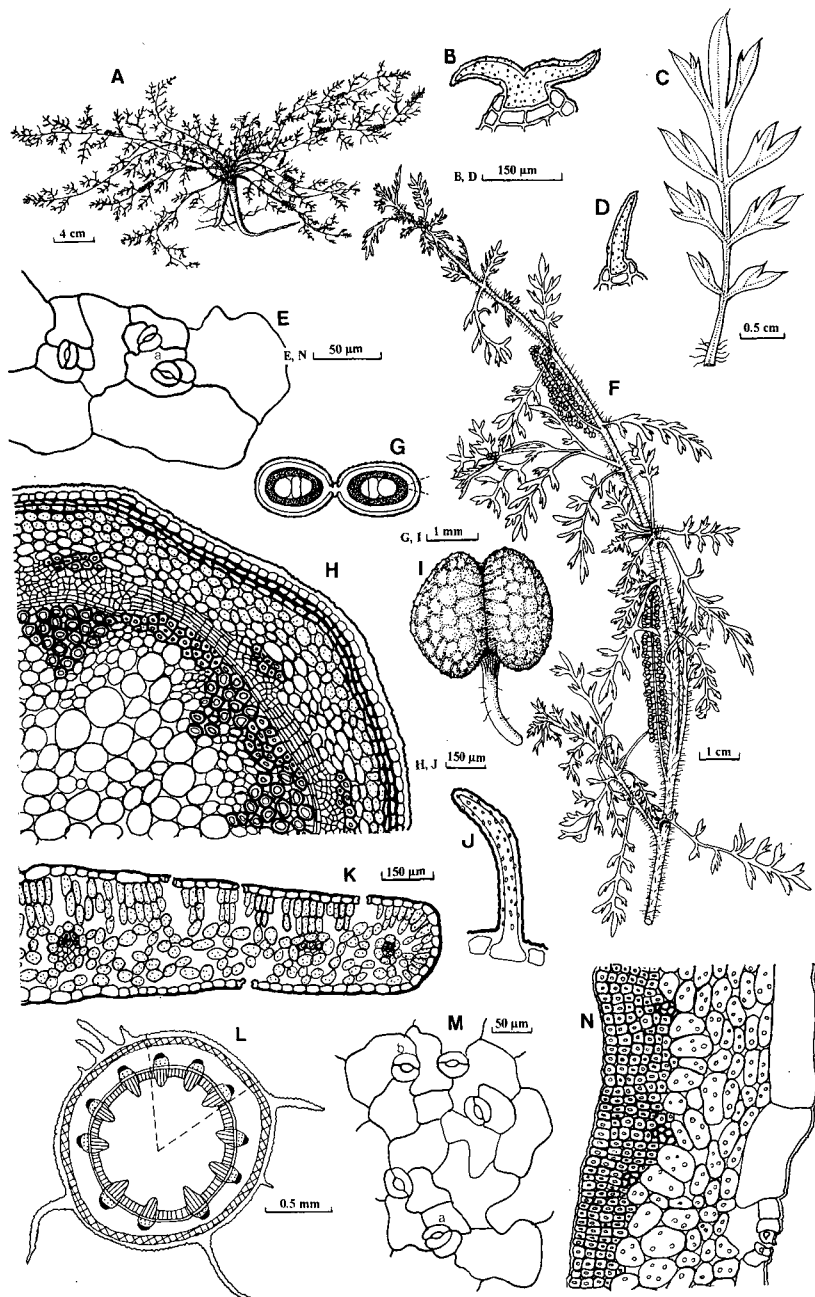


Fig. 2 - *Coronopus didymus* (Filippa 5). A: habit; B, D: bifurcate and unbranched eglandular trichomes, respect., C: leaf; E: surface view of the fruit epidermis showing anisocytic stomata; F: fruiting branch; G: cross section of fruit; H: detail of the stem sector indicated in L; I: fruit; J: unicellular eglandular trichome of stem; K: transverse section through leaf; L: transverse section of stem; M : surface view of leaf epidermis showing anisocytic (a) and anomocytic (b) stomata; N: detail of the pericarp in zone indicated in G.

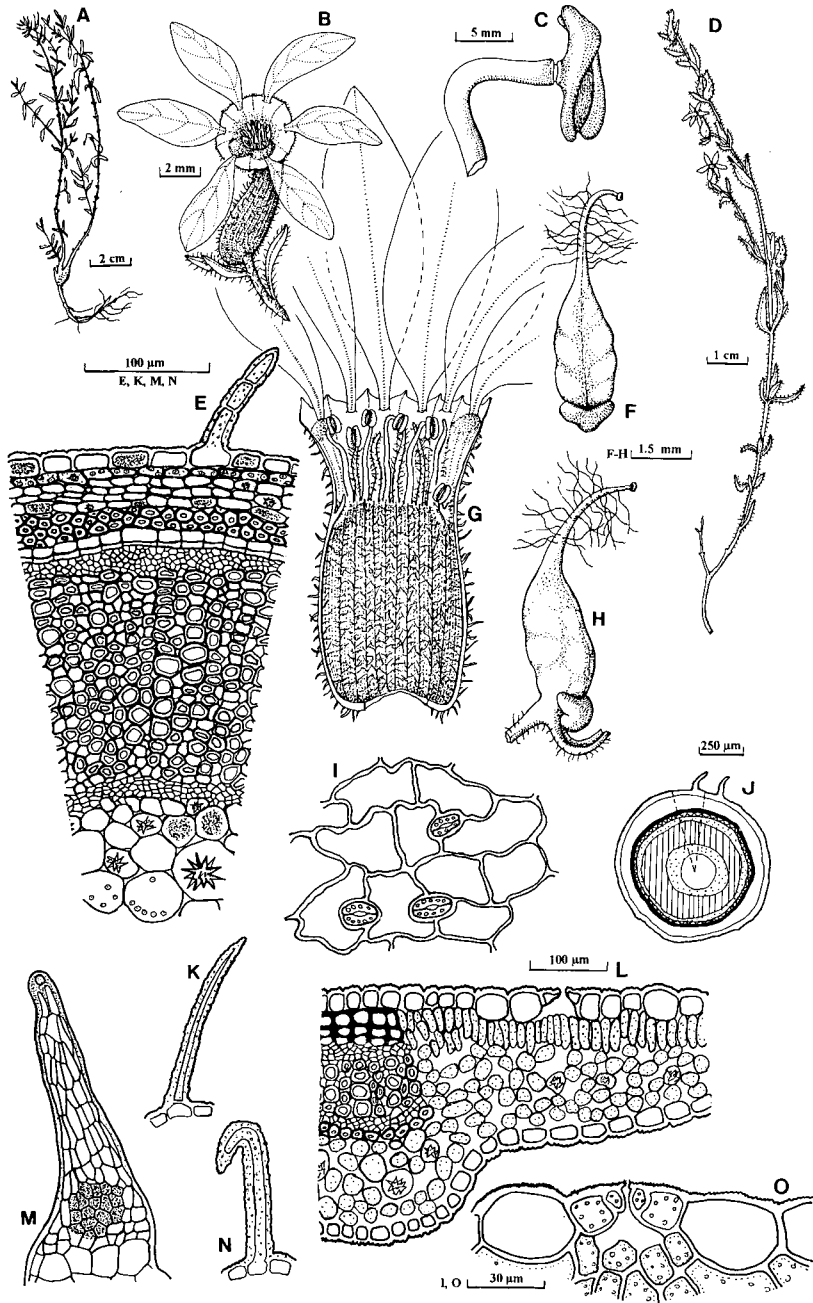


Fig. 3 - *Cuphea glutinosa* (Ariza Espinar 3329). A: habit; B, G: lateral and internal view of flower, respect.; C: apex of stamen; D: flowering branch; E: detail of the stem sector indicated in J; F, H: gynoecium, dorsal and lateral view, respect.; I: epidermis of the leaf in surface view; J: transverse section of stem; K, N: erect and uncinulate glandular trichomes, respect., of stem; L: detail of a transverse section through leaf; M: bristle-like glandular trichome; O: stoma in transverse section.

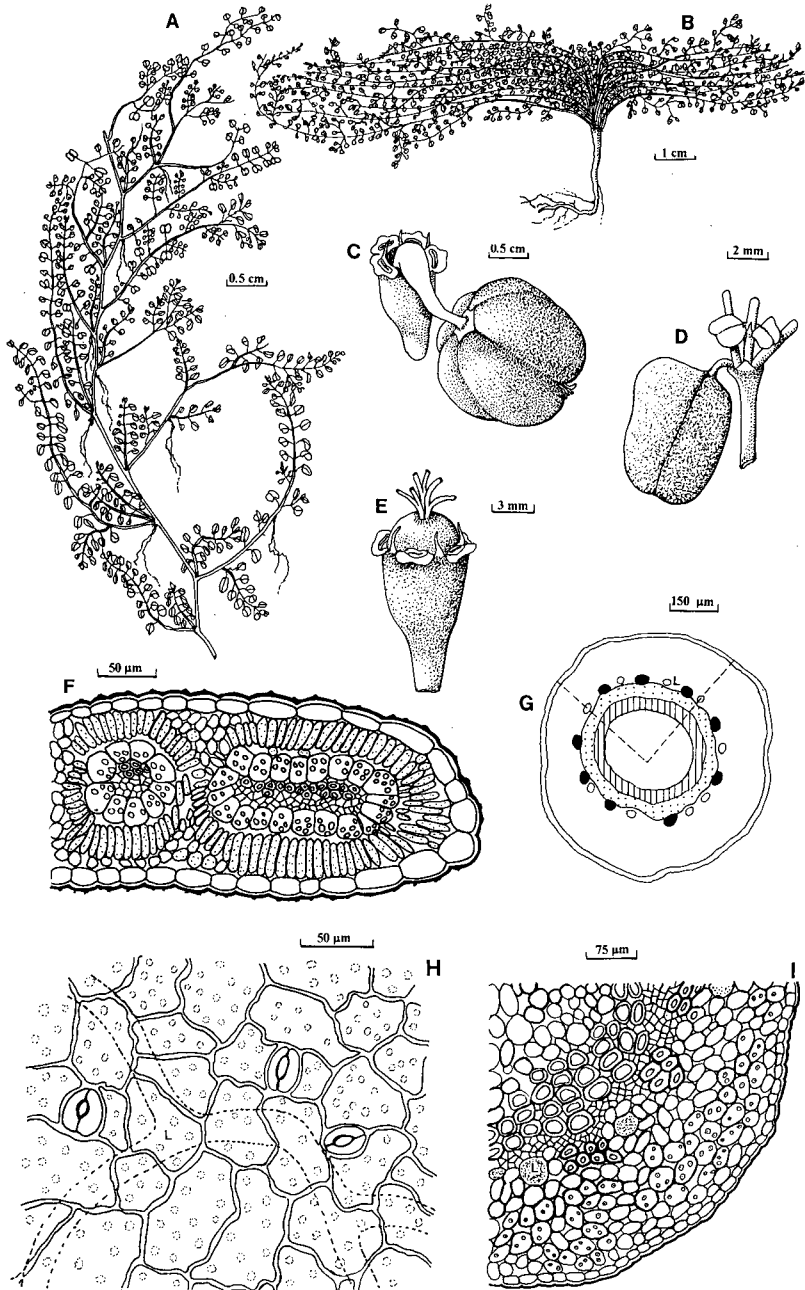


Fig. 4 - *Euphorbia serpens* var. *serpens* (Subils 4598). A: flowering branch; B: plant; C: young fruit; D: vegetative nodes showing the leaves; E: cyathium; F: transverse section through leaf showing Kranz structure; G, I: transverse sections through stem (I: detail of a sector marked in G); H: surface view of epidermis showing stomata and a branched laticifer. Abbreviation. l: laticifer

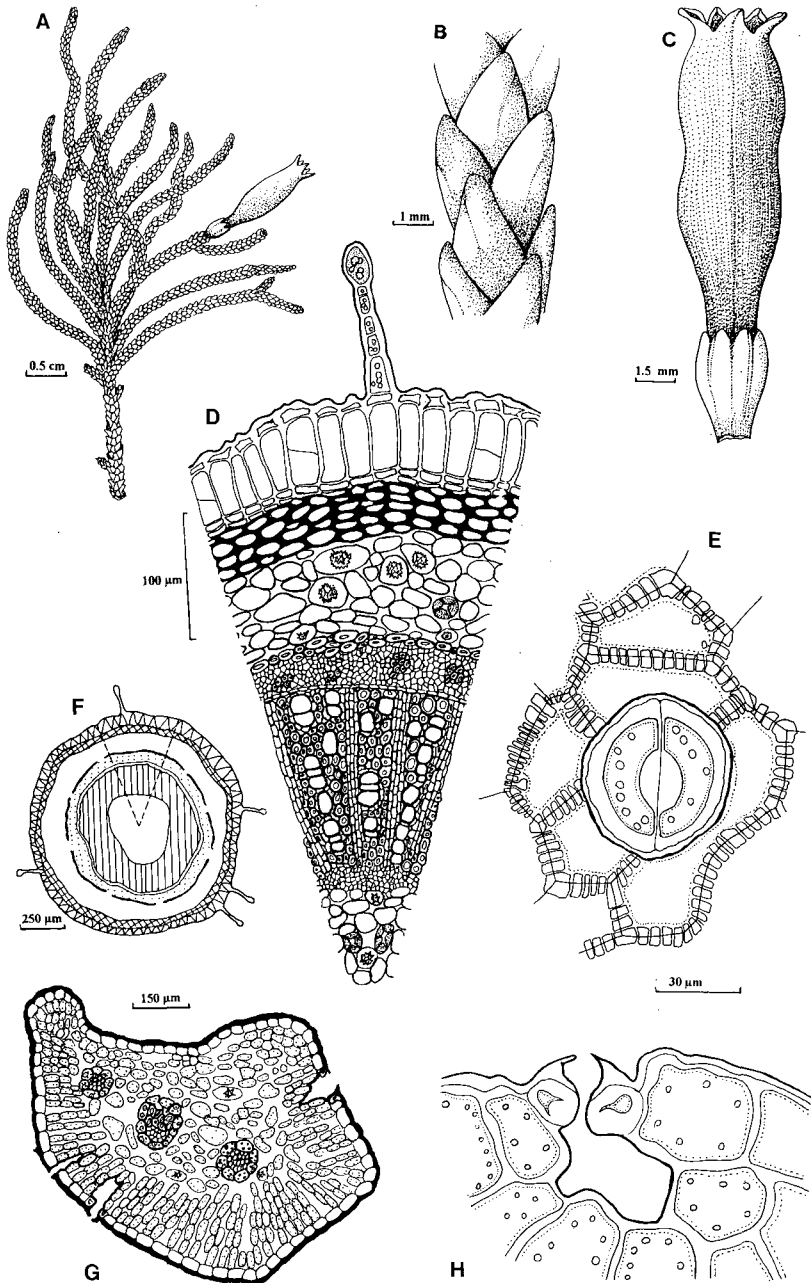


Fig. 5 - *Fabiana imbricata* (Subils 4593) A: flowering branch; B: leafy branchlet; C: flower; D, F: transverse sections through stem (D: detail of a sector marked in F); E: epidermis of leaf in surface view showing an stoma and epidermic cells with pits; G: transverse section through leaf showing the inverted dorsiventral structure; H: stoma in transverse section.