Stem morpho-anatomy of *Baccharis cylindrica* (Less.) DC. (Asteraceae)

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*Baccharis cylindrica* (Less.) DC. (Asteraceae) is a three-winged stem species, which belongs to the Trimera group and is commonly named as carqueja, as well as several other species of Baccharis. It is employed in the traditional medicine as stomachic and diuretic. This work has carried out the stem morpho-anatomical analysis of the medicinal plant, in order to contribute to its identification and to the knowledge for the Trimera group. Stem fragments were collected, fixed and prepared according to usual optical and scanning electron microtechniques. The epidermis is uniseriate, coated by striated cuticle and has anomocytic stomata, pluricellular glandular and non-glandular trichomes. In the wings, chlorenchyma, composed of palisade parenchyma beneath both epidermal faces and spongy parenchyma in the middle, and collateral vascular bundles are seen. In the stem axis, angular collenchyma alternating with chlorenchyma, included phloem, secretory ducts and calcium oxalate styloids are also observed.

INTRODUCTION

The Asteraceae family comprises about 1100 genus and 25000 species, from herbs to medium-sized trees, distributed in tropical, subtropical and temperate regions (Barroso, 1991; Joly, 1998). The genus *Baccharis*, probably originated in the South America, consists of approximately 500 species (Carneiro, Fernandes, 1996), classified in 28 groups based on morphological similarities (Barroso, 1976).

*Baccharis cylindrica* (Less.) DC. belongs to the Trimera group, which is composed of shrubs ranging from 80 cm to 3 m high and with winged stem, assuming photosynthetic role, since the leaves are lacking or reduced (Kissmann, Groth, 1999). This species presents three to five assembled capitula, distributed in long branches accompanied by three wings of 2-3 mm wide.

Carquejas are one of the most commercialized medicinal plants in Brazil and Paraná State is said to be their greatest collector (Correa Júnior et al., 1991). Since the identification of Baccharis species is considered difficult, various studies have dealt with morpho-anatomical characters, in order to supply information to the taxon (Jorge et al., 1991; Sá, Neves, 1996; Chicourel et al., 1997; Cortadi et al., 1999; Gianello et al., 2000; Ortins, Akisue, 2000). In this perspective, as Baccharis cylindrica has been little studied and is similar to B. trimera (Barroso, 1976), the present work has carried out the stem morpho-anatomical analysis of this species, aiming to contribute to the medicinal plant identification and to the Trimera group knowledge.

MATERIAL AND METHODS

Baccharis cylindrica (Less.) DC. was collected in Campo Largo, a city near Curitiba, Paraná, Brazil, between September 2001 and February 2002. The dried material was identified and the voucher was registered under number ICN122944, at the Herbário do Instituto de Ciências Naturais, from Universidade Federal do Rio Grande do Sul.

Stem fragments were fixed in FAA 70 (Johansen, 1940) and maintained in 70% ethanol solution (Berlyn, Miksche, 1976). Transversal and longitudinal freehand sections were stained either with toluidine blue (O’Brien et al., 1965) or with basic fuchsine and astra blue combination (Roeser, 1962). Histochemical reactions were applied with ferric chloride to detect phenolic compounds (Johansen, 1940), Sudan IV to lipophilic compounds (Foster, 1949), phloroglucin to lignified compounds (Johansen, 1940), and combinated (Roeser, 1962). Histochemical reactions were applied with ferric chloride to detect phenolic substances (Foster, 1949), phloroglucin to lignified elements (Sass, 1951) and iodine-iodide to starch (Berlyn, Miksche, 1976). The results were illustrated with photos taken by the optical microscope Olympus BX40 attached to the control unit PM20.

For the ultrastructural analysis, samples fixed in FAA 70 and dehydrated in an ethanolic series were prepared according to scanning electron microtechniques - SEM (Souza, 1998), by means of the equipment Balzers CPD-010 and Sputtering SCD-030. The material was examined employing the electron microscope Philips SEM 505.

RESULTS

The stem of Baccharis cylindrica (Less.) DC. (Asteraceae) (Figures 1 and 2) consists of three narrow wings along a caulinar axis which measures approximately 90 cm high. The wings, in face view, have the epidermal cells with a polygonal shape and thick anticinal cell walls presenting evident primary pit fields (Figure 4). The epidermis is uniseriate (Figure 6) and coated by a thin and striated cuticle (Figure 5). The stomata are anomocytic (Figure 4) and even or slightly raised regarding the other epidermal cells. Several pluricellular glandular trichomes (Figures 5 – 7), uni- or biseriate, terminating by a round apical cell, are united at the base and localized in a small depression. Pluricellular non-glandular trichomes, presenting a bend and slender apical cell (Figure 8), are also seen on the epidermis, but less frequently.

The chlorenchyma comprises an atypical palisade parenchyma, composed of three or four strata of relatively short cells adjacent to both epidermal faces and a spongy parenchyma in the middle (Figure 6). Collateral vascular bundles are embedded in the chlorenchyma and are surrounded by a parenchymatic sheath (Figure 6). Near the phloem, one or two secretory ducts may occur, lined with a uniseriate epithelium whose cells have dense cytoplasm, evident nucleus and release a lipophilic product (Figure 12).

The caulinar axis, in transection, reveals a circular contour (Figure 3). The epidermis is similar to the wing one and, beneath it, strands of chlorenchyma and collenchyma alternate. The latter is classified as angular, formed by about three layers (Figure 10). The secretory ducts have the same characteristics previously described and occur near the sheath which encircles the cortex internally (Figure 10). This sheath is parenchymatic and presents lipophilic compounds impregnating the cell walls.

The vascular cylinder is formed by phloem outside and xylem inside. Perivascular fibre caps may adjoin the phloem and, in older basal regions, included phloem may occur (Figures 9 and 12). At the centre of the stem, surrounded by the xylem, lies the pith. It is formed by thin-walled parenchymatic cells and, in the perimedullar zone, calcium oxalate styloids are encountered (Figure 11).

DISCUSSION

Concerning the external morphology, Barroso (1991) has cited the occurrence of winged stems for the genus Baccharis. In B. cylindrica, this feature corresponds to the Trimera group (Barroso, 1976), having been also mentioned in B. articulata, B. crispa Spreng., B. myriocephala and B. trimera (Sá, Neves, 1996; Cortadi et al., 1999; Ortins, Akisue, 2000).

The uniseriate epidermis of B. cylindrica, formed by polygonal cells in face view, follows the genus pattern
Stem morpho-anatomy of *Baccharis cylindrica* (Less.) DC. (Asteraceae) and is similar to *B. articulata* (Cortadi et al., 1999; Ortins, Akisue, 2000), *B. crispa* (Cortadi et al., 1999), *B. myriocephala* (Sá, Neves, 1996) and *B. trimera* (Cortadi et al., 1999). Similarly, the striated cuticle has been reported in the genus (Spinar, 1973) and in *B. crispa* and *B. trimera* (Cortadi et al., 1999). Nevertheless, in *B. articulata* (Cortadi et al., 1999) and *B. myriocephala* (Sá, Neves, 1996) the cuticle has been considered smooth.

According to Metcalfe and Chalk (1950), the Asteraceae family may present anomocytic and anisocytic stomata, being the former the predominant. Those stomata types have been also encountered in the genus *Baccharis* (Spinar, 1973) and in *B. articulata* (Spinar, 1973; Cortadi et al., 1999; Ortins, Akisue, 2000), *B. crispa* (Spinar, 1973; Cortadi et al., 1999; Ortins, Akisue, 2000), *B. trimera* (Alquini, Takemori, 2000) and *B. myriocephala*, in which Sá and Neves (1996) have found the tetracytic type as well. Contrasting partially with those findings, anomocytic stomata is observed in *B. cylindrica*.

Metcalfe and Chalk (1988) have stated that trichomes possess taxonomic value, and those authors and Spinar (1973) have verified the presence of glandular and non-glandular trichomes in *Baccharis*. For *B. cylindrica*, the glandular trichome features are similar to *B. articulata* (Spinar, 1973; Cortadi et al., 1999; Ortins, Akisue, 2000), *B. crispa* (Cortadi et al., 1999), *B. myriocephala* (Sá, Neves, 1996) and *B. trimera* (Cortadi et al., 1999).

On the other hand, Oliveira and Bastos (1998) have reported T-shaped non-glandular trichomes in *B. dracunculifolia* DC. They differ from the non-glandular trichomes of *B. cylindrica*, whose aspects are similar to *B. crispa* though (Cortadi et al., 1999). Non-glandular trichomes have been widely described in different members of *Baccharis*, as in *B. anomala* DC. (Barroso,

The chlorenchyma organisation in the species analysed corresponds to the description for B. articulata (Spinar, 1973; Cortadi et al., 1999; Ortins, Akisue, 2000) and B. myriocephala (Sá, Neves, 1996). On the contrary, spongy homogeneous mesophyll has been verified in B. trimera (Jorge et al., 1991; Chicourel et al., 1997), whilst palisade homogeneous chlorenchyma has been reported for B. trimera and B. crispa (Cortadi et al., 1999).

In general, the vascular bundle features and their association to secretory ducts in B. cylindrica and various species of Baccharis are alike (Spinar, 1973; Sá, Neves, 1996; Alquini, Takemori, 2000; Ortins, Akisue, 2000). However, according to Cortadi et al. (1999), the secretory ducts have not been accompanied the vascular bundles in B. crispa.

With reference to the caulinar axis, the alternating chlorenchyma and collenchyma is common in different members of the genus (Spinar, 1973; Sá, Neves, 1996; Cortadi et al., 1999; Ortins, Akisue, 2000), and the occurrence of endodermis with Casparian strips is frequent in Asteraceae stem and root (Spinar, 1973), having been observed in B. myriocephala (Sá, Neves, 1996). Nevertheless, the cortex is bounded internally by a sheath of parenchymatic cells in B. cylindrica. The
vascular system organisation corresponds to the other species and the observation of included phloem refers to the anomalous secondary growth widely reported in Asteraceae (Metcalfe, Chalk, 1950).

Based on Metcalfe and Chalk (1988), crystals, starch and other ergastic substances may be stored in pith cells. Despite Jorge et al. (1991) having stated that calcium oxalate crystals are not found in *Baccharis*, they have been pointed out to different species, for instance, *B. articulata* (Spinar, 1973; Cortadi et al., 1999; Ortins, Akiue, 2000), *B. myriocephala* (Sá, Neves, 1996), *B. crispa* (Cortadi et al., 1999) and *B. trimera* (Cortadi et al., 1999), including *B. cylindrica*. Plant crystals may assume different functions, related to avoidance of the oxalate toxic accumulation, storage of calcium, protection against herbivorous animals and mechanical support (Franceschi, Horner Jr., 1980).

**FIGURES 9-12** – *Baccharis cylindrica* – 9 – Caulinar organisation, in transection of the stem axis. 10 – Detail of the previous figure, showing the duct next to the parenchymatic sheath. 11 – Calcium oxalate styloids in the perimedullar zone. 12 – Perivascular fibre cap adjoining the phloem (co – collenchyma; du – duct; ep – epidermis; gt – glandular trichome; pc – perivascular fibre cap; ph – phloem; pi – pith; sh – sheath; xy – xylem).
CONCLUSIONS

The morpho-anatomical characters described for *B. cylindrica*, with emphasis on the three-winged stem, anomocytic stomata, pluricellular non-glandular and glandular trichomes, secretory ducts and calcium oxalate styloid crystals, contribute to the identification of this medicinal plant and supply additional knowledge for the Trimera group.

RESUMO

Morfo-anatomia de *Baccharis cylindrica* (Less.) DC. (Asteraceae)

*Baccharis cylindrica* (Less.) DC. (Asteraceae) é uma espécie com caule trialado, pertencente ao grupo Trimera e denominada popularmente de carqueja, do mesmo modo que outras espécies de Baccharis. É empregada na medicina tradicional como estimulante e diurético. Este trabalho analisou a morfo-anatomia caulinar da planta medicinal, a fim de contribuir com a identificação e com informações para o grupo Trimera. Fragmentos do caule foram coletados, fixados e preparados de acordo com técnicas usuais de microscopia fotônica e eletrônica de varredura. A epiderme é unisseriada, revestida por cutícula estriada, e apresenta estômatos anomocíticos, tricomas glandulares e tecores pluricelulares. Nas alas, encontra-se o clorênquima, consistindo de parênquima paliçádico adjacente a ambas faces epidermicas e parênquima esponjoso no meio, sendo percorrido por feixes vasculares colaterais. No eixo caulinar, colênquima angular e alternância com clorênquima, floema incluso, dutos secretores e criptais estiloides de oxalato de cálcio são também observados.


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REFERENCES


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