

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

Jane Manfron Budel*, Márcia do Rossil Duarte, Cid Aimbiré de Moraes Santos

Laboratório de Farmacognosia, Departamento de Farmácia, Universidade Federal do Paraná

Baccharis cylindrica (Less.) DC. (Asteraceae) is a three-winged stem species, which belongs to the Trimeria 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 Trimeria 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.

Uniterms

- Trimeria group
- Asteraceae
- Winged stem
- Carqueja

*Correspondence:

Jane Manfron Budel
Rua Prof. Lothário Meissner, 3400
80210-170 – Curitiba – Paraná
E-mail: janemanfron@hotmail.com

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 Trimeria 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.

Popularly, this species and others, such as *Baccharis articulata* (Lam.) Pers., *B. trimeria* (Less.) DC., *B. fastigiata* Baker, *B. gaudichaudiana* DC., *B. genistifolia* DC., *B. glaziovii* Baker, *B. junciformis* DC., *B. lundii* DC., *B. microcephala* Baker, *B. notoserigila* Griseb., *B. opuntioides* Mart., *B. pauciflosculosa* DC., *B. pentaptera* DC., *B. polyptera* DC., *B. sagittalis* (Less.) DC. and *B. stenocephala* Baker are named indistinctly in Portuguese as *carqueja* (Barroso, 1976; Corrêa, 1984) and employed as stomachic and diuretic in the traditional medicine (Alonso, 1998; Mors *et al.*, 2000; Takeda, Farago, 2001).

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 Trimeria 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 fuchsin and astra blue combination (Roeser, 1962). Histochemical reactions were applied with ferric chloride to detect phenolic compounds (Johansen, 1940), Sudan IV to lipophilic 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 anticlinal 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 biseriata, 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).

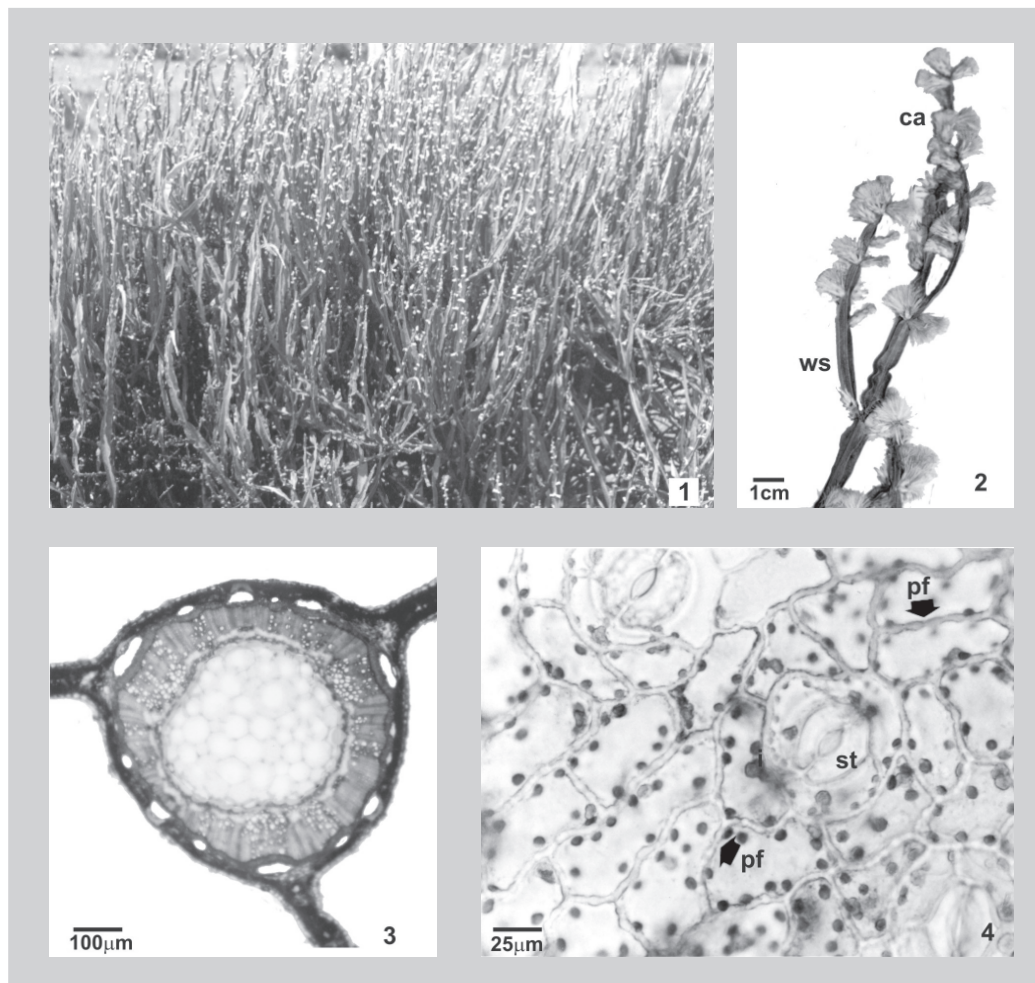
The caulinar axis, in transection, reveals a circular contour (Figure 3). The epidermis is similar to the wing one and, beneath it, strands of chlorenchyma and collenchyma alternate. The latter is classified as angular, formed by about three layers (Figure 10). The secretory ducts have the same characteristics 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 Trimeria 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



FIGURES 1-4 – *Baccharis cylindrica* – **1** - General aspect. **2** – Flowering winged stem, in detail. **3** – Three-winged stem, in transection. **4** – Epidermal cells of the wing, in face view. (ca – capitulum; pf – primary pit field; st – stomatum; ws – winged stem.)

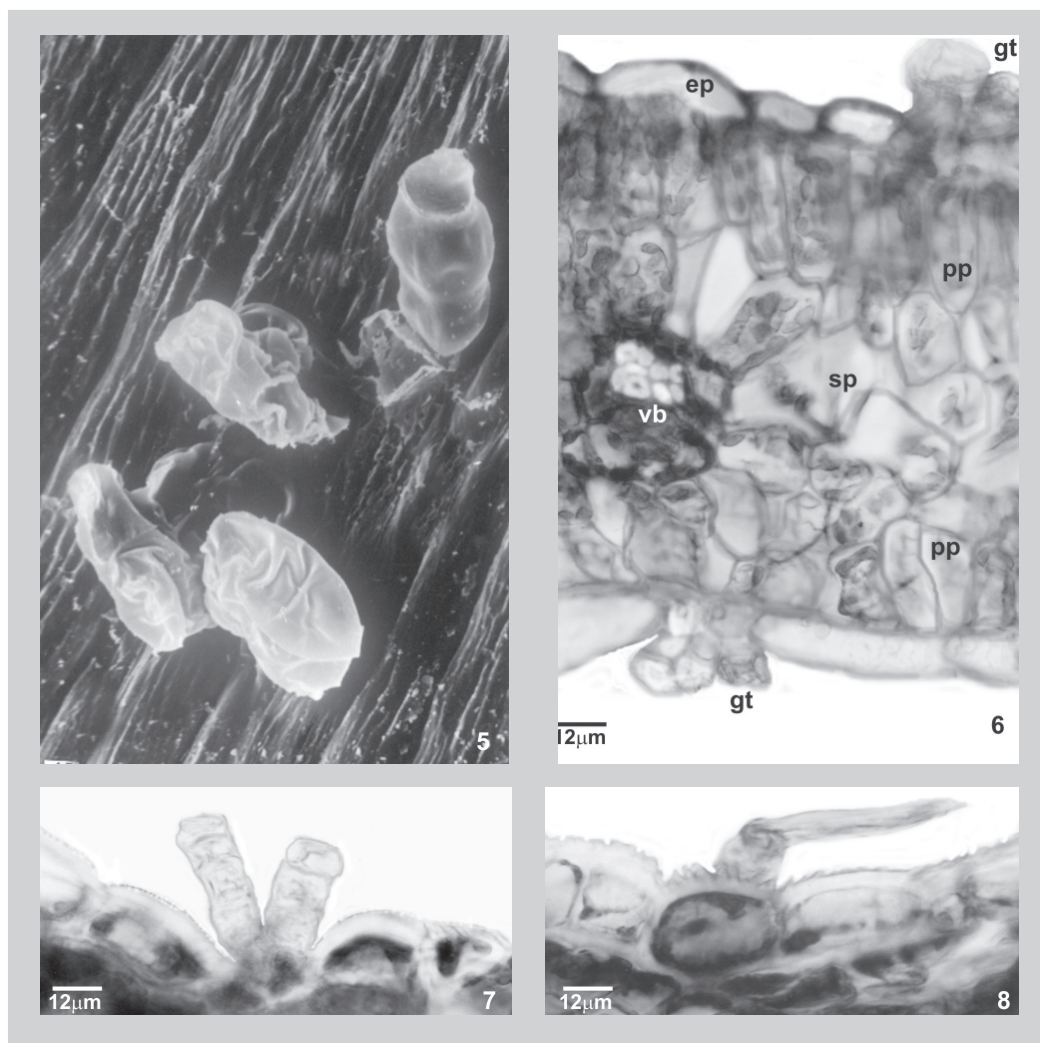
(Spinar, 1973) and is similar to *B. articulata* (Cortadi *et al.*, 1999; Ortins, Akisue, 2000), *B. crispa* (Cortadi *et al.*, 1999), *B. myriocephala* (Sá, Neves, 1996) and *B. trimera* (Cortadi *et al.*, 1999). Similarly, the striated cuticle has been reported in the genus (Spinar, 1973) and in *B. 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), *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,



FIGURES 5-8 – *Baccharis cylindrica* – **5** – Glandular trichomes and striated cuticle (SEM 1185x). **6** – Wing, in transection. **7** – Pluricellular glandular trichomes. **8** – Pluricellular non-glandular trichome and striated cuticle (ep – epidermis, gt – glandular trichome; pp – palisade parenchyma; sp – spongy parenchyma; vb – vascular bundle).

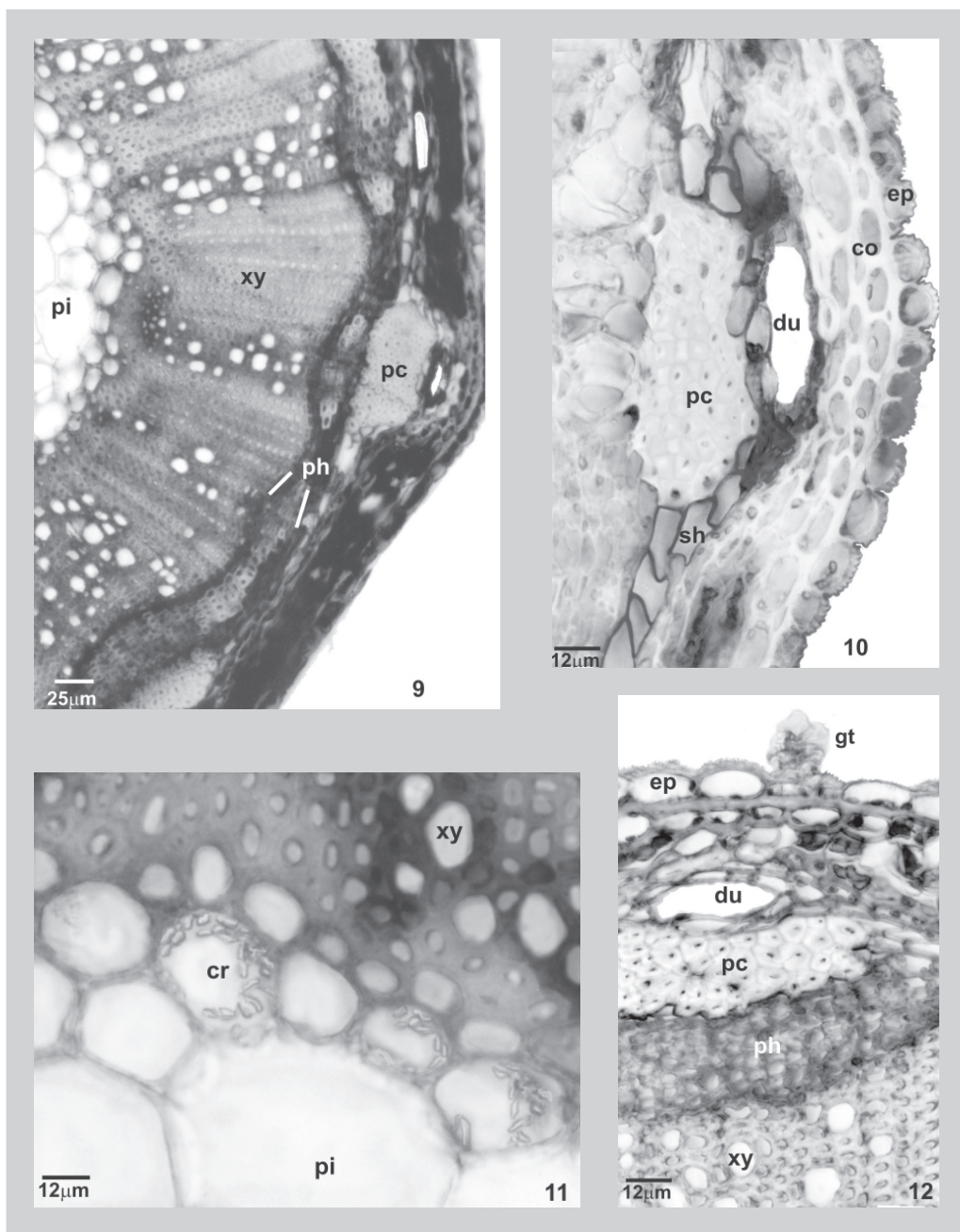
1976), *B. pulchella* Sch. Bip., *B. artemisioides* Hook. & Arn., *B. lilloi* Heer., *B. salicifolia* (Ruiz & Pav.) Pers. and *B. rupestris* Heer. Those epidermal appendages have in common the basal and stalk cell morphology, differing in relation to the apical cell that varies from moderately long to whip-like (Spinar, 1973).

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



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 perimedullary 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).

vascular system organisation corresponds to the other species and the observation of included phloem refers to the anomalous secondary growth widely reported in Asteraceae (Metcalf, 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, Akisue, 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).

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 triado, pertencente ao grupo *Trimera* e denominada popularmente de carqueja, do mesmo modo que outras espécies de *Baccharis*. É empregada na medicina tradicional como estomáquico 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 tectores pluricelulares. Nas alas, encontra-se o clorênquima, consistindo de parênquima paliçádico adjacente a ambas faces epidérmicas e parênquima esponjoso no meio, sendo percorrido por feixes vasculares colaterais. No eixo caulinar, colênquima angular em alternância com clorênquima, floema incluso, dutos secretores e cristais estilóides de oxalato de cálcio são também observados.

UNITERMOS: Grupo *Trimera*. Asteraceae. Caule alado. Carqueja.

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