

# Anatomical Characteristics of Leaves and Flowers of *Cornus sanguine subsp. australis* (C.A.Mey.) Jav.

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## ABSTRACT

**Introduction:** *Cornus sanguinea subsp. australis* (C.A.Mey.) Jav. is a widespread plant of the Caucasus (Russia). This is a small decorative tree with a large mass of raw material of leaves and flowers, which contain phenolic compounds. Currently, this plant is used in traditional medicine in some countries. **Materials and Methods:** *C. australis* leaves, and flowers were collected during the flowering period on the Mount Mashuk in Pyatigorsk, Stavropol region, Russia in June 2019. The anatomical structure of *C. australis* is considered in accordance with the requirements of the State Pharmacopoeia XIV. **Results:** There are heavily sinuous walls of cells of the upper and lower epidermis in microscopy of the leaves of *C. australis*, stomatal anomocytic type, T-shaped trichomes, two types of mesophyll: palisade and spongy. In the vascular system of the leaf and petiole, there are two vascular bundles: small and larger. In the small vascular bundle, the xylem is located from the abaxial surface, the phloem – from the adaxial surface, in the big vascular bundle on the contrary. The lower epidermis of the petal and sepal is covered with T-shaped trichomes. **Conclusion:** Obtained anatomical signs are necessary for identification, authenticity, standardization for the use of *C. australis* as raw materials for pharmaceutical purposes.

**Key words:** Collenchyma, *Cornus sanguinea subsp. australis* (C.A.Mey.) Jav., Cross-section, Mesophyll, Stomatal anomocytic type, Vascular bundle, T-shaped trichomes.

## INTRODUCTION

*Cornus sanguinea subsp. australis* (C.A.Mey.) Jav., synonym *Cornus australis* C.A. Mey. is the tree or bush 2-4 m high of family *Cornaceae*. *C. australis* grows in Russia in Crimea, in all regions of the Caucasus and in the south of the European part of Russia,<sup>1</sup> also the plant is spread in Turkey<sup>2</sup> and in Europe.<sup>3</sup>

In leaves of *C. australis* are found by spectrophotometry rosmarinic acid 2.86%, caffeic acid 2.55%, flavonoids 1.37%.<sup>3</sup> Also in leaves are identified phenolic glycoside salidroside, flavonoids (quercetin, kaempferol), phenol carboxylic acid – hexahydroxydiphenic acid.<sup>1</sup> In Turkey from the wood of *C. australis* manufacture paper.<sup>4</sup> In the wood of *C. australis* are identified by HPLC holocellulose  $72.27 \pm 0.27\%$ ,  $\alpha$ -cellulose  $43.24 \pm 0.17\%$ , lignin  $16.32 \pm 0.09\%$ . Sucrose 25.53%, fructose 17.10%, glucose 16.63%, galactose 1.21% and arabinose 0.61% were determined by HPLC in the wood.<sup>2</sup>

Information on the pharmacological activity of *C. australis* is not found. But this species, as and other species of the family *Cornaceae* are used in traditional medicine in some countries.<sup>5</sup> The leaves and flowers of *Cornus mas* have antioxidant and cytotoxic effects. The leaves of *C. mas* have antimicrobial action.<sup>6</sup>

## MATERIAL AND METHODS

The material for research were the leaves and flowers of *C. australis*. Leaves and flowers were

collected on the Mount Mashuk in Pyatigorsk, Stavropol region in June 2019 during the blossoming of the plant (Figure 1).

The anatomical structure of the leaves and flowers of *C. australis* was reviewed according to the requirements of the State Pharmacopoeia XIV.<sup>7</sup> The material was fixed in the mixture of solvents ethyl alcohol-glycerol-water in the ratio 1: 1: 1, also used fresh and dry raw materials. Dry raw materials were boiled in solution NaOH 3%. Micropreparations were studied on a microscope "Biomed", lenses  $\times 4$ ,  $\times 10$ ,  $\times 40$ , eyepiece 16 $\times$ .

## RESULTS

### Morphological study

Petioles up to 2 cm long, surface covered with pressed trichomes. The shape of the leaves is usually elliptical. The base and apex of the leaves are rounded. Leaves 3-8 cm long, 2-5 cm wide. Veins 4-5 pairs. The margin of the leaf is entire. The trichomes are short on both sides of the leaf. The upper side of the leaves is green; the lower one is lighter. Inflorescence umbel up to 3 cm long and 6 cm wide. Pedicels covered with trichomes. Sepals triangular up to 1 mm long, covered with trichomes outside, no trichomes on the inside. White lanceolate petals up to 6 mm long. Stamens up to 5 mm, usually shorter than the petals. Style on top expanded, 3-4 mm in length.

### Anatomical study leaf

Cells walls of the upper epidermis heavily sinuous. There are no stomata, trichomes T-shaped (Figure

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2A). Cells walls of the lower epidermis heavily sinuous, too; many stomatal anomocytic type (Figure 2B), trichomes T-shaped (Figure 2C). On the edge of the leaf are outgrowths.

On the cross-section of the leaf (Figure 2D) squared epidermis cells, are tightly located in a single layer, cuticle covered cells. There are stomata and trichomes on the epidermis.

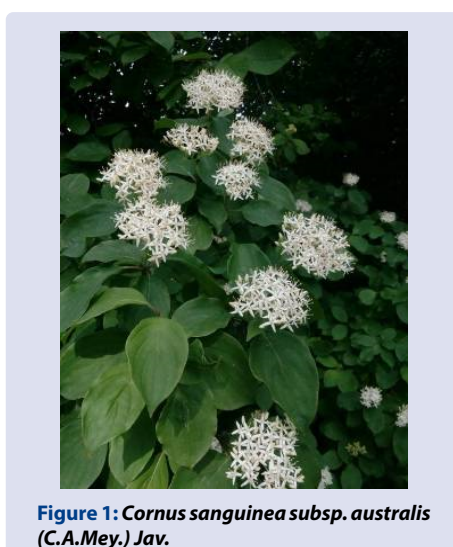
Leaf mesophyll is differentiated on palisade and spongy. The palisade (upper) mesophyll is a one layer of rectangular cells located under the upper epidermis, cells thin-walled, contain a large number of chloroplasts. The spongy (lower) mesophyll consists of cells of a round or oval shape with a smaller amount of chloroplasts. The spongy mesophyll is located between the palisade and lower epidermis (Figure 2E).

On the leaf vein occurs collenchyma. Its first section is located under the upper epidermis (3 layers) and several layers of cells - under the lower epidermis (Figure 2G).

In the vascular system is the two vascular bundles: small and larger. In the small vascular bundle the xylem is located from the abaxial surface, the phloem – from the adaxial surface, in the big vascular bundle on the contrary (Figure 2F). The rest of the vein is occupied by parenchyma. Cells of its round or multi-faceted shape.

### Petiole

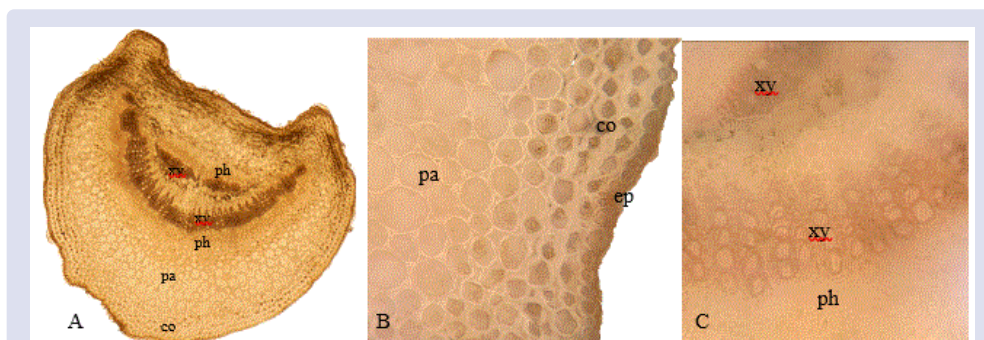
The petiole on the cross-section of a cylindrical shape with a recess on the top (Figure 3A). The first layer is the epidermis. Its cells have a square shape, arranged in a single layer; there is a cuticle. On the epidermis are T-shaped trichomes. Under the epidermis is collenchyma, consisting of 3-4 layers of oval cells (Figure 3B). The vascular system is composed of a larger and small collateral vascular bundles. In the small vascular bundle, the xylem is located from the abaxial surface, the phloem – from the adaxial surface, in the big vascular bundle on the contrary. Phloem is a small sieve elements. Xylem vessels of different sizes (Figure 3C).



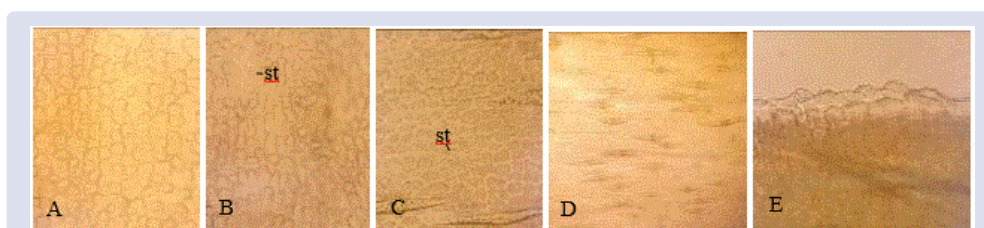
**Figure 1:** *Cornus sanguinea subsp. australis* (C.A.Mey.) Jav.



**Figure 2:** Leaf of *C. australis*: A – upper epidermis (640x); B – lower epidermis (640x); C – T-shaped trichomes on the lower epidermis (160x); D – leaf cross-section (160x); E – mesophyll on leaf cross-section (640x); F – vascular bundle (640x); G – collenchyma on leaf cross-section (640x): st – stomata, ep – epidermis, co – collenchyma, mp – palisade mesophyll, ms – spongy mesophyll, xy – xylem, ph – phloem, pa – parenchyma.



**Figure 3: Petiole of *C. australis*: A – cross-section of the petiole (64x); B – collenchyma (640x); C – vascular bundle (640x): ep - epidermis, co – collenchyma, xy - xylem, ph - phloem, pa – parenchyma.**



**Figure 4: Petal of *C. australis*: A – upper epidermis at the base of the petal (640x); B – upper epidermis at the middle of the petal (640x); C – lower epidermis (640x); D – trichomes T-shaped on the lower epidermis (160x); E – outgrowths on the edge of the leaf (640x): st – stomata.**

## Flower

The cells of the upper epidermis at the base of the petal of polygonal shape (Figure 4A), in the middle and the upper part of the petal cells of the epidermis with outgrowths, stomata rare (Figure 4B). The cells of the lower epidermis are polygonal, stomata of anomocytic type are more common than on the upper epidermis, they are located below the plane of the epidermis (Figure 4C); the surface of the petal is covered with T-shaped trichomes (Figure 4D). The cells of the upper and lower epidermis have a cuticle that predominates on the lower epidermis. On the edge of the petal are outgrowths (Figure 4E). The sepals of a triangular shape are completely covered with T-shaped trichomes.

## DISCUSSION

The leaves of *C. australis* are elliptical; the base and apex are rounded; the trichomes are present on both sides of the leaf. Veins 4-5 pairs. The margin of the leaf is entire. Inflorescence umbel. Pedicels covered with trichomes. Sepals triangular, covered with trichomes outside, no trichomes on the inside. Petals are white lanceolate.

The main microscopic signs of the leaves of *C. australis* are heavily sinuous walls of cells of the upper and lower epidermis, stomatal anomocytic type, trichomes T-shaped, two types of mesophyll: palisade and spongy. In the vascular system of the leaf and petiole, there are two vascular bundles: small and larger. In the small vascular bundle the xylem is located from the abaxial surface, the phloem – from the adaxial surface. In the big vascular bundle – on the contrary. On the surface of the petal there are anomocytic stomata and T-shaped trichomes located on the lower epidermis.

## CONCLUSION

This article for the first time presents data of the anatomical study of leaves and flowers of *C. australis*. These data are necessary for the

correct pharmacognostic characteristics of raw materials. Further study of the chemical composition and pharmacological activity will assess the prospects of *C. australis* for medicinal use.

## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

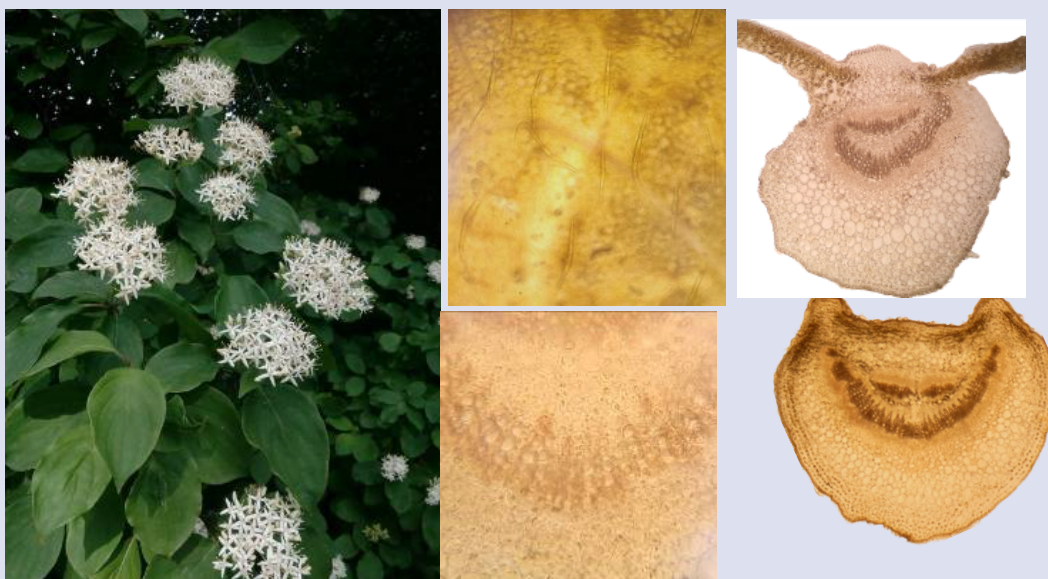
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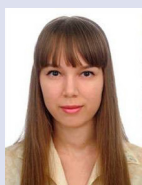
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## GRAPHICAL ABSTRACT



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