Anatomical study of Ficus carica L. leaf

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Summary

The paper presents an anatomical study concerning the leaf structure (petiole and blade) of a well known Ficus species, Ficus carica L. The petiole consists of epidermis, a differentiated cortex and the conductive tissue represented by two rings one of phloem and another of xylem elements. The bifacial blade has a heterogeneous and hipostomatic mesophyll and possesses a fascicular vascular system. The upper epidermis is followed by a one-layered hypodermis with lithocysts and cystoliths. Lithocysts and cystoliths sizes were measured as well. Anomocytic stomata and simple one-celled non-glandular trichomes are present in the petiole and blade as well. Remarkable is the presence of the medullar leptocentric vascular bundles, laticifers and druses in the petiole and mid rib structure. The thick cuticle thicknesses, the lignifications, a multiple epidermis, the presence of hypodermis are probably anatomical features of adaptation to xerophytic environments.

Introduction

Ficus species are trees or shrubs belonging to the Moraceae family. This genus includes about 2000 species originating in tropical regions of America, Asia, Africa and Australia. In cold and temperate regions are grown as houseplants (Preda, 1979). Ficus carica L. (known as fig tree) is a shrub native to the Mediterranean, less resistant to frost and heliophyll. He was first cultivated by the inhabitants of South Arabia. Large areas are cultivated in the Mediterranean countries (Minor or Central Asia) and in California (USA). The fig tree - Ficus carica - has large, alternate leaves (10-20 cm, palmately lobed with 3-5 lobes deeply toothed edges. The leaves are hairy on the underside (Fig. 3). Fruit – is a syncocionium - is pyriform fleshy, solitary, 5-8 cm long, very sweet and tasty. In the literature there is little information on the leaf anatomy of the species considered. Data on the structure of the leaf of a number of species Ficus of Nigeria, where found in the study by Sonibare et al. (2006) of which F. elastica and F. lyrata. Ficus maroma leaf structure belongs to Cabrera et al (2009). Some studies relate the presence of the laticifers elements and chemical analysis of the latex found in some Ficus species belong to Ali et al. (2012), Lazreg-Aref et al., (2012) and Metcalfe & Chalk (1983). Romanian studies on the structure of the leaf lamina, with special reference to the presence of cystoliths and laticifers in F. elastica and F. carica occur sporadically in some textbooks of Morphology and anatomy of plants (Andrei & Predan, 2001; Șerbănescu & Toma, 1980; Tarnavschi et al., 1974). A morphometrical study of some species of Ficus leaves belongs to Bercu & Bavaru (2003).

The purpose of this paper is to highlight the anatomical features of Ficus carica leaf and
to contribute with more information to the knowledge concerning this species.

Materials and methods

The plant leaves were collected from S.C. Bricostore Romania S.A., Constantza. Small pieces of petiole and blade were fixed in FAA (formalin: glacial acetic acid: alcohol 5:5:90). Cross sections of the petiole and blade were performed by the freehand made technique (Andrei & Predan, 2001). The samples were stained with alum-carmine and iodine green. Anatomical observations and micrographs were performed with a BIOROM–T bright field microscope, equipped with a TOPICA 6001A video camera.

Results and discussions

Cross section of *Ficus carica* petiole has a slightly sinuous circular shape (Fig. 1). On the exterior, the petiole is protected by a single layer of epidermis, consisting of small cells with rounded shape, which thickened lateral walls, whereas the external walls on the outside are covered by a thick cuticle. From place to place, the epidermis presents rare short or long simple uniglandular trichomes.

Just below the epidermis is the cortex differentiated into two regions. The external zone is represented by a collenchyma (7-8 cell layers), followed by the inner one parenchymaous in nature, consisting of 9-10 cell layers. A number of parenchyma cells are oxaliferous - druses - calcium oxalate crystals. In the cortex numerous non-articulated laticifers occur (Figs. 1, 2, A).

The vascular system is represented by two rings - one phloem and the other xylem. Some of the xylem vessels are rounded and have primary origin embedded into a celulosis parenchyma whereas other others – larger - have secondary origin, separated by one, two or three seriate homogrnous lignified, pith rays. Few xylem parenchyma elements occur, especially in the peripheral aria of the phloem ring. The phloem is less developed than xylem and consists of phloem vessels, companion cells and phloem parenchyma (Fig. 2, A, B). Rare isolated lignified elements occur. In the inner basic parenchyma 6 apparently medullary leptocentric bundles are present (Fig. 1).

![Fig. 1. Cross section og the petiole - ensamble: bt- basic tissue, c- cortex, e- epidermis, lb- leptocentric bundle, t- trichome, vb- vascular bundle.](image1)

![Fig. 2. Cross section of the petiole. Portion with epidermis and cortex (A, x ). A vascular bundle (B, x](image2)
Cross section of the bifacial blade reveals a multiple upper epidermis, the mesophyll and the lower epidermis. There is a multiple upper epidermis – a one-layered hypodermis with protodermal origin. The one-layered upper epidermis is covered by an obvious outward cuticle. The upper epidermal cells are reduced in the mid rib zone. The upper epidermis continuity is interrupted by non-glandular similar to those of the petiole. The same type of trichomes found in the petiole are longer and denser in the mid rib area than in the rest of the blade. The hypodermis consists of large more or less different in size cells. In between the hypodermal cells a number of lithocysts (giant epidermis cell that protrudes into the mesophyll) are present. The lithocysts have 391 μm medium length and 342 μm width. The lithocysts possess calcium oxalate deposes – solitary stalk cystoliths (Fig, 4, A). They have a grape cluster shape with 456 μm in length. Contrary to Tarnavschi et al (1974), the cystoliths are presented adjacent to the adaxial epidermis layer, not abaxial. However, the Ficus carica leaf may be included, such other species of Ficus (F. annulata, F. benghalensis, F. superba, F. elastica), in group 1, by cystolith position classification of Ummu-Hani and Noraiani (2013). The mesophyll has and 436 μm medium thickness and is differentiated into two layers of palisade tissue with numerous chloroplasts and 7-8 layers of spongy tissue with well aligned cells and few chloroplasts. The first layer of palisade tissue is longer than the second one and has both layers totals 371 μm (Fig. 4, A).

The mid rib is very prominent on the lower surface of the blade, and less at the upper one. The mid rib is fascicular in type consisted of a large arched bundle more or less V-shaped in abaxial position, arch I (Tomlinson, 1956), such as Sonibare et al. (2006) found in some Ficus species leaves of Nigeria. Each vascular bundle have a similar structure with those of the petiole but with foliar arrangement of the conductive tissues. Loosely arranged layers of parenchyma cells without chloroplasts surround the vascular bundle. Fiber cells form adaxial caps only. Central, 7-8 apparently leptocentric bundles are present. Laticifers and druses are present as well (Fig. 3).
Between the two epidermises and the mid rib is an angular collenchyma more developed adaxial (Fig. 4, B).

The lower epidermis consists of rectangular cells covered by cuticle which is thinner than those of the upper epidermis. Hypodermis is absent. Stomata are present in between the lower epidermal cells only – hipostomatic blade.

Paradermal sections of the lower epidermis disclose epidermal cells with undulate walls and anomocytic stomata type with 456 µm medium length of no taxonomic value (Fig. 5) (Dilcher, 1974). It was calculated the stomatal density 116.828 stomate/mm². The stomatal index ranges 0.133 µm-0.15 µm with SD ± 2.67 µm.

Conclusions

The petiole consists of epidermis, a differentiated cortex and the conductive tissue represented by two rings one phloem and other xylem. The bifacial blade has a heterogeneous and hipostomatic mesophyll with a fascicular type of the vascular system. Anomocytic stomata and simple one-celled non-glandular trichomes are present in the petiole and blade as well. Remarkable is the presence of the medullar leptocentric vascular bundles, laticifers and druses in the petiole and mid rib structure.

The anatomical features highlighted in this paper make these species of *Ficus* adaptable for the semi-arid and arid regions.

References


