



ANATOMICAL CHARACTERISTICS OF TURKISH STENO-ENDEMIC *ORIGANUM LEPTOCLADUM* BOISS. (LAMIACEAE)

MUHITTIN DİNÇ¹ & SÜLEYMAN DOĞU²

Abstract. *Origanum leptocladum* Boiss. is an endemic East Mediterranean element, naturally growing only in Ermenek district of Karaman province in Turkey. The aim of this study is to determine anatomical features of the species. The study materials were collected from Karaman-Ermenek in 2009 and then preserved in 70 % alcohol. *O. leptocladum* generally exhibits the anatomical features of the family Lamiaceae. However, herbaceous stem is weakly-rectangle shaped or tends to be circular, the collenchymatic tissue at the corner of the stem and scleranchymatic pericycle around the vascular tissue are weakly-developed. The most striking anatomical feature is that leaf lamina is dorsiventral in the region near to midvein, but equifacial out of the midvein. According to the results, while the stomata are of mesomorphic type on the leaf surfaces, *O. leptocladum* has xeromorphic characters such as palisade richness in mesophyll, the occurrence of rich scleranchymatic tissue in midvein and cuticle thickness on leaf surface.

Key words: *Origanum leptocladum*, Lamiaceae, anatomy, Turkey

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Introduction

Lamiaceae has a cosmopolitan distribution and consists of 236 genera and about 7000 species (STEVENS 2001). Many species of Lamiaceae produce essential oils which are secreted by glandular hairs on aerial vegetative organs and some reproductive organs (AUTUNES & SEVINATE-PINTO 1991; KAYA *et al.* 2009). Turkey is regarded as an important gene center for the family Lamiaceae (BAŞER 1993). With their pleasant fragrance, many species of Lamiaceae have been used as herbal teas in Turkey. Many of species are used as raw material in cosmetic industry. Some species are traditionally used as medicinal plants (BAYTOP 1984).

The genus *Origanum* L. belongs to the family Lamiaceae and comprises 43 species and 18 hybrids widely distributed in Eurasia and North Africa (IETSWAART 1980; DUMAN 2000). After *Origanum* was revised by J.H. Ietswaart for Flora of Turkey (IETSWAART 1982). *O. munzurense* Kit Tan et Sorger (DAVIS

et al. 1988), *O. husnucan-baserii* H. Duman, Z. Aytaç et A. Duran (DUMAN *et al.* 1995) and *O. xadanense* (*O. bargyli* Mouterde × *O. laevigatum* Boiss.) have been described as new to science species from Turkey. As a result 24 species of *Origanum* are now known from Turkey. Generally 18 hybrids of *Origanum* are known (IETSWAART 1980), six of which grow in Turkey (IETSWAART 1982, DUMAN *et al.* 1998).

The anatomical studies were carried out on some *Origanum* species growing in Turkey (GÖNÜZ & ÖZÖRGÜCÜ 1999; DOĞU & DİNÇ 2011) and out of Turkey (MOON *et al.* 2009). But, there is no anatomical study on Turkish steno-endemic species *Origanum leptocladum* Boiss. The aim of the present study is to report some anatomical features of *O. leptocladum*.

Material and methods

Plant samples of the species were collected from the type locality. The specimens were dried according to standard herbarium techniques and stored at Necmettin Erbakan University

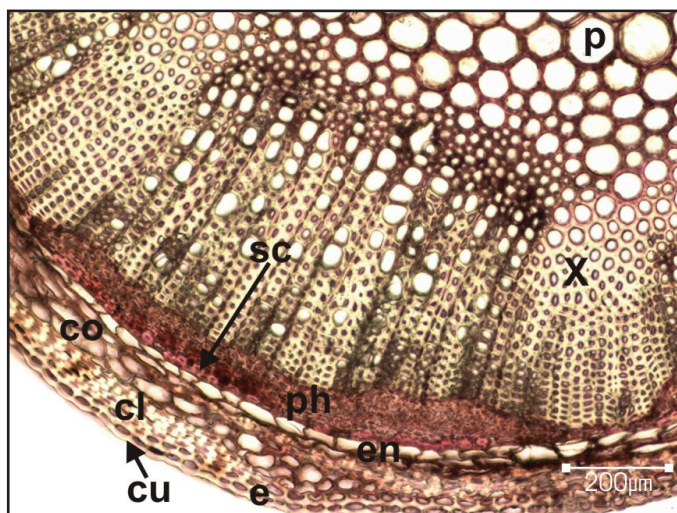


Fig. 1. The transverse section of *Origanum leptocladum* stem: **cu** – cuticle; **e** – epidermis; **cl** – collenchyma; **co** – cortex; **en** – endodermis; **sc** – sclerenchyma; **ph** – phloem; **x** – xylem; **p** – pith.

Ahmet Keleşoğlu Education Faculty herbarium.

The collecting locality of the species: C4 Karamn, Ermenek, between Balkusan Valley and Ermenek, stony slopes, steppe, 1550 m, 12.08.2009, S. Doğu 2051 & M. Dinç.

Some plant samples belonging to the species were fixed in 70% alcohol for anatomical studies. The investigations were performed on the cross-sections of the herbaceous stems and leaves, and the surface sections of leaves. The cross sections were painted with basic fuchsin and covered with glycerin gelatin (VARDAR 1987). Their photographs were taken with an Olympus BX-50 microscope. The stomatal index and stomatal index rate were calculated as described by MEIDNER & MANSFIELD (1968).

Results

Stem Anatomy

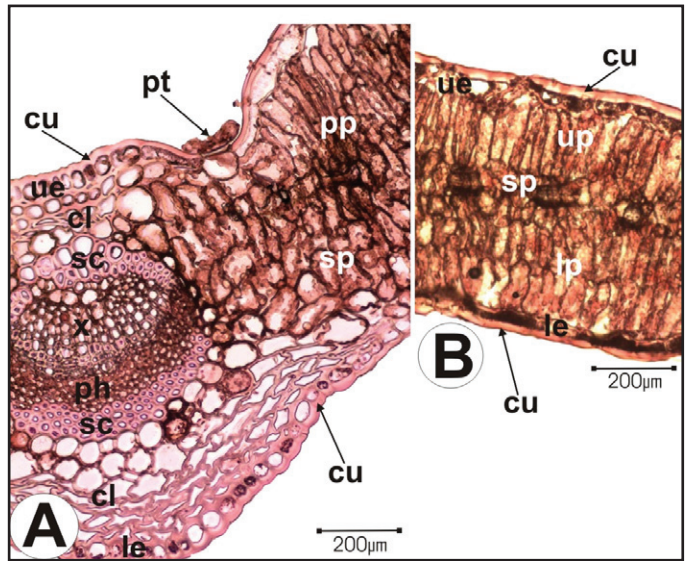
The transverse section of the herbaceous stem is weakly-rectangle shaped or tends to be circular. The epidermis consists of single layer rectangular cells, and is surrounded by a cuticle layer. There is no trichomes on the epidermis. Underneath the epidermis, there is collenchyma with single layered cells between the corners, but 5-6 layers of collenchyma can be seen below the epidermis at the corner of the stem. The shape of collenchymatic cells is ovoid and the walls are very thick. A thin cortex is present between the collenchyma and the endodermis.

The cortex (70-200 μm) consists of 3-6 layers of oval and rectangular parenchymatic cells. The endodermis is conspicuous, regular, single-layered and composed of quadrate, flattened and ovoid cells. A pericycle layer is present under the endodermis. It is sclerenchymatic, continuous, weakly developed and made up from 1-2 sheets. Underneath the pericycle, the vascular tissue is present. Phloem and xylem elements can be distinguished in the vascular tissue. The cambium between xylem and phloem is inconspicuous. In the whole centre of the stem there is a pith filled with circular, slightly pentagon and hexagon angular parenchymatic medullar cells (Fig. 1).

Leaf Anatomy

Epidermis one-layered, consisting of ovoid, quadrate and rectangular cells is present at both leaf surfaces. The upper epidermal cells are as large as the lower ones in the midvein region, but they are larger in the other parts of the leaf. Some upper and lower epidermal cells contain mucilage. Both surfaces are covered by a thick cuticula layer, lack indumentum built of non-glandular trichomes. Some peltate glandular trichomes are present in the sinks on the upper surface. The midvein region was well developed and projected outwards. Leaves are dorsiventral in the region near to midvein, with 2-3 layers of palisade parenchyma under the upper epidermis and 3-5 layers of spongy parenchyma under the

Fig. 2. The transverse sections of *Origanum leptocladum* leaves: **A** – midvein region; **B** – veinless region; **cu** – cuticle; **pt** – peltate trichome; **ue** – upper epidermis; **cl** – collenchyma; **sc** – sclerenchyma; **ph** – phloem; **x** – xylem; **pp** – palisade parenchyma; **up** – upper palisade; **lp** – lower palisade; **sp** – spongy parenchyma; **le** – lower epidermis.



lower epidermis. But they are equifacial in the veinless region, with poorly developed spongy parenchyma between the upper and lower palisade. Upper palisade is generally 1-layered, lower one is generally 2-layered. Upper palisade cells are longer than the lower ones (Fig. 2 A-B).

The mesophyll is thicker around midvein region. There are collenchyma under both epidermises in this region. The collenchyma under the upper epidermis is 5-7 layered, the upper one is 2-3 layered. A vascular bundle is present in the central part of midvein. Vascular bundles were collateral. The phloem facing the lower epidermis and the xylem facing the upper epidermis are present in the vascular bundle. It is encircled by sclerenchyma at both side (Fig. 2 A-B).

The leaves are amphistomatic with diacytic, anomocytic and anisocytic type stomata. The stomata on the both surface are localized at about the same level as the epidermis and they are of the mesomorphic type. The anticlinal walls of epidermal cells on both surface are undulated, but those on the upper surface are more undulated. Some epidermal cells contain mucilage or druse type crystals. The stomatal index for the upper surface is 17.6-19.2 (mean 18.6) and for the lower surface is 18.8-21.3 (mean 19.7) (Fig. 3 A-B).

Discussion and conclusions

Trichomes are among the most useful taxonomic characters in some genera of Lamiaceae. Their absence or presence and their typology can be used as taxonomic markers in the infrageneric classification of some genera (NAVARRO & EL OUALIDI 2000; MOON *et al.* 2009). MOON *et al.* (2009) reported that while uniseriate non-glandular, capitate and sessile glandular (= peltate) trichomes are present on the upper (abaxial) leaf surface of *O. vulgare*, *O. rotundifolium* has capitate and sessile glandular trichomes on its vegetative parts. On the other hand, *O. onites* has papillose (= unicellular) and villose (= uniseriate non-glandular) trichomes (GÖNÜZ & ÖZÖRGÜCÜ 1999), *O. saccatum* lacks trichomes (Doğu & Dinç 2011), and there is only sessile glandular trichomes (= peltate) on the leaves of *O. leptocladum*.

Stomata are of anomocytic type in *O. vulgare*; of anisocytic, diacytic and diallelocytic type – in *O. rotundifolium* (MOON *et al.* 2009); of diacytic type – in *O. saccatum* (DOĞU & DİNÇ 2011); of anomocytic, diacytic and anisocytic type – in *O. onites* (GÖNÜZ & ÖZÖRGÜCÜ 1999); of diacytic, anomocytic and anisocytic type – in *O. leptocladum*. According to the data, stoma type has very limited taxonomic value in interspecific classification.

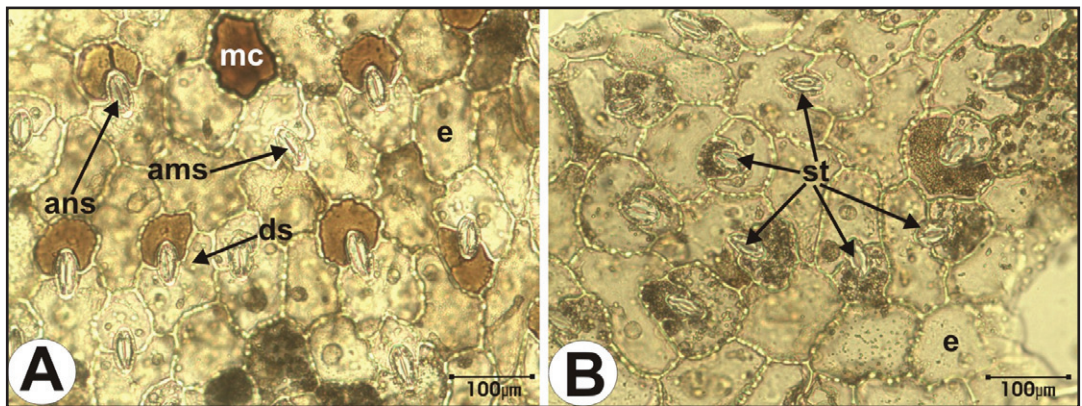


Fig. 3. The surface sections of *Origanum leptocladum* leaf: **A** – the upper surface; **B** – the lower surface; **ans** – anisocytic stoma; **ams** – anomocytic stoma; **ds** – diacytic stoma; **e** – epidermal cell; **st** – stomata; **mc** – mucilage.

Laminas were reported as dorsiventral or isobilateral (= equifacial) in the tribe Mentheae (MOON *et al.* 2009). According to the studies previously carried out, the leaves are dorsiventral in *O. onites* and *O. saccatum* (GÖNÜZ & ÖZÖRGÜCÜ 1999; DOĞU & DİNÇ 2011). In *O. leptocladum* laminas are dorsiventral in the region near to midvein, but they are equifacial in the veinless region. This mesophyll structure has been firstly reported in the genus *Origanum* in the present study.

The present study show that *O. leptocladum* generally have the anatomical feaures of the family Lamiaceae. However, herbaceous stem is weakly-rectangle shaped or tends circular, the collenchymatic tissue at the corner of the stem and scleranchymatic pericycle around the vascular tissue are weakly-developed. While the stomata are of mesomorphic type on the leaf surfaces, *O. leptocladum* has xeromorphic characters such as palisade richness in mesophyll, the occurrence of rich scleranchymatic tissue in midvein and cuticle thickness on leaf surface.

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