

A Morphological and Anatomical Study on a Medicinal and Edible Plant *Trachystemon orientalis* (L.) G.Don (*Boraginaceae*) in the Black Sea Region

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Abstract: *Trachystemon orientalis* (L.) G.Don (*Boraginaceae*), which is distributed in various habitats in the Black Sea region, was investigated morphologically and anatomically. The flowering branches, leaves and rhizomes of *T. orientalis* are used as food. This species is a Euro-Siberian floristic element. The genus *Trachystemon* D.Don is represented by one species in Turkey. In the morphological study it was observed that the species have a perennial root. The rhizome is blackish and 6-10 cm. The stem is 25-50 cm tall and erect. In anatomical studies, the cross and surface sections of the root, stem, rhizome, leaf and petiole were examined. In addition, the stomatal index was calculated.

Key Words: *Boraginaceae*, *Trachystemon orientalis*, morphology, anatomy

Karadeniz Bölgesinin Tıbbi ve Besin Bitkisi olan *Trachystemon orientalis* (L.) G.Don (*Boraginaceae*) Üzerinde Morfolojik ve Anatomik Bir Çalışma

Özet: Karadeniz Bölgesinin değişik habitatlarında yayılış gösteren *Trachystemon orientalis* (L.) G.Don (*Boraginaceae*) morfolojik ve anatomik olarak incelenmiştir. *T. orientalis*'in çiçek durumu sapları, yaprakları ve rizomları besin maddesi olarak kullanılmaktadır. Bu tür Avrupa-Sibirya floristik elementidir. *Trachystemon* D.Don cinsi Türkiye de tek tür ile temsil edilmektedir. Morfolojik çalışmada türün çok yıllık köke sahip olduğu belirlendi. Rizom siyah ve 6-10 cm'dir. Gövde 25-100 cm ve diktir. Anatomik çalışmalarda türün kök, gövde, rizom, yaprak ve yaprak sapından alınan enine ve yüzey kesitler incelenmiştir. Ayrıca stoma indeksi hesaplanmıştır.

Anahtar Sözcükler: *Boraginaceae*, *Trachystemon orientalis*, morfoloji, anatomi

Introduction

The genus *Trachystemon* D.Don belongs to the family *Boraginaceae* and is represented by one species in Turkey: *T. orientalis* (L.) G.Don. This plant is distributed in East Bulgaria and West Caucasia and in various habitats in the Black Sea region in Turkey. It is 30-40 cm tall, with a rhizome, it is hairy, with blue-red flowers and is perennial and herbaceous (Edmondson, 1978; Baytop, 1994). *T. orientalis* is a Euro-Siberian element (Edmondson, 1978).

The flowering branches, rhizomes, leaves and

petioles are consumed as vegetables in İstanbul and different parts of the Black Sea region. Moreover, the roots and petioles are used in making pickle (Baytop, 1994; Yıldırım, 1994). This plant is known to cause diuresis and plasmapheresis (Baytop, 1984). *T. orientalis* is also used either boiled in water or cooked with oil and eggs (Başer, 1997).

Its local names are Hodan, Galdirek, Kaldırık and Kalduruk (Bolu); Burğu (Artvin); Tamara (Trabzon); and Zılbit (Karadeniz Ereğlisi, Zonguldak) (Baytop, 1994). According to the records in the Flora of Turkey, this plant

grows extensively at 50-1000 m, on shady riverbanks and in humid habitats and *Fagus* L. forests (Edmondson, 1978).

The rhizomes of *T. orientalis* are used as reproductive organs in spite of it being a flowering species. The species occurs in habitats with low light intensity and so it cannot produce enough seed.

Studies on the morphology of this species are limited. Systematic notes and the distribution of the species were given by Yıldırım (1994). The chromosome numbers of *T. orientalis* are $2n: 56$ (Lamaison, 1992). The anatomical structure of this species has not been studied. Therefore, the purpose of this paper was to investigate the morphological and anatomical properties of *T. orientalis*.

Materials and Methods

T. orientalis samples were collected from different localities in Ordu and Samsun. These localities are listed below. Specimens were preserved in the herbarium of the Faculty of Art and Science at Ondokuz Mayıs University.

1- A6 Samsun: Tepecik village, road side, 150 m, 20.04.2001, Akçin 1040.

2- A6 Ordu: Perşembe, Efirli village, road side, 25 m, 01. 05. 2001, Akçin 1042.

3- A6 Ordu: Aybastı, Perşembe Yaylası, road side, 1500 m, 04. 05. 2001, Akçin 1044.

4- A6 Ordu: Bayadı village, field side, 400 m, 10. 05. 2001, Akçin 1045.

5- A6 Ordu: Perşembe, Medreseönü, road side, 25 m, 21. 05. 2001, Akçin 1046.

The plants samples were identified according to Edmondson (1978). Fresh samples were used for morphological measurements. Samples were fixed in 70% alcohol for anatomical studies. The length and width of the stomata were measured with an ocular micrometer using the surface section from the upper and lower parts of the leaf epidermis. The stomatal index was calculated according to the method described by Meidner and Mansfield (1968).

Results

Morphological Properties (Figure 1 & 2)

Perennial. Root 5-10 cm long, dark brown. Rhizome blackish, 6-10 cm long. Stem 25-50 cm tall, erect with few branches, glandular and eglandular hairy. Leaves glandular and eglandular hairy. Basal leaves 8-20 x 7-18 cm, ovate-cordate, acuminate with 10-25 cm petiole. Cauline leaves 5-7 x 2-3 cm, sessile, amplexicaul. Bracts 0.8-1 x 0.3-0.5 cm, elliptic-lanceolate to oblanceolate, sessile. Calyx 2-4 mm in flower, 5-8 mm in fruit; calyx lobes triangular, glandular hispid. Corolla pubescent outside, 10-14 mm, reddish purple at first then turned purplish blue, 5 lobed; lobes separated at the end of anthesis. Anthers 2 mm in length and filaments 8-9 mm, hairy, pink except for the white base. Style 1.2 - 1.5 cm, reddish purple, gynobasic. Nutlets obliquely ovoid, 1-2 mm (Table 1).

Anatomical Properties

Root (Figure 3)

Periderm is 3-6 layered. Cortex is multilayered and parenchymatic. Parenchymatic cells are 15-25 x 25-50 μ . Primary xylem rays are 3-10 layered. The pith consists of primary xylem tissue (Table 2).

Rhizome (Figure 4)

Periderm is 1-4 layered. Cortex is 10-12 layered and parenchymatic. They are 75-100 x 75-125 μ . Parenchymatic cells have simple and compound excentric starch grains. Simple grains are more common. Cambium is distinguishable and 2-3 layered. There are many vascular bundles in the rhizome. Vascular bundles are covered with cells containing starch. Primary rays 2-7 layered. The pith consists of large parenchymatic cells (Table 2).

Stem (Figure 5)

There is a thick cuticular layer. Epidermis is single layered. There are glandular and eglandular hairs on the epidermis. They are unicellular or multicellular. Eglandular hairs are more common than glandular hairs. Collenchyma is located under the epidermis. This tissue is 8-12 layered on the corners and 4-7 layered between the corners. Parenchyma tissue is 8-12 layered and cells are 25-100 x 25-80 μ . Cambium is distinguishable and 4-5 layered. There are large vascular bundles on the corners and 4-5 small bundles between the corners. Vascular bundles are surrounded by a parenchymatic bundle sheath. The pith consists of large parenchymatic cells (Table 2).

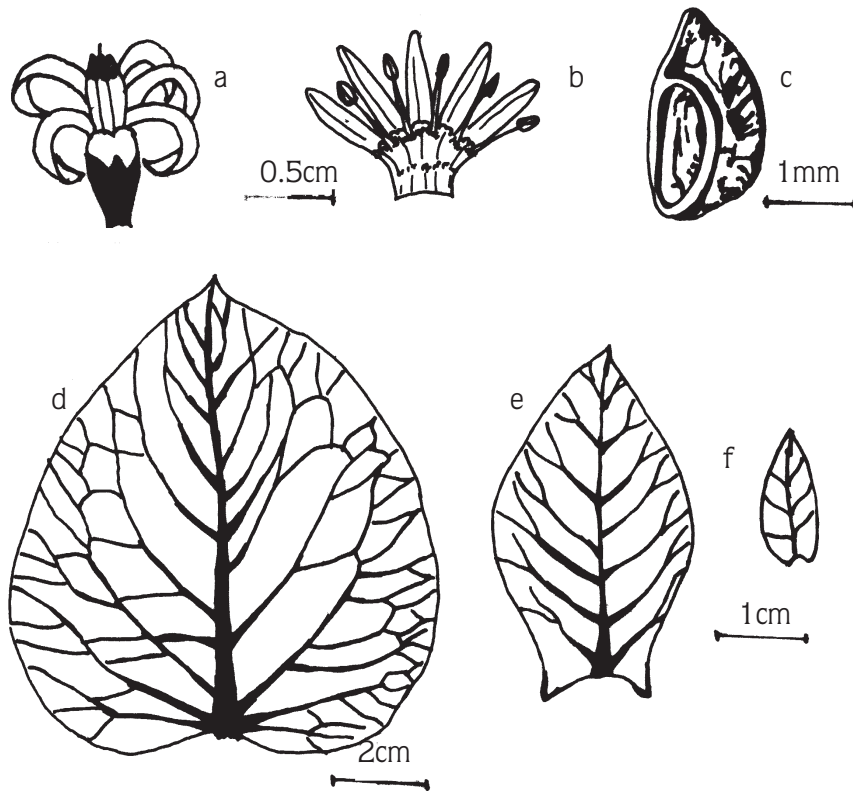


Figure 1. a. flower b. corolla and stamens c. fruit d. basal leaf e. cauline leaf f. bracts.

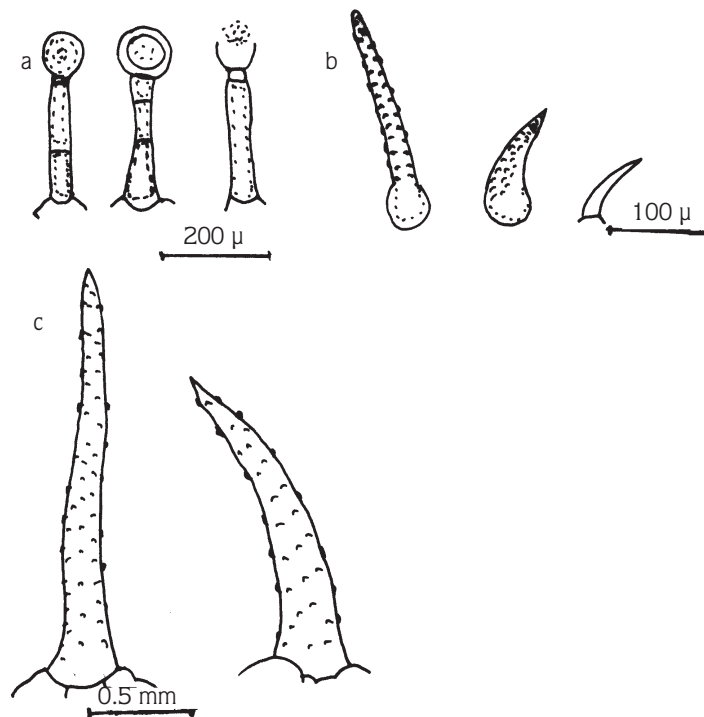


Figure 2. Glandular and eglandular hairs in different parts of *T. orientalis* a. glandular hairs b-c. eglandular hairs.

Table 1. Measurements of some parts of *T. orientalis*.

Parts of plant	Measured number	Breadth (cm)			Length (cm)		
		Min.	Max.	Mean ± SE	Min.	Max.	Mean ± SE
Root	30	-	-	-	5	10	7.5 ± 0.119
Stem	30				25	60	42.5 ± 0.839
Rhizome	30				6	10	8 ± 0.095
Basal leaf	30	7	18	12.5 ± 0.263	8	20	14 ± 0.287
Cauline leaf	30	2	3	2.5 ± 0.024	5	7	6 ± 0.047
Bract	30	0.3	0.5	0.4 ± 0.0047	0.8	1	0.9 ± 0.005
Calyx	In flower	30	-	-	0.2	0.4	0.3 ± 0.005
	In fruit	30	-	-	0.5	0.8	0.65 ± 0.007
Corolla	30	-	-	-	1	1.4	1.2 ± 0.009
Filament	30	-	-	-	0.8	0.9	0.85 ± 0.002
Anther	30	-	-	-	0.18	0.2	0.19 ± 0.0005
Fruit	30	-	-	-	0.4	0.6	0.5 ± 0.005

Table 2. Anatomical measurements of *T. orientalis*.

		Breadth (µ)		Length (µ)	
		Min	Max	Min	Max
ROOT	Periderm cells	37.5	100	15	40
	Parenchyma cells	25	50	15	25
	Diameter of trachea	10	17.5		
STEM	Epidermis cells	10	17	12	17
	Collenchyma cells	10	25	20	30
	Parenchyma cells	25	88	25	100
	Diameter of trachea	13	25		
RHIZOME	Diameter of pith cells	35	110		
	Periderm cells	25	50	25	30
	Parenchyma cells	75	125	75	100
	Diameter of starch	5	25		
LEAF	Diameter of trachea	12	38		
	Cuticle	2	3.5		
	Upper epidermis cells	25	34	7	18
	Lower epidermis cells	12	30	10	15
	Palisade paren. cells	12.5	20	37	55
PETIOLE	Spongy paren. cells	18	50	20	25
	Abaxial cells	12.5	17.5	15	20
	Adaxial cells	10	22.5	20	22.5
	Cortex cells	37.5	100	35	85
	Collenchyma cells	12.5	25	15	20
	Diameter of trachea	12.5	37.5		

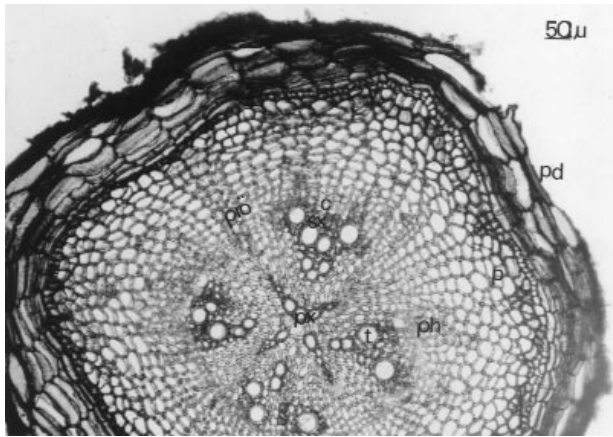


Figure 3. Cross-section of root of *T. orientalis* (pd peridermis p parenchyma pr pith ray c cambium ph phloem sx secondary xylem t trachea px primary xylem).

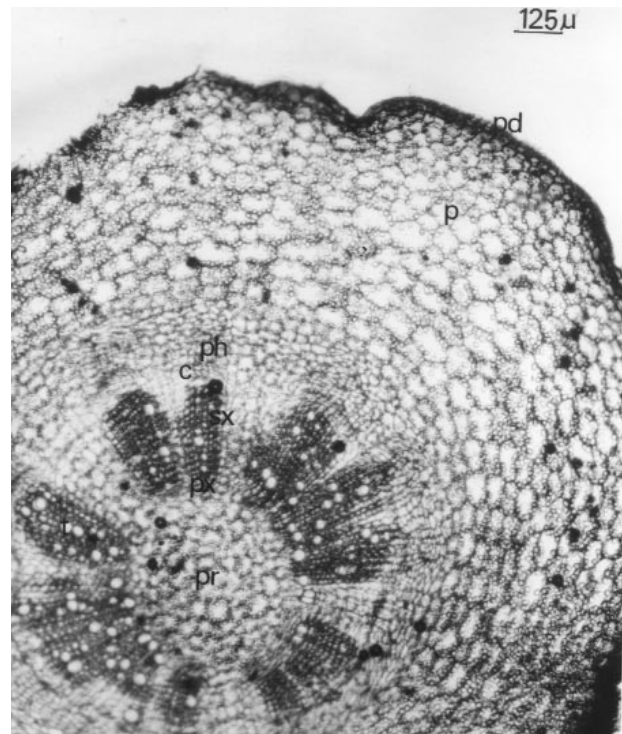


Figure 4. Cross-section of rhizome of *T. orientalis* (pd peridermis p parenchyma c cambium ph phloem pr pith region sx secondary xylem t trachea px primary xylem).

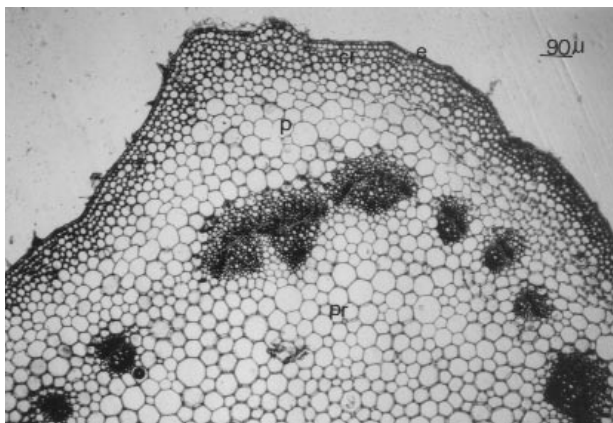


Figure 5. Cross-section of stem of *T. orientalis* (e epidermis cl collenchyma p parenchyma c cambium ph phloem x xylem pr pith region).

Petiole (Figure 6a&b)

Epidermis is single layered. There is a thick cuticular layer. There are many glandular and eglandular hairs on the epidermis. Collenchyma, which is 4-5 layered, is located under the epidermis. Cortex consists of large parenchymatic cells. Parenchymatic cells are 35-85 x 37.5-100 μ. There is a large vascular bundle in the median region of the petiole. Three small bundles are present on both sides of this bundle. Vascular bundles are surrounded by a parenchymatic bundle sheath. Cambium is distinguishable and 3-4 layered (Table 2).

Leaf (Figure 7)

There is a single layered epidermis on the upper and lower surface of the leaf. Upper epidermis cells are larger than lower ones. There are many glandular and eglandular hairs on the epidermis. Glandular hairs are more common on the upper epidermis. Glandular hairs are multicellular and eglandular hairs are unicellular or multicellular. Stomata type is anomocytic. Stomata cells are more common on the lower epidermis. The number of stomata is 14 ± 1 on the upper epidermis and 42 ± 1 on the lower epidermis of the leaf. Stomata index is 13.46 for the upper epidermis and 24.13 for the lower epidermis (Table 3). Leaf is bifacial. Palisade parenchyma cells are single layered and 37-55 x 12.5-20 μ. Spongy parenchyma cells are 4-6 layered. In the median region of the leaf, there is a large vascular bundle. Collenchymatic cells are located under the upper (2-3 layered) and lower epidermis (2 layered). Type of vascular bundle is collateral.

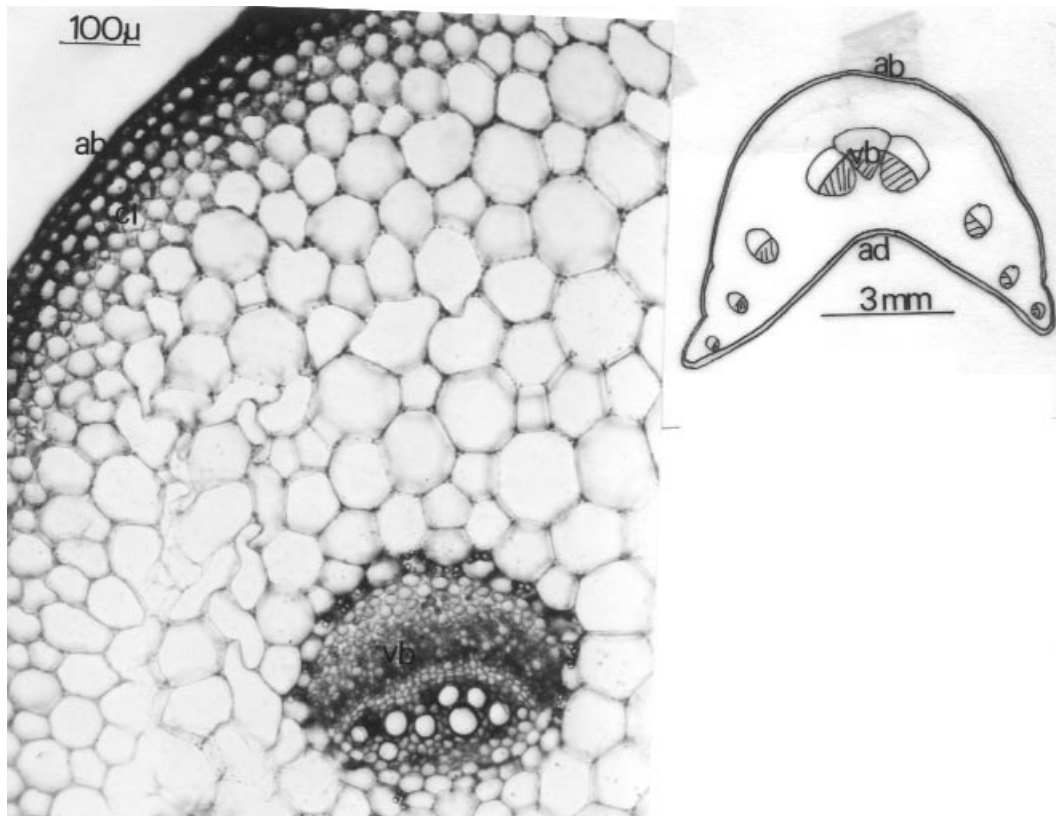


Figure 6. Cross-section of petiole of *T. orientalis* (ab abaxial epidermis ad adaxial epidermis cl collenchyma vb vascular bundle).

Table 3. Stoma features on the upper and lower epidermis of *T. orientalis*.

	Upper surface of leaf	Lower surface of leaf
Number of stomata (1 mm ²)	14 ± 1	42 ± 1
Number of epidermis cells (1 mm ²)	90 ± 2	132 ± 2
Stoma index	13.46	24.13
Stoma length	20-25 μ	20-25 μ
Stoma width	15-20 μ	12-15 μ

Discussion

Trachystemon is a monotypic genus and *T. orientalis* distributed along the Black Sea coast in Turkey. *T. orientalis* is consumed as a vegetable, pickle and medicinal plant. The rhizome is the main reproductive organ since this species cannot produce enough seed. Öztürk and Seçmen (1996) determined that shady plants prefer shady habitats to protect themselves from intense light and temperatures and parasitic plants.

It was determined that morphological characters such as the shape of the leaf, the corolla, the structure of the bract and calyx and the properties of glandular and eglandular hairs have been used as taxonomical characters. Although our results are generally similar to those in the Flora of Turkey, a few differences were determined. It was reported that the basal leaves were 20 x 18 cm, the calyx was 3-4 mm in the flower and up to 7 mm in the fruit by Edmondson (1978). In our study, it

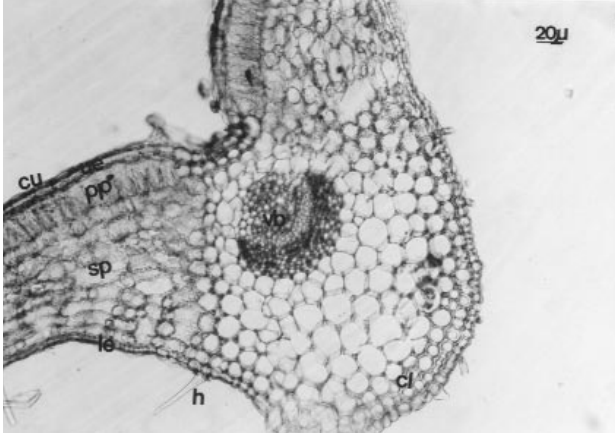


Figure 7. Cross-section of leaf of *T. orientalis* (cu cuticle ue upper epidermis pp palisade parenchyma h hair sp spongy parenchyma v vascular bundle le lower epidermis)

was determined that the root was 5-10 cm, the rhizome was 6-10 cm, the basal leaf was 8-20 x 7-18 cm, the cauline leaf was 5-7 x 2-3 cm, the bracts were 0.8-1 x 0.3-0.5 cm, the calyx was 2-4 mm in the flower and 5-8 mm in the fruit, the corolla was 10-14 mm, the anther was 2 mm, the filament was 8-9 mm and the nutlet was 1-2 mm. The root, rhizome, cauline leaf, bract, filament and anther sizes and hair properties are reported here for the first time.

Metcalf and Chalk (1979) gave information about the general anatomical characteristics of the family *Boraginaceae*. There was no any information about the anatomical structure of this species. In our study, this species had a more or less rectangular and round stem. The collenchyma was 8-12 layered on the corners and 4-7 layered between the corners. The cortex was 8-10 layered and the cells were parenchymatic. There were large vascular bundles on the corners and 4-5 small bundles between the corners. The anatomical properties of *T. orientalis* showed some similarities and differences compared to other *Boraginaceae* genera. *Onosma* L. species had an orbicular stem. The collenchyma was 2-3

layered in *O. isauricum* Boiss. & Heldr. and *O. bornmuelleri* and 1-2 layered in *O. stenelobum* Hausskn. ex H.Riedl. Vascular bundles are the same size in both species (Akçin & Engin, 2001). There are glandular and eglandular hairs on the epidermis of the stem, leaf, petiole and calyx. They are unicellular or multicellular. Eglandular hairs are more common than glandular hairs. It was determined that the family *Boraginaceae* had glandular and eglandular hairs (Metcalf & Chalk, 1979).

There are 7 genera with rhizomes in the family *Boraginaceae*. One of them is the genus *Trachystemon* (Edmondson, 1978). The rhizome of *T. orientalis* had a periderm 1-4 layered. The cortex was 10-12 layered and parenchymatic. Parenchymatic cells had simple and compound excentric starch grains. Simple grains were more common.

This species has bifacial leaves. However, *Onosma* species have isobilateral (isolateral) leaves. The median veins of *T. orientalis* and *O. isauricum* are similar in structure (Akçin & Engin, 2001). Metcalfe and Chalk (1979) pointed out that there were both anomocytic and anisocytic stomata in the family *Boraginaceae*. It was stated by Özörgücü (1991) there was an anomocytic stomata in this family. Anomocytic stomata were also described in some *Onosma* species (*Boraginaceae*) (Akçin & Engin, 2001). In our study, the stomata was anomocytic. Stoma cells were more common on the lower epidermis. The same results were seen in *Onosma* species. The number of stomata was 14 ± 1 on the upper epidermis of the leaf and 42 ± 1 on the lower epidermis. The stomata index was 13.46 for the upper surface of the leaf and 35 for the lower surface. Metcalfe and Chalk (1979) pointed out that in many families, especially in *Lamiaceae*, the structure of the petiole is important in terms of taxonomy. In *T. orientalis*, there is a large vascular bundle in the median region of the petiole. Three small bundles are present on both sides of these bundles. We think that the structure of the petiole can be used as a taxonomic feature.

References

- Akçin ÖE & Engin A (2001). *Onosma isauricum* ve *O. stenolobum* Türlerinin Karşılaştırmalı Anatomisi. *Ot Sistematik Botanik Dergisi* 8(2): 75-95.
- Baytop T (1984). *Türkiye'de Bitkiler ile Tedavi (Geçmişte ve Bugün)*. İstanbul: İÜ Ecz Fak Yayını No: 40.
- Baytop T (1994). *Türkçe Bitki Adları Sözlüğü*. Ankara: Atatürk Kültür, Dil ve Tarih Yüksek Kurumu Türk Dil Kurumu Yayınları: 578.
- Edmondson JR (1978). *Trachystemon* D.Don. In: Davis PH (ed.). *Flora of Turkey and the East Aegean Islands*. Vol 6. pp. 386-387. Edinburgh : Edinburgh University Press.

- Başer KHC (1997). Current knowledge of the wild food and non-food plants of Turkey. In: Heywood VH & Skoula M (eds.). Identification of Wild Food and Non-Food plants of the Mediterranean Region. *Cah. Options Mediterr.* 23: 129-159.
- Lamaison JL (1992). *Trachystemon orientalis* (L.) G.Don (*Boraginaceae*), Plante Naturalisee Nouvelle Pour l'Auvergne. *Monde Plantes* (Toulouse) 444:10.
- Meidner H & Mansfield TA (1968). *Physiology of Stomata*. London: McGraw-Hill.
- Metcalf CR & Chalk L (1979). *Anatomy of Dicotyledons* I. London: Oxford University Press.
- Özörgücü B, Gemici Y & Türkan İ (1991). *Karşılaştırmalı Bitki Anatomisi*. İzmir: Ege Üniv Fen Fak Yayınları No:129.
- Öztürk M & Seçmen A (1996). *Bitki Ekolojisi*. İzmir: Ege Üniv Fen Fak Yayınları No: 141.
- Yıldırım Ş (1994). Karadeniz Bölgesinin Bir Tıbbi ve Besin Bitkisi *Trachystemon orientalis*. *OT Sistematiik Botanik Dergisi* 1(2): 7-12.