

The Morphological and Anatomical Studies on *Fritillaria caucasica* J.F. Adam (Liliaceae)

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Abstract: *Fritillaria* L. is a genus of about 100 species of bulbous plants in the family Liliaceae in the World. *Fritillaria caucasica* has a narrowly campanulate perianth, perianth purple outside and inside, style entire. In this study, morphological and anatomical properties of *F. caucasica* J.F. Adam were investigated. At the anatomical review the cross-sections of the root, stem and leaf parts of the plant were examined and demonstrated by photographs. Most of the anatomical properties were similar to the other member of Liliaceae family.

Keywords: *Fritillaria caucasica*, Liliaceae, Morphology, Anatomy.

Fritillaria caucasica J.F. Adam (Liliaceae) Üzerine Morfolojik ve Anatomik Bir Çalışma

Özet: *Fritillaria* L. cinsinin dünyada yaklaşık 100 türü bulunmaktadır. Bunlardan *Fritillaria caucasica* içte ve dışta pembe renkli dar, çansı bir çiçek örtüsüne sahip olup stilus parçalı olmayıp tamdır. Bu çalışmada, *Fritillaria caucasica* 'nın morfolojik ve anatomik özellikleri çalışıldı. Anatomik incelemelerde kök, gövde ve yaprak gibi kısımlar fotoğraflandırıldı. Anatomik özelliklerinin çoğunluğunun *Liliaceae* familyasına ait bitkilerle benzerlikler gösterdiği gözlemlendi.

Anahtar kelimeler: *Fritillaria caucasica*, *Liliaceae*, Morfoloji, Anatomi.

1. Introduction

Fritillaria L. genus is a member of the Liliaceae family and it is a bulbous perennial herbaceous. Because of the contains steroidal compounds used in the treatment of many diseases. The genus *Fritillaria* has about 165 taxa world-wide [1]. The Flora of Turkey, Volume 8 and 11, recognised 41 taxa within Turkey, 19 of which were considered endemic. Eighteen species and 4 subspecies are distributed in the Mediterranean region, 12 of which are endemic [2].

The bulbs of *Fritillaria* species, Beimu, have been used as one of the most important anti-tussive, expectorant and anti-hypertensive drugs in traditional Chinese medicine for centuries [3]. The chemical constituents of Beimu have been extensively investigated, including alkaloids, saponin, terpenoids, steroids, succinic acid, thymidine and adenosine [4, 5].

There is a few studies on the morphology and anatomy of this genus [2, 6, 7, 8, 9]. There are no morphological and anatomical studies on this taxa. In this research, detailed morphological and anatomical features of *F. caucasica* were studied.

2. Materials and Methods

Plant materials collected from natural population: A8 Erzurum, Narman district, steppe, 2000 m, 18.05.2009, Akyol 2494.

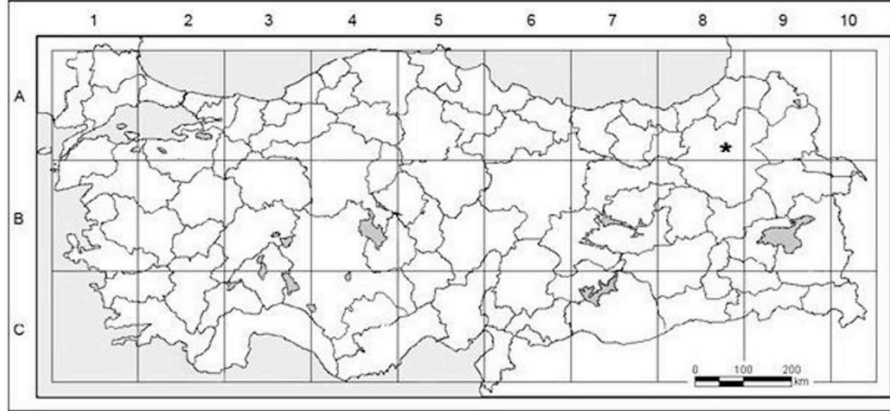


Figure 1. * Plant natural population at Erzurum province, Narman district (According to grid system by Davis, 1984).

Fresh plant samples were used for morphological measurements. For anatomical studies plant specimens were fixed in 70 % alcohol. The paraffin method was used for preparing a cross-section of stem, leaves and root [10]. Transverse sections 15-20 μ were made using a sliding microtome and stained with Safranin-Fast Green.

3. Findings

3.1. Morphological Findings

Bulb 2 cm diam, without bulblets. Stem 18 cm, smooth. Leaves 2-4, all alternate, lowest 5,5 x 1,5 cm, broadly lanceolate to lanceolate, acute. Flowers solitary, perianth narrowly campanulate, rounded, often constricted at mouth, reflexed at apex, dark purplish-brown; outer segments ovate to narrowly ovate, acute 2,5 x 1,2 cm, inner 0,6-1,4 cm broad, sometimes obtuse. Nectaries 4-5 x 1 mm, linear-lanceolate, greenish. Filaments 15 mm, slender, smooth or sparsely papillose, slender entire. Capsule not winged (Figure 2.a).

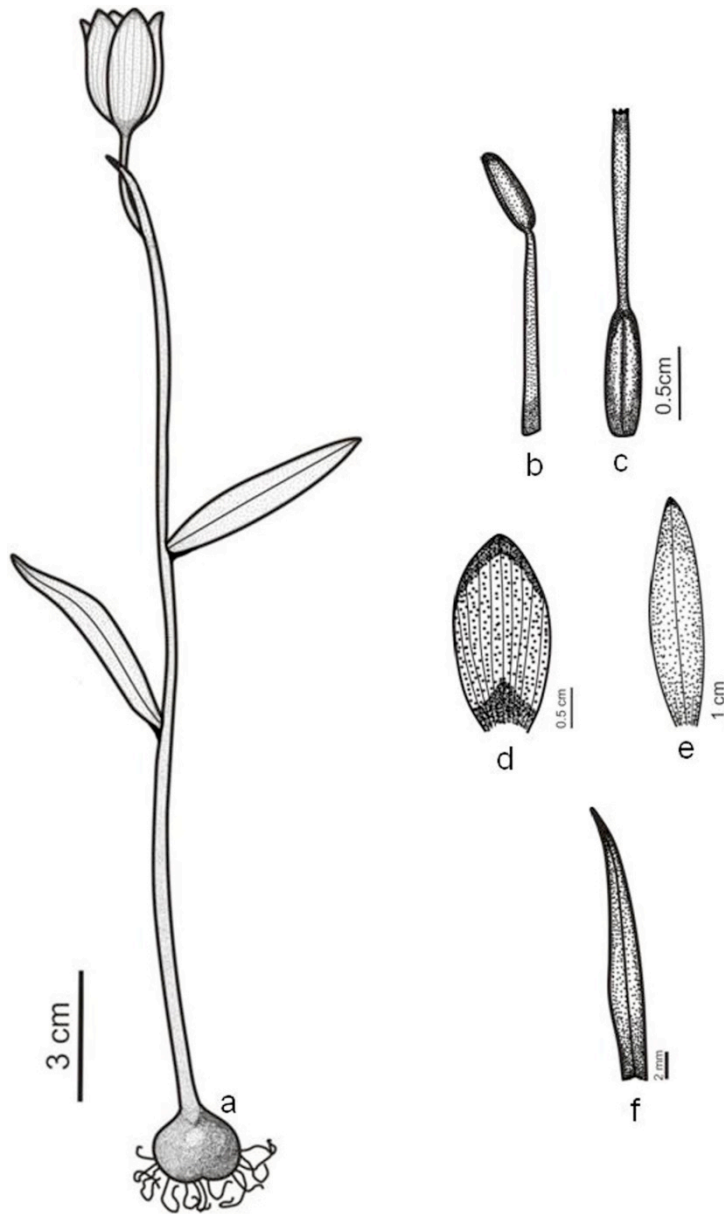
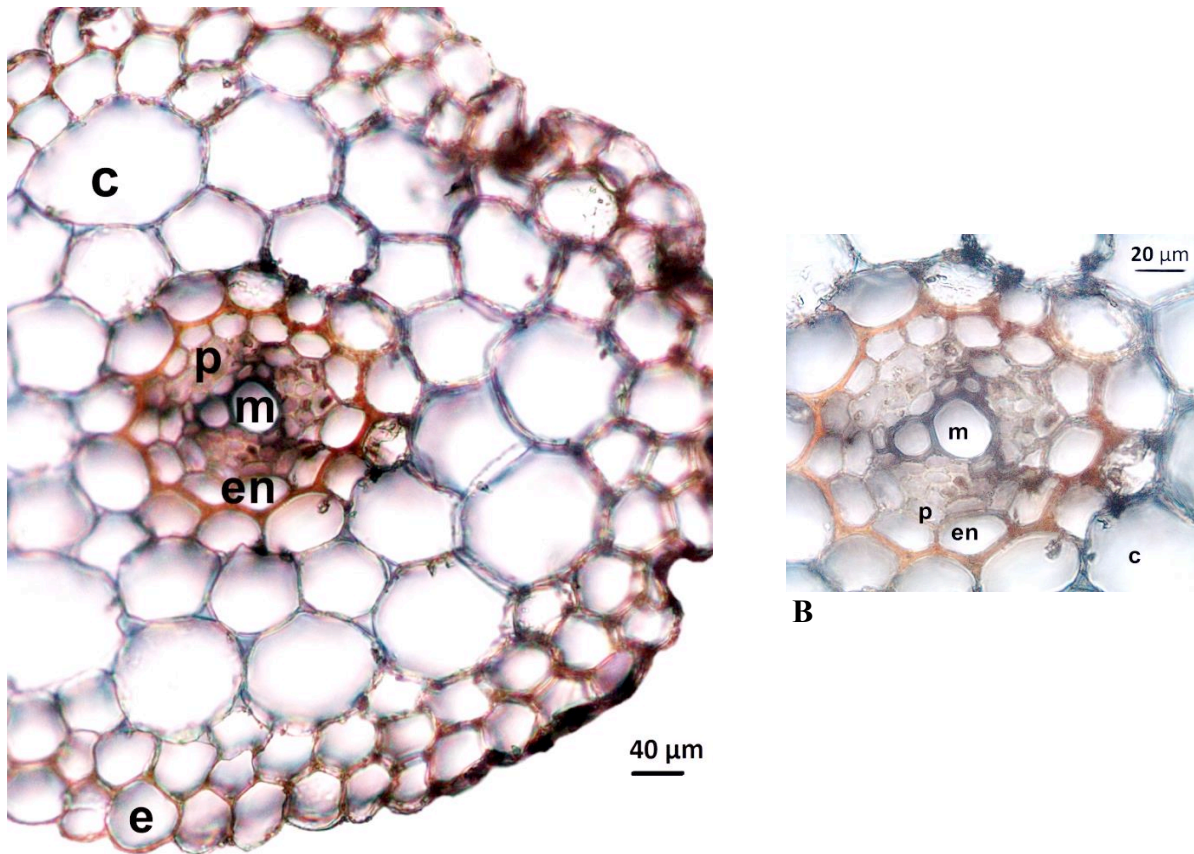


Figure 2. a: General appearance of *F. caucasica*. b: anter, c: pistil, d: tepal, e: leaf, f: bract

3.2. Anatomical Findings

3.2.1. Root

A single layered epidermis was present in the root cross-section. The cortex has 3-4 layered and $41-72\mu$. The wall thickening of the endodermis three-sided and thickening of the cortex. Single-layered pericycle was located inside endoderm. Metaxylem is present on the median part of cross- section and $21-30\mu$ (Figure 3, Table 1).



A

Figure 3 A, B. The cross section of root of *F. caucasica*. c: cortex, e: epidermis, en: endodermis, m: metaxylem, p: pericycle.

3.2.2. Stem

Cross-section of the stem shows that, the cells of epidermis are covered by a cuticle. The cortex cells are consisting of 4-5 layered (Figure 4-6). These cells are thin, parenchymatic and hasn't intercellular spaces. Collenchyma is 3-5 layered under the cortex. These cells walls which at the corners. Small collateral bundles are 23-25 circular positioning. There are two large vascular bundle in the centre of the section. These of them, xylem is cover broader area than floem. There is a pith centre of scape, which has thin walled and intercellular area of normal parenchyma cells.

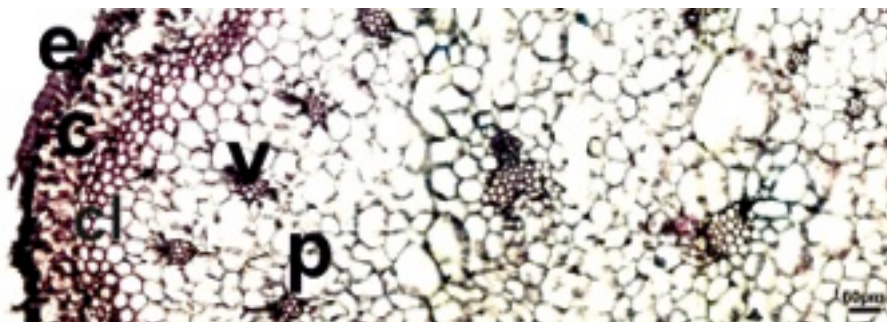


Figure 4. The cross section of stem of *F. caucasica*. c: cortex, cl: collenchyma, e: epidermis, p: pith, v: vascular bundle.

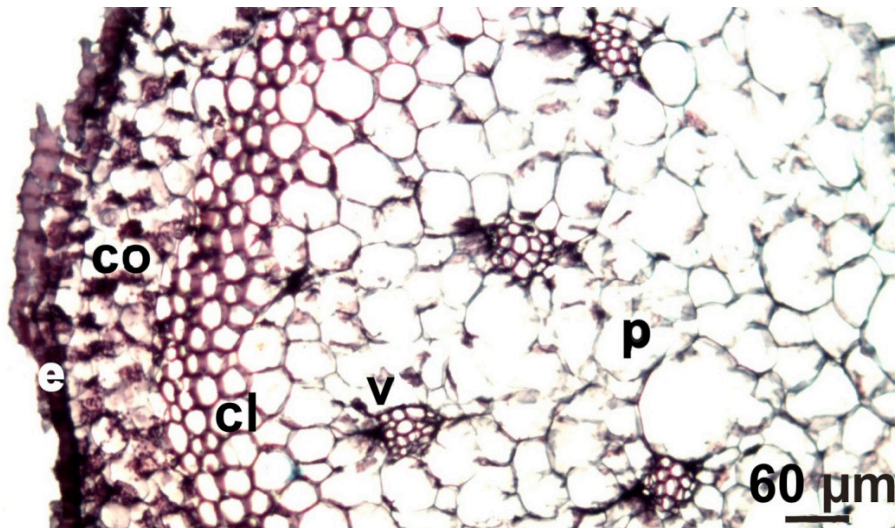


Figure 5. The cross section of stem of *F. caucasica*. e: epidermis, cl: collenchyma, co: cortex, p: pith, v: vascular bundle.

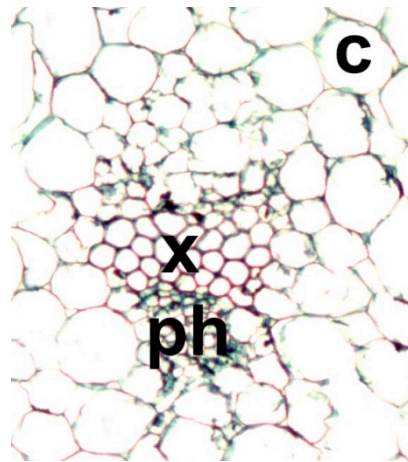


Figure 6. Vascular bundle in cross section from stem of *F. caucasica*. c: cortex, ph: phloem, x: xylem.

3.2.3. Leaf

Both adaxial and abaxial surfaces have a cuticle. The epidermis was single layered on abaxial and adaxial surfaces of the leaf. There was no differentiation as palisade and spongy parenchymas at mesophyll. There is also large intercellular area at these surfaces. Vascular bundles regular and at frequent intervals arranged at the centre of mesophyll (Figure 7, 8).

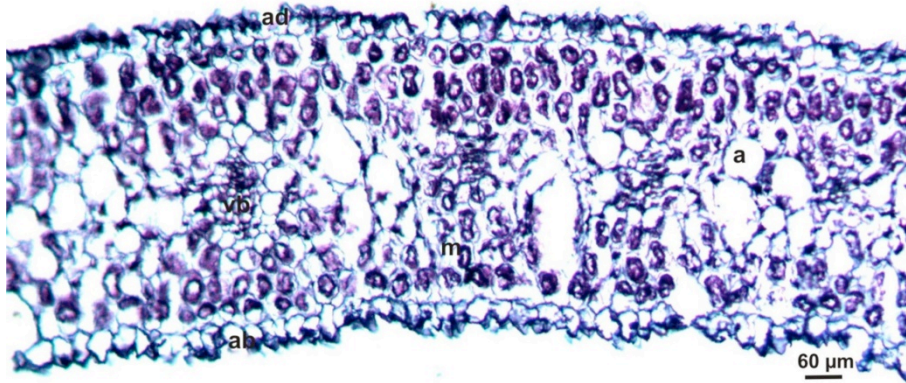


Figure 7. The cross section of leaf of *F. caucasica*, a; aerenchyma, ab: abaxial epidermis, ad: adaxial epidermis, m: mesophyll, vb: vascular bundle.

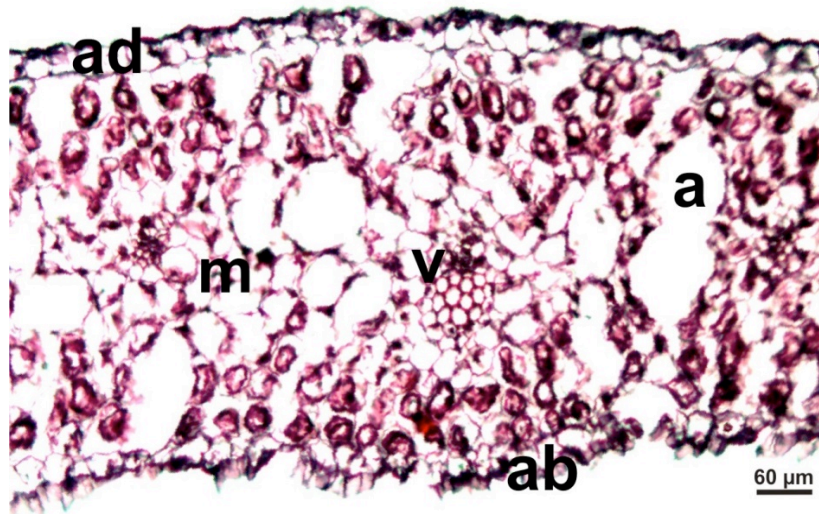


Figure 8. The cross section of leaf of *F. caucasica*, a: aerenchyma, ab: abaxial epidermis, ad: adaxial epidermis, m: mesophyll, v: vascular bundle.

4. Discussion

No studies on the morphology of *F. caucasica* have been found except the general description in Flora of Turkey [11]. In this study we have tried to demonstrate the characteristics of the taxon evaluating the results obtained from morphological and anatomical investigations. Differences have been determined comparing the results obtained from other geophytes in previous studies.

Our numerical findings belonging to the morphological characters this species seem to be somewhat similar to the first measurements given by Davis [11]. Three-sided thickening are very clear on the walls of the endodermal cells of roots. Researchers have observed that *F. baskilensis* Behçet has three-sided thickening of epidermis [12]. The same features have been observed in roots of some species belonging to Liliaceae and Iridaceae family [13]. This type endodermis cells have been seen in most monocotyledone plants and it is a common feature [14].

Cross-section of the stems small collateral bundles are 23-25 circular positioning. According to the results in the presents study vascular bundles are located in periphery and central parts of stem. These bundles are in position ring. The same feature has been observed on the stem of *Crocus aerius* Herb, *Crocus fleischeri* Gay, *Crocus danfordiae* Maw, *Merendera attica* (Spruner) Boiss. & Spruner and *Romulea columnae* Seb. & Mauri subsp. *columnae* [15-18]. These findings are almost similar to other monocots. There is no differentiation as palisade and spongy parenchyma at mesophyll of base leaf in the species. Finally, anatomical structure of *F. caucasica* was very similar to those of other Liliaceae and Iridaceae members.

Table 1. Anatomical Measurements of *F. caucasica*

	Width (µm)		Lenght (µm)	
	Min.-Max.	Mean± S.D	Min.-Max.	Mean± S.D
Root				
Epidermis cell	20-31	25.75±4.8	21-52	36.5±11.8
Cortex cell	41-72	52.2±10.5	48-110	65.6±23.6
Endodermis cell	17-25	22.1±2.8	18-27	23.4±3.2
Metaxylem (Diameter)	21-30	23.5± 3.9		
Stem				
Epidermis cell	20-30	22± 4	19-42	28±7.4
Cortex cell (Diameter)	20-50	33.6± 10.9		
Trachea (Diameter)	15-20	21.5±3		
Pith cell (Diameter)	50-83	67.16±13		
Leaf				
Adaxial epidermis cell	20-27.5	21.5±3	22.5-30	26.5±3.2
Mesophyll	30-37.5	32 ±2.9	32.5-52.5	42.5± 7.5
Abaxial epidermis cell	15-27.5	23.5±5.3	20-30	25±4.1

S.D. Standard deviation

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