



**ANATOMICAL STUDY ON *BELLEVALIA* LAPEYR. SECT. *PATENS* AND *CONICA*
IN IRAN**

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ABSTRACT

In the present research, morphological and scape and leaf anatomical characteristics of seven *Bellevalia* species from sections *Patens* and *Conica* distributed in Iran were assessed. Primarily, species was identified using Flora Iranica, Flora of Turkey and Flora of Russia. For anatomical study, cross sections of the fresh or dried scape base and leaf were prepared and stained by differential staining. In morphological evaluation, transitional features was noticed which they were not helpful for distinguishing of species limitation . Anatomically, a few differences were noticed in vascular bundle shape and arrangement, and the shape of leaf mesophyll cells among the species but they were not useful to recognize species circumscription.

Key words: Anatomy, Asparagaceae, internal structure, Scilloideae, upper mesophyll,
sect. *Patens*, sect. *Conica*

INTRODUCTION

Bellevalia Lapeyr belongs to Asparagaceae and subfamily Scilloideae [1]. This genus comprises 63 species distributed in Europe, the Mediterranean area and SW Asia of

which 19 species have been recorded from Iran [2-9]. *Bellevalia* is divided into four sections: *Nutans*, *Patens*, *Conica* and *Oxydonta*. Based on Jafari and Maassoumi

report, *Bellevalia* has 19 species in Iran of which, five species belong to sect. *Patens* and six species to sect. *Conica* although one of the species of latter section is doubtful [8]. Traditionally, these sections are recognizable on the basis of the shape of raceme, pod, the color of flowers and flower buds, the direction of pedicels and the relation of the length of leaves to length of raceme [3]. Due to the high polymorphism in morphological characteristics and transitional features, this genus faces to taxonomical problems, so that, the circumscription of some species are not completely clear. Sect. *Patens* differentiate from sect. *Conica* due to have short length, leaves longer than scape, cylindrical raceme, ascending or patent pedicel, pedicel shorter than flower or sessile and circular, elliptical or ovate capsule while sect. *Conica* was recognized based on leaves shorter than scape, cilia at leaf margin, conical or oblong ovate raceme and oblong obovate capsule. On the other hand the color and shape of flower and flower buds are features to help species identification. But color of flower in dried specimens change so species identification is difficult. Moreover, anatomical characteristics sometimes is useful for identification, while, just anatomical report about *Bellevalia* is related to Kahraman *et al.*, research [10]. So, the present study was

focused on the morphological and anatomical characteristics of Iranian *Bellevalia* species from sections *Patens* and *Conica* to observe the variation in internal structure and their role for species circumscription.

MATERIALS AND METHODS

Three taxa of *Bellevalia* sect. *Patens* i.e. *B. heweri*, *B. tabriziana* and *B. decolorans* and four species from sect. *Conica* or *Bellevalia* e.g. *B. glauca*, *B. longistyla*, *B. saviczii* and *B. sarmatica* were examined. Samples of *Bellevalia* were selected from fresh and dried materials collected from their localities in Iran. Voucher specimens were deposited in IAUM herbarium. For species identification used Flora Iranica [7], Flora of Turkey,[4] Flora of URSS[2], Flora of Palaestine [6] and the species were compared with type specimens kept in B, BG, E, G, GB, K, NAP, P, S, W and WU. The studies *Bellevalia* species and their localities were presented in Table. 1.

Morphological study

The morphological characters, like the relation of leaves length to stems length, the shape of perigonium, color of flower buds and flowers, the color of anther, the direction of pedicels, form of leaves and color of lobes were assessed.

Anatomical study

For anatomical study, the mature fresh or dried scape and leaves were fixed in FAA

solution. Cross sections were made from the base of scape and middle part of leaves and stained by green methyl- carmine and safranin- fast green. Then, photographed in different magnification of light microscopy LABOMED and Dinocapture camera

model. Some anatomical characters such as the type of cells in cortex, the shape and arrangement of vascular bundles, presence of air space and the shape cells of mesophylls were assessed.

Table 1: The locality of studied *Bellevalia* species

section	species	Locality
<i>Patens</i>	<i>B. heweri</i>	Kohglouieh and Boyerahmad, 8 km south west Yasouj, 2350 m, Jafari and Dezyanian.
	<i>B. tabriziana</i>	Azarbaijan, Ahar to Tabriz, Gouijebel valley, Jafari, Dezyanian and Imani.
	<i>B. decolorans</i>	Kermanshah, Parrow mount, 1350 m, Naeimi and Mirabdali, 3098; Parrow mount, 1700-2100 m, Wendelbo and Assadi, 16724.
<i>Conica</i>	<i>B. glauca</i>	Kurdestan, Sanandaj to Marivan, Tijtj, 1680 m, Jafari, Dezyanian and Kaffash; Fars, 30 km hiraz to DashteArjan, Hosseinabad protected area, 1970 m, Jafari&Hatami, 39.
	<i>B. longistyla</i>	Azarbaijan, Uromieh to Salmas, Ghouschi pass, 1800 m, Jafari, 59; Azarbaijan, Ahar to Tabriz, Gouijebel valley, 1750 m, Jafari, and Imani, 51.
	<i>B. saviczii</i>	Fars, Sarvestan, Mianfasa protected area, 1775 m, Jafari&Hatami, 33; Khorassan, Sarakhs, Bazangan lake,;
	<i>B. sarmatica</i>	Kermanshah, Parrow mount, 1970 m, Jafari&Dezyanian.

RESULTS AND DISCUSSION

In present research, seven species from two above sections growing in Iran were identified. Their morphological features were presented in Table. 2. and Figs. 1A-G. Anatomical results of scape, revealed epidermis layer, parenchymatous and sclerenchymatous cortex, single or double

ringed vascular bundles and parenchymatous pith. Also, in leaf internal structure, the arrangement of mesophyll is isolateral. Upper, middle and lower mesophyll with different cell shapes were noticed. The detail information was presented in Table. 3.

Table 2: Morphological characters of studied species of *Bellevalia*

species	Cilia at leaf margin	Perigonium color	Perigonium shape	Lobes color	Stamen color
<i>B. heweri</i>	short	Blue, ar the base brown	Tubular	Green-brown	Violet
<i>B. tabriziana</i>	-	Light violet-blue or red	Tubular-urceolate	Green-violet with red-brown nerves	Light violet
<i>B. decolorans</i>	-	Brown in dried specimen	Tubular-campanulate	White with brown nerves	Violet
<i>B. glauca</i>	Wide and continuous base, apex obtuse and curved	Purple-green	campanulate	Purple with green nerve	violet
<i>B. longistyla</i>	Finger shape, apex obtuse and continuous base	purple	campanulate	Purple with green nerve	violet
<i>B. saviczii</i>	Triangular and oblong ovate	White, blue at the base	Tubular-campanulate	violet	violet
<i>B. sarmatica</i>	Curved, thin , long and acute	white	campanulate	Yellow-white	violet



Fig. 1

Fig. 1: The habitus of studied *Bellevallia* species. A) *B. heweri*. B) *B. tabriziana*. C) *B. decolorans*. D) *B. glauca*. E) *B. longistyla*. F) *B. saviczii*. G) *B. sarmatica*

Table 3: Scape and leaf anatomical characteristics of studied *Bellevalia* species

species	Sclerenchyma in scape cortex	v.b shape in scape	Air space in middle mesophyll	m.m/u.m+l.m	u.m and l.m cell shape
<i>B. heweri</i>	2-3-layered	Cortical v.b elliptical, inner v.b oblong diamond	no	0.3	circular
<i>B. tabriziana</i>	3-4-layered	Cortical v.b circular-ovate, inner v.b oblong ovate	+	0.66	palisadic
<i>B. decolorans</i>	-	-	no	0.3	palisadic
<i>B. glauca</i>	Wider than p.c	Cortical v.b oblong, inner v.b ovate	no	2	circular
<i>B. longistyla</i>	Without sclerenchyma	Single ring, oblong ovate	+	0.65	Elliptical-palisadic
<i>B. saviczii</i>	Without sclerenchyma	Single ring, oblong ovate	no	0.45	circular
<i>B. sarmatica</i>	-	-	no	0.66	circular

u.m: upper mesophyll. l.m: lower mesophyll v.b: vascular bundle p.c: parenchymatous cortex m.m: middle mesophyll

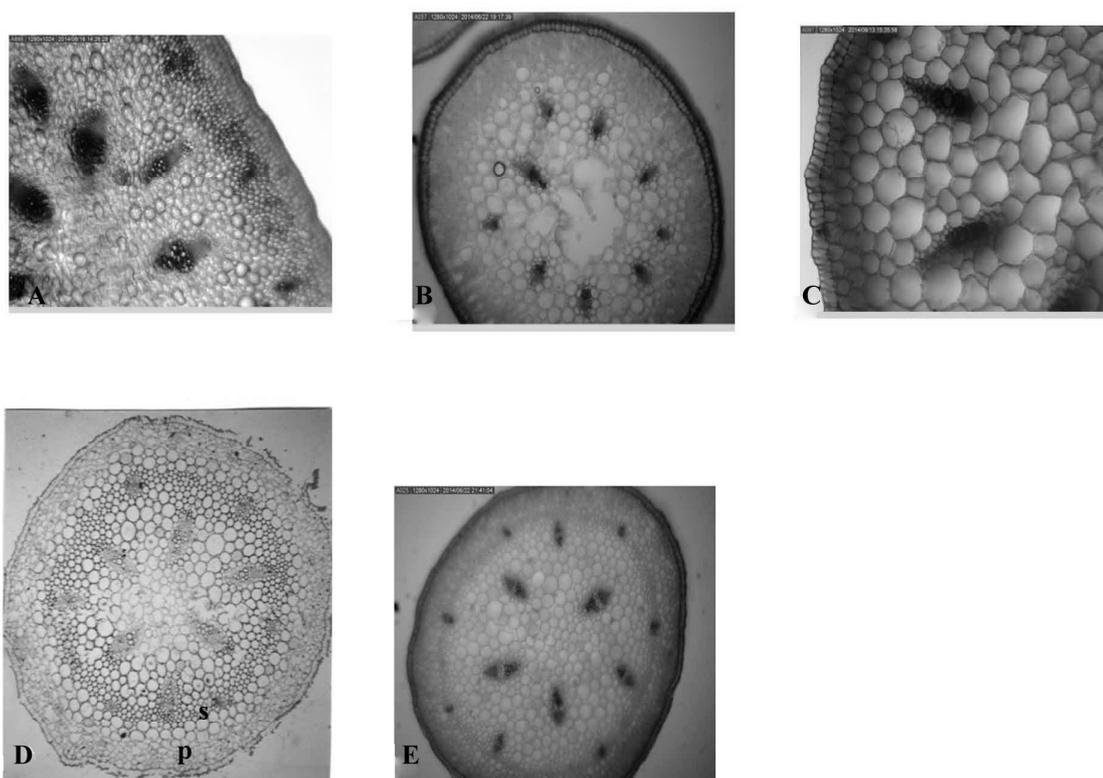


Fig. 2

Fig. 2. Cross section of stem: A) *B. glauca*. B) *B. longistyla*. C) *B. sarmatica*. D) *B. tabriziana*. E) *B. heweri*.

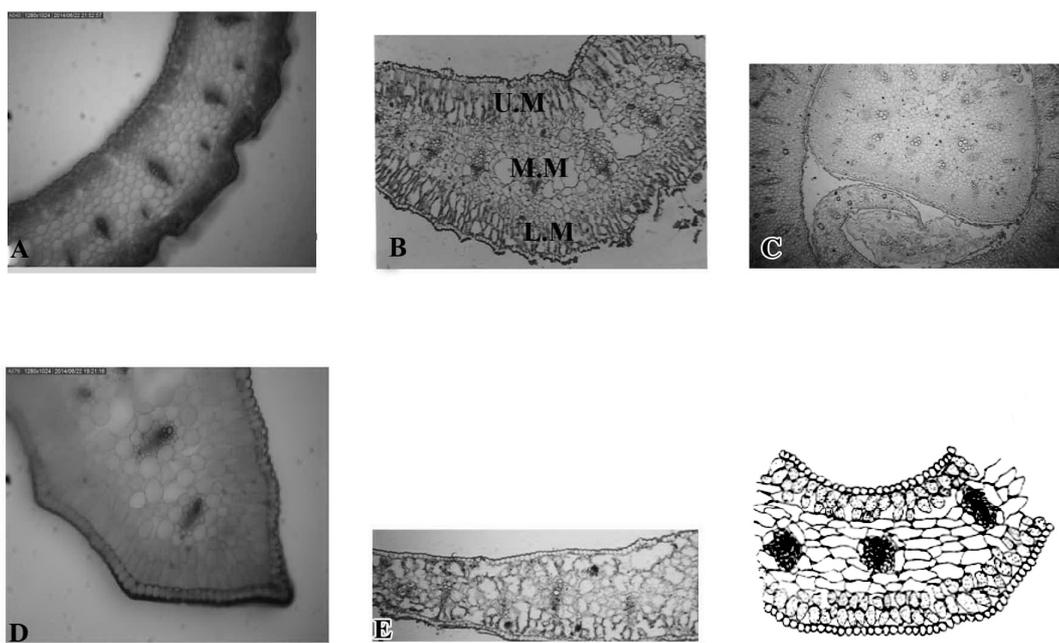


Fig. 3

Fig. 3: Cross section of leaf: A) *B. heweri*. B) *B. tabriziana*. C) *B. glauca*. D) *B. longistyla*. E) *B. saviczii*. F) *B. sarmatica*.

Studied Iranian *Bellevalia* species posed in sect. *Patens* subsect. *Chlorata* and sect. *Conica* subsect. *Orientalis* and *Occidentalis*. Morphological characteristics help to identify sections more than species because one of the important features used to identify is the shape and color of flower and flowers bud, while two above characters change in dried specimens. In the scape anatomical of some studied species, sclerenchymatous layers including double -ringed vascular bundle were noticed although in other ones single-ring vascular bundle without sclerenchymatous layer in cortex were observed. Also, in studied species, the shape of vascular bundles is variable.

Moreover, mucilage cells posed just in *B. longistyla* pith. In leaf, the arrangement of mesophyll is isolateral. Mesophyll cell shape was divided into three type i.e. circular, palisadic and elliptical-palisadic. The minimum and maximum middle mesophyll to upper and lower mesophyll ratio was observed in *B. heweri* and *B. decolorans* (0.3) and *B. glauca* (2) respectively. In previous report, Kahraman *et al.* mentioned, scattered and numerous vascular bundle surrounded by sclerenchymatic bundle in scape and 2-3-layered palisadic parenchyma and raphide crystal in *B. paradoxa* leaves too (Kahraman, *et al.*, 2010). According to morphological characteristics, section are

separated from each other but these features and internal structure characteristics are not useful for species identification.

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