



**COMPARATIVE MORPHOLOGICAL AND ANATOMICAL STUDY ON  
*BELLEVALIA LAPEYR. SECT. CONICA AND NUTANS IN IRAN***

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**ABSTRACT**

This study has examined, morphological and scape and leaf anatomical characteristics of seven *Bellevalia* species from sections *Nutans* and *Conica* growing in Iran. At first, morphological characters was assessed to identify species. Then for anatomical study, transverse sections of the mature fresh or dried scape base and leaf were prepared and stained by differential staining. Morphological results showed no significant feature to identify species. Anatomically, a few differences were noticed in vascular bundle shape and arrangement, and the type of leaf mesophyll among the species but they were not useful to recognize species circumscription.

**Keywords:** Anatomy, Asparagaceae, internal structure, Scilloideae, upper mesophyll

**INTRODUCTION**

*Bellevalia* Lapeyr is a bulbous plant 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 [2,3,4,5,6,7,8,9]. *Bellevalia* is divided into

four sections: *Nutans*, *Patens*, *Conica* and *Oxydonta*. Based on the recent report, this genus has 19 species in Iran of which, three species belong to sect. *Nutans* and five species to sect. *Conica*[8]. Traditionally, these section are recognizable basis on the shape of raceme, pod, the color of flowers

and flower buds, the nutation of pedicels and the relation of the length of leaves to length of raceme [3]. This genus faces to taxonomical problems, so that, the circumscription of some species are not completely clear due to the high polymorphism in morphological characteristics. Sect. *Nutans* differentiate from sect. *Conica* based on the shape of raceme and nutation of pedicels. So that, cylindrical raceme including nutant pedicle and conical raceme with patent pedicles were observed in sections *Nutans* and *Conica* respectively. Since just anatomical report is related to Kahraman *et al.*, research [10] and internal structure characteristics can help to better identification, the present study was focused on the morphological and anatomical characteristics of Iranian *Bellevalia* species from sections *Nutans* and *Conica* to notice the variation in internal structure and their importance for species identification.

#### MATERIALS AND METHODS

Seven taxa of *Bellevalia* from two sections i.e. *B. macrobotrys*, *B. wendelboi*, *B. fominii* from sect. *Nutans* and *B. glauca*, *B. longistyla*, *B. savizii* and *B. sarmatica* from sect. *Conica* 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 herbarium scape and leaves were selected and fixed in FAA solution. Cross sections were made from the base of scape and middle part of leaves. They were 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 evaluated.

Table 1: The locality of studied *Bellevalia* species

section	species	Locality
<i>Nutans</i>	<i>B. macrobotrys</i>	Khouzestan, Majed Soleiman to Lali, 150 m, Jafari.
	<i>B. wendelboi</i>	Kurdestan, Marivan to Tijtj, 1680 m, Maaroufi & Kargar, 990; Kermanshah, Kerend, Sharif, 29661/1.
	<i>B. fominii</i>	Azarbaijan, Ardebil, Meshkinshahr, 15 km Lahroud, Ghotoursouie, 2345 m, Jafari & Imani, 48; Azarbaijan, Ahar to Tabriz, Gouijebel valley, Jafari, Dezyanian and Imani.
<i>Conica</i>	<i>B. glauca</i>	Kurdestan, Sanandaj to Marivan, Tijtj, 1680 m, Jafari, Dezyanian and Kaffash; Fars, 30 km hiraz to Dashte Arjan, 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

Morphologically, seven species from two sections growing in Iran were identified. The morphological features of Iranian studied species were presented in Table. 2. and Figs. 1A-G.

Anatomical results of scape, revealed epidermis layer, parenchymatous and sclerenchymatous cortex, one or two rings of vascular bundles and parenchymatous pith. Also, in leaf internal structure, upper, middle and lower mesophyll with different cell shapes were noticed. The detail information was presented in Table. 3.

According to Feinbrun's belief, sections are separated based on raceme shape and nutation of pedicle. Studied Iranian *Bellevalia* species posed in sect. *Nutans* subsect. *Chlorata* and sect. *Conica* subsect. *Orientalis* and *Occidentalis* based on Feinbrun's opinion (Feinbrun, 1938). Although, another morphological characteristics are not useful to identify species circumscription based on her

opinion in present research due to overlapping some features along the species. In most of scape anatomical of studied species sclerenchymatous layer and double ring of vascular bundle were noticed even, wide sclerenchymatous layers was observed in *B. macrobotrys* and *B. glauca* while, no sclerenchymatous layers and single ring vascular bundle were noticed in *B. longistyla* and *B. saviczii*. Moreover, mucilage cells posed in *B. longistyla* pith. In leaf, mesophyll cell shape was divided into three type i.e. circular, palisadic and elliptical-palisadic. Kahraman *et al.*, reported, scattered and numerous vascular bundle surrounded by sclerencymatic 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.

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

species	Cilia at leaf margin	Perigonium color	Perigonium shape	Lobes color	Stamen color
<i>B. macrobotrys</i>	Capitule, short with continuous base	violet- green	Tubular-campanulate	Yellow-brown with green nerve	violet
<i>B. wendelboi</i>	-	Violet- blue	Oblong campanulate	Violet-brown	yellow
<i>B. fominii</i>	-	Violet- blue	Tubular-campanulate	Green at apex black	yellow
<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

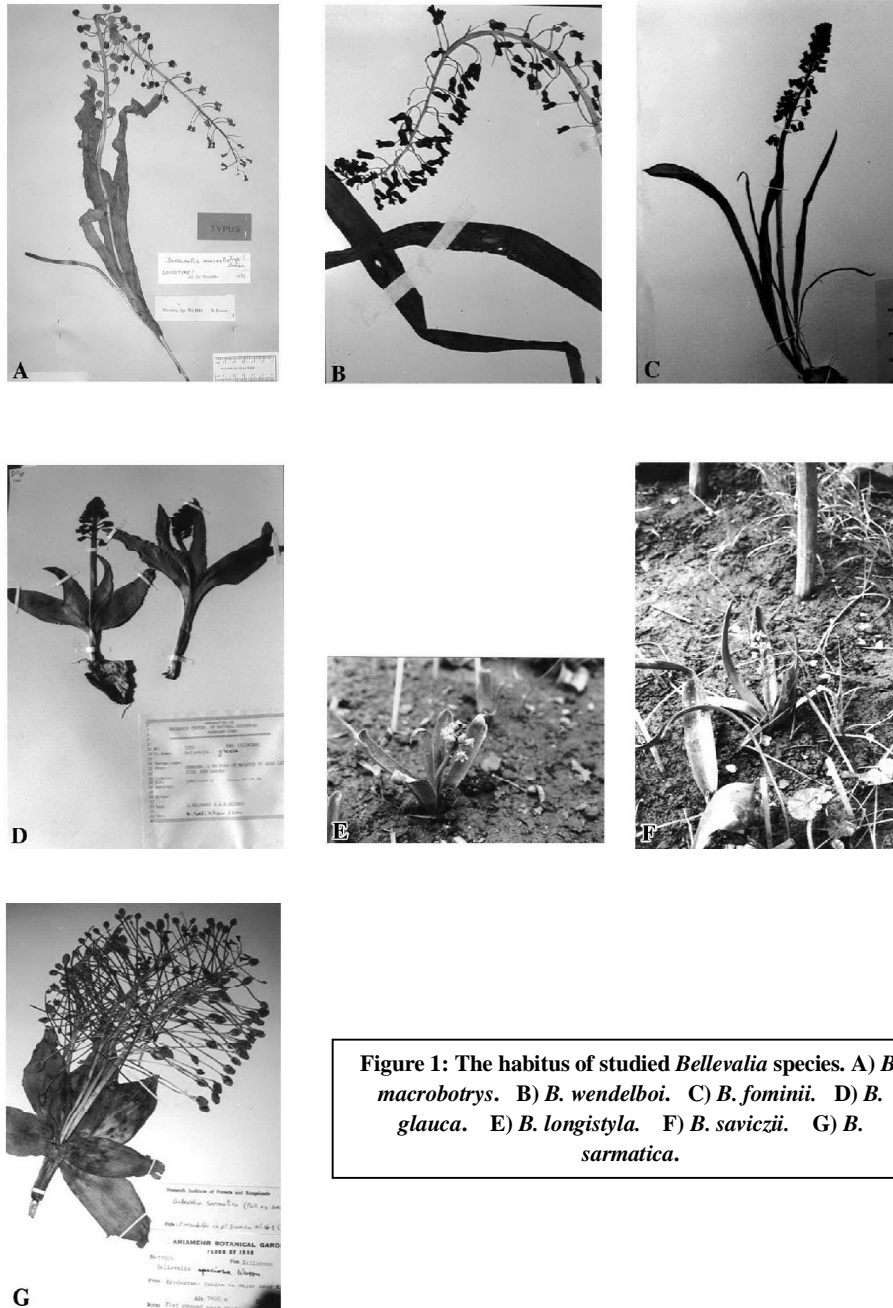
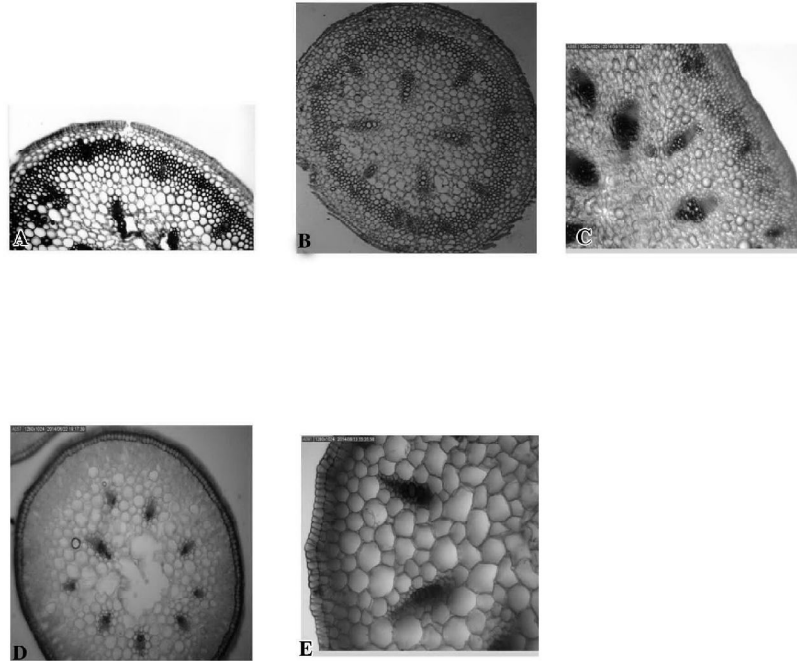


Figure 1: The habitus of studied *Bellevalia* species. A) *B. macrobotrys*. B) *B. wendelboi*. C) *B. fominii*. D) *B. glauca*. E) *B. longistyla*. F) *B. saviczii*. G) *B. sarmatica*.

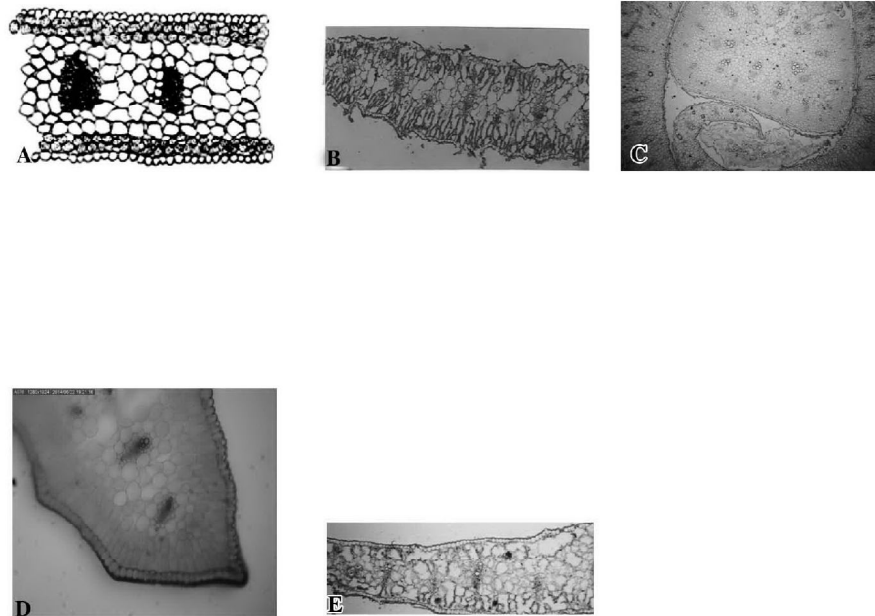
**Table 3: Scape and leaf anatomical characteristics of studied *Bellevia* species**

species	Sclerenchyma in scape cortex	v.b shape in scape	Air space in middle mesophyll	u.m and l.m cell shape
<i>B. macrobotrys</i>	4-5 layered, wider than p.c	Cortical v.b circular-ovate, inner v.b oblong ovate	no	circular
<i>B. wendelboi</i>	-	-	no	circular
<i>B. fomonii</i>	3-4 layered	Both of them oblong ovate	+	palisadic
<i>B. glauca</i>	Wider than p.c	Cortical v.b oblong, inner v.b ovate	no	circular
<i>B. longistyla</i>	Without sclerenchyma	Single ring, oblong ovate	+	Elliptical-palisadic
<i>B. saviczii</i>	Without sclerenchyma	Single ring, oblong ovate	no	circular
<i>B. sarmatica</i>	-	-	no	circular

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



**Figure 2: Cross section of stem: A) *B. macrobotrys*. B) *B. fominii*. C) *B. glauca*. D) *B. longistyla*. E) *B. saviczii*.**



**Fig. 3. Cross section of leaf: A) *B. wendelboi*. B) *B. fominii*. C) *B. glauca*. D) *B. longistyla*. E) *B. saviczii*.**

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