

COMPARATIVE STUDY OF SEVERAL MORPHOLOGICAL AND  
REPRODUCTIONAL ASPECTS FOR SOME SPECIES  
OF THE *BELLEVALIA* LAPEYROUSE, 1808 AND *ORNITHOGALUM*  
*LINNAEUS*, 1753 (ASPARAGALES, ASPARAGACEAE) IN CENTRAL  
AND NORTH OF IRAQ

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ABSTRACT

This study aims to study some morphological and reproductional characteristics in eleven species of two genera belonging to the family of Asparagaceae, which are *Bellevalia* Lapeyrouse, 1808 and *Ornithogalum* Linnaeus, 1753 and the species are: *Bellevalia chrisii* Yildirim and Sahin, 2014; *Bellevalia flexuosa* Boissier, 1854; *Bellevalia kurdistanica* Feinbrun, 1940; *Bellevalia longipes* Post, 1895; *Bellevalia macrobotrys* Boissier, 1853; *Bellevalia paradoxa* Boissier, 1882; *Bellevalia parva* Wendelbo, 1973; *Bellevalia saviczii* Woronow, 1927; *Ornithogalum brachystachys* C. Koch, 1849; *Ornithogalum neurostegium* Boissier, 1882 and *Ornithogalum pyrenaicum* Linnaeus, 1753. These species were identified and compared with each other; the results showed that there were differences between the two genera in studying the shape of bulbs, length of leaves and color of the flowers. Each of them showed an important taxonomic mark to be distinguished from the studied species. Morphological studies used with some characters of the reproductive, including the shape and color of the fruits, seeds and embryos were used to diagnoses the species. Also, the current investigation was found that the characteristics of the fruit and how it was connected to the pedicels was very important in the field of taxonomic and identification the species.

Two new record species were studied within the country, namely; *Bellevalia chrisii* and *Bellevalia flexuosa*; it should be noted here that the study of embryos is also one of the first studies conducted on these plants.

Keywords: Asparagaceae, *Bellevalia*, Morphological study, *Ornithogalum*, Seeds.

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### INTRODUCTION

Plants of the Asparagaceae family are one of the wide spread plant families, they are distributed naturally in temperate, tropical-subtropical regions, mentioned by Antoine De Jussieu as the group of hexagonal plants with colored calyx (Jussieu, 1789). They include about 114 -143 genera and 3632 species (APGIII); for a long time they were a part from Liliaceae which has 220-250 genera and 3500 species, 21 genera are included in the Iraqi Botanical Encyclopedia (Townsend and Guest, 1985). Plants of this family are distinguished by being annual herbaceous shrubs that may be in the form of trees (Peruzzi, 2016). They are characterized by parallel striped green cauline leaves alternately arranged around the pedicel which is connected to an oval bulb; the importance of this family comes from the use of their plants for food such as onions and garlic, and the use of others for ornamental purposes, such as Asparagaceae, tulips, and other species, due to their beauty and bright colors (Li, 2017).

The genus *Bellevalia* Lapeyrouse has an important variety within the family of Asparagaceae, which took a large part of the attention of researchers; the first to refer to it was the scientist Lapeyrouse (1808). It includes 50 species around the world, and 10 of them exist in Iraq according to (Hutchinson, 1959), and it is known as Al-'Ansalan or Al-Hawsalan with a bell-shaped violet flowers. As for the second genus that was studied, *Ornithogalum* Linnaeus, 1753 known as the star of Bethlehem (Purger *et al.*, 2017), it has flowers that are white and rarely yellowish, it comprises about 150 species of which 8 are present in the Iraqi flora. This genus was referred to in the study of Oran and Odah (2015) on pollen grains of several species of the genus *Ornithogalum* within the Jordanian flora. According to recent literatures, these genera belong to Asparagaceae family (Chase *et al.*, 2009). The studies done in Turkey by Firat *et al.* (2014), and Yildirim *et al.* (2014); in Iran by Jafari *et al.* (2016); and in Italy by Astuti *et al.* (2017), all classified the two genera within Asparagaceae family, while in Iraq there was only one study by Abdul-Raheem and Al-Bayat (2018) that classified *Bellevalia* and *Ornithogalum* within Liliaceae.

The research examined the morphological aspects of the reproductive and vegetative parts of both genera, as this is one of the first bases relied upon in the field of plant taxonomy because of its simplicity, ease of diagnosis in the field, low cost and the possibility of conducting it by the naked eye; it is followed by most researchers in distinguishing between plant species and genera (Al-Abide, 2019; Yildirim and Sefali, 2020), as well as, the study focused on examination the shape of fruits and seeds and the study of embryos. This study is the first at the level of the country and the Arab world and there are a few studies that deal with different aspects such as that of Abdul-Raheem and Al-Bayat (2018) which pointed out some morphological traits of both genera in Al-Uzaim region, the study of Çitak *et al.* (2015) which dealt with two species of the *Ornithogalum* within the Turkish flora, and the morphological and molecular study of the *O. brevipedicellatum* species by Aykurt *et al.* (2016). That of Pinar and Eroglu (2018) recorded the species of *B. turcicas* for the first time in Turkey, and the study of Baser *et al.* (2019) which focused on the shape of pollen grains for three species of the *Bellevalia* genus within the Turkish flora.

The aim of this study to study the morphological aspects: bulbs, leaves, scapouse, inflorescence, and reproductive characteristics such as fruits, seeds and embryos of eleven species belonging to the two genera of the Asparagaceae family.

## MATERIALS AND METHODS

### Specimens' collection

Wild specimens of the plant species under study were collected from the central and northern regions of Iraq for each of the provinces of Salah-Al-Din: Al-Sharqat, Al-Hawija, Al-Alam, Al-Abbasi, Balad and Amerli districts; Nineveh Rabi'a, Zummar and Qayyara districts; Kirkuk: Kirkuk Center, Al-Hawija and Lower Zab districts; Erbil: Koysinjq district only during 2019. Then, specimens were preserved by ethylene alcohol of 70% concentration, and stabilizing solution, F.A.A, until later used (Al-Abide, 2013 and 2016).

### Identification and morphological study

The information about specimens was recorded; and they were identified by the second author based on (Hutchinson, 1959; Cullen, 1984; Townsen and Guest, 1985; Davis *et al.*, 1988); also, the diagnosis was assured by comparing them with the specimens available at the National herbarium of Iraq. The morphological measurements of the plant species were carried out using a ruler, where the general length of plant, length of the root, length and width of the leaves and bulbs, the lengths of fruits and fruit pedicels were measured.

The fresh plant specimens were tested by a dissecting microscope with 2X and 4X powers, their dimensions were measured by the Ocular, and they were photographed by a digital camera.

## RESULTS AND DISCUSSION

Through field study, it was found that all the species were perennial of herbaceous nature for *Bellevalia* species and all were annual for *Ornithogalum* species. They also spread in several areas, including Al- Sharqat, Al-Hawija, Rabi'a, the Hamrin Mountains, Erbil, Lower Zab and Amerli. Bulbs are found usually at a depth of 20- 50 cm of soil; their blooming takes place for a period during spring in Iraq for 3-5 months.

### General appearance of the plants

The results show that all species under study appeared with fibrous roots; *O. pyrenaicum* with longest root, it was 9.5 cm; while it was shorter (1 cm) in *B. parva*, because the species of *O. pyrenaicum* was longer than *B. parava*. Through morphological examination, all of the species appeared with disc- shaped stem, and the stem width was greater in *B. macrobotrys* with 3.2 cm, and *O. neurostegium* had the least width of 0.7 cm.

Also we found the species had bulbs with different dimensions (Pl.1, 2; Tab.1), where the *B. parva*, *O. brachystachys* and *O. neurostegium* species were characterized by having elongated bulbs compared to others with oval bulbs; the *B. kurdistanica* species had the longest bulb with 6 cm length, whereas the shortest bulbs with 1.5 cm length were of *O. neurostegium*. The colors of these bulbs varied from pinkish white in *B. parva* and *B. longipes*, to brown in *B. paradoxa*, to yellowish white in the other species.

Except for *B. chrisii* and *B. flexuosa* which were collected from Erbil - Kasnazan mounts they were with acute apex, and *B. parva* with tubular leaves, as in Plate (3), the other species were similar with their striped blade. *O. neurostegium* species was distinguished by its distinctive leaves' shape, as it appeared with a curly blade, unlike the other two species, namely; *O. brachystachys* and *O. pyrenaicum* as they were distinguished by their stripped

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blades but with truncate or flat apex for *O. pyrenaicum*. The shape of the leaf's base varied between flat in the *B. saviczii*, *B. macrobotrys*, *B. kurdistanica*, *B. chrisii*, *O. brachystachys*, *O. neurostegium*, *O. pyrenaicum* species; tapered in *B. flexuosa*, *B. longipes* and *B. paradoxa* and obtuse in *B. parva*. Table (1) shows that *B. kurdistanica* had the longest leaves which reached 40 cm, while *O. neurostegium* had the shortest with 15 cm. *B. flexuosa* had the widest leaf with 4.5 cm, and the least width was of *O. pyrenaicum* with 0.9 cm. The three members of the *Ornithogalum* had smooth leaf bract which *Bellevalia* lacks, the longest was in the *O. pyrenaicum*, which was 3 cm, and the species *O. neurostegium* had the shortest bracts with a length of 1.8 cm. The widest leaf bracts were found in *O. brachystachys* with a width of 2.5 cm, and the least width was found in the *O. pyrenaicum*, and was 2cm. Both the species; *O. brachystachys* and *O. pyrenaicum*, were distinguished by acute apex of the bract, while the bract of *O. neurostegium* was pointed. The three species were similar in having a smooth margin of the bract and a round base; the elongated shape of the leaf was important in the taxonomy of the species where *B. saviczii* was characterized by long curly leaves which helped to diagnose and differentiate it from the rest of the species, especially the *B. kurdistanica* and *B. macrobotrys*, as *B. kurdistanica* leaves were longer and wider than *B. macrobotrys*, and it was found that the width of the leaf also helped distinguish *B. flexuosa* from others because it had the widest leaf.

The results of the study are similar to that of Yildirim *et al.* (2014) who studied *B. chrisii* in terms of the elongated leaf shape, and it helped distinguish it from both *B. rixii* and *B. crassa*, and the study of Yetisen and Özdemir (2015) for *O. alpigenum* striped leaf shape was identical to that of the species of *Ornithogalum*, but differed from them by not mentioning the auricles that characterized the species of this genus.

The *B. Chrisii* was characterized by an oval scapouse whereas all the species were similar in having a circular scapouse. The longest scapouse was of the *B. saviczii* species, and its average was 45cm whereas the shortest was 14.5cm of the *B. longipes*. Style of attachment of the fruit pedicels with the flower ones was different; it was found that the fruit pedicels of the species *B. chrisii* and *B. flexuosa* were perpendicular to the flower-pedicels, and the *B. parva* were having shorter fruit-pedicels 1.2cm compared to the *B. chrisii* and *B. flexuosa*, *B. kurdistanica* and *B. macrobotrys* and *B. saviczii*, and the direction of the pedicels in *B. parva* was downward and not perpendicular to the flower pedicels as it was in the other types. The two species; *B. macrobotrys* and *B. saviczii*, were similar regarding the length of the fruit pedicels and by being perpendicular to the flower pedicels and at somewhat a straight angle.

With regard to the species of the *Ornithogalum*; it was found the fruit pedicels of the *O. brachystachys* facing upward and at an acute angle with the flower pedicels, while the *O. neurostegium* had a number of fruit less than the *O. brachystachys* and *O. pyrenaicum*, and the number of fruit was more in *O. pyrenaicum* compared to *O. brachystachys* and *O. neurostegium*, and the direction of fruit pedicels was at right to acute angles.

*B. longipes* and *B. pycnanth* were distinguished by the crowded inflorescences from the rest of the species that were distinguished by their spreading inflorescences as well as the violet colour of the flowers of the *Bellevalia* species, by which it was possible to distinguish them from the species of the *Ornithogalum* which had white colour flowers that matched the

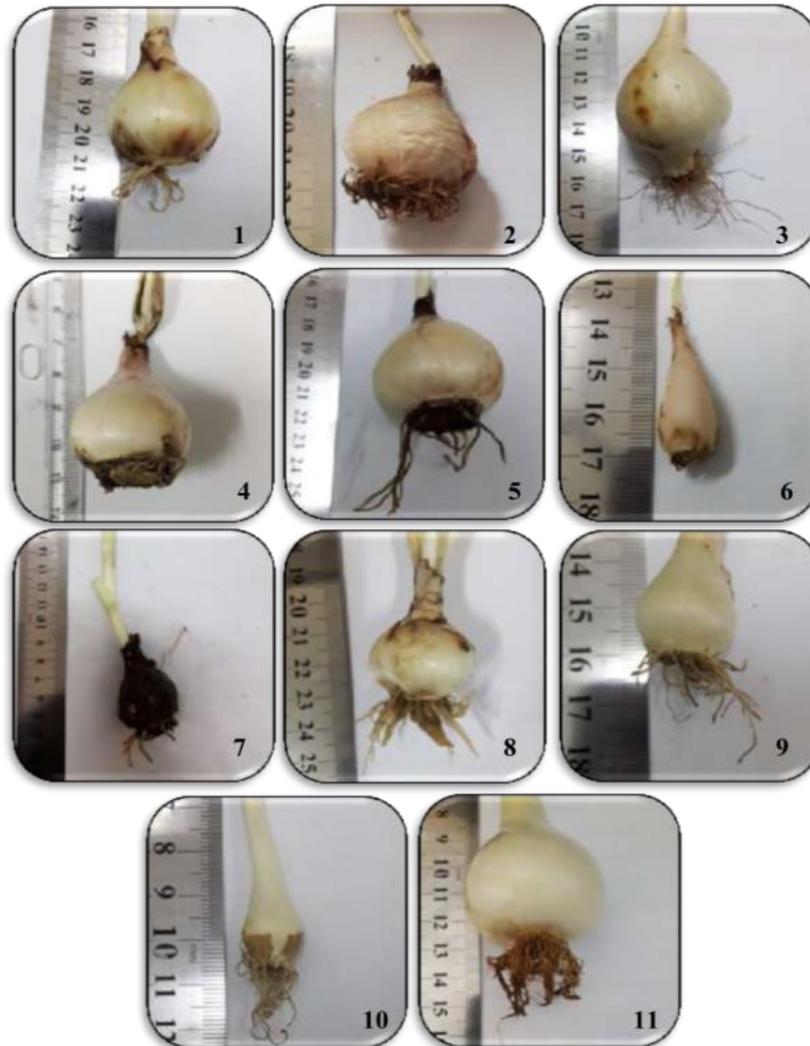
study of Aykurt *et al.* (2016), which indicated the white colour flowers with the central green midrib of the species of *Ornithogalum*, and the violate colour of the floral cover and the stamens of the *Bellevalia* species within the study of Jafari *et al.* (2016), which came in accordance with the results of the current study. The presence of bulbs and the difference in their shape between the oval and the elongated also helped to recognize them as taxonomic traits in the diagnosis of the studied species, which was similar to the study of Abdul-Raheem and Al-Bayaty (2018) that referred to these traits and for several wild species belonging to both genera.

All species were distinguished by having flowering raceme inflorescences consisting of perianth called tepals composed of 6 combined violet leaves in the species of the *Bellevalia* (Jafari *et al.*, 2016), while the three species of the *Ornithogalum* had separated white six-leaf flowers with middle green midrib in the middle of perianth leaves which are combined with the sepal leaves (Pl. 1).



**Plate (1):** Morphological characteristics of the species; (1) *Bellevalia chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

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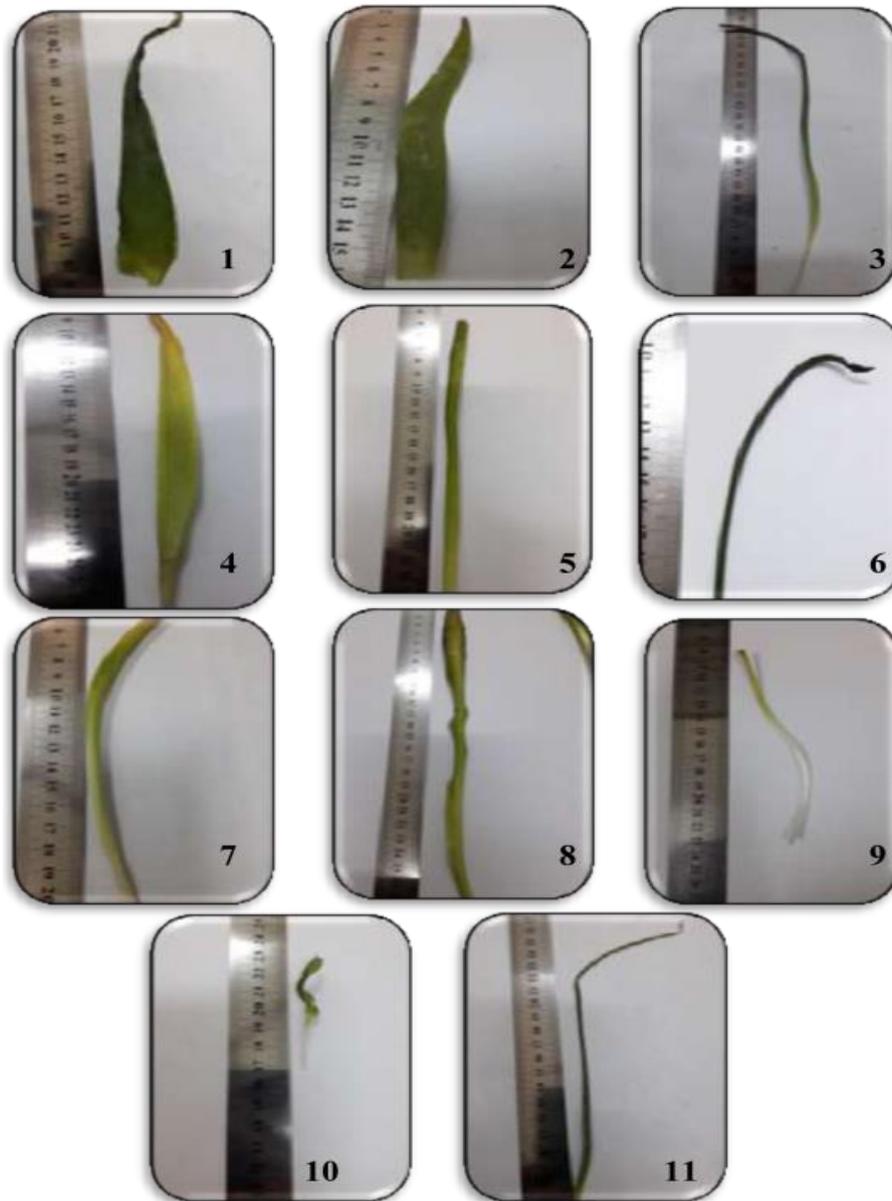
**Plate (2):** Quantitative and qualitative characteristics of bulbs the species studied; (1) *Bellevalia chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

**Table (1):** Quantitative and qualitative characteristics of the roots, aerial stems, bulbs and leaves of plant species under current study.

Species	Characteristics						
	Root length (cm)	Pedicel length (cm)	Bulb length (cm)	Leaf dimensions (cm)		Leaf apex	Leaf base
				width	length		
<i>B. chrisii</i>	(2.5) 3.6-1.9	(14.0) 19.5-11.5	(3.15) 4.5-2.5	4.0-2.4 (3.5)	22.0-17.5 (18.75)	acute	truncate
<i>B. flexuosa</i>	(1.85) 2.0-1.5	(17.0) 18.5-15.5	(2.75) 4.0-2.5	4.5-0.5 (4.2)	14.0-10.0 (12.0)	straight	obtuse
<i>B. kurdistanica</i>	(2.75) 4.5-1.0	(27.2) 35.0-20.0	(4.5) 6.0-3.0	2.0-0.6 (1.5)	40.0-30.0 (35.5)	straight	truncate
<i>B. longipes</i>	(1.06) 1.5-0.5	(12.3) 14.5-5.11	(3.35) 4.3-2.5	3.0-0.5 (1.95)	16.0-5.2 (10.5)	straight	obtuse
<i>B. macrobotrys</i>	(3.37) 4.5-1.5	(24.3) 37.0-17.5	(3.5) 5.0-2.0	1.5-0.5 (1.12)	38.0-23.0 (33.3)	straight	truncate
<i>B. parva</i>	(0.65) 1.0-0.5	(15.3) 25.0-9.5	(1.75) 3.0-0.9	1.2-0.5 (0.78)	22.5-16.0 (18.3)	acute	obtuse
<i>B. paradoxa</i>	(2.55) 3.5-1.2	(15.85) 18.5-13.0	(2.6) 3.5-1.7	1.4-0.8 (0.92)	18.0-12.0 (16.4)	straight	obtuse
<i>B. saviczii</i>	(1.75) 3.0-0.5	(42.5) 45.0-22.0	(2.3) 3.2-1.5	1.5-0.5 (0.9)	35.0-20.0 (30.3)	straight	truncate
<i>O. brachystachys</i>	(2.35) 2.5-1.2	(17.75) 20-14	(1.85) 2.4-1.0	2.0-1.5 (1.7)	18.0-7.0 (12.6)	acute	truncate
<i>O. neurostegium</i>	(0.9) 1.0-0.8	(15.37) 18.0-9.5	(1.25) 1.5-0.8	5.0-2.5 (2.8)	15.0-5.0 (8.6)	acute	truncate
<i>O. pyrenaicum</i>	(5.9) 9.5-1.5	(26.5) 34.5-21.0	(3.75) 5.0-2.5	0.9-0.2 (0.6)	26.0-15.0 (16.5)	straight	truncate

(Values between brackets represent the mean)

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**Plate (3):** Quantitative and qualitative characteristics of leaves; (1) *Bellevalia chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

**Study of fruits and seeds**

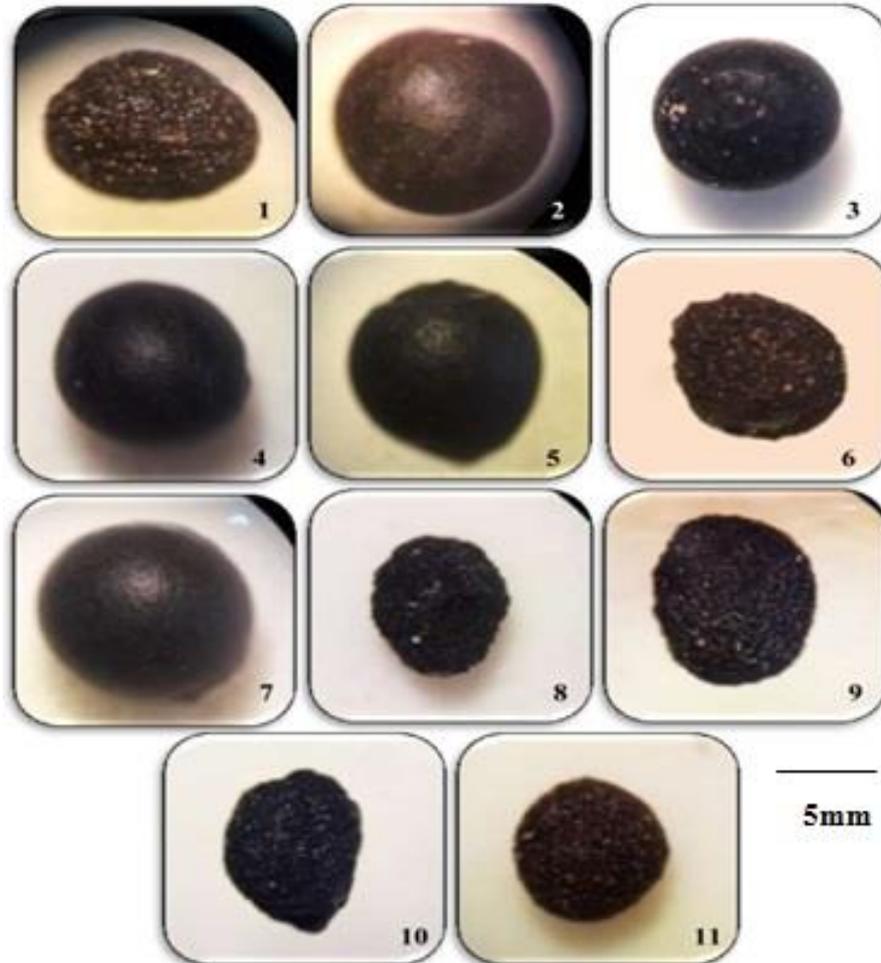
Results of the study of the *Bellevalia* and *Ornithogalum* showed the similarity of the fruit type of their species, which was a trilobite capsule of green color for *B. chrisii*, *B. flexuosa*, *B. kurdistanica*, *B. longipes*, *B. macrobotrys* and *B. parva*, to light green for *O. Brachystachys*, *O. neurostegium* and *O. Pyrenaicum* as in Plate (4). The fruits appeared in a wide and large form in *B. chrisii* and oval in *B. flexuosa*, *B. kurdistanica* and *B. macrobotrys*.



**Plate (4):** Fruit pedicels of the plant species under study; (1) *B. chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

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The fruits of the species; *O. brachystachys*, *O. neurostegium*, and *O. Pyrenaicum* were characterized by an oval- shape striped with a white line and a green line, and the presence of bracts at the point of connection of the fruit with the fruit pedicels; the length of these pedicels varied between 6.5 cm in *B. kurdistanica* which was the longest, and 1.2 cm in *B. parva* which was the shortest. The number of these pedicels was about 65 in *B. macrobotrys* and *O. pyrenaicum*, and the fruits of *B. chrisii* and *B. kurdistanica* were large lobed in the form of an equilateral triangle, with a longitudinal slit at the apex of the separation of the fruit in the *B. chrisii*; and with elongated lobes in the form of an equilateral triangle in *B. flexuosa*. The *B. longipes* and *B. paradoxa* species had prominent lobed margins, with the connection mark of the style in triangular shape for *B. longipes*, and round for *B. paradoxa*. The fruit of *B. macrobotrys* was elongated of broad apex and the mark of the style's connection was bulgy while the fruit appeared in a near- asterisk form in *B. parva* with thin lobe margins. *B. saviczii* was distinguished by a two-lobed fruit, and the fruits of the three species of the *Ornithogalum* had no sharp corners and appeared in a spherical shape with lobes divided by linear lines. The fruits varied in the number of seeds between 8 seeds in the fruit of *O. pyrenaicum*, and 3 seeds in the fruit of *B. flexuosa* and *B. longipes*. As for *B. chrisii*, *B. kurdistanica*, *B. macrobotrys*, *B. paradoxa* and *B. saviczii*; their fruits contained 6 black colored seeds, their largest were in *B. longipes* with a length of 3.75 mm and the smallest in *B. parva* with a length of 1.3 mm. The surface pattern of the seeds differed between reticular in *B. chrisii*, *B. parva*, *B. saviczii*, *O. brachystachys*, *O. neurostegium*, and *O. pyrenaicum*, and smooth surface in *B. flexuosa*, *B. kurdistanica* and *B. longipes*; and granular surface in *B. macrobotrys* and *B. paradoxa* (Pl. 5, Tab. 2), and these results are similar to the studies of Shuka (2014), Çitak *et al.* (2015) and Aykurt *et al.* (2016) regarding the capsule fruit shape and its importance in distinguishing between species; this matches what this study has concluded; *B. macrobotrys* was characterized by an elongated oval- shaped fruit with a prominent connection mark and this helped in distinguishing it from the rest of species, we also found that the difference in fruit pedicels' length was considered a taxonomic trait among species and this matches the study of Aykurt *et al.* (2016) which used the difference of fruit pedicels to distinguish between species of the *Ornithogalum* in a molecular and morphological study.



**Plate (5):** Morphological variations of seeds of plant species under study; (1) *Bellevalia chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

The variation in seeds' shapes between spherical and oval had an additional taxonomic importance that contributed to the identification of the plant species under study, as the study of Mourad *et al.* (2010) was identical to the current study in terms of the spherical seed shape of species of the *Bellevalia* and contradicted with the study of Martinez-Azorin *et al.* (2010) which explained the seed shape of the *O. brevipedicellatum* was elliptical to spherical, also the results of this study are similar to that of Çitak *et al.* (2015); it confirms the oval shape, the black color and the reticular surface of the seeds of species of the *Ornithogalum* (Tab.3).

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**Table (2):** Quantitative characteristics of the fruit and fruit pedicels for the plant species under study.

Species	Characteristics				
	Fruit dimensions			Fruit pedicels length (cm)	Number of seeds in the fruit
	Shape of fruit	Length (cm)	Width (cm)		
<i>B. chrisii</i>	capsule	1.7-0.8 (1.2)	1-0.5(0.76)	5.5-2.5 (4.37)	6-2
<i>B. flexuosa</i>	capsule	1.0 -0.6(0.72)	0.8-0.5(0.7)	5.0-3.5(4.5)	3-1
<i>B. kurdistanica</i>	capsule	1.4-0.7(1.2)	1.0-0.4(0.75)	6.5-3.0(4.5)	6-2
<i>B. longipes</i>	capsule	1.0-0.5(0.91)	0.8-0.3(0.6)	4.5-2.0(3.5)	3-1
<i>B. macrobotrys</i>	capsule	1.2-0.5(1.11)	1.2-0.5(0.95)	6.0-3.0(4.5)	6-2
<i>B. parva</i>	capsule	0.7-0.4(0.62)	0.5-0.3(0.41)	1.2-0.8(0.9)	4-2
<i>B. paradoxa</i>	capsule	0.9-0.4(0.72)	0.6-0.4(0.52)	3.5-1.5(3.25)	6-4
<i>B. saviczii</i>	capsule	1.5-1.0(1.16)	1.0-0.7(0.90)	6.0-4.0 (3.25)	6-2
<i>O. brachystachys</i>	capsule	1.0-0.7(0.85)	0.6-0.3(0.55)	4.2-1.0(2.5)	5-3
<i>O. neurostegium</i>	capsule	1.4-0.5(0.78)	0.8-0.4(0.6)	3.5-1.2(2.08)	4-1
<i>O. pyrenaicum</i>	capsule	0.9-0.5(0.81)	0.5-0.2(0.45)	6.0-3.0(4.2)	8-4

(Values between brackets represent the mean)

**Table (3):** Quantitative characteristics of the seeds and embryos of plant species under study.

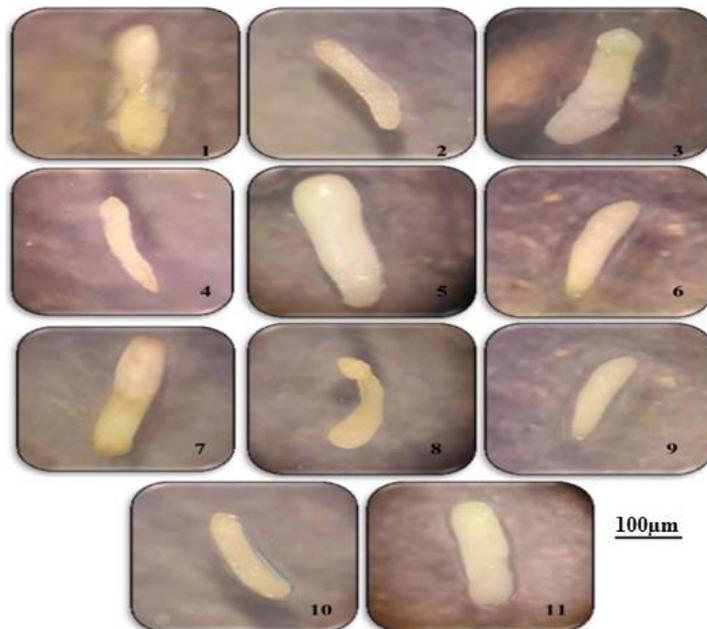
Species	Characteristics					
	Seeds (mm)			Embryo $\mu$		
	Length	Width	of length/width	Length	Width	Range of length/width
<i>B. chrisii</i>	(2.7) 3.0-2.5	(1.6) 3.0-2.0	1.5	100	15	6.6
<i>B. flexuosa</i>	(2.5) 3.0-2.0	(2.5) 3.0-2.0	1.0	80	12	6.6
<i>B. kurdistanica</i>	(2.5) 3.0-2.0	(2.5) 3.0-2.5	1.0	120	25	4.8
<i>B. longipes</i>	(2.6) 3.5-2.5	(2.6) 3.0-2.5	1.0	60	6	10.0
<i>B. macrobotry</i>	(1.14) 2.0-0.5	(1.1) 2.0-1.0	1.1	118	40	2.9
<i>B. parva</i>	(1.6) 2.0-1.0	(1.3) 1.5-0.5	1.2	72	8	9.0
<i>B. paradoxa</i>	(3.25) 3.5-3.0	(3.25) 3.5-3	1.0	100	20	5.0
<i>B. saviczii</i>	(2.75) 3.0-2.0	(1.75) 2.0-1.5	1.6	80	10	8.0
<i>O. brachystachys</i>	(2.7) 3.0-2.5	(1.7) 2.0-1.5	1.5	68	15	4.5
<i>O. neurostegium</i>	(2.4) 3.0-2.0	(1.7) 2.5-1.5	1.4	90	15	6.0
<i>O. pyrenaicum</i>	(1.7) 2.5-1.5	(0.9) 1.5-0.5	1.8	105	20	5.25

(Values between brackets represent the mean)

### Study of Embryo

Through microscopy, it was found that *B. chrisii*, *B. kurdistanica*, *B. macrobotrys*, *B. parva*, *B. paradoxa*, *O. brachystachys*, *O. neurostegium*, and *O. pyrenaicum* species had elongated embryos, whereas it was a curved- end embryo in *B. flexuosa*; *B. longipes* with a semi-curved embryo and a pointed end, and a curved embryo close to the crescent shape in the *B. aviczii* (Pl.6, Tab.3).

The results found that the embryos appeared in white colour in *B. chrisii*, *B. kurdistanica*, *B. longipes*, *B. macrobotrys*, *B. parva*, *B. paradoxa*, *B. saviczii*, *O. brachystachys*, *O. neurostegium* and *O. pyrenaicum*, and yellowish white in *B. flexuosa* and *B. saviczii*; we also noted that the *B. kurdistanica*, *B. longipes*, and *B. saviczii* species had a hat- shape structure, and the hat changed shape as it was wide and oval with a green colour in *B. kurdistanica*. In addition, *B. longipes* was distinguished by being yellow, pointed and similar to the arrowhead in *B. saviczii*. According to the Table (3), the results showed that the longest embryos were in *B. kurdistanica* reaching 120  $\mu\text{m}$  and the shortest were in *B. longipes* reaching 60  $\mu\text{m}$ . *B. macrobotrys* had the widest with 40  $\mu\text{m}$  and the least width was of *B. flexuosa* and reached 12  $\mu\text{m}$ . The embryo and its study are of great importance in separating the species, as it was noticed that there were differences in their ends and colors, which motivated their adoption as prominent characteristics to distinguish the species *B. kurdistanica*, *B. longipes* and *B. saviczii* which were distinguished from the other species by their embryo as having a hat- like structure; the elongated shape of the embryos is due to the fact that these plants are monocots, which are distinguished by elongated embryos.



**Plate (6):** Qualitative characteristics of the embryos of plant species; (1) *Bellevalia chrisii*, (2) *B. flexuosa*, (3) *B. kurdistanica*, (4) *B. longipes*, (5) *B. macrobotrys*, (6) *B. parva*, (7) *B. paradoxa*, (8) *B. saviczii*, (9) *Ornithogalum brachystachys*, (10) *O. neurostegium*, (11) *O. pyrenaicum*.

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### Description of *B. chrisii*

Bulb globose - ovoid, 2.5-4.5 cm in diameter, with a coriaceous outer tunic, brownish, and papery inner tunic, light brownish. Leaves 17.5-22 cm (18.75 cm), lanceolate - oblong, equivalent to or longer than the flowering leaf, 7-12 cm, shorter than the fruiting leaf, 1.5-2.5 cm. glaucous margins tinged purplish- brown, scape single with 11.5-19.5cm long, green-purplish green; raceme cylindrical; bracts entire, pinkish, triangular-oblong, pedicels equaling or slightly longer than flowers, horizontally ascending-erect 5.6-10.5mm. Flowers with 7.5-10 mm, tubular-campanulate; perianth violaceous, length tube 3.5-6 mm, lobes with 2-2.5 mm long, ovate- lanceolate, violaceous to whitish, distinctly shorter than tube, stamens flat, narrowly triangular, basally connate filaments attached, anther purplish, 1-1.5 mm reaching at least-middle of the lobes, capsule valve semilunar, cordate-broadly elliptic, triquetrous, 5-10cm in diameter, 8-17 cm long, thin, elliptic, retuse at apex, persistent, seed ellipsoid 2.5-3 X 2-3 mm, black.

### Description of *B. flexuosa*

Bulb globose with 4-2.5cm in diameter, with 4 or 5 lanceolate leaves, 11-14 cm (12cm) in length while width 0.5-4.5 more from any species straight or truncate apex and spire base, double scape 15.5-18.5 cm shorter than *B. chrisii* green. Raceme cylindrical; flowers 15-25 purple to white-creamy color. The fruits are capsule 0.6-1cm length and 0.5-0.8cm width elongated, with three lobes. Green Pedicels with 3.5-5 cm length shorter than *B. chrisii*. Flowering period from January to March, stamens peripetals, cylindrical filaments. Anther purplish with 3mm length; seeds were spherical 3.2-3.2 mm in diameter, black and smooth.

## CONCLUSION

Through the study, it was possible to depend on the morphological features in the taxonomy of plants, especially the shape of the elongated leaves, the presence of bulbs of different sizes, spike inflorescences crowded in some species and spread in others, the violet colour of flowers of *Bellevalia* species and the white of the *Ornithogalum* species. The shape of the fruit capsule also has a taxonomic significance that helped distinguish the species. Also the differences in seeds shapes between spherical, oval and the elongated shape of embryos are considered prominent traits of importance in the separation of species.

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مقارنة بعض الجوانب المظهرية و التكاثرية لبعض الأنواع التابعة لجنسي  
*Ornithogalum* Linnaeus, و *Bellevalia* Lapeyrouse, 1808  
1753

(Asparagales, Asparagaceae)

في وسط وشمال العراق

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الخلاصة

يهدف البحث الحالي إلى دراسة الخصائص المظهرية والتكاثرية لأحد عشر نوعاً تعود لجنسي *Bellevalia* Lapeyrouse, 1808 و *Ornithogalum* Linnaeus, 1753 عائلة Asparagales رتبة Asparagaceae؛ إذ شملت الأنواع التالية:

*B. flexuosa* ؛ *Bellevalia chrisii* Yildirim and Sahin, 2014  
*B. longipes* ؛ *B. kurdistanica* Feinbrun, 1940 ؛ Boiss, 1854  
*B. parva* ؛ *B. macrobotrys* Boissier, 1853 ؛ Post, 1895  
*B. saviczii* ؛ *B. paradoxa* Boissier, 1882 ؛ Wendelbo, 1973  
*Ornithogalum brachystachys* C. Koch, ؛ Woronow, 1927  
*O. pyrenaicum* L., و *O. neurostegium* Boissier, 1882؛ 1849  
.1753

شخصت الأنواع و قورنت مع بعضها البعض؛ إذ بينت النتائج وجود اختلافات بين افراد الجنسين في دراسة شكل البصيلات وطول الأوراق ولون الأزهار، حيث أظهرت كل منها علامة تصنيفية مهمة لتمييز الأنواع المدروسة. استخدمت الدراسات المظهرية مع بعض صفات التكاثر منها شكل ولون الثمار والبذور والأجنة لتشخيص الأنواع. كما وجدت الدراسة أن

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لخصائص الثمار وكيفية ارتباطها بالسويق اهمية كبيرة في مجال التصنيف و  
تشخيص الأنواع.

درس جديدين للفلورا العراقية، هما *B. flexuosa* و *B. chrisii*؛ وتجدر  
الإشارة هنا إلى أن دراسة الأجنة هي أيضا واحدة من أولى الدراسات التي  
أجريت على هذه النباتات.