Mesopotamia Journal of Agriculture

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STUDY OF THE ANATOMICAL CHARACTERISTICS OF FRUITS AND SEEDS OF SEVERAL SPECIES OF THE GENUS BELLEVALIA AND ORNITHOGALUM OF THE ASPARAGACEAE FAMILY SPREAD IN IRAQ

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Article information
Article history:
Received: 28/10/2021
Accepted: 24/1/2022
Available: 31/3/2022

Keywords:
Bellevalia, Ornithogalum, Anatomical study, Asparagaceae family, Fruit anatomical.

DOI:
10.33899/magrj.2022.131771.1141

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ABSTRACT

The study dealt with anatomical characters of 11 plant species Bellevalia chrisii, Bellevalia flexuosa, Bellevalia kurdistanica, Bellevalia longipes, Bellevalia macrobotrys, Bellevalia parva, Bellevalia pycnantha, Bellevalia saviczii, O. brachystachys, O. neurosteginm, O. pyrenaicum that belong two genera Bellevalia and Ornithogalum from Asparagaceae family growing in different area in Iraq. The pericarp consist from three layers, there outer exocarp, middle mesocarp and enter endocarp. The results show the number of lobes from each species and there were tailored of the most species, except the fruit of Bellevalia saviczii was bilobed while the specie O. pyrenaicum fruit was multilobed. Also the anatomical sections of fruits showed the shape of seeds which were different like elongated, ovoid, semi ovoid, spherical and semi spherical, the measurements shows the Bellevalia chrisii that had most thickness of seeds which was 170 □m, While the species Bellevalia pycnantha recorded the lowest thickness of 50 □m. and the shape of cells which all were globular, the results also cleared the vessels bands in the mesophyll of fruits.

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INTRODUCTION

The two genera, *Bellevaalia* and *Ornithogalum*, belong to the *Asparagaceae* family, and were previously considered within the *Liliaceae* family. Both genera were mentioned in the Iraqi Botanical Encyclopedia by Hutchinson (1959), Al-Rawi (1988), the taxonomy of their species changed to be placed (based on phylogenic relationships of wild plants) within the Asparagus family (APG, 2009; 2016) These species are characterized by herbaceous, seasonal nature, some are herbs and shrubs, and a few of them are in the form of trees spread in vast areas of the world (Chase *et al*., 2009). Their species have great economic importance through their medicinal and therapeutic as well as for ornamental purposes due to their bright colors; it was possible to distinguish the species of the genus *Bellevalia* with its violet flowers gathered in inflorescence spike (Jafari *et al*., 2016 and Yildirim and Sefali, 2020) from the species of the genus *Ornithogalum* which have white flowers and green mid rib with a star-flowered inflorescence (Nikolić, 2015). Their wild species are also important as they are a source of food for livestock (Christenhusz and Byng, 2016), besides, both genera have received great interest from researchers and taxonomists in genetic and molecular applications related to determining kindship relations and

finding species that are close to each other (Aykurt *et al*., 2016 and Chen *et al*., 2019). Anatomical studies play a major role in the classification of plant species and are of high value equal in importance to phenotypic traits due to their tolerance to environmental factors surrounding the plant (Karagüzel and Özkan, 2019). The study of fruits and seeds is important in terms of their content of active substances such as vitamins, proteins and antioxidants As well as the use of these parts of plants on a large scale in academic studies (Ibraheem *et al*., 2021), and genetics using several varieties and treatments in terms of the percentage of active substances (Altaweel and Yousef, 2020).

MATERIALS AND METHODES

The research of relied on fresh samples collected between February and May 2019 season from various areas of the northern and central provinces distributed among the governorates of Nineveh, Salah al-Din, Al-Ta'mim, Erbil. Species were diagnosed as mentioned in (SA'eed *et al*., 2020) and compared with available herbal samples in the National Herbarium in Abu Ghraib. Then the samples were kept in the fixative solution *Formaldehyde acetic alcohol* (F.A.A) described by Johansen (1940) followed by (AL-Abide, 2016, 2019) for later use.

F.A.A :

Distil water	35 ml
Ethyl alcohol	50 ml
Formaldehyde	10 ml (37% _ 40%)
Glacial acetic acid	5 ml

Method of work

To prepare the cross-sections of the fruits of the mentioned species, we followed the Paraffin embedding Method According to what was mentioned by (Sass, 1958 and Nasrallah, 2007), and followed by many researchers to conduct anatomical sections of different plant parts (Al-Khazraji *et al*., 1990), the samples were examined under the compound microscope type *Motic* by eyepiece and at 40X power and photographed with a camera (type *Coolpix*) installed on the microscope, and the required measurements were recorded for the fruit of each type.

RESULTS AND DISCUSSION

-The Study of Fruits

The results of the anatomical study of the fruits cross-sections showed that they are composed of lobes, including bi-lobed in type *B. saviczii*, plate (1), figure (8), and multi-lobed in type *O. pyrenaicum*, plate (1), figure (11), while the rest of the species were characterized by being tri-lobed. The results also showed that the cover of the fruit consists of three layers: the outer layer (*Exocarp*), the middle (*Mesocarp*), and the inner layer (*Endocarp*), and these species varied in the thickness of the layers that make up their fruits, as it is clear from the results of table (1) that the highest thickness of the outer layer was 15 micrometers in the species *B. macrobotrys, B. pycnanth, B. saviczii* and *B. pycnantha,* while the species *B. flexuosa* recorded the lowest thickness of 2 µm. The thickness of the *Mesocarp* layer, which was highest recorded in *O. neurostegium* species, reached 135 µm, while the species *B. chrisii* had the lowest

thickness of the same layer and reached 20 µm. The inner layer Endocarp showed that the fruit of the species *B. pycnantha* was the thickest with 20 µm. finally the species *B. chrisii* had the lowest inner layer thickness of 4 µm.

-The Study of Seeds

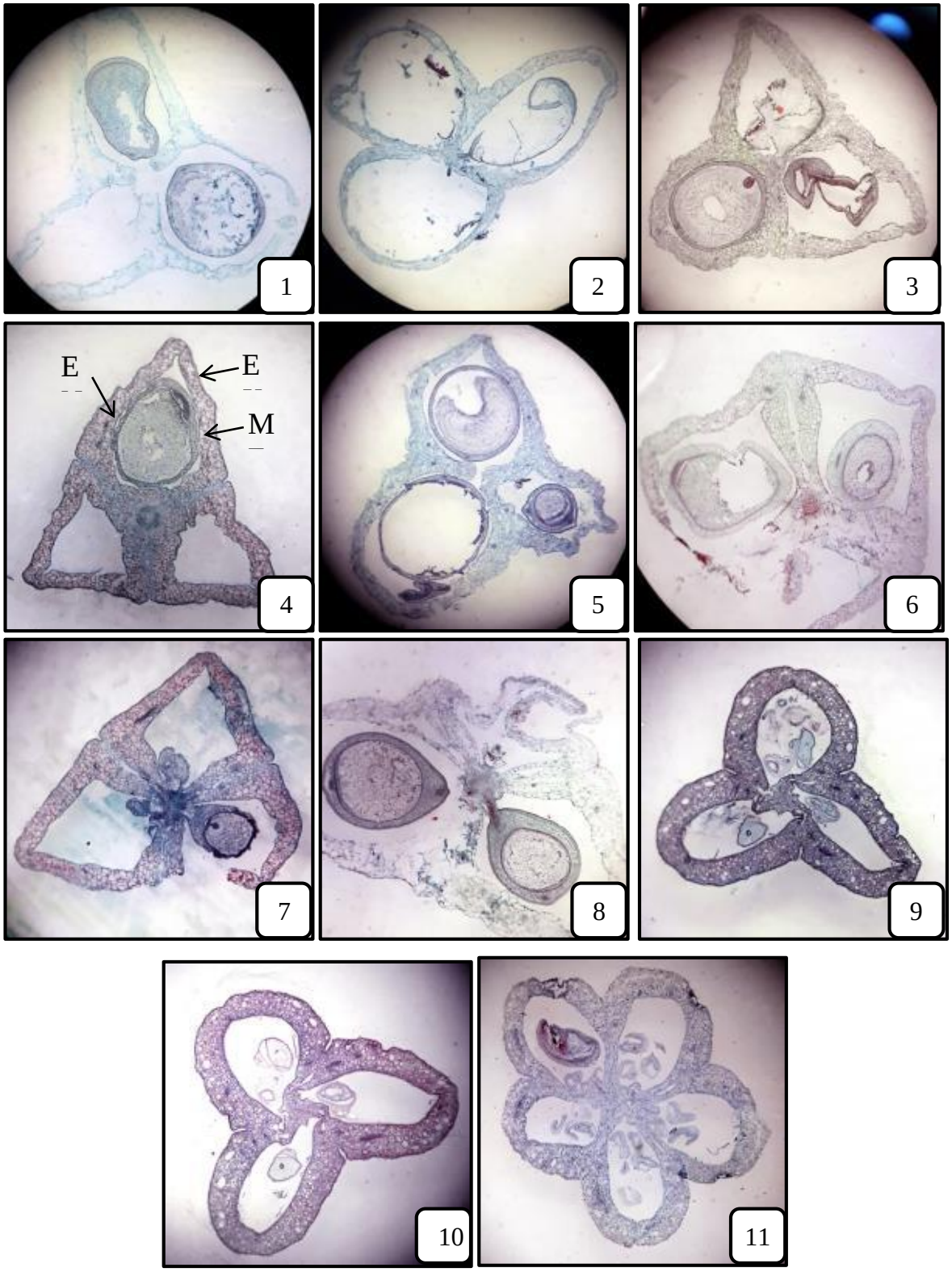
The seeds within the cross sections appeared in different shapes between elongate in *B. chrisii, O. brachystachys, O. neurostegium* and *O. pyrenaicum*, panel (2) figures (1, 9, 10, 11), and spherical in *B. kurdistanica* and *B. macrobotrys*, panel (2), figures (3 and 5). As for the seeds of the species *B. parva*, they were ovoid, figure (6), compared to species *B. flexuosa*, *B. longipes* and *B. saviczii*, images (2, 4, 8) with semi-ovoid seeds, while *B. pycnanth* was distinguished by Sub-spherical seeds, panel (2) image (7), in addition, the results of table (1) showed a variation in the thickness of the seed of each species, where the thickest seed reached 170 micrometer in the species *B.chrisii*, and the least thickness of seed was recorded for the species *B. pycnantha*, which was 50 micrometer, and we note a clear variation in the thickness of the two layers of the seeds, where the highest thickness of the outer seed layer was recorded in the two species *B. saviczii* and *O. pyrenaicum* which reached 11 micrometer, while each of the species *B. kurdistanica, B. longipes* and *B. parva*, recorded the thinnest outer seed layer which was 3 micrometer. The species *B. saviczii* recorded the highest thickness of the inner seed layer of 12 µm, and the two species *B.flexuosa* and *B.parva* shared a thickness of 2 µm for the inner seed layer. Regarding the shapes of the cells forming the fruit layers, it was noted that they are spherical cells arranged in one row, (panel 3), and this is explained by the fact that these species belong to monocotyledonous plants, while the cells located below the outer epidermal layer were characterized by being large cells (panel 3, Fig. 3, 5), in addition to the presence of vascular bundles spread within the visceral tissue (panel 3, Fig. 6). Researches did not refer to the anatomical side of the fruits and seeds of these species, they all dealt with the phenotypic aspect, which confirms that they are capsule fruits (Pinar and Eroglu, 2019), lobed (Şahin *et al*., 2016 and Corominas *et al*., 2017), and of black spherical or elliptical seeds with a smooth or reticulated surface (Çitak *et al*., 2015). so there are no studies to compare it with the results obtained, and this research is the first that is concerned with studying the anatomical characteristics such as the shape of cells and the number of layers that constitute the fruits of the mentioned species.

The period of appearance of the fruits plays an effective role in obtaining accurate anatomical results when performing the tissue sections, as these sections were conducted on the soft fruits, which confirms the importance of the times of plant germination. (Al – juboori *et al*., 2019).

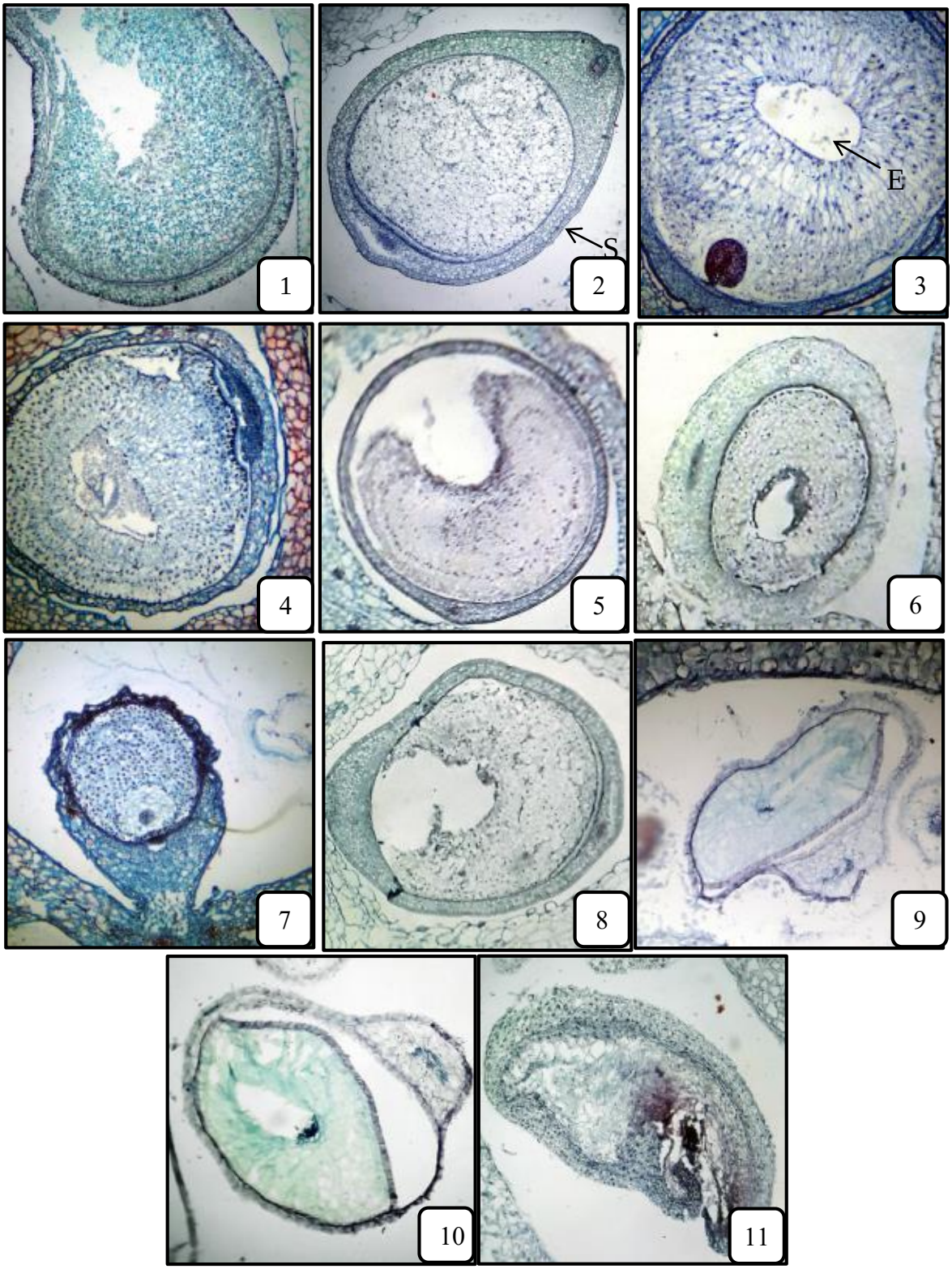
The existence of different shapes of seed sections can be considered an anatomical characteristic through which one species can be distinguished from another, and that the difference in the thickness of the layers that constitute the fruit of each species can be used to distinguish the species, and this is due to physiological

Table (1): Characteristics of the cross-sectional for fruits and seeds of plant species (μm).

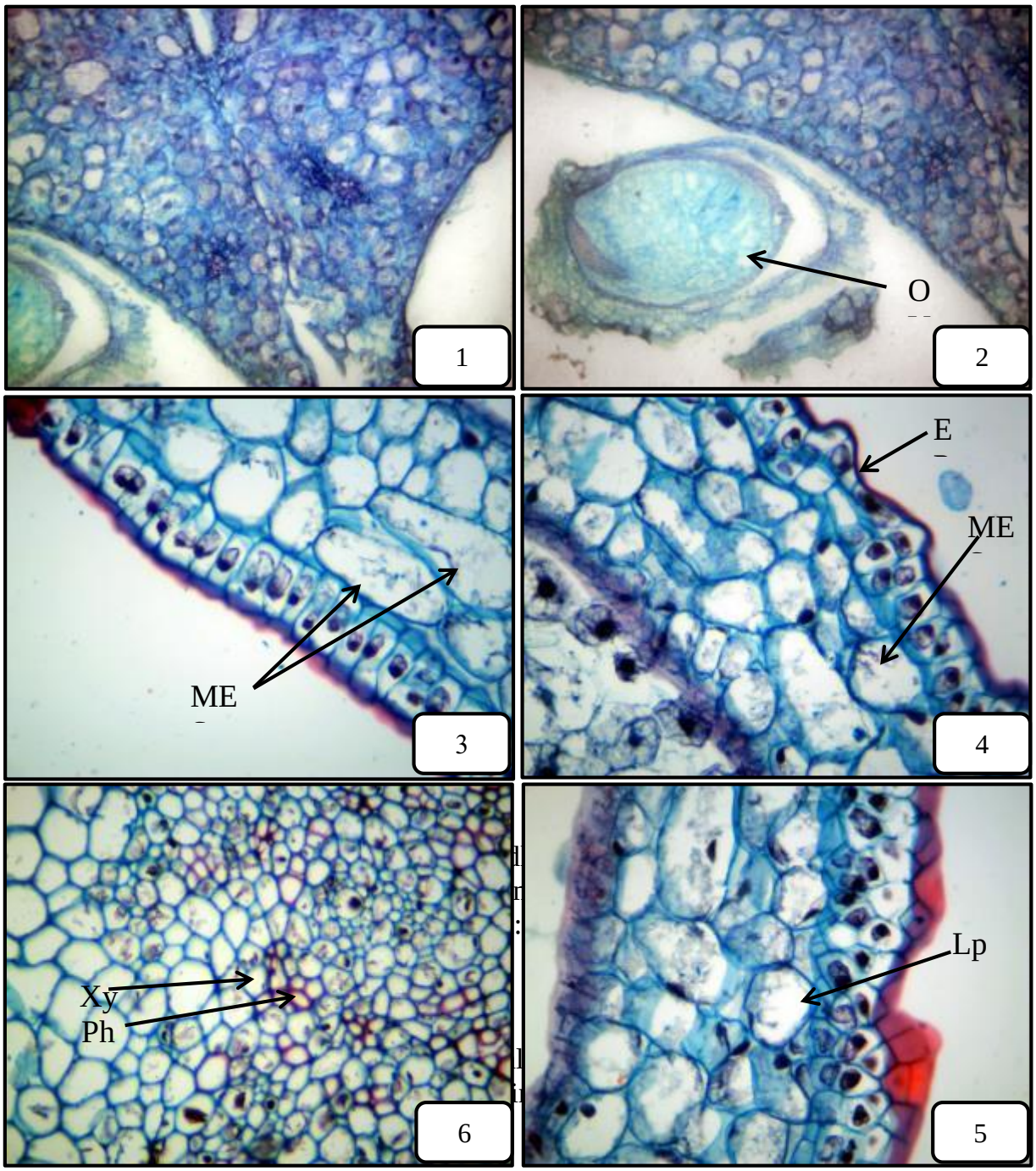
Traits/ Species	Number of Lobes for each fruit	Thickness of outer layer	Thickness of middle layer	Thickness of inner layer	Shape of the seed	Thickness of the seed	Thickness of outer layer of the seed	Thickness of Inner layer of the seed
B. chrisii	Tri-lobed	(4) 5-3	(27) 30-20	(5) 6-4	Elongated	(160)170-150	(6)8-4	(4)5-3
B. flexuosa	Tri-lobed	(3.7)5-2	(47)50-45	(7) 8-6	Semi- ovoid	(78) 80-75	(4.5)5 -4	(3)4-2
B. kurdistanica	Tri-lobed	(9)10-8	(30)35-25	(6) 7-5	Spherical	(68)70-65	(5)6-3	(6)7-5
B. longipes	Tri-lobed	(9)10-8	(75)80-70	(8.5) 9-8	Semi- ovoid	(135)140-130	(4)5-3	(4.5)5-4
B. macrobotrys	Tri-lobed	(12)15-10	(85) 90-80	(9)10-8	Spherical	(156)160-150	(6)7-5	(5)6-4
B. parva	Tri-lobed	(11)12-10	(73)80-70	(8) 9-7	ovoid	(70) 85-70	(4)5-3	(3) 4-2
B.pycnantha	Tri-lobed	(13)15-10	(65)70-60	(17) 20-15	Semi spherical	(53)55-50	(9)10-8	(7)8-6
B. saviczii	Bi- lobed	(13)15-12	(42)45-40	(8)10-5	Semi ovoid	(112)115-110	(10)11-9	(11)12-10
O. brachystachys	Tri-lobed	(10.5)12-10	(125)130-120	(7) 8-6	Elongated	(57) 60-55	(8) 9-7	(4) 5-3
O. neurostegium	Tri-lobed	(11)12-10	(130)135-125	(9) 10-8	Elongated	(95)100-90	(9)10-8	(3.5) 5-3
O. pyrenaicum	Mil-lobed	(13)15-10	(128)130-125	(16) 18-15	Elongated	(85) 90-80	(10) 11-8	(5.5) 6-5



Panel (1): Variation of fruit shapes of plant species
EN: endocarp; EX: exocarp, ME: mesocarp
1-*B. chrisii 2-B. flexuosa* 3-*B. kurdistanica* 4-*B. longipes* 5-*B. macrobotrys* 6-*B. parva* 7-*B. pycnantha* 8-*B. saviczii* 9-*O. brachystachys* 10-*O. neurostegium* 11-*O. pyrenaicum*



Panel (2): Variation in seed shapes of plant species.
S: seed, EG: Endo tegmen
1-*B. chrisii 2-B. flexuosa* 3-*B. kurdistanica* 4-*B. longipes* 5-*B. macrobotrys* 6-*B. parva* 7-*B. pycnantha* 8-*B. saviczii* 9-*O. brachystachys* 10-*O. neurostegium* 11-*O. pyrenaicum*



CONCLUSIONS

The current study demonstrated the success of the paraffin slicing method in obtaining anatomical sections of the fruits that appeared tri-lobed and differed in the species *B. savizii* which was bi- lobed and the fruit of the species *O. pyrenacium* which was multi-lobed. The pericarp appeared consisting of three layers: outer, middle and inner. We may also conclude through this research the presence of different shapes of the seeds that resulted from slicing the fruits, varying between elongated and ovoid- shaped, indicating the diversity of these species in their anatomical characteristics despite their similarity in phenotypic characteristics.

دراسة الصفات التشريحية لثمار وبذور عدة انواع من جنسي *Bellevalia* و*Ornithogalum* من العائلة الهليونية Asparagaceae المنتشرة في العرا ق

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الخلاصة

تناول هذا البحث تشريح الثمرة لـ 11 نوعاً نباتياً برياً هي *Bellevalia* ,*Bellevalia chrisii* ,*flexuosa* ,*Bellevalia macrobotrys* , *Bellevalia longipes*, *Bellevalia kurdistanica* ,*O. brachystachys* , *Bellevalia saviczii*, *Bellevalia pycnantha*,*Bellevalia parva* ,*O. neurostegium* ,*O. pyrenaicum* تابعة لجنسين هما *Bellevalia*و *Ornithogalum*من العائلة الهليونية Asparagaceae family المنتشرة في مناطق مختلفة من العراق ,حيث ظهرت بأن ثمار هذه الانواع مؤلفة من الطبقات الثلاثة الخارجية Exocarp والوسطى Mesocarp والداخلية Endocarp, وظهرت من خلال تشريح ثمار هذه الانواع عدد الفصوص المكونة لثمرة كل نوع والتي كانت ثلاثية الفصوص Trilobed في معظم الانواع باستثناء ثمرة النوع *Bellevalia saviczii* والتي ظهرت بشكل ثنائي الفص bilobed والنوع *O. pyrenaicum* بثمرة متعددة الفصوص Multilobed ,كما بينت صور المقاطع التشريحية للثمار اشكال البذور التي تنوعت بين المتطاولة والبيضوية وشبه البيضوية والدائرية وشبه الدائرية, وبينت القياسات بأن النوع *Bellevalia chrisii* امتلك اكثر البذور سمكا بلغ 170 مايكروميتر, بينما سجل النوع *Bellevalia pycnantha* اقل سمك بلغ 50 مايكروميتر فضلاً عن شكل الخلايا المكونة لطبقات الثمار والتي كانت كروية, كما دلت نتائج الدراسة التشريحية وجود الحزم الوعائية مرتبة ضمن النسيج الحشوي المكون للثمار.

الكلمات الدالة : *Bellevalia*, *Ornithogalum*, الدراسة التشريحية، عائلة الهليونية، تشريح الثمار.

REFERENCES

AL-Abide, N.M. (2016). Taxonomic morphological and anatomical study of fruits and seeds for different species of the family Brassicaceae in Iraq. *kirkuk university journal for scientific studies*, *11*(2):278-296.

Al-Abide, N.M. (2019). A morphological comparative study of some species of the Brassicaceae in the governorate of Erbil-Iraq. *Plant Archives*, *19*(2): 289-293.

Al–Juboori, A.A.H., Al-hamdani, S.Y. H. and Hamdon, M.M. (2019). Effect of sowing date on growth and yield of four radish (*Raphanus sativus* l .) varieties. *Mesopotamia Journal of Agriculture 47*(2): 96-103.

Al-Khazraji, T.O. & Aziz F.M.(1990). *Practical Plant Anatomy and Mcroscopic Preparations*. Salah al-Din University, Press of the Ministry of Higher Education and Scientific Research, Iraq., p. 220 (In Arabic).

Al-Rawi, A. (1988). "*Wild Plants of Iraq";* Ministry of Agriculture and Irrigation; p173.

Altaweel, M.S. and Yousef, Q.A. (2020). Study of gentic parameters using half diallel cross in maize (Zea mays l.). *Mesopotamia Journal of Agriculture 48*(4): 11-22.

APG, (Angiosperm Phylogeny Group). (2009). An update of the angiosperm phylogeny goup classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society*, *161*(2):105-121.

APG, I. (2016). An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG IV. *Â Botanical Journal of the Linnean SocietyÂ 181*: 1-20.

Aykurt, C., Deniz, İ.G., Sari, D., Vural, M. & Sümbül, H. (2016). Resurrection of *Ornithogalum brevipedicellatum* (Asparagaceae) with morphological and molecular data. *Acta Botanica Croatica*, *75*(1):60-66.

Chase, M.W., Reveal, J.L. & Fay, M.F. (2009). A sub familial classification for the expanded asparagalean families Amaryllidaceae, Asparagaceae and Xanthorrhoeaceae. *Botanical Journal of the Linnean Society*, *161*(2):132-136.

Chen, Q.W., Zhang, X., Gong, T., Gao, W., Yuan, S., Zhang, P.C. & Kong, J.Q. (2019). Structure and bioactivity of cholestane glycosides from the bulbs of *Ornithogalum saundersiae* Baker. *Phytochemistry*,*164*:206-214.

Christenhusz, M.J., & Byng, J.W. (2016). The number of known plants species in the world and its annual increase. *Phytotaxa*, *261*(3):201-217.

Corominas, G.M., Azorín, M.M., & Crespo, M.B. (2017). Confirmation of the presence of *Ornithogalum umbellatum* (Hyacinthaceae) in the Iberian Peninsula. In *Anales del Jardín Botánico de Madrid , 74*(1):1-6.

Hutchinson, J. (1959). Flora of Iraq. Ministry of Agriculture and Agrarian Reform, *Baghdad. 4*(8):87-113.

Ibraheem, F.R., Hamdoon, M.M. and Sultan. A.M. (2021). Response of three varieties of broad bean (Vicia faba L.) to np mineral fertilizer, *Mesopotamia Journal of Agriculture 49*(2): 19-25.

Jafari, A., Forghanifard, M.M., Farsi, M.& Behroozian, M. (2016). Comparative morphological and anatomical study on *Bellevalia* lapeyr. Sect. Conica and Nutans in Iran. *International Journal of Biology, Pharmacy and Allied Sciences*, *5*(1):206-211.

Johansen, D.A. (1940). *Plant Micro Technique*. Mc Graw-Hill book company. New York and London, p:523 .

Karagüzel, Ü.Ö., & Özkan, C. F. (2019). Soil and plant relations of some *Ornithogalum* (*Endemic/non endemic*) species. *Applied ecology and environmental research, 17*(2):3107-3121.

Nasrallah, E.K. (2007). *Taxonomic Study of Wild Species of Both Sexes Phlomis L. and Sideritis L. of The Labiatae family*, Ph.D thesis, Ibn Al-Haytham College, University of Baghdad, Iraq.

Nikolić, T. (2016). Flora croatica database. *Sveučilište u Zagrebu, Prirodoslovno-matematički fakultet, Botanički zavod, On-Line< http://hirc. botanic. hr/fcd Pristupljeno*, *5*, 698-703.

Pinar, S. M., & Eroglu, H. (2018). *Bellevalia turcica* sp. nov. (Asparagaceae): a new species from South Anatolia, Turkey. *Biologia, 74*(5):447-454.

Sa'eed, N. A., Al-Abide, N.M., & Al-Asi, A.H.A. (2020). Comparative study of several morphological and reproductional aspects for zome species of the *bellevalia lapeyrouse, 1808* and *ornithogalum linnaeus*, 1753 (*ASPARAGALES, ASPARAGACEAE*) in central and north of IRAQ. *Bulletin of the Iraq Natural History Museum, 16*(2):173-191.

Şahin, B., Aslan, S., Karabacak, O.& Martin, E. (2016). *Bellevalia vuralii B. Şahin & Aslan* (Asparagaceae): a new species from SE Turkey. *Turkish Journal of Botany*, *40*(4):394-401.

Sass, J.E. (1958). *Botanical Microtechnique.* ., (3rd ed),p:228

Yildirim, H., & Sefali, A. (2020). *Bellevalia bayburtensis* (Asparagaceae): a new species from northeastern Anatolia, Turkey. *Phytotaxa, 441*(3):285-293.