

## TAXONOMIC STUDIES ON SOME SPECIES OF APIACEAE (UMBELLIFERAE) SEED MICRO AND MACRO MORPHOLOGICAL FEATURES.

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### ABSTRACT

Morphological seed characters and seed ultrastructural variation of 10 species belong to 9 genera of the family Apiaceae (Umbelliferae) were studied. These species are; *Eryngium campestre* L., *Torilis arvensis* (Spreng)Thell., *Daucus Carota* Boiss., *Coriandrum Sativum* L., *Petroselinum crispum* (Mill.) Nym.ex. A. W. Hill., *Anethum graveolens* L., *Bupleurum semicompositum* L., *Devera tortuosa* (Desf.) DC., *Apium graveolens* L. and *Apium leptophyllum* (Pers)F. Muell ex Benth.

The objective of this investigation was to find out remarkable micro and macro-morphological seed features which could be used by further studies as taxonomic evidences reflecting the taxonomic relationship between these species.

The macro morphological characters reveal that, there are two different seed shapes, each characterized more than one species, namely; Elliptic in two species (*Devera tortuosa* and *Apium leptophyllum*) and lanceate in three species (*Torilis arvensis*, *Anethum graveolens* and *Petroselinum crispum*). In addition, there are five seed shapes, each restricted only in one species, namely; Rotund in *Coriandrum sativum*; Narrowly ovate in *Bupleurum semicompositum*; oblong in *Apium graveolens*; Narrowly oblong in *Daucus carota* and Narrowly obvate in *Eryngium campestre*.

The micro-morphological results clarify that there are three sharply distinct seed sculpture patterns; Tuberculate in *Torilis arvensis*; Reticulate in *Eryngium campestre* and *Coriandrum sativum* and Rugose in *Anethum graveolens*. While the seeds of the other six species have sculpture patterns overlapping between two shapes; Reticulate – Favularlate in *Daucus carota*; Ruminant - Pusticulate in *Apium graveolens*; Reticulate-Rugulose in *A. leptophyllum*; and Rugose-Pusticulate in *Carum petroselinum*. and Verrucate – Falsifoveate in *Bupleurum semicompositum* and Verrucate Ruminant in *Devera tortuosa*.

### INTRODUCTION

The family Apiaceae (Umbelliferae) is a large and widely distributed family among the flowering plants. Umbelliferous plants are mainly annual or perennial herbs, rarely shrubs or tree-like plants. The family could be distinguished by its inflorescence and fruit features. It comprises some 440 genera and 2540 species (Boulos, 2000) chiefly of north temperate but cosmopolitan found at high elevations in the tropics (Samuel & Arlene, 1986) and in very different habitats (Metcalf & Chalk, 1979).

Satisfactory classifications of various parts of the family do not achieve yet (Heywoods, 1993) so, any efforts could be done for gathering new information about Apiaceae plants will be appreciated. This study concentrated on the seed micro and macro morphological characters as taxonomic evidences reflecting the relationship between some species of Apiaceae.

Umbellifrous plants have many economical importance; used as food (*Daucus carota*); gum-resins; medicine products; flavoring and ornamental plants (Samuel & Arlene,1986) .

## MATERIALS AND METHODS

This investigation was performed during seasons 2006 on ten species belong to nine genera of Apiaceae (Table 1). Fresh plants and herbarium specimens of each species were used in this study. Seeds of the cultivated species.; *Coriandrum sativum*,- *Apium graveolens*, *Petreselinum crispum* and *Anethum graveolens* were obtained from Medicinal and Aromatic Plants Research Department , while *Daucus carota* seeds were obtained from Stock Research Department, Horticultural Research Institute, Agricultural Research Center, Dokki, Giza. Seeds of the other five wild species were collected during germplasm collection trips to different regions, (i.e . North Coast, Balteem and Sakha).

**Table (1): Scientific, English, Arabic names and habit of the studied species.**

Scientific name	English name	Arabic name	Habit
1- <i>Eryngium campestre</i> L.	Common eryngo, field eryngo	Shaqaqel, Shaqaqool, Foggaa	Wild
2- <i>Torilis arvensis</i> subsp <i>neglecta</i> (Spreng)Thell = <i>T. radiata</i> Moench.= <i>T. neglecta</i> Spreng.	Hedge parsley	Gazar eshshheytaan, Qameyla, Gazar frang	Wild
3-- <i>Daucus carota</i> subsp <i>sativus</i> = <i>D. gingidium</i> L.	Carrot	Gazar	Cultivated
4- <i>Coriandrum sativum</i> L.	Coriander	Kuzbarah	Cultivated & Wild
5-- <i>Apium graveolens</i> L.	Celery	Karafs, Garrabees	Cultivated
6- <i>A. leptophyllum</i> (Pers.) Fmueux Benth. = <i>Sison ammi</i> Jacl. = <i>Cnidium tenuifolium</i> Moench = <i>Pimpinella leptophyllum</i> Pers. = <i>Apium ammi</i> (Jacq) Urb. = <i>A. tenuifolium</i> (Moench) Thell.		F: Cnidion	Wild
7- <i>Petreselinum crispum</i> (Mill) A.W.Hill (= <i>Carum Petreselinum</i> L= <i>P. sativum</i> (L.) Hoffm. = <i>Apium crispum</i> Mill.)	Parsley	Maqdanés, Baqdunes	Cultivated
8- <i>Anethum graveolens</i> L.	Dill seed	Shibith, Sathab bari	Cultivated
9- <i>Bupleurum semicompositum</i> L. = <i>B.glaucu</i> Robill & Cast.	Thorow – wax	HlabHlab	Wild
10-- <i>Devera tortuosa</i> (Desf) Dc.= <i>Bubon tortuosu</i> Desf = <i>Pituranthe tortuosus</i> (Desf.) Benth.		Kerddwy , Zakook , Qeseekh , Qozzaah	Wild

These seeds were sown in the experimental field of Faculty of Agriculture, Cairo University. In addition, the herbarium specimens, represent each species, were obtained from the herbaria of the Flora and Phylo-taxonomy Researches Department (CAIM), Horticultural Research Institute, Agricultural Research Center, Giza. These specimens were matched against the text books of flora (i.e. Student Flora of Egypt, Flora of Palestina, Flora of Egypt, Flora of Syria; Palestina and Sinai and Flora of Saudi Arabia) to be sure that the nomenclature identification is correct.

Macro morphological characters of plants and seeds of each species were measured by using binocular stereo-microscope, while seed micro morphological features (shape, size and surface sculpture patterns) were examined by using Scanning Electron Microscope (SEM), where seeds were mounted with SPI supplies on copper stubs and then coated with a golden thin layer in Edwards Sputter Coater Unit, S150 B. Scanning was carried out by JEOL-JSMT 100 Model SEM at National Research Center, Giza.

## RESULTS AND DISCUSSION

This study is devoted to investigate the seed macro and micro-morphological features of 10 species belong to 9 genera of Apiaceae.

### I. Seed macro-morphological features:

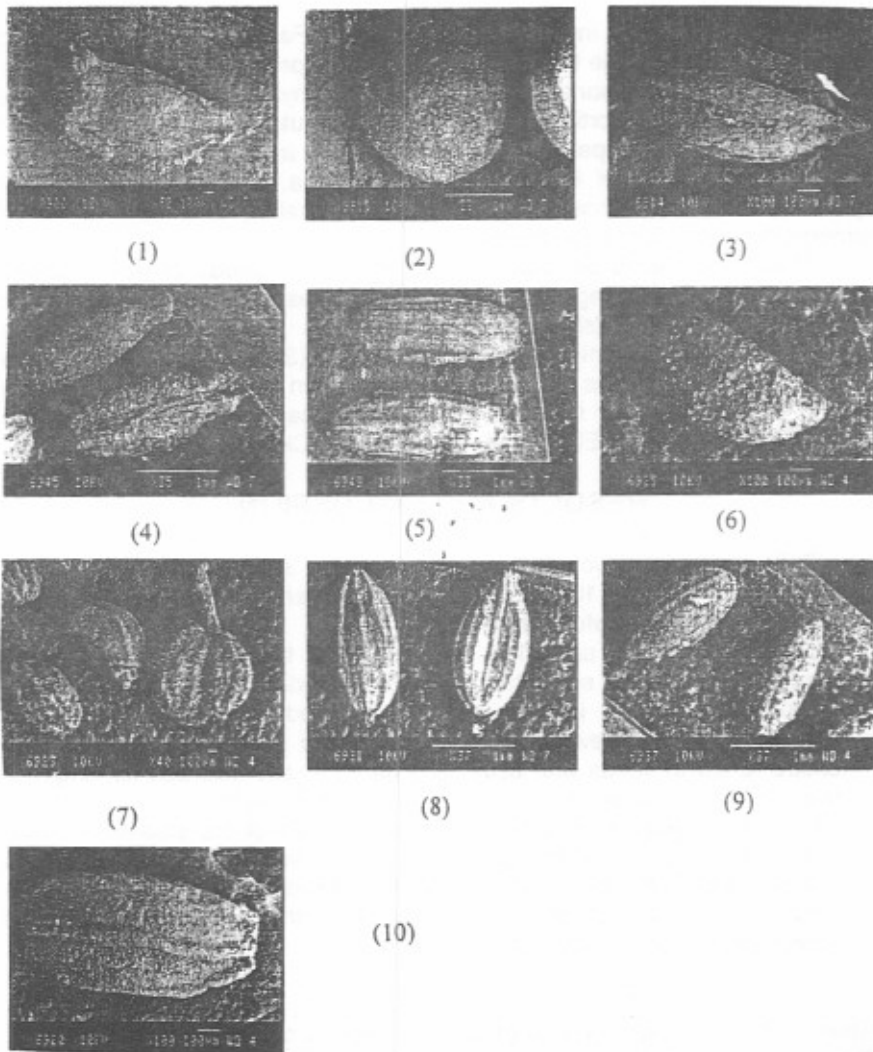
Data in Table (2) and Plate (1) show that, there are seven different shapes and three sizes of seed characterized the studied species as follows:

- Elliptic seed shape is characterized the seeds of two of the studied species, namely; *Devera tortuosa* and *Apium leptophyllum*. The elliptic shape refers to seeds with acute end and the ratio between its length to breadth is about 2:1 with sides curved equally from middle.
- Lanceolate shape seed is distinguished in three of the studied species; *Torilis arvensis*, *Anethum graveolens* and *Petroselinum crispum*, this shape refers to the ovate seeds broad at the lower end (resembling the longitudinal section of an egg), the length of this type of seed is quite double or triple of its width 3:1.

Table (2): Morphological description of the seeds of the studied species.

No.	Species	shape	Length mm	Width mm	Lxw mm <sup>2</sup>	Grade
1	<i>Eryngium campestre</i>	Narrowly obovate	3.5	1.5	5.25	L
2	<i>Torilis arvensis</i>	Lanceolate	3.7	1.3	4.81	S
3	<i>Daucus carota</i>	Narrowly oblong	5	1.5	7.5	M
4	<i>Coriandrum sativum</i>	Rotund	3.5	3	10.5	L
5	<i>Apium graveolens</i>	oblong	1.6	0.8	1.28	S
6	<i>A. leptophyllum</i>	Elliptic	1.3	0.6	0.78	S
7	<i>Petroselinum Crispum</i>	Lanceolate	3	1	3	S
8	<i>Anethum graveolens</i>	Lanceolate	4.5	1.5	6.75	M
9	<i>Bupleurum semicompositu</i>	Narrowly ovate	5	0.6	0.78	S
10	<i>Devera tortuosa</i>	Elliptic	1.5	1	1.5	S

Key: Seed      S < 5      L ≥ 10      10 > M ≥ 5



Plate(1): Seed shapes types of the studied species as shown by SEM

- (1) *Eryngium campestre* (x=50)
- (2) *Coriandrum sativum* (x=33)
- (3) *Apium leptophyllum* (x=100)
- (4) *Torilis arvensis* (x=33)
- (5) *Daucus carota* (x=33)
- (6) *Bulpeurum semivompositum* (x=100)
- (7) *Devera tortuosa* (x=40)
- (8) *Anethum graveolens* (x=37)
- (9) *Petroselinum crispum* (x=37)
- (10) *Apium graveolens* (x=100)

- Rotund (nearly rounded ) seed shape is characterized the seeds of *Coriandrum sativum*. This shape is due to the equality in dimensions between its length and width.
- Narrowly ovate seed shape is characterized the seeds of *Buplurum semicompositum*, this shape refers to the ovate seeds broad at the lower end, the length of this type of seed is quite double or triple of its width 2:1.
- Oblong seed shape is characterized the seeds of *Apium graveolens*. This shape refers to seeds with broad end and the ratio between its length to breadth is about 2:1 with sides curved equally from middle.
- Narrowly Oblong seed shape is characterized the seeds of *Daucus carota*, this shape refers to the oblong seeds broad at the two end, the length of this type of seed is quite double or triple of its width 3:1.
- Narrowly obovate seed shape is characterized the seeds of *Eryngium campestre*, this shape refers to the obovate seeds broad at the upper end, the length of this type of seed is quite double or triple of its width 2:1.

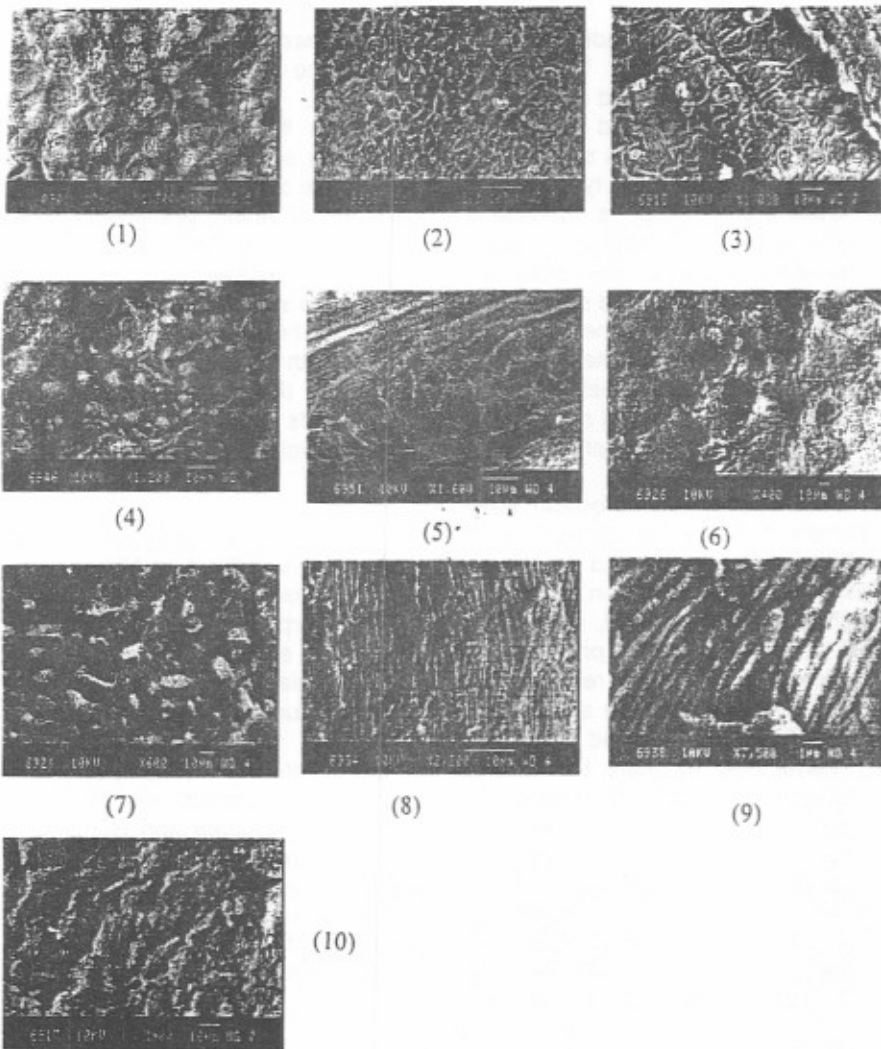
## II. Seed micro-morphological features :

To detect the minute variation of seed coat sculpture patterns which enable to distinguish between and among species, the scanning Electron Microscope (SEM) is proved to be an suitable tool for such study . Murley (1951) and modified by Stearn(1983), stated that the micro-morphological description of seed testa by using ESM provided a good taxonomic evidences to identify and differentiate species and represent the taxonomic relationship between these species. The seed surface sculpture features of the studied species were found in six patterns (Table 3 and Plate 2) as follows:-

- A. Verrucate- Ruminante to Verrucate – Falsifoveate as in the species of *Devera tortuosa* and *Buplurum semicompositum*, respectively. The first pattern means an intermediate shape between Verrucate and Ruminante. verrucate refers to the irregular projections or knobs, while Ruminante refers to penetrated by irregular channols giving an eroded appearance and running in different directions. The second pattern means an intermediate shape between Verrucate and Falsifoveate. Falsifoveate pattern refers to the pitted-shape that do not have the same depth through out, as a little depression made laterally.

**Table (3): Seed surface patterns as represented by SEM for the studied species**

No	Species	Seed Surface Patterns
1	<i>Eryngium campestre</i>	Reticulate
2	<i>Torilis arvensis</i>	Tuberculate
3	<i>Daucus carota</i>	Reticulate – Favulariate
4	<i>Coriandrum sativum</i>	Reticulate
5	<i>Apium graveolens</i>	Ruminante - Pusticulate
6	<i>A. leptophyllum</i>	Reticulate –Rugulose
7	<i>Petresetinum crispum</i>	Rugose – Pusticulate
8	<i>Anethum graveolens</i>	Rugose
9	<i>Buplurum semicompositum</i>	Verrucate – Falsifoveate
10	<i>Devera tortuosa</i>	Verrucate - Ruminante



**Plate(2):** Seed surface sculpture patterns of the species as shown by SEM

- (1) *Eryngium campestre* (x=1300)
- (2) *Coriandrum sativum* (x=200)
- (3) *Apium leptophyllum* (x=1000)
- (4) *Tarolis arvensis* (x=1200)
- (5) *Daucus carota* (x=1600)
- (6) *Bulpeurum semivompositum* (x=400)
- (7) *Devera tortuosa* (x=600)
- (8) *Anethum graveolens* (x=2200)
- (9) *pertoselinum crispum* (x=7500)
- (10) *Apium graveolens* (x=900)

- B. Rugose to Rugose–Pusticulate as in *Anethum graveolens* and *Petresetinum crispum* respectively. Rugose shape means wrinkled, the irregular elevation making up the wrinkles and running mostly in one direction. While pusticulate shape means with small broad slight elevations not so high or abundant as on a colliculate surface and not howing as abrupt elevations as a minutely tuberculate surface,
- C. Reticulate as in *Eryngium campestre* (weak Reticulate with many agglomerate bodies )and *coriandrum sativum* (irrigular Reticulate) . The pattern refers to surface with a raised network of narrow and sharply angled lines frequently presenting a geometric appearance, each area or depression out lined by the reticulum being an interspace.
- D. Reticulate - Rugulose to Reticulate –Fovularlate as found in *Apium leptophyllum* and *Daucus carota*, respectively. The first surface means an intermediate shape between reticulate and Rugulose. The second surface means an intermediate shape between reticulate and Fovularlate. Rugulose pattern refers to with very small wrinkles. Fovularlate pattern refers to with the surface finely ribbed , the ribs separated by zigzag furrows.
- E. Tuberculate is characterized the seed surfaces of *Torilis arvensis*, respectively. Tuberculate surface shape means sculpture with small smooth rounded projections or knobs.
- F. Ruminant - Pusticulate is characterized the seed surface of *Apium graveolens* The first Pattern means an intermediate shape between Ruminant – Pusticulate . This pattern refers to what already mentioned earlier

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دراسات تقسيمية على بعض أنواع الفصيلة الخيمية: الصفات المورفولوجية الكبرى والصغرى للبذرة  
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أجريت دراسة للعلاقات التصنيفية بين عشرة أنواع نباتية تنتمي للفصيلة الخيمية و كانت تمثل تسعة أجناس وهي:

*Eryngium campestre* L., *Torilis arvensis* (Spreng)Thell., *Daucus Carota* Boiss.,  
*Coriandrum Sativum* L., *Petroselinum crispum* (Mill.) A.W.Hill., *Anethum graveolens* L.,  
*Buplurum semicompositum* L., *Devera tortuosa* (Desf.) DC .,  
*Apium graveoles* L. and *Apium leptophyllum* (Pers)F. Muell ex Benth.

ويهدف هذا البحث الى تحديد العلاقات التصنيفية المتشابهة بين الأنواع (الوحدات التصنيفية) تحت الدراسة باستخدام بعض الصفات المورفولوجية و خصائص سطح البذرة للأنواع المدروسة باستخدام المجهر الإلكتروني الماسح وأوضحت نتائج الدراسة المورفولوجية الكبرى أن هناك ٧ أشكال مختلفة للبذرة يميز كل شكل مجموعة معينة من الأنواع تحت الدراسة هي:

Elliptic : ويميز نوعين هما *Devera tortuosa* , *Apium leptophyllum*  
Narrowly Obovate : ويميز النوع *Eryngium campestre*  
Lanceolate : ويميز ثلاثة أنواع هم *Torilis arvensis* , *Anethum graveolens* .,  
*Petroselinum crispum*  
Rotund : ويميز النوع *Coriandrum sativum*  
Ovate : ويميز النوع *Buplurum semicompositum*  
Oblong : ويميز النوع *Apium graveolens*  
Narrowly Oblong : ويميز النوع *Daucus carota*  
وأوضحت دراسة سطح البذرة باستخدام المجهر الإلكتروني الماسح أن بذور الأنواع تحت الدراسة تميزت بوجود ٩ أشكال مختلفة لزخرفة سطح البذرة وهذه الأشكال كما يلي:  
Tuberculate, Reticulate, Ruminant - Pusticulate , Rugose - Pusticulate,  
Verrucate -Ruminant , Reticulate - favularlate, Verrucate – Falsifoveate, Rugose,  
Reticulate –Rugulose