

Research Article

Pollen morphology of some species of family Caryophyllaceae in Iraq

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Abstract

The pollen morphology of ten species of Caryophyllaceae family including *Acanthophyllum bracteatum* Boiss., *A. caespitosum* Boiss., *A. crassifolium* Boiss., *Agrostemma gracile* Pres., *A. githago* L., *Arenaria balansae* Boiss., *Bufoia oliveriana* Ser., *Polycarpon tetraphyllum* L., *P. succulentum* (Delile) J.Gay and *Vaccaria pyramidata* Med. was studied. The pollen micromorphology of Caryophyllaceae were investigated using light microscopy. Qualitative and quantitative variables related to the type, shape, size, exine thickness and ornamentation were measured. Based on the results, two types of pollen grains tricolpate in *Polycarpon* species and polyporate in the other species were found. The pollen grains shape was suboblate in *P. tetraphyllum*, prolate spheroidal in *A. gracile* and *Bufoia oliveriana*, and oblate spheroidal in the rest species. The pores were 8-12 in *A. crassifolium*, 8-10 in *A. caespitosum* and 18-20 in *Agrostemma* sp. and 6-8 in the remaining species. The exine thickness was higher as 5µm in *A. gracile* and lower value of 1.10 µm *P. succulentum*. All species had significant variances in grain size, small grains in *Polycarpon* species and medium grains in other species.

Keywords: Caryophyllaceae, Pollen grains, *Acanthophyllum*, *Agrostemma*, *Polycarpon*.

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Introduction

Caryophyllaceae is a diverse family including 86 genera and about 2200 species. In Iraq, it is represented by 24 genera and 135 species. They are mostly found in temperate regions of the northern hemisphere and include both annual and perennial herbaceous plants, subshrubs and, more rarely, shrubs (Al-Musawi 1987; Bittrich 1993; Wu et al. 1995; Tang et al. 1996; Fior et al. 2006; APC 2009). Most of the species of this family have medicinal and ornamental properties (Arora & Panday 1996). The Caryophyllaceae family belongs to the order Caryophyllales (APG IV 2016), and is divided into three subfamilies: Paronychioideae, Alsinoideae and Silenoideae (Tutin et al. 1964; McNeill 1967; Gorshkova et al. 1970). Ke (2001) divided this

family in China into Paronychioideae, Alsinoideae, and Caryophylloideae. However, Reveal (2012) classified it into Alsinoideae, Caryophylloideae and Illecebroideae subfamilies.

Many researchers have described some of the pollen features (Erdtman et al. 1986; Nowicke 1975; Nowicke & Skvarla 1979; Skvarla & Nowicke 1976; Iwarsson 1977; Al-Eisawi 1989; Taia 1994; Parent & Richard 1993; Punt & Hoen 1995; Dang et al. 1998; Yildiz, 2001; Perveen & Qaiser 2006; Chen et al. 2009; Bozchaloyi & Keshavarz 2014). Pollen grains from various researchers have been studied in Iraq (Al-Fahad, 2005; Musa, 2006; AL-Mowla, 2011; Al-Taie, 2014; Altaie & Almosawi, 2018). Pollen morphology of 12 species of three genera of the tribe Alsineae and two species of *Spergularia* in China

studied by Dang & Jiang (1995, 1996), and their pollen grains were discovered to be spherical, with a pantoporate and tricolpate aperture with granulate surface ornamentation. A total of 74 species of 23 genera of Caryophyllaceae in Turkey divided the pollen surface ornamentation into spinulose-punctate and scabrate-punctate types (Perveen & Qaiser 2006). Doğan & Ömer (2018) studied the pollen of 11 taxa of *Arenaria* and found that their pollen grains are pantoporate apertures and microechinate-perforate surface ornamentation. Pollen from 18 species in seven genera of the Alsinoideae subfamily was studied in Pakistan by Ullah et al. (2019), and discovered subspheroidal or prolate pollen grains with echini on the surface; surface ornamentation is microechinate-punctate or microechinate-perforate. Cui et al. (2020) studied pollen morphology of tribes Alsineae and Sperguleae (Caryophyllaceae) and its systematic importance. This work aims to investigate palynological of 10 species belonging to six genera of Caryophyllaceae in Iraq and evaluate their taxonomical application.

Materials and Methods

Pollen grains of ten Caryophyllaceae taxa were collected from herbarium specimens at Iraq's National Herbarium in Baghdad, Abo-Ghraib (BAG) (Table 1). The pollen grains were prepared to examine under Light Microscope (LM), following the acetolysis method of Erdtman (1952). The pollen grains were fixed in the glycerin-jelly mixture, and their general exomorphological features were examined using Olympus microscope model SMZ 600, equipped with Dc-2 image analysis software. Each specimen's measurements were based on 10-20 readings. The pollen grain size was calculated based on Demendia (1939) and Erdtman (1971). The pollen grain was divided into small size pollen grains between 10-25µm and medium-size between 25-50µm and large pollen grains 50-100µm. The pollen diameter, polar axis (P) and equatorial diameter (E), aperture size, pore and colpate diameter, number of pores and colpate, and exine thickness were measured (Table 2)

(Erdtman 1952).

Results and Discussion

Quantitative and qualitative characters of all examined samples are shown in Table 2 and Figure 1.

Pollen shape: The shape of pollen grains is different significantly between species. The results showed that pollen grains shape was oblate-spheroidal in *Acanthophyllum bracteatum*, *A. caespitosum*, *A. crassifolium*, *Agrostemma githago*, *Polycarpon succulentum* and *vaccaria oyramidata*, prolate-spheroidal in *Agrostemma gracile*, *Arenaria balansae* and *Bufonia oliveriana*, suboblate in *P. tetraphyllum* (Table 2; Figs. 1, 2). This result agrees with findings of Erdtman (1971).

Pollen Size: The results showed that pollen grains are small in *Polycarpon* species and medium in others. The highest polar axis range was 49.55µm in *A. gracile* and the lowest range was 17.11µm in *P. tetraphyllum*. While the highest equatorial axis range was 48.33µm in *A. gracile*, and the lowest range was 18.25µm in *P. succulentum* (Table 2).

Pollen grain types: Two types of pollen grains were found in our work; *Polycarpon* species had tricolpate, while the others had polyporate (Table 2; Fig. 2). These results agree with some previous findings (Erdtman 1971; Al-Elsawi 1989; Taia 1994; Perveen & Qaiser 2006; Altaie 2014; Altaie & Al Mosawi 2018). Tricolpate pollen grains found in *P. tetraphyllum* and *P. succulentum*. The maximum length for colp was 12.40µm in *P. tetraphyllum* and the minimum length was 11.12µm in *P. succulentum*. While the maximum width for colp was 4.33µm in *P. tetraphyllum*, and the minimum width 4.22µm in *P. succulentum*.

The pollen grains shape was suboblate in *P. tetraphyllum*, prolate spheroidal in *A. gracile* and *Bufonia oliveriana*, and oblate spheroidal in the rest species. The lowest number of pores was 6-8, while the highest number was 18-20 (Fig. 2, Tables 1, 2), supporting to distinguish species using this character. The maximum diameter for pore was 6.05µm in

Table 1. The Caryophyllaceae taxon specimens used in the study.

N.	Taxon	Localities
1	Boiss. <i>Acanthophyllum bracteatum</i>	260 km NW. OF Ramadi alt:500 m,7/6/1957, No.20959
2	<i>Acanthophyllum caespitosum</i> Boiss.	Biyara , Jabel Avroman alt:950m 6/6/1948 , No.11742
3	<i>Acanthophyllum crassifolium</i> Boiss.	Haji Omran , alt:1700m , 21/6/1047 ,No.9155
4	<i>Agrostemma gracile</i> Pres.	Magor range Haji Omran , alt:2200m , 25/8/1957, No.24313
5	<i>Agrostemma githago</i> L.	Tawela , alt:1350m , 8/6/1957 ,No.22324
6	<i>Arenaria balansae</i> Boiss.	Erbil law, arlgirdbagh, alt:2500-3200m, 5/8/1947 ,No.9602
7	<i>Bufonia oliveriana</i> Ser.	Penjwin 21/6/1957, No.22531
8	<i>Polycarpon tetraphyllum</i> L.	17 km E. of Haklaniya alt:150m, 17/5/1980, No.52345
9	<i>Polycarpon succulentum</i> (Delile) J. Gay	Fabba, alt:200m, 21/4/1955. No.14971
10	<i>Vaccaria pyramidata</i> Med.	Near Bald , 2/5/1965 ,No.33710

**Fig.1.** LM photos of pollen grains of Species: 1-2: *Acanthophyllum bracteatum*; 3-4: *A.caespitosum*; 5-6: *A.crassifolium*; 7-8: *Agrostemma gracile*; 9-10: *A. githago* 11-12: *Arenaria balansae* (Scales =10µm).

A. gracile and the minimum length was 3.83µm in *A. githago*. While the maximum width for pore was 6.10µm in *A. gracile*, and the minimum width was 4.00µm in *A. bracteatum*. The distance between the pore was the highest in *V. pyramidata* as 11.16µm and the lowest as 4.23µm in *A. githago*. These results agree with the findings of Shamsabad et al. (2013), Bulbul & Varli (2016), and Aldobaissi (2017).

Wall thickness: Two layers were distinguished using a light microscope, the external exine, sexine and nexin. The results showed that exine is thicker than entine, as reported by Altaie (2014) and Altaie & Al

Mosawi (2018). In the Caryophyllaceae family in Iraq, they recorded that the thickness of the exine is more than entine. The maximum thickness in exile was found in *A. githago* as 5.00µm, and the minimum in *P. succulentum* as 1.10µm. While *A. bracteatum* had a maximum average thickness of 1.04µm and *A. caespitosum* a minimum average of 0.80µm for entine (Table 2; Figs. 1, 2).

Ornamentation: Ornamentation of the pollen grains are good characters to separate species. The species contains three types of ornamentation. Microechinate-punctate recognized in all species and

Table 2. General pollen characters of some genus Caryophyllaceae family in Iraq (μm).

Taxon	Polar axis	Equatorial axis	P/E X 100	Size of pollen	Pollen shape	Pore or colpate diameter		Exine thickness	Intine thickness	Pores or colpate distance	Number of pores or colpate
						Length	Width				
<i>A. bracteatum</i>	(26-32) 28.66*	(28-33) 30.00	95	Medium	Oblate spheroidal	(4.5-5) 4.70	(4-4.5) 4.00	(2.1-3) 2.50	(1-1.1) 1.04	(8.5-9.5) 9.00	(6-8)
<i>A. caespitosum</i>	(33.5-34) 33.70	(35.5-36) 35.80	94	Medium	Oblate spheroidal	(5-6.5) 5.66	(5-6) 5.50	(1-1.5) 1.33	(0.7-0.9) 0.80	(8.5-10) 9.16	(8-10)
<i>A. crassifolium</i>	(25-26) 25.11	(25-27) 26.25	95	Medium	Oblate spheroidal	(4-4.5) 4.41	(4-4.5) 4.20	(3.5-4.8) 4.10	(0.8-1) 0.90	(7-7.5) 7.16	(8-12)
<i>A. gracile</i>	(48-50) 49.55	(47-50) 48.33	102	Medium	Prolate spheroidal	(5-7) 6.05	(5-7) 6.10	(5-5.1) 5.00	(1-1.1) 1.00	(7-7.5) 7.45	(18-20)
<i>A. githago</i>	(28-33) 31.00	(32-33) 32.25	96	Medium	Oblate spheroidal	(3.5-4) 3.83	(3.5-4.5) 4.00	(2.5-3.5) 3.22	(1-1.1) 1.0	(4-4.5) 4.23	(18-20)
<i>A. balansae</i>	(30-34) 32.75	(31-33) 32.15	101	Medium	Prolate spheroidal	(4.5-5.1) 4.90	(4-5) 4.50	(2.5-3) 2.71	(0.9-1.1) 1.00	(9.5-10) 9.72	(6-8)
<i>B. oliveriana</i>	(29-29.75) 29.00	(27-28) 27.75	104	Medium	Prolate spheroidal	(4-5) 4.50	(4.5-5) 4.88	(1.2-1.5) 1.30	(0.8-0.9) 0.85	(8.5-9) 8.75	(6-8)
<i>P. tetraphyllum</i>	(17.5-18) 17.11	(19-19.75) 19.50	87	Small	Suboblate	(12-12.5) 12.40	(4-4.5) 4.33	(1.1-1.2) 1.16	(0.75-0.9) 0.81	(10.5-12) 11.51	Tricolpate
<i>P. succulentum</i>	(14-19) 17.50	(15-20) 18.25	95	Small	Oblate spheroidal	(10-12) 11.12	(3.5-5) 4.22	(1.1-1.2) 1.10	(0.7-0.8) 0.75	(12.5-13.5) 13.00	Tricolpate
<i>V. pyramidata</i>	(35-37) 36.15	(36-38) 37.00	97	Medium	Oblate spheroidal	(5.5-6) 5.70	(5-5.5) 5.33	(1.9-2) 1.95	(0.8-0.9) 0.84	(10-12.5) 11.16	(6-8)

*The values between arches represent the mean and the values out the arches represent the minimum and maximum values.

Microechinate-perforate recognized in *A. gracile* only. Our results agreed with the results of Shamsabad et al. (2013), Bulbul & Varli (2016) and Aldobaissi (2017).

1-Pollen grains tricolpate in type.....1
 1-Pollen grains polyporate in type2
 2-Pollen grains oblate spheroidal in shape.....
*Polycarpon succulentum*
 2-Pollen grains suboblate in shape.....
*Polycarpon tetraphyllum*
 3-Pollen grains with microechinate perforate.....
*Agrostemma gracile*
 3-Pollen grains with microechinate punctate.....4
 4-Pollen grains with prolate spheroidal5
 4-Pollen grains with oblate spheroidal.....6

1-Polar and equatorial axis more than 30 μm
*Arenaria balansae*
 5-Polar and equatorial axis less than 30 μm
*Bufonia oliveriana*
 2-Numbers of pores in pollen grains more than
 15.....*Agrostemma githago*
 6-Numbers of pores in pollen grains less than 15.....
7
 7 – Exine thickness less than 2.....8
 3-Exine thickness more than 2.....9
 4-The ratio of P/E less 95.....*A. caespitosum*
 8-The ratio of P/E more than 95.....
*Vaccaria pyramidata*
 5-Exine thickness less than 2.....
*Acanthophyllum bracteatum*



Fig.2. LM photos of pollen grains of species: 1-2: *Bufonia oliveriana*; 3-4: *Polycarpon tetraphyllum*; 5-6: *P. succulentum*; 7-8: *vaccaria pyramidata* (Scales =10µm).

9-Exine thickness more than 2.....*A. crassifolium*

Conclusion

The pollens of the Caryophyllaceae species showed variation in size, type, and ornamentation. Based on features of surface apertures, *Polycarpon* sp. was separated from other species by having tricolpate pollen of small size. The exine surface appeared microechinate, having the sculptured element of spinules and puncta or perforate. As well as the shape of pollen grains differed significantly between oblate-spheroidal, suboblate.

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