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Morphological remarks on four species of the genus *Polygonum* L. from Istanbul (Turkey)

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Abstract

The genus *Polygonum* (Polygonaceae) contains almost 300 species in the world. It consists of 41 species as seven sections in Turkey. A number of *Polygonum* species are used as food and for traditional folk medicines**.** It is one of the difficult genera for taxonomical identification. In this study, morphological characteristics were examined on four species of the genus *Polygonum* from Istanbul (Turkey) and were presented with photographs of their leaves, ocreae, flowers, and seeds; *P. aviculare, P. patulum subsp. pulchellum, P. lapathifolium, and P. istanbulicum* (endemic). Also, collected specimens were compared with ISTE (The Herbarium of the Faculty of Pharmacy, Istanbul University) specimens.

Keywords: *Polygonum*, endemic, morphology, Istanbul, Turkey.
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İstanbul'dan (Türkiye) toplanan dört *Polygonum* L. türüne morfolojik katkılar

Özet

Polygonum cinsi dünya üzerinde yaklaşık 300 kadar tür içermektedir. Türkiye'de 7 seksiyon halinde 41 türle temsil edilmektedir. Çok sayıdaki *Polygonum* türünün geleneksel tıpta ve gıda olarak kullanımı mevcuttur. Taksonomik açıdan tanımlanması zor olan cinslerden biridir. Bu çalışmada İstanbul'dan toplanan dört türün morfolojik özellikleri incelenmiştir ve yaprak, okrea, çiçekleri ve tohumlara ait fotoğraflar sunulmuştur. Bu türler şunlardır; *P. aviculare, P. patulum* subsp. *pulchellum, P. lapathifolium,* and *P. istanbulicum* (endemik).Ayrıca toplanan örnekler ISTE (İstanbul Üniversitesi, Eczacılık Fakültesi Herbaryumu)'deki örneklerle karşılaştırılmıştır.

Anahtar kelimeler: *Polygonum*, endemik, morfoloji, İstanbul, Türkiye.

Introduction

The genus *Polygonum* is a member of Polygonaceae family that contains, ca. 300 species and distributed worldwide in temperate climates (The Plant List 2016). A number of *Polygonum* species are used as food (Koçyiğit and Özhatay 2009; Özüdoğru et al. 2011) and for traditional folk medicinessuch as cardiovascularprotection (Howesand Perry 2011), antiinflammation (Fabricant and Farnsworth 2001), neuroprotection (Firenzuoli and Gori 2007) and mitigation of biochemical processes involved in age-related neurodegenerative disorders such as Alzheimer's (Ma et al. 2005) and Parkinson's disease (Halliwell and Gutteridge 1990). Chemical constituents recognized in the *Polygonum* species are flavonoids, triterpenoids, anthraquinones (Chakraborty and Duary 2014), coumarins (Savithramma et al. 2014), phenylpropanoids (Gürdal and Kültür 2013; Tuttolomondo et al. 2014), lignans (Hsu et al. 2007), sesquiterpenoids (Yıldırım et al. 2003; Intisar et al. 2013), stilbenoids (Lee et al. 2014), and tannins (Halliwell and Gutteridge 1990). Amongst them, flavonoids are the most common components found in the genus *Polygonum* and have previously been used as chemotaxonomic markers of the genus, also playing an important role in the systematics of the family Polygonaceae (Alam et al. 2014). The genus *Polygonum* called asknotweed. It consists of 41 species under seven sections in Turkey (Coode and Cullen 1967; Keskin 2012).

According to literature, stalks, seeds, and roots are the most common parts of this genus of herbs used in traditional medicine. It is the chemical composition, and pharmacological capacity of this group which also includes melliferous flower makes this genus's position more important among the other floras (Hsu et al. 2006). Moreover, this genus is considered as one of the difficult genus for taxonomical identification, which makes the classification daunting. In this study, morphological remarks were presented on four species of the genus *Polygonum* from Istanbul.

Materials and methods

The aerial and underground parts of *P. aviculare, P. patulum* subsp. *pulchellum, P. lapathifolium,* and *P. istanbulicum* were collected from the Maltepe & Çatalca regions of Istanbul during September and October 2013. The collected fresh samples were first driedby pressing with a plant press. Thereafter, the dried species were placed in a freezer for at least 3 days at -18°C. This step is crucial, as all species must be free from any pests. Later, the specimens were morphologically identified to genus, species level and by family. After identification, every specimen got a label and ISTE number. All the species were kept in ISTE. Four collected plants from different regions in Istanbul were compared to almost 30 other species of the *Polygonaceae* family that exist in ISTE (Table 1). The process of screening, sorting and manipulating the sampleswas performed using Stereo microscope (Leica S8APO) and morphological software application (Suite Version 2.8.1). Primary analysis of *P.aviculare, P. patulum* subsp. *pulchellum, P. lapathifolium, and P. istanbulicum* were done by comparing of each taxon with already existing analysis archived in the herbarium. Since a reliable analysis depends on identification of several morphological characteristics, following are the characteristics that were defined for each plant in this study:

i. Size (width × height cm), body structure and overall shape of the plant.

ii. Internodes' features and ocreae structure and their length were determined.

iii. Size and shape of the leaves bracts were defined.

iv. Features of the buds along with flower structure, flower size, color, and size of the nut were also defined.

v. Towards the end of the analysis, information about flowering time and habitat were also collected.

Table 1. Morphological information about four *Polygonum* species used in this study and archived in ISTE.

Polygonum aviculare			
ISTE number	**Locality**	**Date**	**Determination**
68339	A2(E) Maçka	10.06.1995	A.Baytop
6560	A1(E) Edirne	19.05.1961	T.Baytop
7865	A2(E) Üniversite Bahçesi	15.09.1964	G.Ertem
92412	A1(E) Demirköy	26.07.2009	E.Akalin
30711	A2(A) Çınarcık	4.08.1974	G.Dökmeci
7793	A2(E) Belgrat Ormanı	29.10.1964	A.Baytop
31733	A1(E) Kırklareli	25.05.1975	K.Alpinar
Polygonum patulum			
2622	A2(A) Gemlik	14.09.1954	A.Baytop
43470	A1(E) Enez	13.08.1979	E.Tuzlaci
63734	A1(E) Terkirdağ	28.10.1991	E.Akalin
43518	A1(A)	24.08.1979	E.Tuzlaci
10382	A1(E) Edirne	4.09.1966	A.Baytop
34056	A1(E) Kocag yolu	5.09.1975	K.Alpinaz
34054	A1(E) Babaeski	5.09.1975	K.Alpinaz
18474	A2(E) Güzelceköy	11.10.1970	A.Baytop
10429	A1(E) Edirne	5.09.1966	A.Baytop
31130	A2(E) İstanbul	29.10.1974	G.Cakiser
18474	A2(E) Güzelceköy	11.10.1970	A.Baytop
3764	A2(A) İstanbul	28.08.1950	T.Baytop
3765	A2(A) İstanbul	13.10.1950	T.Baytop
5773	A2(A) Maltepe	24.09.1959	A.Baytop
Polygonum lapathifolium			
62397	A1(E) Kırklareli: Pınarhisar	1.08.1990	A.Baytop
64698	A1(E) Tekirdağ: Karahisarlı Köyü	23.07.1992	E.Akalin
80924	A1(E) Kırklareli: Hamidiye köyü	25.06.2002	Sukran Kultur
22425	A1(E) Edirne	16.06.1972	A.Baytop
18479	A2(E) Güzelceköy	11.09.1970	G.Ertem
3133a	A2(E) Kemerburgaz, Bahçeköy	3.09.1952	A.Baytop
11599	A2(E) Karamandere	28.07.1967	A.Baytop
1826	A2(A) Bursa, Orhangazi	19.09.1948	A.Husnu Demiriz
23076	A2(A) Şile	11.08.1972	H.Arpöksel
3783	A2(A) Aydos	17.08.1950	A.Baytop
3782	A2(A) Büyükbakal	26.08.1950	A.Baytop
3132	A2(A) Ömerli Deresi	24.08.1952	T.Baytop
3134	A2(A) Şile	24.08.1952	T.Baytop
92411	A1(E) Kırklareli, Demirköy	26.07.2009	E.Akalin
57213	A2(E) Küçükçekmece	18.08.1986	K.Engezem
18725	A2(A) Kuş Cenneti	16.09.1970	A.Baytop
82277	A2(E) Çatalca	15.08.2003	I.Genc
Polygonum istanbulicum			
83798	A2(A) Maltepe, Başıbüyük Mah.	05.11.2006	M.Keskin

Results

Polygonum aviculare L.

Results from morphological analysis of *P. aviculare* showed that the plant is an annual herbs and prostrate or procumbent. The stems were numerous with branched base and above prostrate with a size of 5 − 60 cm and slight sulcate. The internodes were between 15 − 25 mm. The size of ocreae membrane was about 1.5 −2 mm and was veined with upper hyaline glabrous and entire when young but becoming lacerate upon maturing and shorter than internodes. Leaves were sessile and elliptic of size 1.5-2 × 8 -10 mm and green in both postulate and undulate positions.

Inflorescences were generally branched, spicate and dense. There were flowers of almost 2 −3 located at each node and pedicels were 1 −2 mm. The color of flowers belonging to this specimen was pink, and buds were recognized as pink as well. The size of the flowers was between 1.5 − 2.0 mm. The nut was brown in color with was between 1.5 −2 mm in size (Fig. 1).

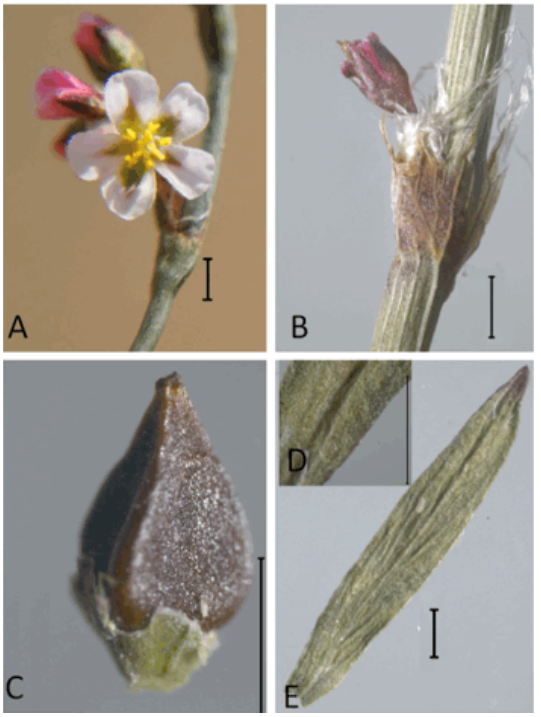

Figure 1. Morphology of ***Polygonum aviculare***: A) Flower, B) Ocreae, C) Nut, D) Surface of leaf, E) Leaf (Scale bar 1 mm).

Flowering time for this plant was estimated to be between July and November. The habitat belonging to *P. aviculare* was identified as barren at sea level of 700 m.

Polygonum patulum Beib. subsp. *pulchellum* (Lois.) Leblebici

Plan erect, flowering time is June to October. The size of the plant was between 20 − 50 cm. Stems were slender with tickness of less than 2.5 mm. The striate of the plant was white, and internodes were between 10-30 mm. The ocreae is shorter or longer than internodes and membrane of the ocreae was about 2 − 2.5 mm with a brownish color. The leaves were narrowly elliptic (10 − 45 × 3 − 8 mm) and longer than the bracts. Terminal inflorescences of the flowers were 1.5 − 2 mm in size. The nut of this plant was glossy and brownish, about 1− 1.8 ×1−1.5 mm (Fig. 2). The habitat belonging to *P. patulum* was recognized as open places at sea level of 1600 m.

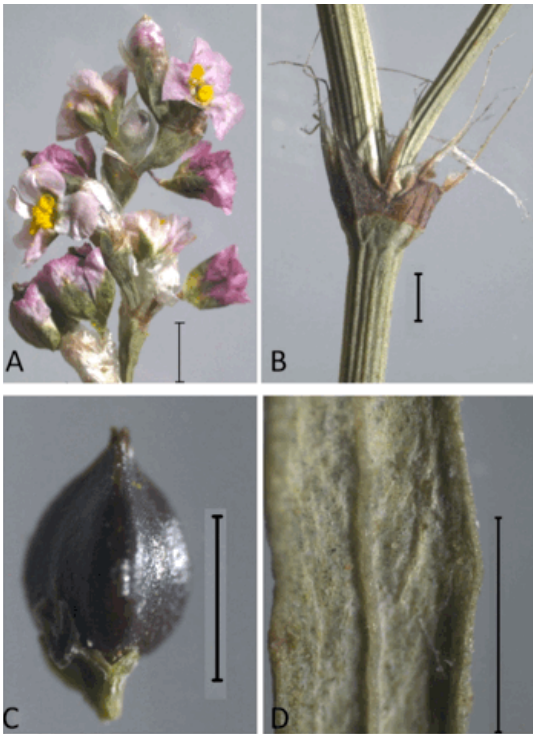

Figure 2. Morphology of ***Polygonum patulum***: A) Flower, B) Ocreae, C) Nut, D) Surface of leaf, E) Leaf (Scale bar 1 mm)

Polygonum lapathifolium L.

The morphological analysis of this plant confirmed that it is an annual herb with ascending stems and branches of size 10-50 cm and internodes of about 4 − 6 cm. The ocreae was shorter than internodes and membrane of the ocreae was about 4 − 6 mm with a hyaline glabrous. The leaves were narrowly elliptic with blackish spot and cuneate at the base. Peduncles were yellow and pink colored flower of size 1.5 − 2 mm. The nut of this plant was glossy, brownish, and about 1.8-2 × 1.5-1.8 mm in size (Fig. 3). The habitat belonging to *P. lapathifolium* was recognized as marshes at sea level of 1500 m. The flowering time between August and September.

Figure 3. Morphology of ***Polygonum lapathifolium****:* A) Flower, B) Ocreae, C) Nut, D) Surface of leaf, E) Leaf (Scale bar 1 mm).

Polygonum istanbulicum Keskin. (Endemic)

Results from morphological analysis of *P. istanbulicum* showed that this plant had a suffruticose perennial with a hard woody stock. The stems were branched at the base and were of the size of 5 −120 cm. The internodes were between 5 − 40 mm. The size of ocreae membrane was up to 10 mm and was veined with upper hyaline glabrous and entire when young but becoming lacerate upon maturing and shorter with a reddish brown color. Leaves were numerous with short but linear petiolate of size 5 −13 × 10 − 30 mm. The bracts were similar but smaller than cauline leaves. There were 2-3 flowers located at each node and had violet /pink color pedicels of 4 mm. Flowers were 2.5 − 4.0 mm in size and were of white color when young and became rose pink upon maturing. The nut was a brown color and 4× 5 mmin size (Fig. 4).

Figure 4. Morphology of ***Polygonum istanbulicum****:* A) Flower, B) Ocreae, C) Nut, D) Surface of leaf, E) Leaf (Scale bar 1 mm).

Flowering time for this plant was deduced to be between July to December. The habitat belonging to *P.istanbulicum* was recognized as open forest at sea level to 70 m.

Discussion

Since the genus *Polygonum* was revised by Coode and Cullen (1967) for the flora of Turkey, eight new species have been recorded (Davis et

al. 1988; Leblebici 1990; Tan and Baytop 1995), and five species new to science have been described from Turkey, (Leblebici 1985;Yıldız and Tan 1988; Yıldırımlı and Leblebici 1989, Zielinski 1991; Leblebici et al. 1993; Özhatay 2000). Eventually, *P. istanbulicum* described as a new to science (Keskin 2009).

They vary widely from prostrate herbaceous annual plants under 5 cm high, others erect herbaceous perennial plants growing to 3 − 4 m, and yet others perennial woody vines growing up to 20−30 m high in trees. Several are aquatic, growing as floating plants in ponds. The leaves are 1− 30 cm long, and vary in shape between species from narrow lanceolate to oval, broad triangular, heart-shaped, or arrowhead forms. The stems are often red-speckled or reddish. Flowers are small, white, pink or greenish, appearance in summer in dark cluster from the leaf joints or stem apices.The usual look of the leaves is mostly simple. However, stipules that forms on nodes and are known for their defensive role are mostly united around the stem. The spikes of flowers are found in varies forms like fascicles or panicles, hermaphrodite or unisexual and actinomorphic. In this genus, the wood and pollen are extremely different stated (Habibi et al. 2011; Mohammad et al. 2011).

Polygonum is a genus with indistinct taxonomic features between its members, systematic evidence obtained from a study of the features of the foliar epidermis, such as trichome morphology, is useful in providing significant distinctive characters for identification (Bunawan et al. 2011).

The results of our study revealed potentially important distinctive features of the four *Polygonum* species. These results suggest that more extensive study should be done on the micromorphology of the genus *Polygonum* to determine the usefulness of morphological features for making clearer taxonomic distinctions.

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