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Asperula anatolica (Rubiaceae), a new species from south-east Anatolia, Turkey

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Abstract: A new species, *Asperula anatolica* M.Ozturk (Rubiaceae), is described from south-east Turkey. *A. anatolica* grows on limestone bedrock, in Uludere District (C9 Şırnak Province). It is an endemic confined to south-east Anatolia, and it is related to *A. comosa* Schönb.-Tem in the section *Cruciana*. *Asperula anatolica* is distinct from a closely allied species, *A. comosa*, by its inflorescence, indumentum, corolla lobes and shape, bracts, bracteoles, internodes, seed coat surface, and pollen grains. Photos of the new species are provided, and observations on the population are discussed. Special attention is also given to its ecology and conservation status. In addition, pollen characteristics and mericarp surface features are examined by scanning electron microscope. The geographical distribution of *A. anatolica* and other related species are mapped.

Key words: *Asperula*, Rubiaceae, scanning electron microscope, ecology, Turkey

1. Introduction

Rubiaceae is the fourth largest family of flowering plants after Asteraceae, Orchidaceae, and Fabaceae. It contains approximately 13,200 species in 620 genera, of which 26 have more than 100 species (Robbrecht et al., 2007). *Asperula* L. is one of the most important genera of the family Rubiaceae, with 183 species. The total number of *Asperula* taxa is 230 with subspecies and varieties (Minareci et al., 2010).

Ehrendorfer and Schönbeck-Temesy conducted the revision of *Asperula* in the *Flora of Turkey*, denoting that the Mediterranean phytogeographical region and south-west Asia are genetic diversification centres of this genus (Guo & Wang, 2011). However, further studies are needed to support this hypothesis (Senol & Yıldırım, 2010). Most of the wild and endemic plants of the genus occur in Greece (38 species) and Turkey (41 species). Hence, this region was supposed to be the genetic diversification centre of the genus, probably dating back to the Pleistocene and Holocene ice ages. On the other hand, species of the genus also occurring in Australia are endemic. As such, this situation is very important in terms of diversification and occurrence of the genus.

Recently, *Asperula samia* Christodoulakis & Georgiadis was added and *A. pseudochlorantha* Ehrend. var. *antalyensis* (Ehrend.) Minareci et Yildiz was reported for the *Flora of Turkey* (Davis et al., 1988; Minareci & Yıldız, 2010).

Overall, *Asperula* in Turkey includes 51 taxa, placed in 6 sections, 26 of which are endemic (Minareci & Yıldız, 2010). The sections are *Cruciana* Griseb., *Oppositifoliae* Schischkin., *Cynanchicae* (DC.) Boiss., *Glabella* Griseb., *Asperula*, and *Thliphthisa* (Griseb.) Ehrend. The endemism rate of the genus *Asperula* in Turkey is 49%. *Asperula comosa* Schönb.-Tem., which occurs in Iran and Iraq, belong to the sect. *Cruciana*, which includes 4 species in Turkey, namely *Asperula prostrata* (Adams) K.Koch, *A. kotschyana* (Boiss. & Hohen.) Boiss., *A. molluginoides* (M.Bieb.) Reichb., and *A. glomerata* (M.Bieb.) Griseb. In addition to these taxa, the total number is raised to 5 with the addition of *Asperula anatolica* M.Ozturk, presented in this study.

The family Rubiaceae is known for its difficult intrafamilial classification. The position of Rubiaceae in the order Gentiales was established by Wagenitz (1959, 1964). This position is accepted by most taxonomists dealing with higher-level classification (Dahlgren, 1989; Thorne, 1983, 1992; Takhtajan, 1987) and is also supported by molecular and morphological data (Downie & Palmer, 1992; Chase et al., 1993; Olmstead et al., 1993).

Pollen morphology of the family has been examined by Erdtman (1952, 1971), Huysmans et al. (1994, 1999), Kuprianova and Alyoshina (1978), Nowicke and Skvarla (1979), Persson (1993), Puff et al. (1996), Vinckier et al. (2000), and Sotolongo (2002). Pollen morphological characters of some genera have extremely important taxonomic value

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(Block & Robbrecht, 1998; Dessein et al., 2000, 2002). Robbrect emphasised that general pollen characteristics are very important values in systematic studies for many different genera, like *Asperula* (Robbrecht, 1982).

Rubiaceae seem to be particularly suitable for palynological studies (Perveen & Qaiser, 2007). Minareci (2010), who revised the genus *Asperula* in Turkey, stated that seed and pollen micromorphological properties could be used for intra/interspecific classification of *Asperula*, which is taxonomically critical.

Huysmans et al. (2003) noted that the ornamentation of the sexine and nexine, rather than pollen shape and size, is important in the separation of species. Chaw and Sivarajan (1989) noted that seed coat patterns may not be of considerable taxonomic value in generic delimitation, which is far from clear in Rubiaceae.

2. Materials and methods

During field trips during the 2009–2010 vegetation periods, some specimens belonging to the genus *Asperula* in south-eastern Anatolia were collected, in Uludere District (Şırnak Province). After careful examination, it was concluded that a new species had been found. Further studies were carried out on the specimens based on the floristic literature and research in the G, W, WU, PH, E, GAZI, HUB, K, KNYA, AEF, ISFE, ISTO, ISEF, and ANK herbaria. The description of *Asperula* was compared with the publications by Ehrendorfer and Krendl (1974), Ehrendorfer and Schönbeck-Temesy (1980, 1982), Schönbeck-Temesy and Ehrendorfer (2005), Davis et al. (1988), Özhatay et al. (1999, 2009, 2011), and Özhatay and Kültür (2006). These specimens were concluded to be new to science. In the description below, each numerical value is the average of 10 measurements from different specimens. The specimens of *Asperula anatolica* were examined and compared with specimens of *Asperula comosa* Schönb.-Tem. in Iraq and Iran. The investigated representative specimens of *A. comosa* from different localities are cited in the Appendix. The authors of plant names were checked in Brummitt and Powell (1992).

Palynological investigations were conducted with both light microscope (LM) and scanning electron microscope (SEM). For LM studies, the pollen slides were prepared using the Wodehouse technique (Wodehouse, 1935). The material of this research is either new or was obtained from dried specimens. The descriptive terminology in Punt et al. (1994) and Moore et al. (1997) was employed. For shape classes (P/E), the definitions given by Nilsson and Praglowski (1992) were used. For SEM investigations, seeds and pollen grains were directly mounted on prepared stubs and coated with gold. Photographs were taken with a Zeiss LS-10 after the seeds and pollen grains had been coated with a Polaron SC7620 sputter coater in SEM studies. The averages and standard deviations of the measurements were calculated.

The specimens were identified using the key in Ehrendorfer and Schönbeck-Temesy (1982). The terminology given by Stearn (1996), Prentice (1979), and Barthlott (1981) was used for the description of the SEM aspects.

2.1. Species description

Asperula anatolica M.Ozturk **sp. nova** (Figures 1, 2).
Sect. *Cruciana* Griseb.

Type: Turkey, C9 Şırnak: Uludere, between Yemişli and Dağdibi village, Kurudere district, 1093 m, limestone rocks, 21.vi.2009, 37°22′924″N, 43°07′446″E, *A.Duran* 8382 & *M.Öztürk* (holotype: KNYA, isotypes: GAZI, ANK).

Diagnoses: *Asperula anatolica* is related to *Asperula comosa*. It mainly differs from *A. comosa* because it has leaves of the uppermost node long ciliate (not glabrous), involucral bracts 2–2.5 mm wide, margins ciliate (not 1.2–1.5 mm wide, margins glabrous), bracts 6–7 mm long, margins densely long ciliate and 0.5–1.2 mm long (not 3–4 mm, margins sparsely short ciliate and 0.1–0.2 mm), pedicels 1–1.3 mm long, glabrous (not c. 2 mm long, densely scabrous).

Description: Perennial, with several flowering and some vegetative shoots, woody at base. Stems numerous, 15–30(–35) cm tall, basally ascending, erect upwards, glabrous, mostly branched mainly in the upper half and with obliquely erect short branches or rarely simple, internodes 1.5–2.5 cm in lower parts and 5–9 cm long in upper parts, the lower and upper nodes always longer than leaves. Leaves in whorls of 4, persistent, 12–20 × 1.5–11 mm, slightly decreasing upwards, lanceolate to narrowly elliptic, above and below surfaces glabrous, only sparsely setulose hairs on margins and on the main midrib, ±obtuse, margins slightly rolled under; lower leaves narrowly elliptic, ±obtuse to acuminate, 1–3 nerved, with thin midrib, 0.1–0.3 mm wide, margin entire; upper leaves ±acuminate, linear to lanceolate, margin flat. Leaves of the uppermost node nearly entirely long ciliate. Inflorescence in terminal capitates 30–45(–50) flowered, 12–20 mm in diameter, distinctly compact, verticillasters of inflorescence 2–6 and 1 mm distance, and verticillasters with numerous primary branches. Flowers subsessile. Involucral bracts 4–5, narrowly oblanceolate, 6–7 × 2–2.5 mm, apex ±obtuse, margins distinctly and densely long ciliate; bracts 1, linear to linear-lanceolate, 4–7 × 0.2–0.5 mm, gradually attenuating towards the base, 2.5 mm long, with both surfaces glabrous and margins densely long ciliate, 0.5–1.2 mm long, apex ±obtuse; bracteoles similar to bracts, concave, 2–3 × 0.1–0.2 mm, apex ±acuminate. Pedicels 1–1.3 mm long, filiform, glabrous. Corolla purplish when dry to brownish, 10–11 mm long with

Figure 1. Photos of *Asperula anatolica* and *A. comosa*. *Asperula comosa*: a- flowering part, b- calyx and mericarps. *A. anatolica*: c- flowering part, d- calyx and mericarps. Abbreviations: i.b.: involucral bracts; br: bract; brk: bracteols; m: mericarps.

glabrous tube (6–7 mm) and 4-lobed limb, lobes 1.0–1.2 × 0.2–0.5 mm long, oblong, apex rounded, appendiculate 0.5–0.8 mm long. Anthers exserted from throat. Style 4–4.5 mm long, bifid, with 2 stigmas globose-papillose, basally fused. Mericarps 1.33–2.43 × 0.47–2.04 mm, greenish when immature, blackish when mature, glabrous, oblong-ellipsoid, ornamentation lineolate-sulcate.

Seed coat surface and pollen morphology: Pollen morphologies were examined with LM and SEM. The pollen of *Asperula anatolica* has radial symmetry, isopolar. Polar axis (P) is 18.5–25.5 µm, equatorial axis (E) is 15.2–24.5 µm. P/E ratio is 1.05. The pollen grain is spheroidal. Exine is 0.8–1.58 µm. The exine is tectate, and the sexine is perforate with microspines. The orientation of the colpus margin is perforated. The number of perforations is 3 in 1 µm^2. The number of spines is up to 13 in 1 µm^2. Mesocolpium is 3.5–6 µm, apocolpium 5–7.9 µm, microperporate diameter 0.10–0.35 µm. Colpus Clg is 9–17.2 µm, and Clt is 1.1–2.2 µm. The aperture membrane ornamentation is 7–8 colpate. Mericarps are 1.33–2.43 × 0.47–2.04 mm, greenish when immature, blackish when mature, glabrous, oblong-ellipsoid, lineolate-sulcate; hilum is 0.1–0.15 × 0.18–0.3 mm; testa cell 10–27 × 11–20 µm, between testa cell distance is 1.1–3 µm, number of testa cells is 45–50 in 0.1 mm^2 (Tables 1, 2; Figure 2).

The pollen of *Asperula comosa* has radial symmetry, isopolar. Polar axis (P) is 18.02–24.78 µm, equatorial axis (E) is 19.0–24.5 µm. P/E ratio is 0.94. The pollen grain is oblate-spheroidal. Exine is 0.88–1.6 µm. The exine is tectate, and the sexine is perforate with microspines. The colpus margin is perforated. Number of perforations is 2 in 1 µm^2. The number of spines is up to 13 in 1 µm^2. Mesocolpium 3–4.5 µm, apocolpium is 5–14 µm, microperporate diameter is 0.10–0.23 µm. Colpus Clg is 7–17 µm, and Clt is 0.4–2.5 µm, sometimes extending to the polar parts and connected. The aperture membrane ornamentation is 7–8 colpate rarely 9. Mericarps 1.95–2.54 × 0.71–0.89 mm, blackish, glabrous, oblong-ellipsoid, lineolate-sulcate; hilum is 0.1–0.16 × 0.21 mm; testa cells 28–42 × 11–41 µm, between testa cell distance is 1–4 µm, number of testa cells is 16–30 in 0.1 mm^2. Palynological and seed coat surface comparisons of the studied species are shown below (Tables 1, 2; Figure 2).

Distribution and ecology: *Asperula anatolica* is an endemic species and confined to the Tanin Mountains and environments in the Zagros system (Şırnak Province), in

Table 1. Summary of the pollen characters for *Asperula comosa* and *A. anatolica* investigated and measurements on SEM images.

Characters	*Asperula comosa*	*Asperula anatolica*
	V (M ± S)	V (M ± S)
Polar length (P) (µm)	18.02–24.78 (21.77 ± 1.6)	18.5–25.5 (21.25 ± 2.7)
Equatorial diameter (E) (µm)	19.0–24.5 (22.99 ± 1.3)	15.2–24.5 (20.12 ± 2.9)
P/E ratio	0.94	1.05
Exine thickness (µm)	0.88–1.6 (1.3 ± 0.3)	0.8–1.58 (1.2 ± 0.2)
Colpus length (Clg) (µm)	7–17 (12.4 ± 2.5)	9–17.2 (13.5 ± 2.8)
Colpus width (Clt) (µm)	0.4–2.5 (1.6 ± 0.6)	1.1–2.2 (1.72 ± 0.5)
Mesocolpium (M) (µm)	3–4.5 (3.9 ± 0.4)	3.5–6.0 (4.8 ± 0.8)
Apocolpium (µm)	5–14 (7.9 ± 2.1)	5–7.9 (0.8 ± 1.1)
Microperporate diameter (µm)	0.10–0.23 (0.31 ± 0.1)	0.10–0.35 (0.19 ± 0.05)
Number of colpi	7–8–(9)	7–8
Shape	oblate-spheroidal	spheroidal

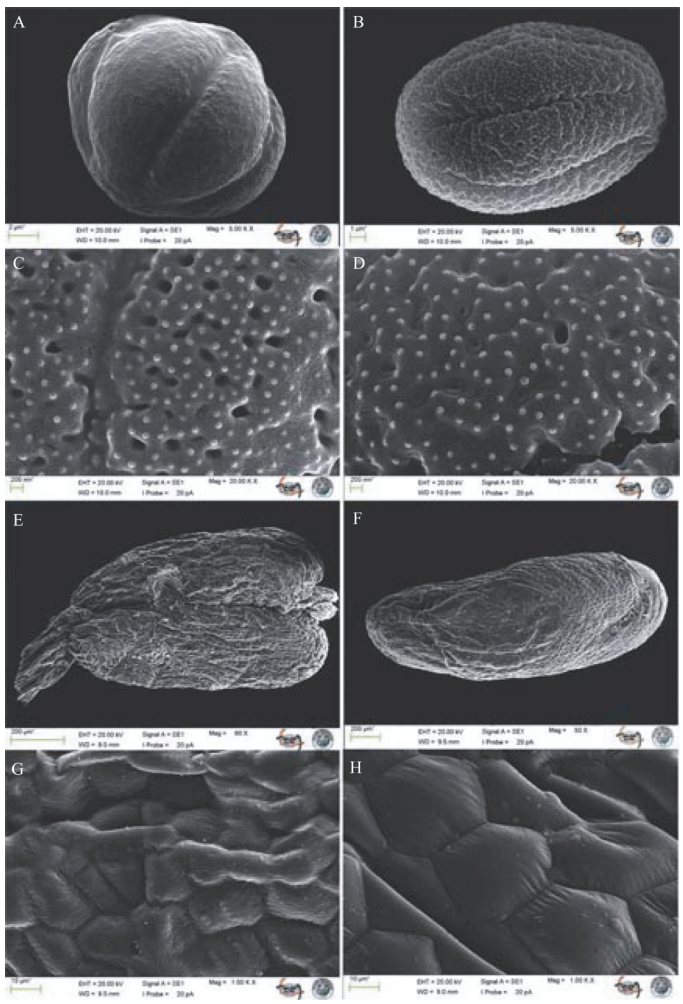

Figure 2. SEM photos of pollen grains of *Asperula anatolica*: A= general appearance, C= ornamentation; seed coat surface: E= general appearance, G= ornamentation. *A. comosa*: B= general appearance, D= ornamentation; seed coat surface: F= general appearance, H= ornamentation.

Table 2. Summary of the seed characters for *Asperula comosa* and *A. anatolica* investigated and measurements on SEM images.

Characters	*Asperula comosa*	*Asperula anatolica*
	V (M ± S)	V (M ± S)
Seed length (mm)	1.95–2.54 (2.3 ± 0.26)	1.33–2.43 (1.66 ± 0.37)
Seed width (mm)	0.71–0.89 (0.84 ± 0.11)	0.47–2.04 (0.86 ± 0.45)
Hilum length (mm)	0.1–0.16 (0.14 ± 0.03)	0.1–0.15 (0.11 ± 0.01)
Hilum width (mm)	0.21–0.3 (0.9 ± 0.01)	0.18–0.3 (0.11 ± 0.01)
Testa cell length (μm)	28–42 (34.43 ± 4.01)	10–27 (21 ± 6.7)
Testa width (μm)	11–41 (26.68 ± 10.9)	11–20 (16.4 ± 3.6)
Between testa cells distance mean (μm)	1–4 (1.87 ± 0.95)	1.1–3 (2.2 ± 0.77)
Number of testa cells/0.1 mm^2	16–30	45–50
Seed type	oblong-ellipsoid	oblong-ellipsoid
Ornamentation	lineolate-sulcate	lineolate-sulcate
Colour	blackish	greenish to blackish

south-eastern Turkey, Irano-Turanian element (Figures 3, 4). The great Zagrosian district of the Irano-Turanian region can be divided roughly into 3 parts: the Anatolian, the Iraqi, and the Iranian. The Anti-Taurus mountain range is divided into 2 arms in Turkey. One tends northward and joins the Pontic system, while the other turns eastwards, joining the Zagros system south of Lake Van (Zohary, 1973). Şırnak Province is included in the Zagros system. The Tanin Mountains and environs are characteristic of open oak forests and scrubs in Turkey, Iraq, and Iran.

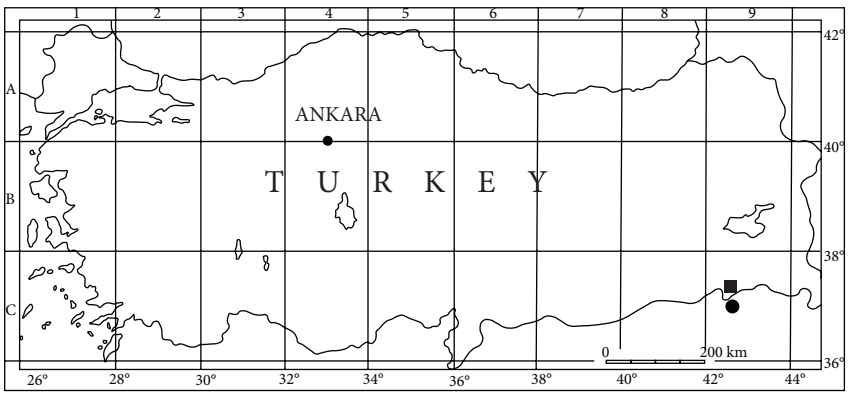

Figure 3. The distribution map of *Asperula anatolica* (■) and *A. comosa* (●).

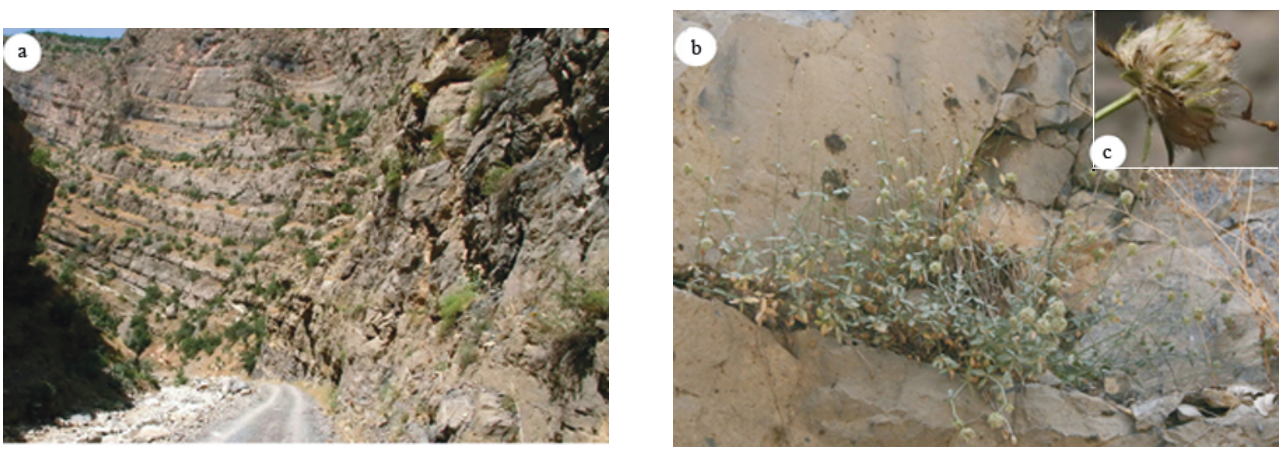

Figure 4. *Asperula anatolica*: a- habitat and general view of the type locality, b- general aspects, c- inflorescence (photos by M.Öztürk).

They include quite a number of associations that have become gradually impoverished from north to south, both in density and the number of their arboreal species. This system never forms pure forest stands. Thus, the 3 oaks, which are edificatory of the Zagrosian oak forest, never exclude one another completely (Zohary, 1973).

Asperula anatolica grows in limestone rock crevices with *Quercus birantii* Lindley, *Q. libani* Olivier, *Q. boissieri* Reuter, *Parlatoria cakiloides* Boiss., *Scrophularia gracilis* Blakelock, *Marrubium anisodon* C.Koch., *Arabis montbretiana* Boiss., *Teucrium polium* L., *Pholomis armeniaca* Willd, *Thymus praecox* Opiz subsp. *grossheimii* (Ronniger) var. *grossheimii*, *Stachys kurdica* Boiss. & Hohen. var. *kurdica*, *Johrenia dichotoma* DC. subsp. *dichotoma*, *Tanacetum arygrophyllum* (C.Koch) Tvzel. var. *arygrophyllum*, and *Pimpinella* sp.

3. Discussion and conclusion

The Zagros system is made up of parallel ridges with more or less deep intermountain fertile valleys, deep rough gorges, intermountain plains, and other lowlands formed by water courses and faults. The permanent rivers that cross the mountains and the hill region are the Great and the Little Zab and the Dilaya, which empty into the River Tigris (Zohary, 1973).

The great Zagrosian district of the Irano-Turanian region can be divided roughly into 3 parts: the Anatolian, the Iraqi, and the Iranian. This division is justified in as far as each part has some floristic peculiarities of its own.

The area is very rich in terms of endemic plants. In recent times some new endemic species have been described, such as *Cicer uludereensis* A.Dönmez (Dönmez, 2011), *Silene gevasica* Hamzaoğlu (Hamzaoğlu et al., 2011), and *Allium shirnakiense* L.Behçet & Rüstemoğlu (Behçet & Rüstemoğlu, 2012), and some new records, namely *Allium giganteum* Ragel, *Grammosciadium scabridum* Boiss., and *Ferula angulata* Boiss. subsp. *carduchorum* (Boiss. & Hausskn) D.F.Chamb. (Behçet et al., 2012), are reported from this region.

Based on the limited herbarium specimens, *Asperula anatolica* is distributed in south-eastern Turkey (Figures 3, 4). Considering the fact that the area is poorly investigated, especially due to the cliffs and risk of terrorism, it is highly possible to find new locations for this species. Therefore, it is not evaluated in terms of the threat categories of the IUCN (2008).

3.1. Key to related Asperula species in Turkey

1. Pedicel glabrous, corolla lobes rounded, bracts densely long ciliate 0.5–1.2 mm long……..…***A. anatolica***
1. Pedicel densely scabrous, corolla lobes triangular, bracts sparsely short ciliate 0.1–0.2 mm long……...…***A. comosa***

Asperula anatolica has some distinctive features in its morphologic characteristics when it is compared with *A. comosa*. It mainly differs from *A. comosa* because it has shorter internodes in lower parts 1.5–2.5 cm (not 3.5–4.5 cm); leaves of the uppermost node are early entirely long ciliate (not glabrous); inflorescence is distinctly compact (not ±loose); margins of involucral bracts are ciliate (not glabrous); bracts 6–7 × 0.2–0.5 mm, margins densely ciliate and 0.5–1.2 mm long (not 3–4 × 0.3–0.5 mm, sparsely ciliate and 0.1–0.2 mm); 1 bracteole is on the terminal and primary branches (terminal absent, primary 1 or 2, secondary 2 connate at base); pedicel 1–1.3 mm long (not c. 2 mm). The main differences between *A. anatolica* and *A. comosa* are outlined in Table 3.

In previous studies, it was reported that in Rubiaceae the aperture is mostly colpate and sometimes colporate. The number of colpi in colpate grain is 3–11, but it is commonly 6–7 (Perveen & Qaiser, 2007). In Turkish *Asperula* species number of colpi was given as 6–7 in previous research (Minareci et al., 2010). In the present study, the number of colpi was 7–8 for *Asperula anatolica* and 7–8 or rarely 9 for *A. comosa*. These numbers are reported for the first time in Turkey. Previous pollen studies about *Asperula* species from Turkey also show some differences, like pollen length maximum 19 µm and mesocolpium 6.4–6.6 µm (Minareci et al., 2010). In the present study, maximum pollen length of *Asperula anatolica* was 18–25 µm, and its mesocolpium was 3.9–4.8 µm.

Polar lengths of *Asperula anatolica* and *A. comosa* are very close to each other. Equatorial diameter of *A. anatolica* is smaller than that of *A. comosa*. Thus the colpi of *A. anatolica* are longer than those of *A. comosa*. Average microperforate diameter is 0.31 µm in *A. comosa* and 0.19 µm in *A. anatolica*. According to these results, microperforate diameter is greater in *A. comosa* than in *A. anatolica*; in contrast, microperforate number is lower than in *A. anatolica*. Based on these characters, compared with all *Asperula* taxa in Turkey, these 2 taxa have different shapes and ornamentations.

Asperula anatolica has some distinctive morphologic characteristics when compared with *A. asterocephala*. It mainly differs from *A. asterocephala* because it has long ciliate bracts (not lanate), purplish to brownish corolla (not reddish or brownish-green to yellowish), oblong corolla lobes (not ovate), and completely glabrous stem (not velutinous to puberulent).

Asperula anatolica is closely related to *A. kotschyana*. It is readily distinguished from *A. kotschyana* by its glabrous stem (not sparsely puberulent to glabrescent); leaves lanceolate to narrowly elliptic, 1.5–11 mm wide, not leathery (not oblanceolate, 2–4 mm wide, quite leathery); corolla 10–11 mm long (not 7 mm long); and fruit glabrous, blackish (not ±lanate, brown).

Table 3. Comparisons of diagnostic characters of *Asperula comosa* and *A. anatolica*.

Characters	*Asperula comosa*	*Asperula anatolica*
Internode	3.5–4.5 cm long in lower parts	1.5–2.5 cm long in lower parts
Leaves	lanceolate to narrowly lanceolate-ovate	lanceolate to narrowly elliptic
Cauline leaves	predominantly acute, mostly glabrous or sparsely scabrous above, margins plain	±acuminate, minutely setulose hairs on margins, margin flat
Leaves of the uppermost node	glabrous	nearly entirely long ciliate
Inflorescence	±loose, verticillasters 2–4 and up to 0.5 mm distance, with numerous primary and secondary branches	compact, verticillasters 2–6 and 1 mm distance, with numerous primary branches
Branches of verticillasters	primary and secondary	primary
Involucral bracts	4–10 × 1.2–1.5 mm, apex acute to acuminate, margins glabrous	6–7 × 2–2.5 mm, apex ± obtuse, margins ciliate
Bracts	3–4 × 0.2–0.5 mm, gradually attenuating 1–1.5 mm long towards the base, concave, margins sparsely short ciliate and 0.1–0.2 mm long, apex acute	6–7 × 0.2–0.5 mm, gradually attenuating 2.5 mm long towards the base, not concave, margins densely long ciliate and 0.5–1.2 mm long, apex ±obtuse
Bracteoles	on terminal absent, primary 1 or 2, secondary 2 connate at base	on terminal 1 and primary 1
Corolla lobes	0.9–1.2 mm wide, oblong ovate to broadly ovate, apex acuminate, appendiculate 1–1.2 mm	0.2–0.5 mm wide, oblong, apex rounded, appendiculate 0.5–0.8 mm
Pedicel	c. 2 mm long, completely densely scabrous	1–1.3 mm long, glabrous
Mericarps	1.95–2.54 × 0.71–0.89 mm, 16–30 testa cells in 0.1 mm^2	1.33–2.43 × 0.47–2.04 mm, 45–50 testa cells in 0.1 mm^2

In conclusion, *Asperula anatolica* has some distinctive characteristics in terms of inflorescence, indumentum, corolla lobes, shape, bracts, bracteoles, internodes, seed coat surface, and pollen grains, in spite of the fact that this new species is closely related to *A. comosa*.

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Appendix

Additional specimens examined:

Asperula asterocephala: Iraq. Kurdistania (Assyria orient.): in montis Kuh-Safin reg. infer. ad pagum Schaklava (ditionis Erbil.) Iter Persico-turcicum, 12.vi.1893, 1100–1500 m, *Bornm*. 1337 (WU, K, PH photo!); ibid., 1200 m, *Bornm*. 1336 (WU, K, PH photo!). - ***Asperula comosa***: Iraq. Distr. Mosul (Kurdistan). Ad confines Turciae prov. Hakkâri, in ditione pagi Sharanish, in montibus calc. A. Zakho septentrionem versus. In rupium fissuris faucium supra Marsis, 1200 m, 04/09.vii.1957, *Rech*. 10890 (E, WU photo!); ibid., inter Marsin et montem Zawita, 1100–1400 m, *Rech*. 10901 (E photo!); ibid., Jabal Khantur in rupium fissuris, 1200 m, *Rech*. 10765 (E photo!). - ***Asperula kotschyana*** (Boiss. & Hohen.) Boiss.: S.E.Anatolia. C10 Hakkâri: Cilo Tepe, 3050 m, D. 24046 (E photo!).

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