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Comparative Morphological Investigations on Three Related *Sideritis* L. Species Belonging Section *Empedoclia* (Rafin) Bentham

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Introduction

The genus *Sideritis* L. within subfamily Lamioideae (Stachyoideae) in Labiatae (Lamiaceae) comprising approximately 150 species of annual and perennial herbs and small shrubs worldwide found chiefly in Turkey[1] and Spain[2]. *Sideritis* species have been known since the times of Dioscorides and widely used in folk medicine as herbal tea for their numerous beneficial and curative effects for thousands of years[3]. In Turkey, 1-5% infusions of *Sideritis* species, which are commonly known as Ada çayı (Island tea), Dağ çayı (Mountain tea) and Yayla çayı (Plateau tea), are used as traditional medicine, especially for their tonic, diuretic, carminative and appetizing properties to treat stomachache and common cold and as herbal tea[4-6].

In the Flora of Turkey and the East Aegean Islands, 38 *Sideritis* species were reported by Huber-Morath in 1982[1]. Since then, 6 species and 2 new records[7-9] have been described in the flora of Turkey and the number of *Sideritis* species reached to 46, including 4 annuals and 42 perennials. While annual species are belong to section *Hesiodia* Bentham, section *Empedoclia* (Rafin) Bentham includes perennial species of the genus. Because of the high percentage of endemism and wide use of its members as herbal tea in traditional medicine Section *Empedoclia* (Rafin) Bentham is the important group of the genus. However, this section is known for their taxonomic

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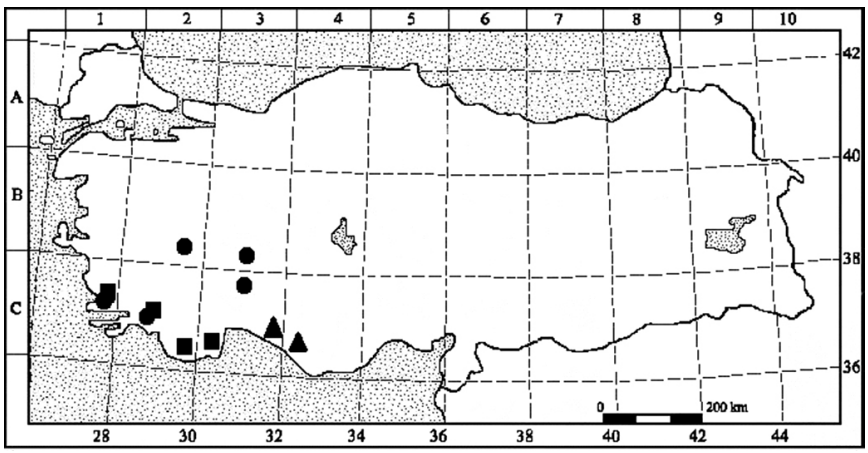
complexity and was reported with few clear-cut species in the Flora of Turkey[1]. It is obvious that morphological information on the species of section *Empedoclia* are limited in the Flora of Turkey and the East Aegean Islands[1] and further investigations are needed.

In this study, in a continuation of our reports on taxonomy of *Sideritis* species growing in Turkey[4-6], three endemic *Sideritis* species, S. *leptoclada* O. Schwarz & P.H. Davis, *S. brevibracteata* P.H. Davis and *S. albiflora* Hub.-Mor., which belong to *Empedoclia* section and were reported to be closely related species, were investigated by means of their botanical characteristics. This study provides detailed morphological descriptions and discriminating characters of *S. leptoclada, S. brevibracteata* and *S. albiflora* to ensure a reliable identification in addition to their conservation status, chorology and habitat.

Material and Methods

Plant materials were collected at flowering time in Southern Anatolia and the voucher specimens have been deposited at the Herbarium of Faculty of Pharmacy, Hacettepe University, Ankara, Turkey (HUEF) and Herbarium of Gazi University, Ankara, Turkey (GAZI). Morphological data was gathered during field works and mainly from herbarium specimens. Descriptions were given in the same order as stated in in the Flora of Turkey and the East Aegean Islands[1]. The distribution of all species, according to the herbaria records and Flora of Turkey and The East Aegean Islands, is shown in Figure 1.



• S. leptoclada ▲ S. brevibracteata ■ S. albiflora

Figure 1
Distribution of examined *Sideritis* species

Results and Discussion

1. Morphological Characters

1.1 S. leptoclada O. Schwarz & P.H. Davis

Type: [Turkey C2] Muğla: d. Köyceğiz, between Dalaman and Göcek (Köcek), below 300 m, in open Pinetum brutiae, 26 vii 1947, P.H. Davis, 13566 (holo. K, iso E! W!)

Perennial, herbaceous, woody at base. Stem erect or ± ascendant, 20-70 cm, simple or little-branched, densely adpressed white tomentose and glandular below, sparsely erect short eglandular and densely glandular above. Cauline leaves finely white eglandular and glandular, eglandular hairs adpressed on upper side, spreading on lower side, scrobiculate, reticulately veined, sessile; lower cauline leaves elliptic-oblanceolate, linear-oblanceolate, lamina 1.5-3.6 x 0.4-0.5 cm, acute, finely crenate to crenate-serrate, attenuate at base; middle cauline leaves oblong–lanceolate to lanceolate-linear and linear-oblanceolate, 1.5-5 x 0.3-0.7 cm, acute-obtus, crenate-serrate, attenuate or amplexicaul at base, bearing buds in their axils, upper cauline leaves oblong-linear, linear-lanceolate to lanceolate, 1.1-2 x 0.3-0.6 cm, acute, entire to crenate-serrate, rounded or amplexicaul at base, bearing buds in their axils. Middle and upper leaves shorter than internodes. 3.5-6.5(-7.5) cm above, 4.5-7.5 cm in the middle, 3-4.5 cm or shorter below. Inflorescens simple, rarely branched. Verticillasters 4-8, 1-5 cm distant, 6-flowered. Bracts ciliate, outer side densely short glandular, very short eglandular along with vessels, inner side long white adpressed eglandular and glandular, acumen ± glabrescent, reticulately veined; lower bracts lanceolate, 1.5-2 x 0.6-0.8 cm, acute, entire, ± amplexicaul at base, middle bracts ovate, orbicular to reniform, 0.9-1.8 x 1-1.3 cm including 0.3-0.7 cm acumen, amplexicaul at base; upper bracts ovate to reniform, 0.9-1.4 x 0.9-1.2 cm including 0.3-0.5 cm acumen, amplexicaul at base. Calyx 7-8 mm, tube 5-6 mm, teeth triangular-lanceolate, 2-2.5 x 1-1.5 mm, with 0.5-1 mm yellow mucro (Figures 2,3). Calyx outer side sparsely short glandular, long eglandular; teeth inner side eglandular, glandular at margins, tube glabrescent inside. Corolla yellow, 9-12 mm, longer than calyx, lower and upper lip densely eglandular, interruptedly hairy under filaments. Upper lobe with brown striae inside (Figure 4).

Flowering time: 6-7.

Habitat: *Pinus brutia* and *Cedrus* forests, serpentine rocks, macchie, 0-1800 m.

Phytogeographic region: Endemic to SW of Anatolia. East Mediterranean element.

Examined specimens: B2 Afyon: Dazkırı, Hisaralan village, Tınaztepe, rocks, 1500 m, 13.7.1984, Z. Aytaç 1508 (GAZI). B3 Isparta: Milas mountain, Mesire area, 10.8.1993, R. Kököz (GAZI). C1 Muğla: 5 km from Marmaris to Muğla, 23.6.2000, 300 m, open *P. brutia* forest, serpentine, N 36° 54' E 28° 16', F.P Şahin, H. Duman, (HUEF 00222), HD 7272 (GAZI); 5 km from Marmaris to Muğla, 27.10.2001, 300 m, open *P. brutia* forest, serpentine, H. Duman 8659 (GAZI); Marmaris, 13.7.1960, Khan et al. 23 (ANK); Dalaman, 26.7.1947, P.H. Davis 13583 (ANK); 20 km from Marmaris to Datça, serpentine, 100 m, 4.10.1982, A. Güner 4567, T. Ekim, M. Koyuncu (HUB). C2 Muğla: 10 km from Fethiye to Kaş, 24.6.2000, 300 m, serpentine, phyrigana, N 36° 38' E 29° 16', F.P Şahin, H. Duman, (HUEF 00224), HD 7273 (GAZI); 50 km from Fethiye to Korkuteli, 1000 m, 29.7.1992, M.Koyuncu 9296 (AEF); Marmaris, 260 m, serpentine, open *P. brutia* forest, 29.6.1997, H.Şağban 1872 (HUB); Köyceğiz, Beyobası village, Süpürgelik hill, 130-180 m, macchie, 21.6.1991, A. Güner 9547, M. Vural, H. Duman, A.A. Dönmez, H. Şağban (HUB, GAZI); Köyceğiz; Beyobası, Süpürgelik hill, 150-200 m, serpentine, macchie, 15.7.1981, A. Güner 9623 ve ark. (GAZI); Fethiye, Yanıklar village, near Küçükkargı, slopes, 20.8.1989, 10-600 m, S. Avcı (GAZI); Fethiye, Göcek, 20.7.1993, S. Avcı (GAZI). C3 Isparta: Barla Dağı, near Çobanevleri, 1600-1800 m, open *Pinus* and *Cedrus* forest, 21.9.1995, H.Özçelik 7452 (GAZI) (Figure 1).

Conservation status: VU (Vulnerable).

Figure 2
Habitat and floral part of *S. leptoclada*
(photo Hayri DUMAN)

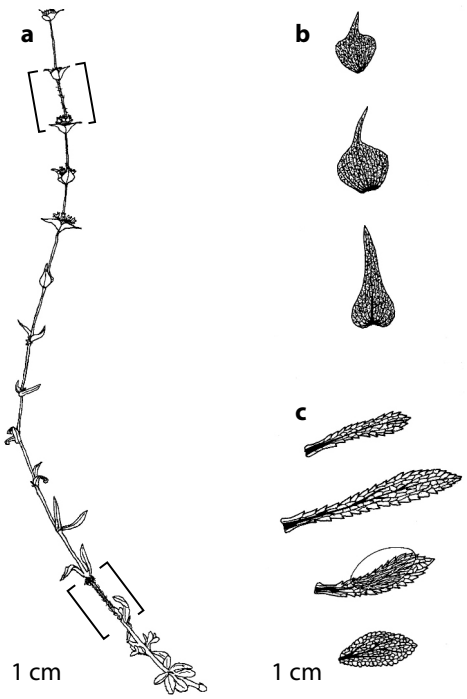


Figure 3
S. leptoclada, **a.** gross appearence, **b.** bracts, **c.** leaves

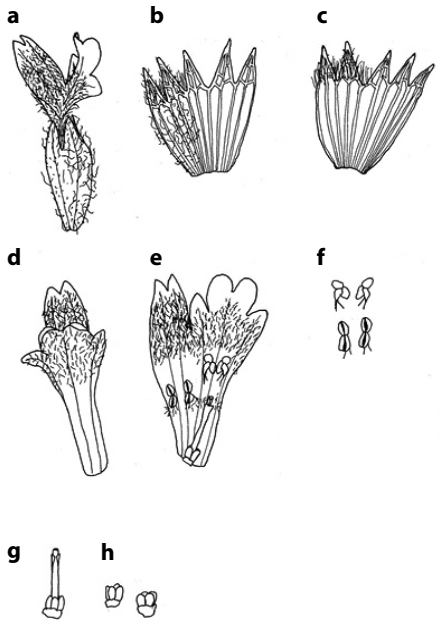


Figure 4
Floral parts of *S. leptoclada*. **a.** general appearence, **b.** calyx outer side, **c.** calyx inner side, **d.** corolla outer side, **e.** corolla inner side, **f.** stamens, **g.** gynaecium, **h.** ovary

1.2 S. brevibracteata P.H. Davis

Type: Turkey C4 Antalya: Alanya, rocky limestone slopes above the harbour, 30 m, 23 viii 1947, P.H. Davis 14493 (holo. K!, iso. ANK!, E!).

Perennial, herbaceous, woody at base. Stem erect or ascendant, 70-90 cm, simple or little branched, densely adpressed white tomentose below, loosely adpressed white tomentose above. Cauline leaves white eglandular on both sides, lower side denser, scrobiculate, reticulately veined; lower leaves sessile or with a short petiole to 3 mm, lamina spatulate, obovate, oblanceolate, (1.4-)2-2.5 x (0.4-)0.5-0.8 cm, acute, sometimes obtus, crenate to crenate-dentate, attenuate at base; middle cauline leaves sessile, lamina linear, linear-oblong, linear-obovate, sometimes linear-falcate (1-)2.1-3.6 x (0.2-)0.6-0.8 cm, acute-obtus, crenate-dentate, often enlarged and ± auriculate at base, bearing buds in their axils; upper leaves sessile, lamina linear, sometimes falcate or subulate, 1-2.1 x 0.2-0.35 cm, auriculate at

base, crenate-dentate, acute, bearing buds in their axils. Middle and upper leaves shorter than internodes. Internodes 4-6.5 cm. above, 4-5.5 cm in the middle, 2-3.5 cm or shorter below. Inflorescens branched, rarely simple. Verticillasters 3-15, 6-flowered, 2-4.5 cm distant below, denser above (up to 0.5 cm). Bracts ciliate, outer side finely puberulent, inner side sparsely finely long adpressed white eglandular, reticulately veined; lower bracts ovate, orbicular-reniform, 0.7-1.2 x 0.9-1.2 cm including 1.5-3 mm acumen; middle bracts broadly orbicular to reniform, 0.6-0.8 x 0.8-1 cm including 1-2 mm acumen; upper bracts orbicular-reniform, 0.4-0.6 x 0.5-0.8 cm; all bracts amplexicaul at base, greenish, red suffused (Figures 5,6). Calyx 6.5-9 mm, tube 4-6 mm; teeth linear, 2-3 x 1 mm, equal, brownish-red, calyx outer side puberulent with short glands and sparsely eglandular under corolla lower lobe, tube glabrous and teeth long adpressed eglandular inside. Corolla yellow 9-10 mm, longer than calyx, outer side of upper part of tube and lobes (except margins) densely eglandular, corolla inner side eglandular near throat, with a uniform ring of hairs inside under filaments. Upper lobe with brown striae inside (Figure 7).

Figure 5
Habitat and floral part of *S. brevibracteata*
(photo Hayri DUMAN)

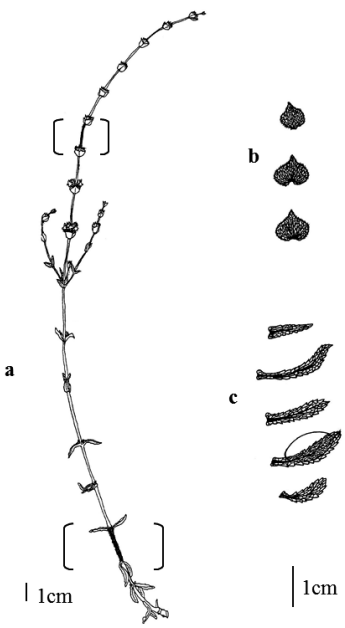


Figure 6
S. brevibracteata, **a.** gross appearence, **b.** bracts, **c.** leaves

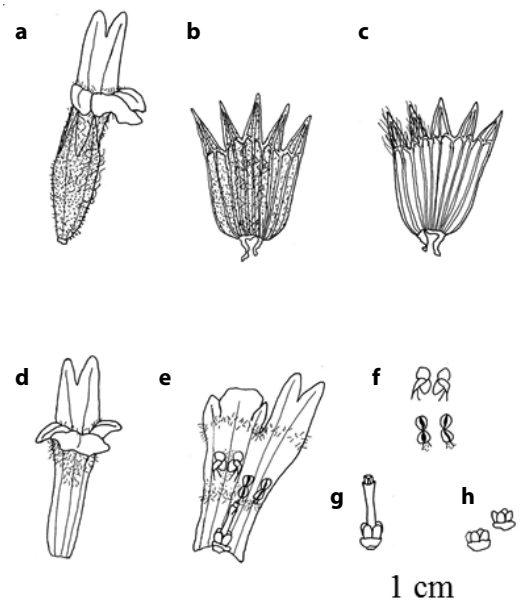


Figure 7
Floral parts of *S. brevibracteata*. **a.** general appearence, **b.** calyx outer side, **c.** calyx inner side, **d.** corolla outer side, **e.** corolla inner side, **f.** stamens, **g.** gynaecium, **h.** ovary

Flowering time: 5-8.

Habitat: Rocky slopes, macchie, phyrigana, 30-250 m.

Phytogeographic region: : Endemic to Antalya province. East Mediterranean element.

Examined specimens: C3 Antalya: Alanya, Hacımehmetli village, near Bağderesi, macchie, 200 m, 27.06.1993, H. Duman 4970 & F. Karavelioğulları (GAZI); Alanya, Hacımehmetli village, 20.8.1999, 250 m, macchie, H. Duman 7081 (GAZI); Alanya, Ulaş, 22.5.2000, 100 m, open macchie, calcareous rocks, F.P. Şahin, H. Duman (HUEF 00203), H. Duman 7147 (GAZI); Alanya, near Akhan, 22.5.2000, 100 m, calcareous rocks, F.P. Şahin, H. Duman (HUEF 00204), H. Duman 7148 (GAZI); Ulaş, 26.6.2000, 20 m, phyrigana, calcareous rocks, N 36° 34', E 31° 56', H. Duman 7291 (GAZI); Ulaş, 25.8.2000, 20 m, phyrigana, calcareous rocks, N 36° 34', E 31° 56', H. Duman 8440 (GAZI); Between Alanya and Türbelinaz road, near Bektaş, 27.5.2001, 200 m, calcareous rocks - macchie, H. Duman 8565 (GAZI);

Alanya, Hacımehmetli village, 200 m, 4.6.1993, H.Duman 4802 (GAZI). C4 Antalya: Alanya castle, ca. 250 m, 12.5.1971, R. Çetik 3762 (ANK); ibid., 1.7.1994, M. Koyuncu, M.Coşkun, 18699, (AEF) (Figure 1).

Conservation status: CR (Critically endangered).

1.3 S. albiflora Hub.-Mor.

Type: Turkey C3 Antalya: Elmali-Finike, 38 km nach Elmali, Macchie am Südfuss des Bey Dağ, 750-800 m, 25 vi 1948, A. Huber-Morath 8276, J. Renz (holo. Hb. Hub.-Mor.!).

Perennial, herbaceous, woody at base. Stem erect or ascendant, 50-77 cm, simple or little-branched, tomentose and glandular above, densely adpressed tomentose below. Cauline leaves sessile, finely eglandular on both sides, eglandular hairs adpressed on upper side; lower leaves scrobiculate, reticulately veined, lamina linear, linear-oblong, sometimes ± falcate, 1.7-3.6 x 0.2-0.55 cm, acute, sometimes with a 0.5 mm yellowish mucro, crenate-serrate, ± auriculate at base; middle cauline leaves linear to linear-oblong, 1-5 x 0.2-0.7 cm, acute-obtus, sometimes with a 0.5 mm yellowish mucro, crenate-serrate, crenulate-serrate, enlarged and auriculate at base, bearing buds in their axils; upper leaves linear-lanceolate, linear-oblong, 1.3-2.4 x 0.2-0.4 cm, acute, integer or crenulate-serrate, enlarged and auriculate at base, bearing buds in their axils. Middle and upper leaves shorter than internodes. Internodes 5.5-8(10 cm) cm above, 4--7.5 cm in the middle, 1.5-3.5 cm or shorter below. Inflorescens simple or rarely branched. Verticillaters 3-10, (2.5-)4.5-6 cm distant below, 0.8-2.5 cm above, 6-flowered. Bracts ciliate, outer side densely adpressed white short eglandular and glandular, inner side ± glabrescent, sparsely and finely eglandular near margins; reticulately veined, integer, ± amplexicaul at base; lower bracts ovat-cordate, 1.3-3 x 0.8-1.4 cm; middle bracts ovate to orbicular, sometimes reniform, 0.9-2 x 0.9-1.5 cm including a 5-10 mm acumen; upper bracts orbicular, 0.7-1.1 x 0.7-1 cm, including a 2-3(3.5) mm acumen (Figures 8,9). Calyx 7-9 mm, tube 4.5-6 mm, teeth equal, triangular, with short yellowish mucro, 2-3 x 1 mm, outer side of teeth and tube spreading eglandular and sparsely glandular, teeth inner side eglandular near margins, tube inner side glabrescent. Corolla white, 10-12 mm, longer than calyx, upper part of tube and outer side of lobes densely adpressed eglandular; lips inner side eglandular near the throath, interruptedly hairy under filaments. Upper lobe without brown striae inside (Figure 10).

Flowering time: 5-7.

Habitat: *Quercus* scrub, macchie, conglomerate scree, limestone cliffs, calcerous rocks, marly steppe, 0-750 m.

Phytogeographic region: Endemic to SW of Anatolia East Mediterranean element.

Figure 8
Habitat and floral part of S. albiflora
(photo Hayri DUMAN)

Examined specimens: C1 Muğla: 5 km from Muğla to Yatağan, 23.6.2000, 720-750 m, macchie, calcareous rocks, N 37° 13' E 28° 19', F.P Şahin, H. Duman, (HUEF 00221), HD 7270 (GAZI); 20. km from Marmaris to Muğla, 23.6.2000, 200 m, open *P. brutia* forest, calcareous rocks, F.P Şahin, H. Duman, (HUEF 00223), HD 7271 (GAZI); 5 km from Muğla to Yatağan, 27.10. 2001, 720-750 m, macchie, calcareous rocks, H. Duman 8658 (GAZI), C2 Muğla: Köyceğiz, Yangı village, Çiçekbaba (Yarıkkaya), 50-80 m, rocks, 17.6.1991, A. Güner 9451, M. Vural, H. Duman, A. Dönmez, H. Şağban (HUB); Köyceğiz, between Ülemez-Çandır, 580 m, macchie, calcareous rocks, 25.7.1992, A. Güner 10699 (GAZI); Köyceğiz, Yangı village, Yangı creek, 60-80 m, valley, calcerous slopes, A. Güner 9318, M. Vural, H. Şağban (GAZI); Yenice

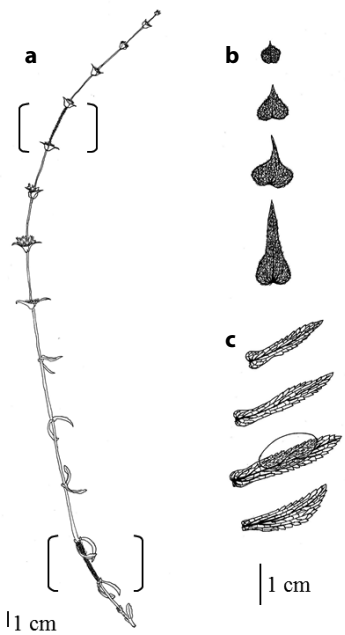


Figure 9
S. albiflora, **a.** gross appearence, **b.** bracts, **c.** leaves

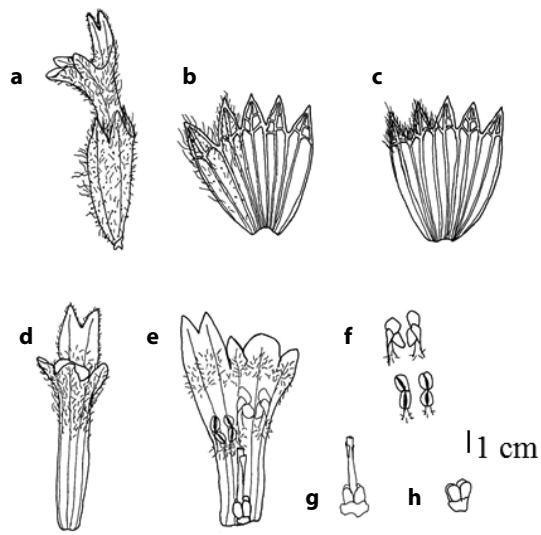


Figure 10
Floral parts of *S. albiflora*. **a.** general appearence, **b.** calyx outer side, **c.** calyx inner side, **d.** corolla outer side, **e.** corolla inner side, **f.** stamens, **g.** gynaecium, **h.** ovary

village, 600 m, 12.7.1994, M. Temel (GAZI). C2 Antalya: Kaş, 21.5.2000, 200 m, F.P Şahin, H. Duman, (HUEF 00193), HD 7135 (GAZI); 20 km from Kaş to Demre, 24.6.2000, 500-550 m, macchie, calcareous rocks, N 36° 15' E 29° 45', F.P Şahin, H. Duman, (HUEF 00225), HD 7275 (GAZI); Kale (Demre), macchie, 250 m, 14.07.1993, H. Duman 5154 & F. Karavelioğulları (GAZI); C3 Antalya: Kemer, Kesmeboğaz, *P. brutia* forest, Tehneli, 400 m, 29.7.1980, H. Peşmen 4909 (ANK); Antalya: Kemer, Kumluca, *P. brutia forest*, ca. 250 m, 27.5.1984, Y. Akman 13639 (ANK) (Figure 1).

Conservation status: VU (Vulnerable).

A comprehensive revision of Turkish *Sideritis* has been undertaken by our group since 2000[11]. A large number of the specimens have been collected from all over the Turkey and taxonomical properties of samples have been described. As a part of this revision and our ongoing botanical studies on *Sideritis* species[4-6], here we report detailed morphological characteristics of three endemic species, *S. leptoclada*, *S. brevibracteata* and *S. albiflora* in addition to their conservation status, distribution and habitat.

Some morphological features of these species such as inflorescens, internodes, upper and lower leaves and bracts which were not given previously in The Flora of Turkey[1] were described in this study for the first time and given with details of the stem, middle leaves, bracts, calyx and corrolla. Moreover, the findings were also compared with those in The Flora of Turkey and some differences were determined.

Although in the Flora of Turkey, *S. leptoclada*, *S. brevibracteata* and *S. albiflora* are regarded as closely related species[1], *S. albiflora* appears to be a distinct species in the genus on account of its white corolla (Figure 8). *S. brevibracteata* is mainly differs from *S. leptoclada* in its small bracts and corolla (Figures 5-7). Further diagnostic morphological characteristics determined in this study were given comparatively in Table 1.

We have compared our findings with those in The Flora of Turkey and East Egaean Islands[1] as well. According to mentioned reference, *S. leptoclada* is 20-60 cm and white-tomentose below, middle cauline leaves are rounded and semiamplexicaul, middle bracts are orbicular to cordate, renifom, 0.9-1.5 cm, calyx teeth is with 0.5 mm yellowish mucro. In our study, we have determined that stem is 20-70 cm and white-tomentose below but also glandular, middle cauline leaves are attenuate or amplexicaul at base, middle bracts are orbicular to renifom, 0.9-1.8 x 1-1.3 cm, calyx teeth is with 0.5-1 mm yellowish mucro (Figures 2-4). According to Huber-Morath[1], middle cauline leaves of *S. brevibracteata* is linear-oblong, 1-2.5 x 0.2-0.6 cm, cuneate, acutish, verticillasters are 5-15, 1-4,5 cm distant, middle bracts are cuspidate (1-3 mm), calyx teeth is 2-2.5 mm, corolla is subglabrous while we have determined that middle cauline leaves of *S. brevibracteata* is linear-oblong but also linear, linear-obovate, sometimes linear-falcate, (1-)2.1-3.6 x (0.2-)0.6-0.8 cm, acute-obtuse, verticillasters are 3-15, 2-4,5 cm distant, middle bracts includes 1-2 mm acumen, calyx teeth is 2-3 x 1mm, corolla is eglandular (Figures 5-7). *S. albiflora* was reported to be 50-60 cm long, and stem is densley adpressed white tomentose, soon glabrescent, middle cauline leaves linear-onlong, verticillasters are 2-11 cm distant, middle bracts are ovate to orbicular. According to our findings, stem of *S. albiflora* is 50-77 cm, densley adpressed white tomentose but also glandular above, middle cauline leaves linear-onlong, verticillasters are (2.5)4.5-6 cm distant, middle bracts are ovate to orbicular but also somtimes reniform (Figures 8-10). In addition, all bracts of *S. albiflora* are ciliate which is a diagnostic value in the genus *Sideritis* and has not been mentioned in the Flora of Turkey (Figures 9).

TABLE 1

Comparison of morphological characteristics of *S. leptoclada, S. brevibracteata* and *S. albiflora*

	S. leptoclada	***S. brevibracteata***	***S. albiflora***
Stem	eglandular and glandular	eglandular	eglandular and glandular
Leaves	eglandular and glandular	eglandular	eglandular
lower leaves	elliptic-oblanceolate, linear-oblanceolate, attenuate at base	spatulate, obovate, oblanceolate, attenuate at base	linear, linear-oblong, sometimes ± falcate, ± auriculate at base
middle leaves	not linear-falcate, attenuate or amplexicaul at base	linear-falcate, often enlarged and ± auriculate at base	not linear-falcate, enlarged and auriculate at base
upper leaves	not falcate or subulate, rounded or ± amplexicaul at base	falcate or subulate, auriculate at base	not falcate or subulate, enlarged and auriculate at base
Internodes	3.5-6.5(-7.5) cm above	4-6.5 cm. above	5.5-8(10 cm) cm above
Verticillasters	4-8	3-15	3-10
Bracts	glandular and eglandular	eglandular	eglandular and glandular
lower bracts	lanceolate, 1.5-2 x 0.6-0.8 cm	ovate, orbicular-reniform, 0.7-1.2 x 0.9-1.2 cm including 1.5-3 mm acumen	ovat-cordate, 1.3-3 x 0.8-1.4 cm
middle bracts	0.9-1.8 x 1-1.3 cm including 3-7 mm acumen	0.6-0.8 x 0.8-1 cm including 1-2 mm acumen	0.9-2 x 0.9-1.5 cm including 5-10 mm acumen
upper bracts	0.9-1.4 x 0.9-1.2 cm including 3-5 mm acumen, not red suffused	0.4-0.6 x 0.5-0.8 cm, red suffused	0.7-1.1 x 0.7-1 cm, including 2-3(3.5) mm acumen, not red suffused
Calyx	teeth triangular-lanceolate, not brownish-red	teeth linear, brownish-red	teeth triangular, not brownish-red
Corolla	yellow, 9-12 mm, eglandular hairs dense, interruptedly hairy under filaments, upper lobe with brown striae inside	yellow 9-10 mm, eglandular hairs not dense, with a uniform ring of hairs inside under filaments, upper lobe with brown striae inside	white, 10-12 mm, eglandular hairs not dense, interruptedly hairy under filaments, upper lobe without brown striae inside

Habitat of *S. leptoclada*, *S. brevibracteata* and *S. albiflora* were reported to be *Pinus brutia* forest, serpentine rocks, conglomerate ledges and scree, s.l.-800m; rocky limestone slopes, 30-80 m and conglomerate scree, limestone cliffs, *Quercus* scrub, macchie, s.l.-800 m, respectively[1]. In addition to these habitats, during our studies, we have determined that *S. leptoclada* also grows near *Cedrus* forest, macchie and phrygana, from sea level to 1800 m, *S. brevibracteata* occurs near macchie and phrygana, on calcareous rocks between 30-250 m, *S. albiflora* occurs near marly stepe, open *P. brutia* forest, serpentine up to 1000m.

Sideritis species are usually named Ada çayı (Island tea), Dağ çayı (Mountain tea) and Yayla çayı (Plateau tea) in Turkey. During our floristic studies, we have determined that local names Kızlan and Kırtıl are used for *S. leptoclada* while *S. brevibracteata* and *S. albiflora* are known as Dağ çayı and Bozlan çayı, respectively. Dried florescens of these endemic species are also frequently used to make herbal tea in Anatolia, therefore, plants are heavily collected from nature in flowering times. In the Red Data Book of Turkish Plants[12], conservation status of *S. brevibracteata* was reported as "Vulnerable (VU)" while *S. leptoclada* and *S. albiflora* were classified as "Lower Risk (LR) conservation dependent (cd)". According to new IUCN Red List Category[13], species are classified based on the "extent occurence, area of occupancy and number of locations or subpopulations. Regarding these criteria, *S. brevibracteata* could be evaluated as "Critically Endangered (CR)" since its extent of occurence is not more than 100 km^2, area of occupancy is estimated to be less than 10 km^2 and one fragmented location is known. Both *S. leptoclada* and *S. albiflora* could be regarded as "Vulnerable (VU)" since their extent of occurence is not more than 20,000 km^2, area of occupancy is estimated to be less than 2,000 km^2 and fewer than 10 fragmented locations are known.

Conclusions

S. leptoclada, *S. brevibracteata* and *S. albiflora,* which belong to section *Empedoclia* and endemic to Turkey, are used as herbal tea in Turkish folk medicine. In the Flora of Turkey and East Aegean Islands, these species were reported to be closely related. This study provides detailed diagnostic morphological characters of these species. Botanical features of inflorescens, internodes, upper and lower leaves and bracts, which have great value in the identification of each species, were presented in this study for the first time. In addition, as a result of our floristic studies, it appears that the habitat of three species has widened.

It is a fact that demand for medicinal and aromatic plants is increasing and wild crafting of herbs is expected to continue. Therefore, cultivation of these endemic plants, which are categorized as "Critically Endangered (CR)" and "Vulnerable (VU)" in this study and is also of commercial importance as they are sold in the market as herbal tea, seems to be necessary.

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Abstract

The taxonomy of *Sideritis* L. (Labiatae) section *Empedoclia* (Rafin) Bentham in Turkey is notoriously problematic and reliable discriminating characters for species identification are missing. In this study, we have explained detailed morphological characteristics of three related endemic *Sideritis* species, *S. leptoclada* O. Schwarz & P.H. Davis, *S. brevibracteata* P.H. Davis and *S. albiflora* Hub.-Mor., which belong to section *Empedoclia* and used as herbal tea. Diagnostic morphological characters of various organs, such as stem, leaf, bract and flower, were illustrated and results were given comparatively. In addition, chorology and habitat of three species were evaluated and their conservation status were disscussed.

Keywords: Labiatae, *Sideritis*, *Empedoclia*, *S. leptoclada*, *S. brevibracteata*, *S. albiflora*, endemic, morphology, Turkey.

Özet

***Empedoclia* (Rafin) Bentham Seksiyonuna ait ve Taksonomik Olarak Yakın Üç Sideritis L. Türü Üzerinde Karşılaştırmalı Morfolojik Araştırmalar**

Türkiye'de yetişen *Sideritis* L. (Labiatae) cinsine ait *Empedoclia* (Rafin) Bentham seksiyonu taksonomik olarak oldukça problemli bir seksiyondur olup, bu seksiyonda yer alan türlerin teşhisi için gerekli olan ayırıcı karakterler tam olarak ortaya konmamıştır. Bu çalışmada, *Empedoclia* Seksiyonunda yer alan, taksonomik olarak birbirine yakın olan ve bitkisel çay olarak kullanılan üç endemik *Sideritis* türü; *S. leptoclada* O. Schwarz & P.H. Davis, *S. brevibracteata* P.H. Davis and *S. albiflora* Hub.-Mor.'un morfolojik özellikleri detaylı olarak belirlenmiştir. Gövde, yaprak, brakte ve çiçek gibi değişik

organların ayırıcı morfolojik karakterleri çizimler ve fotograflarla gösterilmiş, sonuçlar karşılaştırmalı olarak verilmiştir. Ayrıca türlerin korolojileri ve habitatları değerlendirilerek koruma statüleri tartışılmıştır.

Anahtar kelimeler: Labiatae, *Sideritis*, *Empedoclia*, *S. leptoclada*, *S. brevibracteata*, *S. albiflora*, endemik, morfoloji, Türkiye.

REFERENCES

1. Huber-Morath A. "*Sideritis* L.", Davis P.H. (ed), Flora of Turkey and The East Aegean Islands, Edinburgh, University Press (1982), Volume 7, 178-199.
2. Obon De Castro, C., Nunez, D.R. A Taxonomic Revision of the Section *Sideritis* (Genus *Sideritis*) (Labiatae), Berlin-Stuttgart, Cramer, (1994).
3. Apostolos, G,: Genetic studies on Greek Mountain Tea (*Sideritis* L.), Lamiales Newsletter, 5, 8 (1997).
4. Şahin, F.P., Duman, H., Ezer, N.: Comparative morphological investigation of *Sideritis* Species I: *Sideritis bilgerana* P.H. Davis, *Sideritis hispida* P.H. Davis. FABAD Journal of Pharmaceutical Sciences, 30, 182 (2005).
5. Şahin, F.P., Duman, H., Çalış, İ., Ezer, N.: Botanical properties of a herbal tea: *Sideritis stricta* Boiss. & Bal. apud Bentham, FABAD Journal of Pharmaceutical Sciences, 30, 190 (2005).
6. Şahin, F.P., Duman, H., Ezer, N.: Comparative Morphological Investigation of *Sideritis* Species II: *S. cilicica Boiss. & Bal. & S. niveotomentosa Hub.-Mor.*, Turkish Journal of Pharmaceutical Sciences, 5, 35 (2008).
7. Davis, P.H., Mill, R.R., Tan, K. Flora of Turkey and the East Aegean Islands, Edinburgh, University Press (1988), Volume 10, 203.
8. Duman, H. "*Sideritis* L.", Güner A. Özhatay N. Ekim T. & Başer K.H.C. (eds), Flora of Turkey and The East Aegean Islands (supplement II), Edinburgh, University Press (2000). Volume 11, 201-204.
9. Aytaç, Z., Aksoy, A.: A new *Sideritis* species (Labiatae) from Turkey. Flora Meditterraneana, 10, 181 (2000).
10. Çelebioğlu, S., Baytop, T.: Bitkisel tozların tetkiki için yeni bir reaktif, Farmakolog, 19, 301 (1949).
11. Duman, H., Kırımer, N., Ünal, F., Güvenç, A., Şahin F.P., Türkiye *Sideritis* L. Türlerinin Revizyonu, Tübitak Projesi, TBAG-1853, 2005.
12. Ekim, T., Koyuncu, M., Vural, M., Duman, H., Aytaç, Z., Adıgüzel, N.: Türkiye Bitkileri Kırmızı Kitabı (Eğrelti ve Tohumlu Bitkiler), Van, Türkiye Tabiatını Koruma Derneği ve Yüzüncü Yıl Üniversitesi (2000).
13. IUCN: IUCN Red List Categories: Version 3.1., Gland, Switzerland, Cambridge, IUCN Species Survival Comission.