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# ANATOMICAL STUDIES ON SOME MEDICINAL *SALVIA* L. SPECIES*

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## SUMMARY

Herbaceus stems and leaves of *Salvia aethiopis* L., *S. virgata* Jacq. and *S. dichroantha* Stapf (endemic) which are medicinal plants, collected from Eskişehir has been studied anatomically.

In herbaceus stems, cortex is collenchymatic and parenchymatic in all investigated species. Vascular system consisting of a complete cylinder of xylem surrounded by phloem. Covering hairs are simple and unicellular or multicellular. Glandular trichomes are capitate and peltate type. The presence of amylum in the inner layer of cortex of *S. aethiopis* and the druse and prismatic crystals in the pith parenchyma of *S. virgata* are characteristic. On the other hand, some differences are found in glandular and non-glandular hairs and medullary rays of the examined species also. Leaves are dorsiventral and amphistomatic in all studied species. The covering and glandular hairs of leaves are similar to those on the stems.

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## ÖZET

*Salvia aethiopis* L., *S. virgata* Jacq. ve *S. dichroantha* Stapf (endemik) tıbbi türlerdir. Eskişehir'den toplanan örneklerin otsu gövde ve yaprakları anatomik olarak incelenmiştir.

İncelenen bütün türlerin otsu gövdelerinde korteks kollenkimatik ve parenkimatiktir. Vasküler sistemde floem ve ksilem kesintisiz silindir şeklindedir. Örtü tüyleri basit, bir ve çok hücrelidir. Salgı tüyleri kapitat ve peltat tiptedir. *S. aethiopis*'de korteksin en iç tabakasının nişasta taşıması ve *S. virgata*'nın öz parenkimasında bulunan druz ve prizmatik kristaller karakteristiktir. Bunların dışında türlerin örtü ve salgı tüyleri ile öz kollarında da türler arasında bazı farklılıklar saptanmıştır. Yapraklar ise incelenen türlerin tümünde dorsiventral ve amfistomatiktir. Örtü ve salgı tüyleri gövdedekilere benzerdir.


**Key words:** Lamiaceae, *Salvia*, Anatomy.

## INTRODUCTION

The genus *Salvia* L. (Lamiaceae) is widely distributed in middle of America, southwest and east Asia with it's about 900 species (1, 2). The genus is represented by 88 species and 92 taxa in Turkey and 45 of them are endemic, endemism ratio is 51% (1,3). In addition to the taxanomical researchers about this genus, studies on nutlet ornemantation (4), nutlet anatomy (5), musilage of *Salvia* fruits (6) and morpho-anatomical and histochemical properties have also been realized (7). Few morphological, anatomical and karyological studies are present about the *Salvia* species growing in Turkey (8-12).

*S. aethiopis* L., *S. virgata* Jacq. and *S. dichroantha* Stapf (endemic) are perennial herbs and used as medicinal plants in folk medicine (13-14). The anatomical structure of these species had not yet been studied. The aim of this work is therefore to describe the anatomy of the herbaceus stems and leaves of these species comparatively.

## MATERIAL and METHOD

Plant material was collected from Eskişehir. Voucher specimens are deposited at the Herbarium of the Faculty of Pharmacy of Anadolu University, Eskişehir (ESSE). Permanent microscobic preparations were made of plant material fixed in the field in

70% alcohol. Cross and surface sections of the plant leaf and stem were made by hand and stained with Sartur solution (15). Anatomical studies were made using a Leitz SM-LUX binocular light microscope with a drawing tube.

## RESULTS and DISCUSSION

### Herbaceus stem (Figs 1-3)

In cross sections, the stem is rectangular in all species (Figs 1A-3A). Epidermis: one layered and with a thin cuticle, composed of roundish-oval cells in *S. aethiopis* and *S. dichroantha* (Figs 1B, 3B); compressed cells in *S. virgata* (Fig. 2B); the outer and inner tangential walls are thicker than the anticlinal walls (Figs 1B-3B). There are covering and glandular hairs on the epidermis. Covering hairs: uniseriat, straight or recurved, 3-7 celled in *S. aethiopis* (Fig. 7Aa), 1-6 celled in *S. virgata* and *S. dichroantha* (Fig. 7Ba, Ca). Glandular hairs: head and stalk unicellular and multicellular; head 1 stalk long or short, 1-2 celled, also head multicellular peltate hairs in *S. aethiopis* (Fig. 7Ab); head 1 stalk 1-3 celled; head 2 stalk 1 celled in *S. virgata* (Fig. 7Bb); head 1 stalk 1-3 celled, head 2 stalk 1 celled, head 8 celled (Labiatae type) in *S. dichroantha* (Fig. 7Cb). Cortex: parenchymatous (with both chlorenchyma and colourless parenchyma) with well-defined groups of collenchyma in the four angles; lisigen cavities present in the parenchyma tissue. Inner layer of the cortex (1-2 cells layer) contains starch grains in only *S. aethiopis* (Fig. 1B). Pericyclic region: composed of groups of fibres interspersed with parenchyma. Vascular system: consisting of a complete cylinder of xylem surrounded by phloem. Cambium: indistinct, Medullary rays: 1-5 cells wide in *S. aethiopis* and *S. virgata* (Figs 1B-2B); 1-2 cells wide in *S. dichroantha* (Fig. 3B). Pith: Parenchymatous and covers a large area; druse and prismatic crystals were observed in only pith parenchyma cells of *S. virgata* (Fig. 2B).

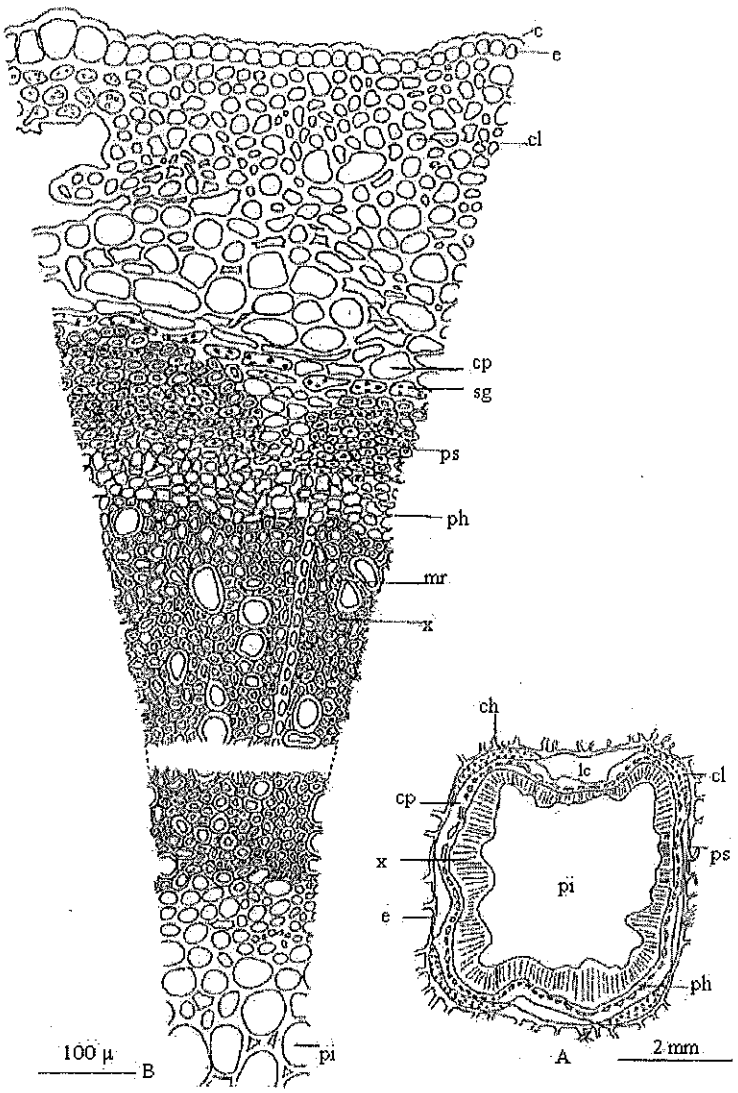


**Fig. 1.** *S. aethiopis* (ESSE 13627) Cross section of herbaceous stem:
A diagrammatic, B detail from A, c: cuticle, e: epidermis, cl: collenchyma, cp: cortex parenchyma, sg: starch grain, ps: pericyclic sclerenchyma, ph: phloem, mr: medullary ray, x: xylem, pi: pith, ch: covering hair, lc: lisigen cavity.

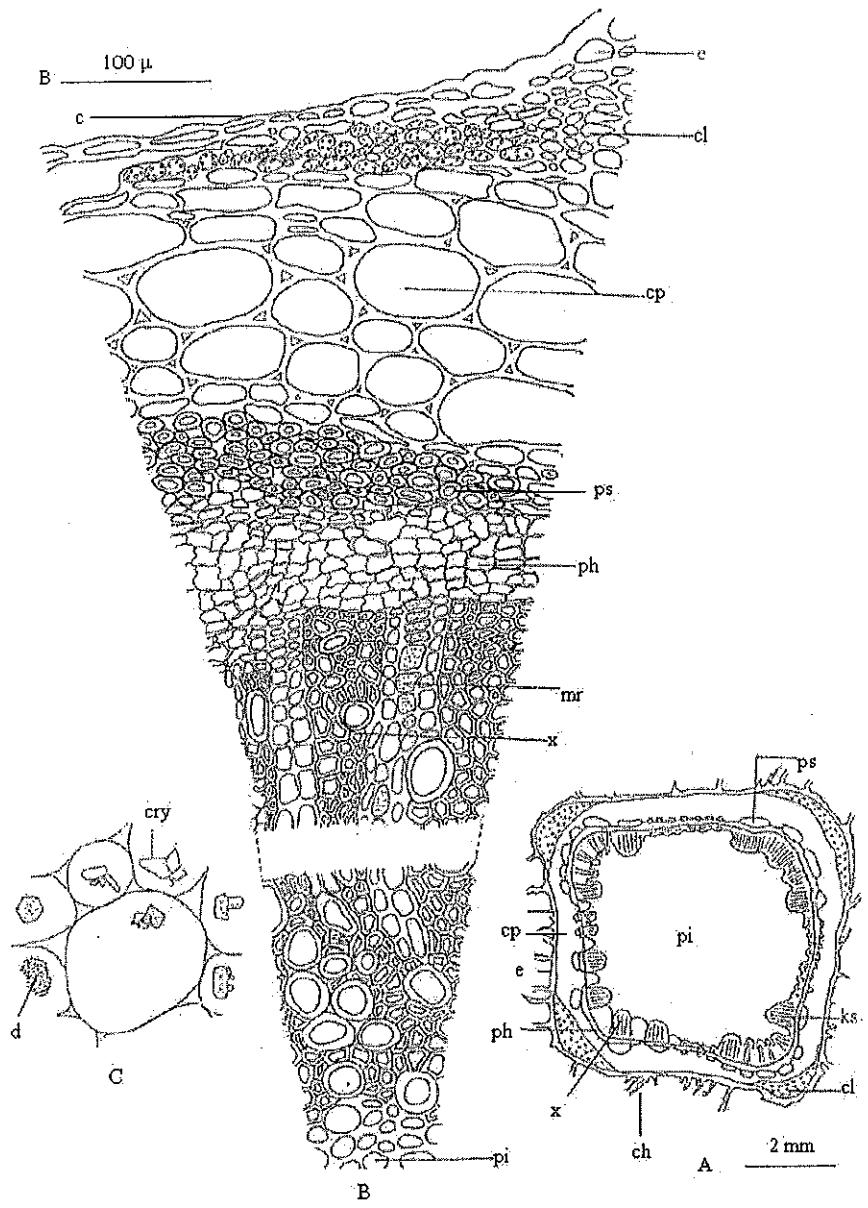


**Fig. 2.** *S. virgata* (ESSE 13628) Cross section of herbaceous stem:
A diagrammatic, B detail from A, C prismatic crystals and druse in the pith parenchyma, c: cuticle, e: epidermis, cl: collenchyma, cp: cortex parenchyma, ps: pericyclic sclerenchyma, ph: phloem, mr: medullary ray, x: xylem, pi: pith, cry: prismatic crystal, d: druse, ch: covering hair.

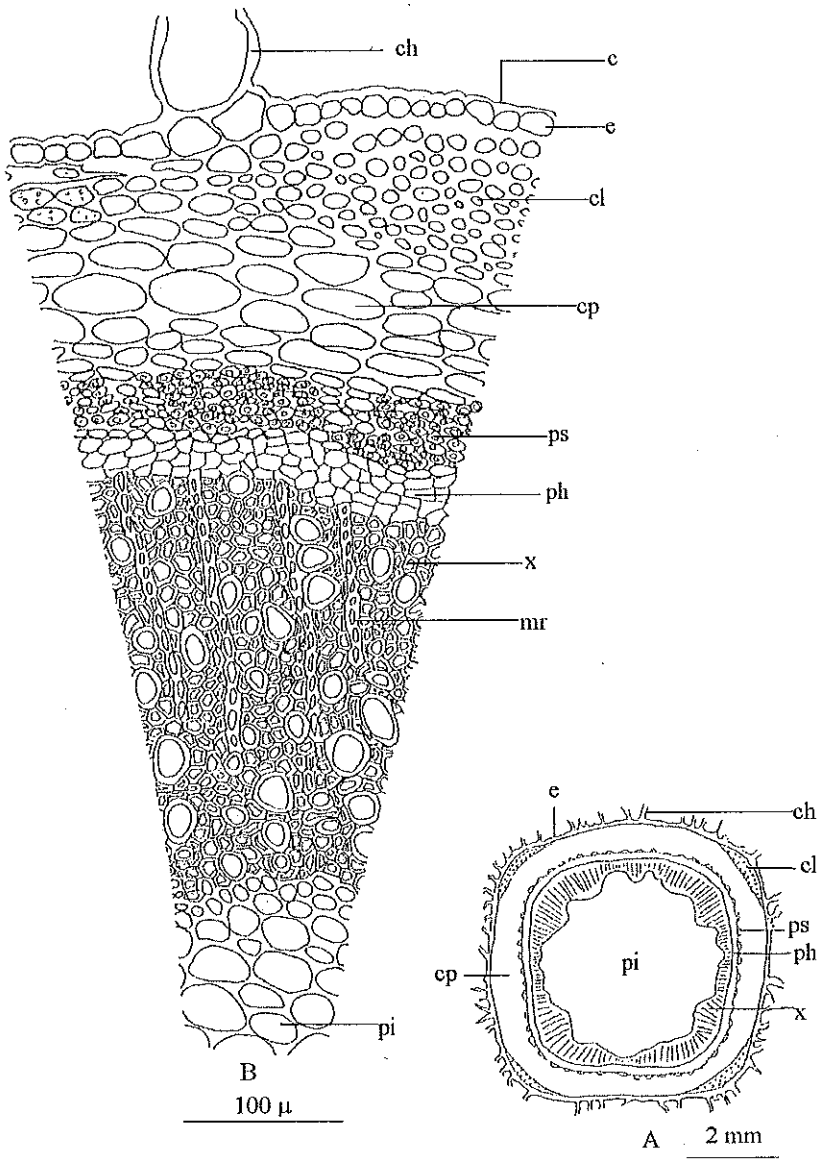


**Fig. 3.** *S. dichroantha* (ESSE 13320) Cross section of herbaceous stem:
A diagrammatic, B detail from A, ch: covering hair, c: cuticle, e: epidermis, cl: collenchyma, cp: cortex parenchyma, ps: pericyclic sclerenchyma, ph: phloem, x: xylem, mr: medullary ray, pi: pith.

**Leaf (Figs 4-6)**

In cross sections, epidermis is one layered and has roundish or rectangular cells with a thin cuticle; the cells of upper side are larger than lower side and the outer tangential walls are thickened (Figs 4B-6B), the anticlinal cell walls are sinuous in the lower side and are almost straight in the upper side (Figs 4CD-6CD). Covering and glandular hairs were observed on both upper and lower epidermis. Covering hairs: uniseriate, straight or recurved, 1-7 celled with smooth cuticle in *S. aethiopis* (Fig. 8Aa); 1-4 celled with rough cuticle in *S. virgata* (Fig. 8Ba); 1-6 celled with rough or smooth cuticle in *S. dichroantha* (Fig. 8Ca). Glandular hairs: head 1 stalk 1-2 celled and head 8 celled (Labiatae type) in *S. aethiopis* (Fig. 8Ab); head 1 stalk 1-3 celled, head 2 stalk 1 celled in *S. virgata* (Fig. 8Bb); head 1 stalk 1-3 celled, head 2 stalk 1 celled, head 8-9 celled peltate hairs in *S. dichroantha* (Fig. 8Cb). Stomata: the leaves amphistomatic, with diacytic stomata (Figs 4B-6B) superfacial or slightly raised above the epidermal level (Figs 4CD-6CD) and more numerous on the lower side of the leaf. Mesophyll: bifacial, palisade tissue 2-layered, spongy parenchyma 3-4 layered (Figs 4B-6B). Midrib: prominent arced in lower side. Below the upper and lower epidermis, there is a collenchyma tissue a few layered. Vascular bundles are collateral and phloem in the abaxial, xylem in the adaxial direction. Collenchymatic bundle caps present in the xylem and phloem poles.

According to our anatomical findings, there are some differences among the studied species and these are indicated in the Table 1. The presence of amylum in the most inner layer of the cortex of *S. aethiopis* and the druse and prismatic crystals in the pith parenchyma of *S. virgata* are charactersitic. On the other hand, some differences are found in glandular and non-glandular hairs and medullary rays of the examined species also. This study has revealed that anatomical findings can be used in determination of the *Salvia* species. Otherwise, our results also show some differences and similarities with other species of the genus *Salvia* (7-9, 16).

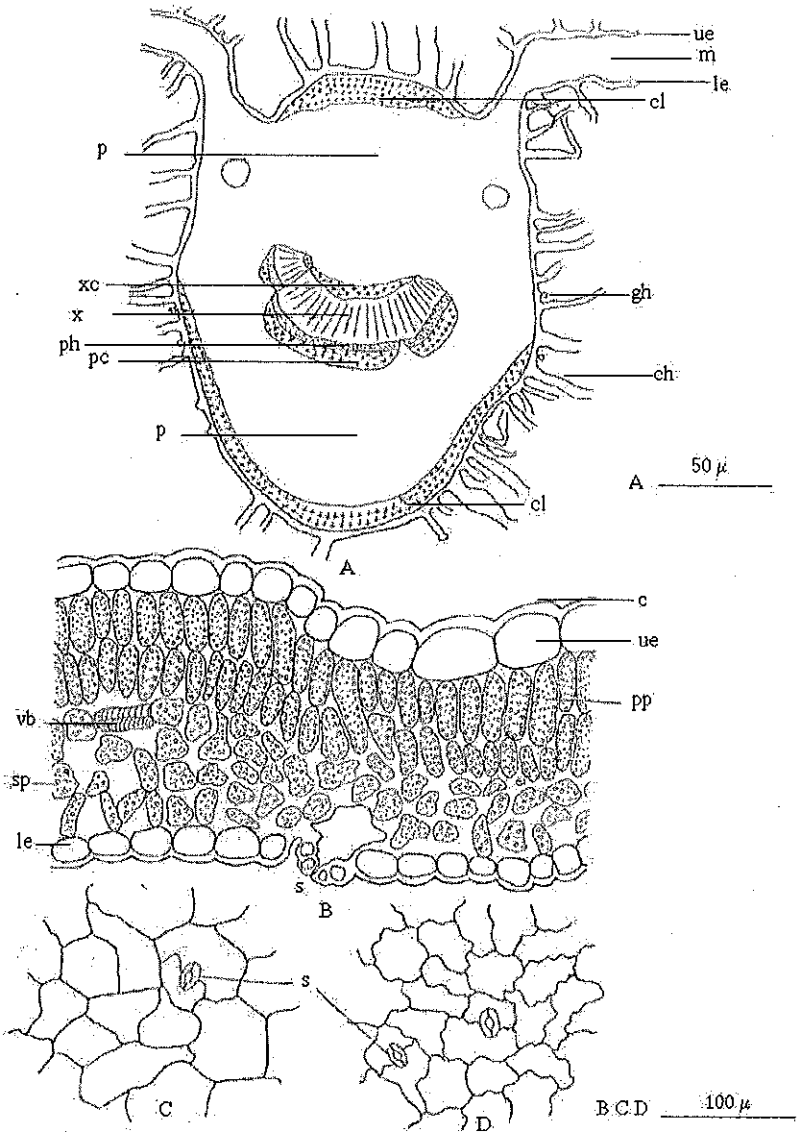


**Fig. 4.** *S. aethiopis* (ESSE 13627) Cross section of the leaf: A diagram of the midrib, B detail from intervessel area; surface views of epidermis: C upper epidermis, D lower epidermis, ue: upper epidermis, m: mesophyll, le: lower epidermis, cl: collenchyma, gh: glandular hair, ch: covering hair, p: parenchyma, pc: phloem collenchyma, ph: phloem, x: xylem, xc: xylem collenchyma, c: cuticle, pp: palisade parenchyma, s: stoma, sp: spongy parenchyma, vb: vascular bundle.

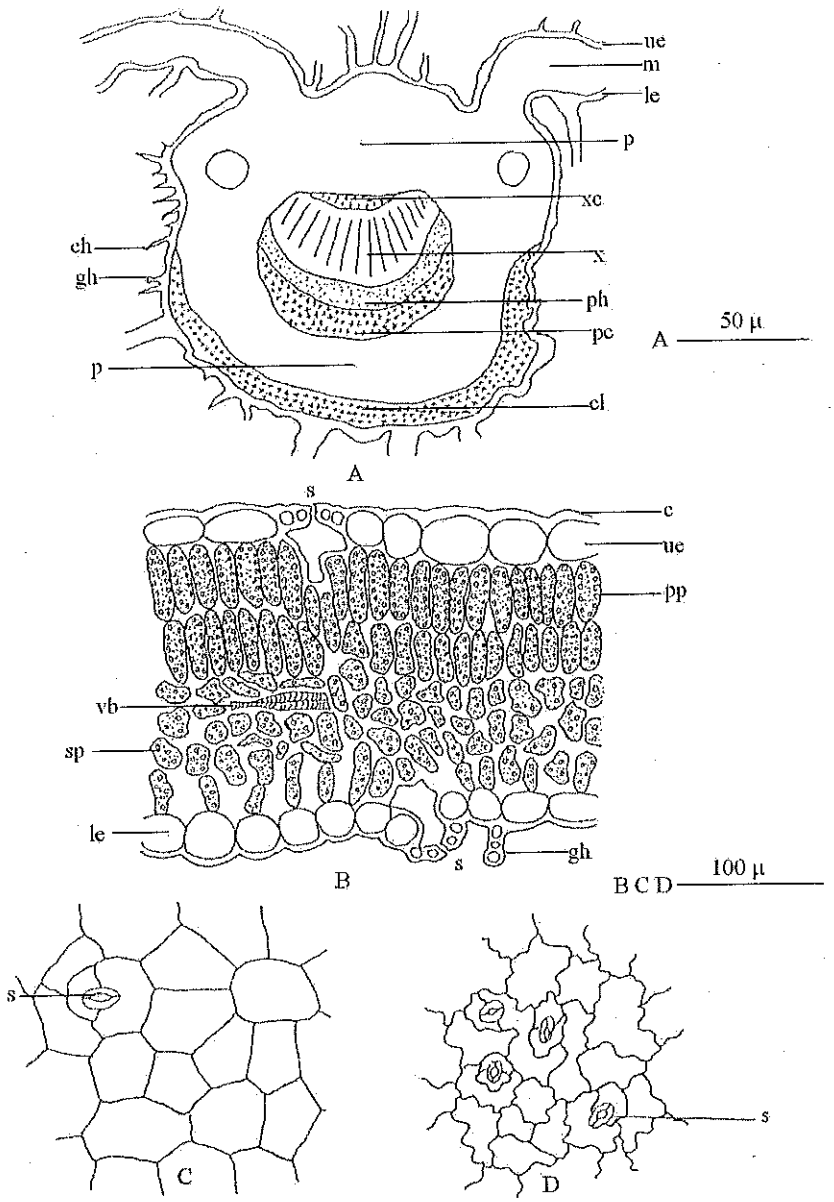


**Fig. 5.** *S. virgata* (ESSE 13627) Cross section of the leaf: A diagram of the midrib, B detail from intervessel area; surface views of epidermis: C upper epidermis, D lower epidermis, ue: upper epidermis, m: mesophyll, le: lower epidermis, p: parenchyma, xc: xylem collenchyma, x: xylem, ph: phloem, pc: phloem collenchyma, cl: collenchyma, gh: glandular hair, ch: covering hair, s: stoma, c: cuticle, pp: palisade parenchyma, sp: spongy parenchyma, vb: vascular bundle.

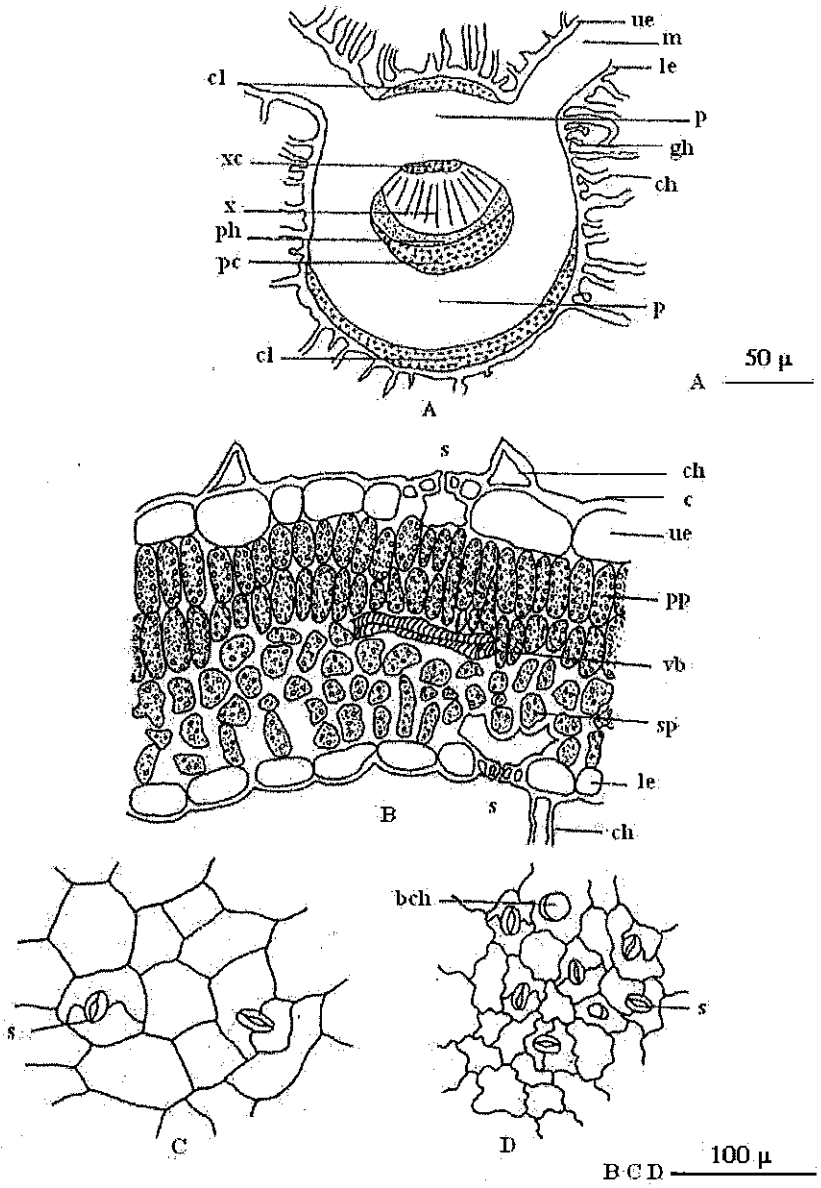


**Fig. 6.** *S. dichroantha* (ESSE 13320) Cross section of the leaf: A diagram of the midrib, B detail from intervessel area; surface views of epidermis: C upper epidermis, D lower epidermis, ue: upper epidermis, m: mesophyll, le: lower epidermis, p: parenchyma, gh: glandular hair, ch: covering hair, cl: collenchyma, pc: phloem collenchyma, ph: phloem, x: xylem, xc: xylem collenchyma, s: stoma, c: cuticle, pp: palisade parenchyma, vb: vascular bundle, sp: spongy parenchyma, bch: base of covering hair.

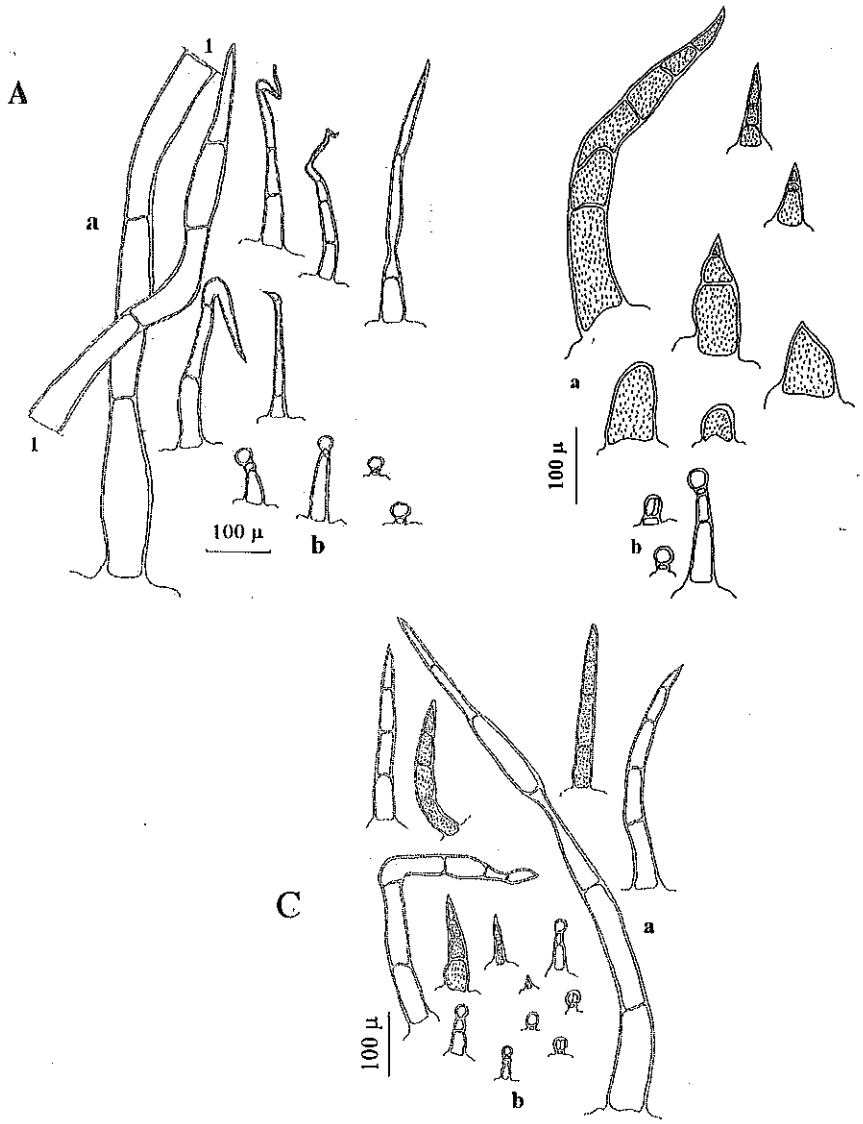


**Fig. 7.** Stem hairs. A: *S. aethiopis*, B: *S. virgata*, C: *S. dichroantha* a: covering hairs, b: glandular hairs.

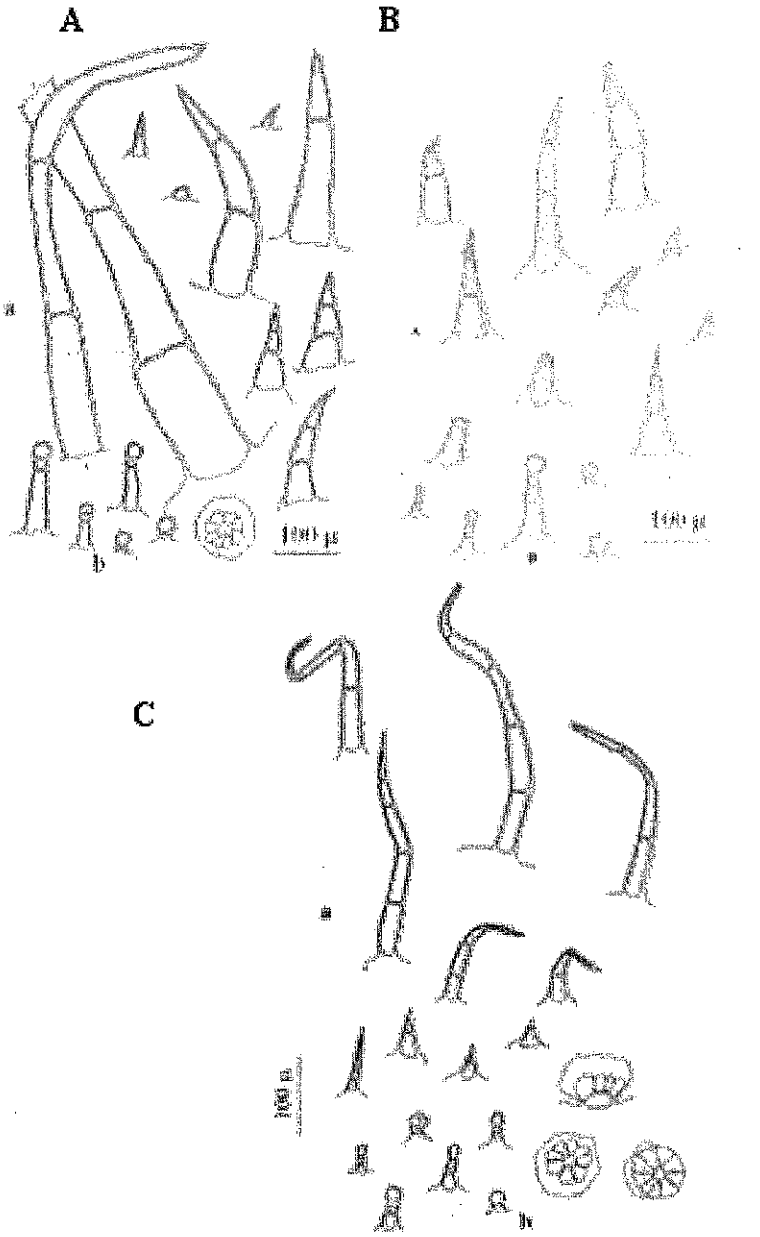


**Fig. 8.** Leaf hairs. A: *S. aethiopis*, B: *S. virgata*, C: *S. Dichroantha* a: covering hairs, b: glandular hairs.

**Table 1:** Anatomical differences of the species.

| | *S. aethiopis* | *S. virgata* | *S. dichroantha* |
|---|---|---|---|
| Crystal | ——— | Pith parenchyma contains prismatic crystals and druse. | ——— |
| **Starch** | The most inner layer of the cortex contains starch grains. | ——— | ——— |
| **Covering hairs in the stem** | 3-7 celled, with smooth cuticle. | 1-6 celled, with rough cuticle. | 1-6 celled, with rough or smooth cuticle. |
| **Covering hairs in the leaf** | 1-7 celled, with smooth cuticle. | 1-4 celled, with rough cuticle. | 1-6 celled, with rough or smooth cuticle. |
| **Glandular hairs in the stem** | Head 1 stalk 1-2 celled; head multicellular peltate hair. | Head 1 stalk 1-3 celled; head 2 stalk 1 celled. | Head 1 stalk 1-3 celled; head 2 stalk 1 celled; head 8 celled peltate hair. |
| **Glandular hairs in the leaf** | Head 1 stalk 1-2 celled; head 8 celled (peltate hair). | Head 1 stalk 1-3 celled; head 2 stalk 1 celled. | Head 1 stalk 1-3 celled; head 2 stalk 1 celled; head 8-9 celled peltate hairs. |
| **Medullary rays** | 1-5 cells wide. | 1-5 cells wide. | 1-2 cells wide. |

**Specimens examined:**

***Salvia aethiopis* L.**

**B3 ESKİŞEHİR:** Anadolu University, Yunusemre Campus, 10.6.1988, A. Kaya, ESSE 8402! Eskişehir to Bozüyük 20$^{th}$ km, 17.6.1990, A. Kaya, ESSE 9029! Bozdağ, 18.7.1987, K. H. C. Başer, ESSE 7879! Vicinity of Yörük Kırkabey village, meadow, 3.6.1984, M. Diri, H. Soker, ESSE 6434! Bozdağ 21$^{st}$ km, 6.6.1985, K. H. C. Başer, H. Malyer, M. Yıldırımlı, ESSE 7239! Faculty of Pharmacy to Academy, 6.6.1980, F. Koca, ESSE 7251! Yunusemre Campus, 8.6.1983, F. Koca, ESSE 3568! Bozdağ, Yarımca village, Bozaniç plateau, 16.6.1981, K. H. C. Baser, H. Malyer; ESSE 1104! Eskişehir to Kütahya, around the Aktaş bridge, roadside, 31.5.1999, İ. Eröz, ESSE 13322! Campus of Anadolu University, 1.6.1999, İ. Eröz, ESSE 13267! Aktaş water duct, 18.06.1999, İ. Eröz, ESSE 13323!

***S. virgata* Jacq.**

**B3 ESKİŞEHİR:** İnönü to Dutluca village, Hacımahmut environs, water duct to Aktaş, 4.6.1988, S. Kahya, ESSE 8607! Eskişehir to Bozüyük, 20$^{th}$ km. 17.6.1990,

A.Kaya, ESSE 9007! Gümele village to Akpınar village, near the quarry, İ. Eröz, ESSE 13268! Yunusköy, F. Koca, ESSE 13269!

***S. dichroantha* Stapf**

**B3 ESKİŞEHİR:** Mahmudiye, farm, meadow, 900 m, 10.7.1980, H. Malyer, ESSE 296! Kizilinler, Hakkıbey farm, 9.7.1989, K. H. C. Başer, A. Kaya, ESSE 8680! Oklubal village, İnönü road, 2nd km, İnönü to Kütahya, around the junction, 810 m, ESSE 11409! Sivrihisar, Yahşiyan village, 10.8.1992, ESSE 9762! Mahmudiye, farm, meadow, 900 m, 10.7.1980, ESSE 269! Musaözü-Takmak village, roadsides, İ. Eröz, ESSE 13319! Aktaş water duct, İ. Eröz, ESSE 13320! Kızılinler, Hakkıbey farm, İ. Eröz, ESSE 13321!

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