

ANATOMICAL FEATURES OF GENUS *PRUNELLA* L. GROWING IN TURKEY

Jehad H. AHMED, Nurten EZER*

Hacettepe University, Faculty of Pharmacy, Department of Pharmaceutical Botany,
06100 Sıhhiye -Ankara, TURKEY

Abstract

In this study, we have investigated anatomical characteristics of Prunella L. (Lamiaceae) species; Prunella vulgaris L., Prunella laciniata (L.) L. and Prunella orientalis Bornm. which are growing in Turkey. P. vulgaris among of them has been used for a long time against several diseases in traditional medicine. Anatomical studies were performed on transversal sections leaves and stems and powders of leaves. Figures were drawn, the original photographs were taken and the anatomical features were given comparatively. Also some distinctive characteristics which can be useful for the determination of the species, have been recorded. The anatomical properties of P. orientalis were represented for the first time in this study.

Key words: *Lamiaceae, Prunella, P. vulgaris, P. laciniata, P. orientalis, Anatomy.*

Türkiye’de Yetişen *Prunella* L. Cinsinin Anatomik Özellikleri

Bu çalışmada, Türkiye’de yetişen Prunella L. (Lamiaceae) türlerinin; Prunella vulgaris L., Prunella laciniata (L.) L. ve Prunella orientalis Bornm. anatomik özelliklerini incelenmiştir. Bu türlerden P. vulgaris halk ilacı olarak çeşitli hastalıklara karşı uzun zamandan beri kullanılmaktadır. Anatomik çalışmalar gövde ve yaprakların enine kesitleri ve yaprak tozu üzerinde gerçekleştirilmiştir. Şekilleri çizilmiş, orijinal fotoğrafları çekilmiş ve sonuçlar karşılaştırmalı olarak verilmiştir. Ayrıca türlerinin tayininde kullanılabilecek bazı ayırt edici karakterler kaydedilmiştir. P. orientalis’in anatomik özellikleri ilk defa bu çalışmada verilmiştir.

Anahtar Kelimeler: *Lamiaceae, Prunella, P. vulgaris, P. laciniata, P. orientalis, Anatomi*

*Correspondence: E-mail: nezer@hacettepe.edu.tr

“This article is dedicated to the memory of Pharm. Kürşat Avcı (M.Sc.), for his great contribution to collecting the plants.”

INTRODUCTION

The family Lamiaceae has an important role as a source of medicinal and aromatic plants. The genus *Prunella* L. (Lamiaceae) consists of 9 species, 2 subspecies and 1 variety in the world¹⁻⁴. In Turkey, *Prunella* genus is represented by 3 species; *Prunella vulgaris* L., *Prunella laciniata* (L.) L. and *Prunella orientalis* Bornm⁵.

P. vulgaris has been used against several diseases in traditional medicine in Europe and Asia for a long time. The infusions of *P. vulgaris* flowers were used against the mouth and thorax ulcers as gargle in Germany. While the inflorescences of *P. vulgaris* have been utilized as expectorant, the aerial parts of this plant have been used against hemorrhage, hemorrhoid, diarrhea and dysentery. Furthermore, the infusions of *P. vulgaris* were mixed with honey and used as tonic in Europe⁶⁻⁹. In India and China, *P. vulgaris* has been used against pulmonary disease, jaundice, liver inflammations and as antipyretic. Moreover, it has been used as laxative, anticough, antiparasitic, antirheumatic, against vertigo and hemorrhoid as well as for eye and ear diseases in India¹⁰⁻¹². In Ozbekistan, *P. vulgaris* is recorded as a plant which is useful in cardiovascular diseases¹³. Furthermore, *P. vulgaris* flowers have been reported as diuretic in Japan¹⁴. In Turkey, the aerial parts of *P. vulgaris* have been used as antirheumatic, antiarrhythmic and against common colds¹⁵.

The biological activities of *Prunella* species including antiinflammatory, antioxidant, antiallergic, antiviral, antihyperglycemic, antimutagenic, photoprotective and anticancer activities have been investigated^{3,4,11,16-20}. Furthermore, cosmetic products of *Prunella* species used as skin emulgent and hair tonic have been reported²¹⁻²³.

P. vulgaris and *P. laciniata* are widespread and approximately occurred in similar geographic regions, however, *P. orientalis* has a limited spread in the South and East Anatolia⁵. There is no anatomical information on three *Prunella* species growing in Turkey. However, only one preliminary anatomical study of *P. vulgaris* and *P. laciniata* growing in middle Europe has been reported²⁴. In this study, transversal sections of the leaves, stems and the elements of the powder of the leaves of these species were investigated. The findings of each species were compared with the reference records and with each other.

EXPERIMENTAL

Plant material: *Prunella vulgaris* and *Prunella laciniata* were collected at flowering time from Ankara, Beypazari, Karaşar, near Eğriova lake, 1400 m, 2.07.1999. *Prunella orientalis* Bornm. was collected at flowering time from Adana, Saimbeyli, Avcıpınar village, near the old quarry, 1350 m, 27.06.2000. The voucher specimens have been deposited at the Herbarium of Faculty of Pharmacy, Hacettepe University, Ankara, Turkey (HUEF 99050!, 99099!, 00025!).

The materials used for anatomical studies were fixed in 70 % alcohol. Anatomical studies were performed on the hand cut transversal sections of the leaves and stem and powders of leaves. Figures were drawn (Leitz SM-Lux Microscope and Leitz drawing tube) and the original photographs were taken (Olympus Bx 40 exposure control unit Olympus P.M.-20 with Olympus P.M.-C3PX photograph machine). All the preparations and sections were prepared with Chloralhydrate and Sartur reagents²⁵.

RESULTS

Prunella vulgaris

Stem is rectangular, however in transversal sections corresponding two sides are depressed and corners are thick. Epidermal cells are isodiametric and covered by cuticle. Under the

epidermis there is multilayered collenchyma that is well-developed. Collenchyma is 7-10 rowed in the corners and 1-3 rowed between them. Under the collenchyma, 3-6 rows of starch containing parenchyma cells and closed ring of elongated endodermis cells are observed. Phloem cells are small and crushed. Cambium is not distinguishable. Xylem consist of radially oriented tracheas and tracheids is well-developed and more wide in the corners. Pith rays and parenchyma cells are more distinct in the corners. Pith is wide with large parenchyma cells and some ergastic materials (Figure 1).

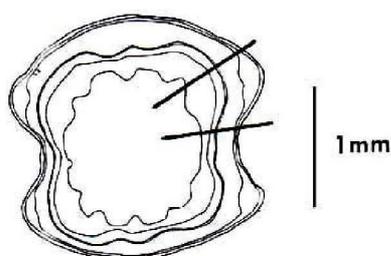
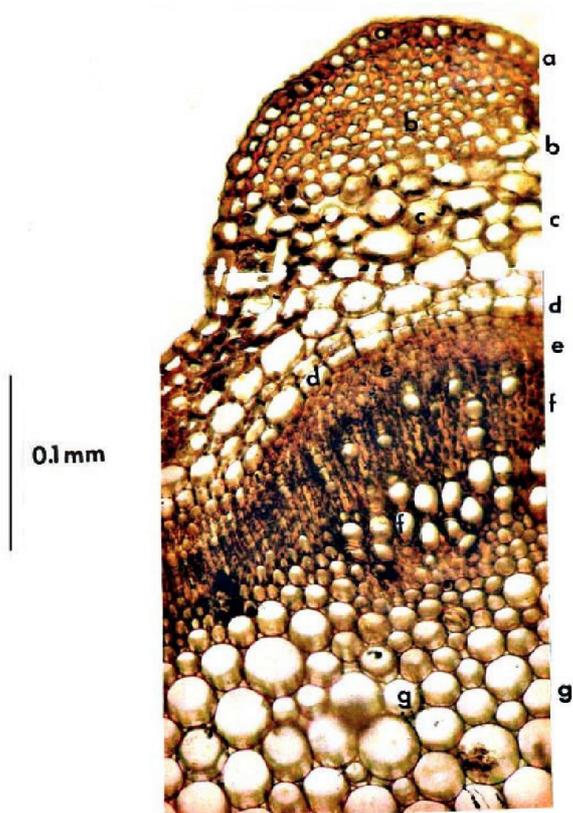


Fig. 1. Anatomical characteristics of *P. vulgaris* stem,
a. epidermis,
b. chollenchyma,
c. cortex parenchyma,
d. endodermis,
e. phloem
f. xylem,
g. pith parenchyma.



In transversal section of the leaves, upper and lower epidermal cells are covered by a thin cuticle. Epidermal cells are irregular, rounded or tetragonal in shape. The veins of the lower epidermis have very few non-glandular hairs and both epiderma have glandular hairs. Non-glandular hairs are simple, 1-2 celled conic or sometimes slightly curved, 3-8 celled of varying length. Glandular hairs are with head 1,2 celled and 1 celled, short stalk. Stomata are present in two surfaces but more abundant in the lower epidermis. The leaf is bifacial, palisade, usually consists of 2-3 rowed elongated parenchyma. Spongy is 2-4 rowed and consists of rounded parenchyma cells with large intercellular spaces (Figure 2,3).

In the powder of the leaves of *P. vulgaris*, wavy lower and upper epidermal cells with diacytic stomata, glandular hairs and very few non-glandular hairs are present (Figure 2).

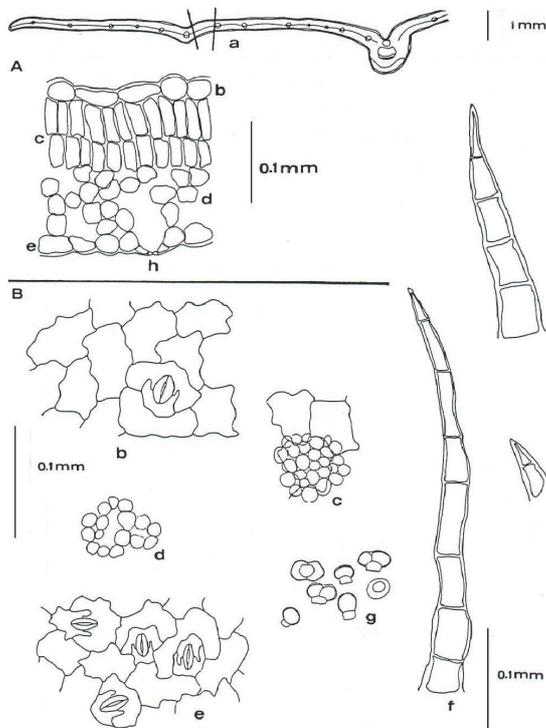


Fig. 2. Anatomical characteristics of *P. vulgaris* leaf, A. transversal section of the leaf, B. Leaf powder, a. general view of leaf transversal section, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. non-glandular hairs, g. glandular hairs, h. stomata.

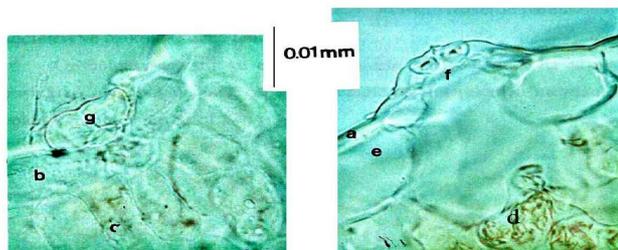


Fig. 3. Transversal sections of *P. vulgaris* leaf, a. cuticle, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. stomata, g. glandular hair.

Prunella laciniata

Stem is rectangular but in transversal sections corresponding two sides are depressed and corners are irregularly thick. Epidermal cells are isodiametric, wavy and covered by cuticle. Non-glandular hairs are 3–8 celled, sometimes articulate and long. Under the epidermis there is multilayered collenchyma that is well-developed and 6–8 raved in the corners and in the sides 1–2 raved. Under the collenchyma, 3–6 raws of starch containing rounded-oval parenchyma cells and closed ring of long, endodermis cells are observed. In the phloem, cells are crushed and small. Cambium is not distinguishable. Xylem consist of radially oriented tracheas and tracheids is well-developed, more wide and pith rays and parenchyma cells are more distinct in the corners. Pith is wide and consists of large parenchyma cells and some ergastic materials observed in parenchyma cells (Figure 4).

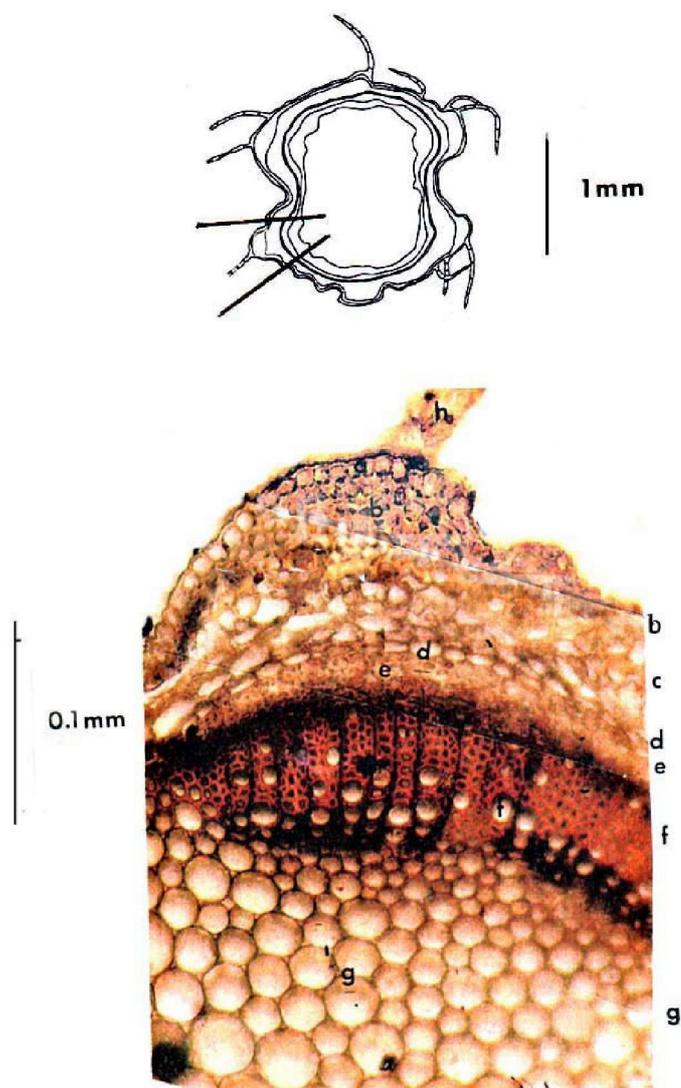


Figure 4. Anatomical characteristics of *P. laciniata* stem, a. epidermis, b. chollenchyma, c. cortex parenchyma, d. endodermis, e. phloem, f. xylem, g. pith parenchyma.

In transversal section of the leaves, upper and lower epidermal cells are covered by a thin cuticle. Epidermal cells are rounded or tetragonal in shape. Both epiderma have non-glandular and glandular hairs. Non-glandular hairs are simple, 3–8 celled, sometimes articulate of varying length and 1-2 celled conic or sometimes slightly curved. Glandular hairs are with head 1,2 celled, 1 celled, short stalk. Stomata are present in the two surfaces but more abundant in the lower epidermis. The leaf is bifacial and palisade, usually consists of elongated 2-4(5) rowed parenchyma. Spongy is 3-4 rowed and consists of rounded-oval parenchyma cells with large intercellular spaces. (Figure 5,6).

P. laciniata leaves powder contains lower epidermis and upper epidermis fragments with diacytic stomata, glandular hairs and abundant non-glandular hairs. The lower epidermis cells are more wavy than upper ones (Figure 5).

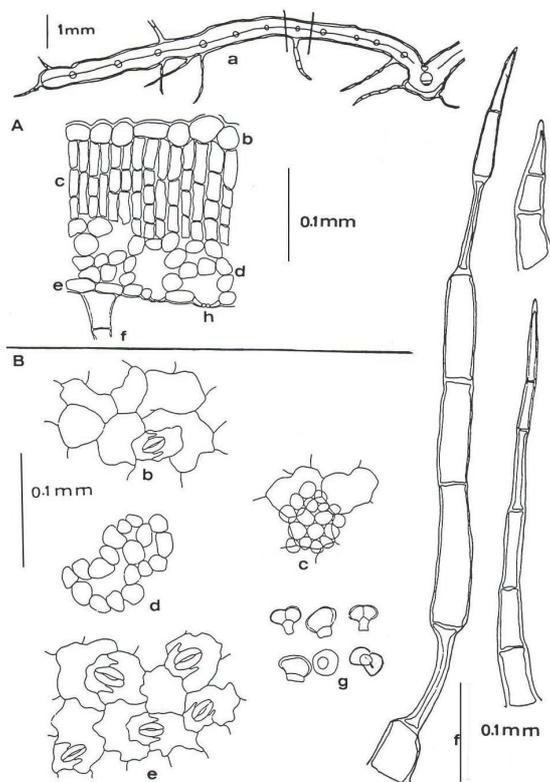


Fig. 5. Anatomical characteristics of *P. laciniata* leaf, A. transversal section of the leaf, B. Leaf powder, a. general view of leaf transversal section, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. non-glandular hairs, g. glandular hairs, h. stomata.

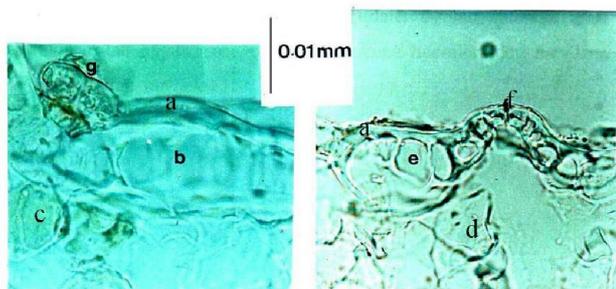


Fig. 6. Transversal sections of *P. laciniata* leaf, a. cuticle, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. stomata, g. glandular hair.

Prunella orientalis

Stem is rectangular, although in transversal sections corresponding two sides are depressed and corners are irregular thick. Epidermal cells are isodiametric and covered by cuticle, stomata and glandular hairs are rarely present. Further in corners, non-glandular hairs are 3-8 celled, sometimes articulate, long. Under the epidermis there is multilayered collenchyma that is well-developed. Collenchyma is 6-9 rowed in the corners and 1-2 rowed between the corners. Under the collenchyma, 3-6 rows of starch containing parenchyma cells and closed ring of elongated endodermis cells are observed. Phloem cells are small and crushed. Cambium is not distinguishable. Xylem consist of radially oriented tracheas and tracheids is well-developed and

more wide in the corners. Pith rays and parenchyma cells are more distinct in the corners. Pith is wide with large parenchyma cells and some ergastic materials (Figure 7).

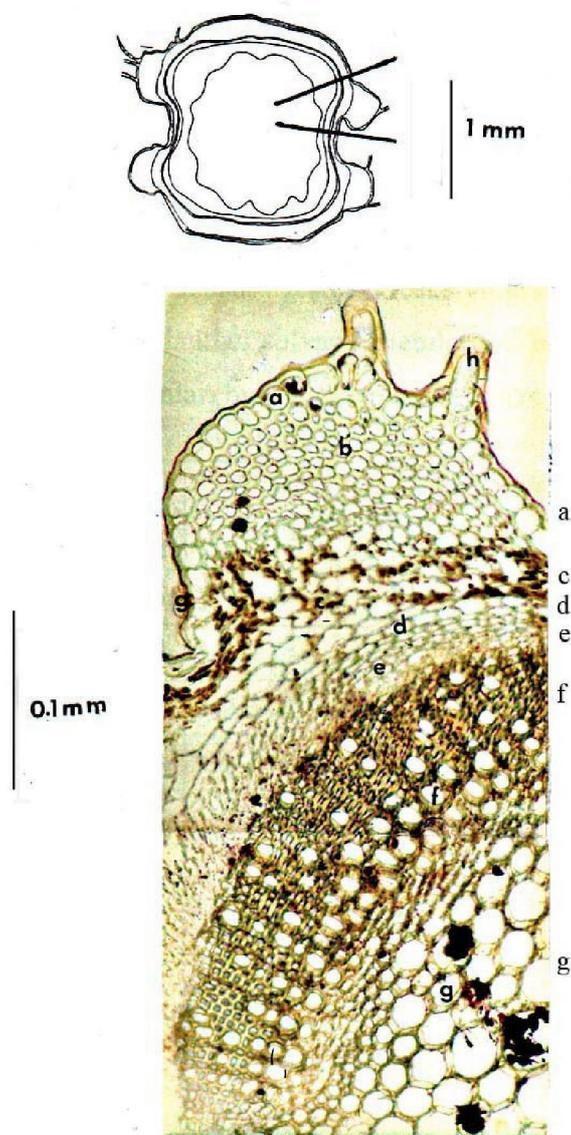


Figure 7. Anatomical characteristics of *P. orientalis* stem, a. epidermis, b. chollenchyma, c. cortex parenchyma, d. Endodermis, e. Phloem, f. Xylem, g. pith parenchyma, h, non-glandular hairs.

In transversal section of the leaves, upper and lower epidermal cells are covered by a thin cuticle. Epidermal cells are rounded-tetragonal in shape. Both epiderma have non-glandular and glandular hairs. Non-glandular hairs are simple, 1-2 celled conic or 3-8 celled, sometimes with curved peak, generally articulate. Glandular hairs are with 1,2 celled head and 1 celled, short stalk. Stomata are presented in the two surfaces but more abundant in the lower epidermis. The leaf is bifacial and palisade, consists of 3-4 rowed elongated parenchyma. Spongy is 3-4 rowed and consists of rounded-oval parenchyma cells with large intercellular spaces (Figure 8,9).

In the powder of leaves of *P. orientalis*, wavy lower and upper epidermal cells fragments with diacytic stomata, glandular hairs and abundant non-glandular hairs are present (Figure 8).

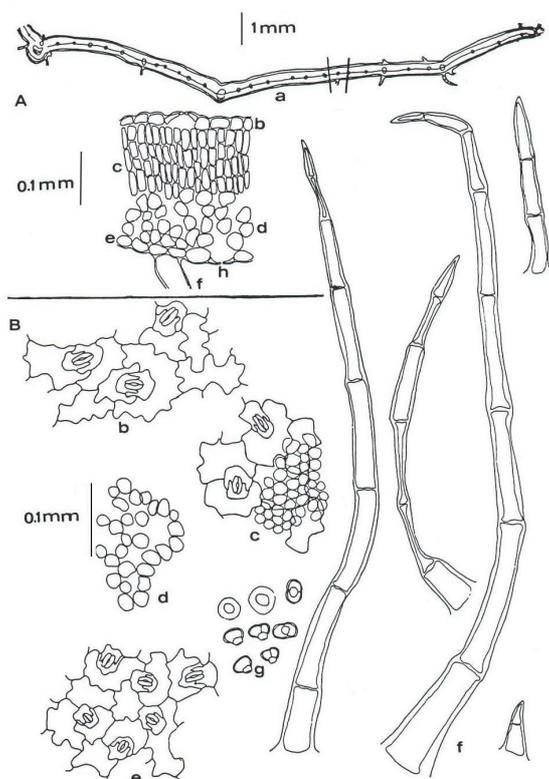


Fig. 8. Anatomical characteristics of *P. orientalis* leaf, A. transversal section of the leaf, B. leaf powder, a. general view of leaf transversal section, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. non-glandular hairs, g. glandular hairs, h. stomata.

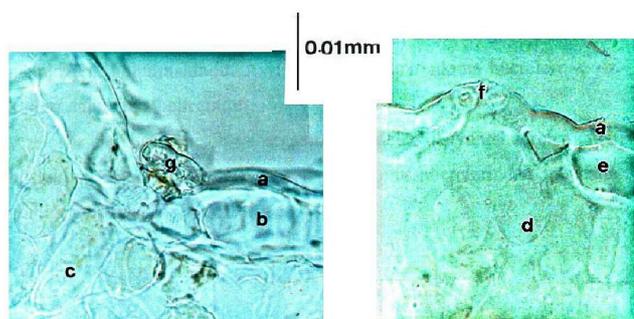


Fig. 9. Transversal sections of *P.orientalis* leaf, a. cuticle, b. upper epidermis, c. palisade parenchyma, d. spongy parenchyma, e. lower epidermis, f. stomata, g. glandular hair.

DISCUSSION

General anatomical features of Labiatae and some special anatomical features of stem and leaves of *Prunella* L. genus have been previously reported by Metcalf and Chalk²⁶. In addition to this article, it has been observed that corresponding two sides of stem in transversal sections of *P. vulgaris*, *P. laciniata* and *P. orientalis* are depressed and corners are irregular thick in our study. Further, in the corners sometimes articulate, long, 3–8 celled non-glandular hairs were recorded. Furthermore, phloem cells are small and crushed, cambium is not distinguishable. As well as xylem consists of radially oriented tracheas and tracheids is well-developed and more wide in the corners. Pith consists of large parenchyma cells and contains some ergastic materials

(Figure 1,4,7). In both epiderma of the leaves of these three species, simple, 1-2 celled conic and 3-8 celled long, sometimes with curved peaked, generally articulate non-glandular hairs and 1,2 celled headed and 1 celled short stalked glandular hairs were observed (Figure 2,5,8).

In 1972, the anatomical study of stems and leaves of *P. vulgaris* and *P. laciniata* growing in middle Europe has been carried out by Natherova and Rezacova²⁴. The anatomical features of stem and leaves of these two species reported in the article were differed from our anatomical observations. At first, the cortex of *P. laciniata* stem has two different parenchymatic regions and the outer region consists of parenchyma cells is narrower than the inner one in previous article²⁴. These features were not observed in our study (Figure 4). Secondly, the leaves of *P. laciniata* and *P. vulgaris* have had 3 and 2 rowed palisade parenchyma respectively and in both species glandular hairs are with 1 celled head, and 1,2 celled stalk in the previous article²⁴. However, in our study, the palisade parenchyma of *P. laciniata* is 2-4 (5) rowed and of *P. vulgaris* L. is 3 rowed as well as glandular hairs of the leaves of both species are with 1,2 celled head, short and 1 celled stalk (Figure 2,5).

The anatomical characteristics of *P. orientalis* were represented for the first time in the present study. Furthermore, the anatomical characteristics of the stems and leaves of *P. vulgaris*, *P. laciniata* and *P. orientalis* were found to be similar to each other, except with some different characteristics given in Table 1. These distinctive characteristics can be useful for the determination of the species.

Table 1. Comparison Between Anatomical Features of Stems and Leaves of *P. vulgaris* *P. laciniata* and *P. orientalis*

Features	<i>P. vulgaris</i>	<i>P. laciniata</i>	<i>P. orientalis</i>
LEAVES			
Palisade	2-3 rowed	2-4(5) rowed	3-4 rowed
Spongy	2-4 rowed	3-4 rowed	3-4 rowed
Non-glandular hairs	Few	Abundant and sometimes articulate	Abundant and sometimes articulate
STEM			
Epidermis	In corners glabrous and straight	In corners wavy and hairy	In corners wavy and hairy
Collenchyma	In corners 7-10 rowed In sides 1-3 rowed	In corners 6-8 rowed In sides 1-2 rowed	In corners 6-9 rowed In sides 1-2 rowed

REFERENCES

1. Hooker J.D., Jackson, B.D., Index Kewensis, Tomus II, pp.634- 635, Oxford University Press, Amen House, London, 1960.
2. Hayek, A., Prodromus Florae Peninsulae Balcanicae, Band II, pp.264-265, Im Verlag Von Otto Koeltz, Koenigstein- Taunus, 1970.
3. Lamaison J.L., Petitjean-Freytet, C., “Derives hydroxy cinnamiques et flavonoides dans le genre *Prunella*(Lamiaceae): Activites antioxydantes et interet chimiotaxonomique”, *Plant. Med. et Phytoth.*, 24(3),152-157, 1990.

4. **Horikawa, K., Mohri, T., Tanaka, Y., Tokiwa, H.,** “Moderate inhibition of mutagenicity and carcinogenicity of benzo (a) pyrene, 1,6-dinitropyrene and 3,9-fluoranthene by Chinese medicinal herbs”, *Mutagenesis*, 9(6), pp.523-526(1994), Ref: C.A. 122, 25669a, **1995**.
5. **Edmondson, J.R.,** *Prunella L.*, , pp.295-297, Davis P.H. (Ed.), *Flora of Turkey and The East Eagean Islands*, Volume 7, University Press Edinburgh, Edinburgh, **1982**.
6. **Fournier, P.,** *Le Livre de Plantes Medicinales et Veneneuses de France*, Volume 1, pp.247-248, Paul Lechevalier Editeur, Paris, **1947**.
7. **Garnier, G., Bezanger-Beauquesne. L., Deraux. G.,** *Ressources Medicinales de La Flore Francaise*, Tome II., pp. 1158-1159, Vigot Freres Editeurs, Paris, **1961**.
8. **Grieve, M., Leyel, C. F.,** *A modern Herbal*, Volume II, pp.731-732, Hafner Publishing Co., New-York, **1967**.
9. **Baytop, T.,** *Therapy with plants in Turkey (Past and Present)*, 2. Edition, pp. 375, Nobel Tip Publications, İstanbul, **1999**.
10. **Saxena, V.R., Archana, S.,** “Flower pigments of *Brunella vulgaris* Roxb.”, *Acta Ciencia Indica*, 10(1),37-38, **1984**.
11. **Lee, B.H., Jung-Yaw, J.,** “Antimutagenic activity of extracts from anticancer drugs in Chinese medicine”, *Mutation Research*, 204, 229-234, **1988**.
12. **Pinkas, M., Trotin, F., Peng, W., Torck, M.,** “Use, chemistry and pharmacology of ten Chinese medicinal plants”, *Fitoterapia*, 65(4), 343-353, **1994**.
13. **Pulatova, T.P.,** “Terpene compounds of several plants of the Labiatae family that grow in Uzbekistan”, *Mater. Yubileinoi Resp. Nauchn. Konf. Farm. Posvyashch 50-Letiyu Obraz. SSSR*, pp. 34-35(1972), Ref: C.A. 82, 167489w, **1975**.
14. **Kojima, H., Ogura, H.,** “Triterpenoids from *Prunella vulgaris*”, *Phytochemistry*, 25(3), 729-733, **1986**.
15. **Yeşilada, E., Honda, G., Sezik, E., Tabata, M., Goto, T., Ikeshiro, Y.,** “Traditional medicine in Turkey IV. Folk medicine in the Mediterranean subdivision”, *J. Ethnopharmacol.*, 39, 31-38, **1993**.
16. **Kwak, W.-J., Han, C.-K., Kim, H.-S., An, J.-S., Kim, T.-S.,** “Process of extracting and purifying biologically effective ingredients from combined plants and their extracts composition”, *Eur. Pat. Appl. EP 832,652*, Ref: C.A. 128(22), 275068k, **1998**.
17. **Yao, X.-J., Wainberg, M.A., Parniak, M.A.,** “Mechanism of inhibition of HIV-1 infection in vitro by purified extract of *Prunella vulgaris*”, *Virology*, 187, 56-62, **1992**.
18. **Ryu SY; Oak MH; Yoon SK; Cho DI; Yoo GS; Kim TS; Kim KM,** “Anti-allergic and anti-inflammatory triterpenes from the herb of *Prunella vulgaris*”, *Planta medica*, 66(4), 358-60, **2000**.

19. **Psotova J., Svobodova A., Kolarova H., Walterova D.**, “ Photoprotective properties of *Prunella vulgaris* and rosmarinic acid on human keratinocytes”, *Journal of Photochemistry and Photobiology B: Biology*, 84, 167–174, **2006**.
20. **Zheng J., He J., Ji B., Li Y., Zhang X.**, “Antihyperglycemic activity of *Prunella vulgaris* L. in streptozotocin-induced diabetic mice”, *Asia Pacific journal of clinical nutrition*; 16 Suppl, pp. 427-31, **2007**.
21. **Hayashi, K., Hayashi, H.**, “Hair growth stimulants containing α -amyrin triterpenes or extracts of *Centella* sp. or *Prunella* sp.”, Jpn. Kokai Tokkyo Koho JP 07 10, 722(95 10,722), Ref: C.A. 122, 196541g, **1995**.
22. **Gao, X.**, “Functional perfumed soap containing traditional Chinese herbal medicines”, Faming Zhuanli Shenqing Gongkai Shuomingshu CN 1,113,264, Ref: C.A. 124(22), 292918x, **1996**.
23. **Tachibana, S., Hara, H.**, “Emulsions containing plant extracts and oils”, Jpn. Kokai Tokkyo Koho JP 08,268,837(96,268,837), Ref: C.A. 126(3), 36863t, **1997**.
24. **Natherova, L., Rezacova, A.**, “Pharmacognostic studies of 3 species of the genus *Prunella* L.”, *Acta Fac. Pharm. Univ. Comeniana*, 21, 33-61, **1972**.
25. **Çelebioğlu, S., Baytop, T.**, “A New Reagent for Microscopical Investigation of Plant”, Publication of the Institute of Pharmacognosy, No.10, Farmakolog., 19: 301, İstanbul, **1949**.
26. **Metcalf, C.R. & Chalk, L.**, *Anatomy of the Dicotyledones*, Volume 2, pp. 1041-1053, Clarendon Press, Oxford, **1965**.

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