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Statistical Comparison of Some Micro Morphological Characters

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Abstract

In this study, some micromorphological features of *Valeriana sisymbriifolia* Vahl. belonging to the family Caprifoliaceae Juss. (Synonyms are Valerianaceae Batsch and Dipsacaceae Juss.) were tried to be determined and statistically compare. The determined micromorphological features of the taxon were compared with the anatomical studies of some other taxa of the genus *Valeriana* in the literature. In addition, the numerical values obtained from the micromorphological studies of the taxon were evaluated statistically. Caprifoliaceae family, to which the studied taxon belongs, are naturally found in most regions of the world, except Australia. Some species are grown as ornamental plants. Some are herbaceous plants used in sedatives and herbal remedies against insomnia. With these features, it is a family of economic importance. Anatomical sections taken by hand from the root, stem and leaf parts of the taxon were then stained with safranin and fast-green. Sections belonging to the taxon were examined and microscope measurements were obtained from their micromorphological characters. These numerical values were statistically evaluated at the significance levels of P<0.01P and P<0.05P, and the results are shown in tables. In this study, the micromorphological features of the taxon obtained from root, stem and leaf anatomy were compared with the studies in the literature of different taxa of the same genus, it was seen that they generally showed similar features, but also different micromorphological features were determined. The fact that the cortex parenchyma cells surrounding the vascular tissues in the stem sections of the taxon have starch particles, as well as the presence of a large pith space in the stem center are remarkable micromorphological features.

Keywords: Caprifoliaceae, statistic, micro morphologic, features, valeriana

Bazı Mikro Morfolojik Karakterlerin İstatistiksel Karşılaştırması

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Özet

Bu çalışmada Caprifoliaceae Juss. (Sinonimleri Valerianaceae Batsch Dipsacaceae Juss.) familyasının çok yıllık *Valeriana* (Kedi otu) cinsine ait *Valeriana sisymbriifolia* Vahl taksonunun bazı mikro morfolojik özellikleri belirlenmeye ve istatistiksel olarak karşılaştırmaya çalışılmıştır. Taksonun belirlenen mikro morfolojik özellikleri literatürdeki Valeriana cinsinin diğer bazı taksonlarına ait yapılan anatomik çalışmalar ile karşılaştırılmıştır. Ayrıca taksonun mikro morfolojik çalışmalarından elde edilen sayısal değerler istatistiksel olarak değerlendirilmiştir. İncelenen taksonun ait olduğu Caprifoliaceae familyası Avustralya hariç dünyanın çoğu bölgesinde doğal olarak bulunurlar. Bazı türler süs bitkisi olarak yetiştirilir. Bir kısmı ise sakinleştirici ve uykusuzluğa karşı bitkisel ilaçlarda kullanılan otsu bitkilerdir. Bu özellikleri ile ekonomik öneme sahip bir familyadır. Taksonun kök, gövde ve yaprak kısımlarından el ile alınan anatomik kesitler daha sonra safranin ve fast- green ile boyanmıştır. Taksona ait kesitler incelenerek mikro morfolojik karakterlerinden mikroskop ölçümleri elde edilmiştir. Bu sayısal değerler P<0.01P ve P<0.05P

önemlilik seviyelerinde istatistiksel olarak değerlendirilmiş ve sonuçlar tablolar ile gösterilmiştir. Bu çalışmada taksonun kök, gövde ve yaprak anatomi çalışmalarından elde edilen mikro morfolojik özelliklerinin literatürde aynı cinsin farklı taksonlarına ait yapılan çalışmalar ile karşılaştırıldığında genelde benzer özellikler gösterdiği görülmüş olmasının yanında farklılık gösteren mikro morfolojik özellikler de tespit edilmiştir. Taksonun gövde kesitlerinde iletim dokularını dıştan saran korteks parankima hücrelerinin nişasta taneciklerine sahip olması bunun yanı sıra gövde merkezinde geniş bir öz boşluğunun bulunması dikkat çekici mikro morfolojik özelliklerdir.

Anahtar Kelimeler: Caprifoliaceae istatistik, mikro morfolojik, özellik, valeriana

1. Introduction

Valerianaceae, also known as the valerian family, has been accepted as a part of Caprifoliaceae in the recent literature and evaluated as synonyms of Dipsacaceae and Caprifoliaceae [1], [2]. Members of the family are usually strong-smelling annual or perennial herbaceous plants, rarely shrubs. They occur naturally in most parts of the world except Australia. Some species are grown as ornamentals or used in herbal medicine to provide relaxation and sleep. *Valeriana* L., belonging to the Caprifoliaceae family, is represented by about 300 taxa worldwide. *Valeriana* has 15 taxa in Turkey, 4 of which are endemic [3].

Valeriana taxa have economic value with their different uses, especially in natural medicine [4]. Taxa are used for medicinal purposes in many countries of the world. The drugs of *Valeriana* members, which are used as raw materials, do not have any known side effects. That's why they are used so much. *Valeriana officialis* L., the most well-known species of the genus, is widely cultivated in countries such as the Netherlands, England, Germany, France and the United States [5]. Valeriana species are naturally found all over Anatolia. This is very important for Turkey's plant biodiversity.
The studied *Valeriana sisymbriifolia* is a perennial taxon [6], [7] generally distributed in Eastern and Southeastern Anatolia (Figure 1).

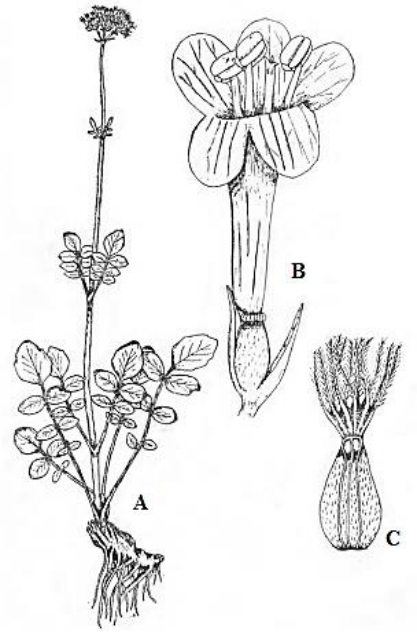


Figure 1. General view of the taxon. **A** -Rhizome and flowering plant, **B-** Flower, **C** -Fruit [4].

Numerous studies have been found in the literature on *Valeriana* taxa, but studies on the micromorphological features of these taxa are very limited. In this study, root, stem and leaf micromorphological features of *V. sisymbriifolia* were investigated. The results obtained were compared with the literature.

2. Materials and Methods

The samples taken from the root, stem and leaf parts of the plant collected from the field to be used in the anatomical studies of the species were divided into 2-3 cm small pieces and determined in 70% alcohol. For microscopic observations, it was placed between the thumb and forefinger from the specified parts of the plant in a way that would not damage the material, and it was cut at right angles to the material with the help of a double-sided razor. In order to take sections from thinner structures such as leaf plant materials, a piece of the material was cut and placed in styrofoam foam, and the hand sections taken with the help of a razor were examined and photographed using a Leica brand (Leica DM3000) camera light microscope with 10x4, 10x10, 10x20 and 10x40 magnification lenses. In order to obtain better results in manually taken section, the sections were prepared according to the method was developed by Bozdağ et al. (2016) [8]. For the statistical evaluation of the study, numerical data obtained from the measurements of the epidermis, basic tissue and vascular tissue micromorphological characteristics of the roots, stems and leaves of the examined taxon were used. These numerical values of the micromorphological features of the taxon were compared with each other using regression analysis and Pearson correlation tests.

3. Results and Discussion

3.1. Anatomy Results

Root: In the cross section taken from the root of the taxon, the epidermis layer was observed as multiple layers. The cells of the epidermic layer have a width of about 14-33 µm and a length of 9-36 µm. Cortex parenchyma cells consisting of primary wall cells were observed under this layer. Secondary metabolites were observed in cortex parenchyma cells in sections taken from developed roots. In the radial vascular tissue, the endodermis layer, which is mostly a single layer, and the pericycle layers with primary walls are prominent. The walls of endodermis cells are observed as thickened. The center of the root is covered with xylem cells (Fig. 2; Table 1).

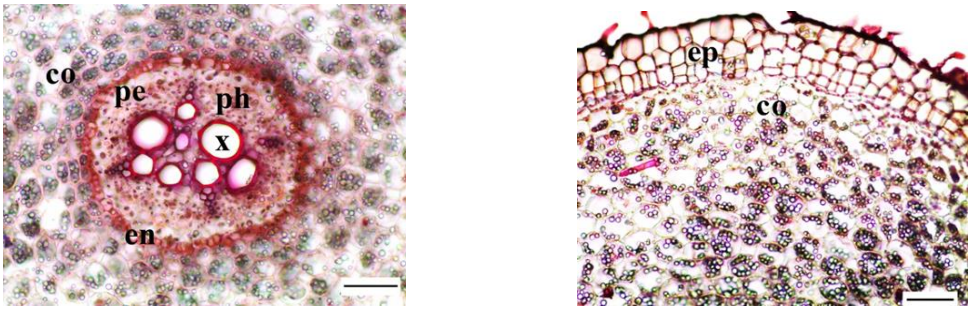
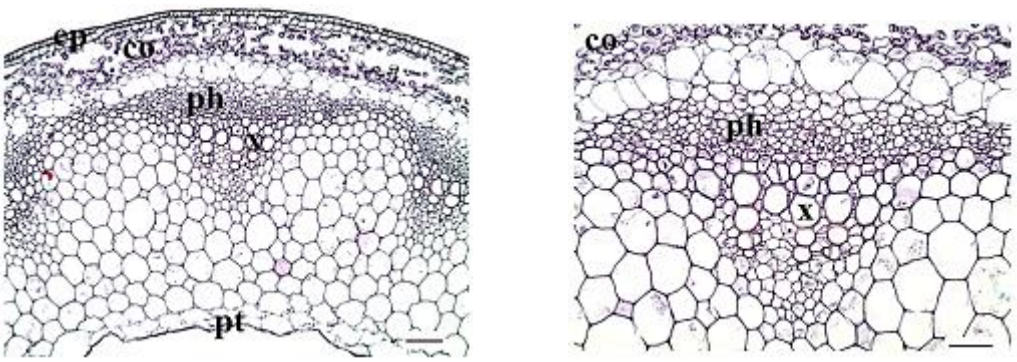


Figure 2. Root anatomical sections of *V. sisymbriifolia* at different magnifications (scale bar: 50 µm)

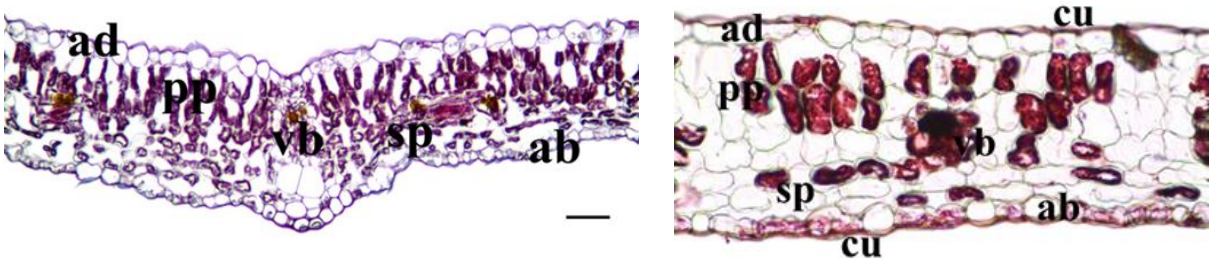
ep: epidermis **co:** cortex parenchyma, **en:** endodermis
ph: phloem **x:** xylem **pe:** pericycle

Stem: In the section taken, the cuticle layer surrounding the body is clearly visible. Under this layer, mostly 1-2 rows of epidermis cells were observed. In addition, the cells of the epidermis layer have a width of about 16-34 µm and a length of 12-20 µm. Cortex parenchyma cells, which have intercellular spaces, are chlorenchymatic. Regularly arranged collateral vascular bundles are clearly observed thanks to the cambium cells. These vascular bundles are surrounded by the parenchymatic starch sheath (Endodermis). A very large pith space was observed in the center of the body (Fig. 3; Table 1).



Şekil 3. Stem anatomical sections of *V. sisymbriifolia* at different magnifications (scale bar: 50 µm)
ep: epidermis **co:** corteks parenchyma **v:** vascular bundle
ph: phloem **x:** xylem **pt:** pith

Leaf: The leaf of the taxon is bifacial with palisade parenchyma on both sides. The mesophyll layer of the leaf is divided into palisade and sponge parenchyma. Palisad parenchyma cells are in 2-3 rows. Leaf collateral vascular bundles are arranged regularly along the axis in the mesophyll layer. Tracheal cells are approximately 6-20 µm in width and 5-28 µm in length. Very sparse glandular and covert hairs were observed on both surfaces of the leaf (Fig. 4; Table 1).



Şekil 4. Leaf anatomical sections of *V. sisymbriifolia* at different magnifications (scale bar: 50 µm)
ad: adaxial epidermis **cu:**cuticla **pp:** palizad parenchyma
sp: spongy paranchyma **vb:** vascular bundle **ab:** abaxial epidermis

Table 1. Micro morphological measurement values of *V. sisymbriifolia* (μm)

			Min.	**-**	**Max.**	**Mean**	**±**	**S.D.**
Root	Epidermis cell	width	14.41	-	33.52	23.56	±	05.38
		length	09.11	-	36.76	20.93	±	06.60
	Cortex cell	width	19.41	-	56.17	32.58	±	10.32
		length	17.35	-	41.47	28.99	±	06.34
	Xylem cell	width	15.03	-	53.18	33.35	±	11.42
		length	14.74	-	48.68	32.84	±	09.96
Stem								
	Kutikula	thickness	03.47	-	08.67	05.72	±	01.22
	Epidermis cell	width	16.18	-	34.10	22.96	±	04.08
		length	12.14	-	20.81	15.58	±	02.56
	Cortex cell	width	23.70	-	52.60	34.00	±	06.94
		length	17.43	-	41.04	24.96	±	05.57
	Trache cell	width	13.87	-	54.91	33.58	±	10.64
		length	11.56	-	56.07	37.75	±	12.36
	Pith cell	width	43.93	-	119.08	76.71	±	21.16
		length	42.20	-	146.24	82.09	±	24.06
Leaf	Adaxial cuticla	thickness	02.31	-	07.51	04.85	±	01.32
	Adaxial epidermis cell	width	16.18	-	64.74	36.79	±	11.25
		length	15.61	-	45.38	26.78	±	07.70
	Palizad parenchma cell	width	19.64	-	39.88	30.79	±	11.25
		length	56.94	-	91.91	74.04	±	08.80
	Spongy parenchma cell	width	17.05	-	64.45	37.79	±	12.93
		length	17.34	-	40.17	27.81	±	06.03
	Trache cell	width	06.36	-	20.23	13.10	±	03.83
		length	05.78	-	28.90	16.68	±	05.38
	Abaxial epidermis cell	width	13.87	-	71.39	36.04	±	16.64
		length	15.61	-	42.20	25.65	±	08.47
	Abaxial cuticle	thickness	02.89	-	10.98	06.43	±	01.93

Min.: minimum **Max.:** maximum **SD:** Standard Deviation

3.2. Statistical Results

The similarities and differences of some micro-morphological features of the taxon examined were also tried to be observed in the statistical evaluation results using two different methods using numerical values. Considering the results of both statistical tests, statistically significant results were found at the P<0.05 and P<0.01 level, especially in the data of root and leaf micromorphological characters (Table 2,3). Obtaining statistically significant values between the same micromorphological characters in both methods shows that these micromorphological features are related to each other.

Table 1. Comparison of micromorphological characters with Pearson correlation test

	Root	Stem
Stem	0,862 0,013*	
Leaf	0,062 0,929	0,004** 0,993

* Significance value at 0.05 level; * * Significance value at 0.01 level

Table 3. Comparison of micromorphological characters with regression analysis test

	MS	F-Value	Possibility	Signifinance
K-G	120,06	14,41	0,013	*
K-Y	0,280	0,11	0,920	NS
G-Y	534,12	70,13	0,010	* *

MS: Square Means; **NS:** No signifinance ; * P< 0.05; * * P< 0.01
K: Root, **G**: Stem, **Y**:Leaf

Some micro-morphological features of *Valeriana sisymbriifolia*, which is the material of this study, were determined in this study. The obtained data were compared with other taxa of *Valeriana*. Although it was determined that the micromorphological features of the examined taxon were generally similar to other taxa of the genus, some differences were also observed.
Doğan (1998), in his study on the root anatomy of *Valeriana alliariifolia* Adams, found that mostly a single row of endodermis and perichyle were observed in the root sections of the taxon. He also stated that thickening in endodermis cells was in all of the cell walls. In our study, we detected the same micromorphological features in root sections of *V. sisymbriifolia*. [9]. In another study, Viktoriya et al. (2013) stated in their study on *Valeriana* tuberosa that the cortex parenchyma cells of the taxon, which are close to the epidermis, are chlorenchymatic in the stem [10]. In this study, it was observed that the cortex parenchyma cells of *V. sisymbriifolia* were in a chlorenchymatic structure, in line with the findings of the researchers. Panchenko et al. (2012) Valeriana grossgeimii Worosch, whose anatomy they examined. They stated that cover and glandular hairs were rarely seen on both surfaces of the leaf [11]. Our findings on the feathers of the taxon we examined in our study are in agreement with the researchers, and cover and glandular hairs were rarely encountered in the leaf micromorphological structure of the taxon. In another study with leaf micromorphological features, they stated that the palisade cells of *Valeriana jatamansi* L. are single

row [12]. In our study, 2-3 rows of palisade parenchyma were observed in leaf sections. Consistent with our findings in our study, the *Valeriana* moon Arn. Ex C.B. In the study of Clarke's anatomy, it was stated that the collateral vascular bundles were arranged properly in the trunk of the taxon [13]. In another study conducted with different *Valeriana* taxa, it was stated that a large sap was found on the stem [14]. In our study, we observed a large pith region on the trunk.

In this study, we tried to evaluate some micromorphological characters of *V. sisymbriifolia* numerically. In the literature, there are different studies on the mathematical comparison of micromorphological characters of different taxa. While some researchers determined the geometrical properties of these characters [15], others made statistical comparisons of the effects of some substances on micromorphological characters [16]-[18]. However, the study on the micromorphological features of *Valeriana* taxa is very limited. In our study, when we statistically compared the numerical values of root, stem and leaf micromorphological features of the taxon, it was determined that some features were statistically significant. Similar numerical studies have been carried out on different taxa in the literature and statistical results consistent with our study have been obtained [19]-[24].

4. Conclusions

In this study, it is aimed to introduce some micromorphological features of *V. Sisymbriif*olia taxon belonging to the genus *Valeriana*, which is known as valerian with different uses and economic value. In addition, as a result of the statistical analysis of the micro morphological characters that we evaluated numerically, the closeness of these characters was tried to be determined. With this study, it has been tried to provide a different perspective and comparison opportunity for future researchers on similar issues.

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