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Araştırma Makalesi / Research Article

An Anatomical and Caryological Investigation On Monotypic *Pallenis spinosa* (L.) Cass. in Türkiye

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Abstract

Pallenis spinosa (L.) Cass., which has an annual and herbacous life form, is represented by a single species (monotypic) in Turkey. There are 1-2 rows of epidermis cells in the root cross section of the taxon. Between the epidermis and the central cylinder is the cortex, which consists of parenchymatic cells. Root has a radial vasculer bundle. The cross-section of the stem has a round shape with single row and regular lined of cortex cell over the vascular bundle as a starch sheath. The sclerenchyma cells is cover the top of floem cells in the collateral vascular bundle. The leaves is a bifacial type. There are stomas and eglandular hairs both side of the leaves. Sclerenchyma cells are both side of vascular bundles in the leaves. We determined 2x = 2n = 10 chromosome number and made chromosome measurement and haploid idiogram of species.

Keywords
Asteraceae; Anatomy; Caryology; *Pallenis spinosa*

Türkiye'deki Monotipik *Pallenis spinosa* (L.) Cass. Türü Üzerine Anatomik ve Karyolojik Bir Araştırma

Öz

Pallenis spinosa (L.) Cass. Türkiye için monotipik bir türdür. Tek yıllık otsu bitkilerden oluşur. Türün kök enine kesiti 1-2 sıra epidermis hücresine sahiptir. Korteks hücreleri epidermis ile merkezi silindirin arasını doldurur. Kökte radyal iletim demetleri bulunur. Gövde enine kesiti yuvarlak şekle sahiptir. İletim demetlerini saran tek sıralı, düzenli dizilmiş, nişasta kınını oluşturan parankima hücreleri mevcuttur. Sklerankima hücreleri, kolleteral iletim demetlerindeki floem hücrelerinin üzerini kaplar. Yapraklar bifasiyal tiptedir. Yaprağın her iki yüzünde de örtü tüyleri ve stomalar bulunur. Yapraklarda iletim demetlerinin her iki yüzünde de sklerankima hücreleri vardır. Türün kromozom sayısı 2x = 2n = 10 olarak belirlendi ve kromozom ölçümleri yapılarak haploid idiogramları ilk kez hazırlandı.

Anahtar Kelimeler
Asteraceae; Anatomi; Karyoloji; *Pallenis spinosa*

1. Introduction

Known as the largest family of flowering plants, Asteraceae includes 1600-1700 genera and about 24 000 species (Funk et al. 2009). *Pallenis spinosa* (L.) Cass. belongs to the Asteracaea family, and the tribe Inuleae and monotypic for Türkiye.

P. spinosa (Spiny Starwort), is an annual herbaceous plant and distribution area is the Mediterranean region (Al-Eisawi, 1982). The taxon has large yellow-orange flowers and spiny involucre bracts below the flowers (Zareh, 2005). Medicinally, different part of the plant as leaves and flowers have been used mouth infections, gastralgia, skin injuries and inflammatory contusions (Agelet and Valles, 2003; Chermat and Gharzouli, 2015). *P. spinosa* have some chemical compounds as sesquiterpenes, oxygenated sesquiterpenoids, oplopanone, eudesmane, flavonoids patuletin, quercetin, sterol components, (Appendino et al. 1997; Senatore and Bruno, 2003; Sanz and Marco, 1991; Ahmed et al. 1990; Ahmed et al. 1992; Dibi et al. 2014) and these compouns have taxonomic and potential

mediclinal importance. Essential oils of *P. spinosa* have antioxidant and anticancer effects (Al-Qudaha et al. 2017).

There are some chromosome investigation about this species (Löve 1981, 1982) but in these studies they gave only the number of chromosomes of the species but we determined chromosome parameters and made haploid idiograms and anatomical features and measurements of species for the first time.

2. Materials and Methods

The plant samples used in this study were collected from the localities in Table 1.

Table 1. The collection area and herbarium information of *P. spinosa*

Species	Locality – Date	Herbarium Number
P. spinosa	Near The Menemen Anatolian High Scholl Menemen-İzmir-Turkey 15.06.2013	BBOZDAG95

Herbarium samples of specimens are kept in the department of Biology at Celal Bayar University. The taxonomic description of the species was made according to Flora of Turkey (Davis 1975). Different part of plant samples were keep in 70% alcohol for anatomical investigations. Handle-blade cross sections were taken from root, stem, leaf and stained with Bozdağ et al.(2016).

Caryological investigation were made according to method of Elçi (Elçi, 1994). Chromosome measurements of the taxon were made on 5 different cells at metaphase stage. Anatomical and caryological photographs were taken with Leica DM 3000 LB photomicroscope and photos were analyzed. Karyotype analysis was performed according to the method developed by Levan et al. (1964).

3. Results

Figure 1. General apperance of *P. spinosa*

3.1. Anatomical results

In the cross section of root of species, we determined that one layer epidermis cells and one layer eksodermis cells where are under the epidermis cells. Epidermis and endodermis cells have rounded or rectangular shape and epidermis cells size are bigger than exodermis cells. Corteks is composed of 5-7 layer paranchymatic cells which have rectangular shape. There is a single layer endodermis cells surround of the vascular bundle. Root has a radial vascular bundle like other dicotil plants. Xylem elements has a wide range of center of section and these elements have triangular shape and have three arm. Phoem elements are located between the arm of the xylem. There are sclerancymatic cells between the phloem cells area. (Figure 2. A,B. Table 2.)

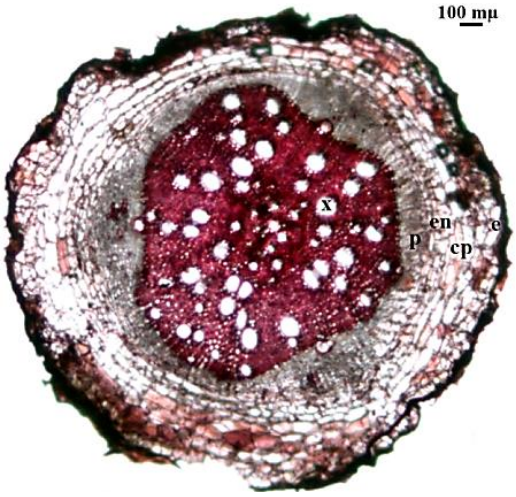
The stem of species has pentagonal shape. Under the cuticle, there is a single or double layer epidermis cells which has oval or round shape. Between the epidermis cells, there are stomata cells and a lot of eglandular hairs. In the cortex, there are 5-13 layer parancymatic cells which have rectangular shape. These cells are big size middle

of the cortex and small size near the epidermis and vascular bundle. Vascular bundle is surrounded by a single layer starch sheath cells. There is no gap between the closed collateral bundles. The top of phloem elements is covered by the sclerenchyma cells. While phloem elemets has narrow area in the bundle, xylem elements has wide area. Center of the section, there are paranchymatic cells which has thin walled, live, big size and ovoid shape. (Figure 2. C,D. Table 2.)The out side of section, there are single layer epidermis cells under the thick cuticle layer on both side of leaves. Cuticle layer is thick abaxial side. Epidermis cells width is big from length. And these cells has thin walled rectangular shape. There are a lot of eglandular hairs and anomocytic stoma cells which are hygromorphic state both side of leaves. Leaves are bifacial and palisade paranchymatic cells which has oblong to square shape has different shape from spongy cells which has close size. There are leaf veins in the spongy paranchymatic layer. Upper and lower side of leaf vascular bundle has scleranchymatic cells layer which is big adaxial side of leaf. These cells are protect the xylem and phloem cells from mechanical effects. There are different number secondary veins left and right side of mid vein. (Figure 2. E, F, G, H. Table 2.)

Table 2. Anatomical measurements of various tissue of *P. spinosa*

	Width		Length	
	Min –max	**Mean ±std dev.***	**Min –max**	**Mean ±std dev.***
Root				
Epidermis	19,05 - 59,52	40,53 ± 13,60	14,29 – 54,76	38,75 ± 12,02
Exodermis cells	11,90 – 47,62	31,05 ± 09,77	14,45 – 42,86	30,63 ± 10,69
Cortex cells	23,81 – 76,19	49,23 ± 16,63	19,05 – 38,10	30,88 ± 04,73
Endodermis cells	14,29 – 50,00	31,37 ± 10,60	11,90 – 19,05	15,25 ± 02,25
Scleranchymatic cells diameter			09,52 – 20,24	16,31 ± 03,57
Trachea cells	23,81 – 52,38	34,03 ± 07,95	25,24 – 59,52	43,64 ± 10,55
Tracheid cells	04,76 – 09,52	07,33 ± 01,42	07,14 – 13,10	10,39 ± 02,06
Phloem cells	08,10 – 26,67	14,31 ± 05,62	03,57 – 12,62	07,42 ± 02,52
Stem				
Cuticle length			01,43 – 04,29	02,69 ± 01,04
Epidermis cells	11,43 – 34,29	24,04 ± 07,52	07,14 – 32,86	20,75 ± 07,92
Cortex cells	08,57 – 71,43	41,75 ± 22,82	08,57 – 45,71	30,62 ± 11,70
Starch sheath cells	08,86 – 31,43	20,84 ± 08,33	06,86 – 25,71	17,35 ± 06,09
Central cells diameter			11,43 – 94,29	54,16 ± 26,90
Xylem cells diameter			05,71 – 13,71	10,05 ± 02,63
Scleranchymatic cells diameter			02,29 – 14,57	09,02 ± 03,33
Leaf				
Adaxial cuticle length			05,26 – 09,65	07,55 ± 01,25
Adaxial epidermis cells	14,91 – 52,63	32,59 ± 13,03	09,65 – 26,32	19,38 ± 05,06
Palisade paranchymatic cells	11,40 – 28,07	20,15 ± 04,75	17,54 – 28,95	22,21 ± 03,53
Spongy parancymatic cells	10,53 – 24,56	18,60 ± 04,20	13,16 – 27,19	19,62 ± 04,23
Xylem cells diameter			02,63 – 07,89	05,04 ± 01,69
Scleranchymatic cells diameter			07,02 – 19,30	13,52 ± 04,17
Abaxial cells	18,42 – 53,07	35,45 ± 11,85	10,53 – 30,70	20,72 ± 05,98
Abaxial cuticle length			06,14 – 11,40	08,73 ± 01,78

* Standard Deviation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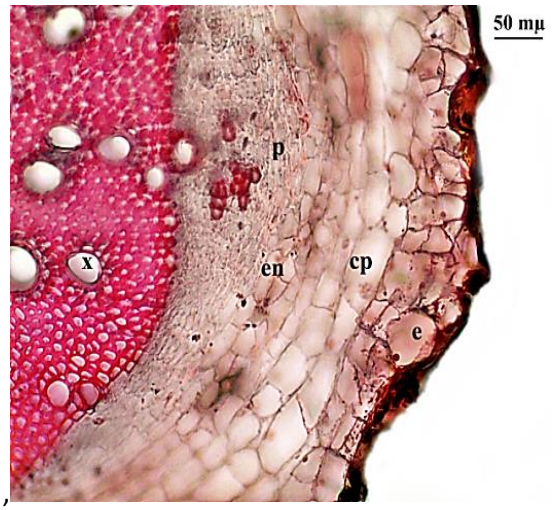
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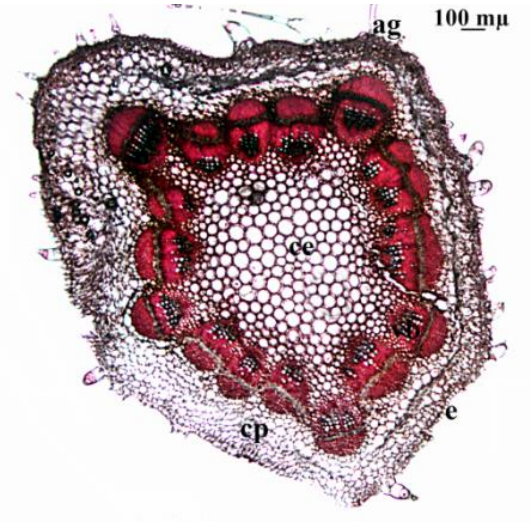
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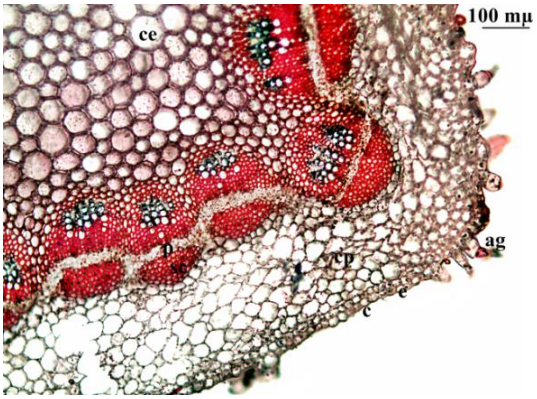
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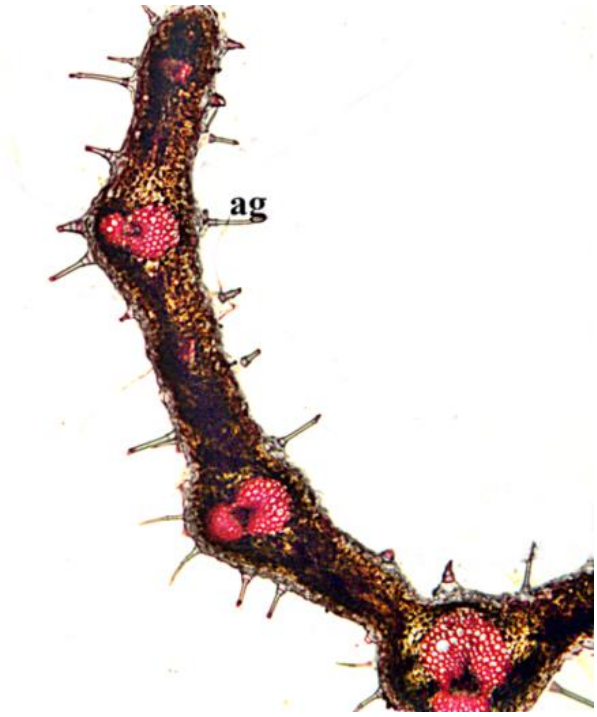
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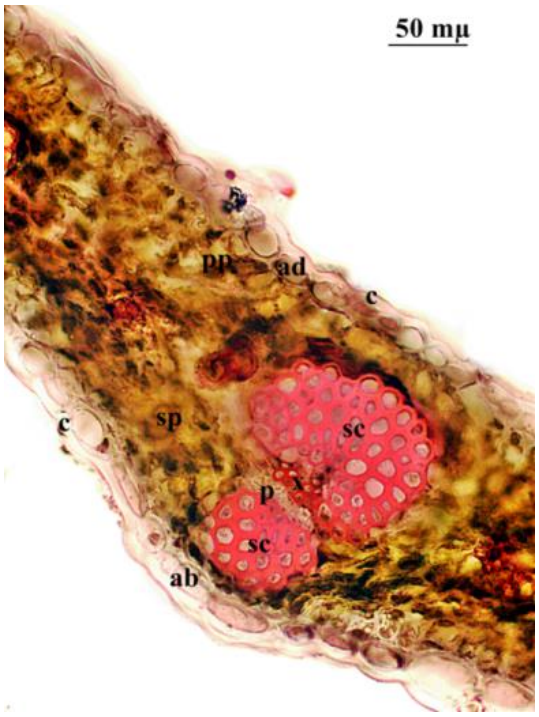
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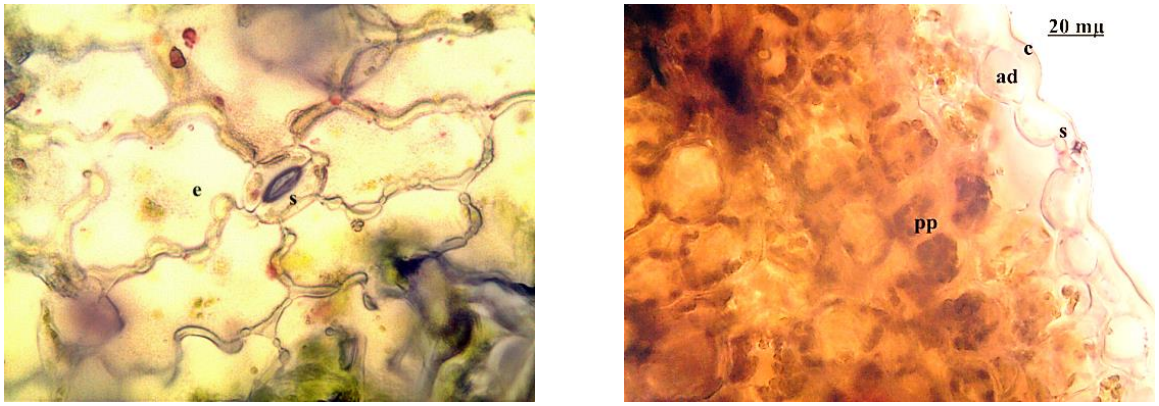

G H

Figure 2. Cross sections of different anatomical tissue of *P. spinosa*. Root (A,B), stem (C, D), leaf (E, F, G, H). e. epidermis, ad. adaxial epidermis cells, ab. abaxial epidermis cells, p. pholem cells, x. xylem cells, sc. sclerancymatic cells, pp. palisade parancymatic cells, sp. spongy parancymatic cells, c. cuticle, ag. eglandular hairs, cp. cortex cells, ce. pith region cells, en. endodermis cells.

3.2. Caryological results

In this study, the chromosome number of *P. spinosa* was found as the basic number x = 5 and 2n =2x=10. The karyotype was prepared by using chromosomes of the species. We determined five couple median region (m) chromosomes but didn't observe satellites on chromosomes of species. Chromosome sizes vary from 1,35 to 2,15 µm. The longest arm is 1,22 µm and the shortest arm is 0, 54 µm (Figure 3, 4; Table 3)

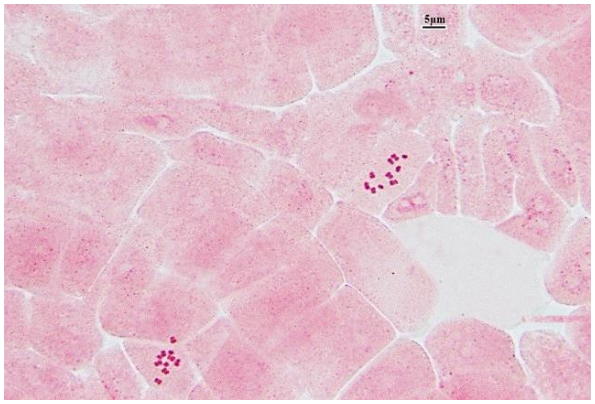

Figure 3. Microphotograph of somatic metaphases. *P. Spinosa*

Table 3. Parameters of mitotic metaphase chromosomes of *P. spinosa*

Cn	C (µm)	L (µm)	S (µm)	R	I (µm)	RS	CP
1	2,15	1,22	0,93	1,31	43,25	24,26	Median region (m)
2	1,98	1,15	0,83	1,38	41,91	22,34	Median region (m)
3	1,76	1,04	0,72	1,44	40,90	19,86	Median region (m)
4	1,62	0,90	0,72	1,25	44,44	18,28	Median region (m)
5	1,35	0,81	0,54	1,50	40,00	15,23	Median region (m)

Total chromosome size: 8,86 µm

Abbreviations: Cn, chromosome number; C, total chromosome length; L, long arm length; S, short arm length; R, arm ratio = L/S; I, centromeric index = (S/C) × 100; RS, relative size; CP, centromeric position.

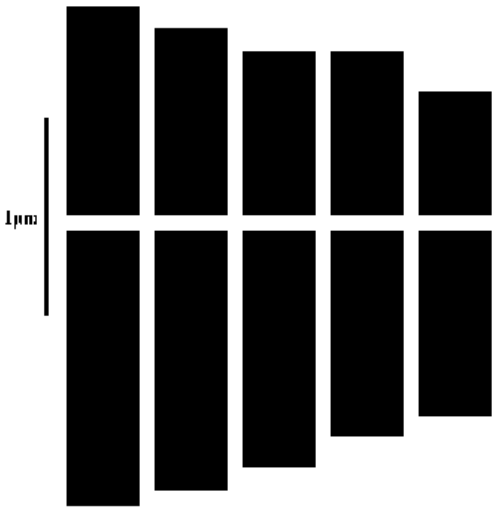

Figure 4. Haploid idiograms of *P. spinosa*.
Scale bars: 1 mµ

4. Discussion

In this study, we aim to determine anatomical and cytological properties of *P. spinosa* which is a monotipic species for Turkey.

Most of Asteraceae taxa as *Mikania glomerata* Spreng., *Porophyllum ruderale* Cass., *Vernonia condensata* Bakerhave, *Vernonia psilophylla* and *V. sessilifolia* have stomata both side of leaf as in *P. spinosa* leaves but some taxa as *V. linearis* has stomata only on the abaxial epidermis (Milan et al. 2006, Sajo 1994). While *M. glomerata, V. condensata* and *P. spinosa* have anomocytic stomata, *P. ruderale* have anomocytic and anisocytic stomata (Milan et al. 2006). According to mesophyle layer and palisade-spongymatic cells, *M. glomerata, V. condensata, P. ruderale, V. sessilifolia* have bifacial and *V. psilophylla* has unifacial leaves (Milan et al. 2006, Sajo 1994). *P. spinosa* has bicafial leaves. There are hydatods, glandular and eglandular hairs, secretory cavities a lot of Asteraceae members leaves or stems. These features are very important for in term of classification of taxa (Castro et al. 1997, Lersten and Curtis 1985, Milan et al. 2006). *P. spinosa* leaves and stems have eglandular hair. But we didn' t observe any hydatods on *P. spinosa*. This fact could be related to different habits of the species. According to Metcalfe and Chalk (1950), Asteraceae taxa show some different anatomical structures and ecological specialization due to the diversity of habits.

According to Zareh (2005), *P. spinosa* leaves have trichomes, sclerenchymatic cells both side of main bundle, four veinlets, four lateral veins and differentiation of mesophyll into palisade and spongy tissues. These results are similiar to this study results. *P. spinosa* has a scleranchymatic cells layer in the stem and leaf vascular bundle. There are single layer eksodermis cells in the root section. Leaves and stem of *P. spinosa* have a lot of eglandular hairs. Species has bifacial leaves.

Ambrosia trifida, *Rudbeckia laciniata*, *Erigeron annuus*, *Arctium minus*, *Silphium perfoliatum*, *Eupatorium rugosum*, *Lactuca scariola* taksons have hidatods on the leaves (Lersten and Curtis, 1985). We did not observe any hidatod on *P. spinosa* leaves.

Artemisia L. taksons has glandular and eglandular hairs. Foliar hairs is an important properties for taksonomy. We didn't see any foliar or glandular hair on the stem and leaves of *P. spinosa* (Hayat at al. 2009).

Duan et al. 2015 determined chromosome features of *Atractylodes lancea* (Thunb.) DC subsp. *luotianensis*. They reported that this taxon have 2n = 24 = 12 m + 12 sm + (2 SAT). Bozdağ et al. (2011) worked on chromosome numbers of *Bellis* L. species in Turkey and they determined as *Bellis sylvestris* Cyr. 2n = 36, *B. perennis* L. 2n = 18 and *B. annua* L. 2n = 18. Watanabe et al. 2001) determined chromosome number of *Stevia* as between 2n=8 to 2n= 24 in Mexica. An other study, Watanabe et al. (2007) determined chromosome numbers in 51 genera and 119 taxa. In that study, first chromosome datas were given that for 45 Asteraceae taxa. Among these taxa, the chromosome number of *Epitriche* Turcz. was determined as 2n=10. We determined that *P.*

spinosa have 2x= 2n= 10 chromosome too and we didn't observ any satellit.

P. spinosa is well known and very popular species in mediterrian area but there is no any investigation about detailed anatomical and caryological investigation. We hope that this study is fill a gap about *P.spinosa* in the literature.

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