

The Morphological and Anatomical Properties of Endemic *Onosma armenum* DC. (*Boraginaceae*) Species

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Abstract

In this study, morphological, anatomical and micromorphological properties of *Onosma armenum* DC. (*Boraginaceae*) were investigated. Morphologically, it was observed that the species have a perennial root system. Anatomically, the cross sections of the root, stem and leaf and the surface sections of leaf were examined. The anatomical properties of root, stem and leaf were determined. It is found that leaf is isobilateral and amphistomatic. Stomata cells are anisocytic and anomocytic. The stomata index is 23.14 for the upper epidermis and 21.48 for the lower epidermis. The fruit surface of *O. armenum* is reticulate type and areolate subtype. Trichome types are simple, porrect -stellate and glandular.

Key words: *Boraginaceae*, *Onosma armenum*, micromorphology, anatomy, SEM.

INTRODUCTION

The genus *Onosma* L. is a member of the family *Boraginaceae*. 100 taxa of *Onosma* (95 species) are found in Turkey [1-3]. The genus *Onosma* has been divided into three sections: *Onosma*, *Protonosma* and *Podonosma*. *O. armenum* DC. is an endemic plant and belong to section *Onosma* [1].

Some *Onosma* species are used as herbs, folk medicines and dyes. *O. armenum* DC. and *O. sericeum* Willd. are used in the treatment of body swellings. The flowers of these species are eaten [4]. Dried flowers of *O. fruticosum* Sm. are used in folk medicine to treat respiratory ailments [5]. *O. argentatum* Hub.-Mor. is used for the treatment of wounds and burns in rural areas in Turkey and shows high antioxidant and antimicrobial activities [6-7].

Studies on the anatomy of this genus are limited. Metcalfe & Chalk [8] and Watson & Dallwitz [9] explained the characteristic properties of the family *Boraginaceae*. Some studies have been published on the leaf anatomy, morphology and trichomes of some genus of *Boraginaceae* [10-11]. Akçin & Engin [12-13] and Akçin [14] studied the anatomical and ecological properties of some *Onosma* species. Binzet & Orcan [15] investigated the anatomical structure and palynological characteristics of two *Onosma* species. Teppner [16-17] reported the chromosome numbers of different species of *Onosma*. There have been phytochemical studies dealing with *Onosma* species [7, 18-20].

Studies on the morphology and anatomy of fruits and seeds have been useful to support the delimitations of individual or groups of taxa [21]. Trichome type and structure are important in genus *Onosma*. In the present work, a detailed study of the fruit and trichomes of *O. armenum* were given. The anatomical and micromorphological properties of *O. armenum* have not been studied. Therefore, the aim of this paper was to investigate

the anatomic structure and micromorphologic properties of *O. armenum*.

MATERIALS AND METHODS

Plant samples of *O. armenum* were collected from different localities in Ankara and Samsun. Locations are following:

- 1- A5 Samsun: Around Ladik, 1000 m, Barbaros 1002
- 2- B4 Ankara: Around Çubuk 2. Dam, 1150m, Barbaros 1007.

Morphological features were identified from fresh and herbarium material. Observed results were compared with the Flora of Turkey [1]. For anatomical analysis, cross sections of root, stem and leaves and surface sections of leaves were used. Their photographs were taken with Nikon FDX-35 microscope. Stomatal index and stomatal index rate were calculated according to Meidner & Mansfield [22].

For scanning electron microscopy, dried fruit and leaf samples were mounted on stubs using double-sided adhesive tape. Samples were coated with 12.5- 15 nm of gold. Coated fruits and leaves were examined and photographed with JMS-6400 Scanning Electron Microscope. Observations on the surface patterns of fruit were made as in Stearn [23].

RESULTS

Morphological Properties

Perennial. Stem, 22- 49 cm tall, erect, glandular and eglandular hairy, patent-setose and with short dense hairs. Leaves glandular and eglandular hairy, tuberculate setae. Basal leaves 1.2-4.2 x 0.3-1 cm, linear oblong with petiole. Cauline leaves 1.5-5.5 x 0.3-0.7 cm, oblong obtuse. Bracts 0.5-2.0 x 0.1-0.4 cm, lanceolate, linear-lanceolate and eglandular hairy. Inflorescence of 2-3 terminal, scorpioid. Pedicel 0.3-0.5 cm in

flower, 0.3-0.35 cm in fruit. Calyx 1.0-1.9 cm in flower, 1.5-2.6 cm in fruit. Corolla clavate, 13-20 mm, white, cream, yellow or pale yellow, 5 lobed, Anthers 6-8 mm in length and filaments 6-20 mm. Nutlets triquetrous, 4-4.5 x 3-3.5 mm (Figure 1-2, 7).

Micromorphological Properties

The fruit surface of *O. armenum* is reticulate type and areolate subtype. Cells are unclear verrucose. Epidermis cells are polygonal shaped (Figure 2).

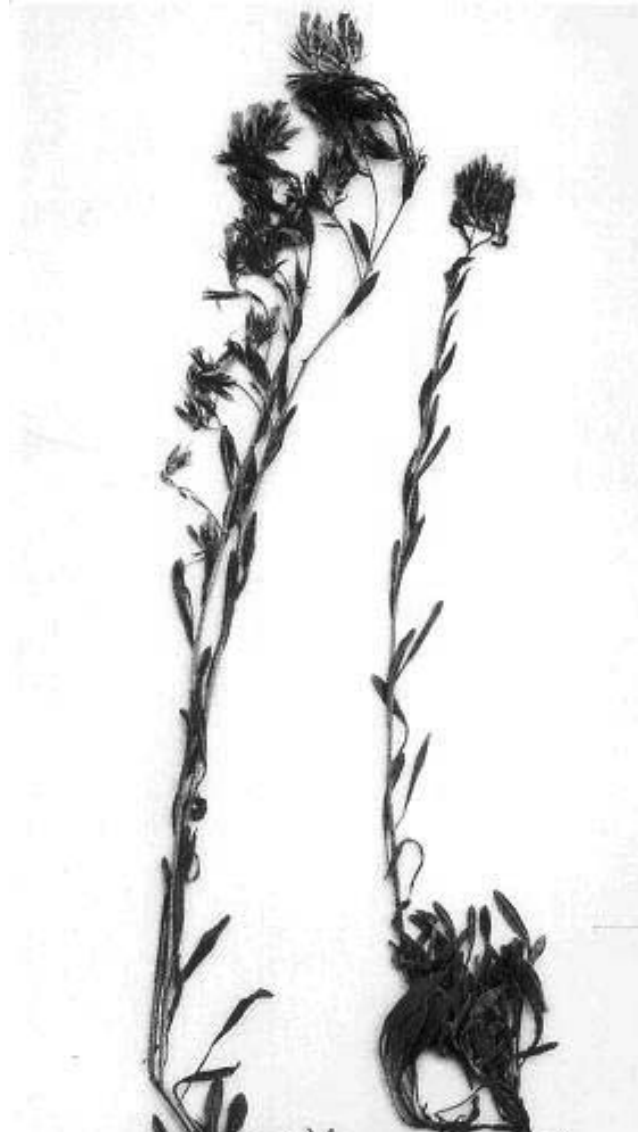


Figure 1. *O. armenum*. General appearance, Barbaros 1007 (Bar: 2 cm).

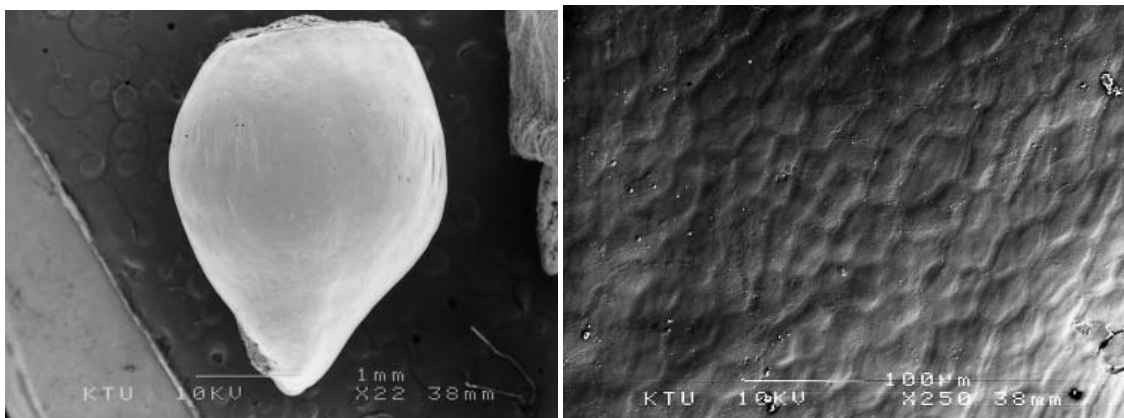


Figure 2. Scanning electron micrographs of *O. armenum* fruits. A-General view on the left (Bars: 1mm), B-fruit surface on the right (Bar: 100µm)

Anatomical Properties

Root

A transverse section taken from the root was observed as follows (Figure 3). Periderm is multilayered. Felloderm is clear.

Cortex is 6-15 layered and parenchymatic. Parenchymatic cells are 10-20 x 17.5-45µ. Cambium cells are 1-3 layered, flat and distinguishable. Xylem is composed sclerenchymatic cells and tracheary elements. Pith rays are present. The pith consists of parenchymatic cells (Table 1).

Table 1. Anatomical measurements of *O. armenum*

		Breath (µ)		Lenght (µ)	
		Min	Max	Min	Max
ROOT	Periderm cells	10	45	17.5	32.5
	Parenchyma cells	17.5	40	10	20
	Diameter of trachea	10	65	-	-
	Epidermis cells	7.5	22.5	10	17.5
STEM	Collenchyma cells	10	37.5	7.5	27.5
	Parenchyma cells	15	50	10	30
	Endodermis	25	50	10	35
	Diameter of trachea	10	30	-	-
	Diameter of pith cells	20	67.5	-	-
	Cuticle	5	7.5	-	-
	Upper epidermis	12.5	22.5	12.5	27.5
LEAF	Palisade parenchyma	10	17.5	25	55
	Spongy parenchyma	12.5	20	12.5	22.5
	Diameter of trachea	5	10	-	-
	Lower epidermis	10	25	10	17.5
	Glandular hairs	40	75	-	-
	Eglandular hairs	65	187.5	-	-

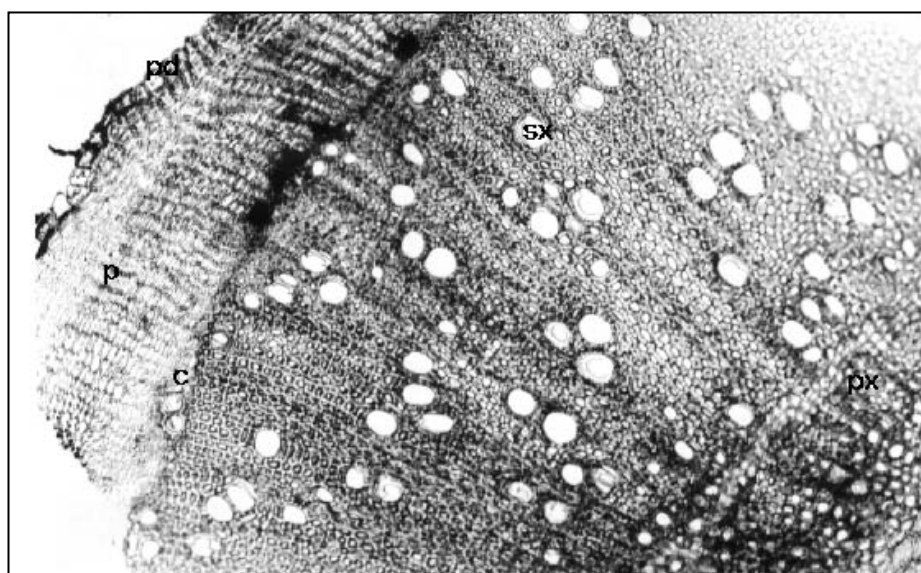


Figure 3. *O. armenum*. Cross-section of root. pd) peridermis, p) parenchyma, c) cambium, sx) secondary xylem, px) primary xylem (Bar: 80 µ).

Stem

A transverse section taken from the middle part of the stem was observed (Figure 4, 7). Epidermis is single layered. There are glandular and eglandular hairs on the epidermis. Eglandular hairs are long and short simple trichomes and porrect-stellate trichomes. Collenchyma is 1-4 layered. These cells are 10-37.5-

7.5-27.5µ. Parenchyma cells are 10-15 x 4-6µ. Compressed cells are present in the cortex. Endodermis is located above the phloem. Cambium is distinguishable. Diameter of vessel members are 10-30µ. The pith consists of large parenchymatic cells (Table 1).

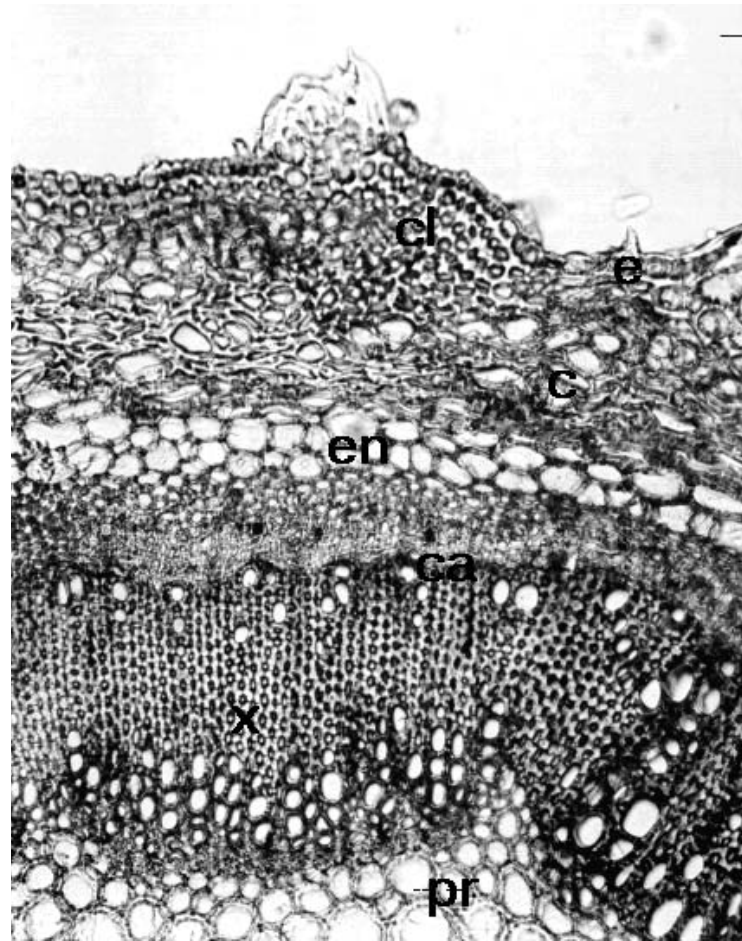


Figure 4. *O. armenum*. Cross-section of stem. e) epidermis, cl) collenchyma, p) parenchyma, en) endodermis, c) cambium, ph) phloem, x) xylem, pr) pith region (Bar: 80 μ).

Leaf

A transverse section of the lamina, midrib and both epidermises was studied (Figures 5-7). There is a single layered epidermis on the upper and lower surface of the leaf. There are simple trichomes, porrect-stellate trichomes and glandular hairs on the epidermis. Leaf is isobilateral. Palisade parenchyma cells are 2- 3 layered on the upper surface and 2 layered on the lower surface. Palisade parenchyma cells are 25-55x 10-17.5 μ . There

are 2-3 layered spongy parenchyma cells. Vascular bundle is collateral. Vascular bundles are surrounded by a parenchymatic bundle sheath. Midrib has 3-4 layers of collenchyma located below the epidermal cells. Vascular bundle is solitary and arch-shaped in the midrib. Stomata are anisocytic and anomocytic. Stomata occur on the both surfaces. Anisocytic stomata are dense on the upper epidermis. Stomata index is 23.14 for the upper epidermis and 21.48 for the lower epidermis (Table1, 2).

Table 2. Stomata features on the upper and lower epidermis of *O. armenum*

	Upper surface of leaf	Lower surface of leaf
Number of stomata (1mm ²)	92.8	110.8
Number of epidermis cells (1mm ²)	339.2	368
Stomata index	21.48	23.14
Stomata rate	0.92	

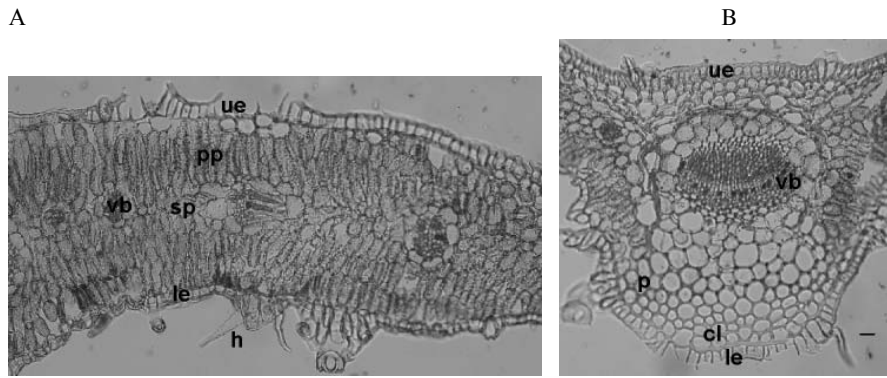


Figure 5. *O. armenum*. Cross-section of leaf. ue) upper epidermis, pp) palisade parenchyma, sp) spongy parenchyma, vb) vascular bundle, le) lower epidermis (Bar: 50 μ).

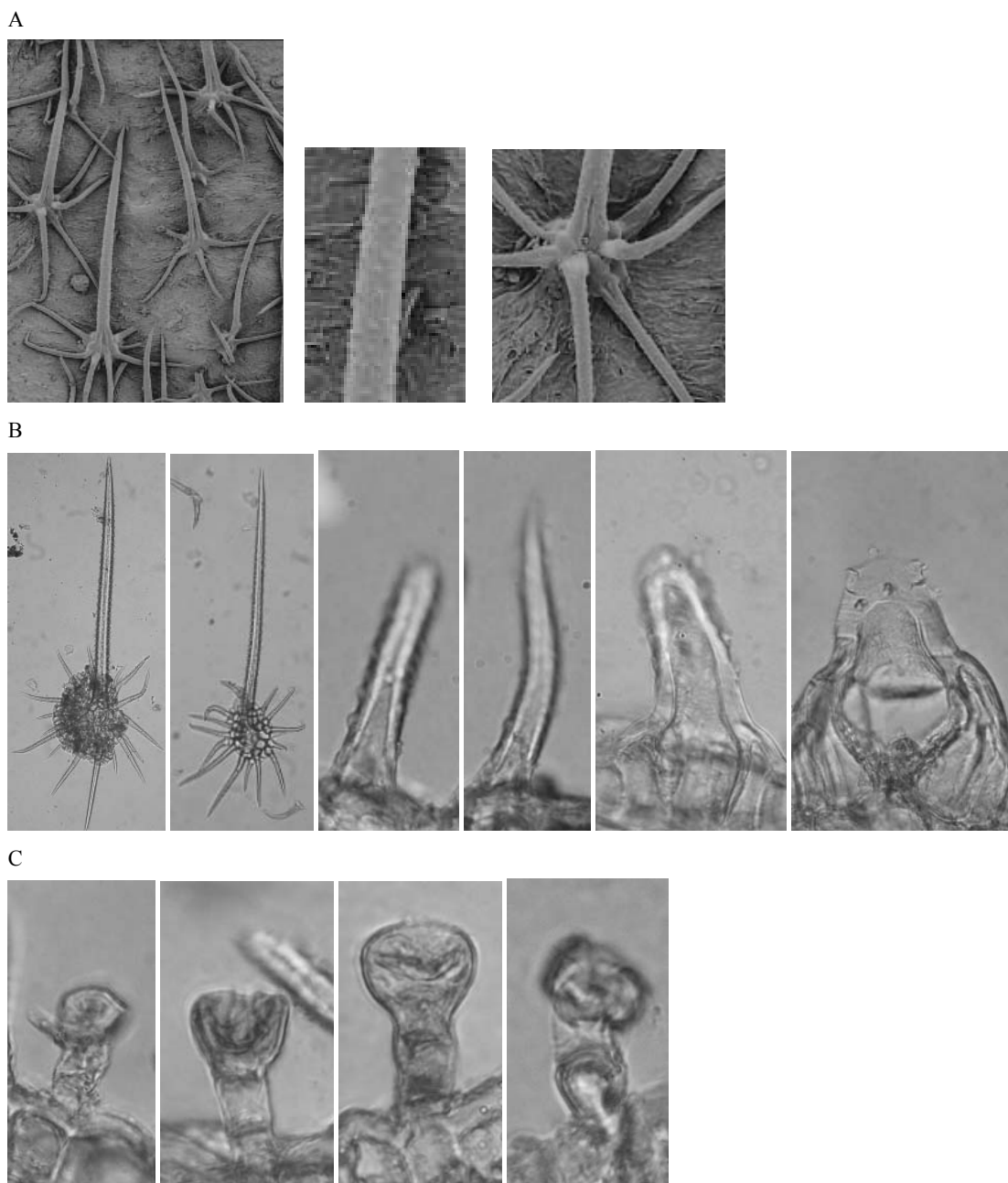


Figure 7. Hair types of *O. armenum*. A- Scanning electron micrographs of eglandular hairs, B) eglandular hairs, C) glandular hairs.

DISCUSSION

Morphological, micromorphological and anatomical characteristics of *O. armenum* which is an endemic taxon were examined in this study.

There are a few information about morphological properties of *O. armenum* in the Flora of Turkey [1]. A lot of properties and sizes are reported for the first time in this study. In our study, it was determined that the basal leaves were 1.2-4.2 x 0.3-1 cm, the cauline leaves were 1.5-5.5 x 0.3-0.7 cm, the bracts were 0.5-2.0 x 0.1-0.4 cm, the calyx was 1.0-1.9 cm in flower, 1.5-2.6 cm in fruit, the corolla was 13-20 mm and the nutlets were 4-4.5 x 3-3.5 mm.

Metcalfe & Chalk [8] and Watson & Dallwitz [9] explained the characteristic properties of the family *Boraginaceae*. But there is no any specific information about the anatomical structure of endemic *O. armenum*. The anatomical properties of endemic *O. armenum* have the general characteristics of family *Boraginaceae*. In this research it was found that this species had a secondary root structure. The xylem was composed of sclerenchymatic cells and tracheary elements. The pith cells were large and parenchymatic. Binzet and Orcan [15] explained that lignified parenchyma cells were found in the pith region of *O. roussaei* DC. The pith region consist of primary xylem elements in some species as *O. bracteosum* and *O. giganteum* Lam. [13, 15]. There was a single-layered epidermis on the stem. The collenchyma was 1-4 layered. The leaf was isobilateral. The stomata were anisocytic and anomocytic. Metcalfe & Chalk [8] pointed out that there were both anomocytic and anisocytic stomata in this family. The same results were seen in some other *Onosma* species [12-14]. Stomata index is 23.14 for the upper epidermis and 21.48 for the lower epidermis of *O. armenum*.

The porrect stellate trichomes were used as taxonomic characters to determine *Onosma* species in Italy by Pignatti [24]. The *Onosma* section was separated two subsection according to trichome type by Riedl [1]: *Asterotricha* (Boiss) Gürke and *Haplotricha* (Boiss) Gürke. In subsect. *Haplotricha*, the tubercles are glabrous (the haplotrichous state). In subsect *Asterotricha*, has tubercular setulae (porrect- stellate), spinules or hairs. *O. armenum* was in subsection *Asterotricha* [1]. There were simple, porrect- stellate and glandular hairs on the epidermis of the stem and leaf of *O. armenum*. Porrect –stellate trichomes have long central ray and short lateral rays. *O. armenum* had porrect- stellate with 6-12 lateral rays. The number of lateral rays is very changeable in this genus. The number of lateral rays was 5-6 in *O. isauricum* Boiss. & Heldr, 8-12 in *O. stenolobum* Hausskn. ex H. Riedl, 7 (6) in *O. bornmuelleri* Hausskn and 6-10 in *O. bracteosum* [12-14].

The micromorphology of several plant seeds and fruits has been examined by SEM and their taxonomic importance has been proven by many authors [21, 25-26]. In this study the fruit surface of *O. armenum* was found reticulate type and areolate subtype.

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