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COMPARATIVE ANALYSIS OF THE ANATOMICAL STRUCTURE OF SPECIES OF THE GENUS *KALIDIUM* MOQ. FLORA OF THE SYRDARYA RIVER VALLEY

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Annotation: The article presents the results of a morphological and anatomical study of the structures of species of the genus *Kalidium* Moq., growing in the valley of the Syr Darya River. Anatomical and morphological features of the structure of leaves and stems of *Kalidium caspicum* (L.) Ung.- Sternb species are considered and *Kalidium foliatum* (Pall.) Moq.

It was determined that *K. foliatum* differs from *K. caspicum* in morphological and anatomical features, sclerenchymal tissue cells are expressed and the stem is more isolated from the leaves. Characteristic of *K. foliatum* is the presence of druses, which are not found in the second species.

Keywords: *Kalidium caspicum, K. foliatum*, anatomy, leaf, stem, Syrdarya river valley

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ОСОБЕННОСТЕЙ АНАТОМИЧЕСКОГО СТРОЕНИЯ ВИДОВ РОДА *KALIDIUM* MOQ. ФЛОРЫ ДОЛИНЫ Р.СЫРДАРЬИ

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Аннотация: В статье приводятся результаты морфолого-анатомического исследования структур видов рода Kalidium Moq., произрастающих в долине реки Сырдарьи. Рассматриваются анатомо-морфологические особенности строения листьев и стеблей видов Kalidium caspicum (L.) Ung.-Sternb. и Kalidium foliatum (Pall.) Moq.

Определено, что K. foliatum отличается от K. caspicum по морфологическим и анатомическим признакам, выражены клетки склеренхимной ткани и более обособлен стебель от листьев. Характерным для K. foliatum является наличие друз, которые не встречаются у второго вида.

Ключевые слова: Kalidium caspicum, K. foliatum, анатомия, лист, стебель, долина реки Сырдарьи

Introduction.

A significant part of the territory of Kazakhstan is located in the desert zone. One of the characteristic types of its vegetation is halophytic communities dominated by the shrub genus potashnik – *Kalidium: K. capsicum* (L.) Ung.-Sternb., *K. foliatum*.(Pall.) Moq. and *K. schrenkianum* Bunge ex Ung.-Sternb.

These species have a fairly wide distribution, occurring in the south-east of the European part of Russia, the south Caucasus, Western and Eastern Siberia to Dauria, western China and Mongolia [1].

Representatives of the genus *Kalidium* for the desert territories of Kazakhstan (Kyzylorda region) are zonal (characteristic of this zone) plants. For a long time, potashnik and some other close genera, which are landscape plants for the desert zone, serve as fodder for livestock: camels, goats and sheep. For example, in Mesopotamia, since ancient times, potashnik was used to produce potash used for the production of glass.

The study of the anatomy of the potash of the Syrdarya River valley, as poorly studied dominants of the vegetation cover of arid territories, is an important direction for the republic.

Objects and methods of research.

The objects of research are two species of the genus *Kalidium: K. caspicum*, *K. foliatum*. Materials for anatomical studies were collected in natural conditions of species growth in the Syrdarya River valley. The plants were selected in the flowering phase. Namely, in the Kyzylorda region, in the village of Zhalagash. (N 44'45,6620 E 65º15,3670; N 45º23'51,30 E 64º16'18,50 N 44'46,8580 E 65º16,8550) [2-9].

Classical anatomical methods were used in the course of the study. Cross-sections of plants were made according to the generally accepted method of P.P. Barykina on the freezing device OL-ZSO 30 (INMEDPROM, Russia). Fixation of anatomical sections was carried out in 40 % alcohol. Anatomical preparations were made using a microtome with a freezing device OL-ZSO (Inmedprom, Russia). Micrographs of microscopic studies were performed on a microscope (Levenhuk D 740T 5.1M) at magnification x180 and x720.

Results and their discussion.

Kalidium caspicum and *Kalidium* foliatum were selected for anatomical analysis. Anatomical sections of the leaf blade and stem were made. When comparing anatomical sections, special differences between them draw attention to themselves. Before proceeding to the discussion of the anatomical structure, let us recall the differences of species by morphological characteristics [1-4].

	K. caspicum	***K. foliatum***
Life form	Shrub, with a height of 20-80cm.	Shrub, with a height of 15-100cm.
Habitus	The shape of the aboveground part of the plant is rounded, hemispherical; generative and vegetative stems are approximately the same length, creating a single shape.	Vegetative shoots together create a spherical or hemispherical shape. Since generative shoots are longer than vegetative ones, they rise above them.
Stem	Strongly splayed- branched, with whitish, strongly elongated, straight, glabrous at the bottom, short-leafed branches at the top.	From the very base it is strongly branched, harsh, glabrous or rough; lignified, whitish annual shoots.
Leaf	The leaves are alternate, linear, 5-15 mm long, fully stem-embracing, fleshy, semi-calcareous, bluish or green; slightly above the base with a constriction, below expanded, falling off along the constriction.	The leaves are alternate, triangular 3-10 mm long, partially stem-embracing, prickly, sessile.

A comparative analysis of the anatomical and morphological structure of the stem of *Kalidium caspicum* and *K. foliatum* was carried out. The analysis showed that in the species *Kalidium caspicum* (fig. 1), the following component features are noted: the epidermis cells are arranged in a row, the presence of a thickened cuticle is characteristic. Under the layer of epidermal cells there are parenchymal cells of the primary cortex, which are represented by 4-5 layers of large parenchymal cells. Next, the zone of the central cylinder is marked, which begins with one layer of pericycle cells. In the center of the central cylinder are the

elements of the primary phloem and primary xylem. Single sclerenchyma cells located radially in the center of the stem were noted.

The anatomical and morphological features of the *K. foliatum* stem include the presence of a secondary structure. The cells of the epidermis have more a thick layer of cuticle, which is associated with the growing conditions of this species in more arid conditions. The cells of the primary cortex are smaller and more numerous, have an oval-rectangular shape. The pericycle consists of several layers of densely alternating tabular cells. Under the pericycle there is a dense layer of primary phloem cells, under which there are groups of sclerenchymal cells alternating with vessels of the secondary xylem. The central part of the cylinder has a triple structure. Each fragment contains one conducting beam consisting of elements of the secondary phloem and primary xylem (fig. 2).

Despite the general morphological similarity in the structure of the cross-section of *K. caspicum* and *K. foliatum* stems, it was noted that *K. foliatum* has more pronounced anatomical features associated with more arid growing conditions. Its section is distinguished by a well-developed sclerenchyma, which tightly surrounds the central part of the cylinder. In relation to the conductive tissue in *K. foliatum*, it is more developed. In *K. caspicum*, the sclerenchyma is not very pronounced and the cells of the conducting system are located radially (fig. 1). The cells of the parenchyma of the core in both species have a rounded or oval shape.

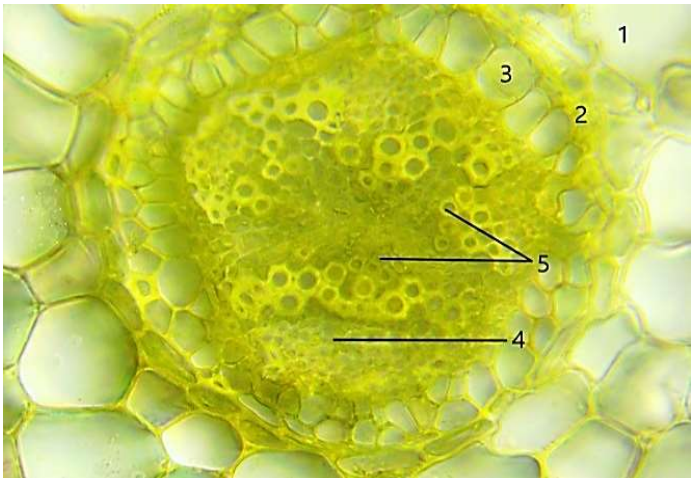


Figure 1 – Cross section of the stem of *Kalidium caspicum* (mag. x720)
(1 – parenchyma of the primary cortex; 2 – endoderm; 3 – parenchyma of the pericycle; 4 – primary phloem; 5 – vessels of the primary xylem)

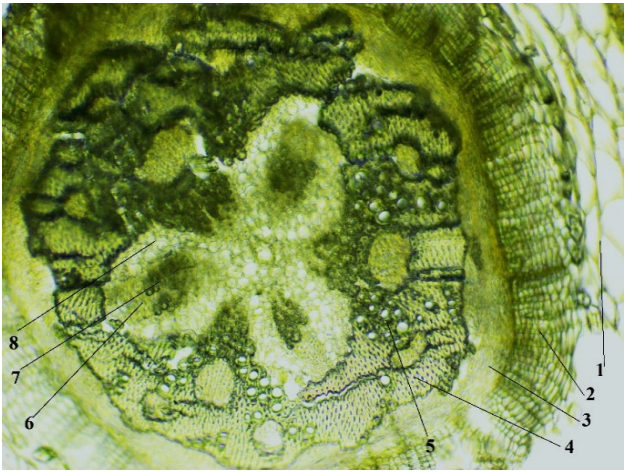


Figure 2 – Cross section of the stem of *Kalidium foliatum*(mag. x720)
(1 – parenchyma of the primary cortex; 2 – pericycle; 3 – primary phloem; 4 – sclerenchyma; 5 – secondary xylem; 6 – secondary phloem; 7 – primary xylem; 8 – parenchyma of the core)

In the process of studying the anatomical and morphological structure of the leaf blade, it was revealed that the *K. caspicum* species (fig. 3, 5 (A), 6 (A)) is characterized by the following order of arrangement of leaf tissues: the cuticle and epidermis of the integumentary tissue make up one row of dense cells, then there is a 1-2-row layer of columnar parenchyma cells, densely arranged, a spongy mesophyll is located under it, also 1-2 rows of loose cells. Photosynthesis is carried out in this tissue. In the zone between the mesophyll of the leaf and the main parenchyma of the stem, there is a denser layer of mesophyll parenchyma (dark green). The main parenchyma refers to the structure of the stem and is an aquiferous tissue. Its cells have a rounded cylindrical shape. In the central part of the stem there is a central cylinder.

Anatomical and morphological features of the cross section of *K. foliatum* differ from the section of *K. caspicum* described above. The main feature is the attachment of the leaf to the stem. The fact is that *K. caspicum* leaves completely, tightly cover the stem along the entire circumference, and *K. foliatum* leaves only partially surround the stem (fig. 4, 5 (C), 6 (C)). With regard to the detailed anatomical structure of the cross-section, there are almost no differences between the two compared species, except for the presence of numerous druses in *K. foliatum*, which are absent in *K. caspicum*.

Despite the general morphological similarity in the structure of the cross-section of *K. caspicum* and *K. foliatum* stems, it was noted that *K. foliatum* has

some anatomical features. Its section is distinguished by a well-developed sclerenchyma, which has a triple-shaped core. (fig. 4). And its conducting system is the same as that of *K. caspicum*, but more well developed. In *K. caspicum*, the sclerenchyma is not very pronounced and the cells of the conducting system are located radially (fig. 3). The cells of the parenchyma of the core in both species have a rounded or oval shape.

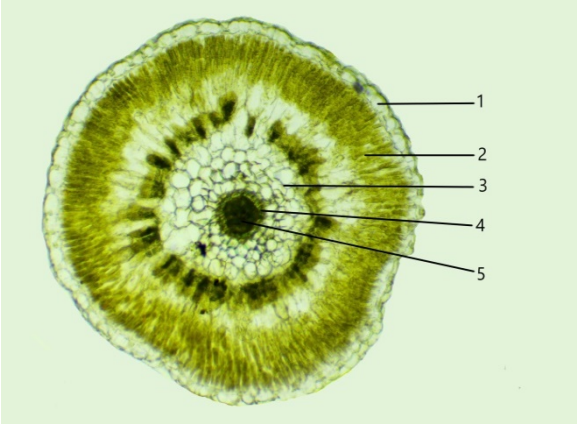


Figure 3 – Cross section of *Kalidium caspicum*
(1 – epidermis; 2 – columnar mesophyll; 3 – primary cortex; 4 – endoderm; 5 – central cylinder)

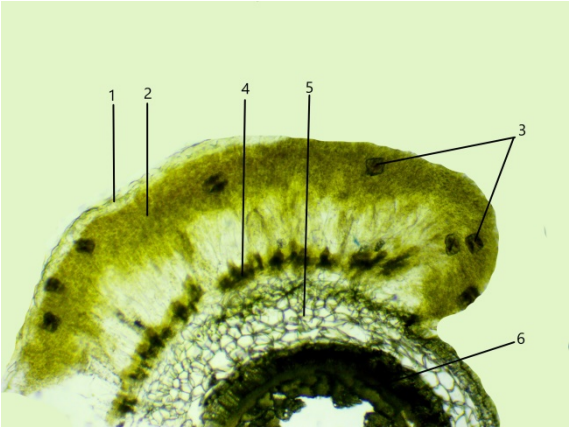


Figure 4 – Cross section of *Kalidium foliatum*

(1 – epidermis; 2 – columnar mesophyll; 3 – druses; 4 – dense layer of parenchyma passing from stem to leaf; 5 – primary bark; 6 – central cylinder of stem)

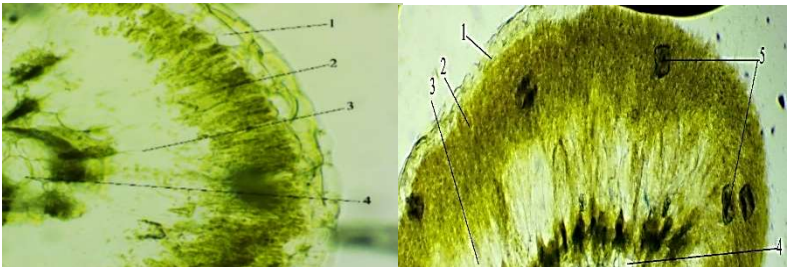


Figure 5 – Cross section of Kalidium foliatum

(1 – epidermis, 2 – columnar mesophyll; 3- druses, 4 – dense layer of parenchyma passing from stem to leaf; 5 – primary bark; 6 – central cylinder of stem)

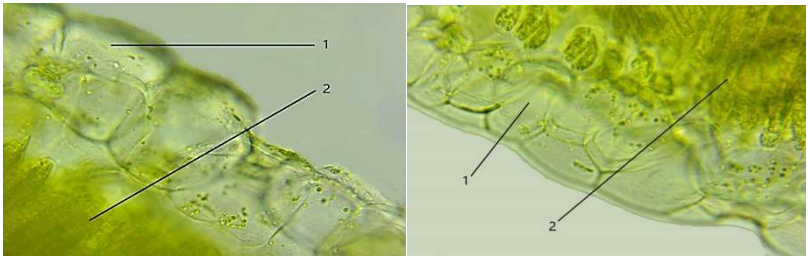


Figure 6 – Epidermis and columnar mesophyll of *Kalidium caspicum* and *Kalidium foliatum*

Figure 5 shows fragments of the leaves of the studied species, which confirm the identity in the general anatomical and morphological structure, a distinctive feature is the presence of numerous calcium oxalate druzes in *K. foliatum*.

Figure 6 shows anatomical sections of the edges of the leaves of *K. caspicum* and *K. foliatum.* Comparing the data, it can be noted that there are no special species differences. In both species, the leaves are covered with a single-layer epidermis, under which columnar mesophyll cells are located, which occupy the main part of the leaf. *K.caspicum* and *K.foliatum* are characterized by a similar anatomical structure of the cross-section of the edge of the leaves, the cells of which have a rounded-oval shape. It should be noted that, in comparison with other types of Chenopodiaceae (*Salsola*) [6], the epidermal cells of the species in question have a more oval shape, represented by a single row of cells. The mesophyll is composed of 1-2 rows of palisade-type cells.

Conclusions.

Thus, a comparative analysis of anatomical sections of stems and leaves of *K. caspicum* and *K. foliatum* revealed the following similarities and differences in morphological and anatomical structure:

– the leaves of *K. caspicum* are completely stem-embracing, and those of *K. foliatum* are partially stem-embracing;

– in the leaves of *K. caspicum* and *K. foliatum*, in the zone between the mesophyll and the main parenchyma, there is a denser layer of mesophyll parenchyma (dark green on the cut), passing from stem to leaf;

– the leaves of *K. foliatum* contain calcium oxalate druses in the structure of spongy and columnar mesophyll;

– the stem of *K. foliatum* is distinguished by a well-developed sclerenchyma, located in groups of cells, as well as a triple-shaped core, whereas in *K. caspicum* the sclerenchyma cells are located radially;

– the stem of *K. foliatum* has a secondary structure, and the cells of the epidermis have a thicker cuticle layer.

Also, it should be noted that *K. foliatum* is a species more adapted (xerophytic) to the conditions of water scarcity due to the presence of water-retaining tissue and well-developed mechanical tissue.

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