

Structure of the Leaf of Certain Genus *ALYSSUM* L. (Brassicaceae Burnett) in the South-Western Kyzylkum

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Abstract: *The anatomical structure of the leaf of 3 species of the genus Alyssum (Alyssum dasycarpum, Alyssum turkestanicum, Alyssum szovitsianum) was studied in the conditions of the southwestern Kyzylkum. The following diagnostic features were determined in the studied species: pubescent with stellate hairs, stomata not submerged, adaxial epidermal cells are larger than abaxial, type of mesophyll is islaterally-palisade. Revealed signs can serve for identification of herbal products.*

Keywords: anatomy, leaf, ephemeral, *Alyssum*, Kyzylkum

1. Introduction

The leaf organs of ephemerals attract the attention of researchers, because of their lability to environmental conditions. The study of their structure in plant ontogeny determines the strategy of adaptation of plants, that is, the way of adaptation at the transition from the embryonic leaf organs (cotyledons) to the leaf. There are data on the structure of a leaf of some types of ephemerals from different habitats: Karakum (Nechaeva, Vasilevskaya, Antonova, 1973), foothills of the western Tien Shan (Ubaidullaev, 1959a, b) and Kopet-Dag (Volkova, 1960). Type of mesophyll leaf of some types of ephemerals of Kyzylkum and the ratio of palisade and spongy tissues are reflected in the works of G.F. Begbaeva (1995; 2002 a, b;), G.S. Tursinbayeva et al., (2015).

In the capital brief of C.R. Metcalfe and L. Chalk (1957) noted that the leaf of the fam. *Brassicaceae* is predominantly dorsiventral, but is also found in islaterally-palisade. Trichomes are very diverse. Stomata anisocytic on both sides of the leaf. In all organs there are idiblasts with myzin, which when coagulated becomes red or purple, that can be used as a diagnostic feature.

E.I. Volkova (1960) studied the structure of 10 species of ephemerals, including species of *Brassicaceae*, in the Kopetdag conditions and the Moscow region. She noted the variety of types of leaf and an increase in mesomorphy in conditions of introduction in the Moscow region.

N. Rao, I. Inamdar (1983) described the morphology and venation of a leaf of 35 species of *Brassicaceae*, including species of the genus *Alyssum*: leaves are simple, the next, but the shape of the plate is very diverse. The venation is predominantly *raspredromnoe*. G.F. Begbaeva (1995) described the type of mesophyll leaf in 2 species of *Isatis*. Types *Isatis* nutritionally valuable plants, contain all the essential amino acids and a significant amount of carbohydrates (Karimov et al., 1965). Thus, information on the structure of the leaf of desert species of the genus *Alissum* is not numerous.

2. Material and Methods

The objects of the study are 3 species of the genus *Alyssum*: *Alyssum dasycarpum*, *Alyssum turkestanicum*, *Alyssum szovitsianum*. The material is collected in the Kyzylkum Desert Station, which is located in the north-west of Bukhara on the basis of Ayak-Guzhumdy springs. The depth of groundwater is 20-30 m, the mineralization of water is - 0.65-1.95 g / l, in some places - 4-5 g / l. Salinization is chloride-sulfate. Soil with admixture of gypsum (10-50%). Soils are diverse: gray-brown gypsum, solonchaks, takyr, semi-fixed sands, sandy loam, variegated, stony slopes of the Remnant Mountains, which determines the diversity of vegetation, including ephemerals. The region is characterized by extreme dryness of air and soil, caused by a minimum amount of precipitation (80-120 mm per year), high summer and low winter temperatures from max. + 40-45o to mines -25-30oC accompanied by a strong wind (Momotov, 1962; Babushkin, 1971; Lee, 1973; An, Gringof, Konovalov, 1978).

Leaves of species of the genus *Alyssum* were collected in 3-5 pieces from the lower, middle and upper tiers of shoots I and II orders in the natural habitat in the budding phase - the beginning of flowering. The mesophyll type was determined on transverse sections through the middle of the leaf. The epidermis was studied on paradermal preparations and transverse sections. The sections were done with a straight razor, stained with methyl blue, sealed with glycerol-gelatin. The shape and shape of the main epidermal cells are described by the method of S.F. Zakharevich (1954). The measurements were carried out according to the generally accepted method (Barykina, Chubatova, 2005). Preparations were drawn using a RA-6 drawing machine under the MBI-3 microscope. The measurements were carried out in 30-fold repetition with the calculation of the mean value, errors in measurement and reliability according to the formula Dospekhova (1979).

3. Results and Discussion

Alyssum dasycarpum. The leaf is simple broadly lanceolate, one-piece, smoothly turning into the petiole. Plate of leaf 6-8

mm long, 4-6 mm wide, on both sides evenly pubescent with 5-8 radial stellate hairs. The epidermis is single-rowed; on the paradermal section the cells are 4 and 5-angled and have slightly sinuous walls. The outer walls are slightly thickened. On the abaxial side, the epidermal cells are smaller and lower than on the adaxial side on the transverse section. The leaf is amphistomatic. Stomata not submerged oval, hemiparasitic and anisocytic, less often anemocytic. The mesophyll is isolaterally palisade, loose. Palisade tissue on both sides is single-row, spongy 3-row. Vascular bundles sclerosed, 25-30 on the transverse section (Figure 1, Table 1, 2).

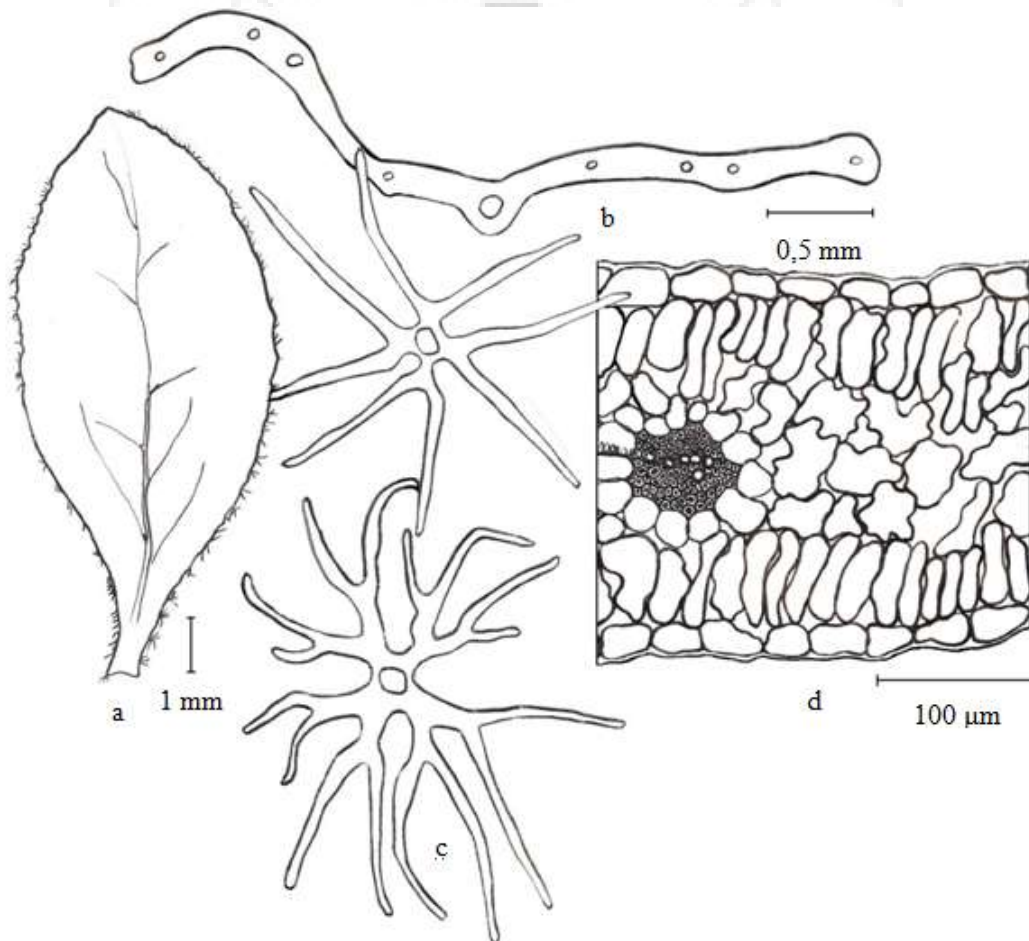
Alyssum turkestanicum. Leaf is simple, oblong almost sessile. The plate is 9-11 mm long, 2-3 mm wide, entire. It is confined by 16-ray stellate hairs thicker on the adaxial side. The epidermis is single-rowed. On the paradermal sections of the cell, its 4-5-carbon with slightly sinuous walls on the adaxial side of the leaf and winding on the abaxial. Their outer wall is slightly thickened. On the adaxial side, the epidermal cells are larger and higher than on the abaxial. The leaves are amphistomatic. Stoma is elongated-oval, anisocytic and tetracitic. The mesophyll is isolaterally-palisade, with 2-3 rows of palisade cells on the adaxial side

and with 1 row on the abaxial. Palisade tissue occupies most of the volume of the entire mesophyll; the height of the palisade cells is 2 times the width. Spongy tissue 4-6 rows. Vascular bundles are numerous, 19-21 on the transverse section, sclerized (Figure 2, Table 2).

Alyssum szovitsianum. Leaf simple, oblong-pointed plate 7-9 mm long, 4-6 mm wide, all-sided, pubescent on both sides with eighteen-sixteen hairs (on the upper side of the leaf, the hairs are predominantly eight-rayed, and the lower sixteen). The epidermis is single-rowed. The leaves are amphistomatic. On the paradermal section, the walls of the adaxial epidermis are slightly arched, abaxial - sinuous. Stomata of anomocytic, hemiparsitic types, larger, but in smaller quantity on the adaxial side of the leaf. The mesophyll is isolaterally palisade, with 2-3 rows of palisade cells on the adaxial side and 1-2 on the abaxial. Between them, 3-4 rows of loose spongy cells. Intercellular spaces are large throughout the mesophyll. Vascular bundles are small, lateral, unclustered, and central with several cells sclerenchyma on the abaxial side and parenchyma (Fig. 3, table 1, 2).

Table 1: Indicators structure of the epidermis leaf species of the genus *Alyssum*

| Species | Height, μm | Outer wall thickness, μm | Length of stomata, μm | | Stomata width, μm | | Number of stomata per 1 mm^2 | |
|------------------------|-----------------------|-------------------------------------|----------------------------------|----------------|------------------------------|----------------|--|------------------|
| | | | adax. | abax. | adax. | abax. | adax. | abax. |
| <i>A. dasycarpum</i> | 17,2 \pm 1,5 | 2,6 \pm 0,2 | 21,9 \pm 2,0 | 21,7 \pm 1,9 | 15,8 \pm 1,4 | 16,2 \pm 1,5 | 129,0 \pm 12,0 | 208,0 \pm 20,0 |
| <i>A. szovitsianum</i> | 21,0 \pm 2,0 | 1,8 \pm 0,9 | 19,8 \pm 1,9 | 22,6 \pm 2,1 | 16,2 \pm 1,5 | 16,2 \pm 1,6 | 155,0 \pm 15,0 | 200 \pm 19,0 |



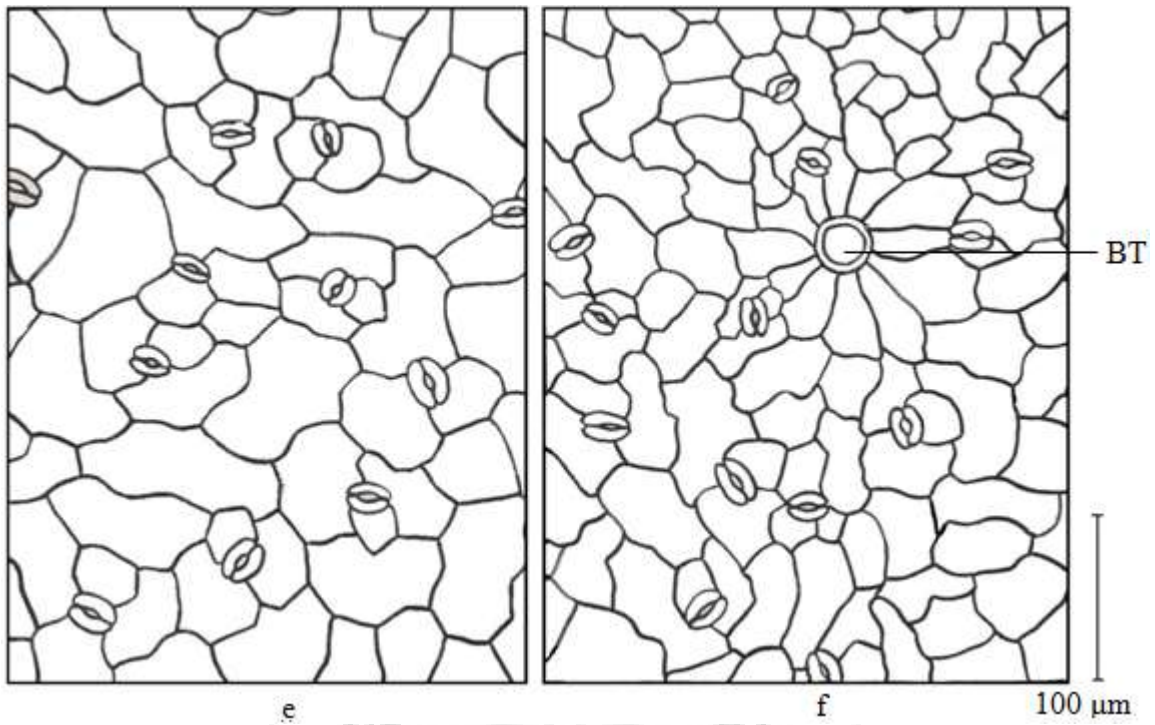
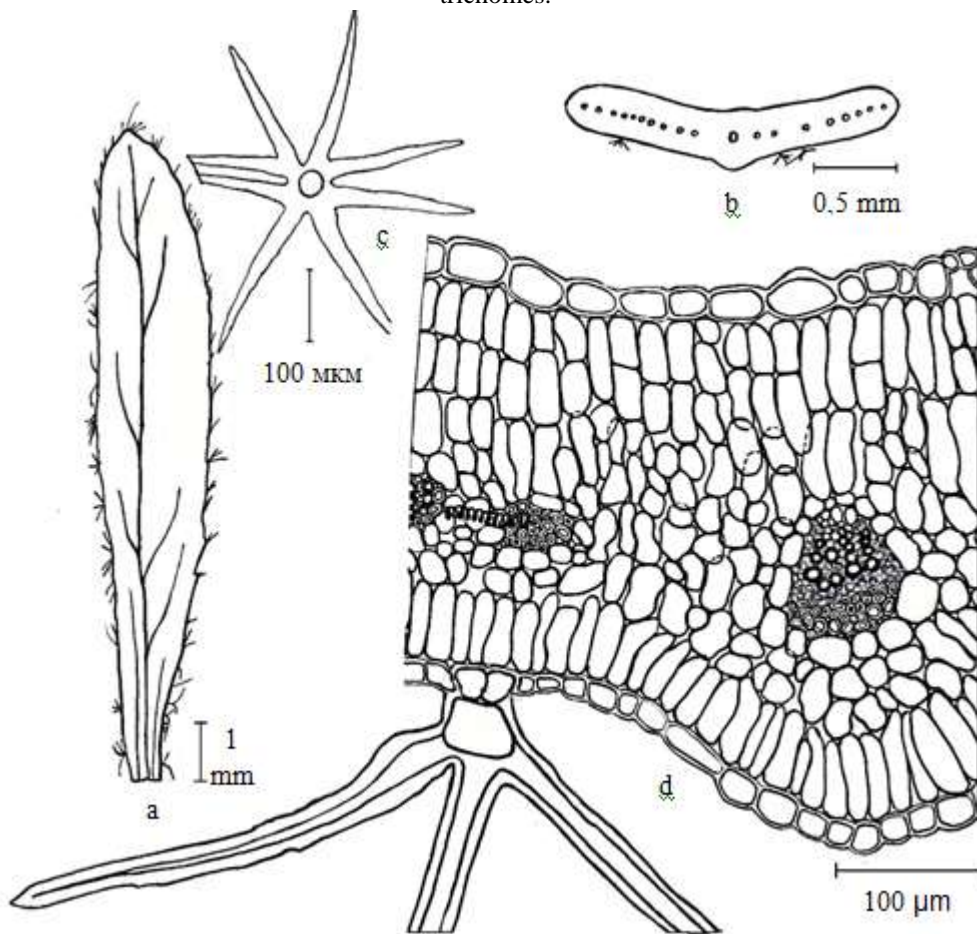


Figure 1: The structure of the leaf *Alyssum dasycarpum*: a - appearance; b - cross-sectional diagram; c - dendroid trichomes; d - detail of the mesophyll; e - adaxial epidermis; f - abaxial. BT - Base of trichomes.



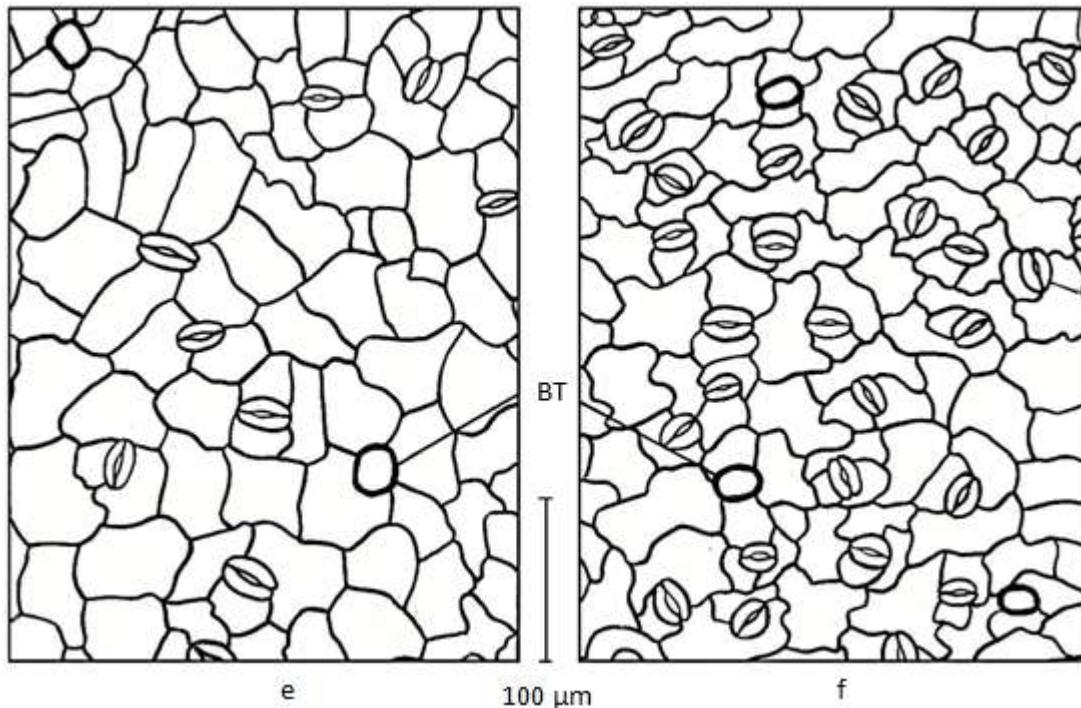


Figure 2: The structure of the leaf *Alyssum turkestanicum*: a- appearance; b - cross-sectional diagram; c - trichomes; d - detail of the mesophyll; e - adaxial epidermis; f - abaxial. BT - base of trichomes.

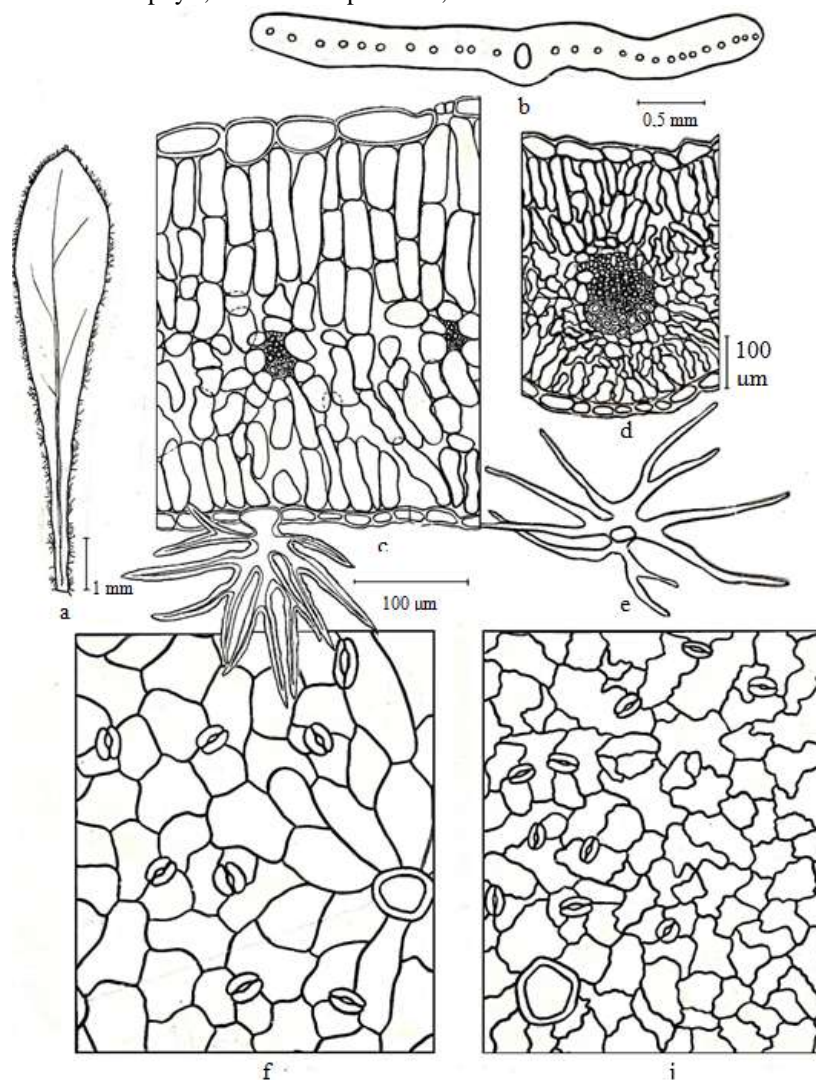


Figure 3: The structure of the leaf *Alyssum szovitsianum*: a - appearance; b - cross-sectional diagram; c - detail of the mesophyll; d - the main vein; e - dendroid trichome; f - adaxial epidermis; j - abaxial

Table 2: Symptoms of the mesophyll leaf of species of the genus *Alyssum*

| Species | Thickness, μm | | Coefficient palisade, % | Palisade cells adaxial, μm | | |
|-------------------------|--------------------------|------------------|-------------------------|---------------------------------------|----------------|-------------------|
| | mesophyll | palisade layer | | height | width | index of palisade |
| <i>A. dasycarpum</i> | 267,4 \pm 21,6 | 93,9 \pm 8,2 | 35,1 | 38,6 \pm 3,2 | 18,5 \pm 1,6 | 2,1 |
| <i>A. szovitsianum</i> | 311,5 \pm 23,5 | 156,2 \pm 12,3 | 56,5 | 40,6 \pm 4,0 | 12,6 \pm 1,1 | 3,2 |
| <i>A. turkestanicum</i> | 158,6 \pm 12,1 | 100,8 \pm 9,3 | 63,6 | 26,9 \pm 2,1 | 12,1 \pm 0,9 | 2,2 |

4. Conclusion

The leaf *Alyssum szovitsianum*, *A. turkestanicum*, *A. dasycarpum* has the following common features: pubescent stellate hairs, amphistomatic, stomata unloaded, cells of adaxial epidermis larger than the abaxial, type of mesophyll is isolaterally palisade. However, the list of species of the genus *Alyssum* differs according to the following diagnostic features: *Alyssum szovitsianum* is characterized by a lanceolate leaf form, a thick mesophyll; *Alyssum turkestanicum* - oblong form of leaf, thin leaf, more pronounced palisade (coefficient of palisade - 63%); *A. dasycarpum* is a wide-lance leaf form. In the ontogenesis of plants, the xero- and heliomorphicity of the structure of the assimilating organs increases: from dorsiventral cotyledons to isolaterally-palisade leaves. The leading factor of the spring period is insolation, which determines the formation of palisade tissue in the leaf with dorsiventral, isolaterally-palisade and specialized types of mesophyll. All leaf organs are xero- and heliomorphic in varying degrees, which is related both to the heliofactor and to the xerophage.

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