
MORPHOLOGICAL AND ANATOMICAL RESEARCH OF THE AERIAL PART OF ATRAGENE ALPINA L.

Topicality. Alpine clematis (Atragene alpina L.) synonym (Clematis alpine Mill.) – a perennial herbaceous liana that grows in the mountain forests of the Carpathians. Widespread in the forests of Northeast Asia, Europe and North America. Atragene alpina L. is also grown as an ornamental plant.

The Atragene alpina L. herb is used in traditional medicine for heart failure, tumors, for resorption of various types of cysts (in the liver, kidneys, uterus), treatment of fibroids, mastopathy, endometriosis, polycystosis, as well as for headaches, pulmonary tuberculosis, flu, colds, metabolic disorders, malaria, epilepsy, and as a general strengthening remedy. Externally – for paralysis, rheumatism, scabies, acne.

The aim of the work was to study the morphological and anatomical structure of the aerial part of alpine clematis (Atragene alpina L.) by establishing the diagnostic features of the raw material.

Research materials and methods. The material for the research was alpine clematis herb, which was harvested in the Rakhiv district of the Zakarpattia region in June 2022 (the vicinity of the southwestern slope of the Chornohora ridge (1750 m above sea level) near Lake Breneskul). The morphological structure of alpine clematis herb was studied using a magnifying glass and a binocular microscope. The study of anatomical features was carried out in accordance with the requirements of The State Pharmacopoeia of Ukraine monograph «2.8.23. Microscopic research of medicinal plant raw materials». Fresh and dried raw materials were used. For anatomical study, temporary micropreparations of surface preparations of alpine clematis leaf, stem, and petals were made. When studying temporary preparations, the optical device Delta Optical Genetic Pro was used and fixed with the help of the camera Delta Optics DLT-Cam Pro.

Research results and their discussion. The macroscopic features of Atragene alpina L. herb have been determined: features of the structure of the leaf blade (length, shape, apex, base, edge) and the presence of a petiole; type and structure of flowers; characteristics of the stem (length, shape, surface, branching) and seed (shape, size, surface). According to the results of the microscopic analysis, it was established that the basal cells of the upper epidermis of the leaf plate with weakly wavy and evenly thickened walls; cells of the lower epidermis with strongly convoluted walls; stomatal complex of the anomocytic type, the cells of which are present in greater amount in the lower epidermis of the leaf. The cells of the epidermis of the stem are straight-walled, elongated in the tangential direction; diacytic type stomatal complex; the stem is covered with simple multicellular hairs; sclereids with slit-like and branched pores are present. The cells of the upper epidermis of the petal are elongated with straight walls; the cells of the lower epidermis are tortuous; stomatal complex of the diacytic type, located only on the lower epidermis; on the surface of the petals there are simple hairs with longitudinal wartiness; petals and sepals are characterized by the presence of calcium oxalate druses.

Conclusions. The main morphological and microscopic diagnostic features of the aerial part of Atragene alpina L. have been studied and established. The obtained data will be used to develop regulatory documentation for the researched raw material – Atragene alpina L. herb.

Key words: morphological features, anatomical features, herb, leaves, flowers, Atragene alpina L.
Морфолого-анатомічне дослідження надземної частини Atragene alpina L.

Актуальність. Княжник альпійський (Atragene alpina L.) синонім (Clematis alpine Mill.) – багаторічна трав’яниста рослина, яка зростає в гірських зонах Європи, Європейської Азії та Північної Америки. Вирощують як декоративну рослину.

Метою роботи було вивчити морфолого-анатомічну будову надземної частини княжника альпійського (Atragene alpina L.) та встановити діагностичні ознаки сировини.

Матеріали та методи дослідження. Матеріалом для дослідження була княжника альпійська трава, яку заготовлено в Рахівському районі Закарпатської області в червні 2022 р. (околиці південно-західного схилу хребта Чорногори (1750 м н.р.м.) поблизу села Бренескул). Морфологічну будову княжника альпійської трави вивчили, використовуючи засоби біологічного та макроскопічного спостережень.

Результати дослідження та їх обговорення. Було встановлено макроскопічні ознаки трави Atragene alpina L.: особливості будови хвоєстворінки та листя, рядів, квіткових елементів та вегетативних апаратів. Вивчення мікроскопічних ознак здійснювали відповідно до вимог монографії Державної Фармакопеї України «2.8.23. Мікроскопічне дослідження лікарської рослинної сировини». Використовували свіжу та висушену сировину.

Висновки. Вивчення та встановлення основних морфолого-також мікроскопічних діагностичних ознак надземної частини Atragene alpina L. отримані дані будуть використані для розробки нормативної документації на досліджувану сировину – Atragene alpina L. траву.

Ключові слова: морфологічні ознаки, анатомічні ознаки, трава, листки, клітини, Atragene alpina L.
**Introduction. Topicality.** Alpine clematis (*Atragene alpina* L.) synonym (*Clematis alpina* Mill.) is a creeping bush, the leaves are opposite, double-triple, with oblong-ovate, sharp serrated leaves. Pedicels are single in leaf axils. The flowers drooped; sepals 4-5, blue, lanceolate, pubescent on the outside, petals whitish, 12 or more, blade-shaped, notched at the top, shorter than the sepals. The fruit is achene with long hairy and fluffy columns. It grows in mountain forests, in the Carpathians (Didukh Ya., 2004; Chopyk V., 2015).

Genus Clematis (*Atragene* L.) of Buttercup family (*Ranunculaceae* Juss.) includes 8 species of herbaceous vines common in the forests of Northeast Asia, Europe and North America (Didukh Ya., 2004; R. Chawla, 2012; P. Buzzini, 2003; Riabchuk V., 2004; Chopyk V., 2015; Wen-Jing YANG, 2009).

Regarding the systematic position of the Genus Clematis (*Atragene* L.) there is no consensus in the literature. Nowadays, the question of its systematic relationship with the Genus Clematis has not been resolved (Didukh Ya., 2004; Wen-Jing YANG, 2009). In various floristic works (Candolle de, 1817; Kuntze, 1885; Prantl, 1891; House 1924; Tamura, 1956; Hutchinson, 1959; Tahtadzhian, 1966, etc.) the genus *Atragene* L. is usually included in the genus *Clematis* L. as a section, subgenus or group. Some scientists (Krylov, 1901; Britton, Brown, 1913; Rydberg, 1954; Popov, 1950; Ahapova, 1980, Linnei, 1753) distinguish *Atragene alpina* L. into an independent genus *Atragene* L. (Didukh Ya., 2004, Chopyk V., 2015).

In traditional medicine, the *Atragene alpina* L. herb is used for heart failure, tumors, for resorption of various types of cysts (in the liver, kidneys, uterus), treatment of fibroids, mastopathy, endometriosis, polycystosis, as well as for headaches, pulmonary tuberculosis, flu, colds, metabolic disorders, malaria, epilepsy, and as a general strengthening remedy. Externally – with paralysis, rheumatism, scabies, acne (Wichtl M., 1994; Wen-Jing YANG, 2009).

Research of *Atragene alpina* L. is relevant today because the analysis of available literature sources showed that the pharmacognostic study of *Atragene alpina* L. is insufficient, there is no information about the morphological and anatomical structure of *Atragene alpina* L. herb.

**The aim of the work** was to study the morphological and anatomical structure of the aerial part of alpine clematis (*Atragene alpina* L.) and establish the diagnostic features of the raw material.

**Research materials and methods.** The material for the research was alpine clematis herb, which was harvested in the Rakhiv district of the Zakarpattia region in June 2022 (the vicinity of the southwestern slope of the Chornohora ridge (1750 m above sea level) near Lake Breneskul). The morphological structure of alpine clematis herb was studied using a magnifying glass and a binocular microscope (Kyslychenko V., 2016; Kovalov V., 2014; Marchyshyn S., 2023). The study of anatomical features was carried out in accordance with the requirements of The State Pharmacopoeia of Ukraine monograph «2.8.23. Microscopic research of medicinal plant raw materials» (Derzhavna Farmakopeya Ukrayiny, 2015). Fresh and dried raw materials were used. For anatomical study, temporary micropreparations of surface preparations of alpine clematis leaf, stem, and petals were made. When studying temporary preparations, the optical device Delta Optical Genetic Pro was used and fixed with the help of the camera Delta Optical DLT-Cam Pro.

**Research results and their discussion**

**Macroscopic signs of alpine clematis herb**

The stems are creeping, thin, furrowed, pubescent. The leaves are opposite, usually with long hairy petioles. The leaves are lanceolate or elliptic, 2-5 cm long and 0.8-2 cm wide, pointed at the top, unevenly serrated along the edge, dark green above, pale green below, pubescent along the veins (Fig. 1). The flowers are large, single, drooping, located on long pubescent peduncles that emerge from the axis of the leaves. The smell is aromatic, peculiar, strong. The taste is a little salty.

**Fig. 1.** Alpine clematis (*Atragene alpina* L.): A – a plant in the flowering phase, B – medicinal plant material (herb)

**Anatomical diagnostic features of alpine clematis herb**

**Leaf.** The leaf blade is covered with a cuticle, under which is a layer of epidermal cells. Cells of the upper epidermis with weakly wavy and uniformly thickened walls, cells of the lower epidermis with strongly convoluted walls. Stomatal cells are located in the lower epidermis and are surrounded by 3-4 (rarely 2) side cells (anomocytic type). Along the veins, the epidermal cells are small, parenchymal, in some places their shell is thickened like a rosary.

The results of the study of the anatomical structure of *Atragene alpina* L. leaves are presented in fig. 2.
**Stem.** *Atragene alpina* L. has stems with rounded corners and subepidermal strands of collenchyma in the ribs and walls. The endoderm is single-row, well defined. The cells of the epidermis of the stem are straight-walled, elongated in the tangential direction. Diacytic-type stomatal complex. The stem is covered with simple multicellular hairs. Sclereids with slit-like and branched pores are present.

The results of the study of the anatomical structure of *Atragene alpina* L. stem are presented in fig. 3.

**Flower.** When examining the petal of the flower *Atragene alpina* L. (Fig. 4), the surface shows elongated cells of the upper epidermis with straight walls, the cells of the lower epidermis are tortuous. The stomatal complex of the diacytic type, located only on the lower epidermis. On the surface of the petals there are simple hairs with longitudinal wartiness; petals and sepals are characterized by the presence of calcium oxalate druses.

**Conclusions**

1. It was established that the distinctive morphological features for the species of the genus *Atragene* L., which grow on the territory of Ukraine, are the color of the plant, the shape of the leaves, and the shape of the fruit.

2. Diagnostic features of the aerial part of *Atragene alpina* L. were established by the method of microscopic analysis: basal cells of the upper epidermis of the leaf blade with weakly wavy and uniformly thickened walls, cells of the lower epidermis with strongly convoluted walls; stomatal complex of the anomocytic type (mainly represented in the lower epidermis). The cells of the epidermis of the stem are straight-walled, elongated in the tangential direction; diacytic type stomatal complex; the stem is covered with simple multicellular hairs; sclereids with slit-like and branched pores are present. The cells of the upper epidermis of the petal are elongated with straight walls, the cells of the lower epidermis are tortuous; stomatal complex of the diacytic type, the cells of which are located only on the lower epidermis; on the surface of the petals there are simple hairs with longitudinal
wartiness; petals and sepal are characterized by the presence of calcium oxalate druses.

3. The perspective and practical significance of the study was the use of the established main morphological and anatomical diagnostic features of Atragene alpina L. herb for the development of a project of quality control methods for medicinal plant raw materials.

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Conflict of interests: none.

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