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Morphological-anatomical study of *Achillea L.* species in western region of Ukraine

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Abstract

The article presents the results of study of morphological-anatomical structure of *Achillea L.* genus species in Western Ukraine. There were studied the morphological-anatomical structure of the researched species and the main diagnostic features of aboveground organs were determined: leaf plate has undulated wall cells of upper and lower epidermis, anomocytic type of stomata complex, hairs, basic hairs and essential oil glands.

Keywords: *Achillea L.* species, morphological-anatomical features, leaves, stem, flowers.

1. Introduction

Medicinal plants materials play a very important role in modern medicine. Introduction of new species of medicinal plants raw materials (MPRM) and their processed products into medical practice, diversification of phytomedications, require improvement of standardization and quality control system. Therefore, an important step in the development of quality control methods are morphological-anatomical studies, permitting the identification of MPRM and the establishment of the basic anatomical diagnostic signs.

Plants of *Achillea L.* genus were used since ancient times in non-traditional medicine. Fresh plants were used in bleedings from the nose, throat, stomach, intestines, bladder, in internal bleedings after surgery and bleedings from wounds. Extracts of *Achillea* herb are widely used in modern medicine and they are the part of complex phytotherapeutic drugs "Vundehil", "Tonzilgon", "Rotokan", "Fiton", "Fitulvent". Extracts of *Achillea L.* species have antispasmodic, choleretic, wound healing, haemostatic and hypotensive effect. Essential oils and extracts of *Achillea* have antibacterial and antifungal activity [1].

Achillea L. genus of Asteraceae family has more than 100 species that are common throughout Europe, in Eastern Siberia, the Far East, in Central Asia. They grow in fields, upland forest meadows, steppe and meadow slopes, in light sparse forests, along the roads. 20 species of *Achillea L.* genus grow on the territory of Ukraine. In the Carpathians, *Achillea distans* is common, which grows in open places, in the valleys, in the subalpine zone. In glades in the woods of Transcarpathia, the Carpathians and Precarpathian region *Achillea stricta* is common. In the high meadows of the Carpathians in the Transcarpathian region *Achillea carpatica* is growing [2].

Raw material of *Achillea millefolium* is officinal in Ukraine and many other countries, such as the Netherlands, Switzerland, Sweden, Finland, Romania, Australia.

According to the requirements of the Pharmacopoeia article "*Achillea millefolium* herb" raw material consists of: leaves of green or grayish-green colour, slightly pubescent on the upper surface and very pubescent on the lower surface, twice- and thrice pinnate into linear segments with whitish finely pointed tip. Baskets are collected in the shield on the top of the stem. Each basket from 3 mm to 5 mm in diameter, consists of a bed, usually with 4 or 5 false semiflosculous marginal flowers and from 3 to 20 tubular disk florets. Spathe consists of 3 rows of tegular, lanceolate, pubescent green bracts with brownish or whitish hulled edge. Basket bed is somewhat convex and in the axils of the scales has false semiflosculous marginal flower with threeplate whitish or reddish limb and tubular disk florets with radial, fiveplate, yellowish or light brownish corolla. Stems are pubescent, green, partly brown or purple, longitudinally striated, up to 3 mm thick, with a light core [3].

The aim of our study was to investigate the morphological-anatomical structure of leaves and flowers of *Achillea L.* species that grow in the western region of Ukraine with determination of diagnostic features of raw materials.

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2. Materials and methods

The objects of the study were raw materials of: *Achillea millefolium*, *Achillea carpatica*, *Achillea stricta*, *Achillea distans*, harvested during flowering in Ivano-Frankivsk and Transcarpathian regions in 2013-2014.

For research air-dried and freshly picked and fixed in a mixture of glycerin-alcohol-water (1:1:1) plant materials were used. The study of signs of morphological structure of raw materials was performed according to the requirements of State Pharmacopoeia of Ukraine [3-5]. Raw material was viewed with the naked eye and under a magnifying glass (x10) in daylight. In determination of the anatomical features, *Achillea* organs were studied in the epidermis and the preparations from the surface under the microscope LOMO R-1 (Russia) and REICHERT L.4 (Austria) (eyepiece - $\times 7$, $\times 10$, $\times 15$ lenses - $\times 10 \times 20$, $\times 40$). The obtained data were recorded using schematic drawings and photographs taken by camera Canon A 720 IS.

3. Results

Species of *Achillea* L. genus - are perennial herbaceous plants with pinnate or, rarely, integral serrated leaves. Pinnate leaves are linear or lanceolate, their segments are incised into few lanceolate particles. Baskets are ovate, small (less than 6 mm in diameter), in the final corymbose inflorescence, rarely solitary, apical. Leaflets of spathal are tegular, with brown or white membranous edge. Coenanthium of the basket is covered by membranous scales. Marginal flowers are false semiflosculous pistillate, with short, rounded limb, in an amount of 5-10, white, pink or yellow; median flowers are tubular, bisexual. Achenes are obovate or oblong, flattened, without bangs or crowns [1].

Plants of species *Achillea* L. genus are similar in external signs, that's why it is important to study morphological signs of studied species, which makes it possible to identify the most characteristic features of the genus. Differential peculiarities of diagnostic features of *Achillea* L. genus species are presented in Table 1.

Table 1: Differential morphological characteristics of Western Ukraine *Achillea* L. genus species

Name of the plant	Stem	Leaves	Inflorescence and flowers
1	2	3	4
<i>Achillea millefolium</i> L.	Two types of stems: sterile - have only leaves, flowering - inflorescence, 30 - 70 cm	The core of the leaf is of 1-2.5 or 4mm wide, throughout with sinuate-notched teeth, parts of segments are widely-lanceolate or lanceolate 0.8-2 mm in width	Spathe is 2.5 - 3 mm in diameter, tabs of marginal flowers are white or pink, 2.5 - 3 mm wide
<i>Achillea stricta</i> Schleich.	Stem is erect, slightly branched 20 - 70 cm	Final leafy particles are nonlinear, wider, core of the leaf is 1.5-2 mm wide, from the middle or near from the base with intermediate pinnately cut or holistic particles, final particles of leaves are lanceolate 0.3-1 mm wide	Spathe is 3 - 3.5 mm in diameter, its leaves with yellowish-brown edging
<i>Achillea carpatica</i> Blocki ex Dubovik	Upright, lignified at the base	Complex pinnate, wide; components of the leaves on the edge are serrated	Flowers are collected in baskets in small complex corymbs. Flower is actinomorphic, white or pink, marginal flowers are ligulate, median ones - are tubular, bisexual
<i>Achillea distans</i> Wald. et Kit.	Comes out by bundles of 3 - 10, 30 - 50 cm	Linear-lanceolate	With ovate spathes of 2.5 - 3.5 mm in length

The data presented in the table 1, indicate that distinctive morphological diagnostic characteristics of *Achillea* L. genus species are the length of the stem, leaf plate structure and inflorescences.

Anatomical structure of leaf plate. To identify *Achillea* L.

species anatomical characteristics of vegetative and generative organs were studied. During their study, fundamental specific quality distinctive features were not found. In this regard, further anatomical description is presented for all the studied species.

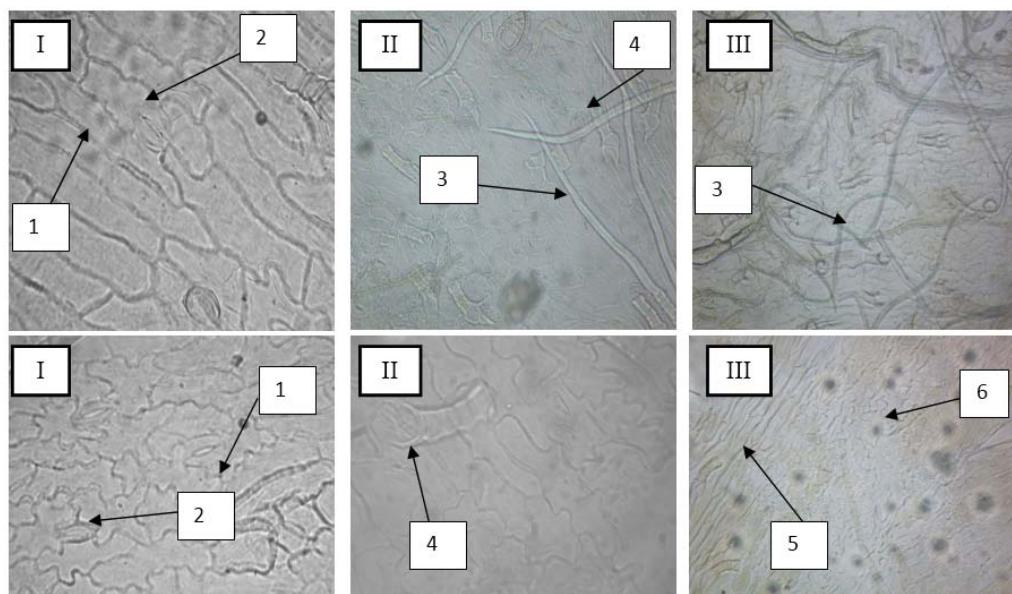


Fig 1: Anatomical features of upper and lower leaf epidermis of *Achillea* L. genus species

Notes: I - *Achillea distans* (7×20); II - *Achillea stricta* (10×40); III - *Achillea carpatica* (10×40): 1 - thick-walled cells; 2 - stomata complex (anomocytic type); 3 - hairs; 4 - basic hairs; 5 - vessels of conducting bundle of fibrilla; 6 - essential oil glands

Plate of the leaf is covered by cuticle, under which there is a layer of epidermal cells. On the surface of the leaf there are hairs and glands. The cells of the upper and lower (Fig. 1, 2) epidermis of the studied *Achillea* L. species have oval-rectangular shape slightly elongated in plain area. Chlorophyll parenchyma is differentiated: one-, two-layer palisade and multi raw spongy parenchyma. The upper epidermis cells have sinuous and uniformly thickened walls. Stomata apparatus is of anomocytic type, number of cells around the stomata varies

from 3 to 6.

Hairs are simple, based with 4 - 7 short cells with thin shells, the final cell of the hair is long, slightly tortuous, with a thick shell and a narrow threadlike cavity. Secretory ways have yellowish content and they accompany the leaf fibrilla.

Anatomical structure of flower petal. The upper epidermis of petals of studied *Achillea* L. genus species is papilliform, somewhere with wavy cuticle (Fig. 2).

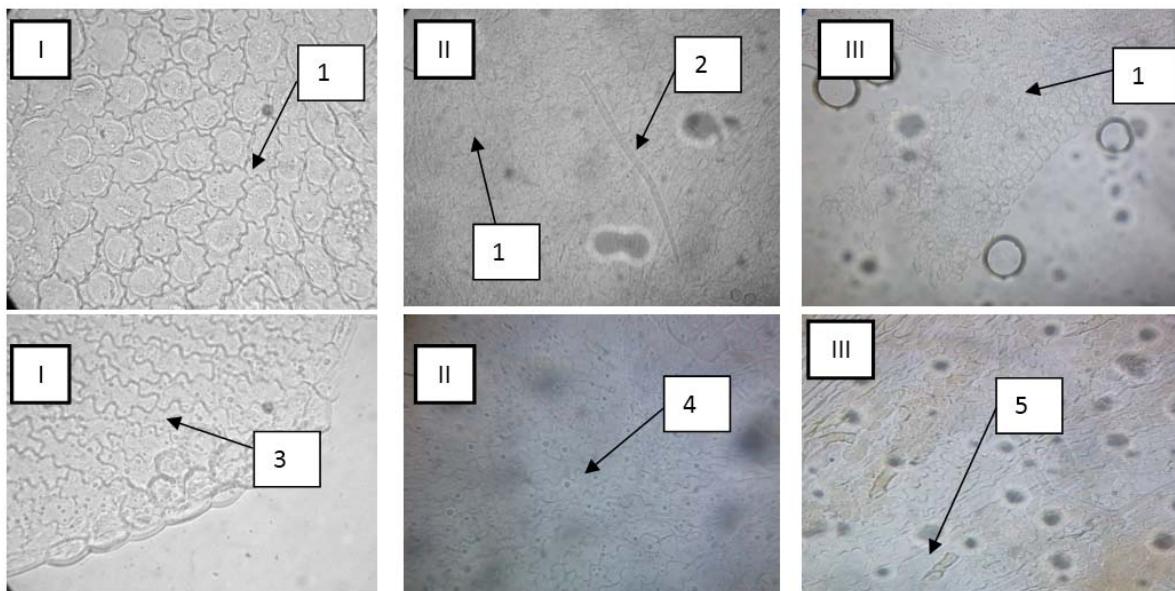


Fig 2: Anatomical characteristics of the flower petal epidermis of *Achillea* L. genus species

Notes: 1. I-B - *Achillea distans* (7×10); II-B - *Achillea stricta* (7×20); III-B - *Achillea carpatica* (10×40); 2. 1 - cells of the upper epidermis of the petal; 2 - hair; 3 - cells of the lower epidermis of the petal; 4 - druze of calcium oxalate; 5 - basic hairs

The cells of the lower epidermis are elongated, with very long tortuous walls and undulate cuticle. On the surface of petals there are essential oil glands, consisting of 8 secretory cells with stacked arrangement.

As a result of the conducted research morphological-anatomical structure of leaves and flowers of *Achillea distans*, *Achillea stricta*, *Achillea carpatica* was studied. The diagnostic signs of the leaves are tortuous wall cells of the upper and lower epidermis, anomocytic type of stomata complex, simple hairs and essential oil glands. Macro- and microscopic diagnostic features of leaves and flowers can be used to identify species of *Achillea* L. genus.

4. Conclusions

- 1 The study of morphological structure of leaves, stems and flowers of *Achillea* L. genus species growing in the western region of Ukraine was performed.
- 2 Microscopic diagnostic features of aboveground organs for *Achillea distans*, *Achillea stricta*, *Achillea carpatica* were found out: leaf plate is characterized by tortuous wall cells of the upper and lower epidermis, anomocytic type of stomata complex, simple hairs and essential oil glands.

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