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## MORPHOLOGICAL AND ANATOMICAL STUDY OF EUROPEAN VERBENA HERB (*VERBENA OFFICINALIS* L.)

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*Morphological and anatomical study of a new promising domestic type of medicinal plant raw materials – European verbena herb was carried out according to the thematic plan of the R&D works of VILAR No. 0576–2019–0010. As a result of study, morphological and anatomical features were established that have diagnostic significance and allow to determine the authenticity of this type of medicinal plant raw materials. The obtained data will be used in the development of the draft regulatory documentation for a new type of medicinal plant raw materials – European verbena herb.*

**Keywords:** European verbena (*Verbena officinalis* L.), herb, morphological and anatomical features

European verbena in the Middle ages was considered as a universal remedy for all diseases. In Greece, it is still considered as a sacred plant that brings happiness. European verbena has a tonic, antipyretic, anti-inflammatory, anti-edema effect. Verbena is often used in homeopathy: the homeopathic medicine Verbena is recommended for insomnia, nervous disorders, kidney and gall bladder stones. It is also widely used in Chinese, Tibetan and Korean medicine as a sudorific agent for malaria and fever [1, 2, 4, 6].

The above-ground part of European verbena contains glycosides (verbenalin, verbenin), triterpenoids, steroids, tannins, small amount of camphor and essential oils, bitterness, mucus [2,4,6].

European verbena – *Verbena officinalis* L. of the Verbenaceae family is perennial herb of height of 30–70 cm with a straight branching stem four-sided in the upper part. Lower leaves are pinnated-incised, middle leaves are trehyadernye, upper leaves are inciso-crenate or smooth-margin, sessile. The flowers are small, light purple, collected in spike-shaped inflorescences on the tops of the stems. Verbena blooms in June and August. European verbena is widespread in the temperate zone in Europe, Asia and North America; the plant grows in meadows, clearings, forest edges, along rivers and seas, on vacant lots or hills, on roadsides, as a weed in gardens, vegetable gardens, among crops [1–3,6].

The European verbena herb is included in the European, British herbal, American herbal, and Chinese Pharmacopoeia [5]. In Russia, this type of medicinal plant raw materials is not official and there is no regulatory documentation for it.

Currently, VILAR is studying the possibility of using the aboveground part of European verbena as a raw material for development of a new medicine. In this regard, the need arose

to standardize this type of raw material. One of the stages of standardization of medicinal plant raw materials is the establishment of morphological and anatomical characteristics as one of the indicators of identity.

**The purpose** of this work was studying the morphological and anatomical structure of the aboveground organs of European verbena (leaves, stems, flowers) and identifying their characteristic diagnostic features.

## MATERIALS AND METHODS

The object of study is a dried whole herb of European verbena, harvested in 2018 on the territory of the Botanical garden of VILAR.

Morphological and anatomical study of raw materials was carried out according to the pharmacopoeial monographs of the State Pharmacopoeia of the Russian Federation, XIV edition: OFS.1.5.1.0002.15 "Herbs" [7] and OFS.1.5.3.0003.15 "Technique of microscopic and microchemical study of medicinal plant raw materials and herbal medicinal products" [8]. Microscope slides were studied using a biological microscope "Altami BIO 2 LED" with a digital ocular USB camera 3.1 Mpix (Russia). The photos were processed on computer in Adobe Photoshop 7.0.

## RESULTS AND DISCUSSION

*Morphological study.* Macroscopic examination revealed morphological features of the European verbena herb. It is established that the raw material is whole and partially crushed frondose stems with flowers and buds, individual leaves, flowers, buds. Stems are straight, branched, four-sided, longitudinally ribbed, along the edges of the sides covered with pressed hairs. Leaves are ovoid, ovoid oblong, oblong-lanceolate or oblong, 4–8.5 cm long, up to 4 cm wide, wedge-shaped narrowed at the base, sessile, pinnated-incised, with prominent

veins on the lower side, pubescent. The middle leaves are trehyadernye, large-toothed, with blunt teeth, the upper leaves are oblong, inciso-crenate or smooth-margin. Flowers are small, numerous in apical, thin axillary spikes, collected in a large panicle; bracts are ovoid or lanceolate, sharp, shorter than the calyx. Calyx is pubescent, 2.5 mm long, 1.5 mm wide, short, sharp teeth. Corolla is five-lobed, almost twice as long as the calyx; the lobes are unequal: 3 lobes are larger and 2 lobes are slightly smaller. There are 4 stamens. Upper leaves are green, lower leaves are lighter, the stems are green, calyx is green, corolla is light purple.

*Anatomic study.* Microscopic examination revealed anatomical features of the European verbena herb. When examining the leaf surface (Fig. 1–8), cells of the upper and lower epidermis with sinuous walls are visible. Stomata on both sides of the leaf, more numerous on the lower surface, are surrounded by 3 stomatal cells, one of which is much smaller than the other two (anisocyte type), and another 3–5 (6) cells (anomocyte type). On the entire surface of the leaf, especially on the veins on the lower side, there are two types of hairs: simple and glandular. Simple hairs are single-celled thick-walled, with warty surface, having an expanded base and a pointed tip. At the base, simple hairs are surrounded by a single row of rounded polygonal cells that differ from other epidermal cells, i.e. they have a characteristic rosette. Glandular hairs are of two types: on a long thin-walled leg, often collapsed, with a flattened head consisting of 4–8 radially arranged cells, and on a short single-celled leg with an ovoid head consisting of 4 radially arranged cells.

The epidermis of the stem (Fig. 9–11) consists of polygonal and slightly elongated cells with straight, often beaded-thickened walls and cuticle folding, the epidermis cells along the edges are longer and narrower. Stomata are numerous, of a characteristic structure, oriented along the length of the stem. The hairs have the same structure as on a leaf; simple hairs are found

only along the edges of the stem faces. Around the stomata and articulations of glandular hairs, the radiant folding of the cuticle is clearly visible.

When viewing the calyx from the surface (Fig. 12–15), longitudinally elongated cells of the inner and outer epidermis with strongly branched walls are visible; on the outer epidermis, there are clear beaded thickenings of the cell walls and cuticle folding. Stomata of a characteristic structure are located on the outside, on the inside they are met on the teeth. On the surface of the calyx, there are hairs of the same structure as on the leaf. On the outside, there are numerous simple large hairs, on the inside – they are smaller and fewer. Glandular hairs are found on the outside of the calyx.

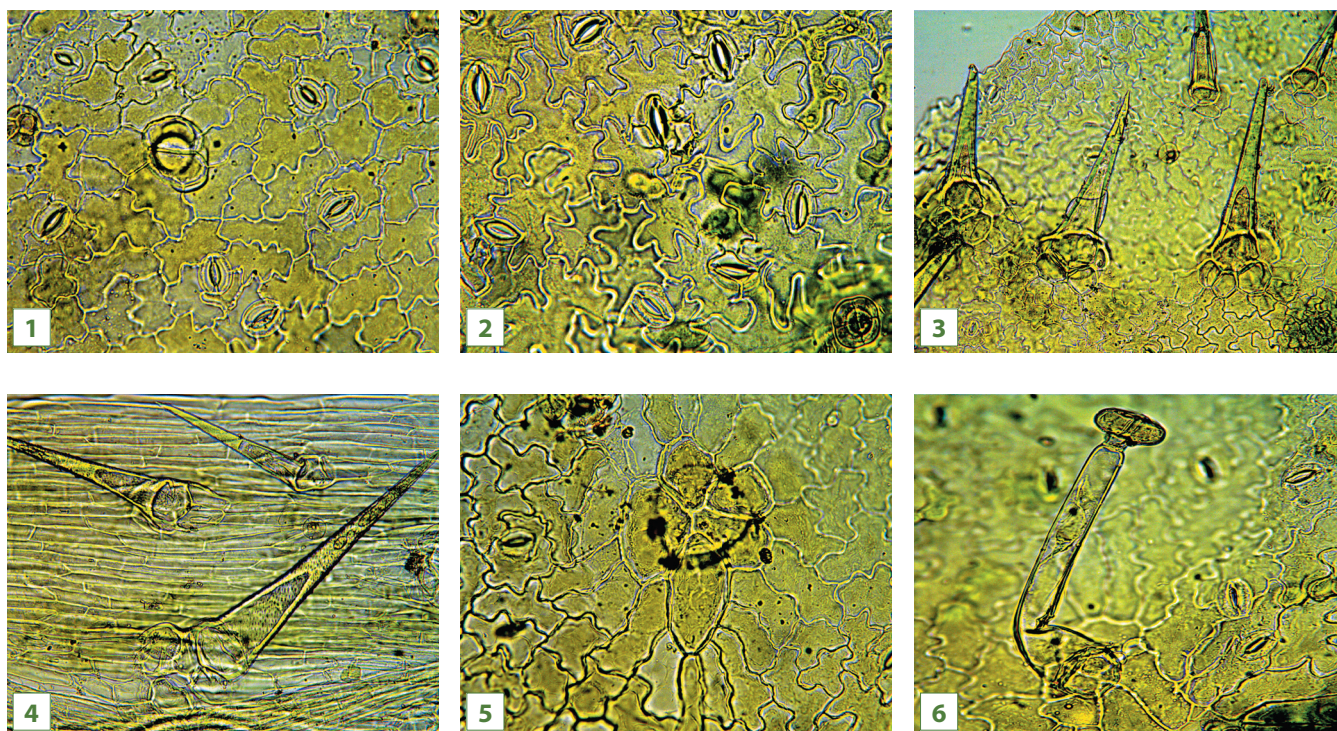
The corolla epidermis (Fig. 16–18) is covered with papillary outgrowths on the inner side

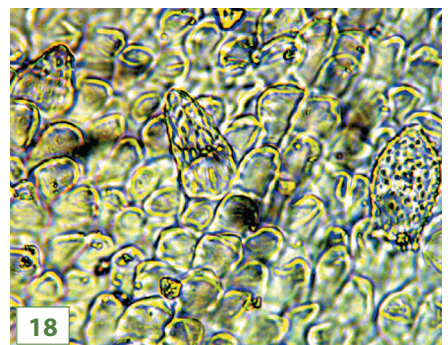
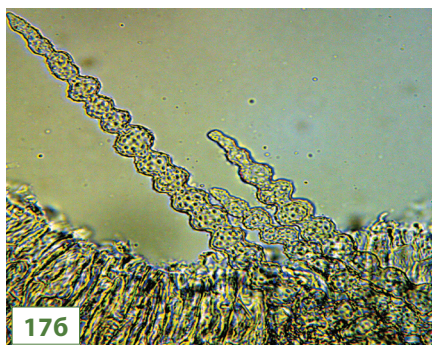
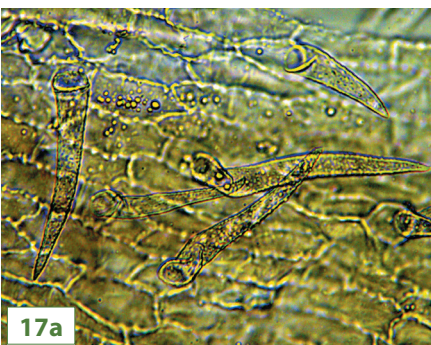
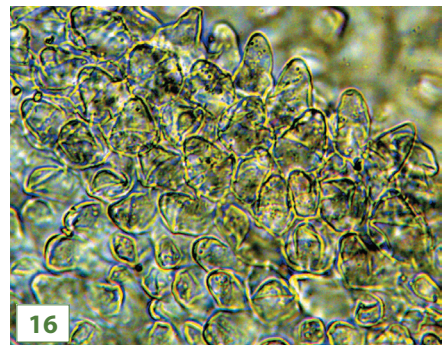
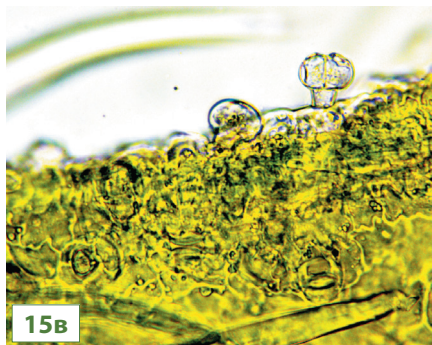
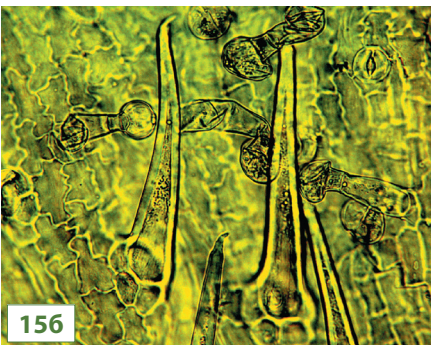
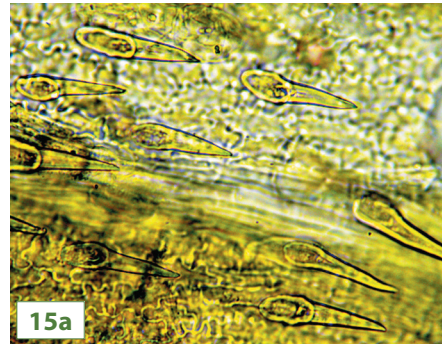
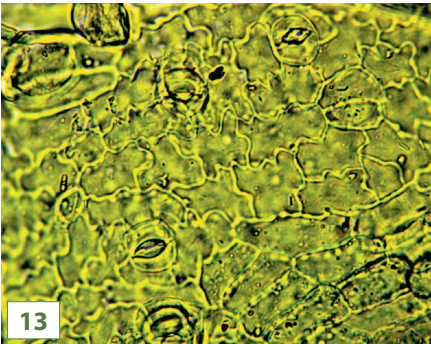
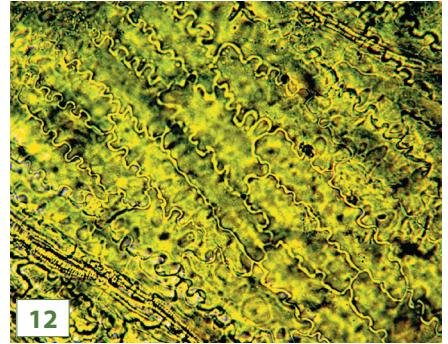
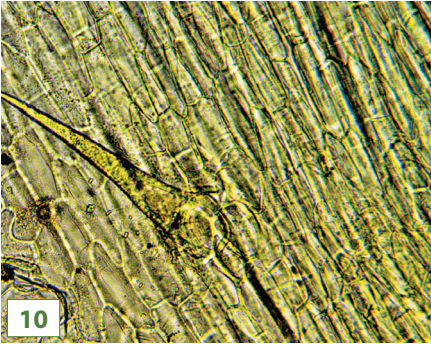
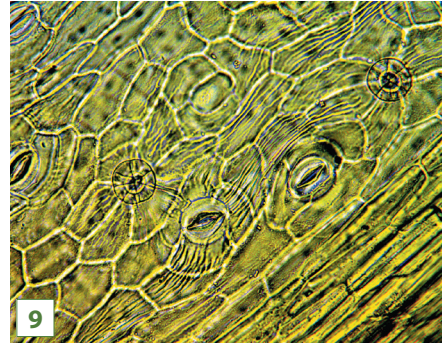
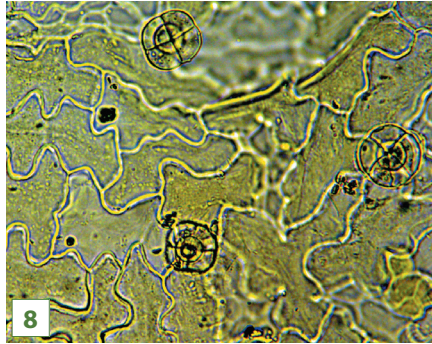
and along the edge, and the epidermis cells on the outer side have sinuous walls. The corolla is pubescent with simple single-celled thin-walled hairs with a pointed end, covered with soft-warty cuticle; long simple single-celled hairs with rough-warty cuticle, having a strongly branched shell, the hairs are often twisted together. In addition, there are papillary outgrowths of the epidermis with a rough-warty cuticle and head hairs on a 1–2-cell leg with a rounded 1–2-cell head. Pollen is tricolpate-porous with a smooth exine.

### CONCLUSION

Based on the study of European verbena herb, morphological and anatomical features were

**FIG.** Diagnostic signs of the anatomical structure of European verbena herb (1–3, 5, 6, 8, 9, 11–13, 15–18 –  $\times 400$ ; 4, 7, 10, 14 –  $\times 200$ ): 1 – upper leaf epidermis; 2 – lower leaf epidermis; 3 – simple hairs on the leaf surface; 4 – simple hairs along the leaf vein; 5 – rosette at the base of simple hairs; 6 – glandular hair on a long leg (side view); 7 – glandular hair on a short leg (side view); 8 – glandular hairs (top view); 9 – stem epidermis; 10 – simple hair; 11 – glandular hair on a long leg; 12 – inner calyx epidermis; 13 – outer calyx epidermis; 14 – hairs on the edge; 15 – hairs on the epidermis of the calyx: 15a – on the inner epidermis, 15b, 15c – on the outer epidermis; 16 – inner epidermis of the corolla; 17a – simple hairs with a soft-warty cuticle; 17b – simple hairs with a rough-warty cuticle; 18 – papillary outgrowths





determined that have diagnostic significance and allow to establish the identity of this type of raw material, which will be included in the regulatory documentation for a new promising type of domestic medicinal plant raw material such as European verbena herb.

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