

## MICROMORPHOLOGY AND ANATOMY OF TWO TYPES OF NECTAR IN CITRUS LEMON PLANT FLOWERS

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### ABSTRACT

The article provides scientific information on the micromorphology and anatomy of two types of nectar in the flowers of the lemon plant. The article also provides information on the growth characteristics of nectars.

**Keywords:** nectary, hermaphrodite, stomata, flowers, tissue.

### Morphological Characteristics of the Nectary

The intrastaminal, a greenish yellow colour nectary in hermaphrodite and functionally male flowers of *C. limon* 'Ponderosa' is located on the receptacle between the ovary base and the base of the filaments, which form a single whorl. Nectar droplets were observed on the nectary surface in both types of flowers in the closed- and open-bud stages. The flattened and fused filaments (in 2-3) as well as the fleshy petals prevent the nectar released by the nectary tissues from flowing out of the nectary. When viewed from above, it has a spherical shape in the hermaphrodite flowers and most frequently a polygonal shape in the functionally male flowers. Its upper surface shows irregular folds, while the lateral part is characterized by distinct ribs. The diameter of the annular nectary in the hermaphrodite flowers reaches 7-8 mm and its height 1-1.5 mm, whereas in the functionally male flowers its diameter is 5-6 mm and its height 0.5-0.8 mm. Unlike in the sepals, the petals as well as the ovary and the style, we did not find any essential oil cavities in the nectary.

### Nectary Micromorphology

The nectary surface in *C. limon* - in both types of flowers differed distinctly from the ovary surface. In the outer layers of the ovary, quite regularly arranged depressions could be seen, at the bottom of which essential oil cavities were found. No such depressions were observed on the nectary surface. The surface of the degenerated ovary in functionally male flowers was characterized by strong undulation, and the cells of the ovary epidermis were very irregularly shaped. The upper surface of the nectary showed a number of small projections, whereas the lateral walls of the gland were characterized by the occurrence of numerous groove-like depressions, arranged in a wavy pattern in the vertical direction, which facilitated the downward movement of the nectar.

Stomata were observed in the nectaries of both types of flowers and they were located primarily on the upper surface of the nectary, but few stomata also occurred on the lateral walls of the

gland. It was calculated that in the epidermis of the upper part of the nectary there were about 45 stomata per mm<sup>2</sup>. In dorsal view, the nectar stomata had a shape close to spherical. Small outer cuticular ledges, located far apart from each other, surrounded a large outer stomatal chamber of the stoma leading to a permanently open stomatal aperture. Most frequently, the stomata were situated at the level of the other epidermal cells. Only some of them were located above the epidermis surface. The stomata were surrounded by 7-8 epidermal cells that did not differ from the other cells of this tissue. Therefore, they can be classified as a normocytic. Some epidermal cells were covered with striated cuticle, but most cells were characterized by a layer of smooth cuticle. A slight wax coating and a spongy substance, which could have been nectar residues, were observed in the vicinity of the stomata or on their surface. Two stomata being in contact with each other through their guard cells were found sporadically. Some stomata were sealed with a cuticular plug. The nectarostomata differed in size compared to the leaf stomata. The length of the nectarostomata ranged from 20.6 pm to 23.1 pm, their width reached larger dimensions, ranging between 24.9 and 26.7 pm, whereas the leaf stomata had a similar length to that of the nectarostomata, but their width was smaller by 27% (21.7 x 18.9 pm).

### **Nectary Anatomy**

In both types of flowers, the nectary cells were more intensely colored and had smaller dimensions than the neighboring cells of the receptacle. The nectary surface was covered with a single-layered epidermis which formed folds in the upper part of the nectary, corresponding to the surface irregularities observed in SEM. In longitudinal section, it was difficult to find stomata, probably due to their small number. The epidermal cells were radially elongated. In most epidermal cells the cytoplasm with the nucleus and numerous plastids containing starch grains were located centrally, while the vacuoles most frequently occupied positions adjacent to the tangential walls.

The glandular tissue consisted of a dozen or so layers of cells which had different sizes and exhibited varying degrees of vacuolation depending on their position in the nectary. In the nectaries of both flower types, in the closed-bud stage, the results of the reaction indicated the presence of starch grains in all cells of the secretory parenchyma. More starch grains were present in the central (upper) region of the nectary, than in the lateral region of the gland. In the open-bud stage, two differently functioning secretory parenchyma regions differing in the content of starch grains were observed. The cells located in the upper region of the nectary were small and strongly colored, with numerous starch grains in the plastids. On the other hand, the cells located on the lateral walls of the gland were much brighter, with well-developed vacuoles and often without starch. Small intercellular spaces were found in the nectariferous tissue, much smaller than those in the subglandular tissue. The nectariferous tissue is penetrated by numerous branches of vascular bundles which contain xylem and phloem elements. Numerous small phloem branches reached the subepidermal layers

### **CONCLUSIONS**

The nectaries in the hermaphrodite and functionally male flowers of Citrus limon have different sizes, but their microstructure is very similar. These glands are characterized by the occurrence

of many similarities to the nectaries described in other Citrus species and various representatives of Rutaceae. However, the nectary microstructure in the family.

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