MICRO-MORPHOLOGICAL STRUCTURES OF MEDICINAL PLANT POLLEN IN THE SAMARKAND REGION

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In our country, strong emphasis is being placed on the field of medicine, alongside other sectors. In the realm of human health protection, step-by-step and consistent efforts are being implemented in the regions to provide high-quality and modern medical care that is convenient for the population, as well as for the early detection of diseases. For this purpose, the necessity of studying the composition of natural medicinal plants and the micro-morphological structure of pollen grains is being recognized worldwide.

Pollen grains of medicinal plants in the Samarkand region are one of the most important micromorphological features of the flora in the studied area. Their morphostructural composition is significant not only for diagnostics at the species and family level but also in phylogenetic, ecological, and geobotanical research. By studying the pollen grains of medicinal plants in the Samarkand region, scientists can draw conclusions about their taxonomic position, pollination biology, environmental adaptability, and even biodiversity levels. The morphology of medicinal plant pollen grains was described primarily based on characteristics such as shape, size, number of poles (apertures), and the structure of the exine layer. In this regard, plant pollen grains possess distinctive features at the microscopic level and are often used for specific species identification. The pollen grains of medicinal plants are also closely linked to their pharmacological importance. Since pollen grains are frequently one of the structures containing plant bioactive compounds, they are used to study the biosynthesis processes of various essential oils, flavonoids, saponins, and alkaloids. Consequently, the analysis of plant pollen grains has practical significance not only for botany and ecology but also for pharmaceuticals and medicine. This chapter examines the morphostructural composition of pollen grains from some medicinal plants growing in the Samarkand region. The analysis results are presented by family, detailing the shape, size, and apertures of pollen grains for each species, the structure of the exine, as well as ecological and palynological characteristics. This serves to scientifically illuminate the palynological features of medicinal plants in the region's flora[1].

The Asteraceae family is one of the largest families of flowering plants, distinguished by its abundance of medicinal species. During our research, we assembled a collection of several species representing this family. Notably, Achillea

millefolium, Helichrysum maracandicum, Inula macrophylla, and Tussilago farfara are considered important species not only as medicinal raw materials but also as indicator plants for ecological conditions. The morphology of pollen grains from these species plays a crucial role in studying the family's systematics, ecological adaptations, and the reproductive status of populations.

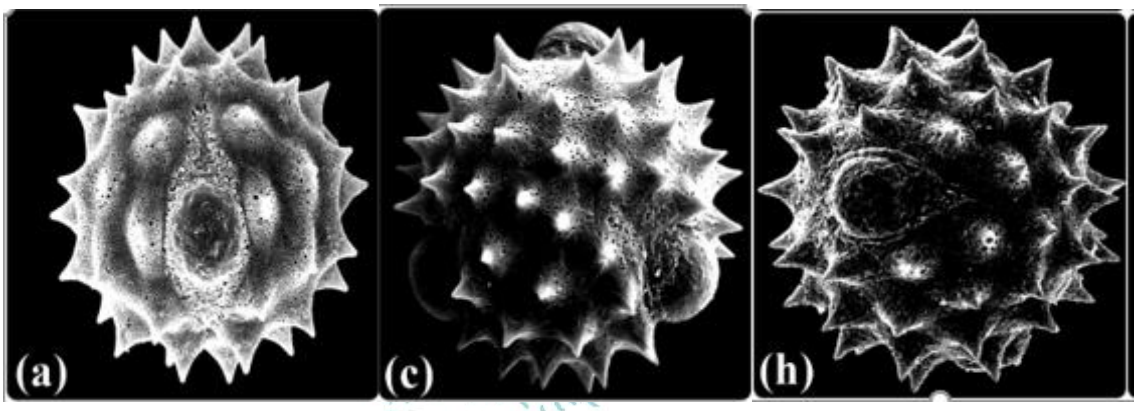


Figure 1 Scanning electron photomicrographs and exine structures of Achillea millefolium L., Helichrysum maracandicum Popov ex Krip., Inula macrophylla Kar. & Kir.

Based on the palynological properties of pollen grains, medicinal plants of the Asteraceae family exhibited the following characteristics.

Achillea millefolium is an herbaceous plant of the genus Achillea. The stem is erect, 20-80 cm tall, covered with soft hairs. Leaves are lanceolate, oblong, 3-15 cm long, 0.5-3 cm wide, with punctate glands in the lower part, twice or thrice pinnately dissected, almost to the base, with numerous (15-30) noticeably distant primary lobes, each having 9-15 toothed lobules. Flower heads are gathered into corymbs at the top of the stem. There are 5 ray florets, white, rarely pink. Achenes are flat, oblong, silvery-gray, 1.5-2 mm long. It blooms from June to the end of summer; seeds ripen in July-September. According to the morphology of pollen grains, in polar view they have a circular-apolar shape, in equatorial view - an oblate-spheroidal shape, the polar axis size is 35 μm, the aperture type is tricolpate, the exine thickness is 1.81 μm, and there are spine-like projections. Under SEM analysis, the surface of the pollen grains is covered with medium-length spines, between which a microreticulate structure is visible. The high aperture density indicates that this pollen species is adapted for insect pollination, limiting its dispersal through the air[3,5].

Helichrysum maracandicum, a species of the genus Helichrysum, is a herbaceous, multi-stemmed plant reaching 35-70 cm in height. The leaves are entire, often white-felt-pubescent along with the stems. Lower leaves are oblong-obovate or oblong-lanceolate, narrowing towards the petiole. Stem leaves are sessile, lanceolate-linear or linear, with the upper ones protruding and slightly pointed. The inflorescence is hemispherical or spherical when flowers open, 8-10 mm in diameter. Involucral bracts are lemon-yellow, multi-rowed, large, and densely imbricate. Outer bracts are

ovate, while inner ones are spatulate, obtuse, rigid-membranous in the upper part, smooth, shiny, almost concave, and coarsely hairy at the base. The corolla is dark yellow, with the pappus almost equal to it in length and yellowish in color. The plant flowers in June-July and fruits in July-August. According to pollen grain morphology, in polar view, they have a rounded-apolar shape, while in equatorial view, they are oblate-spheroidal. The polar axis measures 36-45 μm, with an exine thickness of 1.7-2.5 μm, featuring rounded protrusions (Figure 1). SEM results show that in Helichrysum maracandicum pollen grains, the length of exine protrusions is 1.4-1.7 μm, with their number ranging from 9-11 per 13 μm2, and apertures covered by a fine reticulate structure. This morphology provides high mechanical protection and is adapted to strong solar radiation in high-altitude conditions[1,4].

Inula macrophylla is a perennial herbaceous plant of the genus Inula L. The plant's height is 50-120 cm, with stiff, leathery leaves covered in glandular hairs, sometimes densely pubescent, and fragrant. The leaf edges are faintly sinuate-dentate, with sharp reticulate veins. Basal leaves are up to 70 cm long and 20-30 cm wide, broadly elliptical, acute, and tapering into a petiole. Middle stem leaves are sessile with a cordate, stem-clasping base, while upper leaves are reduced in size. Flower heads form a dense, broad corymb, 2-3 cm in diameter, on long peduncles. Involucral bracts are lanceolate, ciliate, densely glandular-pubescent, with outer bracts elongated-acuminate and inner ones gradually pointed. Ray florets are bright yellow, with ligules up to 2 cm long, narrowly linear. Achenes are slightly pubescent only below the pappus, cylindrical, slightly flattened, with numerous longitudinal ribs, brown, 3-5 mm long and 1-1.5 mm wide. The pappus at the base consists of 3 fused bundles, 2-3 times longer than the achene, composed of short-plumose, dull yellowish hairs. It blooms in May-July and fruits in July-August. Pollen grain morphology shows a spheroidal shape from the polar view and a flat-rounded shape from the equatorial view. The polar axis is 34-39 μm, with an exine thickness of 2.0-2.4 μm, and small spines are present. SEM analysis reveals an uneven pollen surface with fewer spines but a thick wall. Microscopic openings between the spines indicate a combined aperture. This structure increases the likelihood of pollen adhering to an insect's body.



Figure 2. Appearance of Helichrysum maracandicum, Achillea millefolium, and Inula macrophylla during their flowering period.

It has been established that the pollen grains of all medicinal plant species belonging to the Asteraceae family have a tricolpate structure. The largest pollen grains were observed in Inula macrophylla (averaging 39 μm), while the smallest were found in Achillea millefolium (35 μm). Our research has demonstrated that the greater thickness of the exine is an indication of this family's adaptation to xerophytic conditions[2,3,5].

In the species Helichrysum maracandicum and Inula macrophylla, the robust surface of the exine provides protection from solar radiation and facilitates attachment to pollinating insects. Tussilago farfara has adapted to humid conditions through relatively soft surface structures. Palynological differences in the pollen grains of Asteraceae species have diagnostic significance in determining the taxonomic boundaries of species.

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