

Pollen Structure of *Kelussia odoratissima* (Umbelliferae) from Iran

Leila Amjad*, Hamidreza Akkafi

Abstract— *Kelussia odoratissima* Mozaff. is a sweet-smelling, self-growing plant which is traditionally consumed in Iran as a garnish. The aim of this project was study the structure of pollen grains in *Kelussia odoratissima*. Anthers of *Kelussia* were collected at full flowering stage from wild populations. Structure pollen grains were studied by scanning electron microscopy. The results showed that pollen grains are radially symmetrical, isopolar, prolate, operculate and tricolporate with costae. The data presented suggest that palynological characters display taxonomic significance in the genus.

Index Terms— *Kelussia odoratissima*, pollen, structure, SEM.

1 INTRODUCTION

POLLEN is an indispensable part of the life cycle of flowering plants and represents the male gametophytic generation of seed plants and is source and transport unit for the male gametes. The study of pollen grain biology has relevance in agriculture, plant breeding, paleobotany and biotechnology. Pollen grain have potential use in monitoring cytotoxic, gene transfer, effect of biochemical such as herbicides, pesticides and pollutants, understanding the organization and function cytoskeleton and association proteins, studies on expression and cloning of gene and researches on intracellular differentiation and polarity [1].

Kelussia odoratissima Mozaff. (wild celery) belongs to the Apiaceae family and is a sweet-smelling, self-growing, glabrous, perennial aromatic herbs, which is traditionally consumed in Iran and grows to a height of 120 to 200 cm. The flowers are 1-2 mm in diameter, all hermaphrodites. It is native to Zagros (central region of Iran) and is an Iranian endemic plant [2], [3].

Around 80% of human daily has now turned to community healers and medicinal plants for protection from illness. In spite of tremendous development in the field of modern medicine. Plants still rank in modern as well as traditional medicine throughout the world [4]. In traditional medicine, *Kelussia odoratissima* is used as antioxidant, antimicrobial, antidiabetic and antilipidemic [3], [5], [6]. The usual stenopalynous type of pollen has been reported for the Apiaceae [7]. The pollen morphology of Apiaceae family including the genera: *Tetrateanum*, *Diplotaenia*, *Bupleurum*, *Echinophora* and *Pimpinella* has been reported [7]. In present study has been made to provide information on pollen morphology of *Kelussia odoratissima* by scanning electron microscopy (SEM).

2 MATERIALS AND METHODS

2.1 Sampling

The flowers of *Kelussia odoratissima* were collected at full flowering stage from wild populations. They collected from around area of Isfahan city (Iran) in the June of 2011. The voucher specimen was deposited at the herbarium of Research Institute of Isfahan Forests and Rangelands.

2.2 Scanning Electron Microscope

Pollen grains were investigated by Scanning electron microscopy (SEM). Samples were coated with gold for 4 min in a sputter coater. These samples were analyzed using a Scanning electron microscope (Model SEM - XL30, Philips, Netherland) [8].

3 RESULTS

The pollen grains are radially symmetrical and isopolar (Fig 1). The shape is prolate (shape classification follows Erdtman, 1969), with polar axis of $26.98 \pm 0.60 \mu\text{m}$ and equatorial axis of $17.24 \pm 0.45 \mu\text{m}$ and P/E: $1.56 \mu\text{m}$ and colpus length: 13 ± 0.01 . The outline is elliptic in the equatorial optical section and triangular in the polar optical section. In the inner contour of the mesocolpium side is straight, and the outer contour is straight (Fig 1). The pollen grains are operculate and tricolporate with costae (Fig 2). Ectoaperture rather long ($12.1-15.1 \mu\text{m}$) and slit-like, margins distinct, wavy, ends distinct, acute, fastigium absent. Endoaperture elliptic in outline, often with straight margins (Fig 2). The exine is subtectate and nexine thinner than sexine at poles or about equally thick, always thinner than sexine in equatorial area. Columella short and distinct at poles, longer and distinct at equator (Fig 3). Ornamentation types was observed rugulate at equator and striate at poles (Fig 4). The aperture is region of the pollen wall which differs significantly morphologically or anatomically from the rest of the pollen wall, presumed to function usually as germination site and to play a role in harmomegathy (Fig 5).

*Dr. L. Amjad is with the Department of Biology, Falavarjan Branch, Islamic Azad University, Esfahan-Iran (Corresponding author, telefax: +98-312-312-0136; e-mail: amjad.leila@gmail.com or amjad@iaufala.ac.ir).

H.R. Akkafi is with the Department of Biology, Falavarjan Branch, Islamic Azad University, Esfahan-Iran (e-mail: akkafi@iaufala.ac.ir).

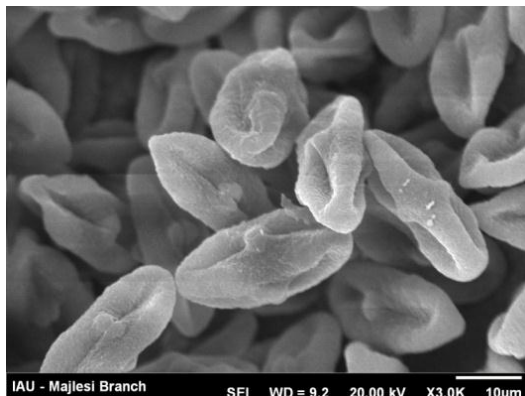


Fig. 1. Pollen grains with the triangular polar optical section and elliptic equatorial optical section

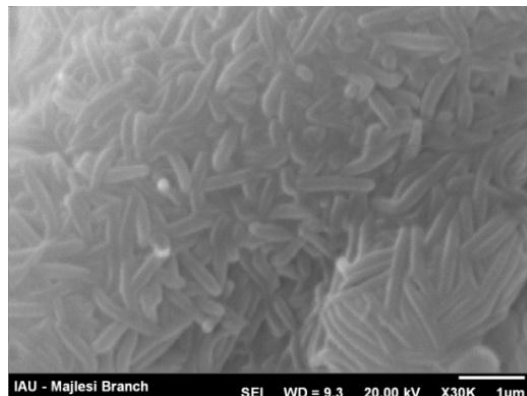


Fig. 4. Pollen grain with the elongated exine elements longer than 1 μ m: irregularly arranged.

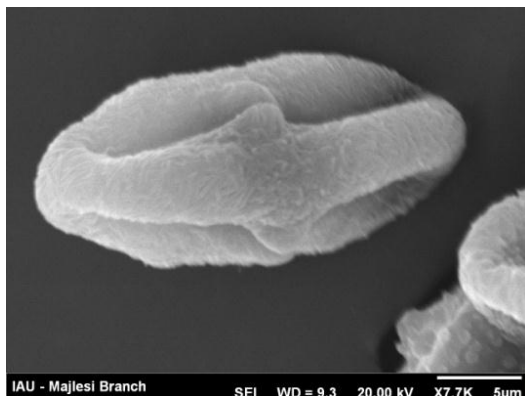


Fig. 2. Pollen grain with the polar axis longer than the equatorial diameter, operculate and tricolporate with regulate-straite exine pattern.

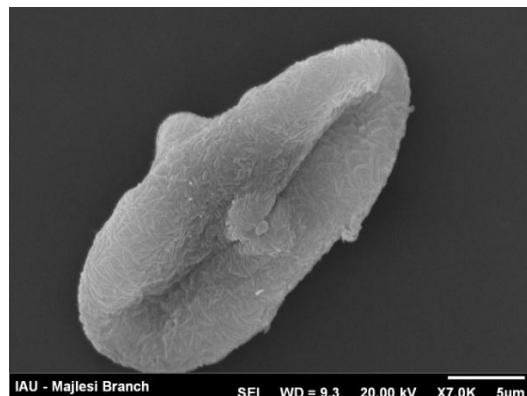


Fig. 5. Pollen grain with the aperture which is region of the pollen wall as germination sit.

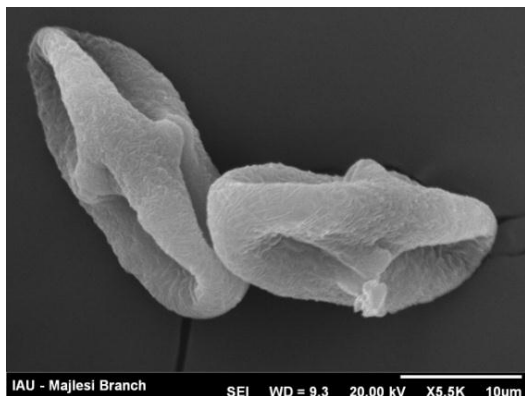


Fig. 3. Pollen grain of *Kelussia odoratissima*, equatorial view (scale bar: 10 μ m), the exine is subtectate and columella short and distinct at poles.

4 DISCUSSION

Palynology is a science of pollen grain and spores. It is particularly related with the study of taxonomy, paleobotany, ethnobotany, evolution studies, pollination and climatic changes and environment [9]. The pollen morphologies of the *Kellusia* have taxonomic significance. Umbelliferae is a stenopalynous family (Erdtman 1952)[10]. Palynological share on the family Apiaceae are numerous [11]. The most complete studies are by Cerceau-Larival (1962), he and De Leonardis et al. (2009) which not only allowed us to correlate the shape of fruits with the symmetry of radiosymmetric pollen, the pollen shape with the size of cotyledonous leaves, the value of the P/E ratio with the phenotype stability of the belonging tribe, but also to better deepen the science of the shape of the pollen grains, the mutability of sporoderm wall and the presence of columellar hypertrophy as adaptation to environmental conditions [12], [13].

Cerceau-Larival (1962) divided the pollen of Umbelliferae

into 5 types based on P/E ratio: subhomboidal (type 1, P/E: 1-1.5), subcircular (type 2, P/E: 1-1.5), oval (type 3, P/E: 1.5-2), subrectangular (type 4, P/E: 2), and equatorially constricted (type 5, P/E: over 2). In the present study, this taxa examined belong to oval-type with a P/E ratio of 1.5-2 [12].

Van Zeist et al. (1977) divided the pollen grains of Umbelliferae into 9 pollen types, *Anisosciadium*, *Bunium*, *Bupleurum*, *Eryngium*, *Ferula*, *Malabaila*, *Pimpinella*, *Sium erectum*, and *Turgenia* types [14]. Punt (1984) divided the family Umbelliferae into 50 pollen types. According to Punt, pollen grains of Umbelliferae are very distinctive with their characteristic inner and outer slit-like ectocolpi and broad, band-like costae [9], [15]. Punt (1984) presented that ornamentation is of little value as a intuitive factor for identification of pollen grains in Umbelliferae. Three ornamentation patterns have been determined in his studies: irregularly rugulate, irregularly striate or cerebroid [15].

Perveen and Qaiser (2006) recognized 3 pollen types of Umbelliferae in Pakistan on the basis of exine pattern [16]. They determined that the pollen grains of Umbelliferae are generally tricolporate, shape of grains varied from prolate-perprolate, P/E ratio ranged from 1.2 to 2.6, thus, they showed that, other pollen characters such as exine thickness and colpal membrane of the grains are of little taxonomic value and can rarely be useful at specific level.

Two *Tetrataenium* (DC.) Madnen species were studied by Yousefzadi et al. (2006). They showed that the pollen grains of two studied species were prolate, tricolporate, exine sculpturing was rugulate, size medium and P/E ratio 1.97 to 2.53 μ m. According to Mungan et al. (2011), pollen grains of six *Smyrniium* species were prolate, in equatorial outline were triangular, in apertural condition were tricolporate, ornamentation type were rugulate and P/E ratio were 1.38 to 1.49 μ m. Their results compared with our study, other pollen characteristics except for P/E ratio are mostly similar. Halbritter and Weber (2000) reported that the pollen grains of *S. perfoliatum* are prolate, triangular, tricolporate and rugulate. Their results are parallel to our study results [17].

By our analysis would support classification based on morphology. The pollen characters seem to have the potential for evaluation of infrageneric relationships in the genus *Kelussia*.

5 CONCLUSION

The study of pollen biology has direct relevance in forestry, agriculture, plant breeding and biotechnology. Therefore, diversity in pollen morphology has made such studies a valuable taxonomic tool. Palynological research, while studying plant taxonomy, has proved useful in dealing critical and disputed taxonomic problems.

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