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Research Article

COMPARATIVE POLLEN MORPHOLOGY OF TWO *MAHONIA* TAXA GROWING ON MEŞELİK CAMPUS IN ESKİŞEHİR

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ABSTRACT. In this study, pollen morphology of two *Mahonia* taxa grown in Eskişehir Meşelik campus was investigated comparatively. *Mahonia* pollen grains are triocolpatae type and spheroidal shaped. As a result of microscopic examinations, the distinctions between taxa were revealed statistically. While the structure is tectatae in both taxa, the skulp is granulate in *M. aquifolium*; *M. japonica* shows reticulate ornamentation.

Keywords: *Mahonia* ssp., *pollen morphology, meşelik campus, Eskişehir, Turkey*

INTRODUCTION

Palynology is a branch of Botany that examines all the biological properties of pollen and spores. The term was firstly used by H. A Hyde and D. A Williams in 1945. The term palynology is the Latin word "*Paluno*", which means to sprinkle, to disperse.

Morphological characteristics of pollens are important tools in taxonomic studies. In many cases, pollen morphology is among the criteria used to classify families, genera or species. In groups that are close to each other phylogenetically, there are similarities in pollen morphology as well as in other features.

Palynology has important contributions in solving the phylogenetic relationships of plants. Although palynology is a new discipline in Turkey, palynological studies have been increasing in recent years [1, 2, 3].

The contribution of palynology to plant taxonomy is extremely important. Plant systematists have to consider their palynological features as well as their morphological, anatomical and ecological features in naming and classifying plants. Unfortunately, in taxonomic studies based on anatomical or morphological data, clear distinctions between taxa cannot be made. However, a more precise judgment can be reached in the distinction of taxonomic groups by supportive science branches of taxonomy. A classification based only on morphological characters can lead to some inaccuracies. It is a fact that some morphological characters can change a lot depending on the external environmental conditions. With the studies based on the morphological characteristics of pollen, many plant families can be classified more accurately and the origins of these families can be better understood [4, 5, 6].

Investigation of the differences in the size, detailed structural characters and ornamentation of all pollen grains are used as a very useful tools in terms of distinguishing different varieties and types. For example, the exine membrane surface structure is used today to distinguish species and even genotypes [7, 8].

Palynological studies help to reveal new taxonomic plant groups. By using the morphological features of pollen and the differences of these features between taxonomic groups, plant identification keys based on clear and invariant characters can be generated. With the determination of atmospheric pollen, it is possible to easily identify and classify various plant species in forests or in various habitats. In addition, palynomorphological studies help to distinguish between natural and cultivated plant hybrids. Moreover, it gives important clues about the evolution of plants. Today, palynomorphological data is one of the important references of taxonomy in investigating the phylogenetic relationships of plants.

In this study carried out in Eskişehir Meşelik Campus, the palynomorphological characteristics of two Mahonia species were determined. This study aims to create a reference by obtained data from the this study for future taxonomic researches on *Mahonia* taxa.

MATERIALS AND METHODS

The study material consists of pollens of *Mahonia* species grown in Eskişehir Meşelik Campus between 2020-2021 (Fig. 1). The plant sampling process was carried out during the spring months in the 2020-2021 period. Pollen samples collected from newly opened flowers for palynological studies were labeled and stored in paper envelopes.

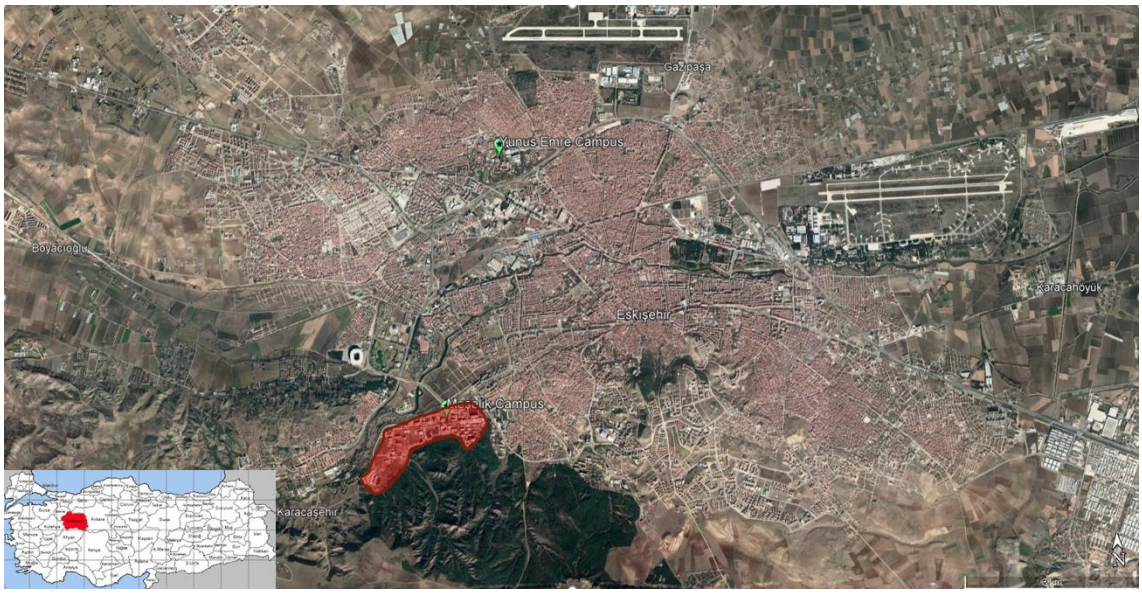

Fig. 1. *Location of Meşelik Campus in Eskişehir/Turkey*

Pollen samples were taken from *Mahonia* taxa grown in Eskişehir Meşelik Campus. In palynological studies, pollens obtained from flowers of 10-15 different plants for each *Mahonia* taxa were used. During the collection of plants, samples belonging to the studied taxa were placed separately in paper envelopes to prevent the mixing of different pollens. In our study, the pollen morphology of taxa were examined by light microscopy. The terminology of Faegri and Iversen has been used in naming the exine layers [9].

The examination of current pollens under the light microscope was done by Wodehouse (1935) and fossilized pollens by Erdtman (1969) methods [10, 11].

Morphological examination of the pollens was done under Nikon binocular microscope by oil immersion lens (x100). All parameters were measured 50 times to determine the averaged values. Standard deviation and variations have been calculated. Each range in the ocular micrometer is 0.98 µm. Microphotographs were taken with a Nikon 80i type microscope and a KAMERAM Digital camera in the Eskişehir Osmangazi University, Faculty of Arts and Science, Department of Biology. The magnification of the photos is x 1000. For Scanning electron microscopy (SEM) examinations, unacetholyzed pollen grains were placed on the fixing plate and covered with gold and examined under Jeol 5600 LV Scanning electron microscope (SEM) [12, 13].

Various basic palynological books and various studies have been used for the diagnosis of pollen [1, 9, 10, 11, 12, 13, 14, 15, 16].

RESULTS

Mahonia aquifolium

Fig. 2. Mahonia aquifolium a: *General view* ***b:*** *Flowers*

Species: *Mahonia aquifolium* (Mahonya)
Pollen Type: Tricolpatae
Pollen Shape: Spheroidal P/E= 1,13 µm (W); 1,10 µm (E)
Exine: Average thickness 1,44 µm (W); 1,36 µm (E)
Aperture: Colpi are wide and long with clear boundaries.
Structure: Tectatae
Sculpture: Granulate

Table 1. *Morfometric Data of Mahonia aquifolium*

	Wodehouse			Erdtman			
	M		S	M		S	
P	32,89	±	3,81	45,16	±	3,35	µm
E	29,60	±	2,66	43,28	±	2,72	µm
clg	28,10	±	3,75	35,20	±	3,21	µm
clt	13,64	±	3,25	32,80	±	3,24	µm
L	41,15	±	2,85	41,92	±	5,76	µm
t	14,28	±	1,47	13,6 0	±	2,43	µm
i	0,98	±	0,13	-		-	µm
Ex	1,44	±	0,18	1,36	±	0,22	µm

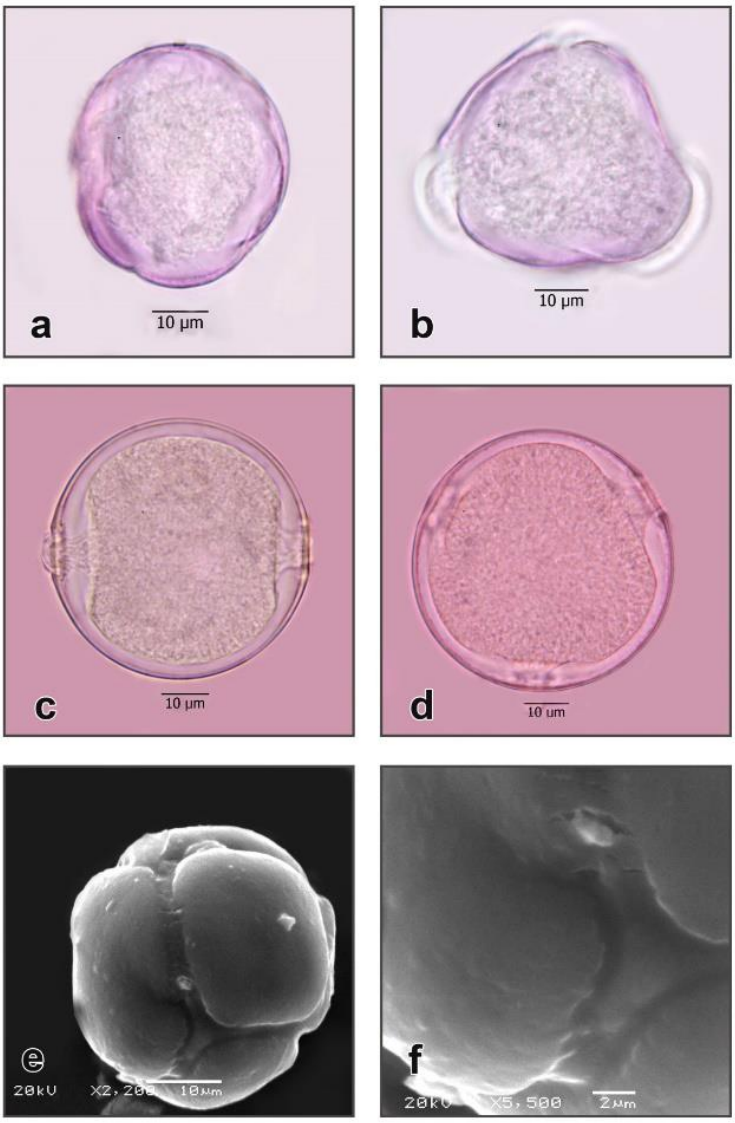

Fig. 3. *LM and SEM microphotograps of Mahonia aquifolium (a. Equatorial (W), b. Polar (W), c. Equatorial (E), d. Polar (E), e. Equatorial (SEM), f. Exine ornamentation (SEM))*

Mahonia japonica

Fig. 4. Mahonia japonica a: *General view* ***b:*** *Flowers*

Species: *Mahonia japonica* (Japon Mahonyası)
Pollen Type: Tricolpatae
Pollen Shape: Spheroidal P/E= 1,4 µm (W); 1,22 µm (E)
Exine: Average thickness 1,10 µm (W); 1,08 µm (E)
Aperture: Colpi are thin and long with clear boundaries.
Structure: Tectatae
Sculpture: Reticulatae

Table 2. *Morfometric Data of Mahonia japonica*

	Wodehouse			Erdtman			
	M		S	M		S	
P	19,25	±	1,72	25,42	±	3,98	µm
E	14,94	±	1,56	22,18	±	3,56	µm
clg	13,85	±	2,18	18,21	±	4,75	µm
clt	7,22	±	1,33	9,47	±	2,18	µm
L	19,10	±	2,43	31,15	±	2,44	µm
t	-	±	-	6,85	±	1,12	µm
i	0,72	±	0,18	-		-	µm
Ex	1,10	±	0,22	1,08	±	0,19	µm

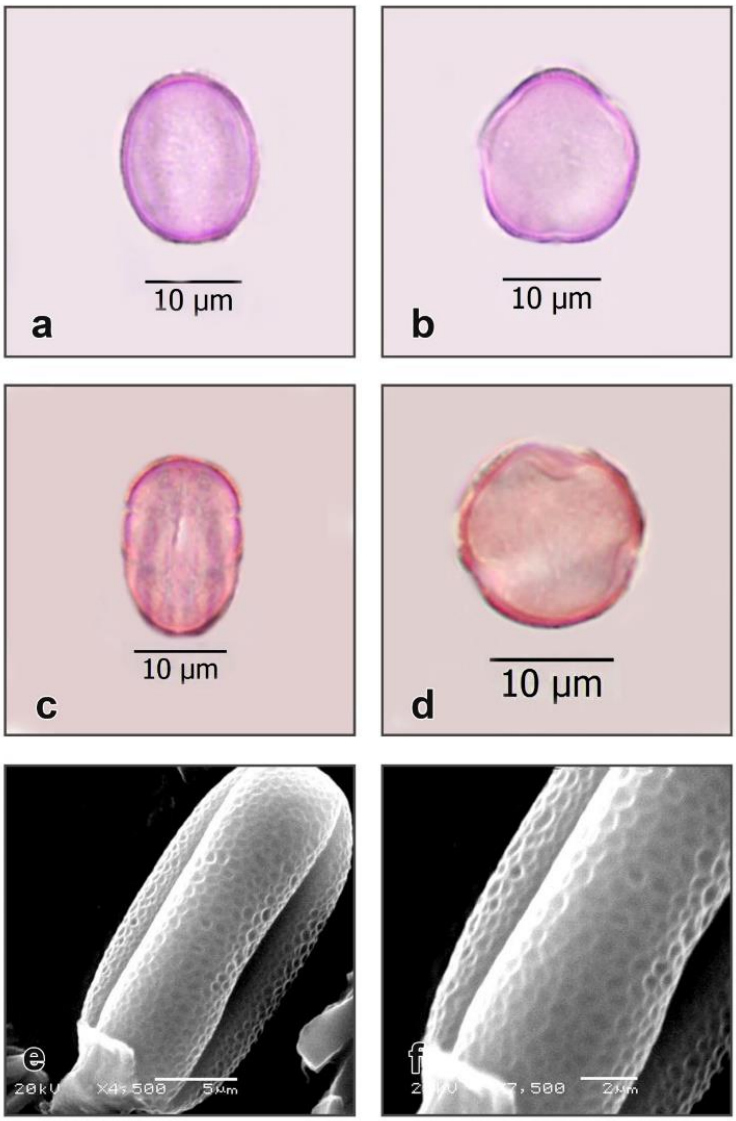

Fig. 5. *LM and SEM microphotograps of Mahonia japonica (a. Equatorial (W), b. Polar (W), c. Equatorial (E), d. Polar (E), e. Equatorial (SEM), f. Exine ornamentation (SEM))*

DISCUSSION

The genus *Mahonia* composed of about 70 species of evergreen shrubs and, rarely, small trees which located in Berberidaceae family. Members of the *Mahonia* distribute in native to eastern Asia, the Himalaya, North and Central America [17].

Mahonia is one of the taxonomically problematic genera of the Berberidaceae family, as it is closely related to the *Berberis* genus. So that reason, many botanists classify the *Mahonia* under the *Berberis* [18, 19, 20]. The main reason for this situation is that taxa of two genera can hybridize with each other and there was no consistent morphological difference other than leaf pinnation between these two groups. Although the relationship between *Berberis* and *Mahonia* has been revealed by DNA-based taxonomic studies in recent years, there are still question marks in the differentiation of these two genera [21, 22].

In this study, pollen morphology of two *Mahonia* taxa distributed in Eskişehir Meşelik Campus was investigated using light microscopy and scanning electron microscopy.

Pollen grains of *Mahonia* are tricolpatae type and spheroidal shaped. Along with these similarities, there are serious differences between the pollens of *M. aquifolium* and *M. japonica*. First difference was determined between the pollen sizes of *M. aquifolium* and *M. japonica*. Pollen of *M. japonica* is almost twice as large as *M. aquifolium*. The second difference was determined between aperture characteristics. In *M. aquifolium*, colpi are wide and long with clear boundaries. In *M. japonica*, colpi are thin and long with clear boundaries. The third palynomorphological difference between these two taxa was determined in exine ornamentation. While the structure is tectatae in both taxa, the skulp is granulate in *M. aquifolium*; *M. japonica* shows reticulate ornamentation.

When we look at the palynological studies conducted around the world in general, it is seen that pollen atlas databases are created electronically in many countries and they are regularly updated. These pollen atlases provide information not only in pollen shape, size and ornamentation, but also in terms of allergic properties. Unfortunately, no studies were found in Turkey except for the pollen atlases made by Aytuğ (1971) and Pehlivan (1995) [1, 3]. This study is important in terms of revealing the pollen morphology of *Mahonia* taxa distributed both in Turkey and Eskişehir.

When evaluated in terms of Plant Systematics, this study is important in terms of contributing to the determination of biological diversity not only in Eskişehir but also in Turkey. Our study will set an example for other provinces and will help to create a pollen atlas of all parks and gardens throughout Turkey.

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