

RESEARCH ARTICLE

The Important Taxonomic Characteristics of the Family Malvaceae and the Herbarium Specimens in ISTE

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Abstract

Herbariums, which are places where dried plant specimens are regularly stored, have indispensable working material, especially for taxonomists. The Herbarium of the Faculty of Pharmacy of Istanbul University (ISTE) is one of Turkey's most important herbariums and has more than 110 000 plant specimens some of which have medicinal properties. The species of the Malvaceae family that make up some of the plant specimens in ISTE are significant because they are widely used in traditional folk medicine. This family is represented by 10 genera and 47 species (3 endemic) in Turkey.

In this study, the specimens of Malvaceae were examined and numerical evaluation of the family in Flora and in ISTE was given. Specimens of one species from every genus that are existing in ISTE were photographed and important taxonomic characteristics of family were shown. In conclusion, 39 taxa belonging to 9 genera in ISTE have been observed and 418 specimens from these taxa were counted. The genus *Alcea*, which has 130 specimens, has been found to have more specimens than all genera of Malvaceae family. Also, the diagnostic key to genera has been rearranged for the new genus added to the family.

Keywords: Malvaceae, Herbarium, Taxonomy, Medicinal Plants

Introduction

The family Malvaceae is represented by 80 genera and over 1000 species in the world. The main spread of these family members, whose majority is widespread, is South America and present almost everywhere except the very cold regions of the world (Hutchinson, 1973; Heywood, 1978). The plants of this family are herbs or shrubs, usually with stellate hairs. Leaves are alternate, palmately nerved, often palmately lobed or divided, with stipulate. Flowers are hermaphrodite and actinomorphic. Epicalyx mostly is present. Calyx consists of 5 sepals, the sepals sometimes united below. Corolla consists of 5 petals, which are free, contorted in aestivation and fused at the base with the staminal tube. Stamens united into a column around the styles, the column divided into filaments at the apex, each filament bearing a 1-celled anther. Pollen grains are big and spiny. Fruit is usually a schizocarp that

splits into numerous mericarps (leaving a variously elaborated carpophore), rarely capsule (Tanker *et al.*, 2014; Davis, 1967). In our country, 10 genera and 47 species are naturally grown. The largest number of species in *Alcea* (Linnaeus, 1753), include 20 species (Güner, 2012).

The family Malvaceae has medicinal uses owing to its mucilage, fixed oils and essential oils. Some of the most commonly used species in folk medicine include the leaves and flowers of *Althaea officinalis* (Linnaeus, 1753) (Deli hatmi) which are used as expectorant and bronchodilator, roots are used as diuretic; the leaves and flowers of *Malva sylvestris* (Linnaeus, 1753) (Ebegümeçi) are used as expectorants and protectors in respiratory and digestive system irritations and inflammations; the flowers of *Alcea biennis* (Winterl, 1781) (Fatmaanagülü) are used as expectorants, roots are used as diuretics and wound healers in respiratory system irritations; infusions

Table 1. Numerical evaluation of the family Malvaceae in ISTE.

Genus	Taxa in Turkish Flora (Güner, 2012)	Taxa in ISTE	Endemic taxa in Turkish Flora (Güner, 2012)	Endemic taxa in ISTE	Types from Turkey	Specimens in ISTE
<i>Abutilon</i> (Miller, 1754)	1	1	-	-	-	2
<i>Alcea</i> (Linnaeus, 1753)	21	17	2	1	6	130
<i>Althaea</i> (Linnaeus, 1753)	4	4	-	-	-	76
<i>Hibiscus</i> (Linnaeus, 1753)	1	1	-	-	-	13
<i>Kitaibelia</i> (Willdenow, 1799)	1	-	-	-	1	-
<i>Lavatera</i> (Linnaeus, 1753)	4	4	-	-	-	32
<i>Malope</i> (Linnaeus, 1753)	2	1	1	-	-	21
<i>Malva</i> (Linnaeus, 1753)	10	7	-	-	-	96
<i>Malvella</i> (Jaubert & Spach, 1855)	1	1	-	-	-	4
<i>Tilia</i> (Linnaeus, 1753)	4	3	-	-	-	44

Table 2. Diagnostic key to genera.

1. Plants woody, trees up to 35 m tall; peduncle of cyme adnate to wing-like bract	<i>Tilia</i> (Figure 1 A-B)
- Plants herbaceous or shrubs; inflorescence without an adnate bract	2
2. Epicalyx absent	<i>Abutilon</i> (Figure 1 C-D)
- Epicalyx present	3
3. Style 5-partite; fruit a capsule; calyx inflated in fruit	<i>Hibiscus</i> (Figure 1 E-G)
- Styles much-branched at the apex; fruit a schizocarp; calyx not inflated	4
4. Epicalyx segments 3	5
- Epicalyx segments 6-9	8
5. Epicalyx segments connate at the base	<i>Lavatera</i> (Figure 2 A-B)
- Epicalyx segments completely free	6
6. Epicalyx segments linear, setaceous, oblong or ovate, not overlapping, narrower than the sepals	7
- Epicalyx segments broadly ovate, broader than the sepals, overlapping	<i>Malope</i> (Figure 2 C-D)
7. Mericarps inflated; petals are not emarginate	<i>Malvella</i> (Figure 2 E-F)
- Mericarps not inflated; petals are emarginate	<i>Malva</i> (Figure 3 A-B)
8. Carpels in many series around of the styles; mericarps dehiscent dorsally	<i>Kitaibelia</i>
- Carpels in one series around the base of the styles; mericarps indehiscent	9
9. Petals 9-16 mm; anthers purple or brownish purple	<i>Althaea</i> (Figure 3 C-D)
- Petals 30 mm or more; anthers yellowish	<i>Alcea</i> (Figure 3 E-F)

which are prepared from the flowers and roots of *Abelmoschus esculentus* (Linnaeus, 1794) (Bamya) are used internally as expectorants, and fruits are used for gastric ulcers. Moreover, this family is important economically due to its cultured plants such as *Gossypium* (Linnaeus, 1753), *Hibiscus* (Linnaeus, 1753) and *Alcea*

(Türkan *et al.*, 2006; Rouhi & Ganji, 2007; Kültür *et al.*, 2018; Kara *et al.*, 2015; Baytop, 1999).

In studies related to floristic and plant systematics, collections of plant samples, which are research materials, are stored continuously in a herbarium as dried samples. The Herbarium of the Faculty of Pharmacy of Istanbul

University (ISTE) was founded in 1945. The herbarium, which exists in a Pharmacy school affiliated to Medical School, has been transferred with its 7760 specimens to the Department of Pharmaceutical Botany (director: Prof. Dr. Asuman Baytop) which was established in 1964. It has been known as ISTE since 1956 and today it has more than 110 000 plant specimens. The specimens are mainly divided into 4 groups, which are *Pteridophyta*, *Gymnospermae*, *Monocotyledones*, *Dicotyledones*. The specimens in each group are located in herbarium cabinets and they are classified in alphabetical order of their family, genus and species names (Baytop, 1984).

The aim of this study is to reveal the systematically important characteristics of the Malvaceae family and research the genera and species belonging to the Malvaceae family in ISTE.

Material and Methods

A total of 418 herbarium specimens of the Malvaceae family in ISTE have been examined in detail with a stereo microscope (Leica S8AP0). Morphological characteristics of Malvaceae family were photographed (Canon 650D) and compared with the recorded species in the Flora of Turkey and other literature. The data obtained was demonstrated in Table 1.

Results and Discussions

The most important systematic characteristics of the Malvaceae family were recognized as presence, shape, dimensions, numbers of segments of the epicalyx, the dimensions and the shape of the petals, fruit type and the features of the schizocarp fruit (Figure 1, 2, 3) (Table 2). As a result of the comparison, the number of the recorded taxon in 'Flora of Turkey and the East Aegean Islands' and 'Türkiye Bitkileri Listesi (Damarlı Bitkiler)' was found different in some genera. For instance the number of taxon in *Alcea* increased from 19 to 21 by addition of *Alcea karsiana* (Bordzilowski & Litvinov, 1924) and *Alcea sophiae* (Iljin, 1949). Furthermore, the names of some of these species have been changed, such as *Malva arborea* (Linnaeus, Webb & Berthelot, 1836) from *Lavatera arborea* (Linnaeus, 1753) and *Malva linnaei* (Ray, 1998) from *Lavatera cretica* (Linnaeus, 1753) and they passed to a different genus (Güner, 2012; Davis, 1967).

Several taxonomic studies have been conducted on this family. In the studies on the pollen morphology of

Malvaceae, variation in pollen size, aperture and spine characteristics, as well as exine stratification were elaborated as taxonomic value (Saad, 1960; Christensen, 1986). Pollen size is considered as a meaningful taxonomic characteristic, especially at the tribal level (El Naggar, 2004). Another pollen morphological study demonstrated that there is diversity between the pollen grains of the *Abutilon* (Miller, 1754) species and *Hibiscus* species (Shaheen *et al.*, 2009a). In addition, some research has revealed that features of hairs and the variability in staminal tubes are considered as useful for detecting the systematic relations within this family (Esteves, 2000; Celka *et al.*, 2006).

The Malvaceae family has been characterized by the existence of important seed oil constituents such as palmitic and linoleic acids. Based on this information, the chemotaxonomic study of some species in Malvaceae has been carried out and fatty acid content is considered as taxonomic value. However, further studies should be fulfilled (Da Silva *et al.*, 2010).

Moreover, some morphological studies indicated that a comprehensive research of mericarp, schizocarp, and schizocarp axis characters in *Lavatera* (Linnaeus, 1753) and *Malva* (Linnaeus, 1753) should be studied to figure out the morphological aspects of the relationships among *Lavatera* and *Malva* species (Ray, 1995). In addition, morphometric and colorimetric features of the seeds of some *Lavatera* taxa show significant taxonomic characteristics (Bacchetta *et al.*, 2011). In the classification of the species, the importance of the foliar epidermis has been proven in anatomical studies on the *Abutilon* family (Shaheen *et al.*, 2009b). Although some *Abutilon* species were investigated morphologically and anatomically, more studies are required to avoid confusion (Taia, 2009; Ali *et al.*, 2017).

Recent molecular studies revealed that the genus *Tilia* (Linnaeus, 1753) in the Tiliaceae family, belongs to the Malvaceae family according to molecular data (APG III, 2009; APG IV, 2016). Nevertheless, this topic is still under discussion among systemists (Nandikar & Ravikumar, 2017).

In herbarium investigations on the Malvaceae family, nine of the ten genera it contains are found in the ISTE herbarium and the genus *Alcea* is represented by most species. Besides, it has been observed that some specimens were recorded by synonym names. The oldest specimen *Tilia platyphyllos* Scop was collected by H. Bağda in 1900. Numerical evaluation of the family Malvaceae in ISTE is given in the table (Table 1).



Figure 1. Herbarium specimens of the genera *Tilia* (A-B), *Abutilon* (C-D), *Hibiscus* (E-G) in ISTE.

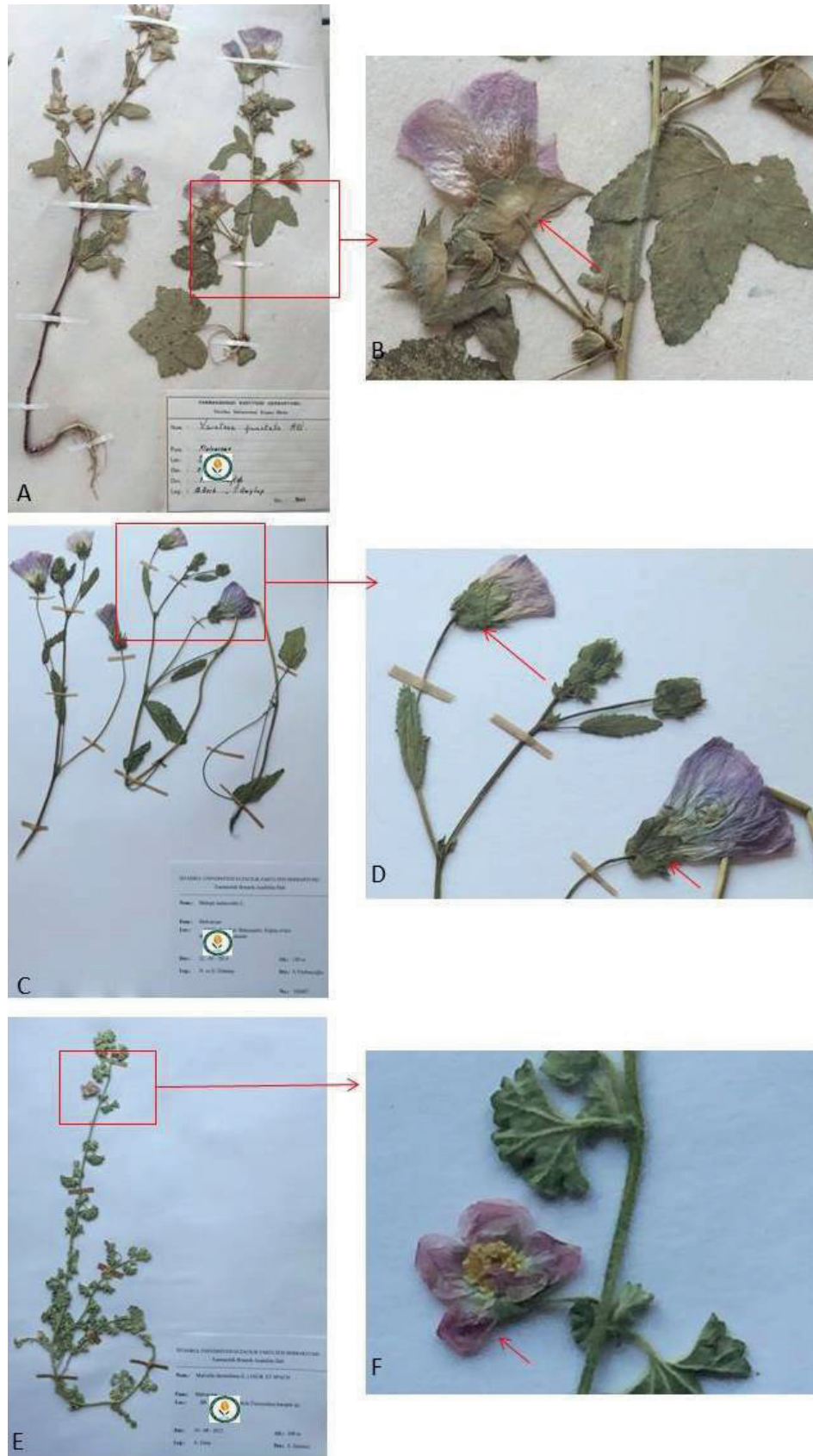


Figure 2. Herbarium specimens of the genera *Lavatera* (A-B), *Malope* (C-D), *Malvella* (E-F) in ISTE.



Figure 3. Herbarium specimens of the genera *Malva* (A-B), *Althaea* (C-D), *Alcea* (E-F) in ISTE.

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