

Original Research

Anatomy of the medicinal plants *Salvia hydrangea*, *Salvia glutinosa* and *Salvia syriaca* in Iran

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ABSTRACT:

Salvia is one of the most useful medicinal plants in Iran. Various species of *Salvia* are used in the industry for preparation of medicine. In this study, we compared the anatomy of leaves, petioles and a variety of glandular and non-glandular trichomes of three species of *Salvia* viz; *Salvia hydrangea*, *Salvia glutinosa* and *Salvia syriaca* present in Iran. Anatomy studies were performed by identification, cutting and staining the samples. The overall shape of leaves, petioles, number of layers and shape of chlorenchyma cells, scleroid the number of vascular bundles, stomata, mesophilic cells, number of layers of palisade parenchyma, alveolar parenchyma, other parenchyma cells, glandular and non- glandular cells and their counts were analysed and studied. In all three species, stomata type was found to be diacytic. The main vein reported in *Salvia glutinosa* and *Salvia syriaca* was square and isobilateral in *Salvia hydrangea*.

Keywords:

Anatomy, *Salvia* L, non-glandular trichomes, mesophilic

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INTRODUCTION

Salvia is one of the most important genus in Iran with large number of species from the family Lamiaceae. The plant material is rich in diterpenoids and are classified into two parts. It included 2,6-dimethyl-10- (p-tolyl) undecane-2,6- (E) -diene and other compounds like labdane, clerodane, and related diterpenoids (Kabouche et al., 2008). Lamiaceae family members are with a rich source of phenolic compounds and are main sources of natural antioxidants (Ziakova and Brandsteterova, 2003; Kan et al., 2007). *Salvia* species are used as a disinfectant and also in perfume and pharmaceutical industries (Kintzios, 2000; Kaya, 2011). This species is found in parks, houses and gardens as ornamental plants. (Habibvash et al., 2007; Malen et al., 2000; Nakbo, 1993). This genus is an useful ethno medicinal plant; their leaves and dried flowers of some species are used in the preparation of medication and for the treatment of certain diseases (Kandemir, 2003).

Plant Anatomical and micromorphological studies of *Salvia divinorum* from Mexico was conducted by Anna et al. (2014). Buyukkartal et al. (2011) studied the anatomy and micromorphology of the meristems of several species of *Salvia*. Kahraman et al. (2009) compared the morphology, anatomy and palynology of two species of *Salvia*. Bagherpour et al. (2010) studied the micromorphological and anatomical characteristics of *Salvia vermisfolia* from Turkey. The main objective of the present study is to compare the anatomy of leaves, petioles and trichomes of three *Salvia* species viz., *Salvia hydrangea*, *Salvia glutinosa* and *Salvia syriaca* in Iran. The similarities and differences of species were determined, followed by morphological and anatomical features.

MATERIALS AND METHODS

Salvia species viz., *Salvia hydrangea*, *Salvia glutinosa* and *Salvia syriaca* were collected from the different regions namely Hamedan heights, Mazandaran

(Dylaman) and Gilan (Zeraatkar) of Iran. Fresh samples were analyzed in terms of quantitative and qualitative characteristics of morphology and the samples were identified. In the next step, to study the anatomy of leaves, very thin sections were taken and bleached for 30 minutes and then placed in a solution of acetic acid (0.1%) for three minutes. Then the sections were stained by immersing in Carmen Zaji and Methyl Green. After each step, washing with distilled water was done. Then, the specimens were observed using 10x and 40x magnification lens in the Nikon microscope and photographed by Dino capture camera.

RESULTS AND DISCUSSION

Anatomical Examination:-

S. hydrangea

Petiole: Generally oval - regular circular shape with two side appendages, surrounded by a circular layer of the epidermis. A chlorenchymatous layer is present followed by 10 polygon parenchyma layer next to the lower epidermis. A vascular bundle sheath at the center and four small bundles are present in the upper petiole (Fig 1-A).

Leaves: Leaves are mesophilic and isobilateral with 12 layers of palisade parenchyma on both the sides and six layers of alveolar parenchyma at the center. The main vein is semi-circular and the cross-section is with a smooth upper surface. Elliptical epidermis layer is present with a chlorenchymatous layer that surrounds the main vein. Five polygonal parenchyma cell layers are present after each layer of the lower epidermis. Sclereid layers of the bundle is surrounded by a vascular bundle sheath. Short, single-cell glandular trichomes and seven-celled non- glandular trichomes are present and mostly of sickle shape with diacytic stomata (Fig 1-B,C,D).

S. glutinosa

Petiole: Generally three-sided shape with two side appendages and recessed V-shaped upper level, surrounded by a layer of the square shaped epidermis.

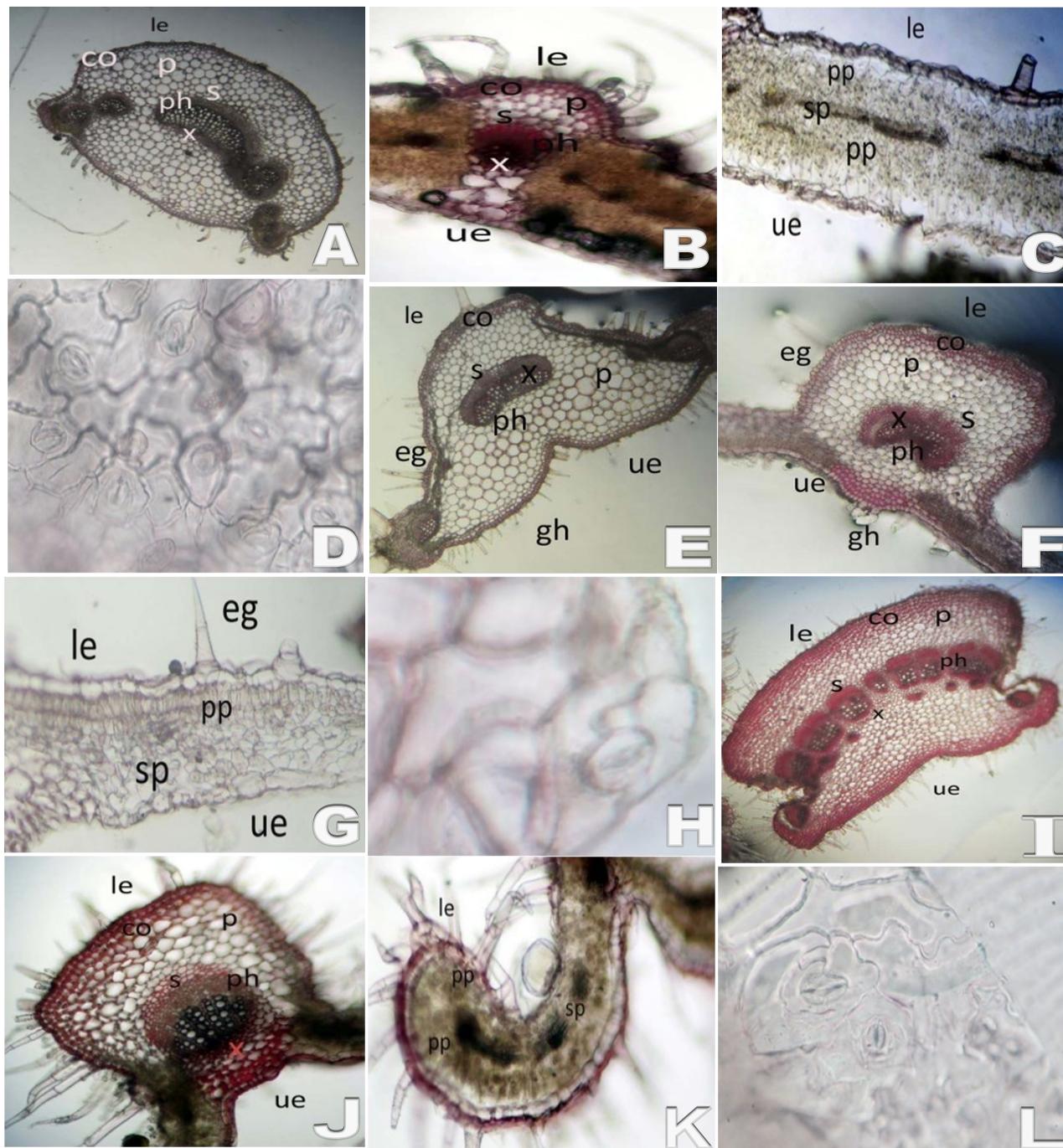


Figure 1. Leaf and petiole anatomy of *Salvia hydrangea* (A,B,C,D), *Salvia glutinosa* (E,F,G,H), *Salvia syriaca* (I,J,K,L). ($\times 40, 100$). ue: upper epidermis; le: lower epidermis; co: collenchyma; pc: parenchymatic cell; s: sclerenchyma; x: xylem; ph: phloem; pp: palisade parenchyma; sp: spongy parenchyma.

Two chlorenchymatous layer are present with 10 parenchyma layer after the lower epidermis. A vascular bundle at the center and two small bundles are present in the upper petiole (Fig 1-E).

Leaves: Leaf mesophilic dorsiventral with two palisade parenchyma layers and six alveolar parenchyma layers.

Square veins are present in the square epidermis layer, totally four chlorenchyma layer surrounds the main vein. Eight cell polygon parenchyma layer is found after the layer of lower epidermis. Sclereids are surrounded by the vascular bundle sheath. Single- two cell glandular trichomes and one- seven- celled non- glandular

trichomes with high-density and diacytic stomata are found (Fig 1-F,G,H).

S. syriaca

Petiole: Generally rectangular shape, surrounded by a oval layer of the epidermis. six collenchyma layer, eight parenchyma polygonal layer following lower epidermis, six vascular bundle in the center and two small handles are located in the upper petiole (Fig 1-I).

Leaves: Leaves mesophylic, isobilateral with six layers of palisade parenchyma on each side and two layers of parenchyma in the center. Square vein is found at the main cross sections, a square layer of the epidermis, five collenchyma layer surrounding the main vein, six polygonal parenchymatous cell layer following lower epidermis. Sclereid bundle is surrounded by a vascular bundle, 1-6 cell non-glandular trichomes with very high density and 1-2 cell glandular trichomes cum diacytic stomata (Fig 1-J,K,L).

In this research, the anatomy of the leaf, petiole, glandular and non- glandular trichomes of three species of *Salvia* in Iran were studied. The overall shape of the leaves in *Salvia glutinosa* and *Salvia syriaca* is square. The general shape of petiole in *Salvia glutinosa*, *Salvia syriaca* and *Salvia hydrangea* were rectangular, three-sided and oval - circular respectively. According to a report by Bagherpour *et al.* (2010), petiole anatomy of *Salvia vermifolia* has three major large vascular bundle in the center, and six small subsidiary bundles. In this research, diacytic stomata is observed (Fig 1-D,H,L). The greatest number of non- glandular trichomous cells and sickle shaped trichomes were observed in *Salvia hydrangea*. *Salvia glutinosa* has four celled non glandular trichomes. Anna *et al.* (2013) determined that *Salvia divinorum* has a lot of capitate glandular and conical non-glandular trichomes at the adaxial leaf surface; polygonal parenchymal cells and diacytic stomata were also reported. Kahraman *et al.* (2009) determined that *Salvia glutinosa* leaves covered the low

and simple trichomes. Mesophylic leaves are bifocal and stomata is of diacytic type.

CONCLUSION

In this study, we can conclude that internal structure of *Salvia* species in addition to the morphology are also distinguished from one another. The most distinctive feature of the species, is the overall shape of the leaf and petiole. And in the next step, differences in the number and shape of the layers of the epidermis, chlorenchyma and parenchyma and vascular bundles position, mesophylic type and the number of layers of palisade and alveolar parenchyma which were differentiated between the species.

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