



Microscopic Illustration of *Pelargonium x hortorum* (Geraniaceae)

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Authors' contributions

This work was carried out in collaboration among all authors. Author VA has designed this work. Authors Kartik and CB have performed the microscopic study of leaf and root. Authors IK and AS have performed the powder microscopy of leaf and section cutting of stem portion. All authors read and approved the final manuscript.

Article Information

Editor(s):

(1) Dr. Magdalena Valsikova, Department of Vegetables Production, Faculty of Horticulture and Landscape, Slovak University of Agriculture in Nitra (SUA), Slovakia.

Reviewers:

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Complete Peer review History: <http://www.sdiarticle3.com/review-history/47711>

Received 24 November 2018

Accepted 08 March 2019

Published 18 March 2019

Original Research Article

ABSTRACT

For identification of a crude drug, there are several parameters which standardize it for sure. Microscopic features describe a crude drug very well. Chances of adulteration are very common due to morphological similarities in different species of drugs and to avoid such confusions, standardization via microscopy helps to create a valuable profile of a given crude drug. Involving different parts of plant drug in microscopy viz leaves, stem, roots and flower etc. helps a lot in identifying the original drug. Transverse section of different parts of plant, powder microscopy and determination of leaf constants like stomatal number, stomatal index, vein islet number, vein termination number and palisade ratio of *Pelargonium x hortorum* describes the basic features of the drug and authenticate it as the original one.

Keywords: *Pelargonium*; identification; microscopic evaluation.

1. INTRODUCTION

Pelargonium x hortorum L.H. Bailey is a species of the genus *Pelargonium* commonly used as an ornamental plant. *Pelargonium x hortorum* is probably a hybrid between *P. zonale* and *P. inquinans* belonging to family Geraniaceae [1]. Plant can be propagated by stem cuttings and requires peaty or loamy soil and flourishes in sunny conditions. The plant varies from height of 45 to 50 cm with fragrant green colored decorative leaves upto 5 to 7.5 cm in length as shown in Fig. 1a with reticulate venations and crenate margin. Flowers appears in many colors like red, pink, orange or white having five petals positioned around the center as ball shaped clusters (Fig. 1b). The inflorescence is long rigid peduncle. Generally tap root system is present in the plant [2].



Fig. 1a. Leaves of *P.x.hortorum*



Fig. 1b. Flowers of *P.x.hortorum*

Different species of *Pelargonium* are available abundantly in nature with immense pharmacological potential and exhibit antifungal [3], mosquito repellent [4], anxiolytic, antidepressant [5] and pediculicidal activities [6]. *Pelargonium* derived essential oils (citronellol, geraniol, p-menthone and α -pinene etc.) are extensively used in perfumery, cosmetics, soaps, creams and aromatherapy products [7-8].

Microscopic profile gives an account of histological characters which are helpful in standardization of drug. The aim of this study is to standardize the particular species of *Geranium* i.e *Pelargonium x hortorum* using qualitative and quantitative parameters and as such no microscopic profile has been available of this species.

2. MATERIALS AND METHODS

2.1 Collection of Plant

The plant is collected in the month of January 2019 from Govt. College of Pharmacy Rohru, Distt. Shimla, Himachal Pradesh, India and the collected samples were subjected to microscopic examination.

2.2 Microscopy

Anatomical sections of the fresh leaf, petiole, stem and roots were prepared for the microscopic studies and examined under Trinocular microscope Olympus-CH-20i model and compound microscope.

For determination of leaf constants like stomatal number, stomatal index, vein islet number, vein termination number and palisade parenchyma ratio camera lucida was used.

Stomatal number and index determination: Stomatal number is a number of stomata per square mm of epidermis of the leaf and stomatal index is the percentage which the number of stomata form to the total number of epidermal cells. The fragment of leaf was cleared by boiling with chloral hydrate solution. Epidermal layer was then peeled out using forcep. A square of 1mm was drawn on a drawing paper using Camera lucida and stomata were counted and stomatal index was calculated using formula:

$$\text{Stomatal index (S.I.)} = \frac{S}{E+S} \times 100$$

Where,

S= Number of stomata,
E= Number of epidermal cells

2.2.1 Determination of vein-islet and termination number

Vein islet number is the number of vein islets per square mm of the leaf surface midway between the midrib and the margin and vein termination is the number of vein terminations per square mm

of the leaf surface midway between midrib and the margin. Fragments of leaf was cut in 2 mm x 2 mm rectangular shape and boiled in chloral hydrate solution followed by dilute hydrochloric acid for few minutes. A square of 1mm was drawn on a drawing paper using Camera lucida and palisade cells and vein islets and terminations were counted.

2.2.2 Determination of palisade ratio

Palisade ratio is the average number of palisade cells beneath each epidermal cells. Fragments of leaf was cut in 2 mm x 2 mm rectangular shape

and boiled in chloral hydrate solution followed by dilute hydrochloric acid for few minutes. A square of 1mm was drawn on a drawing paper using Camera lucida and palisade cells were focused underlying four epidermal cells [9-10].

3. RESULTS

The microscopic examination of the plant consists of its transverse section of leaf, petiole, stem and root. The results of the T.S, powder characteristics and leaf constants are given in the Fig. 2(a-h).



Fig. 2a. Trichomes

CTR: Unicellular, uniseriate covering trichome, GTR: Unicellular, uniseriate Glandular trichome

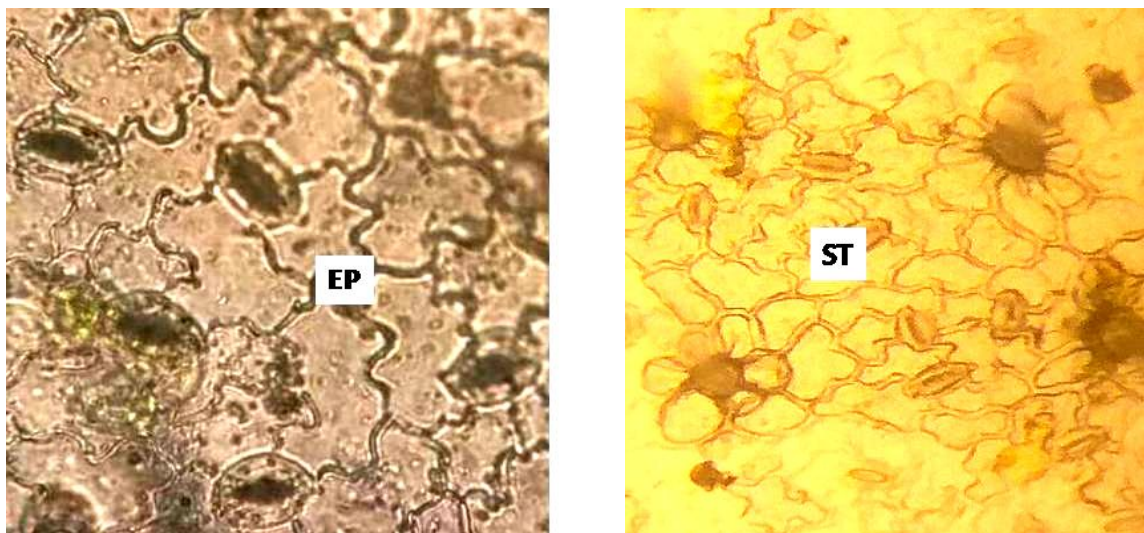


Fig. 2b. Wavy epidermal cells and stomata

EP: Epidermal cells, ST: Stomata

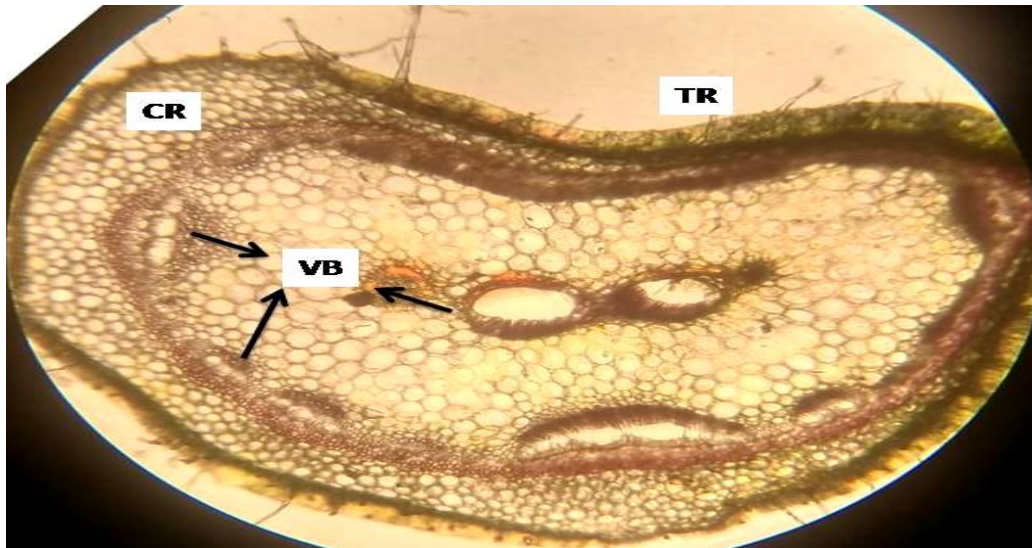


Fig. 2c. Transverse section of petiole
VB: Vascular bundles, CR: Cortex, TR: Trichome

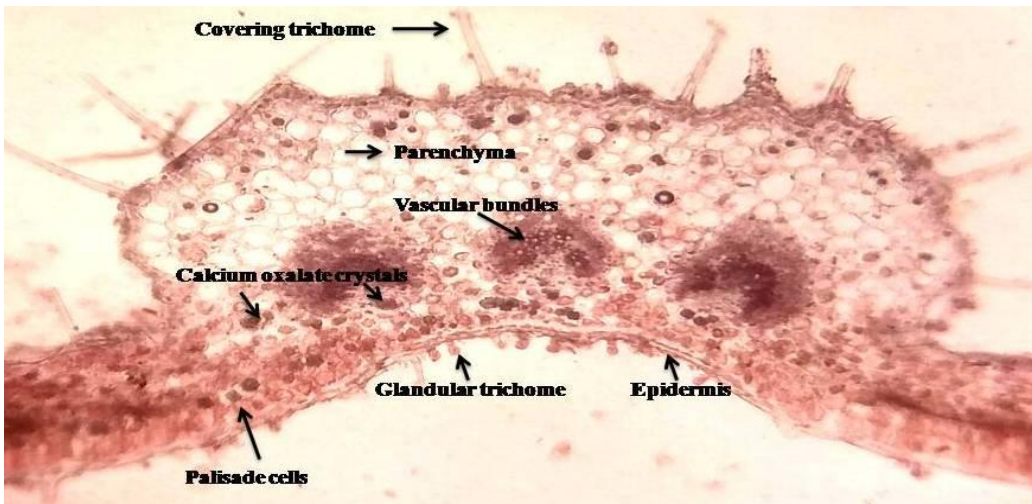


Fig. 2d. Transverse section of leaf

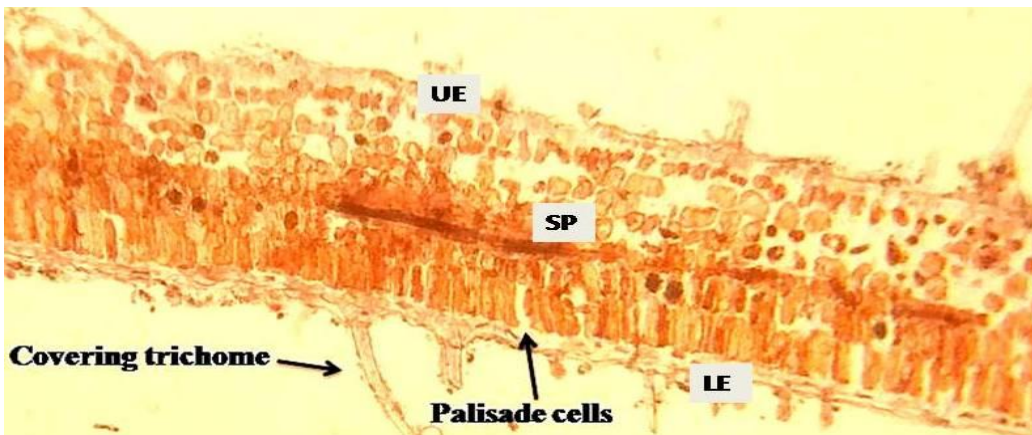


Fig. 2e. Transverse section
SP: Spongy Parenchyma, UE: Upper Epidermis, LE: Lower Epidermis in leaf

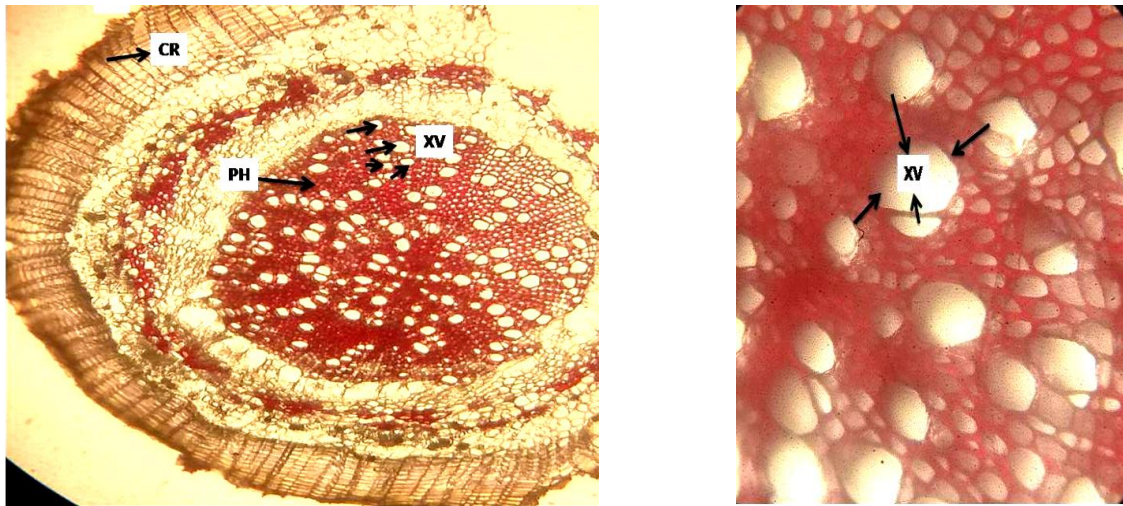


Fig. 2f. Transverse section of root
TR: Trichome, CR: Cortex, PH: Pith, XV: Xylem Vessels

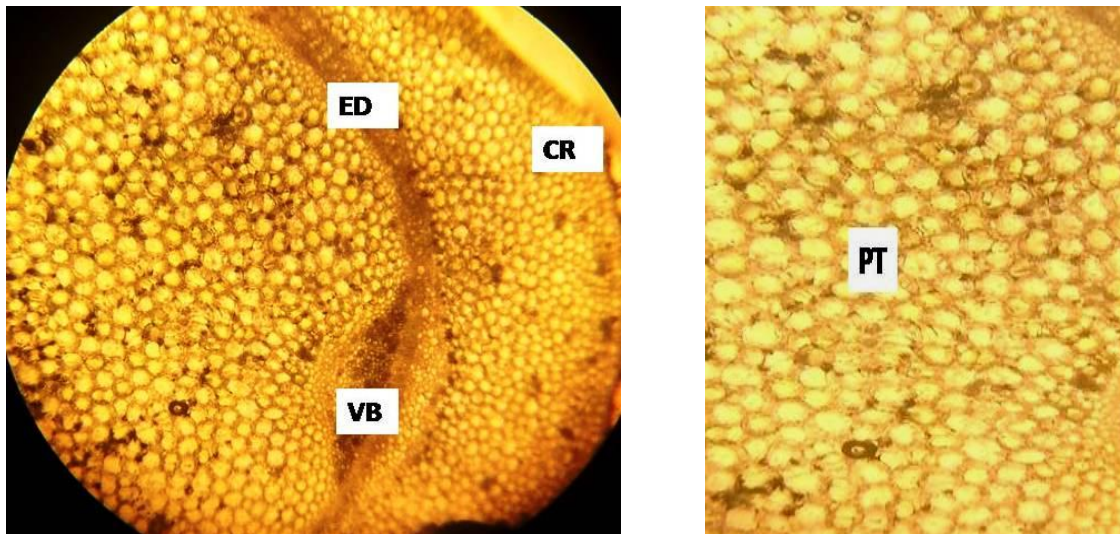


Fig. 2g. Transverse section of stem
ED: Endodermis, VB: Vascular bundle, CR: Cortex, PT: Pith

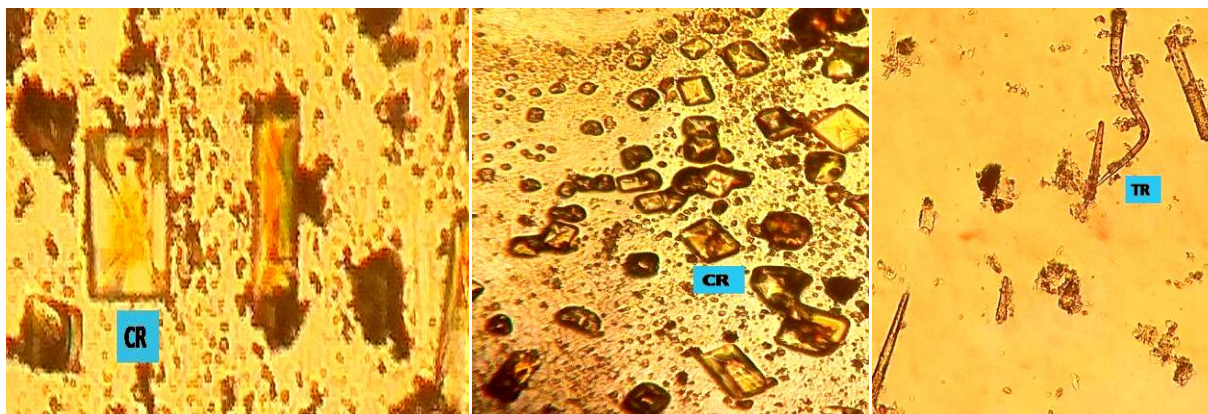


Fig. 2h. Powder microscopy of leaf
CR: Prismatic crystals of calcium oxalate, TR: Covering trichomes

4. CONCLUSION

The macroscopic study reveals the physical characteristics of plant whereas the microscopic studies give us vital information about the histological arrangement of different plant parts. Transverse section of leaf showed the presence of unicellular covering, glandular trichomes, anomocytic stomata, mesophyll type is dorsiventral, bilayered cylindrical arrangement of palisade parenchyma cells, wavy walled epidermal cells, five to six layered parenchymatous tissue, few calcium oxalate crystals and vascular bundles. In petiole five to ten celled layered cortex are present with circularly arranged vascular bundles in parenchymatous tissue. Stem cross-section showed presence of five layered endodermis with fifteen to twenty layered cortex, circularly arranged vascular bundles and pith. Roots showed presence of fifteen to twenty layered cortex and xylem vessels with lignified phloem. Powder characteristic of leaf showed presence of prismatic calcium oxalate crystals, abundantly scattered unicellular covering trichomes and fragments of parenchymatous cells. Evaluation of different leaf constants like stomatal number (262-280), stomatal index (12-16.6), vein islet number (4-8), vein termination number (12-18) and palisade ratio (2-6) helps in framing the microscopic illustration of *Pelargonium x hortorum*. Thus, the above information helps in standardization and identification of given crude drug and its inclusion in various Pharmacopoeias.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:

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