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Anatomical Studies on Medicinally Important C_4 Plant of *Gisekia pharnaceoides* Linn. (Molluginaceae) from Rajasthan



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ABSTRACT

The present investigation has been carried out to determine the anatomical features of whole plant of *Gisekia pharnaceoides* Linn., an important medicinal plant of Rajasthan, which is found in particular geographical area. This plant is commonly known as sareli. It is used for the treatment of swelling, as aperients, purgative, laxative, anthelmintic and to cure some female diseases. For anatomical studies, transverse section of various plant parts i.e. root, stem, leaf and flower have been examined under high magnification and supported by photographs. Anatomical description is a basic and major tool to understand biological mechanism and discipline as it helps to understand basic conceptual aspects. Development triggered by evolution concerns primary and secondary changes in shape and structure and it is often seen as a perspective where the reasons behind replacement remain unresolved. The aim of this study was to analyze the anatomical characters of *Gisekia pharnaceoides* Linn. for species identification, confirmation and interpretation. The results show that leaf possesses hairy trichomes that provide protection. Microscopical studies revealed the presence of anomocytic stomata, more on adaxial surface. Vascular bundles are present throughout the lamina and midrib with kranz-leaf anatomy. Root shows specific sclerenchymatous cells in cortical region, that shows secondary features. Lateral root shows more vessels as compared to medullary rays, most probably supporting faster transportation system. Stem reveals more amount of collenchyma in hypodermis with few crystals. Flowers show some very peculiar feature as non-glandular, unbranched trichomes are present on the margin of petal, most probably providing protection. This study reveals how this plant can be easily identified using these micro-morphological and anatomical markers for accurate identification and conceptualization.



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INTRODUCTION

Traditional Medicine is found to be useful and lasts long in maintaining health status than modern medicine¹. The use of medicinal plants in traditional medicine is well known in rural areas of many developing countries². Ancient Indian literature incorporates a remarkably broad definition of medicinal plants and considers all plant parts to be potential sources of medicinal substances³. Plant anatomy has been found to be very essential as it makes a base for plant taxonomy & categorization. Leaf epidermis and the leaf cross-sectional anatomy provide wide taxonomic data and the literature on this subject is now enormous, it is now a recognised tool in the field of plant systematics⁴⁻⁵. It is a matter of notions that anatomical studies on the medicinal plants lag behind other branches. It is of primary importance for all aspects of research in plant sciences such as morphogenesis, physiology, ecology, taxonomy, evolution, genetics, reproduction, breeding & some other⁶. Anatomical features of medicinal plants for the authenticity and quality control of the drugs are very much useful⁷⁻⁸. Stomatal structure, its ontogeny and other epidermal description have also been measured as analytical character for identification of many plants. Microscopic investigations become essential when identification of a fragmentary material has to be carried out. The methodical anatomy is mainly expected towards relating structure mainly of vegetative organs to taxonomic classification of the plants in which the characters are exemplified. The family Molluginaceae consists of about 14 genera and 120 species. *Gisekia pharnaceoides* Linn. is a common creeping and well branched annual herb of sand dunes⁹. It is used to cure scabies, rhinitis, bronchitis, loss of appetite, heart troubles, leprosy, leucoderma, urinary diseases and also given to cure chest disorders, worm infestation and mental disorders¹⁰. Leaf of this plant is used to treat many incurable diseases¹¹. Methanol and dichloromethane extract of this plant possessed antioxidant activity¹². The hydroalcoholic extract of whole plant of *Gisekia pharnaceoides* showed highly significant CNS(Central Nervous System) stimulant activity¹³. Methanolic and ethyl-acetate extract of root and stem of *Gisekia pharnaceoides* possess several constituents having medicinal and nutritional properties¹⁴.

Gisekia is C₄ plant with atriplicoid Kranz anatomy that use NAD-ME type of biochemical cycle. It represents an isolated C₄ lineage¹⁵. The key objective of the study included detailed anatomical investigation on all parts of the *Gisekia pharnaceoides* Linn. to prepare anatomical evidence & database, that can be used to standardize the anatomical description for providing

possible tool to identify the flora. This study has been initiated with the identification using microscopic and anatomical constraint as the primary step.

MATERIALS AND METHODS

Disease free plants were collected from different places of Jodhpur (Mathaniya, Mandor and Ossian) district of Rajasthan in the month of August, 2016. Preliminary specimen identification was done by Prof. PK Kasera (Head, Department of Botany, JNV Univ.Jodhpur), 'Flora of the Indian Desert' and 'Flora of Rajasthan' was referred for confirm recognition¹⁶⁻¹⁷. Final authentication and identification were done by Botanical Survey of India (BSI) Jodhpur, Rajasthan. Fresh specimens of whole plant were fixed immediately in FAA (5 ml of formalin + 5 ml of acetic acid + 90 ml of 70% ethyl alcohol) for 24 h.

Sectioning and Staining Procedure

Microscopic observations were carried out by using Olympus BX-60 microscope with 10x, 20x, 40x and 100x objectives. Handmade thin section of various plant parts was cut using commercial tools. Fine sections were double stained using safranin (1% solution in 50% alcohol) and fast green (1% solution in hydro-alcohol), glycerine was used for making temporary mounts. The staining results were remarkably good. Photomicrographs were prepared with Sony HD (1920x1080/50i) digital camera. Special identifying features of the plant parts were studied and identified.

RESULT AND DISCUSSION

Anatomy of root

Exterior most layer is cork (1-2) layered being removed at several places, cells are rectangular in shape. Cork is followed by thin layer of cork cambium. 2-3 layered parenchymatous secondary cortex is present beneath cork cambium. Secondary cortex is soon followed by wide secondary phloem (7-8 layered). Some cells of this region possess rosette crystals of variable size. Secondary phloem, in turn, is followed by 2-3 layered fascicular cambium encircling secondary xylem. Central region is almost covered by sec. xylem that is present in more amount, with well-defined medullary rays & vessels. Size of vessels is comparatively larger at periphery. Primary xylem is few celled, located almost adjoining to parenchymatous pith. Pith is made of few parenchymatous cells (Fig.1-3).

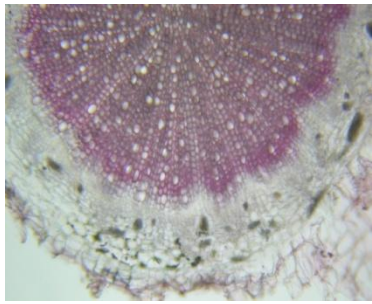


Fig.1-Root (T.S.)

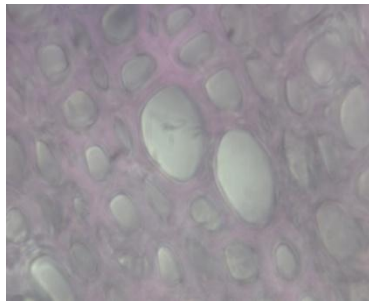


Fig. 2. Root (xylem vessels)

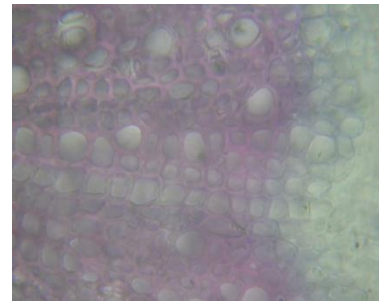


Fig. 3. Root (medullary rays)

Anatomy of lateral/accessory root

Lateral roots are extension of endodermis/pericycle, they crush the cortical tissue and ultimately epidermis. Dermatogen is formed that contains lots of rosette crystals. Xylem elements cover most of the central place. Phloem is either displaced or distorted(Fig.4-5).

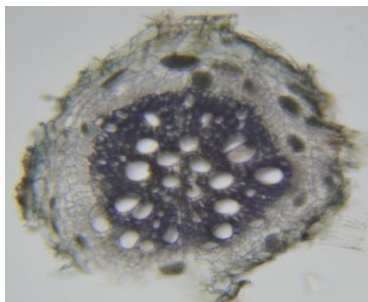


Fig. 4. Lateral Root

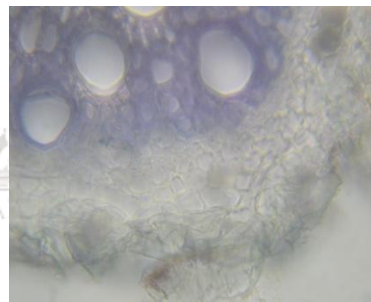


Fig. 5. Lateral Root (xylem vessels)

Anatomy of stem

Transverse section is almost circular in outline except some points where ridges are present. The epidermis is continuous, single layered, covered with thin cuticle. Certain bulliform cells are present in between rectangular cells of normal size. Cortex is wide and collenchymatous (3-4 layered) with some rosette crystals and some amount of chloroplast on radius of some cells. Endodermis is single layered, cells are barrel shaped with wall thickenings. A complete ring of perivascular fibres is present surrounding vascular tissue system that is conjoint, endarch and open forming a ring. Xylem shows variable amount of xylem elements all along the radius. Phloem is less in amount showing only phloem parenchyma. Cambium is 3-4 layered with ray initials and cells are isodiametric. Pith is more in amount, the cells are

smaller in periphery while large in centre, at certain places their wall overlaps and rosette crystals are also present (Fig.6-8).

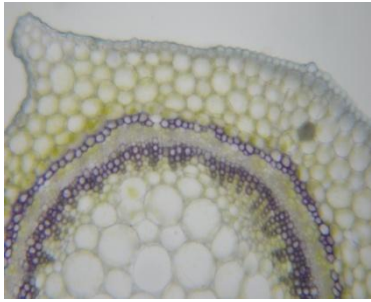


Fig.6.Stem (T.S.)

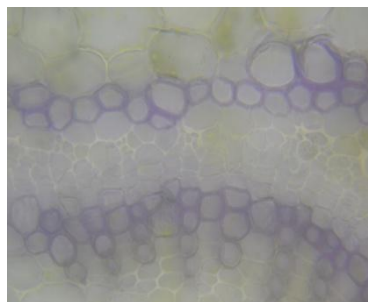


Fig.7.Stem (vascular elements)

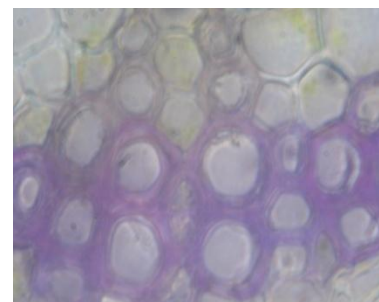


Fig.8.Stem (xylem vessels)

Anatomy of leaf

Epidermis is single layered, cuticularized, some bulliform cells are also present. Stomata are anomocytic and they are more in no.on adaxial surface. Pointed trichomes are present on upper epidermis. Epidermis is followed by few collenchyma and chlorenchyma cells in midrib region only. In wings, epidermis is soon followed by columnar palisade tissue. This tissue is also present towards the lower side (above lower epidermis). This tissue encircles vascular bundle. Vascular bundles are enclosed in bundle sheath. Some cells of this sheath also contain green pigment. Vascular bundles are conjoint, collateral and closed. Protoxylem faces upper epidermis. Protoxylem ends are surrounded by some parenchyma cells without airspace. Vascular bundle in midrib region are soon followed by collenchymas cells that are more in amount in this region as compared to wings where it is one to two celled (Fig.9-11). Leaf anatomical features have been proved to be useful for species grouping and identification with great taxonomic significance¹⁸⁻²¹.



Fig. 9. Leaf (T.S.)

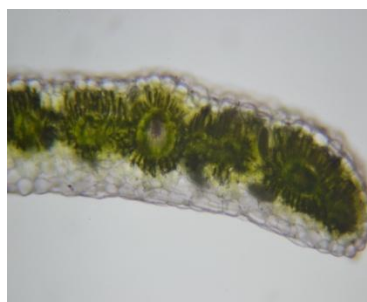


Fig. 10. Leaf (Kranz anatomy)



Fig. 11. Leaf (stomata)

Anatomy of flower

Flower hermaphrodite, pentamerous, complete, sepal-5 (free, large, persistent, green, 2-3mm), petal-5(alternate to sepals, free, white, small and deciduous), stamen-5(anther lobes-creamish white, filament long) ovary superior, apocarpous, pentacarpellary with axile placentation, thallums well developed, carpels are opposite to sepals. Ovary wall contains non-glandular trichomes along the margins. Ovules are clearly visible with their placenta (Fig.12-15).

Floral Formula - $\oplus \text{♀} \text{K}_5 \text{C}_5 \text{A}_5 \text{G}_5$

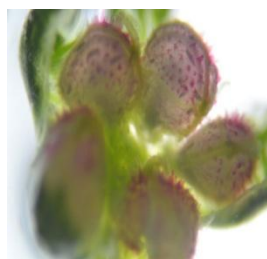


Fig. 12. Flower Fig. 13. Flower (T.S.) Fig. 14. Flower (ovules) Fig. 15. Flower (L.S.)

CONCLUSION

Descriptive anatomical analysis supports to understand plant development and it always becomes a strong & factual tool for future researchers to recognize the target. We have reported pharmacognostical importance earlier. This plant contains various bioactive compounds. Several interesting features i.e. presence of rosette crystal, secondary growth, lateral root, large vessels, perivascular fibers etc. may draw attention of future researchers to explore it further on various aspects.

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