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Anatomical Profile of Four Valuable Medicinal Plants of Family Rubiaceae



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ABSTRACT

Background and Aims: Medicinal plant materials are being adulterated commercially due to many reasons such as similar morphological features, same name as written in classical text, presence of similar active principles in the substituted plant etc., which may badly affect the therapeutic activity of the finished products. Furthermore, the knowledge of plant structure is also essential to solve several common everyday problems such as identification of unknowns, food contaminants and forensic problems. This research work focuses on the comparative anatomy of four valuable medicinal plants of family Rubiaceae for a better understanding of the interrelationships among these species. **Methods:** The preserved specimens were cut into thin transverse section and were stained with safranin, Aniline blue, Eosin Y as per standard methodology. This present study also intends to additionally add fluorescent microscopic studies on these selected species. **Key Results:** *Morinda citrifolia* consists of stem with wide parenchymatous pith, petiole with conjoint, collateral, open vascular bundle, leaf showing paracytic type of stomata, and peduncle with circular vascular bundle. *Morinda tinctoria* displays the stem with small parenchymatous pith, petiole with crescent shaped vascular bundle, leaf showing conjoint vascular bundle with paracytic type of stomata and peduncle with circular vascular bundle. The stem of *Ixora coccinea* consists of uniseriate rays are present in TLS of stem, leaf contains single layered epidermis with thick cuticle, conjoint vascular bundle with paracytic stomata. In *Ixora notoniana* exhibits circular vascular bundle, with sclerenchymatous covering, uniseriate rays with intervessel pits present in TLS of stem. **Conclusions:** The present work describes the anatomical features of some of the important medicinal plants which are useful in the pharmacognosy. The results obtained would help to identify the correct species and would serve as a reference for identification of these plant species commercially available and to differentiate them from their substitute and adulterants.

INTRODUCTION

Morinda citrifolia, known as Noni, grows widely throughout the Pacific and is one of the most significant sources of traditional medicines among Pacific island societies. It is originated in tropical Asia or Polynesia (Zin *et al.*, 2002). Due to its medicinal and nutritional value, it is considered the “Queen” of the other 80 species belonging to the Rubiaceae family (Morton, 1992). Noni fruit and leaves have been consumed as traditional foods in southern Asia and in the Pacific islands (West *et al.*, 2006). Noni juice may help to prevent cancer and other diseases, and maintaining overall good health. The roots, bark, leaves, flowers and fruits of *Morinda citrifolia* have been traditionally used as a folk remedy to treat diseases such as diabetes, hypertension and cancer (Akihisa *et al.*, 2007). Recently, several novel bioactive compounds such as flavanol glycosides, iridoid glycosides and anthraquinones have been identified in the fruits of *Morinda citrifolia* (Kamiya *et al.*, 2004). *Morinda tinctoria* is another member of family Rubiaceae grows wildly and distributed throughout Southeast Asia, commercially known as Nunna, is indigenous to tropical countries and is considered as an important folklore medicine. It has been reported to have a broad range of therapeutic and nutritional values. Every part of the plant has been used medicinally in treating a variety of ailments (Palu *et al.*, 2004). In the traditional system of medicine, leaves and roots of *Morinda tinctoria* are used as astringent, deobstrent, emmenagogue and to relieve pain in the gout (Thirupathy and Saravanan, 2009). Unripe fruit is used to cure rheumatism. Ash of the fruit prevents dysentery, vomiting, diarrhoea and cholera (Kanchanapoom, 2001). Out of 15 Sri-Lankan medicinal plants that were screened for antibacterial and antifungal activities *Morinda tinctoria* displayed the wide spectrum of antibacterial activity (Jayasinghe *et al.*, 2002).

Ixora coccinea Linn (R.) belonging to the Rubiaceae family is an ornamental plant claimed for the management of oral cancer and one of ingredients in curing different ailments. This plant is found throughout India more common in West Peninsula in scrub jungles widely cultivated to throughout the tropics (Srivastava *et al.*, 1991). It is commonly known as Jungle of Geranium or Flame of the woods or Vetchi in ayurveda and is native to India and is found mostly in Konkan region. The roots of the plant *Ixora coccinea* are mostly used as an astringent, antiseptic, stomachic, sedative etc. (Joshi *et al.*, 2013). *Ixora* species contains many important phytoconstituents in the various parts of it and they are responsible for some important biological

activities like antitumour activity, wound healing and antimicrobial activity (Sankhadip *et al.*, 2011). *Ixora notoniana* is such a tree species found in the peninsular India. It is endemic to western ghats-south sahyadri and Palakkad hills, Nilgiris and Bababudangiri hills in Central Sahyadri (Gamble, 1993)

MATERIALS AND METHODS

For microscopic studies, fresh plant materials like stem, peduncle, petiole and leaves were collected from botanical garden of Rapinat Herbarium and Centre for Molecular Systematics, St. Joseph's College (*Autonomous*), Tiruchirappalli. Confirmation was further done with the help of floras and other reputed literature. The healthy fresh plant materials collected separately and were brought to the laboratory. The samples were annotated with the date of collection, the locality and medicinal uses. The fresh plant parts were preserved in fixative solution FAA (Formalin-5ml + Acetic acid-5ml + 70% Ethyl alcohol-90ml) for more than 48 hours. The preserved specimens were cut into thin transverse section and were stained with safranin, Aniline blue, Eosin Y as per standard methodology. The selected diagnostic characters of the transverse section were photographed under suitable magnification using camera. The transverse sections of the stems, petioles and fresh leaves through the midrib were also cleared, mounted and observed under fluorescent microscope.

RESULTS AND DISCUSSION

Morinda citrifolia consists of stem with wide parenchymatous pith, petiole with conjoint, collateral, open vascular bundle, leaf showing paracytic type of stomata, and peduncle with circular vascular bundle (fig.1-7). *Morinda tinctoria* displays the stem with small parenchymatous pith, petiole with crescent shaped vascular bundle, leaf showing conjoint vascular bundle with paracytic type of stomata, and peduncle with circular vascular bundle (fig.8-14).

The stem of *Ixora coccinea* consists of large central parenchymatous pith, circular, vascular bundle with sclerenchymatous covering, uniseriate rays are present in TLS of stem, leaf contains single layered epidermis with thick cuticle, conjoint vascular bundle with paracytic stomata (Fig.15-18). In *Ixora notoniana* exhibits chlorenchymatous hypodermis, large central parenchymatous pith, circular vascular bundle, with sclerenchymatous covering, uniseriate rays

with intervessel pits present in TLS of stem. Leaf of this plant shows paracytic type of stomata with conjoint vascular bundle (Fig.19-22). In both plants raphide cells absent in the wood parenchyma. Vessel groups consist of a smaller number of vessels.

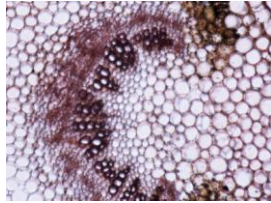


Fig.1.Leaf

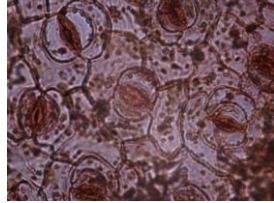


Fig.2.Leaf (Stomata)

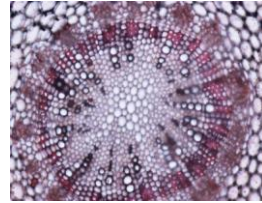


Fig.3.Peduncle

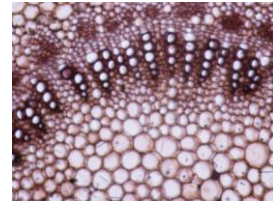


Fig.4.Petiole

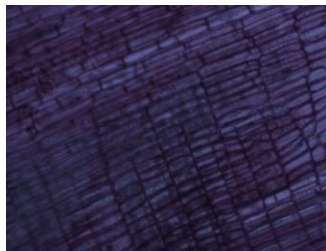


Fig.5.Stem (RLS)

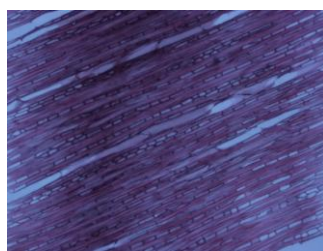


Fig.6.Stem (TLS)

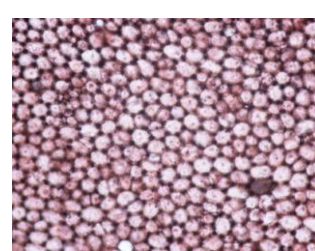


Fig.7.Stem



Fig.8.Leaf

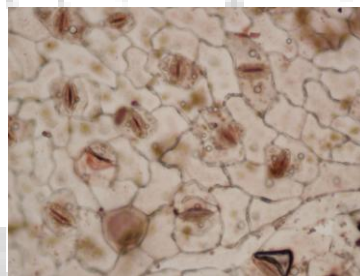


Fig.9.Leaf (Stomata)

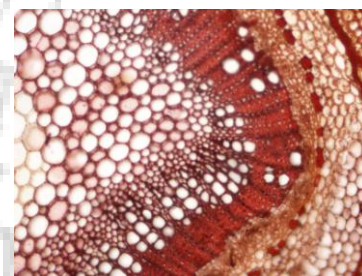


Fig.10.Stem

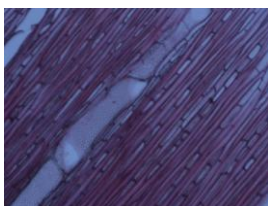


Fig.11.Stem (TLS)

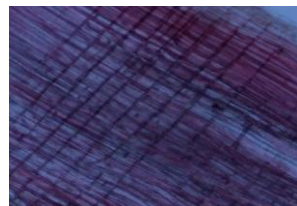


Fig.12.Stem (RLS)



Fig.13.Petiole

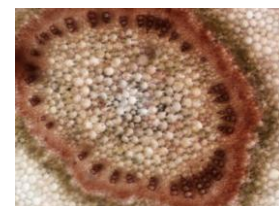


Fig.14.Peduncle

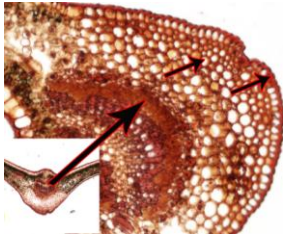


Fig.15.Leaf

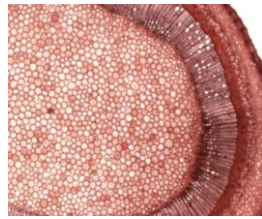


Fig.16.Stem

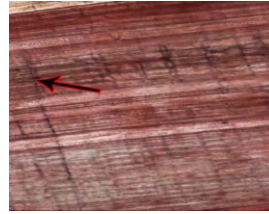


Fig.17.RLS

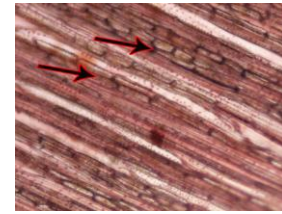


Fig.18.TLS



Fig.19. Stem

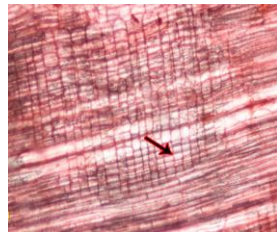


Fig.20. RLS

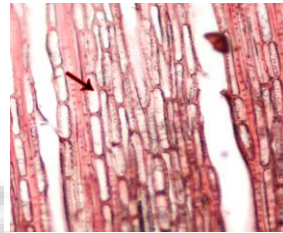


Fig.21. TLS

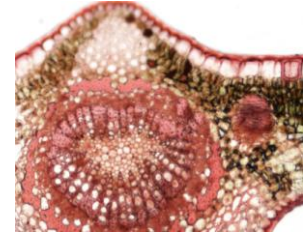


Fig.22. Leaf

There are some common features observed in both species, the leaf of both species are dorsiventral, hypostomatic and mesomorphic in arrangement. Both species have adaxially and abaxially projecting midribs with 1.2mm in thickness. Calcium oxalate crystals are occasionally seen in some of the parenchyma cells. Stomata are present on the lower epidermis. These are two layers of palisade cells along the upper part. The cells are wide, cylindrical and the palisade zone in 60 μ m in height. The spongy parenchyma cells are in 4 (or) 5 rows.

CONCLUSION

Medicinal plants are therapeutically effective and culturally acceptable, since the increase in the use of synthetic chemicals has led to many side effects and undesirable hazards. Present study has revealed an easy technique to identify four medicinal plant materials microscopically and this microscopical detection is easy, reliable and cost effective tool for detection for adulteration in medicinal plant materials. The present work describes the anatomical features of some of the important medicinal plants which are useful in the pharmacogony. The results obtained would help to identify the correct species and would serve as a reference for identification of these plant species commercially available and to differentiate them from their substitute and adulterants. The long list of these drugs suggests that each and every part of the herb can be used in different ailments, which in turn reflects the importance of these plants. From the above work, it may

concluded that these four medicinal plants of great deal and are useful for its various properties by a number of pharmaceutical companies and general public.

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Table.1. Comparative Anatomical Profile of *Morinda tinctoria* and *Morinda citrifolia*

Part	Cell type	<i>Morinda tinctoria</i>	<i>Morinda citrifolia</i>
Stem	Epidermis	single layered with hairs	single layered
	Endodermis	compactly arranged	compactly arranged
	Vascular bundle	metaxylem outside, protoxylem inside, multiseriate rays present	vascular bundle in a ring, mostly uniseriate rays occasionally biseriate
	Pith	wide pith	wide parenchymatous
Petiole	Vascular bundle	crescent shaped	crescent shaped, conjoint, collateral, open
	Epidermis	single layered epidermis with hairs	single layered
	Cortex	parenchymatous without separation	parenchymatous
Leaf	Cuticle	thick	thick
	Vascular bundle	conjoint	conjoint
	Stomata	paracytic	paracytic
Peduncle	Vascular bundles	vascular bundles are arranged in a ring	circular, metaxylem outside and protoxylem inside
	Endodermis	chlorenchymatous tissue	chlorenchymatous

Table.2. Comparative anatomical profile of *Ixora coccinea* and *Ixora notoniana*

part		<i>Ixora coccinea</i>	<i>Ixora notoniana</i>
Stem	Pith	consists of large central parenchymatous pith	parenchymatous pith
	Vascular bundle	circular vascular bundle with sclerenchymatous covering	have uniseriate rays with intervessel pits
	Epidermis	single layered epidermis with uniseriate rays	Hypodermal cells have some chlorenchymatous cells
Leaf	Epidermal cells	single layered square shaped epidermal cells	single layered epidermal cells
	Cuticle	thick cuticle	thick cuticle
	Vascular bundle	conjoint vascular bundle	conjoint vascular bundle
	Hypodermal cells	compact arrangement of lower hypodermal cells	compact arrangement
	Stomata	paracytic type of stomata	paracytic type of stomata