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Morphological and anatomical comparison of three different *Plumbago* species (Plumbaginaceae) found in Kerala

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Abstract
Plumbaginaceae is an angiosperm family with cosmopolitan distribution. Most of the members belong to this family are herbaceous perennial plants. Plumbago is a genus of 10-20 species of flowering plants. In Kerala three species of the genus Plumbago are found: *Plumbago indica* L., *Plumbago zeylanica* L. and *Plumbago auriculata* Lam. All the three species possess high medicinal values. These three species show difference in their anatomical as well as morphological features. The present study aims a comparison between the anatomical and morphological features of these three species. The study of anatomical characteristics gives an idea about the similarities and differences in their structure. Here the stem, petiole and leaves of the plants were subjected to the study. Thin sections were taken and stained. After staining microscopic images were taken and made the comparison. Various anatomical aspects were studied.

Keywords: plumbaginaceae, plumbago species, morphology, anatomical studies

1. Introduction
Plumbaginaceae is an angiosperm family with cosmopolitan distribution. The family comprises of about 27 genera and 730-836 species. Common name of the Plumbaginaceae is leadworts, from the Latin words plumbum ("lead") and agere ("to resemble"). The genus *Plumbago* L. includes 18 species [1]. The Plumbago species are perennial herbs or undershrubs, often scandent [2]. Among the 18 species, three are found in Kerala*: Plumbago indica L.*, Plumbago *zeylanica* L. and *Plumbago auriculata* Lam. Among these, *P. zeylanica* and *P. indica* are indigenous species while *P. auriculata* is a native of South Africa which is introduced to India as a cultivar because of its ornamental value [3]. These three species can be distinguished by the difference in their flower colours. *P. zeylanica* and *P. indica* are well known for their medicinal properties while *P.auriculata* is considered as a garden plant. In Africa, P. zeylanica is used as a remedy for ulcers [4]. In India this plant is used to treat various ailments including intestinal disorders, skin diseases, bronchitis, diseases of liver and spleen and rheumatism in Ayurveda, an alternate system of medicine [5]. Eventhough there were a lot of reports on the phytochemical properties of these plants, anatomical studies are very less. As anatomical characteristics help in the proper identification of the medicinal plant, we have to carry out the micro as well as macro morphological studies and anatomical studies to confirm the plant. This work aims the morphological as well as anatomical characterization and comparison of three Plumbago Species found in Kerala. This is an attempt to analyse and compare the morphological and anatomical features of the three species.

2. Materials and Methods
The plant materials are collected from different places in Kerala (details are given in Table 1). Morphological features are recorded by keen observation of the plants. Fresh stem and petiole of the three *Plumbago* species were used for the anatomical studies. Stems and petioles were collected and cut into small pieces using a new razor blade. After washing it properly to remove the dust and other particles, thin sections were made. For observing the stomata, epidermal layer was carefully peeled off and cleaned. The thin sections were stained with freshly prepared 1% safranin solution and excess stain was removed by continuous washing. Photographs were taken with stereomicroscope (Leica DM 500). Leica Las EZ software was used for this.

Table 1: Details of Plant Collection Sites

Name of Plant	Place of Collection	Geographical Coordinates
Plumbago auriculata Lam.	Vazhuthacaud, Thiruvananthapuram	8° 30' 7.56" N, 76° 57' 51.12" E
Plumbago zeylanica L.	Karunagappally, Kollam	9° 3' 16" N, 76° 32' 7" E
Plumbago indica L.	Nellimoodu, Thiruvananthapuram	8° 22' 51.96" N, 77° 2' 31.56" E

3. Results and Discussion
3.1 Morphological description
The three Plumbago species possess unique morphological as well as anatomical features. Fig. 1indicates the three plants in their natural habitat. Morphological description of the three species are given below.
Plumbago auriculata Lam:
Plant type: Shrub, Leaves are oppositely arranged. Stem is long and thin. Stems are profusely branched from the base.

It attains a length of approximately 3 metres. Flower colour: blue, Calyx 5-sepalate, Petals 5 fused, stamens 5

Plumbago zeylanica L.

Plant type: Shrub, Leaves are oppositely arranged. Stem is slightly thick. Leaves are ovate. Flower Gamopetalous, white in colour Calyx 5-sepalate, Petals 5 fused, stamens 5

Plumbago indica L.

Plant type: Partial climber, Leaves are oppositely arranged. Stem is thin. Leaves are ovate. Flower gamopetalous, bisexual, red in colour, Calyx 5-sepalate, Petals 5 fused, stamens 5

Plumbago auriculata Lam.

Plumbago zeylanica L.

Plumbago indica L.

Fig 1: Three *Plumbago* species at their natural habitat

3.2 Anatomical Characterization

While analyzing the sections, it revealed that the stem T.S of *Plumbago auriculata* is circular in shape (Fig.2A) while in *Plumbago zeylanica*, the stem T.S is not a smooth circle (Fig.2B) and in *Plumbago indica* the stem T.S is wavy in appearance (Fig.2C). Further the sections were closely examined for various anatomical parameters. The anatomical differences and similarities between the three *Plumbago* species are compared in Table 2.

Galal *et al*. reported that the stem T.S are circular in sectional view [6]. But here we couldn't observe it in all the three species. We have observed collateral vascular bundles in the stem as mentioned in their report. According to Bailey, to a certain extent, anatomical features of dicotyledons can be used in studying relationships within orders, families, genera and species [7]. Muthuswamy R and Senthmarai R published a detailed note on the root anatomy of *P. indica* [8]. Jana P *et al*. reported the presence of starch grains in the xylem of roots in *P. zeylanica* [9]. Eventhough the anatomical features of root are extensively studied; the anatomical features of the aerial parts are still least studied.

The petiole of *P. indica* is crescent shaped in sectional view (Fig.3A) while that of *P. zeylanica* is semi-circle in shape (Fig.3B). The number of vascular bundles are more in *P. indica* compared to *P. zeylanica*. It has been observed that *P. auriculata* lacks a distinguishable petiole. The anatomical properties of the petiole are compared in Table 3.

3.3 Stomatal studies

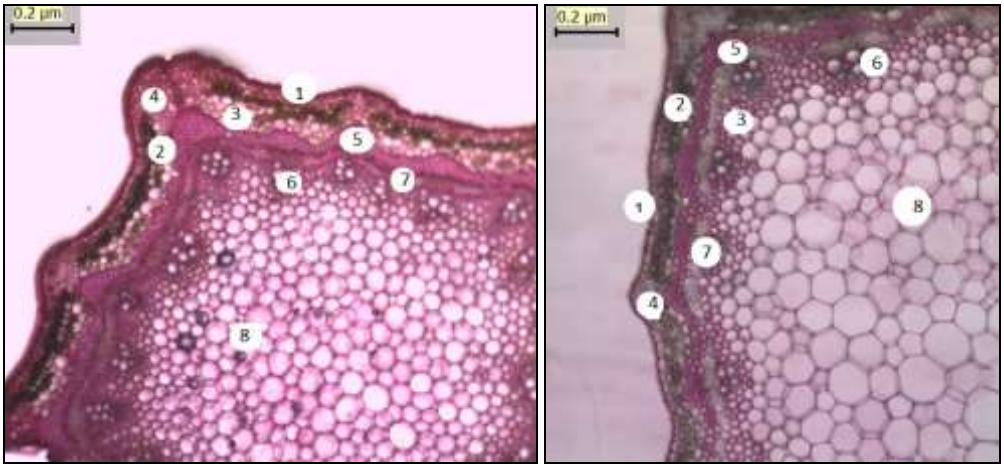
Close examination of the epidermal tissues showed that the stomata are anisocytic in all the three species (Fig.4) as of already mentioned previous reports. Metcalfe and Chalk reported that the stomata in Plumbaginaceae are anisocytic in nature [10].

Table 2: Comparative anatomy of stem T.S

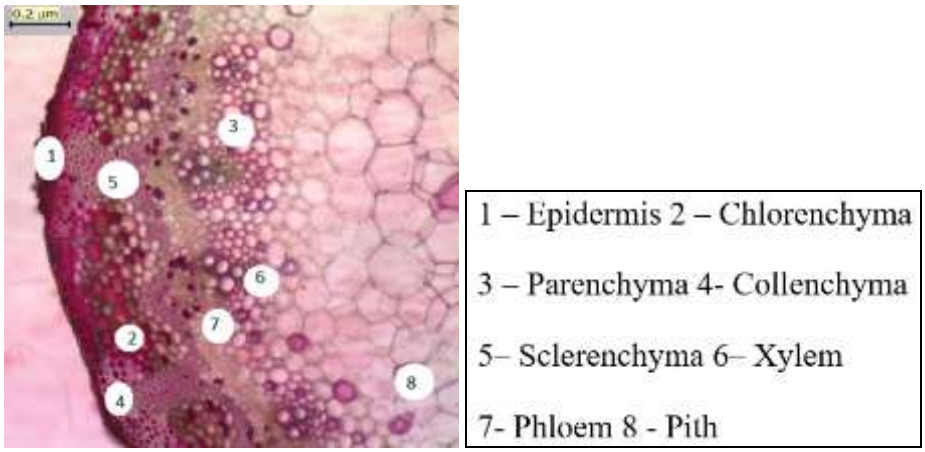
Species	Epidermis	Hypodermis	Cortex	Vascular Bundle	Pith
Plumbago indica L.	Single layered	Collenchymat ous tissues are seen as patches with a few layers of chlorenchym atous tissues	Sclerench ymatous tissues are present	Bundle cap is seen in the form of continuous ring. Collateral and endarch vascular bundles.	A large pith is present
Plumbago zeylanica L.	Single layered	Collenchymat ous and chlorenchym atous tissues are mixed and seen as patches	A distinguish able cortex is not present	Bundle cap is seen in the form of continuous ring. Collateral and endarch vascular bundles.	A large pith is present
Plumbago auriculata Lam.	Single layered	Collenchymat ous and chlorenchym atous tissues are mixed and seen as patches	Parenchy matous cortex is present.	Bundle cap is seen in the form of continuous ring. Collateral and endarch vascular bundles.	A large pith is present

Table 3: Comparative anatomy of petiole T.S

Species	Epidermis	Hypodermis	Cortex	Vascular Bundle	Pith
Plumbago indica L.	Single layered	Collenchymat ous tissues are seen as patches with a few layers of chlorenchym atous tissues	Parenchy matous tissues are present	Bundle cap is absent. Collateral and endarch vascular bundles are scattered.	Pith is absent
Plumbago zeylanica L.	Single layered	Collenchymat ous and chlorenchym atous tissues are mixed and seen as patches	Parenchy matous tissues are present	Bundle cap is absent. Collateral and endarch vascular bundles are scattered.	Pith is absent

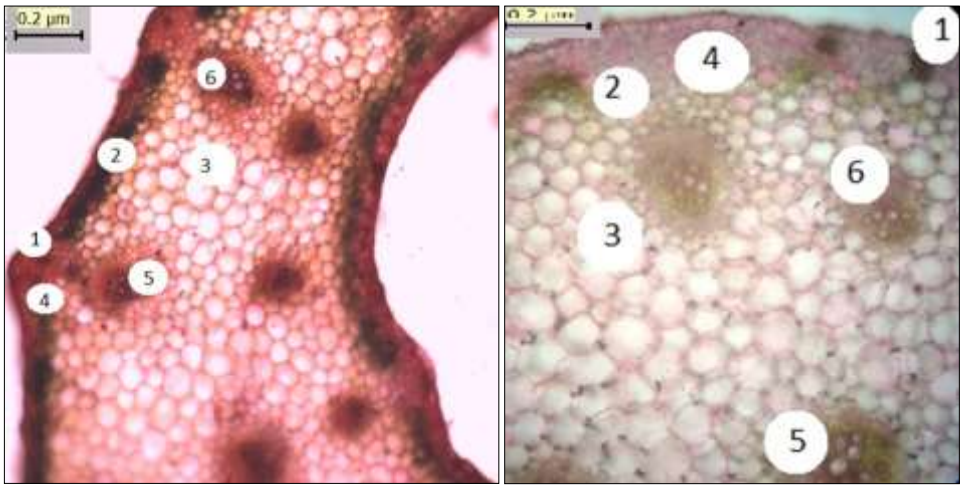


2A. *Plumbago auriculata* Lam. **2B.** *Plumbago zeylanica* L.



2C. *Plumbago indica* L.

Fig 2: Photomicrographs of T. S of stem



3A. *Plumbago indica* L. **3C.** Plumbago zeylanica L.

1 – Epidermis 2 – Chlorenchyma 3 – Parenchyma 4 – Collenchyma 5 – Xylem 6 – Phloem

Fig 3: Photomicrographs of T. S of Petiole

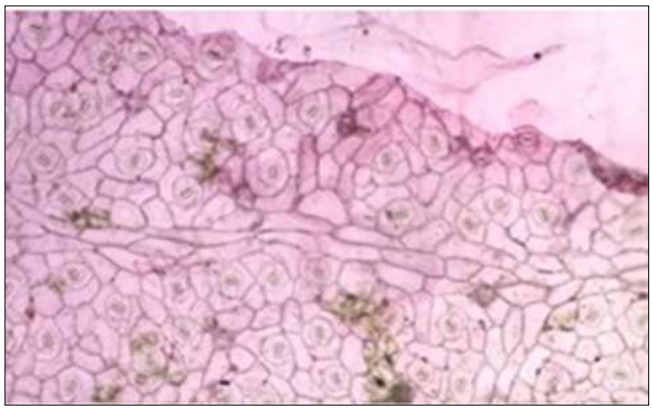


Fig 4: Leaf epidermal layer showing anisocytic stomata

Conclusion

The proper documentation of anatomical features helps in the proper identification of medicinal plants. Also, it helps to avoid adulterations in the drug preparation. The three species of the genus *Plumbago* that found in Kerala show distinguishable anatomical features which helps in their proper identification. *Plumbago auriculata* Lam. is a sessile species which lacks a visible petiole.

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Reference

1. Chatterjee A, Pakrashi SC. The treatise on Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi, 1997.
2. Gamble JS. Flora of the Presidency of Madras. Vol II. Botanical Survey of India, Calcutta, India, 1935, 744-745
3. Nayar TS, Rasiya Beegam A, Sibi M. Flowering Plants of the Western Ghats India Vol. I India, 2014, 724-725.
4. Sharma PC, Yelne MB, Dennis TJ. Database on medicinal plants used in ayurveda (on CD). Central Council for Research in Ayurveda and Siddha, New Delhi, 2000.
5. http://www.theplantlist.org/tpl1.1/search?q=plumbago
6. Galal AM, Raman V, Avula B, Wang YB, Rumalla CS, Weerasooriya AD, *et al*. Comparative study of three *Plumbago* L. species (Plumbaginaceae) by microscopy, UPLC-UV and HPTLC. Journal of National Medicine. 2013; 67:554-561.
7. Bailey I. The Potentialities and Limitations of Wood Anatomy in The Study of The Phylogeny and Classification of Angiosperms. Journal of the Arnold Arboretum. 1957; 38(3):243-254.
8. Muthuswamy R, Senthamarai R. Comprehensive Anatomical Investigation of Root of *Plumbago Roseus* Linn, Iranian Journal of Pharmaceutical Sciences. 2013; 9(3):45-54.
9. Jana P, Rahaman CH, Banerjee N. Pharmaco-anatomical and phytochemical studies of Plumbago zeylanica Linn. Plumbaginaceae- An important medicinal plant. Advances in Plant Biology Debidas Bhattacharya Birth Centenary Commemorative Volume, Eds. S. Mandal and S. Bhattacharya, 2009, 318-336.
10. Metcalfe CR, Chalk L. Anatomy of the Dicotyledons. Vol 1, Clarendon Press, Oxford University Press, London, 1950.