WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 10, Issue 3, 1772-1778. Research Article ISSN 2277– 7105

PATTERNS OF LEAF ARCHITECTURE IN SIX SPECIES OF *PHOEBE* FROM FAMILY LAURACEAE

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Article Received on
11 Jan. 2021,

Revised on 01 Feb.2021,
Accepted on 22 Feb. 2021

DOI: https://doi.org/10.17605/OSF.IO/W4KNV

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ABTRACT

Six species of *Phoebe* have been studied. The studied species are economically important and are a valuable source of wood and timber which are used as a substitute for teak and *Phoebe lanceolata* is medicinally important. The present study was undertaken to identify the six species based on the venation pattern. The types of venation patterns found are Type of venation is Pinnate camptodromous eucamptodromous and Pinnate camptodromous with festooned brochidodromous type. The species studied are *Phoebe angustifolia, P. attenuata, P. cooperiana, P. goalparensis, P. lanceolata* and *P. paniculata.* The type of venation found in them is pinnate camptodromous eucamptodromous and festooned brochidodromous. The species are further separated based on the higher vein order and angle of origin of tertiary veins, areole development and presence or absence of tracheoids.

KEYWORDS: *Phoebe,* venation, pinnate, eucamptodromous, festooned brochidodromous.

INTRODUCTION

The genus *Phoebe* belongs to family Lauraceae and tribe Perseaceae. There are about 150 species of *Phoebe* in the world and 15 species are found in India. They are *Phoebe angustifolia* Meissn., *P. attenuata* Nees., *P. cooperiana* Kan. & Das., *P goalparensis* Hutch., *P. lanceolata* Nees., *P. paniculata* Nees. *P. attenuata* is valuable for its timber which can be substituted for teak. *P. cooperiana* is used for building works, planking doors and also for furniture. *P goalparensis* is used for cabinet making and as a substitute for teak. *P. lanceolata*

is used for cattle fodder. Ash of berries is said to cure sores. The wood is very strong and used for planks. The morphological key to *Phoebe* is based on fruiting perianth segments and hair on the perianth; young shoots are tomentose or not which make it difficult to identify the species (Hooker, 1883 & Kanjilal & Das, 1939). In the present work venation was studied to help in identification of the six species based on the leaf architecture pattern.

MATERIALS AND METHODS

The plant material for the present work was personally collected from Shillong- Meghalaya. The duplicates of herbarium were deposited in the herbarium section of B.S.I. Eastern Circle. The identification of fresh material was checked with the help of Standard Herbaria, Eastern Circle, B.S.I. Shillong.

For the study of leaf architecture, the method used was as described by Payne, (1969) and Mohan Ram and Nayyar, (1978). The terminology used in anatomical studies is in accordance with Hickey and Wolfe (1975), Melville (1976), Hickey (1973, 1979) and Dilcher (1974).

OBSERVATIONS

Six species of Phoebe are studied namely *Phoebe angustifolia* Meissn., *P. attenuata* Nees., *P. cooperiana* Kan. & Das., *P. goalparensis* Hutch., *P. lanceolata* Nees. and *P. paniculata* Nees. Type of venation is Pinnate Camptodromous eucamptodromous; angle of divergence of secondary veins is acute narrow, pattern of tertiary veins percurrent, angle of origin of tertiary veins RR/RA/ RO/ OR/ AA/ OA/ AO and tracheoids absent in *P. angustifolia*.

Type of venation is Pinnate Camptodromous with festooned brochidodromous type in the remaining five species of *Phoebe* namely *P. attenuata, P. cooperiana, P. goalparensis, P. lanceolata* and *P. paniculata*.

Highest vein order of the leaf is 5° and tracheoids present in three species namely P. goalparensis, *P. paniculata* and *P. lanceolata.*

The angle of divergence of secondary veins is acute narrow in *P. goalparensis* and *P. paniculata.* Pattern of tertiary veins is random reticulate and angle of origin is RR/ OR/ OA/ AO/ AR in *P. goalparensis* while percurrent and RR/ RO/ OA/ AR/ OR/ RA in *P. paniculata.*

The angle of divergence of secondary veins is acute moderate and pattern of tertiary veins is random reticulate and angle of origin is RR/ OR/ AO/ RO/ AA in *P. lanceolata.*

The highest vein order is 6° and angle of origin of tertiary veins percurrent in *P. attenuata* and *P. cooperiana.* The angle of divergence of secondary veins is acute wide and angle of origin of tertiary veins is RR/ OA/ OO/ RA/ AR/ AO and tracheoids present in in *P. attenuata.* The angle of divergence of secondary veins is acute narrow and angle of origin of tertiary veins is RR/ RO/ OA/ OO/ AA/ AR/ OR and tracheoids absent in in *P. cooperiana.*

KEY TO THE SPECIES

Venation is Pinnate camptodromous eucamptodromous secondaries

Angle of divergence of 2^{o} veins is acute narrow

Pattern of 3^{o} veins percurrent

Angle of origin of 3o veins RR/RA/ RO/ OR/ AA/ OA/ AO

Tracheoids absent ----------*P. angustifolia*.

Venation is Pinnate camptodromous with festooned brochidodromous secondaries

Angle of divergence of 2^{o} veins is acute narrow

Pattern of 3^{o} veins is random reticulate

Angle of origin is RR/OR/OA/AO/AR

Tracheoids present---------- *P. goalparensis*

Pattern is percurrent

Angle of origin is RR/RO/OA/AR/OR/ RA

Tracheoids present ---------- *P. paniculata*

Angle of divergence of 2^{o} veins is acute moderate

Pattern of tertiary veins is random reticulate

Angle of origin is RR/ OR/ AO/ RO/ AA

Tracheoids present ---------- *P. lanceolata*

Angle of divergence of 2^{o} veins is acute wide

Pattern tertiary veins is percurrent

Angle of origin of 3^{o} veins is RR/ OA/ OO/ RA/ AR/ AO

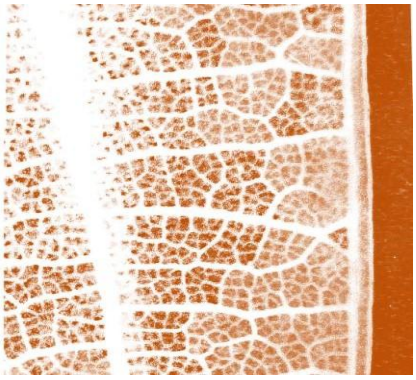
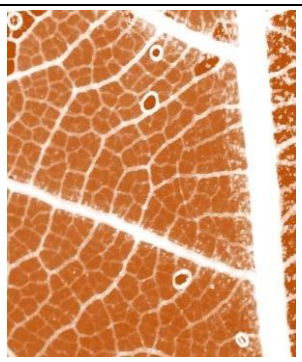
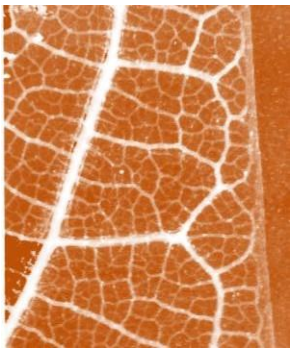
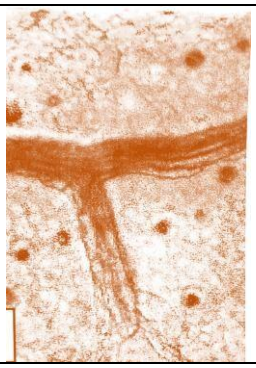
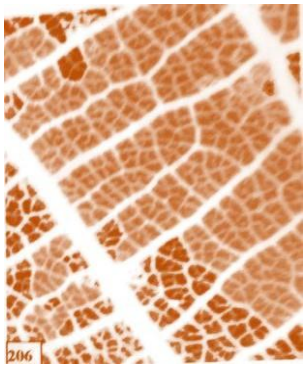
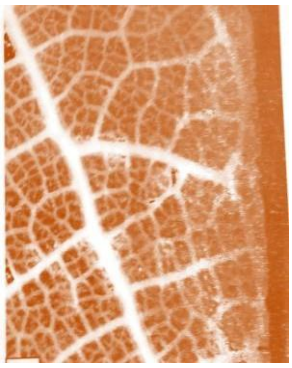
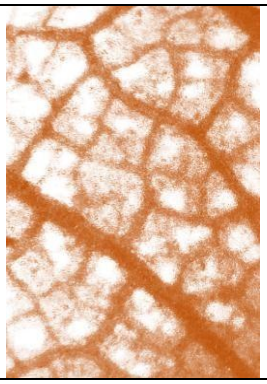
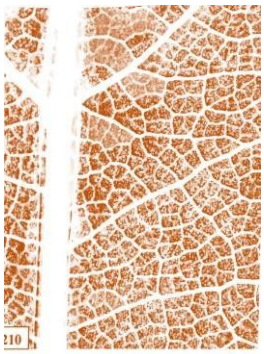
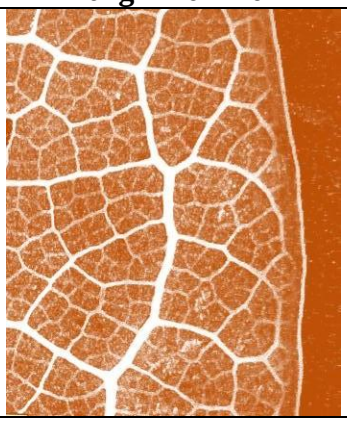
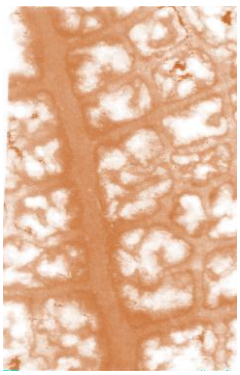
Tracheoids present---------- *P. attenuata*

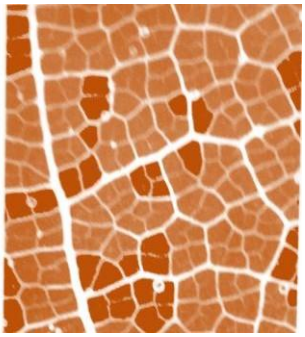
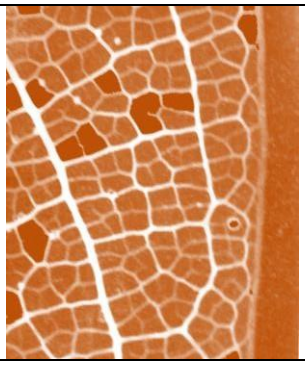
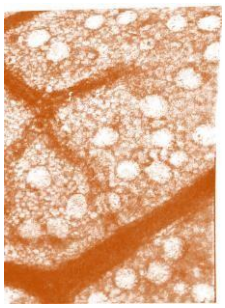
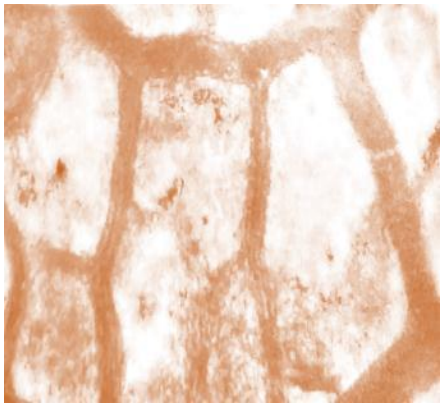
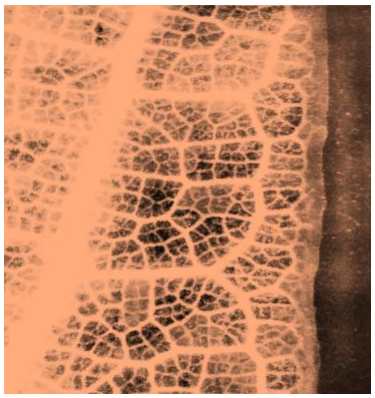
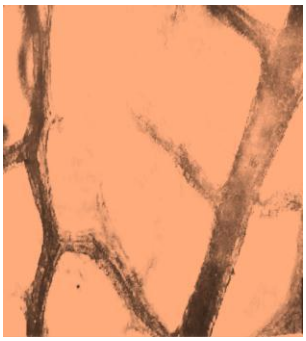
Angle of divergence of 2^{o} veins is acute narrow

Pattern tertiary veins is percurrent

Angle of origin of 3^{o} veins is RR/ RO/ OA/ OO/ AA/ AR/ OR

Tracheoids absent ---------- *P. cooperiana*

			
Phoebe angustifolia ***Entire leaf***	***Phoebe angustifolia*** **Areole 10 x 10X**	***Phoebe angustifolia*** **Margin 10 x 10X**	
			
Phoebe attenuata ***Entire leaf***	***Phoebe attenuata*** **Areole 10 x 10X**	***Phoebe attenuata*** **Margin 10 x 10X**	***Phoebe attenuata*** **Areole 10 x 40X**
			
Phoebe Cooperiana ***Entire leaf***	***Phoebe cooperiana*** **Areole 10 x 10X**	***Phoebe cooperiana*** **Margin 10 x 10X**	***Phoebe cooperiana*** **Areole 10 x 40X**
			
Phoebe goalparensis ***Entire leaf***	***Phoebe goalparensis*** **Areole 10 x 10X**	***Phoebe goalparensis*** **Margin 10 x 10X**	***Phoebe goalparensis*** **Areole 10 x 40X**

			
***Phoebe lanceolata* Entire leaf**	***Phoebe lanceolata* Areole 10 x 10X**	***Phoebe lanceolata* Margin 10 x 10X**	***Phoebe lanceolata* Areole 10 x 40X**
			
Phoebe paniculata	***Phoebe paniculata* Areole 10 x 10X**	***Phoebe paniculata* Margin 10 x 10X**	***Phoebe paniculata* Areole 10 x 40X**

DISCUSSION

Leaf architectural study is found to be useful for taxonomic purpose. Ettingshausen (1869, 1872) pioneered the leaf architectural studies. Kerner and Oliver (1895) had worked out systems of classification based on foliar venation. Later Foster (1952, 1953) published papers dealing with foliar venation. Vein islets area as criteria for classification was first applied by Levin (1929). Hall and Melville (1951, 1954) proposed veinlet termination number as a technique for testing the purity of fragments of a particular leaf type for pharmacognostic properties. System of descriptive terminology and leaf architecture have been presented by Madler and Strauss (1971), Ferguson (1971) and others. Foster (1946, 1955); Rao (1957); Barua and Dutta (1959); Nicholson (1960); Rao and Bhupal (1973) have studied the sclereids. Leaf venation has been used as a tool for identification of some species of genus *Litsaea* (Vaidya, 2014, 2015a & 2015b). Stomatal complexes in some species of *Philodendron* Schott. of family Araceae have already been studied (Vaidya et al, 2015), Pharmacognostic studies of the leaves of *Calophyllum inophyllum* Linn. have also been studied (Vaidya, 2015c) where venation in *Calophyllum* leaves has also been studied.

CONCLUSION

Anatomy is a very important tool which can be used to identify species. The species which are morphologically separated based on characters like perianth silky, pubescent, glabrous etc. are difficult to separate. The present study is a small effort to separate the six species of *Phoebe* based on the venation pattern and a key to the species has also been made.

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