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VENATION PATTERN IN EIGHT SPECIES OF *LINDERA* OF FAMILY LAURACEAE

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ABSTRACT

Lindera belongs to family Lauraceae. The family is economically important. The existing classifications of Lauraceae are based on floral androecial characters. The separation of species of *Lindera* is quite difficult based on morphological characters in the family and so the leaf venation of eight species of *Lindera* is studied and a key to venation is made so that the species can be separated based on venation pattern. Anatomy is a very important tool which can be used to other identify the species along with the morphological characters. The species studied are *Lindera assamica*, *L. bifaria*, *L. caudata*, *L. griffithi*, *L. latifolia*, *L. melastomacea*, *L. nessiana* and *L. pulcherrima.* The types of venation found is pinnate camptodromous with festooned brochidodromous secondaries, acrodromous with perfect basal secondaries and is acrodromous with perfect supra-basal secondaries. There is a variation in angle of divergence of secondary veins and pattern of tertiary veins. The highest vein order also ranges from 4^0 to 6^0. Presence or absence of tracheoids has also been studied along with the angle of origin of tertiary veins from exmedial to admedial sides is also showing a range which can be used to separate the species.

KEYWORDS: Pinnate camptodromous, acrodromous, festooned brochidodromous, basal and suprabasal.

INTRODUCTION

Lindera has about 80 species in the world. Fifteen species are found in India. The genus *Lindera* belongs to tribe II Litsaeaceae which is divided into 4 sections:Section I: Aperula: to which belong *L. assamica* and *L. latifolia* which have persistent leaves, umbels, long pedicelled with 4 bracts, involucriform, 6-12 flowers and 9 stamens. Section II: Polydenia: in which leaves are persistent, with the exception of *L. venosa*, umbels which are sessile or siubsessile with 4-8 bracts and 9-12 stamens and *L. bifaria* belongs to this section. Section III: Daphnidium: to which belong *L. caudata*, *L. pulcherrima* and *L. melastomacea* which have persistent leaves, triple nerved. Section IV: Sassafrimorpha to which *L. nessiana* and *L. griffithi* belong. They have deciduous leaves. *L. nessiana* is triple or quintriple nerved and *L. griffithi* is undetermined section species. The separation of species is quite difficult and so the leaf venation is studied and a key to venation is made so that the species can be separated based on venation pattern (Hooker, 1883; Kanjilal & Das 1939). So the study of venation will be helpful as an aid to identify the species.

MATERIAL AND METHODS

The plant material for the present work was personally collected from Shillong- Meghalaya; Kodaikanal, Kolli Hills-Tamilnadu. The duplicates of herbarium were collected from the herbarium section of B.S.I. Eastern Circle and A.R.I., Pune. The identification of fresh material was checked with the help of Standard Herbaria from B.S.I. Shillong and B.S.I. Yercaud and A.R.I. Herbarium, Pune.

1. For the study of leaf architecture, the mature leaves either fresh, dried or preserved were first cleared by keeping them in 5% sodium hydroxide solution at room temperature for 1-2 days. The decoloured leaves were washed and transferred to 5% sodium hypochlorite till they were transparent. For more clarity the leaves were washed and put into the solution of trichloroacetic acid and phenol (2:1 by weight) for a few minutes at room temperature. They were then thoroughly washed to remove acid traces and were stained with aqueous Saffranine by keeping them in it for 10-15 minutes. The leaves were then transferred to 50% Glycerine and mounted in Glycerine jelly. (Payne, 1969; Mohan Ram and Nayyar, 1968) and the standard terminology is used in anatomical studies as given by Hickey and Wolfe. 1975; Melville, 1976; Hickey, 1973, 1979; Dilcher, 1974.

The microphotographs showing different anatomical features were removed by using Nikon Camera at various magnifications as mentioned in the plates.

OBSERVATIONS

Eight species of *Lindera* are studied namely, *L. assamica, L. bifaria, L. caudata, L. griffithi, L. latifolia, L. melastomacea, L. nessiana* and *L. pulcherrima* (Photoplates I-III)

Pinnate camptodromous with festooned brochidodromous type of venation is observed in six species namely: *L. assamica, L. bifaria, L. griffithi, L. latifolia, L. nessiana* and *L. pulcherrima.* Highest vein order of the leaf is 4°, the angle of divergence of secondary veins is acute moderate, pattern of tertiary veins is percurrent, angle of origin of tertiary veins OO/AO/OA/RR/OR/RO and tracheoids present.

Highest vein order of the leaf is 5°, the angle of divergence of secondary veins is acute narrow, pattern of tertiary veins is percurrent, angle of origin of tertiary veins OO/OA/OR/AR/RR/RO/RA in *L. bifaria* and angle of origin of tertiary veins OA/OR/RR/RO/AA/OO in *L. pulcherrima* tracheoids present.

Highest vein order of the leaf is 6°, the angle of divergence of secondary veins is acute narrow, pattern of tertiary veins is random reticulate in three species *L. assamica*, *L. latifolia* and *L. nessiana.* The angle of origin of tertiary veins RA/RR/OA/RO/OR in *L. latifolia, O*R/OO/RR/RA/AR in *L. nessiana* and RR/AR/OA/OR/AO in *L. assamica* and tracheoids absent.

Two species of *Lindera* namely *L. caudata* and *L. melastomacea* show acrodromous type of venation with perfect suprabasal position, pattern of tertiary veins is random reticulate and angle of origin of tertiary veins is OO/OR/OA/RR/AR and tracheoids absent in *L. caudata. L. melastomacea* shows acrodromous type of venation with perfect basal position, pattern of tertiary veins is random reticulate and angle of origin of tertiary veins is OO/OR/OA/RR/RA and tracheoids present.

SUMMARY: Based on the pattern of venation a key to the species could be made.

KEY TO VENATION

Venation is pinnate camptodromous with festooned brochidodromous secondaries.

Angle of divergence of secondary veins is acute narrow

Pattern is of tertiary veins is random reticulate

Highest vein order 5^0

Tracheoids absent

Angle or origin exmedial to

admedial side is RR/AR/OA/OR/AO -------*Lindera assamica*

Highest vein order 6^0

Tracheoids present

Angle or origin exmedial to

admedial side is RR/AR/OA/OR/AO --- *Lindera nessiana*

Venation is pinnate camptodromous with festooned brochidodromous secondaries.

Angle of divergence of secondary veins is acute narrow

Pattern is of tertiary veins is percurrent

Highest vein order 5^0

Tracheoids absent

Angle or origin exmedial to

admedial side is OO/OA/OR/AR/RR/RO/RA ----*Lindera bifaria*

Angle or origin exmedial to

admedial side is OA/OR/RR/RO/OO----------*Lindera pulcherrima*

Highest vein order 6^0

Tracheoids present

Angle or origin exmedial to

admedial side is RA/RR/OA/RO/OR -------*Lindera latifolia*

Angle of divergence is acute moderate

Highest vein order 4^0

Tracheoids present

Angle or origin exmedial to

admedial side is OO/AO/OA/RR/OR/RO -------*Lindera griffithii*

Venation is acrodromous with perfect basal secondaries.

Angle of divergence of secondary veins is acute narrow

Pattern is of tertiary veins is random reticulate

Highest vein order 4^0

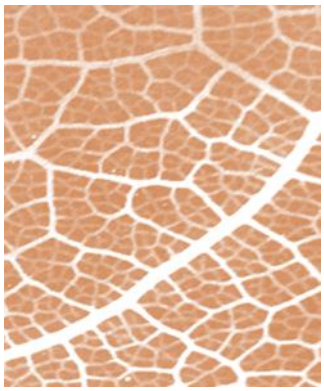
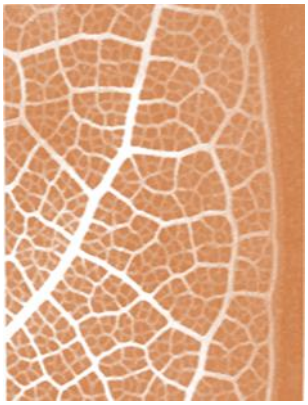
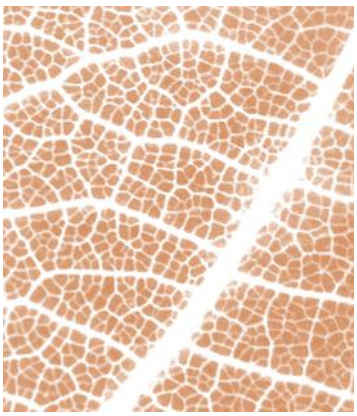
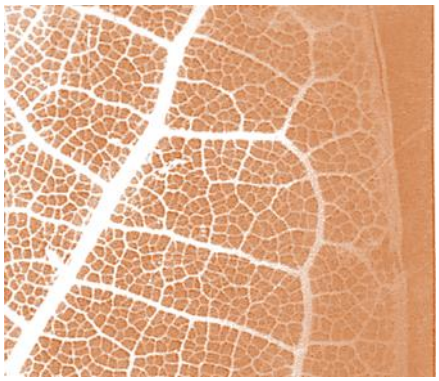
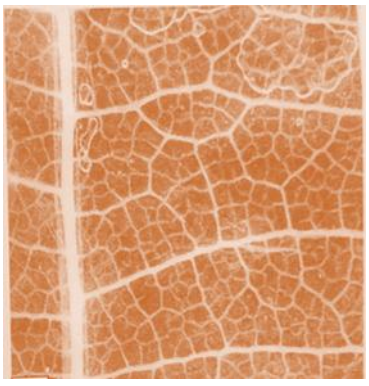
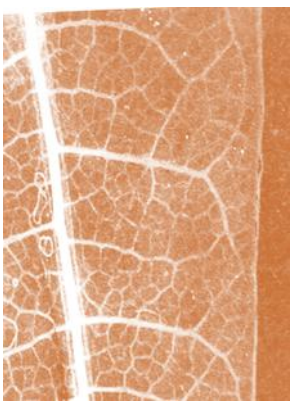
Tracheoids present

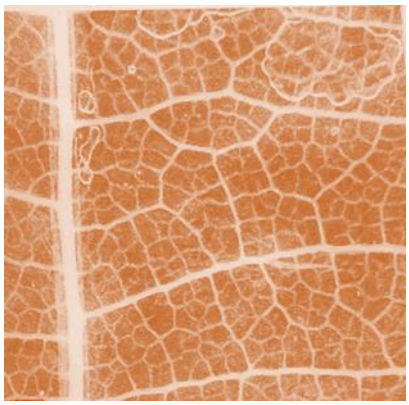
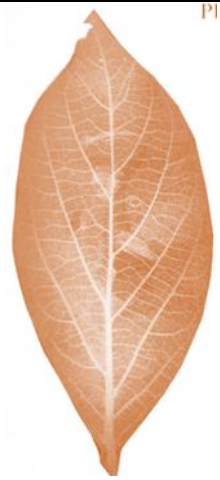
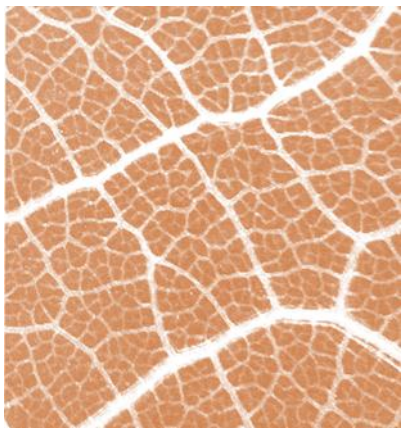
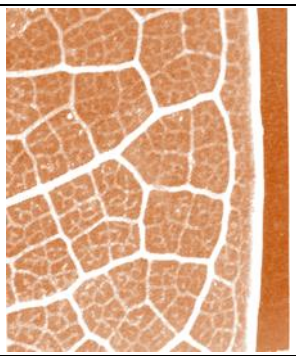
Angle or origin exmedial to
admedial side is OR/OA/RR/OO/RA -------*Lindera melastomacea*

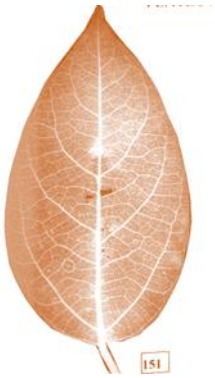
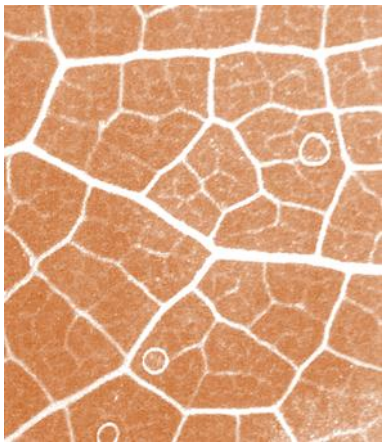
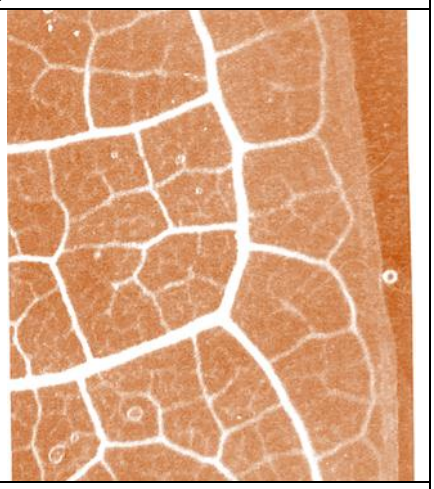
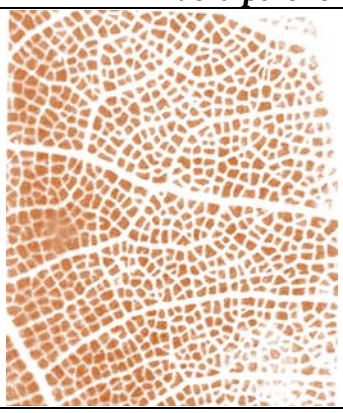
Venation is acrodromous with perfect supra-basal secondaries.
Angle of divergence of secondary veins is acute moderate
Pattern is of tertiary veins is random reticulate
Highest vein order 5^0
Tracheoids absent
Angle or origin exmedial to
admedial side is OO/OR/OA/RR/AR -------*Lindera caudata*
[R- Right angle; A- Acute angle; O- Obtuse angle]

DISCUSSION

Leaf architectural study is found to be useful for taxonomic purpose as suggested by Dilcher (1974) and Hall and Melville (1951). The veinlet termination number is used as a technique for testing the purity of fragments of a particular leaf type for pharmacognostical properties. Further contributions in use of absolute veinislet number were made by Hall and Melville (1954). Venation features of angiosperm leaves have also been added by Gupta (1961) and Meyerhoff (1952). Descriptive terminology and leaf architecture usage has been presented by Klucking (1962), Madler and Strauss (1971) and Ferguson, (1974). An outline of leaf architecture of dicot leaves is also presented earlier which has been revised and the architecture of dicotyledonous angiospermous leaves has been classified. Tracheoids can be used as a diagnostic feature in certain species of Lauraceae Mouten, (1967) & Kim and Moon Hong Kim (1984. Leaf venation patterns have been studied in *Litsaea* by Vaidya (2015) and anatomical studies in *Schleichera oleosa* too have been carried out (20) Vaidya and Guleria (2015). The venation patterns of six species of *Phoebe* and eleven species of *Cinnamomum* have been reported by Chodankar and Vaidya (2021a; 2021b).

PHOTOPLATE I		
Lindera assamica		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**
Lindera bifaria		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 45X**
Lindera caudata		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**

PHOTOPLATE II		
Lindera griffithii		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**
Lindera latifola		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**
Lindera melastomacea		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**

PHOTOPLATE III		
Lindera nessiana		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 10X**
Lindera pulcherrima		
		
Entire leaf	**Areole 10 x 10X**	**Margin 10 x 45X**

CONCLUSION

The eight species of *Lindera* are studied namely, *L. assamica, L. bifaria, L. caudata, L. griffithi, L. latifolia, L. melastomacea, L. nessiana* and *L. pulcherrima* could be separated based on venation pattern study and can be used as an aid to the identification of the eight species. Anatomy can be used to help in the correct identification of a species.

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