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Research article

COMPARATIVE WOOD ANATOMY OF ACTINODAPHNE SPECIES

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ABSTRACT: Comparative wood anatomy of *Actinodaphne angustifolia* (Blume) Nees and *A. obovata* (Nees) Bl. were investigated to study (a) the anatomical features of both species and (b) the anatomical similarities and differences between two species. The present study showed that both species were similar in some anatomical features like diffuse porous wood, scalariform perforation plate, alternate inter-vessel pits, presence of septate fibres and oil/mucilage cells. They differed from each other in some anatomical characteristics like distinction of growth rings, types of parenchyma, types of rays and distribution of oil/mucilage cells. In addition, the quantitative anatomical characteristics like fibre diameter, fibre wall thickness, vessel length, vessel diameter, ray height and ray width also exhibited statistically significant differences between two species.
Key words: Lauraceae, *Actinodaphne* species, tissue proportion, wood anatomy

INTRODUCTION

The genus *Actinodaphne* Nees of family lauraceae is comprised of 70 species of evergreen trees and shrubs. They are widely distributed in Indo Malayan region, Eastern Asia and few in North America. In India, it is represented by 15 species [1] and only two species namely *A. angustifolia* and *A. obovata* are recorded from forests of Meghalaya. Both the species are fairly common at lower elevation and are associated with *Elaeocarpus* species. They are easily identified by verticillate nature of leaves. Leaves of *A. angustifolia* are 10-18cm × 3.5-6cm in size and have tomentose branchlets while leaves of *A. obovata* are 15-30cm × 8-12cm in size and have elongated buds covered with imbricate leaves [2]. The leaves and oil obtained from seeds of *Actinodaphne* species are pharmaceutically important. The decoction of leaves of *A. angustifolia* is used in kidney trouble due to stone [3]. Seed oil obtained from *A. hookeri* is used in treatment of rheumatic pain and traditional healers used to boil *Vitex negundo* in the oil to increase its efficacy [4]. The bark of *A. obovata* is used to treat fractures [5]. Wood anatomical characters provide finger prints for accurate identification of wood and encode additional and novel ecological information [6]. The literature survey shows that gross structure of woods of *A. angustifolia*, *A. malabarica*, *A. obovata* and *A. tadulingmi* was studied by obtaining the samples from Burma and different parts of India like W. Bengal, Maharashtra, Tamil Nadu, East Kannara and Assam [1]. Prior to this, no detailed account of anatomical features of *A. angustifolia* and *A. obovata* from Meghalaya are available inspite of their local uses for cabinet work and furniture. Therefore, the main aim of present study is to investigate anatomical features in detail which may contribute to understand the similarities and dissimilarities between two species for their identification.

MATERIALS AND METHODS

The wood samples of both *A. angustifolia* and *A. obovata* were collected from two sites namely Mukhla and Nongsning in Jaintia Hills district of Meghalaya. These two sites are located at a distance of 21 km and 3.8 km from main city Jaintia. The geographical co-ordinates are $25^0$27'0" N and $92^0$12'0"E. For each species, three mature trees with straight bole and well developed crowns were selected (Table-1) and wood samples of $5cm^3$ were taken at breast height. The samples were further cut in $2cm^3$ size and fixed in FAA for 24-48hrs and were then preserved in 50% alcohol. Sections were cut in three planes namely cross section (C.S.), tangential longitudinal section (T.L.S.) and radial longitudinal section (R.L.S.) with the help of sliding microtome. Permanent slides were prepared by staining as per standard procedures. Anatomical characteristics on different sections were photographed with the help of Leica DFC camera attached to the Leitz Laborlux s research microscope.

Thin slivers of wood from radial sides of each block were taken in test tubes and treated with Franklin's solution for maceration by keeping them in oven at 60^0C for 24 hrs. Temporary slides were made by using 50% glycerol for measuring fibre length and vessel length. For each tree, a random sample of 30 fibres and 30 vessels were measured. 10 fields were selected for vessel frequency and tissue proportion while 30 counts were taken for fibre diameter, fibre wall thickness, ray height, ray width, vessel diameter. The anatomical features of *Actinodaphne* species were studied according to list of microscopic features for hardwood identification of IAWA Committee [7]. Statistical analysis was carried out SPSS 16.0 software package.

RESULTS

The wood of both *A. angustifolia* and *A. obovata* was light grey or brown in colour, moderately hard, moderately heavy, fine textured and with straight to shallowly interlocked grained. The growth rings were distinct and marked by highly thick walled fibres in *A. angustifolia* (Fig. 1A & 1B) and by marginal parenchyma bands in *A. obovata* (Fig. 2A & 2B). Both species were diffuse-porous with mostly solitary vessels or in radial multiple of 2-3, oval or circular in outline. The range of vessel element length and tangential diameter of vessel was greater in *A. obovata* while vessel frequency was more in *A. angustifolia* than *A. obovata* (Table 2 & 3). Both the species had scalariform perforation plate with 10-12 bars, intervessel pits alternate, vessel ray pits with much reduced borders to apparently simple pits (scalariform, gash-like) (Fig. 1E and Fig. 2 F-G).

Table-1: Height and diameter of trees examined.

Species	Locality	Tree Number	Height (m)	Diameter (cm)
Actinodaphane angustifolia	Mukhla	1	15	35.3
	-do-	2	15	35.0
	-do-	3	16	35.5
Actinodaphane obovata	Nongsning	1	21	35.0
	-do-	2	23	35.8
	-do-	3	20	35.6

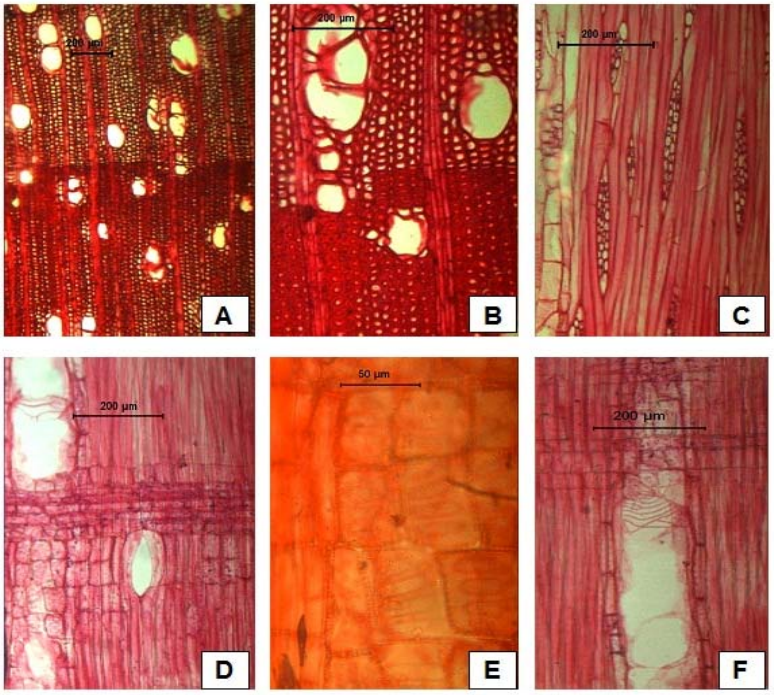


Fig. 1. *Actinodaphne angustifolia*: C. S. Wood diffuse-porous, growth rings distinct due to presence of thick walled fibres; vessel mostly solitary and in radial multiple of 2; axial parenchyma paratracheal scanty (A & B). T. L. S. Rays uniseriate, biseriate and multiseriate; oil cells present in ray and fibres; parenchyma strand 2-5 celled; intervessel pits alternate (C). R.L.S. Heterocellular ray made up of procumbent cells with marginal square cells; oil cells present in marginal square cells (D); vessel-ray pits with much reduced borders to apparently simple: pits scalariform (E); scalariform perforation plate (F).

Fibres were thin walled in *A. obovata* but thin to thick walled in *A. angustifolia.* The mean of fibre length was greater in *A. obovata* and mean fibre wall thickness was greater in *A. angustifolia* (Table 3). Septate fibres were present in both species. Oil/mucilage cells among fibres were observed in *A. obovata.* Rays were mostly biseriate and multiseriate in both species but uniseriate rays were also present in *A. obovata* (Fig. 1C & 2C). The range of ray height and ray width given in Table 3 showed that the rays of *A. obovata* were longer and wider than the *A. angustifolia.* Rays were mostly heterocellular and composed of body ray cells procumbent with marginal upright /square cells. Homocellular rays consisting of procumbent cells were also recorded in *A. obovata*. The difference in rays per mm was not much prominent in both the species. Oil/mucilage cells were observed in marginal square/upright cells of *A. angustifolia* (Fig.1D).

Paratracheal scanty parenchyma was present in *A. angustifolia* while paratracheal vasicentric and marginal bands (5-8 cells wide) of parenchyma were observed in *A. obovata* (Fig.1B and 2B). The parenchyma strands were shorter in *A. angustifolia* than *A. obovata*. (Table 2, Fig. 1C & 2C). The tissue proportion of both species depicted in Fig. 3 showed that the percentage of fibres and vessels were higher in *A. angustifolia* while percentage of rays and parenchyma were higher in *A. obovata.* There was statistically significant differences between two species in their quantitative anatomical features like fibre diameter, fibre wall thickness, vessel length, vessel diameter, ray height and ray width except fibre length (Table 3).

Table-2. Some qualitative and quantitative anatomical features of *A. angustifolia* and *A. obovata*.

S.No.	Anatomical feature	*A. angustifolia*	*A. obovata*
1	Vessel frequency (per mm^2)	11 – 14 Vessels	3 – 6 Vessels
2	Presence of oil/mucilage cells	Present in marginal upright/square cells	Among fibres
3	Rays per mm.	6 – 9 Rays	7 – 9 Rays
4	Ray composition	Heterocellular	Both heterocellular and homocellular
5	Parenchyma type	Paratracheal scanty	Paratracheal vasicentric and marginal band
6	Number of cells per parenchyma strand	2- 5 Cells	3 – 6 Cells
7	Crystals	Absent	Present in parenchyma

Table-3. Some quantitative wood anatomical features of *Actinodaphne angustifolia* and *Actinodaphne obovata* with t-values.

Wood Features	*A. angustifolia* (µm)	*A. obovata* (µm)	t-value	P value
Fibre length	1210.3-1657.5 (1457.6±23.5)	1183.9-1815.4 (1482.1±32.7)	0.678^{ns}	0.503
Fibre diameter	26.0-36.4 (30.1±0.71)	15.6-31.2 (28.6±0.84)	4.958^{**}	0.000
Fibre wall thickness	3.9-9.1 (5.98±1.40)	2.6-6.5 (4.5±0.19)	3.340^{**}	0.002
Vessel length	394.6-894.5 (674.6±25.32)	789.3-1289.2 (1055.9±31.3)	-10.104^{**}	0.000
Vessel diameter	62.52-125.04 (101.3±17.15)	72.94-145.80 (105.45±18.86)	-2.425^{*}	0.023
Ray height	281.34-625.2 (380.1±18)	468.9-1094.1 (805.6±38.5)	-9.161^{**}	0.000
Ray width	20.84-52.1 (31.3±2.1)	62.52-125 (85.8±3.5)	-15.501^{**}	0.000

Values in parenthesis indicate mean value ± standard deviation
* = Significant at P≤0.05 level
** = Significant at P≤0.01 level

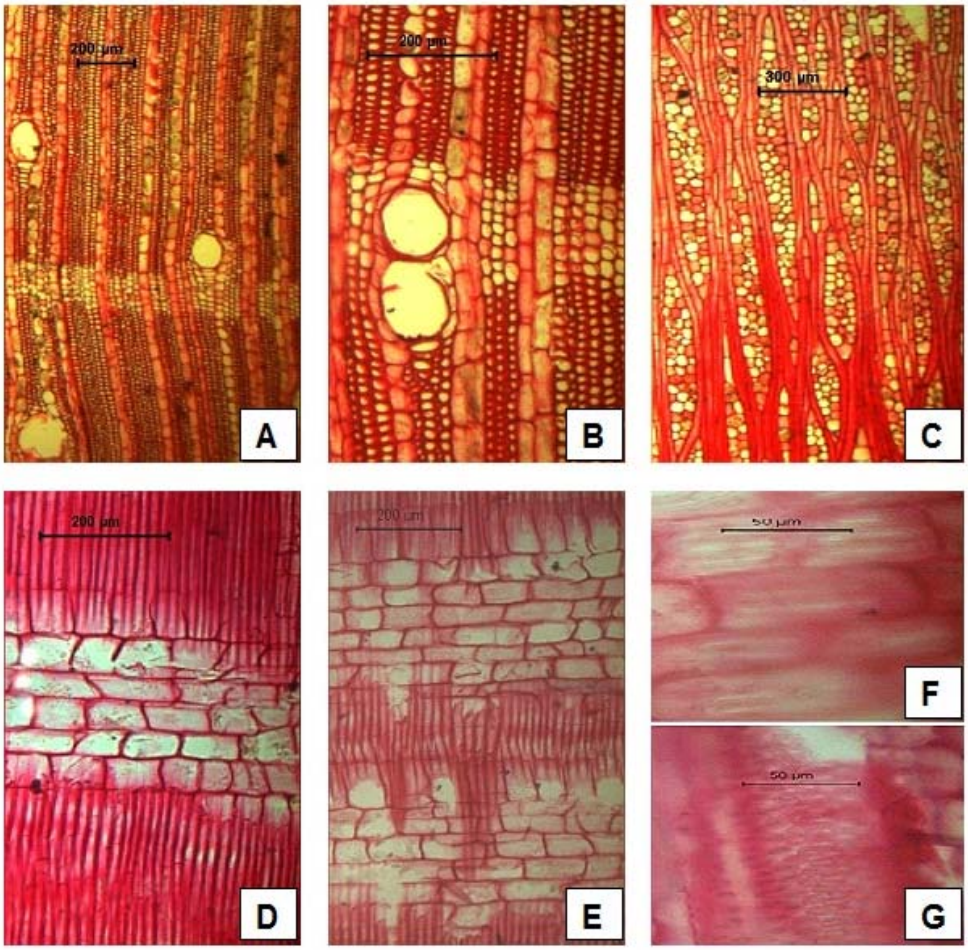
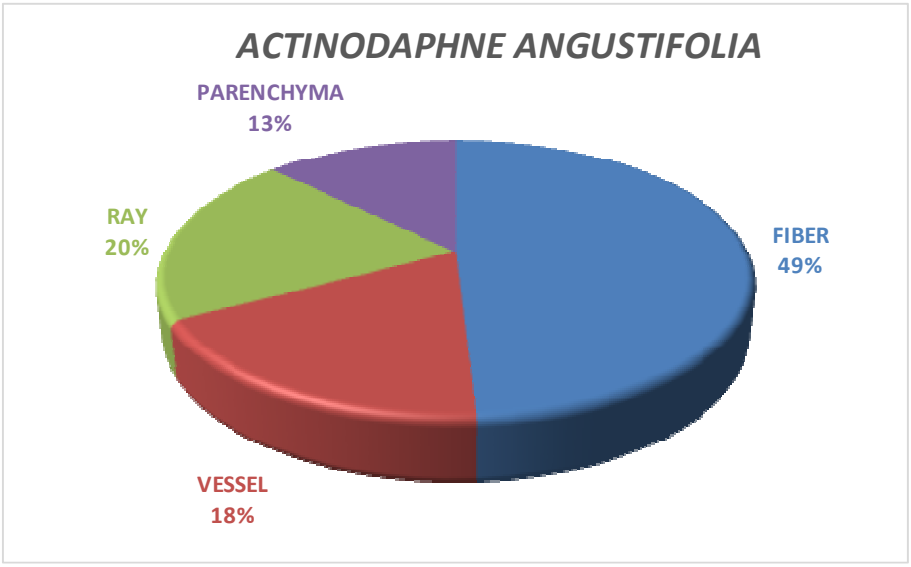


Fig. 2. ***Actinodaphne obovata:*** **C.S. Wood diffuse-porous; growth rings distinct due to presence of marginal parenchyma bands; vessels mostly solitary and in radial multiple of 2; axial parenchyma vasicentric and marginal banded parenchyma (A and B). T. L. S. Rays biseriate and multiseriate; parenchyma strand 3-6 celled (C). R. L. S. Heterocellular ray made up of procumbent cells with marginal square cells (D and E); vessel-ray pits with much reduced borders to apparently simple: pits scalariform (F); intervessel pits alternate (G).**



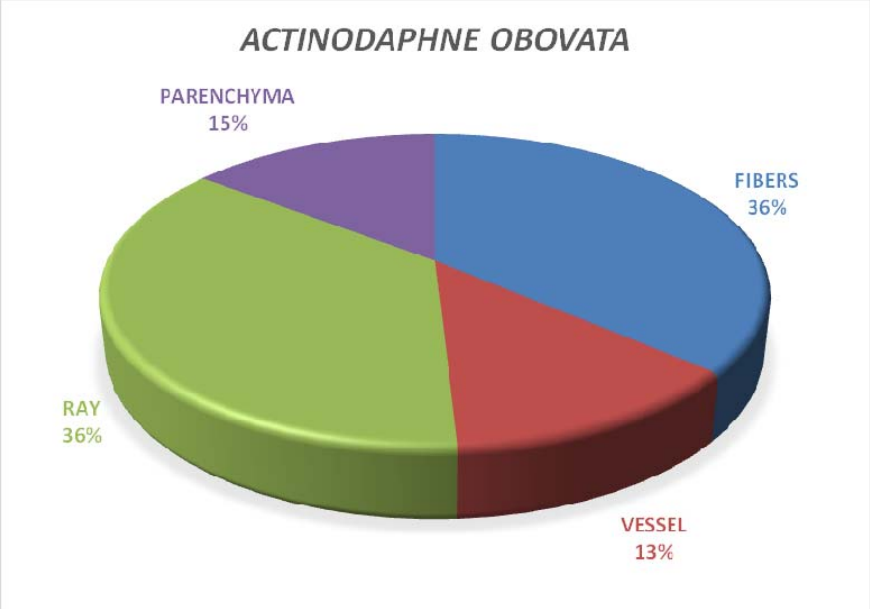


Fig. 3. Tissue proportion of *A. angustifolia* and *A. obovata*.

DISCUSSION

The literature reveals that the quantitative features like vessel frequency, tangential diameter of vessels, ray composition, ray height, ray width and tissue proportion of these species are not investigated. However, [1] listed out some anatomical characteristics of these species and reported absence of septate fibres and presence of oil cells in parenchyma of *A. obovata*. The present results are contrary to his findings for these features. These anatomical differences may be due to site conditions, age of trees or due to use of branch wood in place of stem wood in his studies. The acicular crystals and crystals sand were reported in rays of *Actinodaphne* species [8]. These features are found absent in the selected species but rhomboidal crystals are observed in parenchyma of *A. obovata* occasionally. The present investigation reveals that both species are similar in some anatomical features like diffuse porous wood, scalariform perforation plate, intervessel pits, presence of septate fibres and oil/mucilage cells. These features indicate close affinity between two species and can be used for identification of genus *Actinodaphne*. On the other hand, both species differ from each other in wood characteristics like vessel frequency, types of parenchyma present, ray height, ray width and occurrence of oil/mucilage cells in different tissues. Hence, all these features can be considered as species specific.

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