



Wood Anatomical Study of *Osyris quadripartita* Salz.ex Decne (African Sandalwood) from the Northern Western Ghats, India

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The family Santalaceae is medicinally important. *Osyris quadripartita* Salz.ex Decne has been used for the medicinal use such as anthelmintic, leishmaniasis like leprosy diseases, abnormalities, kidney disease, forage, hygienic/perfuming, eye pain, cold, anaphylactic shock, epilepsy, circumcision wound, toothache, tonsillitis, abdominal pain, urine problem, breast cancer, mental problems and anti-coronavirus disease, etc. It has also been reported for its activities such as anti-ulcer activity, antiviral activity. *Santalum album* and *O. quadripartita* belong to the same family santalaceae and have many similarities in their morphological characteristics. Both plant species belong to the same family, that's why anatomical character help to resolve this problem and easy to distinguish most wood anatomical characteristics. Therefore, distinguishing one from the other anatomically is very easy.

A study has been carried out to authenticate the identity of this specie based on anatomical characters. The anatomical sections of stem (Transverse Section (TS), Transvers Longitudinal Section (TLS) and Radial Longitudinal Section (RLS) of the species were observed under the bright-field compound binocular microscope, and characters were documented. The aim of the study is to elucidate the means and criteria to identify the anatomical structure of *O. quadripartita*. Though the diagrammatic outline of the stem sections is similar, detailed anatomical characters are significantly different. The characters such as the arrangement of cortical tissues, pericyclic fibres, phloem fibers, and phloem rays are useful in differentiating the stem and petiole of the species. Wood anatomical characteristics of *O. quadripartita* were seriation of rays, type of crystalliferous

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cells, and abundance of extractives. Ray cells frequently contain rhomboidal crystals. In cortex, and pith region of the stem observed solitary crystals. Based on the preliminary study, the species can be differentiated from other species of the same family based only on anatomical characters.

Keywords: *Osyris quadripartite*; authentication; anatomy; vegetative parts.

1. INTRODUCTION

The Santalaceae family covered three types of habitat like herbs, shrubs, and rare trees. The family Santalaceae is medicinally important. The family widely distributed about 44 genera and 930 species [1]. In the *Osyris* genus, six or seven species were distributed in Asia, Africa, Europe, and China [2]. *Osyris* genus is the evergreen roothemiparasites, ethnomedicinal shrub plants. Many tribal peoples used this plant leaves for making a herbal tea [3,4,5,6]. The taxonomical characteristic of *Osyrisqua dripartita* Salzmann ex Decaisne, *Ann. Sci. Nat., Bot., sér. 2, 6: 65. 1836.* *O. quadripartita* species are shrub or small tree up to 5- 7 m tall. Leaves are subsessile, rigid, elliptic to elliptic-oblong, 1–7 x 0.5–4 cm, acute or mucronate at the apex, with slightly thickened margins. Flowers yellowish-green; perianth-lobes triangular-ovate, 1–1.5 mm long. Male flowers in 5–13-flowered cymes. Female flowers in 1–3-flowered cymes. Fruit is drupes 5–10 mm in diam., Fruit intially green in colour then becoming ripen bright red colour [7].

The only two main species used to produce commercial sandalwood oil are *Santalum album* (Indian sandalwood) and *S. spicatum* (Australian sandalwood). In domestic as well as international market true sandalwood oil is very costly. Wrongly or intentionally some peoples sell adulterated low quality cheaper substitutes, the 'African sandalwood' (*O. quadripartita*) [8-11]. The heartwood of this plant not as strongly fragrant as sandalwood so, this plant is used as adulterating sandalwood in the market [12,13]. *O. lanceolata* is a timber like true sandalwood and it contains oil components. This oil is used to make a scent [14]. *O. quadripartita* coming under least concern IUCN category [15]. In Ethiopia, this plant leaves and root use as medicinal purpose to cure antihelmintic and leishmaniasis [16]. Its used for curing skin infection [17]. Its use as medicinal purpose to cure eye pain, anaphylactic shock and epilepsy [18]. Disease treated as abdominal pain, kidney disease and urine problem [19,20]. Its use as medicinal purpose to cure eye pain [21]. Disease treated as tonsillitis [22]. Leaf and stem used as circumcission, wound, toothache [23]. Decocted dried leaves are used for the treatment of breast cancer [24].

Anthrax and pasturolosis disease treated with the help of *O. quadripartita* plant root [25]. *O. quadripartita* bark gave to orally for the treatment of jaundice [26]. *O. quadripartita* fruits are consumed as wild edible fruit in the Western Ghats, Tamil Nadu regions, and Delanta region of northern Ethiopia [27,28,29].

Wood anatomical characteristics of *O. quadripartita* were observed different characters such as seriation of rays, type of crystalliferous cells, and abundance of extractives. Ray cells frequently contain rhomboidal crystals [30-32]. In cortex, and pith region of the stem observed solitary crystals. Based on the preliminary study, the species can be differentiated from other species of the same family based only on anatomical characters.

Table 1. Classification of *Osyris quadripartite*

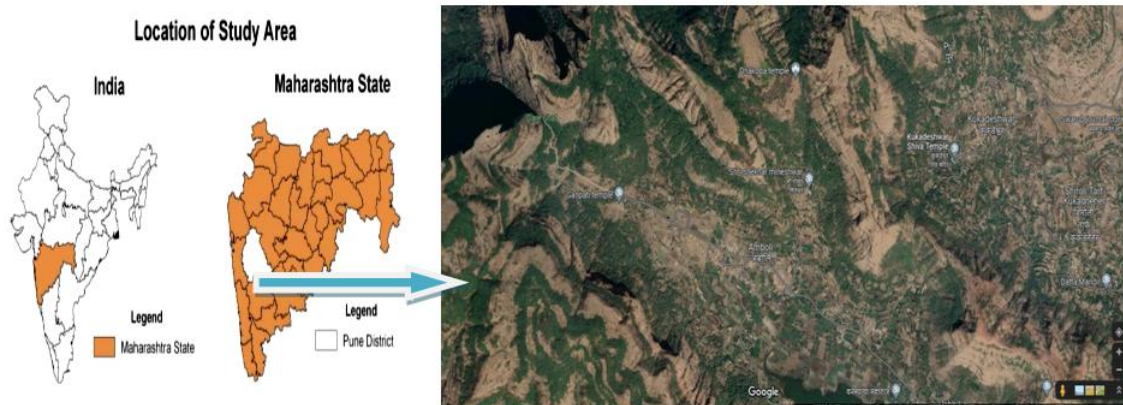
Kingdom	Plantae
Class	Magnoliopsida
Order	Santalales
Family	Santalaceae
Genus	<i>Osyris</i>
Species	<i>O. quadripartita</i> Salzmann ex Decaisne
Common names	Pulluruvi, Popali, Dalmia, Paral and wild tea plant

[33]

2. MATERIALS AND METHODS

Study area and collection: Stem of *O. quadripartita* were collected from Pune, district during 2020-2021 of Maharashtra, India. The plant was identified using Flora of Maharashtra & Flora of China and authenticated by myself and deposited in BSI 829420.

Anatomical study of stem: Make a thin sliced from fresh mature stem samples for anatomical study (8 mm to 10 mm) from plant species. Prepare hand sections stained were stain using 0.1% Safranin and (98 % grade Alka Trading Corporation, Nagpur) mount in glycerin (98% LOBA CHEM PVT LTD) and examined under bright-field compound microscope [34,35]. Measure a morphometric observations of length, diameter, bredth and number of layers (μm) [36] (Salisbury's, 1927).



Map 1. Study area from junnar tehasil (Table 3)

3. RESULTS AND DISCUSSION

During the study of *Osyris* species we observed many of anatomical variation TS of stem (Cork layer, Cortex cell layer, Pericyclic fiber cell number, Phloem cell layer, Phloem medullary layer, Xylem medullary layer, Xylem vessels) of the species were observed under the bright-field light compound microscope and their characters were documented [37,35]. This species produces a annual ring and observed a secondary growth. These plant shows annual rings because of well developed secondary growth. In stem woody anatomy observed a broad range arrangement of vessels and fibers produces a porous wood [37]. Xylem is a complex tissue system composed of different cell types. The vessel elements adjoining to each other, at their end possess a perforations, whereas tracheids elements lack these perforations. Tracheids elements are elongated, lignified, thick walled and pointed at both end. The perforations several openings which are scalariform perforation plate (Fig. 2). Xylem vessels showing a simple pitted in their lateral walls. To observe xylem structure, mature stem are sectioned transversely (transverse section: TS) and longitudinal planes: along the rays (radial longitudinal section: RLS and tangential longitudinal section: TLS). Rays are termed one cell wide tangentially called uniseriate and more than one cell wide called multiseriate observed in both species, viewed in TS and TLS. The vascular cambium produces from secondary xylem and phloem of stem. Prismatic calcium oxalate crystals observed in *O. quadripartita* in the pith region of stem [36,35] (Rudall, 2007). Starch grains is one of the non-nitrogenous stored form observed in studied plant species. Tapioca starch grain type observed in both plant species [38,39]. Wood

anatomical characteristics of *O. quadripartita* were seriation of rays, type of crystalliferous cells and abundance of extractives. Ray cells frequently contain rhomboidal crystals. In Cortex and pith region of stem observed solitary crystals (Fig. 2 b, e) [40,41,36]. The sclerenchyma found in the pericyclic region of stem. The stone cells are observed in both species. Stone cells important function is thickening and lignification of the walls of thin-walled parenchyma cells. Stone cell providing a strengthening and toughness of parenchyma cells. Sclerenchyma cells are classified into two categories fibers and sclereids [36] (Rao, 1957).

Anatomical study of stem: Transverse Section (T.S.) of stem of *O. quadripartita* (Fig. 2) (Tables 4,5 and 6).

Corck: Superficial and strongly thickened cork layer observed in the species. It was 14-16 cork layer.

Cortex: The cortex cells arranged in compact form. The total cortex layer is 10-18 (Fig.2a).

Pericyclic fiber: Pericycle is a part of ground tissue. Ground tissue are primary function is mechanical support. Pericyclic fiber are sclerenchyma in nature. Pericyclic fiber were observed in this species. It was observed in each clump number of cells are 02-06.

Vascular tissues:

Phloem: The phloem stratified in to soft and hard portions. In which hard portions is nothing but primary phloem fibers, or protophloem fibers and secondary phloem fibers. Phloem observed in this species 10-15 layered. Phloem medullary

rays observed in this species there are 2-4 layered. Various cluster of crystalline structures deposition were present in pith cells.

Xylem: The arc type vascular bundles observed. Diffuse porous wood observed because of tracheary elements presents (trachides and vessels). Medullary rays broader and expanded at the distal end. Vessels are arranged in vertical rows. Vessels varying in size 144.31 μm . Medullary rays mostly are 1-2. Well developed xylem fibers were arranged in vertical rows and in group. Fiber both end are pointed. Diffuse, aliform and confluent of parenchymatous cell observed in both species.

Pith: Pith are un lignified, large pitted parenchymatous cell with thin walled. pith region of stem observed solitary crystals.



Fig. 1. *Osyris quadripartita* from Northern Western Ghats of Maharashtra

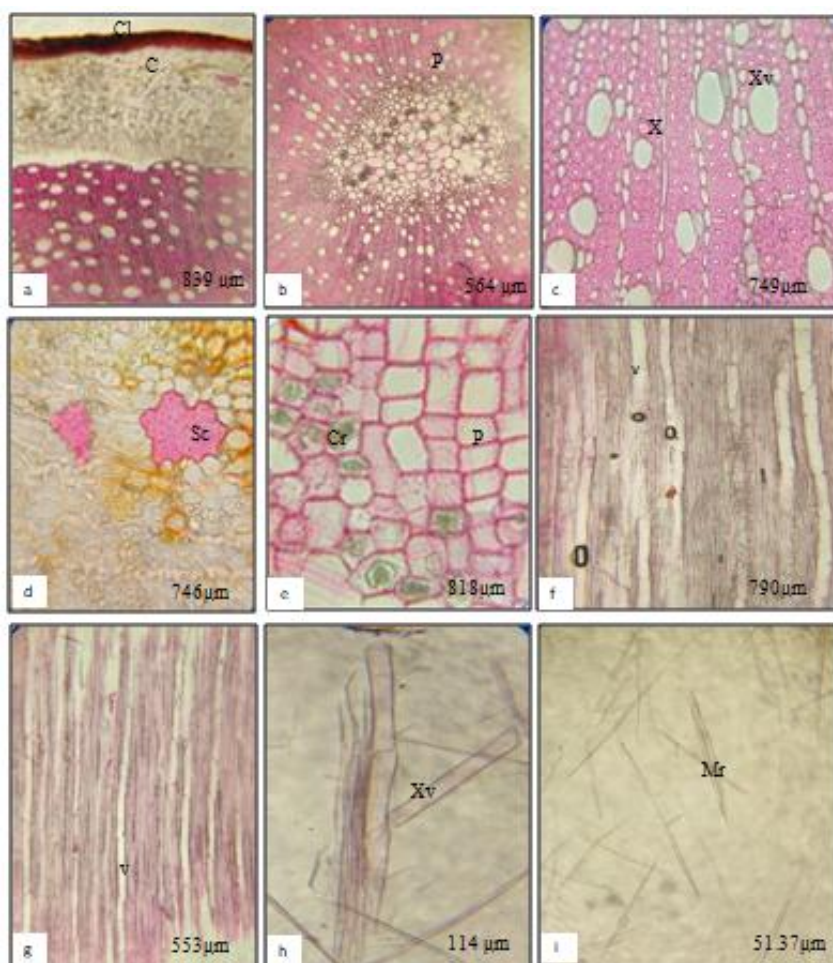


Fig. 2. (a-i) Stem anatomy of *O. quadripartita* (μm)

Cl= Cork layer, C=Cortex layer, E = epidermis, P = pith, Ph = phloem, X = xylem, Xylem vessels (40x), Mr= Medullary rays length (40 X), Xm= Xylem medullary layer, Pm= Phloem medullary layer, V= vessels, Sc= Sclerides, Cr= Crystalliferous cells

Table 2. Morphology of *Osyris quadripartite*

Characteristics	
Hight	2-5 m tall
Bark	Brown in colour
Leaves	Simple
Flower	Yellow in colour
Inflorescence	Cymes axillary
Fruit	Drupe orange to redwhen ripe
Occurrence	Bhutan, Cambodia, India, Laos, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam; Africa, S Europe
Altitude from sea level	600-2700 m

[33,7]

Table 3. *Osyris quadripartita* studied from northern Western Ghats of Maharashtra

Taxon	Place of Collection	Geographic coordinates	Elevation (m)
<i>Osyris quadripartita</i>	19°14'22.2"N	Amboli, Junnar, Maharashtra	1088
	73°41'35.4"E	410502	
	19°13'14.3"N	Keldare, Junnar, Maharashtra	325
	73°43'37.0"E	410502	
	19°13'56.2"N	Uchhil, Junnar, Maharashtra 410502	277
	73°42'42.7"E		
	19°30'42.9"N	Ratangad, Maharashtra 421601	1126
	73°41'42.8"E		

Table 4. Stem anatomical characteristics of *Osyris quadripartite*

Characters	<i>O. quadripartita</i>
Cork layer	14- 16
Cortex layer	10 - 18
Pericyclic fiber cell number	02-06
Phloem cell layer	10-15
Phloem medullary layer	2-4
Xylem medullary layer	1 - 2
Xylem vessels	simple and perforation
Pith cell	Parenchyma cell- rosette solitary crystals present

Table 5. T.S stem anatomical characteristics of *Osyris quadripartite*

Characters	<i>O. quadripartita</i>
Cork layer lengthh 10 X	53.033±9.95
Pericyclic fiber cell diameter (cell number in each pach 18-25) 10 X	35.32±14.81
Vessele diameter 40 X	114.07±22.19
Medullary rays length 40 X	51.37±16.32
Pith cell diameter 40 X	56.66±16.98

*Each value expressed as mean± S.D of 10 replicate

Table 6. T.L.Sstem anatomical characteristics of *Osyris quadripartite*

Characters	<i>O. quadripartita</i>
Vessele Length 10 X	144.31 ±31.36
Bredth10 X	25.98±3.42
Medullary rays length(Medullary rays cell layer number 2-4) 10 X	406.29±99.56
Bredth10 X	13.40±1.31

*Each value expressed as mean± S.D of 10 replicates

4. CONCLUSION

The study undertaken to preliminary stem anatomical study of *O. quadripartita* showed the significant woods anatomy reliably on the basis of anatomical structure.

Microscopically preliminary observation reported ray cells contain rhomboidal crystals are the unique diagnostic characters reported in *O. quadripartita*. In Cortex and pith region of stem observed solitary crystals. On the basis of preliminary study the species can be differentiated from other species of same family based only on anatomical characters.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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