

Pharmacognostic evaluation of *Pterocarpus santalinus* Linn.

Durgavati Yadav¹, Shivani Srivastava¹, Jasmeet Singh², Yamini Bhusan Tripathi^{1*}

¹Department of Medicinal chemistry, Institute of Medical Sciences, BHU, Varanasi

²Department of Dravyaguna, IMS, BHU, Varanasi

Abstract:

Pterocarpus santalinus Linn. (family Fabaceae) also known as Red sanders is endemic to India. It is considered as one of the endangered species and its illegal harvest is being a key threat. It has been known for its characteristic timber quality with exquisite color and beauty. The red wood of this plant yield a natural dye called santalin, which is used as coloring pharmaceutical preparations and foodstuffs. The decoction obtained from heartwood posses various medicinal properties, used in traditional medicine. It has cooling effect hence used in treating eye diseases, ulcers, mental aberrations and in inducing vomiting. Its heartwood also posses anti-inflammatory, anti-helminthic, anti-pyretic, properties; also used as tonic. It is also used in case of hemorrhage, dysentery, aphrodisiac and diphroretic activities. Ethanolic extract of stem bark posses anti-hyperglycemic activity. Wood in combination with other drugs is prescribed for scorpion stings and snake bites. Phytochemical screening of aqueous and ethanolic extracts of stem bark shows the presence of alkaloids, phenols, glycosides, sterols, tannins, flavonoids, triterpenoids, saponins alongwith isoflavone glucosides and two anti-tumor lignans; Savinin & calocedrin. However, this species has been remained unexplored pharmacologically found activities. The present paper reviewed botanical uses, phytochemistry and pharcology of *Pterocarpus santalinus* Linn.

Key words: Pharmaceutical preparations, *Pterocarpus santalinus*, Traditional medicine.

INTRODUCTION

Pterocarpus santalinus, with the common names **red sanders**, **red sandalwood**, and **saunder swood**, is a species of *Pterocarpus* endemic to the southern Eastern Ghats mountain range of South India ^[1]. It is highly valued for its rich red color wood; wood is not aromatic. This tree is not to be confused with sandalwood tree which is natively grown in South India. Due to its slow growth and rarity, *Pterocarpus santalinus* is listed as an Endangered species by the IUCN, because of overexploitation for its timber in South India ^[2] It is also listed in the appendix II of the CITES, which means that a certificate is required in order to export it, that should only be granted if survival of the species is not dependant on the detrimental trade.

VERNACULAR NAMES

Bengali: Raktachandan

Gujarati: Ratanjali

Hindi: Lalchandan, Ragat Chandan,

Kannada: Agslue, Honne

Malayalam: Patrangam, Tilaparni

Marathi: Tambada Chandana or Raktachandan

Tamil: Atti, Chensandanam, Semmaram, Sivaffu Chandanam

Telugu: Agaru gandhamu, Errachandanam, Raktachandanam, Rakta ghandhamu ^[3]

HABITAT

Red sandalwood grown on the shale sub-soils, semi-arid climatic at altitudes around 750 metres (2,460 ft), in Talakona forest, in Chittoor District of Andhra Pradesh.

DESCRIPTION

Pterocarpus santalinus is a small tree, growing upto 8 meters (26 feet) tall with a trunk diameter of 50-150cm. It is fast growing when young, reaching 5 meters (16 feet) tall in three years even on degraded soils. It is frost tolerant, leaves are alternate, 3-9 cm long, trifoliate with three leaflets. The flowers are produced in short racemose; fruit is pod as Fabaceae family characteristic with 6-9 cm long containing one or two seeds.

Medicinal plants are plants containing inherent active ingredients used to cure disease or relieve pain ^[4]. In most of the developing countries, use of traditional medicines and medicinal plants as therapeutic agents has been reported. The World Health Organization estimated that 80% of the populations of developing countries rely on traditional medicines, mostly plant drugs, for their primary health care needs ^[5,6]. Medicinal plants are an important element of the indigenous medical systems, about 35% of the population, even now, depends on traditional systems of medical care ^[7,8]. The Ayurvedic practitioners appeared to have developed a system whereby they select and continue to use plants that they find the most effective for health care purposes. Ayurvedic physicians and traditional practitioners of medicines have an interwoven relationship between the communities and such practitioners. In the rural areas, people collect their requirements of medicinal plants from the forests. While communities practiced sustainable concepts with minimal damage to habitats of these precious plants ^[9]. Nearly 80 medicinal plant species are now considered threatened. *Pterocarpus santalinus* is among the threatened species due to over exploitation without commensurate replacement of natural stands ^[10]. The species is endemic to India and considered globally endangered with illegal harvest being a key threat. Now its demand is increasing, commercial application is yet to be started due to lack of reliable information on various aspects of the plant.

Materials and methods:

Physiochemical parameters of the dried drug were performed.

1. Determination of Moisture Content:

2 g of each sample were placed in pre-weighed flat porcelain dish; dry in the oven at $100^{\circ}\text{C} \pm 5^{\circ}\text{C}$ till the constant weight was obtained. The loss of weight was calculated with reference to air dried material.

2. Determination of Total Ash Content:

2 gram of dried powder was placed in crucible silica and ignited gradually upto $500=600^{\circ}\text{C}$ until it was white (absence of carbon). It was allowed to cool and weighed to determine the percentage of ash with reference to air dried samples.

3. Determination of Acid Insoluble Ash Content:

The ash was boiled with diluted HCl for five minutes and insoluble matter was collected in glass crucible. Then it was washed, ignited and cooled. Finally weighed to calculate the percentage of acid insoluble as with reference to th bone dried material.

4. Determination of Water Soluble Ash Content:

Total ash was boiled with water for 5 minutes and insoluble ash was collected in a sintered glass crucible washed ignited at a temperature not exceeding 450°C . Cool and weighed, it was determined for water soluble ash with reference to the bone dried drug.

5. Determination of Solvent Extractive Values:

5g of the air dried, powdered macerated with 100 ml of solvent for 24 hours, shaken frequently and allowed to stand for 24 hours. Filtrate was evaporated and weighed. The percentage of solvent soluble extractive with reference to bone dried sample has to be calculated.

HPTLC:

3g of powder of *Pterocarpus santalinus* was extracted with 10 ml ethanol (90%) by soaking for 24 hours and heating up to boiling before filtration. 4 and 8 μl of the filtrate was applied on a pre-coated silica gel F₂₅₄ on aluminum plates using CAMAG Linomat 5 TLC applicator. The plate was developed in Toluene: Chloroform: Methanol (8: 1: 1)* in CAMAG twin-trough developing chamber. The developed plates were visualized and scanned at UV 254 nm, 366 nm and under white light at 540 nm in CAMAG Photo-documentation chamber. Developed plate was then sprayed with Anisaldehyde- Sulphuric acid reagent followed by heating at 105°C till the spots appeared and scanned again under white light at 620 nm.

RESULTS:

Table No 1: Preliminary Phytochemical Screening of aquous extracts of *Pterocarpus santalinus* L.

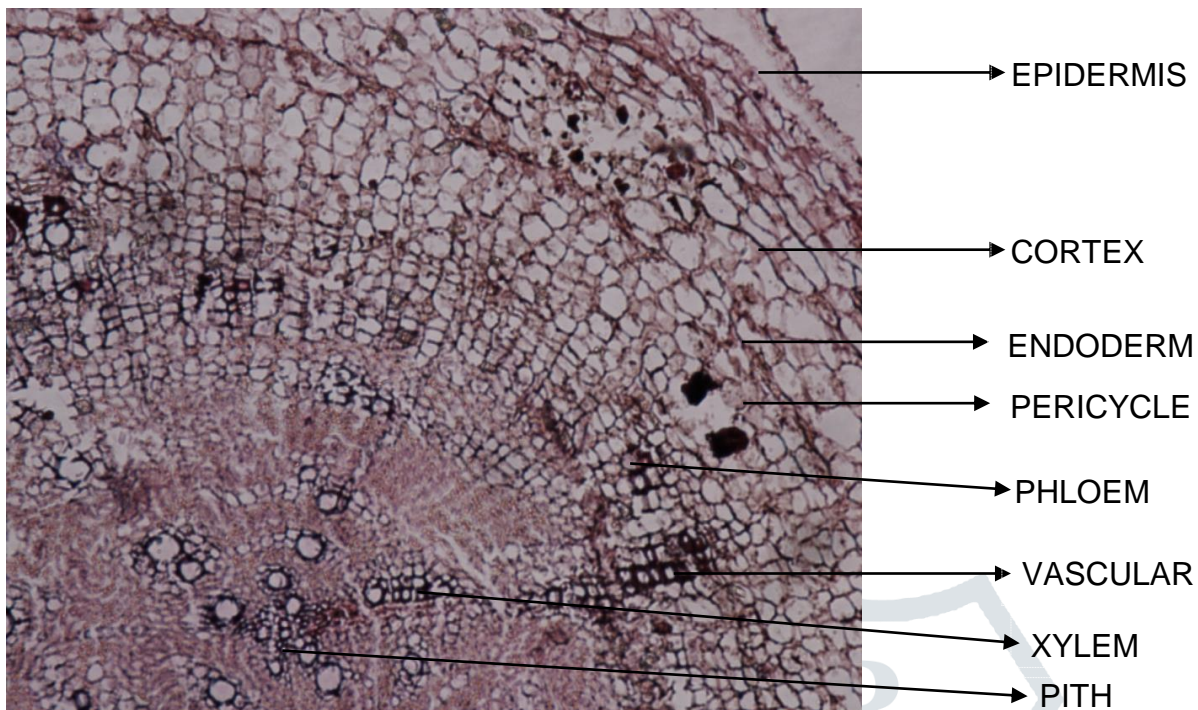
S.N	Constituent	Procedure	Observation	Result
1	Alkaloid	1ml Alcohol extract+1.5% HCl (4drops)+Wagner solution	A yellow color ppt is formed.	Absent

2	Flavonoid	0.5ml alcohol extract +5 to 10 drops HCl + Mg	Pink radish color is Formed.	Absent
3	Resin	1ml extract+2ml Acetone	Turbidity is formed.	Absent
4	Saponin	5ml aqueous solution + NaHO ₃ (1 drops)	Honey comb like is Formed.	Present
5	Tannin	2ml extract + 5% FeCl ₃ (3drops)	Brown color is Obtained.	Present
6	Carbohydrate	2ml aqueous +1ml FeCl ₃	Red or brick red precipitate is formed.	Absent
7	Protein	2ml aqueous extract+10% w/v NaOH (5drops) + 3% CuSO ₄	A red or violet colour is obtained.	Absent
8	Glycosides	2.0 ml of CH ₃ COOH and 2 ml of CHCl ₃ + aqueous plant crude extract, mixture cooled added H ₂ SO ₄	Green color showed its presence	Present
9	Terpenoids	2.0 ml of CHCl ₃ +5 ml aqueous plant extract, evaporated on the water path, then boiled with 3 ml of H ₂ SO ₄	Grey color is formed	Present
10	Steroids	2 ml of CHCl ₃ +H ₂ SO ₄ +5 ml aqueous plant crude extract.	Red color appeared in lower level of CHCl ₃	Present

a) Macroscopic

Lumber pieces with the wavy grain margin are graded as "A" grade. Red sandalwood with wavy grain margins sells at higher prices than the standard wood.

b) Microscopic



TRANSVERSE SECTION OF STEM

Table-2, IDENTITY, PURITY AND STRENGTH

Physiochemical parameters of Raktachandan ^[11]

S.No	Parameters	Results
1	Loss on drying	3.85 ± 0.12
2	Ph	6.5 ± 0.46
3	Ash value	0.83 ± 0.10
4	Moisture content	0.06 ± 0.01
5	Water extract value	53.04 ± 0.29
6	Alcohol extract value	32.02 ± 0.27
7	Water soluble ash	3.97 ± 0.22
8	Acid soluble ash	1.51±0.42

Table-3, CHEMICAL TESTS

Steroids	-	+ve
Terpenoids	-	+ve
Alkaloids	-	+ve
Glycosides	-	+ve
Saponins	-	+ve
Tannins	-	+ve
Flavonoids	-	+ve
Carbohydrate	-	+ve

HPTLC STUDY**HPTLC**

The R_f , colour of the spots and densitometric scan were recorded using CAMAG Scanner with the help of winCATS software. *Reference: Quality Standards of Indian Medicinal Plants. Vol 6, Indian Council of Medical Research, New Delhi; 2008: p. 219-222.

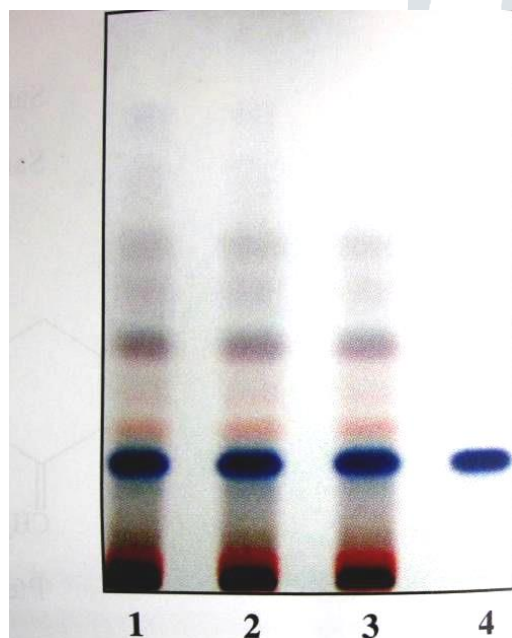


Plate 24.5 TLC profile of methanolic extract of *Pterocarpus santalinus* heartwood.
1-3: Test solution; 4: Pterocarpol standard.

HPTLC photo documentation, R_f values and densitometric scan of the test sample were recorded in respective tables and figures.

Figure 1. TLC photo documentation of *Pterocarpus santalinus*

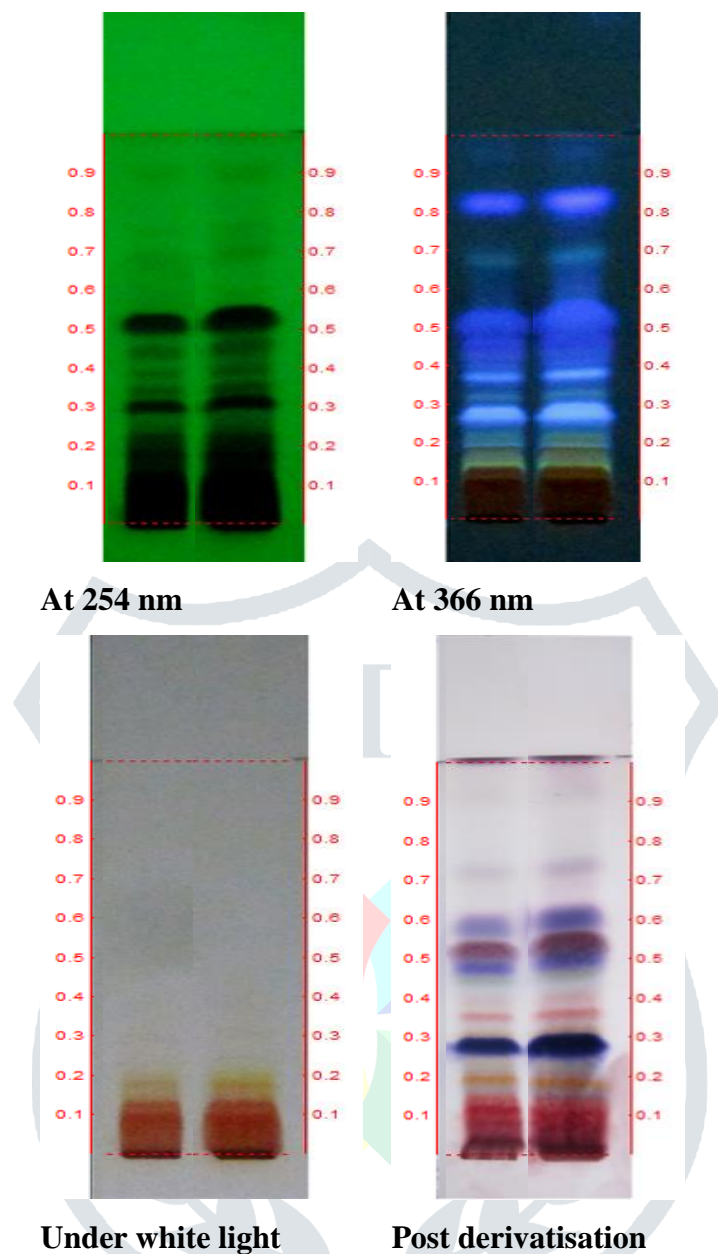


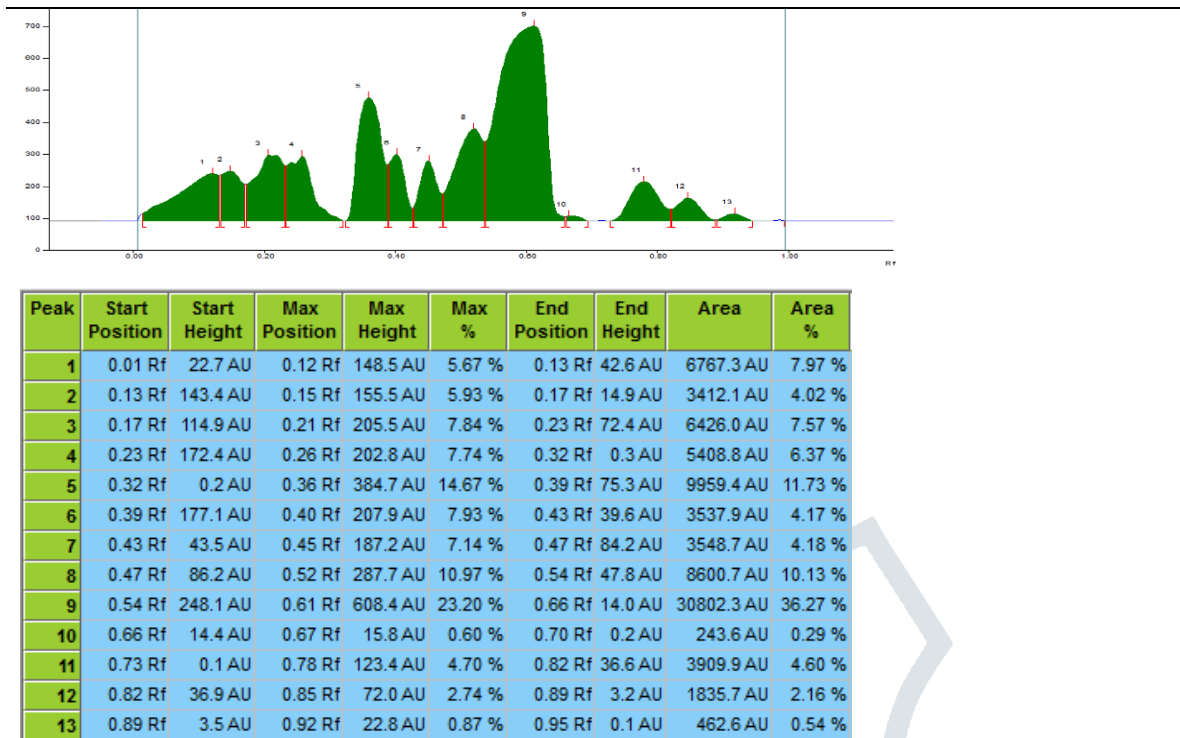
Figure 1: Track 1 – *Pterocarpus santalinus* - 4 µl, Track 2 – *Pterocarpus santalinus* - 8 µl, Solvent system:
 Toluene: Chloroform: Methanol 8:1:1

Table 4: R_f values of ethanol extract of *Pterocarpus santalinus*

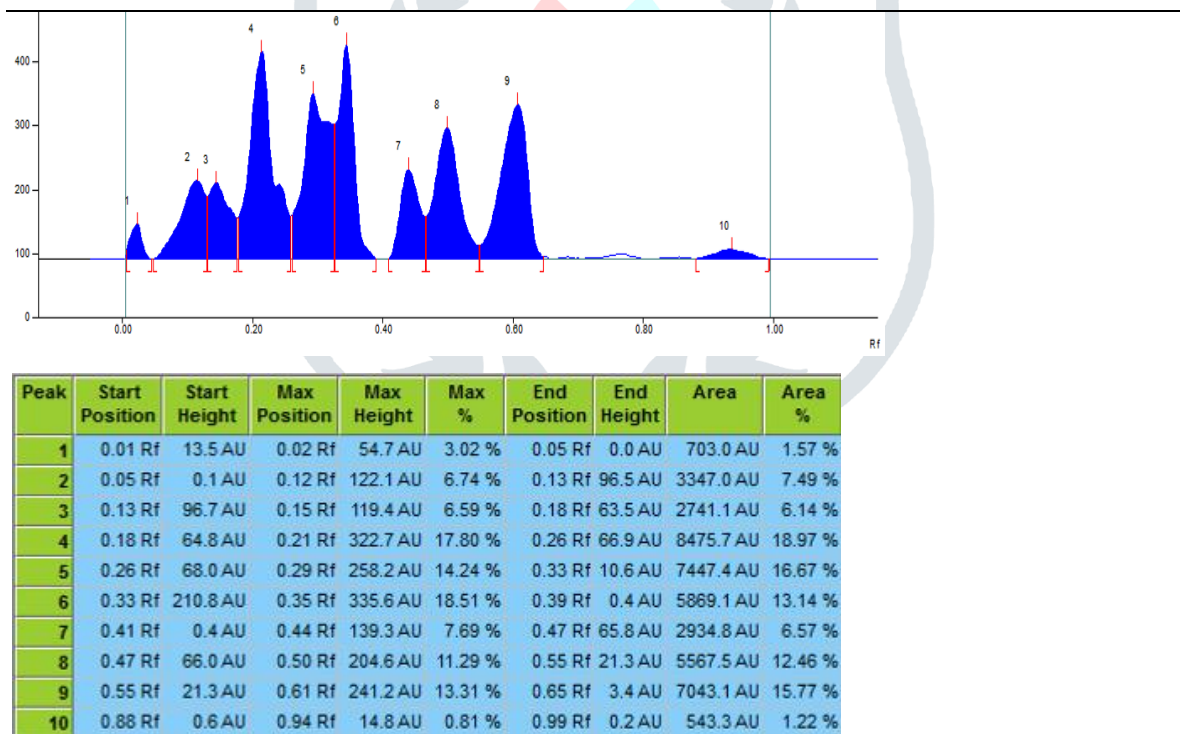
At 254 nm	At 366 nm	Under white light	Post derivatisation
-	-	0.04 L Brown	-
-	0.08 F Brown	0.08 Brown	0.08 Red
0.12 D Green	0.12 F L Brown	0.12 Brown	0.12 Red
-	0.16 F L Green	-	0.16 Buff
0.18 D Green	-	0.18 L Brown	0.18 Orange
0.21 D Green	0.21 F L Green	-	0.21 Buff
-	0.29 F M Blue	-	0.28 Navy Blue
0.31 D Green	-	-	-
-	0.33 F L Blue	-	-
0.36 Green	-	-	0.36 L Red
-	0.38 F Blue	-	-
0.41 Green	0.41 F Blue	-	0.41 L Red
-	0.43 F Blue	-	-
0.45 Green	-	-	0.45 L Green
-	0.47 F Blue	-	-
-	-	-	0.50 Purple
0.54 D Green	0.54 F Blue	-	0.54 D Red
-	-	-	-
0.61 L Green	-	-	0.61 Purple
0.69 L Green	0.69 F L Blue	-	-
-	-	-	0.73 Grey
0.76 L Green	-	-	-
0.82 L Green	0.82 F Violet	-	-
0.90 L Green	-	-	0.90 L Grey
-	0.96 F L Blue	-	-

L – Light; D- Dark; M – Medium; F – Fluorescent.

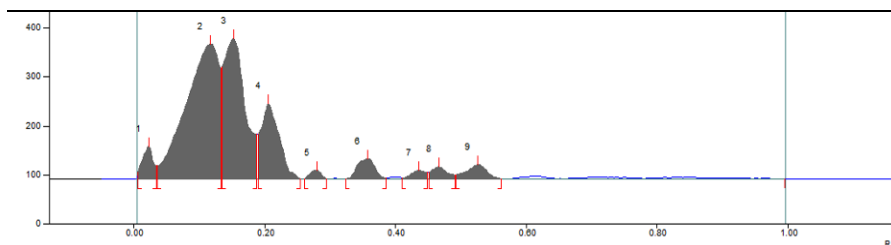
Figure 2. HPTLC photo documentation - 8 µl



Pterocarpus santalinus at 254 nm

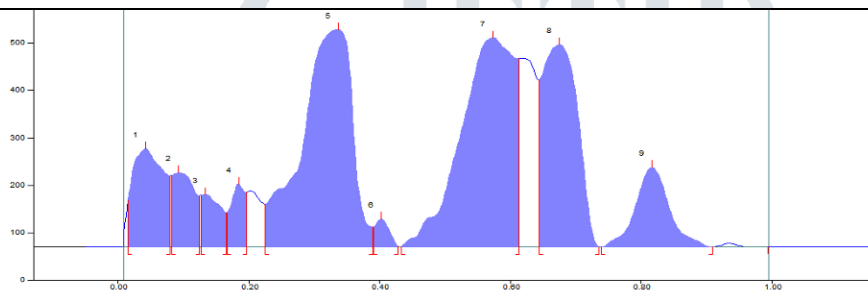


Pterocarpus santalinus at 366 nm Abs



Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.01 Rf	12.7 AU	0.02 Rf	66.1 AU	7.26 %	0.04 Rf	26.7 AU	794.1 AU	3.46 %
2	0.04 Rf	27.2 AU	0.12 Rf	275.1 AU	30.19 %	0.13 Rf	26.4 AU	9951.4 AU	43.38 %
3	0.14 Rf	227.7 AU	0.15 Rf	285.5 AU	31.33 %	0.19 Rf	90.6 AU	6720.9 AU	29.30 %
4	0.19 Rf	91.4 AU	0.21 Rf	154.3 AU	16.93 %	0.25 Rf	0.3 AU	3083.2 AU	13.44 %
5	0.26 Rf	0.5 AU	0.28 Rf	18.1 AU	1.98 %	0.30 Rf	0.3 AU	220.5 AU	0.96 %
6	0.32 Rf	0.0 AU	0.36 Rf	41.0 AU	4.50 %	0.39 Rf	2.4 AU	802.0 AU	3.50 %
7	0.41 Rf	2.5 AU	0.44 Rf	17.0 AU	1.86 %	0.45 Rf	13.5 AU	282.1 AU	1.23 %
8	0.45 Rf	13.8 AU	0.47 Rf	24.4 AU	2.68 %	0.49 Rf	8.2 AU	428.9 AU	1.87 %
9	0.49 Rf	8.4 AU	0.53 Rf	29.7 AU	3.26 %	0.56 Rf	0.6 AU	654.9 AU	2.85 %

Pterocarpus santalinus at 540 nm



Peak	Start Position	Start Height	Max Position	Max Height	Max %	End Position	End Height	Area	Area %
1	0.02 Rf	97.3 AU	0.04 Rf	206.5 AU	9.57 %	0.08 Rf	49.9 AU	7134.2 AU	7.85 %
2	0.08 Rf	150.3 AU	0.09 Rf	156.6 AU	7.25 %	0.13 Rf	07.7 AU	3938.8 AU	4.33 %
3	0.13 Rf	108.2 AU	0.13 Rf	111.1 AU	5.15 %	0.17 Rf	72.0 AU	2405.2 AU	2.65 %
4	0.17 Rf	72.2 AU	0.19 Rf	132.3 AU	6.13 %	0.20 Rf	15.0 AU	2078.9 AU	2.29 %
5	0.23 Rf	90.3 AU	0.34 Rf	458.3 AU	21.23 %	0.39 Rf	41.9 AU	25449.2 AU	28.00 %
6	0.39 Rf	42.4 AU	0.40 Rf	59.1 AU	2.74 %	0.43 Rf	1.0 AU	903.0 AU	0.99 %
7	0.43 Rf	0.7 AU	0.57 Rf	440.7 AU	20.42 %	0.61 Rf	96.6 AU	26212.1 AU	28.84 %
8	0.65 Rf	351.7 AU	0.68 Rf	426.1 AU	19.74 %	0.74 Rf	0.1 AU	16574.7 AU	18.24 %
9	0.74 Rf	0.1 AU	0.82 Rf	167.6 AU	7.77 %	0.91 Rf	0.0 AU	6187.7 AU	6.81 %

Pterocarpus santalinus at 620 nm after derivatisation

ACTIVE CONSTITUENTS

The qualitative phytochemical analysis of *P. santalinus* confirmed the presence of various components, such as carbohydrates, steroids, anthocyanins, saponins, tannins, phenols, triterpenoids, flavonoids, glycosides, and glycerides (Azamthulla et al., 2016) In fact, *Pterocarpus* species are found to be rich in isoflavonoids, terpenoids, and related phenolic compounds, β -sitosterol, lupeol, (-) epicatechin. In addition auron glycosides viz., 6-OH-1-methyl-3',4',5'-trimethoxyaurone-4-O-rhamnoside and 6,4'-dihydroxyaurone-4-O-neohesperidoside, and isoflavone glycoside 4',5-dihydroxy 7-methyl isoflavone 3'-O-beta-D-glucoside are also present in *P. santalinus* [13] also observed pterocarpol, santalins A and B, pterocarprtriol,

ispterocarpolone, pterocarpo-diolones with β -eudeslone and cryptomeridol in heartwood [14]. Heartwood of the tree also contains santal, pterocarpin, homopterocarpin, tannin (small quantity) alongwith ether, alkalies etc. Triterpene is reported to be present in the callus of stem cuttings [15]. The leaves of this plant contain methanol and ethanol can be extracted from stem bark [16].

PROPERTIES AND ACTIONS

Rasa	:	Tikta, Madhur.
Guna	:	Guru, Ruksha.
Virya	:	Shita
Vipaka	:	Katu
Karma	:	Daha Prashman

MEDICINAL USES

Pterocarpus santalinus is used in traditional herbal medicine as an anti-pyretic, anti-inflammatory, anti-helmintic, tonic, hemorrhage, dysentery, aphrodisiac, anti-hyperglycaemic and diaphoretic [13].

DISCUSSION AND CONCLUSION

The increasing demand of this tree for various purposes has placed a great strain on the natural population. Collectors of medicinal plants are resorting to unsustainable exploitation causing serious threat to the survival of the species. This species shows poor regeneration capacity; high scale cultivation is yet to be started for the sustainable development. Therefore, there is a need to conserve the species for the benefit of mankind. Most important of all, effective conservation strategies need to be discussed and various aspects are to be studied.

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