IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

A Review Article: Study of Phytochemical & Pharmacological Action of Tectona Grandis

[1]Miss. Komal D. Salunkhe, [2]Mr.PrashantS.Misal, [3]Miss.Monika R.Mali [4]Miss.DhanashriP.Karande.
[1]Asst.Professor, [2] Asso. Professor, [3]Lectures, [4]Lecturer.
Shri Ganpati Institute Of Pharmaceutical Sciences & Research Tembhurni,India
Pharmacy Tembhurni india

Abstract : Tectona grandis is one of the most famous timber plants in the world and is a major exotic species found in tropical regions. It belongs to the family Verbenaceae. The common name of this plant is teak and locally known as sagon, sagwan. The wood of this plant is renowned for its extreme durability, dimensional stability and hardness which also resist decay even when unprotected by paints and preservatives. The extracts of this plant also found applications in many of the traditional medicines. The present study was carried out to characterize pharmacological potential of ethanolic, methanolic, ethyl acetate and water extracts from leaf and bark of teak plant. The Antimicrobial activity of leaf and bark extracts from Tectona grandis were checked by disc diffusion assay.

.

IndexTerms - Tectona grandis, leaf and bark extracts, antimicrobial activity, disc diffusion assay.

I. INTRODUCTION

INTRODUCTION

Tectona grandis Linn.(Verbenaceae) is a large deciduous tree. Branchlets are quadrangular, channeled and stellatelytomentose. The tree is growing in higher situations, native to central India, Konkan, Western Deccan peninsula, South India and Burma1. It is commonly known as sagwan (Hindi), saka (Sanskrit) and teak tree (English)2, 3. Teak is a hardwood species of worldwide reputation4. Tectonagrandis is a large, deciduous tree reaching over 30 m in height in favorable conditions. Crown open with many small branches; Bark is brown, distinctly fibrous with shallow, longitudinal fissures. The root system is superficial, often no deeper than 50 cm, but roots may extend laterally up to 15 m from the stem Leaves are 30-40 by 15-30 cm, elliptic or obovate acute or acuminate. Upper surface of leaf is rough but usually glabrous and the lower clothed with dense stellate grey or tawny tomentum. The very large, 4-sided leaves are shed for 3-4 months during the later half of the dry season, leaving the branchlets bare. Shiny above, hairy below, vein network clear, about 30 x 20 cm but young leaves up to 1 m long. Flowers are shortly pedicellate with lanceolate bracts at the forks. Flowers small, about 8 mm across, mauve to white and arranged in large, flowering heads, about 45 cm long; found on the topmost branches in the unshaded part of the crown. Fruits are 1-3 cm in diameter, subflobose; pericarp is soft with dense felted stellate hairs1 Fruit is a drupe with 4 chambers; round, hard and woody, enclosed in an inflated, bladder-like covering; pale green at first, then brown at maturity. Each fruit may contain 0 to 4 seeds. There are 1 000-3500 fruits/kg. This family includes about 236 genera and 6900 to 7200 species (Kuete 2017). The genus Tectona comprises 3 species viz T.

grandis, T. hamiltoniana and T. philippinensis, T. grandis (teak) is widely distributed in Bangladesh, Thailand, China, India, and Pakistan. Tectona hamiltoniana (Dahat teak) is an endangered local endemic species confined to Burma. Tectona philippinensis (Philippine teak) is alsoendangered endemic to the Philippines. Teak has worldwide reputation as a quality timber on account of its remarkable physical and mechanical properties, particularly elasticity, strength, durability and decay resistance (Palanisamy et al. 2009). The generic name comes from ‘tekka’, the Malabar name for T. grandis. The specific name, ‘grandis’, is Latin for ‘large’ or ‘great’.

Taxonomical classification:

Kingdom	Plantae
Superclass	Angiosperms
Division	Eudicots
Class	Asterids
Order	Lamiales
Family	Verbenaceae
Genus	Tectona
Species	grandis

LOCAL NAMES:
Bengali - Segun,saigun Burmese - kyun English - teak wood,Indianoak,teak tree Filipino - dalanang,djati French – teck German - tiek,Teak(holz) baum Gujarati - sagach,saga Hindi - saigun,sagwan,sagun Indonesian - kulidawa,deleg,jati Italian - teck Javanese - deleg,kulidawa Malay - jati Nepali - teak,saguan Sanskrit - bardaru,bhumisah,saka,dwardaru,kharchchad Sinhala - takku,teaku Spanish – teca Swahili - msaji,mtiki Tamil - tekku,tekkumaram,tek Thai - sak, mai-sak Trade name – teak

COMMON SPECIES:
Teak belongs to the family Lamiaceae. There are three species of tectona 1. Tectona grandis (common teak) is by far the most important, with a wild distribution in Bangladesh, Sri Lanka, India, China, Pakistan. 2. Tectona hamiltoniana (Dahat teak), is a local endemic species confined to Burma, where it is endangered. 3. Tectona philippinensis (Philippine teak) is endemic to the Phillipine and is critically endangered according to the IUCN

BIOPHYSICAL LIMITS:
Altitude 0.0 - 1200 m,
Mean annual temperature 14-36^{O} C,
Mean annual rainfall (600)1200 - 2500(4000) mm
Soil type- Thess most suitable soil is deep, well-drained, fertile alluvialcolluvial soil with a pH of 6.5-8 and a relatively high calcium and phosphorous content. The quality of growth, however, depends on the depth, drainage, moisture status and the fertility of the soil. Teak does not tolerate water logging or infertile lateritic soils.

Phytochemical constituents:
Root contains lapachol, tectol, tectoquinone, β-sitosterol and a diterpene, tectograndinol5. Roots are used in the treatment of anurea and urine retention6. The flowers are acrid, bitter and useful in the treatment of bronchitis, biliousness and urinary discharges. Bark is astringent, acrid, sweet and useful in the treatment of bronchitis. The wood is acrid, sedative, anthelmintic, expectorant and useful in the treatment of gravid uterus, piles, leucoderma, dysentery, headache and burning pain over liver region. The ashes of wood applied to swollen eyelids and are said to strengthen the sight. The oil of nuts promotes the growth of hair and removes itchiness of skin. The flowers and the seeds are diuretics

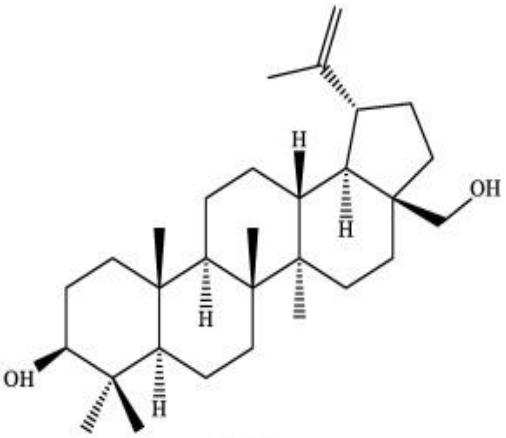
CHEMISTRY:

Various chemical constituents isolated from different parts of plant T. grandis have been given in table-I and structures of some constituents are as below

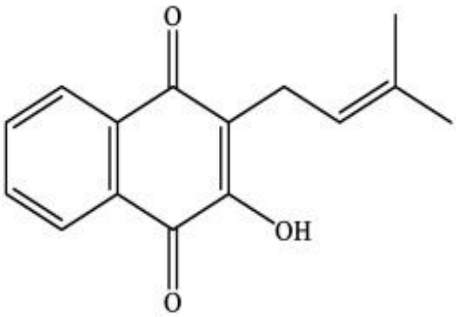
Phytoconstituents of T. grandis:

Sr. No	Plant Part	Chemical constituents isolated
1	Wood	Resin, silica, calcium phosphate, ammonium phosphate, magnesium phosphate (2). Anthraquinone-2carboxylic acid, anthraquinone-2-carboxaldehyde (5). Triterpenic and hemiterpenic compound (6). 9,10-dimethoxy-2-methyl-1,4-anthraquinone, 5-hydroxy-2-methyl-9,10-anthraquinone, 1-hydroxy-5-methoxy-2-methyl-9,10-anthraquinone 1,5-dihydroxy-2-methyl-9,10-anthraquinone, tecomaquinone-I(I), tectoquinone, dehydro-α-lapachone (7,8). lapachol, 5-hydroxy-lapachol, methlyquinizarin, squalene (9). Dehydro-α-isodunnione (10). Lignins (11).
2	Root	Lapachol, tectol(II), dehydrotectol, tectoquinone, β-lapachone, dehydro-α-lapachone, β-sitosterol, new diterpene, tectograndinol(III) (12,13) Non-structural carbohydrates (14) 1-hydroxy-2-methyl anthraquinone, pachybasin, obtusifolina, betulinic acid (15).
3	Leaves	Tectoleafquinone Tannins (6%) and dye (16). Tectoionols-B(IV), tectoionols-A(V), monoterpene, apocarotenoids (17). Protein (7.1%), crude fiber (22.3%), calcium (3%), phosphorous (0.46%) Steroidal compound squalene, polyisoprene-α-tolylmethyl ether and betulinic acid, aanthraquinonenapthaquinone pigment, tectograndone
4	Seed	Seed oil contain fatty acids as caprylic (1.45%) , capric (0.76%), lauric acid (6.77%), myristic acid (2.86%), palmitic acid (12.12%), stearic acid (9.52%), oleic acid (23.33%) and linoleic acid (43.22%)(5). Xanthene (19).
5	Bark	Tannin (7.14%)(6). 5-hydroxy-1,4-napthalenedione(VI) (juglone) (20). Obtusifolina(VII), Desidro-α-lapachona(VIII)21. 6

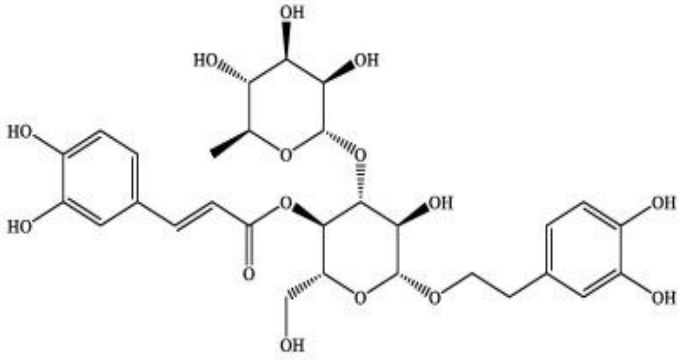
Chemical Structure:



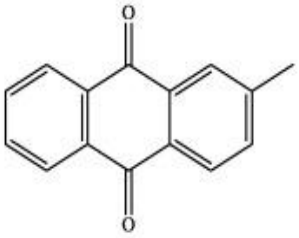
Betulin
(Triterpene)



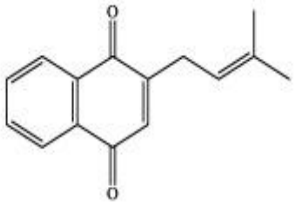
Lapachol
(Naphthaquinone)



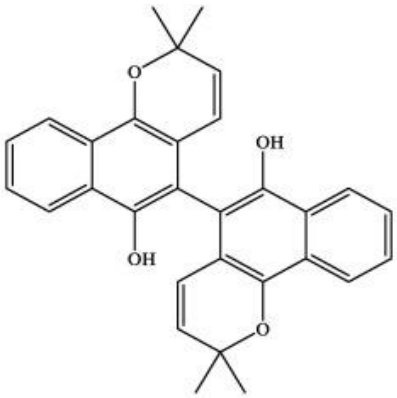
Verbascoside
(Caffeoyl ethanoid)



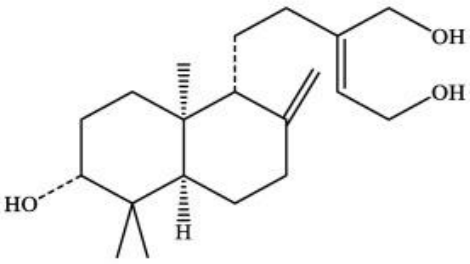
Tectoquinone
(Anthraquinone)



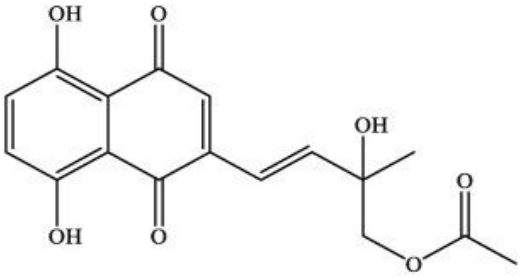
Deoxylapachol
(Naphthaquinone)



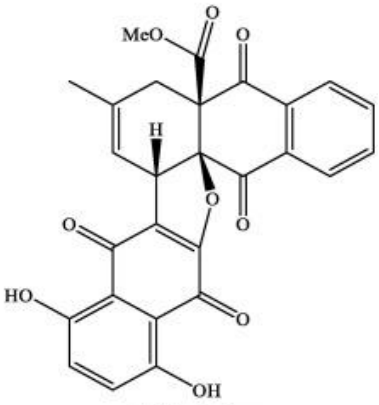
Tectol



Tectograndinol
(Diterpene)

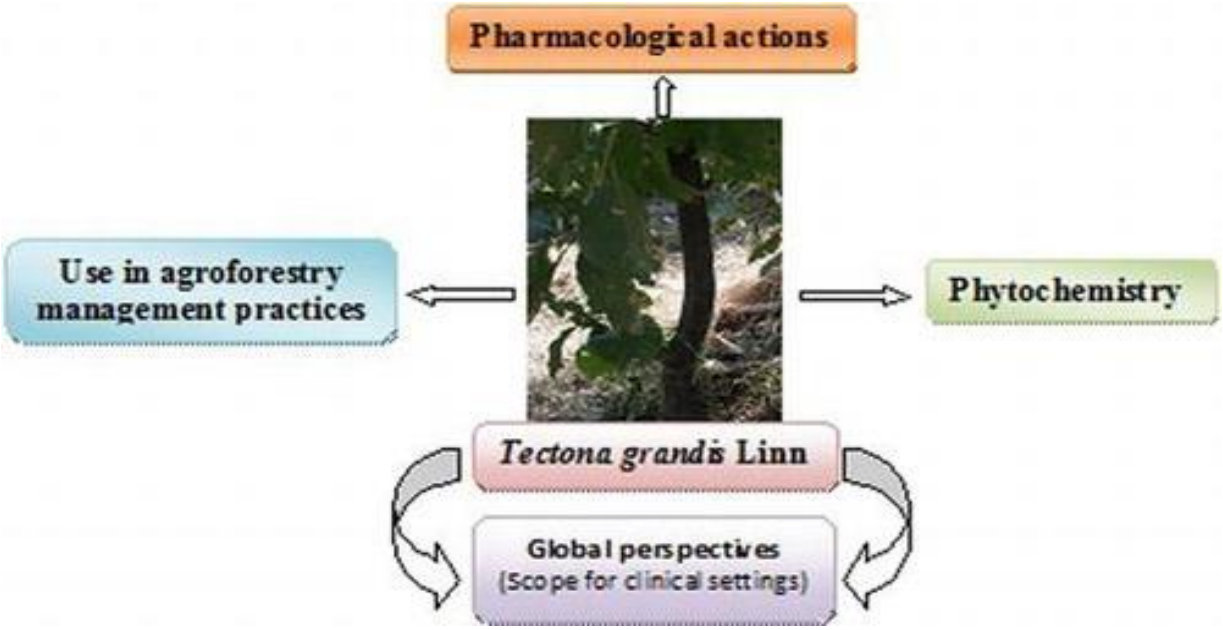


Naphthotectone
(Naphthaquinone)



Anthratectone
(Anthraquinone)

PHARMACOLOGICAL ACTIVITY:



Antibacterial activity:

The methanol extracts of teak bark were inhibitory to Listeria monocytogenes and MRSA (Methicillin Resistant Staphylococcus aureus) by means of disc diffusion.

Cytotoxic activity

The petrol extract of the root heart wood of T. grandis were showed a high level of activity in cytotoxicity test against Atremiasalina (Brine shrimp) with an LC50 of 5ppm. .

Antimitotic activity:

Antimitotic activity was evaluated using the meristematic cells of Allium cepa root. The A. cepa bulbs were sprouted in tap water at room temperature. The sprouted root tips were then treated with ethanol and aqueous extracts (10 mg/ml) for 1 hour. The sprouted root tips treated with distilled water and methotrexate (0.1 mg/ml) were used as control and standard, respectively. The root were fixed and stained with carmine stain and mitotic index was calculated. Results showed that 70% ethanol extract exhibited significant antimitotic activity .

Antifungal activity:

Antifungal activity of Tectona grandis leaf and bark extracts The available literature reveals that tectoquinone, an anthraquinone from teak sawdust, possess antifungal activity.[16] Other phytochemicals reported from teak viz., juglone, lapachol and deoxylapachol (Naphthoquinones) also possess antimicrobial activity

Antiulcerogenic activity:

Lapachol (a naphthaquinone) isolated from the roots of T. grandis given at a dose of 5 mg kg-1 p.o. twice daily for 3 days was found to have an anti-ulcerogenic effect on subsequently induced experimental gastric and duodenal ulcers in rats and quinea-pigs.

Antianaemic effect:

The extract of T. grandis leaves is evaluated on anaemic model of rat induced by intraperitoneal injection of phenylhydrazine at 40mg/kg for 2 days. Oral administration of T. grandis extract at 1 g/kg/day, to the rats previously treated with phenylhydrazine, increased the concentration of haemoglobin, red blood cells number, haematocrit and reticulocytes rate. Moreover, the extract of T. grandis enhanced the osmotic resistance of the red blood cells that confirm the important presence of young red blood cells. These results support partially the traditional use of T. grandis in the treatment of anaemia

Wound healing activity:

The present study was carried out to evaluate the effect of hydrochloric extract of T. grandis on experimentally induced wounds in rats and compared the effect observed with a known healing agent, Aloe vera. .A suitable gel formulation was selected for the application using cellophane membrane penetration. In the excision wound and burn wound models, animals treated with T. grandis leaf extract showed significant reduction in period of epithelisation and wound contraption 50%. In the incision wound model, a significant increase in the breaking strength was observed. T. grandis leaf extract treatment orally produced a significant increase in the breaking strength, dry weight and hydroxyproline content of the granulation tissue in dead space wound. It was concluded that T. grandis leaf extract applied topically (5% and 10% gel formulation) or administered orally (250 and 500 mg/kg body weight) possesses wound healing activity

MATERIALS AND METHODS:

Samples and preparation of samples

Plant material

The plant (Tectona grandis) leaves and bark were collected from Krishna University Dr MRAR PG Centre campus, Nuzvid. Leaves were washed and shade dried for one week. The dried leaves were then crushed into fine powder and then used for further study.

Solvent extraction

Solvent Extraction is the first step in the analysis of medicinal plants, because it is necessary to extract the desired chemical components from the plant materials for further separation and characterization. Leaf and Bark extracts were prepared by adding 0.5gm of dried powder into 10ml of various solvents (ethanol, methanol, ethyl acetate and water) kept at room temperature for 24 hrs to 78hrs. The filtrate was then collected by filtering the mixture using Whatman filter paper No.1 and stored at 4°C until further use.

CONCLUSION:

Tectona grandis is a forest species, which is very famous for its timber value and decay resistance. It possesses a wide spectrum of pharmacological properties such as wound healing, antimicrobial, antioxidant, anti-inflammatory,antifungal, antiviral, insecticidal, allelopathic cytotoxic and hair growth, natural dye etc. In addition to these, cultivation of T. grandis has also become an efficient tool for pest control towards sustainable agriculture due to its phytotoxic activity. However, pharmacological and phytochemical studies have been carried out independentl. The number of studies on this plant is quite high although most of the studies have been done on the extract and isolation level. Hence, more research is required to correlate its pharmacological activity with chemical constituents, so that promising potential drug candidates could be developed. Based upon this critical review it can be concluded that there is sufficient scientifically valid evidence to state that, T. grandis is an interesting source of bioactive compounds used for commercial exploitation. The present study clearly indicates the antimicrobial potential of leaf and bark extracts of Tectona grandis. Both the leaf and bark extracts were found to be effective in inhibiting the growth of gram positive, gram negative bacteria and against pathogenic fungi. Further investigations are needed to identify the bioactive components in the leaf and bark extracts obtained using different solvents.

RESULTS AND DISCUSSION:

Antibiotic resistance is a major concern and development of new agents from plants could be useful in meeting the

Table 1: Antibacterial activity of Tectona grandis Leaf Extracts

Test organism	Diameter of Zone of Inhibition (in mm)			
	Ethanol	Methanol	Ethylacetate	Water
P. aeruginosa	18	10	10	10
S. aureus	16	12	12	11
B. subtilis	21	14	13	12

Table 2: Antibacterial activity of Tectona grandis bark Extract

Test organism	Diameter of Zone of Inhibition (in mm)			
	Ethanol	Methanol	Ethylacetate	Water
P. aeruginosa	15	12	14	11
S. aureus	17	14	10	13
B. subtilis	19	16	12	10

Anti bacterial activity of T. grandis bark extracts towards S. aureus and other bacterial strains was also reported by Rafullah and Suleiman.[11] The leaf extracts of Tectona grandis found to contain two quinones: naphthotectone and anthratectone that were mainly responsible for the antibacterial activity and good antiradical properties.[8,12,13] The other active ingredient that contribute antibacterial activity was found to be 5hydroxy-1,4- naphthalenedione (Juglone). Mahesh and Jayakumaran[14] showed the antibacterial activity of leaf, bark and wood extracts of T. grandis against Staphylococcus aureus (ATCC 25923), Klebsiella pneumoniae (ATCC 700603), hospital strains of Salmonella paratyphi and Proteus mirabilis by disc diffusion assay. They also found that methanol extract of leaf and ethyl acetate extract of wood was also able to show fairly good activity against gram positive and

Negative species. Srinivasan et al.,[15] also reported similar findings. The present results are also inconsistence with these findings. In the present study good antibacterial activity was found against both Gram positive (S. aureus, B. subtilis) and Gram-negative (P. aeruginosa) bacteria.

Antifungal activity of Tectona grandis leaf and bark extracts The available literature reveals that tectoquinone, an anthraquinone from teak sawdust, possess antifungal activity.[16] Other phytochemicals reported from teak viz., juglone, lapachol and deoxylapachol (Naphthoquinones) also possess antimicrobial activity.[8,9]

In the present study leaf and bark extracts of Tectona grandis prepared in solvents (ethanol, methanol, ethyl acetate and water) were tested for the antifungal activity against test fungi available in the lab. The antifungal activity of the extract was assessed by the presence or

absence of zone of inhibition. Table 3 & 4 shows the antifungal activity of teak leaf and bark extracts respectively as is evident by a clear zone of inhibition measured (in mm) around the discs.

Table 3: Antifungal activity of Tectona grandis Leaf Extracts.

Test organism	Diameter of Zone of Inhibition (in mm)			
	Ethanol	Methanol	Ethylacetate	Water
A. niger	19	15	14	12
T. Viride	16	12	11	10
A. flavus	20	16	13	13

Table 4: Antifungal activity of Tectona grandis bark Extracts.

Test organism	Diameter of Zone of Inhibition (in mm)			
	Ethanol	Methanol	Ethylacetate	Water
A. niger	20	18	15	13
T. Viride	21	14	11	12
A. flavus	18	15	16	15

Antifungal activity of T. grandis was also reported by Shalini and Rachana and Florence et al.,Antifungal and antibacterial activity of wood and bark of teak has been reported earlier.

In this study, we found that both leaf and bark extracts of Tectona grandis prepared using ethanol, methanol, ethyl acetate and water were found to be efficient in inhibiting the growth of pathogenic bacteria and fungi. Among different extracts prepared using leaf and bark of teak plants, ethanolic extracts showed significant anti bacterial and antifungal activity. From our observation, it was clear that Tectona grandis leaf and bark extracts were active in inhibiting the growth of bacteria and fungi.

REFERENCES:

1. Nahida Ansari, S.H., and A.N. Siddiqui, PistaciaLentiscus: A review on phytochemistry and pharmacological properties. Int. J. Pharm. Pharm. Sci., 2012; 4(4): 16-20. 2. Ramesh, B.N., A.M. Mahalakshmi and S. Mallappa, Towards a better understanding of an updated ethnopharmacology of Celosia Argentea L. Int. J. Pharm. Pharm. Sci., 2013; 5(3): 54-59.
2. Ramesh, B.N., A.M. Mahalakshmi and S. Mallappa, Towards a better understanding of an updated ethnopharmacology of Celosia Argentea L. Int. J. Pharm. Pharm. Sci., 2013; 5(3): 54-59.
3. 3.K.R. Kirtikar, B.D. Basu, Indian Medicinal Plants, (SriSatguru Publications, NewDelhi, 2000), 3rd edition, VolIII, pp. 1924-192 2.
4. A.K. Nadkarni, K.M. Nadkarni, Indian Materia Medica, (Popular Prakashan, Bombay, 1976), 3rd edition, Vol-I, pp.1197-1198. 3.
5. The Ayurvedic Pharmacopoeia of India, (Department of Indian System of Medicine and Homeopathy, NewDelhi, 2001) Part-I, 1st edition, Vol-III , pp.174-175.
6. D. Verhaegen, D. Ofori, I. Folana, M. poitel and A. Vaillant. Development and characterization of microsatellite markers in Tectona grandis Linn. F. Molecular Ecology Notes. 5 : 945-947 (2005).
7. A.K. Nadkarni, K.M. Nadkarni, Indian Materia Medica, (Popular Prakashan, Bombay, 1976), 3rd edition, Vol-I, pp.1197-1198.
8. The Ayurvedic Pharmacopoeia of India, (Department of Indian System of Medicine and Homeopathy, NewDelhi, 2001) Part-I, 1st edition, Vol-III , pp.174-175.
9. D. Verhaegen, D. Ofori, I. Folana, M. poitel and A. Vaillant. Development and characterization of microsatellite markers in Tectona grandis Linn. F. Molecular Ecology Notes. 5: 945-947 (2005).
10. R.P. Rostogi, Compendium of Indian medicinal plant, (CDRI Lucknow Publication and information Directrate, New Delhi, 1993) Vol-II, pp.-668.
11. Altona, T. 1922. Nieuw-guinea. DjatienGeenHindoes (New-Guinea Teak and no Hindoos). Tectona. 15:612.
12. Arias, L. U. 2005. Advancement in management and productivity of teak in Central America. In: Quality timber Products of Teak from Sustainable Forest Management, Bhat, K.

13. M., Nair, K. K. N., Bhat, K. V., Muralidharan, E. M., and Sharma J. K. (Eds.). Kerala Forest Research Institute, Peechi, Kerala, India, pp. 92-103.
14. Balagopalan, M., Rugmini, M. and Chandbasha, S. 1998. Soil nutrition management for teak plantation of Kerala. Research Report No.138, Kerala Forest Research Institute, Peechi, India.
15. Ball, J. B., Pandey, D. and Hirai, S. 2000. Global overview of Teak plantations. In: Enters, T. and Nair, C. T. S. (Eds.). Site Technology and Productivity of Teak Plantations. FORSPA Publication (FAO, Bangkok) 24:11-33.
16. Bhat, K. M. 1995. A note on heartwood proportion and wood density of 8 year old teak. Indian Forester 121:514-517. Bhat, K. M., Priya, P. B. and Rugmini, P. 2001. Characterisation of juvenile wood in teak. Wood Science and Technology 34: 517-532.
17. Kjaer, E.D., E.B. Lauridsen and H. Wellendorf, Second evaluation of an international series of teak provenance trials. Danida Forest Seed Centre, Humlebaek, Denmark, 1995.
18. Kokutse, A.D., A. Stokes, H. Baill`eres, K. Kokou and C. Baudasse, Decay resistance of Togolese teak (Tectona grandis L.f) heartwood and relationship with colour. Trees, 2006; 20: 219-223.

Varier, P.S., Indian Medicinal Plants: A compendium of 500 species. Orient Longman, Hyderabad, India, 1996; 5: