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REVIEW ON TRADITIONALLY MEDICINAL IMPORTANCE, MORPHOLOGY, PHYTO-CHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF *DALBERGIA SISSOO*

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ABSTRACT: Natural plant products have been used throughout human history for many purposes. *Dalbergia sissoo* is also an herbal medicinal plant that belongs to the family Fabaceae (Leguminosae). Therefore, the aim of the present review is an effort to give a detailed survey of the literature on its traditionally medicinal use, morphology, phytochemistry, and pharmacological activities of the plant *Dalbergia sissoo*. *Dalbergia sissoo* is traditionally used to treat various systemic diseases and disorders such as cardiac diseases, gastrointestinal related disorders and diseases, sexual diseases, and skin diseases. It contains many active constituents, i.e., flavonoids, alkaloids, glycosides, carbohydrates, tannins proteins, fatty acids, and amino acids, useful in treating various types of diseases. Plant part extracts from *Dalbergia sissoo* are reported on anti-inflammatory, anti-termite, anti-diabetic, analgesic and antipyretic, anti-helminthic, antioxidant, antimicrobial, antinociceptive, osteogenic, anti-spermatogenic, gastroprotective, neuroprotective, anti-molluscicidal, anti-larvicidal, antiulcer, immunomodulatory, antibacterial activity are revealed in this review article.

INTRODUCTION: Herbs are plants which having healing properties and can treat a number of health-related problems [1]. Herbal medicine (Herbalism) is the study of pharmacognosy and the use of medicinal plants, which are a basis of traditional medicine [2]. The World Health Organization (WHO) estimates that 80 % of the population of some Asian and African countries nowadays use herbal medicine for some aspect of primary health care [3]. Some prescription drugs have a basis as herbal remedies, including artemisinin, aspirin, digitalis, and quinine [4].

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Herbal remedies are most popular in people having chronic diseases, such as cancer, diabetes, asthma, and end-stage kidney disease [5-7]. Multiple factors such as age, ethnicity, gender, education, and social class are also shown to have an association with the prevalence of herbal remedies use [8].

Dalbergia sissoo is an important medicinal plant which belongs to legume family (Fabaceae) [9]. *Dalbergia sissoo*, commonly known as Indian Rosewood and also known as sisu, Sheesham, tahli, and Tali. It is native to Himalayan foothills in Northern India and is distributed in many countries such as India, Pakistan, Burma, Sri Lanka and Mauritius. It is introduced in many other countries of tropics and subtropics and now naturalized in Africa and America [10]. It occurs at river banks below up to 900 meters (3,000 ft) elevation but can range naturally up to 1,300 m (4,300 ft).

It can withstand in average rainfall up to 2,000 millimeters and it can grow in droughts of 3-4 months. It prefers soils from pure sand and gravel to rich alluvium of river banks, and it grows in slightly saline soils [11]. Sissoo is an important timber tree of India. It has nut-brown heartwood, which is very hard, heavy, strong, and elastic. The wood is used to making doors, window frames, flooring, furniture, boats, cabinets, *etc*. The pulp of wood is also used in papermaking. It enriches soil due to the presence of nitrogen-fixing bacteria in roots. The leaves falling from the tree are help to improves soil quality [10].

Dalbergia Sissoo is also an herbal medicinal tree. In Ayurveda, it is used for the treatment of various diseases. The wood and bark of *D. Sissoo* used abortifacient, anthelmintic, antipyretic, aphrodisiac, expectorant, and refrigerant treatment. In Africa, this tree is used to treat wounds and gonorrhea [11].

The genus consists of 300 species, among which 25 species occur in India. Many species of *Dalbergia* are important timber trees, valued for their decorative and often fragrant wood, rich in aromatic oils [12]. The most famous of these are the rosewoods, so-named because of the smell, but several other valuable woods are yielded by the genus [13.]

The isolation of several compounds of confirmed biological activity such as flavones, isoflavones, quinines and coumarins from *Dalbergia sissoo*. It also contains tectoridin, caviunin-7-O- glucoside, iso-caviunin, tectorigenin, dalbergin, bio-chaninA, and 7-hydroxy -4-methylcoumarin. The heartwood gave 3,5-dihydroxy-trans-stibene, biochanin A, dalbergichromene, dalbergenone and iso-dalbergin [14-17].

*Dalbergia sissoo*is also effective against blood diseases, syphilis, stomach problems, dysentery, nausea, eye and nose disorders, ulcers, skin diseases; it has been used as an aphrodisiac and expectorant; also for its nitric oxide production inhibition activity, anti-inflammatory, analgesic, antipyretic, larvicidal activities [18-23].

Synonyms: [24] *Amermnon Sissoo* (Roxb.) *Kuntze, Amerimnon P. Browne, Ecastaphyllum P. Browne, Coroyo Pierre, Triptolemea Mart.*

Vernacular Names: [25]

Sanskrit - Shinshapa, Aguru
English- Indian Rosewood Bombay Blackwood
Hindi - Shisham, sissu, sissai, sisam
Tamil - Sisso, gette
Kannada - Betti, shista baage agaru, bindi
Bengali - Shishu, Sissoo
French - Ebenier Juane
Arabic - Arabic
Indonesia - du Khaek Pradu Khack
Javanese - Sonowaseso
Spanish - Sisu
Thai - du-Khaek Pradu Khaek
Persian - Jag
Trade Name – *Sisso*

Scientific Classification: [26]

Kingdom – Plantae
Unranked - Angiospermae
Unraked - Ecidicots
Unranked - Rosids
Order - Fabales
Family – Fabaceae (Leguminoseae)
Sub Family – Faboideae
Tribe – *Dalbergia*
Genus - *Dalbergia*
Species – *Sissoo*

Taxonomical Classification: [27-29]

Domain: Eukaryota
Kingdom: Plantae
Division: Magnoliophyta
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Tribe: Dalbergieae
Genus: *Dalbergia*
Species: *D. sissoo*
Binomial Name: *Dalbergia sissoo*

Botanical Description: *Dalbergia sissoo* is a medium to large tree of about 25 meters in height with grey yellow trunk, 2 to 3 meters in diameter [30].

Leaves are leathery, pinnately compound, alternate leaflets, petiolated leaf stalk, measures about 15 cm long, each leaflet widest at the base, 4 to 6cm long with a fine pointed tip [30].

FIG. 1: WHOLE PLANT OF *DALBERGIA SISSOO*

FIG. 2: LEAVES OF *DALBERGIA SISSOO*

FIG. 3: FLOWERS OF *DALBERGIA SISSOO*

Flowers are whitish to pink, fragrant, nearly sessile, and in dense clusters [30].

Pods are oblong, flat, thin, strap-like 4 to 8cm long, 1 cm wide and light brown. They contain 1 to 5 flat bean-shaped seeds up to 8 to10mm long. It has a long taproot and numerous surface roots which produce suckers. Young shoots are downy and drooping; stems have light brown to dark grey bark up to 2.5 cm (0.98 in) thick, shed in narrow strips [31].

Seeds are about 6 to 8×4 to 5 mm, kidney-shaped, thin and flat, light brown. The seed is dry and hard. The sapwood is white to pale brown in colour, and the heartwood is golden to dark brown in colour [32-33].

FIG. 4: SEEDS OF *DALBERGIA SISSOO*

FIG. 5: PODS OF *DALBERGIA SISSOO*

Geographical Distribution:

- **Exotic Range:** Afghanistan, Bangladesh, Bhutan, India, Malaysia, Pakistan.
- **Native Range:** Cameroon, Cyprus, Ethiopia, Indonesia, Iraq, Israel, Kenya, Mauritius, Nigeria, Sudan, Tanzania, Thailand, Togo, US, Zimbabwe [34].

Traditional Use of Various Parts of *Dalbergia sissoo:* *Dalbergia sissoo*is a medicinal plant that has different biological activities. It is used in conditions such as emesis, ulcers, leukoderma, dysentery, stomach troubles, and skin diseases [35-37]. Plant parts of *Dalbergia sissoo* are traditionally used in treating many diseases and are mentioned below:

Bark: Active extracts of bark possess carbohydrates, phenolic compounds, flavonoids, and tannins. In the Ayurvedic medicinal system, the bark of *Dalbergia sissoo* is used for the treatment of abortifacient, anthelmintic, antipyretic, aperitif, aphrodisiac, expectorant, and refrigerant and also used for controlling anal disorders, dysentery, dyspepsia, leukoderma, and skin ailments. The bark is used to treat Vata-related disorders such as sciatica, hemiplegia [38].

Seed: Seed oil *Dalbergia sissoo* is used in treatment of blue itching, burning on the skin and scabies [39].

Leaves: Rural people in India and Nepal use *Dalbergia sissoo* leaves in the treatment of animals suffering from non-specific diarrhoea. Leaf extract has been used to treat sore throats, heart problems, dysentery, syphilis, and gonorrhoea [40]. The juice of the leaves is used for anthelmintic, good for diseases of the eye and the nose. It is used to treat scabies, burning sensations of the body, scalding urine, syphilis, and digestive disorders [41]. Decoction of leaves is used for the treatment of gonorrhoea. Ayurvedics has also prescribed leaf juice for eye ailments.

Wood: The wood was used for anthelmintic, antileprotic, and cooling. Arial parts were used for spasmolytic, aphrodisiac, and expectorant. Wood is used in the treatment of leprosy, boils, vomiting. Yunana use the wood of *D. sissoo* for blood disorders, burning sensations, eye and nose disorders, scabies, scalding urine, stomach problems, and syphilis [42].

Heartwood: The heartwood is used to treat herpes, vitiligo, and fever. Shimshapa Sara ksheerapaka is indicated in treating fever (Sushruta)

Root: Roots is used in the treatment of diarrhoea and dysentery.

Phytochemical Constituents of *Delbergia sissoo:*

Stem Bark: Delbergione, dalbergin, methyl-dalbergin, 4- phenylchromene,dalbergichromene and isotectorigenin [43].

Leaves and Trunk: Dalbergenone, Dalbergin and methyl dalbergin, 4-phenylchromene, dalbergi-chromene [44-45].

Heart Wood: Dalbergiphenol, Delbergenone, Dalbergin, Methlydalbergin.

Flowers: Biochanin A, tectorigenin, 7,4 dimethyl tectorigenin and 7-Omethyletectorigenin. Heart wood also contains fixed oil, containing myristic, palmitic, stearic, arachidic, linoleic, oleic acid, and essential oil, containing two sesquiterpene derivatives bisabolene and nerolidol [46].

Green Pods: Mesoinisitol, 7-O- methyl tectorigenin, and 4'- rhamnoglucoside.

Mature Pods: Isocaviumin, tectorigenin, dalbergin, caviunin and tannins.

TABLE 1: ETHNOMEDICAL INFORMATION OF *DALBERGIA SISSOO* LINN [47-52]

Form used	Pharmacological activity
Extract of aerial part	Used for bronchodilator, antipyretic, analgesic and it has estrogen-like activities
Dried leaves	Antibacterial, antiprotozoal and anti-inflammatory activity
Leaf Juice	Used in gonorrhoea
Wood paste	Used to treat wounds, itching, abscess, and vomiting
Oil	Shows repellent activity against *Anopheles stephensi, Aedes aegypti, Culex quinquefasciatus* and is also resistant to some wood boring insects
Wood and active extract of bark	Ayurvedics: abortifacient, anthelmintic, antipyretic, aperitif, aphrodisiac, expectorant, refrigerant, anal disorders, dysentery, dyspepsia, leukoderma and skin ailments Yunani: wood is useful in blood disorders, scabies, eye and nose disorders, burning sensations, scalding urine, stomach problems, syphilis boils, eruptions, leprosy and nausea

Reported Pharmacological Activities:

Anti-Inflammatory Activity: Anti-inflammatory activity of ethanolic extract of *Dalbergia sissoo* bark was evaluated. It can be concluded that the ethanolic extract at 1000 mg/kg showed the most potent anti-inflammatory activity compared to the other groups (300 and 500 mg/kg) throughout the observation period [53].

Anti-Termite Activity: The anti-termite activity of the heartwood of *Dalbergia sissoo* was evaluated. It was concluded that the plant extracts could be used as an alternative for synthetic pesticides for the control of termites in buildings [54].

Anti-Diabetic Potential: Pankaj Singh Niranjan *et al.,* conducted a study in 2010 to evaluate the antidiabetic activity of ethanolic extract of *Dalbergia sissoo* leaves in alloxan-induced diabetic rats. They concluded that the ethanolic extract of the leaves is 12% more effective in reducing the blood glucose level than standard Glibenclamide [55].

Analgesic and Antipyretic Effects: Phytochemical, analgesic, and antipyretic activities of ethanol extract of *Dalbergia sissoo* seeds were evaluated. It was concluded that *Dalbergia sissoo* seeds extract has moderate analgesic and remarkable antipyretic activities [56].

Anti-Helminthic Potential: The anti-helminthic activity of *Dalbergia sissoo* was determined. The study showed the potential usefulness of *Dalbergia sissoo* against helminthic infections [57].

Antioxidant Potential: The stem bark of *Dalbergia sissoo* was evaluated for its antioxidant potential. Finally results shown, among the different extracts of stem bark of the plant, chloroform extract exhibited marked antioxidant activity, whereas methanolic extract showed moderate activity in different *in-vitro* anti-oxidant assays [58].

Antimicrobial Property: In this study, an herbal preparation of *Dalbergia sissoo* and *Datura stramonium* was evaluated for its antibacterial efficacy against gram-positive (*Staphylococcus aureus* and *Streptococcus pneumoniae*) and gram-negative (*Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumonia*) bacteria. The results of the study show that the extract of *Dalbergia sissoo* and *Datura stramonium* may be used as a potent antiseptic preparation for the prevention and treatment of chronic bacterial infections [59].

Antinociceptive Activity: The antinociceptive activity of ethanolic extract of the plant bark of *Dalbergia sissoo* was evaluated using the tail flick method on Wistar rats. Three different doses (300, 500, and 1000 mg/kg) in 0.5% carboxymethyl cellulose were administered. Phytochemical investigation of the ethanolic extract showed the presence of carbohydrates, proteins, amino acids, phenolic compounds, and flavonoids. The antinociceptive activity of the bark extract may be due to the presence of phytochemical constituents such as flavonoids [60].

Osteogenic Activity: One new isoflavone glucoside, caviunin 7-O-[β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside] and a new itaconic derivative, (E)- 4-methoxy- 2- (3,4-dihydroxy benzylidene)-4-oxobutanoic acid along with series of isoflavones and flavonols with their glucosides, and a lignan glucoside was isolated from the ethanolic extract of *Dalbergia sissoo* leaves and were assessed for osteogenic activity in primary calvarial osteoblast cultures. The result showed that compounds exhibited significant osteogenic activity [61].

Anti-spermatogenic Activity: A study was undertaken to evaluate the anti-spermatogenic efficacy of ethanol extract of stem bark of *Dalbergia sissoo* Roxb. For the *in vitro* study, semen samples were obtained from 15 healthy fertile men aged 25–35 years. Sperm motility was examined by the Sander-Cramer method. Ethanol extract at a concentration of 20 mg/mL caused complete immobilization within 3 minutes. The in vivo studies ethanol extract at a dose of 200 mg/kg body weight resulted in a significant decrease ($p< 00.01$) in weight of the testis and epididymis. A significant decrease ($p<0.01$) in sperm motility and sperm count in the epididymis were observed. Histological changes in the epididymis and testis were also investigated [62].

Gastro Protective Action: This study was conducted to evaluate the antiulcer effects of *D.*

sissoo stem bark methanol extract (DSME) against the diclofenac sodium-induced ulceration in rats. The results of this study showed that DSME exhibits a potential gastroprotective activity probably due to its antioxidant and cytoprotection ability [63].

Neuroprotective Action: This research was performed in 3- Nitro propionic acid-induced neurotoxic rats to characterize the neuroprotective effect of ethanolic extract of *Dalbergia sissoo* leaves. The ethanolic extract of *Dalbergia sissoo* leaves was administered 300 and 600mg/kg orally to neurotoxic rats. These results suggest that ethanolic extract of Dalbergia sissoo leaves may have potential therapeutic value in various neurological disorders, probably by its antioxidant, anti-inflammatory and estrogenic properties [64].

Anti-molluscicidal Activity: The crude aqueous and ethanolic extracts from different parts of *Dalbergia sissoo* were evaluated against egg masses and adults of *Biomphalaria pfeifferi* the intermediate snail host of *Schistosoma mansoni* in Nigeria. Only the ethanolic extracts of the fruits and roots showed significant activities against the adult snails and their egg masses, while all other extracts demonstrated weak molluscicidal and ovicidal activities [65].

Anti-larvicidal Activity: Studies were carried out to evaluate the growth inhibitor, repellent action & anti-larvicidal action of *D. sissoo* oil against *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus* under laboratory conditions. The oil also showed strong repellent action when oil was applied on exposed parts of human volunteers. They were protected from mosquito bites for 8±11 h. The protection obtained with sissoo oil was comparable to that with commercial Mylol oil consisting of di-butyl and dimethyl phthalates [66].

Antiulcer Activity: This study evaluates the Antiulcer activity of crude ethanolic bark extract of *Dalbergia sissoo* using pylorus ligation and Indomethacin induced ulcer model in Wistar albino rats. The antiulcer effect of EBED may be due to any of the probable mechanisms *viz*. reduction in gastric acid secretion, antioxidant action, much protection, or gastric cytoprotection attributed by the presence of various secondary metabolites [67].

Immunomodulatory Activity: The Immuno-modulatory effect of *Dalbergia sissoo* bark by using four methods named as Humoral immune response, WBC count, cellular immune response, and Carbon clearance test. Administration of *Dalbergia sissoo* produced a significant stimulation of the immune system.

The Metabolic extract of *Dalbergia sissoo* bark dose of 250 and 500 mg/kg body weight was used. Control saline (0.9% w/v NaCl) was used as a general vehicle. Administration of *Dalbergia sissoo* produced a significant stimulation of the immune system, and also, it can be concluded that the immunostimulatory property of extract was dose-dependent [68].

Antibacterial Activity: Antibacterial activity of ethanolic, distilled water and methanol extract of the leaves of *Dalbergia Sisso* Roxb. was studied against Escherichia coli and Bacillus licheniformis by agar well diffusion method.

The growth of both *E. coli* and *B. licheniformis* was inhibited by all three extracts of dried leaf extracts of *Dalbergia sisso* Roxb. The root extracts of *Dalbergia sissoo* Roxb. have potent antibacterial activity when compared with conventionally used drugs and is almost equipotent to the standard (gentamycin) antibacterial drug [69].

TABLE 2: LIST OF DIFFERENT SPECIES OF *DALBERGIA* GENUS [70-71]

S. no.	Species	S. no.	Species
1	(Rosewood) *D. abrahamii*	26	(Bombay Blackwood) *D.latifolia*
2	(Burmese Rosewood) *D. bariensis*	27	(Bois de Rose) *D. maritima*
3	(Palisander) D. baronii	28	(African Blackwood) *D. melanoxylon*
4	(Caroba-Brava) *D. brasiliensis*	29	(Canela-De-Buro) *D. miscolobium*
5	(Brown's Indian Rosewood) *D. brawenei*	30	(Rosewood) *D. mollis*
6	(Granadillo) *D. calacina*	31	(Bejuco De Peseta) *D. monetaria*
7	(Dalbergia) *D. candenatensis*	32	(Bahia Rosewood) *D. nigra*
8	(Jacarand) *D. catingicola*	33	(Fragrant Rosewood) *D. odorifera*
9	(Brazilian Kingwood) *D. cearensis*	34	(Bruma Rosewood) *D. oliveri*
10	(Rose Wood)*D. cochinchinensis*	35	(Dalbergia) *D. palauensis*

11	(Granadilo) *D. cubilquitzensis*	36	(Dalbergia) *D. palauensis*
12	(Bruma Blackwood) *D. cultrata*	37	(Akar laka) *D. parviflora*
13	(Bruma Blackwood) *D. cultrate varcultrata*	38	(Nambar) *D. retusa var retusa*
14	(Bastiao-De-Arruda) *D. decipularis*	39	(Rabo-De-Guariba) *D. riparia*
15	(Bejuco De Peseta) *D. ecastaphyllum*	40	(Malabar Blackwood) *D. sissoides*
16	(Mussuta) *D. elegans*	41	(Indian Rosewood) *D. sissoo*
17	(Jacarand-Rosa) *D. foliolosa*	42	(Sabuarana) *D. spruceana*
18	(Jacaranda-Rosa) *D. frutescens*	43	(Rosewood) *D. stevensonii*
19	(Pau-De-Estribo) *D. frutescens var frutescens*	44	(Vernica) *D. subsymosa*
20	(Jacarand-Rosa) *D. frutescens var tomentosa*	45	(Rosewood) *D. trichocarpe*
21	(Ebano) *D. funera*	46	(Dalbergia)*D. tucurensis*
22	Tripa-De-Galinha) *D. gracilis*	47	Heliotropio) *D. villosa*
23	(Sebastiao-De-Arruda) *D. hortensis*	48	(Heliotropio) *D. villosa var barretoana*
24	(jacaranda) *D. inundata*	49	(Rosewood) *D. xerophila*
25	(Shisham) *D. lanceolaria*	50	(Yucatan Rosewood) *D. yucatensis*

CONCLUSION: *Dalbergia sissoo* has many types of pharmacological effects due to its active phytoconstituents. *Dalbergia sissoo* is traditionally used to treat various systemic complications; therefore, it requires further phytochemical and pharmacological research on plant parts of *Dalbergia sissoo*. This review will help researchers to make advancements in the traditional use of different plant parts of *Dalbergia sissoo*. This review will help to do research work on the different species of *Dalbergia* genus.

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