Phytology

Indian rosewood: a versatile tree for economic prosperity

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Abstract

Nature has been an authentic source of medicinal compounds for a long time. Numerous new medications have been identified from natural sources, many of which have been chosen for their application in conventional medicine. Around the world, people have been using a variety of medicinal plants to treat illnesses and for health for many years. The current investigation reveals that *Dalbergia sissoo* has a good source of medicinal properties, which belongs to the family: of Fabaceae. We discussed phytochemistry in this message and how it can be used to treat a range of illnesses. There are 300 species in the genus, 25 of which are found in India. The 18th-century Swedish brothers Nils and Carl Dalberg are honored by the generic name Dalbergia. The plant is used to treat syphilis, gonorrhea, leprosy, and jaundice, among other conditions. It is also known as a large deciduous multipurpose timber tree. The wood is highly regarded as utility and construction timber due to its strength, durability, and elasticity.

Keywords: *Dalbergia sissoo*, chemical constituents, ecological and economic use

Introduction

Dalbergia sissoo (Sheesham) is a valuable plant in India, also known as Indian rosewood, which has potential income through agroforestry and timber wood. It can be grown naturally without any human care and grows widely in India. As it is grown in a wide range in various parts of the India and can cover up to 900 m on the sub-Himalayan ridges, occasionally reaching as much as 1500 m (Srivastava *et al.*2020) [52]. *Dalbergia sissoo* is usually found in Pakistan, India, Afghanistan, Bangladesh, Persia, Iraq, Palestine, India, Malaysia, Thailand, Indonesia, Cyprus, Cameroon, Ethiopia, Mauritius, Nigeria, Sudan, Zimbabwe, Kenya, Tanzania, and the United States of America (Bhattacharya M *et al.*2014) [9]. *Amerimnon sissoo* (Roxb.) Kuntze, Coroya Pierre, *Amerimnon* P. Browne, *Ecastaphyllum* P. Browne, *Miscolobium* Vogel, *Triptolemea* Mart (Bharath *et al.*2013) [8] It is growing at altitudes from 0 to 1500 m. It usually grows in sandy loamy soil but can be grown in alluvial soil providing proper water content to the plant. The Sheesham tree plays an important role in the ecological role in India. It improves soil fertility, prevents soil erosion, and helps in the conservation of water. Additionally, the Sheesham tree is a source of food and shelter for a variety of wildlife, including birds, insects, and mammals. Species of Dalbergia genus are *Dalbergia abbreviata*, *Dalbergia acuta*, *Dalbergia albiflora*, *Dalbergia baker*, *Dalbergia assamica*, *Dalbergia beccarii* and many more. Many diseases in developing countries can be cured with the use of herbs. Medicinal plants are the source of traditional medicines (Shukla, *et al.*, 2000) [50]. In India to the use of plants as medicines has been contributed and has a major part of health care system (Chandra *et al*., 2015) [12]. Sheesham is known for its medicinal properties. It is known to be used as aphrodisiac, abortifacient, anticipaterant, anthelmintic and antipyretic (Yasmeen *et al*. 2016) [61]. It is used to treat conditions such as emesis, ulcers, leucoderma, dysentery, stomach problems and skin disorders (Nikum *et al*.2021) [35]. In many diseases, different parts of plant use to cure the diseases such as skin diseases, blood diseases, syphilis, stomach problems, dysentery, nausea, eye and nose disorders, aphrodisiac, expectorant. *Dalbergia sissoo* is antidiarrheal as it affects bacterial virulence. However, it has no antimicrobial activity (Brijesh *et al*.2006) [11]. There is total 300 species in the genus in which 25 are found in India. Dalbergia trees are valuable timber trees that come in a variety of species. The wood is rich in aromatic oils and fragrant (Neeru Vasudeva *et al*., 2009) [34]. The process of isolating flavones, isoflavones, quinines, and coumarins from *Dalbergia sissoo* that have been shown to exhibit biological activity. It also contains 7-hydroxy-4-methylcoumarin, tectoridin, caviunin-7-O-glucoside, iso-caviunin, tectorigenin, dalbergin, and bio-chanin A. biochanin A, dabergichromene, dabergenone, iso-dalbergin, and 3,5-dihydroxy-trans-stibene were all found in the heartwood (Seshadri, 1972) [48].

Taxonomic classification (Vikrant A *et al.*, 2011) [58]

Domain: Eukaryota, Kingdom: Plantae, Division: Magnoliophyta, Phylum: Tracheophyta, Class: Mangnoliopsida, Tribe: Dalbergieae, Genus: *Dalbergia*, Species: *Sisso*, Binomial name: *Dalbergia Sisso*.

Botanical description

The *Dalbergia sissoo* tree is a medium-sized to large tree that grows to a height of about 25 meters. Its trunk is 2-3 meters in diameter and is grey-yellow. Thin and widely dispersed crown. The bark is thin, grey furrowed longitudinally, and exfoliates in narrow strips. It begins to grow a long taproot at a young age and has many lateral ramifying roots (Troup *et al*., 1921) [54]. Each leaflet is 4 -6 cm long with a finely pointed tip and the

surface of the leaf is leathery, pinnately compound, with alternating leaflets and petiolated leaf stalk. The leaves measure approximately 15 cm in length. Pale white to dull yellow flowers, 5-6 mm in length with racemes 2.5-3.7 cm long in short panicles axillary also fragrant, nearly sessile, and in dense clusters. Pods are 5.7 cam x 8.13 mm, glabrous, indehiscent, and slender at the base, with 1-4 seeds. The kidney-shaped, thin, flat, light brown seeds measure around 6-8 x 4-5 mm. The seeds are hard and dry. The color of heartwood varies from dark brown to golden, while the sapwood is white to pale brown (Orwa agroforestry database, 2009) [38]. A spreading crown is supported by large upper branches whereas young shoots are drooping and downy. Stems have light brown to dark grey bark that can be up to 2.5 cm (0.98 in) thick and shed in narrow strips. It can be easily propagated by seeds or stump planting. Stump planting is the most successful method to propagate *D. sissoo*. For making stumps, 1–2-year-old seedlings with collar diameters more than 1 cm are used and they are cut in such a manner that the root is kept 25 cm and a shoot 2.5 to 3 cm. Stumps are planted during the third week of March or April (Bari *et al*., 2008) [6].

Chemical constituents in different parts of *Delbergia sissoo*

Leaves have Isoflavone-O-glycoside, whereas flowers contain Biochenin A, tectorigenin, 7, 4 dimethyl tectorigenin, and 7-O-methyl tectorigenin. Green pods and Mature pods have Mesoinisitol, 7-O- methyl tectorigenin, and 4'-rhamnoglucoside and socaviumin, tectorigenin, dalbergin, caviunin, and tannins respectively. Stem bark contain Dalberginone, dalbergin, methyl dalbergin and dalbergichromene. Also, Hardwood have Dalbergin, nordalberginones, dalbergichromene, fixid oil and essential oils (Son *et al*., 2022) [53].

Phytochemistry

Several plant compounds, including flavonoids, isoflavonoids, glycosides, steroids, quinines, and others, have been identified in diverse species belonging to the genus Dalbergia. It's important to note that the specific phytoconstituents can vary among different species within the genus Dalbergia. The isolation and identification of these compounds are typically carried out through methods such as chromatography and spectroscopy (Verma *et al*., 2015) [57]. Additionally, the presence and concentration of phytoconstituents can be influenced by factors such as plant part, age, environmental conditions, and geographical location. phytochemicals that are commonly found in various plant species, including those in the Dalbergia genus: Quercetin: A flavonoid with antioxidant properties (Farag *et al*., 2001) [17]. Kaempferol: Another flavonoid known for its antioxidant and anti-inflammatory properties. Genistein: An isoflavonoids with potential health benefits. Daidzein: Other isoflavonoids commonly found in leguminous plants. β-Sitosterol: A plant sterol with potential cholesterol-lowering properties. Epicatechin: A flavonoid with antioxidant effects, found in foods like chocolate and tea. Rutin: A glycoside that belongs to the flavonoid group, known for its antioxidant properties. Quinones: Compounds with potential medicinal properties and involvement in redox reactions. Tannins: Polyphenolic compounds that may have antioxidant and anti-inflammatory effects. Coumarins: A class of phytochemicals with diverse biological activities.

Dalbergia sissoo leaf extractive values were as follows: 4.88±0.04% for chloroform extract, 9.82±0.02% for ether extract, 7.81±0.91% for hexane extract, 8.86±0.48% for petroleum extract, 22.78±0.81% for ethanol extract, 28.74±0.71% for 70% ethanol extract, 21.47± 0.01% for methanol extract, and 18.94± 0.74% for aqueous extract. Water soluble ash: 4.2±0.90%, water insoluble ash: 7.8 ± 0.91, total ash: 8.43–12.00%, acid insoluble ash: 3.33 ± 0.97% (Rashida *et al*.2012) [45].

Pharmacological or biological activities

Anti-inflammatory

The anti-inflammatory activity of hexane and methanol extracts of *Dalbergia sissoo* and okanin was evaluated by carrageenan-induced paw oedema in rats (Behera *et al*.2013) [7]. An assessment was conducted on the anti-inflammatory properties of the ethanolic *Dalbergia sissoo* bark extract. In comparison to the other groups (300 and 500 mg/kg), the ethanolic extract at 1000 mg/kg demonstrated the strongest anti-inflammatory activity throughout the observation period, it can be concluded (Asif M *et al*.2009) [3].

Antiplasmodial activity

The air-dried powdered heartwood of *D. louvelli* contained flavonoids that exhibited Antiplasmodial activity, with IC 50 values ranging from 5.8 to 8.7 um. (Beldjoudi *et al*., 2003) [33].

Anti-diabetic

In 2010, Pankaj Singh Niranjan *et al*. studied the effects of *Dalbergia sissoo* leaf ethanolic extract on diabetic rats that had been given alloxan. They concluded that, when compared to regular Glibenclamide, the ethanolic extract of the leaves is 12% more effective at lowering blood glucose levels (Niranjan *et al*., 2010) [36].

Antimicrobial activity

Gram-positive bacteria (*Bacillus subtilis*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*) and gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, and *Yersinia pestis*) have been demonstrated to be significantly resistant to the citric acid extract of *D. melanoxylon* bark. The plant may have antifungal properties against *Aspergillus niger* and *Candida albicans* (Sahu *et al*.2023) [46].

Osteogenic activity

The osteogenic potential of n-butanol extract (also known as butanol soluble standardized fraction, or BSSF) from *Dalbergia sissoo* leaves was investigated in ovariectomized rats, a model for osteopenia following menopause. Overall, 17-β-estradiol and BSSF both had similar osteoprotective effects (Khedgikar *et al*., 2012) [26]. Caviunin 7-O-[β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside] is one novel

isoflavone glycoside. as well as (E)-4-methoxy-2-(3, 4-dihydroxybenzylidene), a novel itaconic derivative. The ethanolic extract of *Dalbergia sissoo* leaves contained 4-oxobutanoic acid, a few isoflavones and flavanols with their glucosides, and a lignan glucoside. The osteogenic activity of these compounds was evaluated in primary calvarial osteoblast cultures. The compounds had significant osteogenic activity, according to the results (Dixit *et al*.2012) [15].

Anti-arthritic activity

Young, growing albino rats were used in tests to determine the effectiveness of petroleum ether, alcohol, and aqueous extracts of *D. lanternia* against formaldehyde-induced arthritis. The results of the extracts were like those of cortisone, a common medication used to treat arthritis and reduce inflammation (Amrutkar *et al*.2017) [1].

Anti-helminthic potential

Dalbergia sissoo anti-helminthic activity was identified. The study demonstrated *Dalbergia sissoo's* potential efficacy in treating helminthic infections (Upwar *et al*.2011) [55].

Antioxidant activity

Extract of bark of *Dalbergia sissoo* Roxb. (Fabaceae) was evaluated for its antioxidant activity by in-vitro methods. Antioxidant activity was studied using hydrogen peroxide scavenging activity and reducing power assay by Lakshmi and colleagues (Lakshmi *et al*.2014) [30]. The ethanol extract of the *Dalbergia sissoo* bark was investigated for lipid peroxidation inhibitory (LPO). This extract showed 69.1% LPO inhibitory potential/10 µg of extract (Kumari *et al*.2008) [29]. The antioxidant activity of the aqueous and methanol extracts of the stembark of *Dalbergia sissoo* was assessed by 1,1- diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity, ferric ion reducing power, ferrous ion chelating activity and gold nanoparticle formation potential. Ultimately, the results demonstrated that, in various in-vitro antioxidant tests, the methanolic extract demonstrated moderate activity while the chloroform extract of the plant's stem bark displayed significant antioxidant activity (Kaur *et al*., 2011) [24].

Antiparasitic activity

In 2011, Hood *et al.* evaluated the antihelmintic activity of several *Dalbergia sissoo* leaf extracts, including petroleum ether, carbon tetrachloride, benzene, and ethanol, against Indian earthworms (*Pheretima posthuma*) at varying concentrations (10, 25, 50, and 100 mg/ml) and compared the results with piperazine citrate. The larva-killing, growth-inhibiting, and repellent actions of *Dalbergia sissoo* oil were studied against *Anopheles stephensi*, *Aedes aegypri*, and *Culex quinquefasciatus* and found to be highly effective for *Culex quinquefasciatus* and *Anopheles stephensi* (Rana *et al*., 2019) [42].

Analgesic and antipyretic effects

The ethanol extract of *Dalbergia sissoo* seeds was tested for its phytochemical, analgesic, and antipyretic properties. The extract from *Dalbergia sissoo* seeds was found to have notable antipyretic and mild analgesic properties (Hugar *et al*., 2010) [22].

Antiulcerogenic activity

Indomethacin, ethanol, pylorus ligature, and hypothermic-restraint stress have all been shown to cause gastric lesions that can be inhibited by *D. monetaria's* lyophilized aqueous extract (LAE) when taken orally. Any of the possible mechanisms, such as decreased gastric acid secretion, antioxidant action, increased protection, or gastric cytoprotectant brought on by the presence of different secondary metabolites, could account for the antiulcer effect of EBED (Baral *et al*.2016) [5].

Utilizing *Dalbergia sissoo* as the most suitable fodder tree

Rich in crude protein and vital minerals, this leaf fodder is highly nutritious and tasty. Low levels of crude fiber are found in leaves. A high 56% digestibility of dry matter. It gives food for a longer time as it doesn't have leaves for a short while (November to January). Grown in nearly all the country's agroclimatic zones, it guarantees green, nutritious fodder during dry periods and summers when other sources are unavailable. It is a fast-growing, multipurpose tree that is suitable for use in agroforestry, as well as boundary, block, and wastelands forestry (Datt *et al*. 2008).

Table 1

Acid Detergent fibre	38.80%
Hemi cellulose	15.08%
Cellulose	23.37%
Acid detergent lignin	8.98%
Calcium	1.89%
Phosphorus	0.20%
Iron	57.67mgkg-1
Calcium	10.12 mgkg-1
Zinc	15.81 mgkg-1
Manganese	175.45 mgkg-1
Copper	0.17 mgkg-1

***Dalbergia sissoo* in agroforestry**

Production of Timber of Indian rosewood is well known for producing visually beautiful and long-lasting timber. By including this species in agroforestry, a valuable source of wood for building, furniture, and other uses may be sustained (Ijaz *et al*., 2021) [23]. Soil Improvement in Indian rosewood deep roots can help to reduce erosion and enhance the structure of the soil. Because of the tree's leaf litter, the soil becomes more fertile by retaining more organic stuff. Biodiversity Enhancement offering a home and food for a variety of plant and animal species, and agroforestry using Indian rosewood may promote biodiversity. This improves the resilience and general health of the ecosystem. Carbon Sequestration of Trees, such as Indian rosewood, are essential for storing carbon and preventing global warming. This plant is used in agroforestry practices that support overall environmental sustainability and carbon storage. Support for Livelihood as Growing Indian rosewood can help farmers financially (Yadav

et al.2008) [60]. Local lives can be supported by the sale of forest products, including timber, which can serve as an extra source of income. Windbreak and Shade as Indian rosewood acts as a good windbreak, shielding crops from severe gusts because of its thick canopy. It also offers much-needed shade, which is advantageous for crops that do well in partially shaded environments. Medicinal use of Indian rosewood has long been used for certain medical purposes. By using it in agroforestry systems, it may be possible to get therapeutic items that improve health and well-being (Kaur A. *et al*. 2011) [24] The beauty of Indian rosewood can add to the overall aesthetic appeal of agroforestry settings. Additionally, this may open up possibilities for leisure or ecotourism. Water Conservation by reducing soil erosion and increasing water infiltration, Indian rosewood's deep roots contribute to water conservation. This can be especially helpful in areas where water is scarce. Production of Firewood and Fodder in addition to timber, Indian rosewood may supply firewood for domestic energy requirements (Patil *et al*.2004) [39] Furthermore, cattle can be fed on the leaves and twigs of the tree.

Ecological uses

Numerous services related to agro-forestry and the environment are offered by *Dalbergia sissoo*. In intercropping orchards, mango, tea, and coffee plantations, it serves as a shade tree, wind break, and shelter belt. With its suckers, the root system is frequently employed along stream and river banks to stabilize the soil and prevent soil erosion. It is a commonly used plant for reforestation and nitrogen fixation. It is planted as an ornamental plant by the side of roads and in gardens because of its fragrant flowers and shade (Kaur A *et al*.2011) [24].

Economical use

Furniture Manufacturing in Indian rosewood's strength, durability, and aesthetic appeal make it a popular material for high-quality furniture construction. It is also used in musical instruments because of its exceptional acoustics, wood is highly valued for use in the construction of stringed instruments like guitars and sitars (Arunkumar AN *et al*. 2022) [2]. For craftmanship and arti crafts the wood is frequently utilized to create elaborate carvings, handicrafts, and artistic, adding to the area's creative and cultural legacy. Economic Impact and Trade effects of the Indian rosewood trade, including its support of regional economies and any sustainability-related issues, may be brought to light by research (Bansal *et al*.2021) [4]. Cabinetmaking and joinery as because of its ability to take excellent finishes and resilience to decay, Indian rosewood is used in high-end cabinetmaking and joinery work. Used in construction and interior designing because Indian rosewood is durable and termite-resistant, it is used in construction to make flooring, window frames, and doors (Biswas *et al*.2017) [10]. Agroforestry and Biodiversity Conservation in Indian rosewood may be used in agroforestry systems to increase farmers' income while supporting conservation and biodiversity. Carbon sequestration and climate change mitigation as a hardwood with a moderate growth rate, Indian rosewood helps sequester carbon and may help reduce the effects of climate change (Chopra *et al*.2023) [13].

Conclusion

In summary, *Dalbergia sissoo*, sometimes referred to as Indian rosewood or Sheesham, is a multipurpose plant that is both commercially valuable and adaptable. It is an important resource for many industries because of its vast distribution range and natural development without the need for intense human care. From an ecological perspective, Sheesham is essential for preventing erosion, enhancing soil quality, and conserving water. Its dense roots improve fertility, inhibit erosion, and stabilize the soil. They also increase infiltration, which helps conserve water. Moreover, its contribution to agroforestry systems extends beyond financial gains, as it offers crops shelter and windbreaks while also promoting biodiversity and carbon sequestration. cultural importance as well as the possibility for more pharmaceutical study. Sheesham has a long history of usage in medicine and is known for a variety of benefits, such as aphrodisiac, abortifacient, expectorant, anthelmintic, and antipyretic. The plant's use in traditional medicine is indicative of both its cultural importance and its potential for further study in pharmacology. Indian rosewood has demonstrated its economic value across a range of businesses. It is a highly sought-after material because of its strength and visual appeal in the furniture industry. The wood's usage in craftsmanship and creativity enhances its economic worth, and its acoustical qualities make it an attractive material for making musical instruments. Sheesham offers farmers a chance to diversify their revenue streams in agroforestry by producing lumber and adding it to intercropping systems increases farm output in general. Additionally, the plant supports lives by giving important fuel and timber. Its contribution to economic growth goes beyond regional markets into global trade, where there is room for sustainable export and exploitation. *Dalbergia sissoo's* phytochemical makeup, which includes coumarins, quinines, isoflavones, and flavones, lends even more relevance to the plant. The biological activities of the plant, including its anti-inflammatory, anti-diabetic, antioxidant, and osteogenic qualities, highlight its potential for use in nutraceutical and pharmaceutical products. Essentially, the thorough investigation of *Dalbergia sissoo* reveals its many characteristics, including its role as an ecological protector, a traditional medicine supplier, and a mainstay in multiple industries. To maximize its advantages and guarantee the survival of this priceless plant in the Indian environment, conservation and sustainable management initiatives are essential.

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