# Brief Review on Indian Rosewood

**Miss. Gayatri S. Bhange[1], Dr. Nitin B. Kohale[2], Dr. Harigopal .S. Sawarkar[3]**

[1]Student, [2]Professor, [3]Principal
Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Dist. Amravati-444602, Maharashtra (India)

**Abstract**
**Dalbergia latifolia Roxb., a tree species that is highly prized and significant to the global economy, is known for its Indian rosewood. In its native habitats across the world, D. latifolia is sporadically found. In addition to being used in plywood, veneer, carved wood items, and furniture it well known worldwide for its application in the guitar business. With its distinct sound characteristics and exquisite wood grain, it is regarded as a classic material used in guitar construction. Due to the wood's high demand and increasing scarcity, there is an illicit trade and overharvesting. Globally, the natural populations have been rapidly declining as a result of habitat degradation. The best trees have already been taken out for commercial purposes, and rosewood forests are seriously in danger of disappearing.**

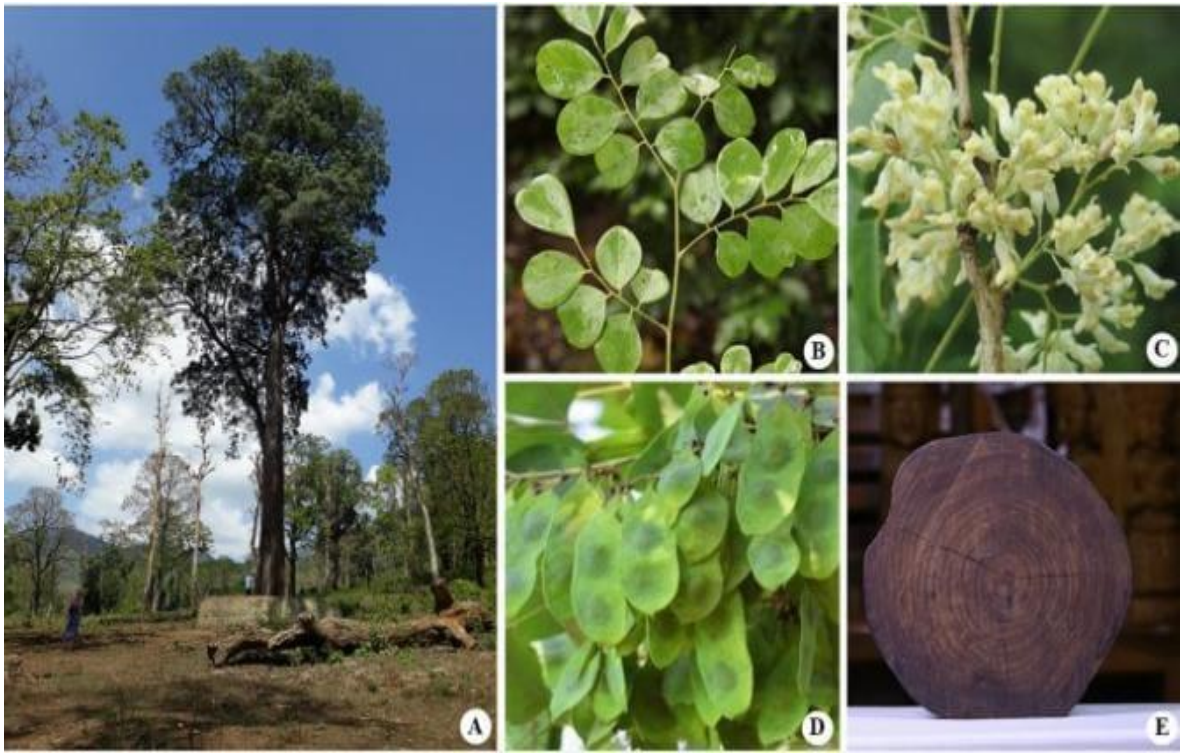
**Keywords: Tree, Guitar, Valuably Important Dalbergia Latifolia, Forest, Anti Inflammatory**

## INTRODUCTION

The most well-known usage of D. sissoo, sometimes called the Indian rosewood tree (Shisham in (Hindi), is as lumber. Shisham is used for shelter, shade, and fuel wood, but it also has medical applications. Numerous bio modulatory actions, including osteogenic activity [2], Anti spermatogenic activity [3], antibacterial activity [4], and anti-inflammatory activity [5], have been documented by researchers. Significant analgesic, bronchodilator, and oestrogen-like properties were demonstrated by extracts from aerial portions [6]. Blood diseases, scabies, eye and nose illnesses, burning feelings, boiling urine, stomach issues, syphilis, boils, eruptions, leprosy, and nausea have all been treated with Yunani wood in traditional medicine. The antibacterial, antiprotozoal, and anti-inflammatory properties of dried leaves where demonstrated, and leaf juice has been shown to treat eye conditions.[7-9]. Bark extracts with active ingredients include flavonoids, carbs, phenolic chemicals, and tannins. It has been demonstrated to have qualities including abortifacient, anthelmintic, antipyretic, aperitif, aphrodisiac, expectorant, and refrigerant in the ayurvedic medical system. It is also used to treat skin conditions, dyspepsia, dysentery, and anal issues [10]. Therefore, thorough research is needed to identify and purify bioactive chemicals as well as determine any potential mechanisms of action that may be involved intreating these medical disorders .Rosewood is a member of the Papilionoideae subfamily of Fabaceae. The wood, which comes from trees in the genera Tipuana, Pterocarpus, or Dalbergia, is characterized by its darkness and fine grain. Other species of trees may also be sold under this name [11], as this wood has long been valued for excellent woodworking and musical instruments. True Rosewoods are derived from Dalbergianigra wood and are highly prized in the west. One of the world's most diversified ecosystems, the coastal Brazilian Atlantic Forest, is home to the rare Brazilian rosewood. The Brazilian Atlantic Forest is home to over 8,000 different plant species, with Brazilian rosewood being among the largest at 40 meters high [12]. Additionally, its dark branches that develop in zigzag patterns help identify .by its plumed leaves. Because of its strength and weight, the lumber is extremely resistant to deterioration and insect damage. As a result, it is highly sought after in local markets as a building material for wall paneling/lining, flooring, and structural beams. Because of its exceptional resonance, its wood is also used globally to create musical instruments [12].The Honduran rosewood grows In Belize, Central America, and yields timber that is highly prized globally for its usage in the manufacture of musical instruments. Honduras Rosewood is highly appreciated in the manufacturing of symphonic xylophones and claves because it provides hard, heavy, resilient, and highly resonant timber that, when struck, produces a clear, loud note (www.arkive.org). Additionally, it's utilized to create thin coatings

for high-end cabinets and furniture, as well as knife handles (www.arkive.org). This species is primarily found in the rural areas of South Western Nigeria, DR Congo, and Ghana. This resilient wood, sometimes known as Rosewood, is widely used for furniture, flooring, and ornaments globally [13]. Pterocarpus erinaceous (West African Rosewood) is a medium-sized, deciduous tree measuring 12-15m tall [14]. The bark surface is brownish-blackish, with thin inner bark that exudes red sap when sliced. Traditionally, the species is employed for producing high-quality charcoal and building construction, particularly by local communities. The species is usually found in the forest savannah transitional zone and parts of the northern savannah woodland ecological zone [14]. Previously, Rosewood timber was used regionally, but its popularity has increased. There are 10 areas in Ghana; Ashanti, Brong-Ahafo, Northern, Upper East, Upper West, and Volta are the six regions where Rosewood is located [14]. Only Ghana's savannah regions—particularly the Northern and the Brong-Ahafo regions—are home to rosewood. Ghana began exporting rosewood in 2005. Both the volume and value of exports have steadily increased. With an average share of 96% of all imports, China is the main market for Ghanaian Rosewood [14]. Ghana implemented a complete prohibition on the harvest and export of rosewood on January 1, 2014 [15]. The indiscriminate felling of rosewood, for which there is a strong demand on the global market, prompted this action. Businesses licensed to export rosewood had, from October to December,2013 to handle all of the existing rosewood stocks prior to the implementation of the ban [15]

**Dalbergia latifolia Roxb: Indian rosewood**




Rosewood is a name that is primarily used to characterize taxa from many genera, although it is most frequently used in reference to some species of Dalbergia (Soerianegara and Lemmens 1994). According to the United Nations Office of Drug and Crime (UNODC 2016), the term "rosewood" is a general phrase used to refer to any tropical hardwood that is fragrant and has beautiful colours. It is frequently linked to species from the CITES-listed genera Dalbergia and Pterocarpus. The main distribution regions of these species are Latin America, West and East Africa, and South and Southeast Asia. In this review, we concentrate on D. latifolia, also referred to as Indian rosewood outside of India. Despite the fact that India is home to various Dalbergia species, such as D. sissoo and D. sissoides, the word "rosewood "Several vernaculars or common names are used to identify D. latifolia (Fig.1), including sitsal, beete, shisham (India); sati-sal (Nepal); sonokeling, sonobrits (Indonesia); palisandre de l'Inde (French); Indisher Rosenholzbaum (German);Bombay blackwood, Malabar rosewood, Indian rosewood, trắc (Vietnamese), sonokeling,

sonobrits, and sonosungu (Java); rosewood (trade name) (Winfield 2016). Being a nitro-gen-fixing tree, Indian rosewood [D. latifolia syn. D. emarginata Roxb. Syn Amerimnon latifolium (Roxb.) Kuntze.] possesses all the qualities needed to be an appropriate species for agro-forestry (Thothathri 1987; Legume Web 2019; WFO 2021a). With 2n = 20 chromosomes, Dalbergia is a fully diploid genus (Atchison 1951; Hiremath and Nagasampige 2004). Aeschynomenoid-type root nodules seen in over 50 species of Dalbergia aid in the fixation of nitrogen (Sprent 2009). It is also cultivated as a shade tree on coffee farms in South India (Lemmens 2008). As feed, the leaves are utilized (Praciak 2013). The tree's many parts are utilized and have traditional medical uses.And as a treatment for worm infections, leprosy, obesity, diarrhea, dyspepsia, and cutaneous infections (Nair 1986; Kare 2007; Lemmens 2008).Globally, the wood has a considerable commercial value. According to Jenkins et al.(2012) and Winfield et al. (2016), the global market values of D. latifolia in 2012 were US$ 49,656/m³ for planks and US$ 16,575/m³ for sawn wood. In their Government Order of 2015, the State Forest Department of Kerala, India (Kerala Forest Department 2015) set the minimum price for export quality(Grade B) at INR 3.5–3.8 lakhs (US$ 5000–6000)/m3, while the price for wood for local consumption was INR 3.6 (US$ 5200) lakhs/m3. According to Kerala Forest Department (2015), the cost of Grade A (export) teak (Tectona grandis L.) wood is INR 155,260/m3 (US$ 2200), whereas mahogany (Swietenia spp.) wood is INR 38,290/m3 (US$ 550). Only comes Indian rosewood for sale .The Government Order of 2015 set the minimum price for export quality (Grade B) at INR 3.5–3.8 lakhs (US$ 5000–6000)/m3, while the price for wood for local consumption was INR 3.6 (US$ 5200) lakhs/m3. According to Kerala Forest Department (2015), the cost of Grade A (export) teak (Tectona grandis L.) wood is INR 155,260/m3 (US$ 2200), whereas mahogany (Swietenia spp.) wood is INR 38,290/m3 (US$ 550). Indian rosewood isn't marketed for retail; it's exclusively available through government depots and auctions. An ancient D. latifolia tree sold for over US$ 9800/m3 at an auction hosted by the Kerala Forest Department in 2018 (Manoj 2018). India exported rosewood to more than six nations(CITES Trade Database).India exported rosewood valued at US$0.33 million in (2020–2021 (Apr–Nov) (GoI 2021). Only timber from government warehouses is exported. The primary supply of rosewood is found in natural forests, therefore illegal felling and exploitation of these populations puts a significant strain on the species' ability to survive. Therefore, the Indian Forest Act of 1927 provides protection for D. latifolia. According to Winfield (2016), the only authorized sources of Indian rosewood timber are those recognized by State Forest Development Corporations and State Forest Divisions, who adhere to the National Working Plan Code's guidelines.

## MATERIALS AND METHODS

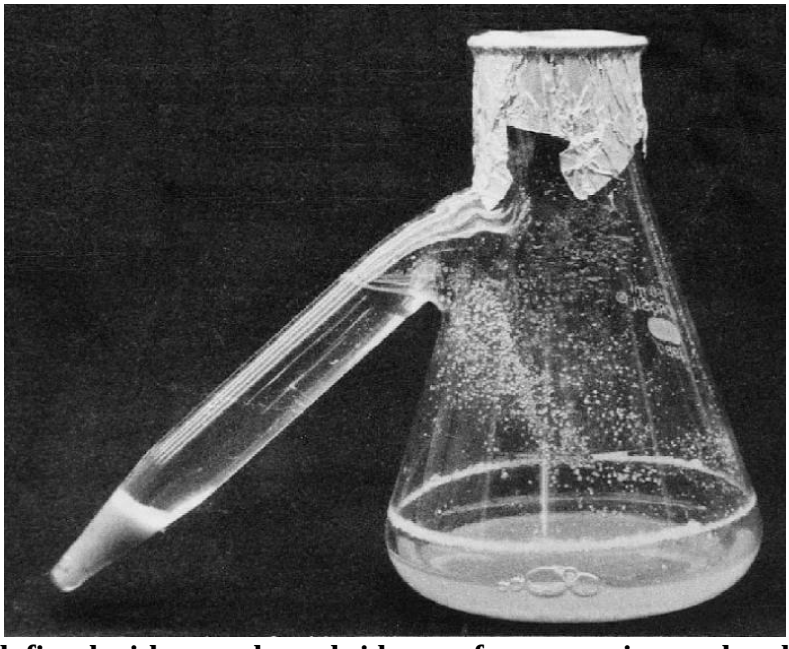


**Fig.1 A culture flask fitted with a graduated side arm for measuring settle cell volume of the cell suspension culture**

Materials and procedures Beginning of suspension culture of cells Mature and healthy Dalbergia latifolia Roxb. Seeds were rinsed five or six times in sterile distilled water after being treated for ten minutes in a 0.1% aqueous solution of HgCl2. Plant growth regulators were not used in the germination of seeds in 30-ml screw-capped glass tubes filled with half-strength Murashige and Skoog (1962) medium (MS). In order to induce callus, 7-day-old axen-ic seedlings were cut into hypocotyl and cotyledon segments, which were then placed in 100-ml Erlenmeyer flasks (Borosil, India) filled with MS medium containing 100 mg/l myo-inositol, 3% (w/v) sucrose, 5.4–21.6 µM naphthaleneacetic acid (NAA), and 1.1–2.2 µM benzyladenine (BA). Before adding the 0.8%, the medium's pH was adjusted to 5.80.8% agar (High-Media, In-dia, (Bacteriological Grade). For 15 minutes, the medium was autoclaved at 120°C and 104 kPa. White fluorescent tubes were used to generate a 16-hour photoperiod of 35 µmol m–2 s–1 irradiance, which was maintained at 25°±1°C for the cultures. The number of calli generated from hypocotyl segments was increased by transferring them every two weeks to a new callus induction medium that was sterilised using a filter, along with 10% to 15% of coconut water (CW). The experiment was repeated twice, with each treatment consisting of five replicate flasks containing four to five explants each.From the second subculture passage, friable, proliferating calli (about 2 g) were placed into 250 ml Erlenmeyer flasks, each of which had 50 ml of MS, B5 (Gamborg et al. 1968), or UM (Uchmiya and Murashige 1974) media. 100 mg/l myo-inositol, 3% sucrose, 10.8 µM NAA, 2.2 µM BA, and 10% (v/v) CW were added to each medium as supplements. The aluminium foil caps were placed on the flasks. The cultures were kept in the above described environmental conditions on a horizontal rotary shaker that rotated at 100 rpm. After 12 days, the cells were harvested by putting the culture media and the cells through sieves of 500 µm and 250 µm particle diameters in succession. After being collected on a 250 µm sieve, the cells were moved to new media with the same composition for additional.Viability of suspension culture Every two weeks, fluorescein diacetate (FDA) was used to assess the vitality of cells in suspension cultures (Larkin 1976). The fluorescein was excited by UV light, resulting in yellow-green fluorescence (495–565 nm) in viable cells. Regeneration ofshoot buds Twenty to twenty-five cell aggregates were taken from the cell suspension at various growth phases and plated on semi-solid MS medium containing 10.8 µM NAA, 2.2 µM BA, 10% CW, and 0.5% agar. The percentage of cell clusters that formed colonies served as a proxy for the plating efficiency. After 12 days, the bigger colonies that emerged from these aggregates were subcultured onto new media with the same composition for further growth. Calli were then moved to 100-ml Erlenmeyer flasks containing MS that contained 0.54–2.7 µM NAA and 4.4– 22.2 µM BA.Five replicate flasks, one for each treatment, were arranged in a completely randomized design (CRD). Every experiment was carried out twice. After eight weeks, data were gathered on the percentage of calli developing shoots and the number of shoots per callus, and the means were computed. To compare the means, Duncan's Multiple Range Test (DMRT) was employed. Before analysis, percentage data were transformed using arc-sin of the proportion, and then they were transformed back to their original values for presentation. To investigate how culture age affects the potential for regeneration, we took cell clumps from various culture passages and plated them over MS that contained 10.8 µM NAA, 2.2 µM BA, and 10% CW.

These cell aggregates gave rise to calli, which were transmitted.optimal regeneration medium (agar + 0.8% + MS+13.3 µM BA + 2.7 µM NAA). Plants taking root in the dirt and moving their branches Shoots measuring 3.0 to 4.0 cm in height were removed in order to facilitate roots, and they were then placed into 60-ml screw-capped glass tubes filled with half-strength MS containing 2% sucrose and 0.8% agar. Moreover, 5.7–11.5 µM of indole-3-acetic acid (IAA), 4.9–9.9 µM of indole-3-butyric acid (IBA), and 5.3–10.6 µM of indole-3-propionic acid .Either separately or in combination. The experiment was conducted twice, with seven replicates for each treatment. After being moved to tiny plastic pots filled with vermi-compost (from Ranjan's Agrotech, Bhubaneswar), rooted plantlets were maintained in the culture chamber for three to four weeks at 26°C and 50 µmol m–2 s–1 irradiance. After that, the plantlets were moved to earthenware pots filled with soil:compost (1:1) and shaded for an extra three weeks before being moved to an outdoor growth space.

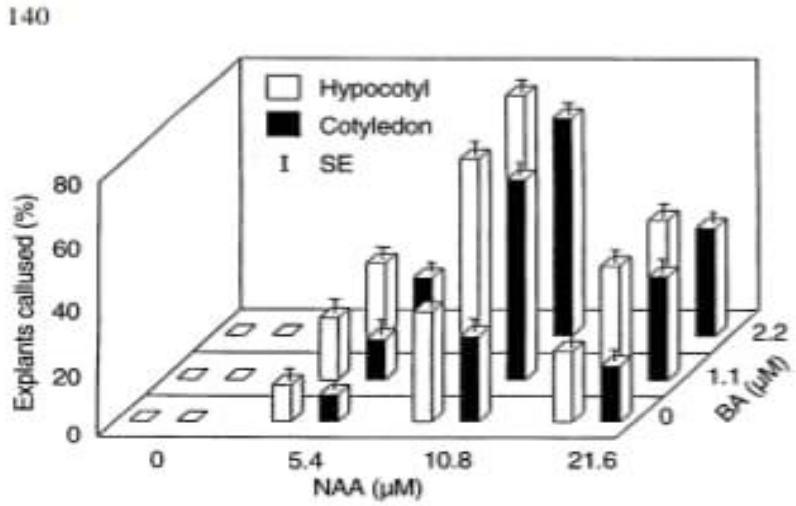



**Fig. 2 callusing response of hypocotyl and cotyledon segments of D. latigolia on MS containing various concentration of NAA and BA**

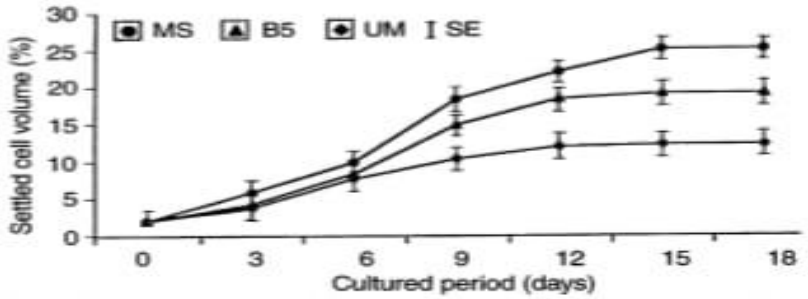



**Fig. 3** Growth curve of cell suspension culture of *D. latifolia* in three different nutrient media

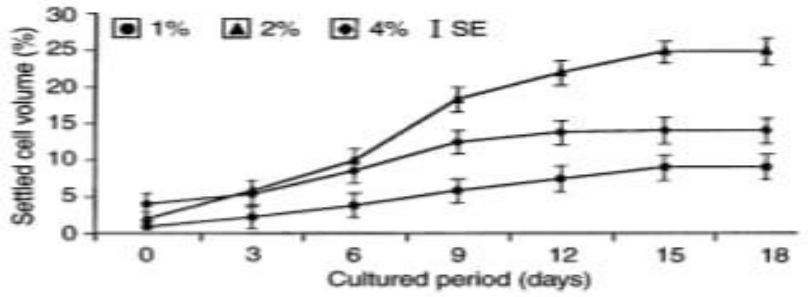



**Fig. 4** Growth of the cell suspension culture of *D. latifolia* at three different inoculum cell densities

## Botanical Discription

The Dalbergia sissoo tree is a large to medium-sized tree that reaches a maximum height of roughly 25 meters. Its grey-yellow trunk has a diameter of two to three meters. Thin crown that is widely spaced. The bark exfoliates in tiny strips and is thin, grey, and longitudinally wrinkled. It has several lateral ramifying roots and starts growing a lengthy taproot at a young age (Troup et al., 1921) [17]. Each leaflet has a tip that is beautifully pointed, measuring 4–6 cm in lengths .The leaf has a leathery, pinnately complex surface with petiolated leaf stem and alternate leaflets. The length of the leaves is roughly 15 cm. Pale white to dull yellow flowers, measuring 5–6 mm in length, with racemes that are 2.5–3.7 cm long and arranged in short panicles along the axilla. The flowers are fragrant, almost sessile, and occur in dense clusters. With one to four seeds, the glabrous, indehiscent, and slender pods measure 5.7 cm by 8.13 mm. The light brown,

kidney-shaped seeds are around 6 x 8 x 4-5 mm in size. They are thin and flat.Dry and hard, the seeds are. The sapwood is white to pale brown, and the heartwood ranges in color from dark brown to golden (Orwa agroforestry database, 2009) [17]. Large upper branches support a spreading crown, while juvenile shoots are drooping and downy. Bark on stems ranges in color from light brown to dark grey, up to 2.5 cm (0.98 in) thick, and sheds in thin strips. It is easily propagated by planting stumps or seeds. Planting stumps is the most effective way to spread D. sissoo. 1-2 year old seedlings with collar diameters more than 1 cm are used to make stumps, and they are trimmed so that the root remains 25 cm and the shoots are 2.5–3 cm. During the third week of March or April, stumps are planted.

**Chemical constituents in different parts of Delbergia sissoo**Isoflavone-O-glycoside is found in leaves, while biochenin A, tectorigenin, 7, 4 dimethyl tectorigenin, and 7-O-methyl tectorigenin are found in flowers. Mesoinisitol, 7-O-methyl tectorigenin, and 4'-rhamnoglucoside are present in green pods, but socaviumin, tectorigenin, dalbergin, cavitin, and tannins are present in mature pods. Dalberginone, dalbergin, methyl dalbergin, and dabergichromene are all found in stem bark. Furthermore, hardwood contains essential oils, fixid oil, dalbergin, nordalberginones, and dalbergichromene (Son et al., 2022).[17]

**Phytochemistry**

A number of plant chemicals have been found in several species of the genus Dalbergia, including flavonoids, isoflavonoids, glycosides, steroids, quinines, and others. It's crucial to remember that distinct species in the genus Dalbergia may have different particular phytoconstituents. Chromatography and spectroscopy are commonly used techniques for the isolation and identification of these substances.Additionally, elements including plant part, age, environmental circumstances, and geographic location might affect the presence and concentration of phytoconstituents. Phytochemicals that are frequently present in a wide range of plant species, including members of the genus Dalbergia: A flavonoid with antioxidant qualities is quercetin (Farag et al., 2001) [17]. Another flavonoid with anti-inflammatoryand antioxidant qualities is kaempferol. One isoflavonoids that may be beneficial to health is genistein. Daidzein: Additional isoflavonoids typically present in plants that are leguminous. B-Sitosterol: A sterol Hfound in plants that may have the ability to decrease cholesterol. Epicatechin is a flavonoid that can be found in tea and chocolate and has antioxidant properties. Rutin is a glycoside with antioxidant qualities that is a member of the flavonoid group. Quinones: Mixtures containing Possible health benefits and participation in redox processes. Tannins: Polyphenolic substances with potential anti-inflammatory and antioxidant properties. A class of phytochemicals with a variety of biological activities is called coumarins.

**Pharmacological or biological activities**

**Anti-inflammatory**

Rats' paw oedema caused by carrageenan was used to test the anti-inflammatory properties of hexane and methanol extracts of Dalbergia sissoo and okanin (Behera et al. 2013) [18]. The antiinflammatory qualities of the ethanolic Dalbergia sissoo bark extract were evaluated. Throughout the observation period, the ethanolic extract at 1000 mg/kg showed the highest antiinflammatory efficacy in compared to the other groups (300 and 500 mg/kg).

**Antiplasmodial activity**

Anti plasmodial action Flavonoids with Anti plasmodial activity were present in the powdered heartwood of D. louvelli that had been air-dried and powdered; the flavonoid concentrations ranged from 5.8 to 8.7 um. (Beldjoudi and others, 2003) [19]

**Antimicrobial activity**

Antimicrobial efficacy It has been shown that the citric acid extract of D. melanoxylon bark significantly resists gram-positive bacteria (Bacillus subtilis, Klebsiella pneumoniae, and Staphylococcus aureus) and gram-negative bacteria (Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium, and Yersinia pestis). According to Sahu et al. (2023) the plant may possess antifungal activities against Candida albicans and Aspergillus niger.[20]

**Antioxidant activity**

The antioxidant activity of an extract from the bark of Dalbergia sissoo Roxb. (Fabaceae) was assessed in vitro. Lakshmi and associates used the hydrogen peroxide scavenging activity and reducing power assay to investigate antioxidant activity (Lakshmi et al.2014) [21]. The lipid peroxidation inhibitory potential of the Dalbergia sissoo bark ethanol extract was examined. (LPO). According to Kumari et al. (2008), this extract exhibited 69.1% LPO inhibitory potential/10 µg of extract. [22]. Gold nanoparticle formation potential, ferric ion reducing power, ferrous ion chelating activity, and 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity were used to measure the antioxidant activity of the aqueous and methanol extracts of Dalbergia sissoo stembark

**Ecological uses**

Ecological applications Dalbergia sissoo provides a wide range of agro-forestry and environmental functions. It acts as a shade tree, wind break, and shelter belt in intercropping orchards, mango, tea, and coffee plantations. The root system is commonly used along stream and river banks with its suckers to stabilize the soil and stop soil erosion. This plant is frequently used for nitrogen fixation and reforestation. Because of its fragrant blossoms and shade, it is planted as an ornamental plant in gardens and by the sides of roadways (Kaur A et al. 2011) [23].

## CONCLUSION

In conclusion, Dalbergia sissoo also known as Indian rosewood or Sheesham—is a versatile plant with a high commercial value that may be grown in a variety of ways. Its wide area of distribution and natural development without requiring intensive human care make it a valuable resource for numerous enterprises. Sheesham is critical from an ecological point of view for mitigating soil erosion, improving soil quality, and preserving water. Its deep roots maintain the soil, prevent erosion, and increase fertility. They also improve infiltration, which contributes to water conservation. Furthermore, its benefit to agroforestry systems goes beyond financial gain because it provides windbreaks and cover for crops while simultaneously fostering biodiversity and carbon sequestration. Cultural significance in addition to the potential for additional medicinal research. Sheesham has been used for many years in medicine and is recognized for its aphrodisiac, abortifacient, expectorant, anthelmintic, and antipyretic properties. The plant's application inconventional medicine is a sign of its cultural significance as well as the possibility for additional pharmacological research. Indian rosewood has shown to be profitable for a variety of industries. In the furniture sector, its strength and aesthetic appeal make it a highly sought-after material. The wood's acoustical properties make it a desirable material for musical instrument construction, and its use in craftsmanship and inventiveness raises its economic value. Sheesham gives farmers the opportunity to diversify their agroforestry revenue streams by manufacturing timber. In the furniture sector, its strength and aesthetic appeal make it a highly sought-after material. The use of wood in artistic and handicrafts raises its value economically, and its acoustical properties make it a desirable material for musical instrument construction. In agroforestry, sheesham gives farmers an opportunity to diversify their sources of income by generating lumber, which when added to intercropping systems boosts overall farm productivity. The plant also provides vital fuel and timber, which sustain life. Beyond local markets and into international trade, where there is potential for sustained export and exploitation, it contributes to economic growth. The phytochemical composition of Dalbergia sissoo, which consists of flavones, isoflavones, quinines, and coumarins, gives the plant even greater significance. The biological activities of the plant demonstrate its potential for usage in pharmaceutical and nutraceutical products. These activities include its anti-inflammatory, antidiabetic, antioxidant, and osteogenic properties. In essence, a careful examination of Dalbergia sissoo exposes several of its attributes, such as its function as a supplier of traditional medicine, an ecological guardian, and a mainstay in numerous businesses. Conservation and sustainablemanagement efforts are crucial to maximizing its benefits and ensuring the survival of this priceless plant in the Indian ecosystem.

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