GMR
The Original

PHYTOCHEMICAL CONSTITUENTS, PHARMACOLOGICAL ACTIVITIES, AND THERAPEUTIC PROSPECTS OF SHIMSHAPA (DALBERGIA SISSOO ROXB.): A REVIEW

Dr. Dibika[1], Dr. Neha Soni[2], Dr. Durga Biswas[3], Dr. Ruchi Tirkey[4], Dr. Rishabh Singh[5]

[1]MD Scholar, Department of Dravyaguna Vigyan Vibhag, Shri NPA Govt. Ayurved College Raipur,(CG) ; Email: dibika444@gmail.com
[2]Lecturer, Department of Dravyaguna Vigyan Vibhag, Shri NPA Govt.Ayurved College Raipur, (CG) Email: drnehasoni511@gmail.com
[3]MD Scholar, Department of Rachana Sharir Vibhag, Shri NPA Govt. Ayurved College Raipur,(CG) Email: durgabiswas720@gmail.com
[4]MD Scholar, Department of Kayachikitsa Vibhag, Shri NPA Govt.Ayurved College Raipur,(CG) ruchitirkey24011991@gmail.com
[5]MD Scholar, Department of Dravyaguna Vigyan Vibhag, Shri NPA Govt. Ayurved College Raipur,(CG) rishabhsingh1819@gmail.com

ABSTRACT
Dalbergia sissoo Roxb. (commonly known as sheesham and Indian rosewood) is a fast-growing deciduous tree native to the Indian subcontinent, widely valued for both its high-quality timber and extensive therapeutic applications in traditional system of medicine such as Ayurveda and Unani. Phytochemical investigations demonstrate that the plant is rich in diverse bioactive secondary metabolites, including flavonoids, isflavonoids, neoflavonoids, phenolics, tannins, saponins present across its bark, leaves, heartwood, seeds and roots. Preclinical and experimental studies substantiate a wide spectrum of pharmacological activities attributed to these bioactive constituents, including analgesic, anti-inflammatory, antioxidant, antimicrobial, antidiabetic, osteogenic, gastroprotective, cardioprotective, neuroprotective, and potential anti-obesity and cytotoxic (anticancer) properties. Despite substantial experimental evidence supporting its traditional uses for ailments such as diarrhea, skin disorders, inflammation, fever, and bone degradation, further rigorous clinical trials are necessary to fully evaluate its safety, efficacy, and therapeutic potential for human drug development. This review summarizes the botanical characteristics, Ayurvedic pharmacodynamics, phytochemical profile, traditional uses, and pharmacological prospects of Dalbergia sissoo.

KEYWORDS: Dalbergia sissoo Roxb., shimshapa, sheesham, phytochemistry, pharmacological activities, traditional uses, therapeutic potential.

INTRODUCTION

Medicinal plant has been used in ancient times for the prevention and treatment of diseases. They remain a major source of therapeutic agents. In modern drug discovery, natural products and their derivatives are of paramount importance, and many drugs used clinically are derived, directly or indirectly, from plants bioactive compounds. The growing prevalence of chronic diseases, antimicrobial resistance and adverse effects of synthetic drugs have spurred scientific interest in medicinal plants as potential sources of safer and more effective therapeutic agents. Advances in phytochemistry, pharmacology and novel drug discovery have enhanced the therapeutic value and clinical applicability of herbal medicine [1,2].

Dalbergia is a genus of fabaceae family of almost 300 species, valued for their medicinal properties and hard timber. Dalbergia species have traditionally been used to treat inflammation, microbial infections, gastrointestinal problems, skin diseases, diabetes, fever, and other chronic conditions. The presence of several classes of secondary metabolites, such as flavonoids, phenolics, terpenoids, tannins and glycosides, has been linked to their therapeutic potential [3].

Dalbergia sissoo Roxb. ex DC. (common name Indian rosewood or sheesham) is one of the most important species of the genus in terms of economic and medicinal importance this fast-growing deciduous tree is native to the Indian subcontinent and occurs throughout Bangladesh, Afghanistan, India, Nepal, and Pakistan. The plant is of commercial importance as a premium timber species and has also been used extensively in ayurveda, Unani and traditional folk medicine. The bark, leaves, roots, heartwood, flowers and seeds have all been used to treat diarrhea, dysentery, skin conditions, wounds, fever, diabetes, gonorrhea, inflammation, ulcers and rhematic disease [4,5].

Phytochemical screening shows that d. sissoo is abundant un flavonoids, isoflavonoids, neoflavonoids, tannins, terpenoids, saponins and phenolic compounds. These bioactive constituents are responsible for several pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, cardioprotective, analgesic, osteogenic, anticancer and immunomodulatory activities. Despite the strong experimental evidence supporting these biological activities further clinical research is needed to determine its efficacy and safety for therapeutic applications [3,6].

Dalbergia sissoo is a valuable medicinal plants with a remarkable phytochemical diversity and a wide range of pharmacological properties, which gives a significant potential for drug discovery and development considering its long history of traditional use. This review summarizes its botanical characteristics, traditional uses, phytochemical constituents, pharmacological activities and potential future applications.

Synonyms [7,8]
Amerimnon sissoo (Roxb.)

Pterocarpus sissoo (Roxb. ex-DC.) Wight &Arn.
Dalbergia pendula Ten.
Kuntze Amerimnon P. Browne
Triptolemia Mart
Coroya Pierre Ecastaphyllum P. Browne

Taxonomical classification [9]
Kingdom – Plantae
Divison – Magnoliophyte
Phylum – Tracheophyte
Class – Magnoliopsida
Order – Fabales
Family – Fabaceae
Genus – Dalbergia
Species – Dalbergia sissoo

Vernacular Names [10]
Sanskrit – Shinshapa, Aguru
English – Indian Rosewood
Hindi – Shisham, sissu, sissai, sisam
Tamil – Sisso, gette
Kannada – Betti, shista, baage agaru, bindi
Bengali – Shishu, Sissoo

Classical Categorization [11]
Bhavaprakash Nighantu – Vatadi verga
Dhanvantari Nighantu – Aamradi verga
Raja Nighantu – Prabhadradi verga
Kaiyadeva Nighantu – Aushadi verga
Sodal Nighantu – Aamradi verga
Charak Samhita – Kashayaskanda
Sushruth Samhita – Shalsaradi, Muskadi gana

Ayurvedic Pharmacodyanamics [12]

Dravya	Shinshapa
Rasa	Kashaya, katu, tikta
Guna	Laghu, ruksha
Virya	Ushna
Vipaka	Katu
Dosha karma	Tridhosha shamak

Botanical description
Indian rosewood, or Dalbergia sissoo Roxb. (sheesham), is a deciduous tree in the fabaceae family. It is medium to large-sized tree with a trunk diameter of about 80 cm to 2 m. it typically reaches a height of 10-25 m, but under ideal environmental condition, it may reach 30 m. the tree goes a wide, spreeding crown and has well-developed lateral roots in addition to a deep taproot. Suckers are produced by many superficial roots, which promotes natural vegetative regeneration [14,15].
The bark is rough, fibrous, and longitudinally fissured, greyish-yellow to dark reddish-brown, and as it ages, it exfoliates in thin strip. Young shoots are slightly pubescent, slender, and drooping.one of the best wood species in the Indian sub-continent, the wood is dark brown, incredibly hard, long-lasting, and prized for its beautiful grain and high mechanical strength.[14]
leaves alternate and are imparipinnate. The leaves have 3 to 5 broad, rounded to ovate leaflets between 2-6 cm long. The upper surface is smoother and a darker green, while the lower surface appears lighter. The petiole is long and slender. D. sissoo is a deciduous plant and drops its leaves during dry season [15,16].
Axillary panicles with numerous small fragrant, flowers are papilionaceous consisting of flower cluster. The flowers are 5-8 mm long and are white to pale yellow in colour, sometimes tinged with pink. Flowering generally takes place from February to April depending on the weather [13,14].
The fruit is a flat, thin, glabrous, indehiscent pod about 5-7.5 cm long and 8-13 mm wide, containing one to four flattened, kidney-shaped, pale brown seeds. The fruiting generally occurs from April to June. It has a wide distribution in the tropical and subtropical regions. Though it is adaptable to a wide range of soil and climatic conditions, it is mostly found in the bank of rivers and well drained alluvial soils [14,15].



WHOLE PLANT



SEED



LEAVES



BARK

Phenology [17]

Its leaves turn brown and fall in November. The tree might in cold climates, it loses its leaves by December or January. Within in areas that are warmer and wetter, some leaves may endure, while fresh foliage begins to appear in the first half of February, and by the first week of march and April, new leaves and flower buds open. D. sissoo may be pollinated by insects, the wind, or both. Its timing of pollination and fertilization, self-pollination, and outcrossing status is not known. April is when the pods first appear, and reach adulthood in July. They get darker by December or January, and the seed ripens.

Phytochemical constituents

Dalbergia sissoo Roxb. is a rich source of bioactive phytochemicals presents in its leaves, bark, pods, flowers, stem bark and heartwood. Preliminary phytochemical screening showed the presence of carbohydrates, proteins and amino acids, flavonoids, phenolic compounds, tannins, glycosides, saponins, steroids, anthraquinones, reducing sugars, oils, lipids and isoflavones responsible [18].

Its leaves contain flavonoids, phenolic compounds, isoflavones, tannins, glycosides, saponins, steroids, carbohydrates, proteins, amino acids, oils and lipids. The leaves have yielded several bioactive compounds such as genistein, biochanin A, pratensein, caviunin, sissotrin, quercetin 3-0-rutinoside, quercetin 3-0-D-glucopyranoside, kaempferol-3-0-rutinoside, genistein 8-C-glucoside, prunetin glycosides, tectorigenin glycosides, lignan glucosides and chalcone okanin [19,21].

Phytochemical screening of ethanolic bark extract showed the presence of flavonoids, phenolic compounds, protein, amino acids and carbohydrates. The stem bark also contains neoflavanoids like dalbergichromene, isodalbergin and nordalbergin that are responsible for the antioxidant and anti-inflammatory properties if the plant [21].

The heartwood is a significant source of neoflavonoids and isoflavonoids like dalbergin, isodalbergin, nordalbergin, dalbergichromene and caviunin derivatives. These compound has been associated with antioxidant, antimicrobial, anti-inflammatory and potential anti-obesity activities [19,20].

The pods are made up of carbohydrates, tannins, phenolics, flavonoids, steroids, glycosides, saponins, reducing sugars, oils, lipids and free amino acids. Typical phytochemicals isolated from pods are caviunin 7-0-glucoside, isocaviudin and tectoridin [18].

The flowers contain flavonoids and isoflavonoids. Tectorigenin was isolated from the ethanolic extract of D. sissoo flowers and considered to be one of the major bioactive constituents [19].

The seeds contain fixed oils, proteins, carbohydrates, fatty acids, flavonoids, phenolic compounds and glycosidic constituents, but they have been less well studied than the leaves and heartwood [20].

Dalbergia sissoo is a rich source of flavonoids, isoflavonoids, neoflavonoids, phenolic compounds, glycosides, lignans and chalcones in general. These phytochemicals are thought to be involved in the antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, anticancer and anti-obesity activities if the plant.

Major phytochemicals isolated from Dalbergia sissoo

Plant Part		Phytochemicals Reported
Bark	-	Isoflavones (sissotrin, biochanin A), tannins, triterpenoids [21]
Leaves	-	Neoflavonoids (dalbergichromene), chalcones, flavonoids, phenolicacids [22]
Seeds	-	Fatty acids, glycosides, sterols [23]
Heartwood	-	Terpenoids, lignans, saponins [24]

Traditional uses

Dalbergia sissoo Roxb. has wide applications in the traditional system of medicine like Ayurveda and many folk medicinal practices throughout the Indian subcontinent. Various parts of the plant such as bark, heartwood, leaves, flowers, roots, seeds and seed oil have been used for treatment of various ailments. Rural people in Nepal and India have long been using the leaves of the plant to treat nonspecific diarrhea. Ayurveda prescribes the juice of the leaf for the condition of the nose and eyes. The leaf juice is traditionally used for therapy for various digestive problems, scabies, syphilis, burning sensation

in the body and scalding urine. Decoction of leaves is used for the treatment of gonorrhea. Leaf extracts is used for the treatment of sore throats, dysentery and syphilis, gonorrhea and heart disease. Leaves are also known for their analgesic, antioxidative, antidiabetic properties, anticancer and antipyretic effects [22,23]. Dalbergia sissoo bark is used as an aphrodisiac, expectorant, aperitif, anthelmintic, antipyretic, skin diseases, dysentery ana anal diseases. It is also known to perform well in conditions like sciatica, hemiplegia etc. are caused by vata. It is also used to treat osteoporosis and other diseases of the bone [23]. The anthelmintic and antileprotic properties of D. sissoo heartwood have long been utilized aphrodisiac, spasmolytic and aerial parts showed expectorant activity. Additionally, it is used to treat boils, burning sensation and blood disorders. Vomiting, boil, syphilis, stomach issues, scabies, burning urine and problems with the eyes and nose. Wood and bark are also utilized for dysentery and dyspepsia. Heartwood is used to treat fever, vitiligo and herpes [23,25]. The roots are frequently used in traditional medicine for the treatment of gastrointestinal disorders, especially dysentery and diarrhea. The whole plant of D. sissoo has been used in traditionally Unani medicine for the treatment of various skin disorders and also for the treatment of gonorrhea [22,24]. The oil extracted from D. sissoo seeds has been used traditionally as a remedy for skin burns, itching and scabies because of its soothing and therapeutic effects [22].

Pharmacological Effects (26-35)

Analgesic effects

Numerous experiments utilizing animal models have shown Dalbergia sissoo analgesic potential using the hot-plate and tail-clip methods, alcoholic leaf extracts given orally at doses of 100, 300 and 1000mg/kg demonstrated notable analgesic activity in mice. It is thought that the plants flavonoid components, which may inhibit prostaglandin synthesis and lessen pain perception, are responsible for the observed pain-relieving effect. Additionally, D. sissoo bark extract peripheral(non-narcotic) analgesic activity has been studied. The highest dose of 1000mg/kg produced the most noticeable analgesic response among the tested dose (300, 500 and 1000mg/kg) by considerably lengthening the reaction time to painful stimuli, while the lower doses had little to no effect on pain sensitivity. These results imply that D, sissoo has analgesic activity that is dose-dependent, with higher doses having more potent analgesic effects.

Anti-inflammatory activity

The anti-inflammatory activity of Dalbergia sissoo has been investigated using different experimental models. Ethanolic bark extract exhibited significant activity in the rat paw edema model, while leaf and root extracts also demonstrated anti-inflammatory effects. These activities may be associated with the inhibition of prostaglandin synthesis, stabilization of cellular membranes, and modulation of inflammatory mediators. Caviunin glycoside and nordalbergin have also shown promising anti-inflammatory effects in experimental studies.

Antioxidant activity

Various extracts of D. sissoo leaves, bark, and roots have demonstrated antioxidant potential in in vitro studies. The activity was evaluated using DPPH radical scavenging, hydrogen peroxide scavenging, and reducing-power assays. Flavonoids and phenolic compounds are considered important contributors to its antioxidant effects, which may help protect cells against oxidative damage.

Antimicrobial and antifungal activity

Extracts of D. sissoo have shown antibacterial activity against several Gram-positive and Gram-negative bacteria, including Escherichia coli, Staphylococcus aureus, and Pseudomonas aeruginosa. Different solvent extracts have also been investigated for antifungal effects. Phenolic compounds, tannins, and flavonoids may contribute to these activities. However, the findings are predominantly experimental and require further validation.

Analgesic and antipyretic activity

Ethanolic extracts of the leaves, seeds, and bark have exhibited analgesic and antipyretic effects in animal models. Analgesic activity has been evaluated through acetic acid-induced writhing, hot-plate, and tail-flick tests, whereas antipyretic activity has been investigated using brewer's yeast-induced fever. Inhibition of prostaglandin synthesis has been proposed as one possible mechanism.

Antidiarrheal activity

Leaf and bark extracts of D. sissoo have demonstrated antidiarrheal effects in experimental models involving castor oil and magnesium sulfate. The extracts reduced diarrheal episodes and intestinal motility in some studies. Research on leaf decoctions has also suggested that their effects may involve interference with enterotoxin activity and bacterial adherence rather than direct antimicrobial action alone.

Antidiabetic activity

Experimental studies have reported blood-glucose-lowering effects of aqueous, alcoholic, and ethanolic extracts of D. sissoo bark in chemically induced diabetic animal models. Improvements in lipid parameters and liver glycogen have also been reported. These findings suggest potential antidiabetic activity, although the responsible constituents and mechanisms require further investigation.

Anticancer activity

Leaf extracts and isolated phytochemicals of D. sissoo have shown cytotoxic or apoptosis-inducing effects in selected cancer cell models. Compounds such as dalbergin and 4-methoxydalbergione have been investigated for their effects on cellular signaling pathways and cancer-cell growth. These results indicate preliminary anticancer potential but do not establish clinical efficacy or safety in humans.

Gastroprotective and antiulcer activity

Methanolic and ethanolic extracts of D. sissoo have demonstrated protective effects in experimental ulcer models. Reported findings include a reduction in ulcer index, changes in gastric acidity, and improvements in antioxidant defense markers. These observations suggest possible gastroprotective activity, although the underlying mechanisms need further confirmation.

Osteogenic activity

The heartwood and leaves of D. sissoo contain bioactive constituents that have been investigated for osteogenic and osteoprotective effects. Neoflavonoids, including dalbergin and dalbergiphenol, and certain leaf isoflavonoids have shown effects on osteoblast activity, mineralization, and bone architecture in experimental studies. These findings suggest possible relevance to bone regeneration and osteoporosis research.

Anti-obesity activity

An aqueous-ethanolic leaf extract of D. sissoo has demonstrated pancreatic lipase inhibitory activity in an experimental assay using chicken pancreas. Its activity was reported to be comparable to that of orlistat under the conditions tested. Since pancreatic lipase contributes to dietary fat digestion, its inhibition provides a plausible mechanism for reducing fat absorption. Nevertheless, this finding represents preliminary evidence; anti-obesity efficacy of D. sissoo heartwood extract in high-fat-diet-induced obese rats requires separate experimental evaluation.

Cardioprotective activity

Alcoholic and methanolic leaf extracts have been studied in experimental models of myocardial injury and altered lipid metabolism. Some studies reported improvements in cardiac injury markers and lipid profiles. These observations indicate potential cardioprotective effects, but further studies are needed to establish the active constituents and clinical relevance.

Neuroprotective activity

Leaf extracts of D. sissoo have demonstrated protective effects in experimental models involving oxidative stress, neuroinflammation, and cognitive impairment. Nordalbergin has also been investigated for its ability to modulate inflammatory signaling and reactive oxygen species production. These findings provide a basis for further investigation into its potential neuroprotective mechanisms.

Anthelmintic and antiparasitic activity

Extracts of different plant parts have been evaluated for activity against earthworms, nematodes, and selected parasites. Ethanolic and other solvent extracts have demonstrated anthelmintic effects in experimental assays. However, the results depend on the extract, dose, and test organism, and should not be interpreted as proof of efficacy against human parasitic infections.

CONCLUSION

Dalbergia sissoo Roxb. (Shinshapa or Sheesham) is an important medicinal plant widely used in Ayurveda and traditional systems of medicine. It contains various bioactive phytochemicals, including flavonoids, isoflavonoids, neoflavonoids, tannins and phenolic compounds. Experimental studies have demonstrated its potential antioxidant, anti-inflammatory, antimicrobial, antidiabetic, analgesic, hepatoprotective and osteogenic activities. These properties highlight its importance in Dravyaguna research and future drug development. However, further clinical studies are required to establish its efficacy, safety, dosage and therapeutic applications in humans.

REFERENCES

1. World Health Organization. WHO traditional medicine strategy 2014–2023. Geneva: WHO; 2013.
2. Atanasov AG, Zotchev SB, Dirsch VM, Supuran CT. Natural products in drug discovery: advances and opportunities. Nat Rev Drug Discov. 2021;20(3):200–216. doi:10.1038/s41573-020-00114-z.
3. Gupta S, Sharma B, Kumar N, et al. Phytochemistry and pharmacology of Dalbergia sissoo Roxb. ex DC.: A review. J Pharm Pharmacol. 2023;75(4):482–506.
4. Khare CP. Indian Medicinal Plants: An Illustrated Dictionary. New York: Springer; 2007.
5. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 1999.
6. Hossen MF, Nijhu RS, Khatun A. A phytochemical and pharmacological review on Dalbergia sissoo: A potential medicinal plant. J Pharmacogn Phytochem. 2023;12(1):52–57.
7. Dalbergia sissoo (shisham) | CABI Compendium [Internet]. [cited 2024 Sep 21]. Availablefrom:https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.17808
8. Kirtikar KR, Basu BD. Indian medicinal plants. Vol. 2. Bhuwaneśwari Âśrama: Basu; 1918.
9. Bharath M, Tulasi EL, Sudhakar K, Eswaraiah MC. Dalbergia sissoo DC–An important medicinal plant. International Journal of Research in Pharmacy and Chemistry. 2013;3(2):384-388.Taxonomic
10. Mamta Bhattacharya et al., Dalbergia Sissoo: Variability in Morphology, Journal of Medicinal Plants Studies,2014, Vol 2, Issue 3, P. 8-13. viii https://niimh.nic.in/ebooks/e-Nighantu/bhavaprakashanighantu
11. P.V.Sharma 'Dravyaguna Vigyan' Vol. I. and Vol. II Chaukhambha Bharati Academy; 2018 p.806-807
12. Luna, R. K. (1996). Plantation Trees. International Book Distributors. Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., & Simons, A. (2009). Agroforestree Database: A tree reference and selection guide (Version 4.0). World Agroforestry Centre (ICRAF).
13. Troup, R. S. (1921). The Silviculture of Indian Trees (Vol. 1). Oxford University Press. Kirtikar, K. R., & Basu, B. D. (2003). Indian Medicinal Plants (2nd ed.). International Book Distributors. https://www.cabidigitallibrary.org. 16 November, 2022.
14. Asif M, Kumar A. Phytochemical and ethnopharmacological review of Dalbergia sissoo Roxb. International Journal of Pharmaceutical Sciences and Research. 2011;2(8):1980–1987.
15. Dixit M, Mishra A, Sharma A. Phytochemical constituents and pharmacological activities of Dalbergia sissoo Roxb.: A review. International Journal of Research in Pharmaceutical Sciences. 2010.
16. Khare CP. Indian Medicinal Plants: An Illustrated Dictionary. New Delhi: Springer (India) Pvt. Ltd.; 2007.
17. Gupta, R., Johri, S., & Saxena, A. M. (2006). Effect of ethanolic extract of Dalbergia sissoo leaves on lipid peroxidation in rats. Indian Journal of Pharmacology, 38(2), 120–121.

18. Kaur, S., Sharma, A., & Singh, R. (2020). Phytochemical and pharmacological evaluation of Dalbergia sissoo Roxb.: A review. Journal of Pharmacognosy and Phytochemistry, 9(4), 2306–2312.
19. Khan, M. A., Khan, H., Hussain, I., & Mahmood, T. (2013). Dalbergia sissoo Roxb.: An overview. International Journal of Pharmaceutical Sciences and Research, 4(4), 1325–1339.
20. Nadkarni, K. M. (1976). Indian Materia Medica (Vol. 1). Bombay: Popular Prakashan.
21. Sharma P, Tomar L, Bachheti RK. Phytochemistry and pharmacological potential of Dalbergia sissoo Roxb.: A review. Journal of Pharmacognosy and Phytochemistry. 2014.
22. Panda SK, Das D, Tripathy NK. Dalbergia sissoo Roxb.: A comprehensive review on traditional uses, phytochemistry and pharmacology. Journal of Pharmacognosy and Phytochemistry. 2014;3(4):84–90.
23. Sharma P, Khandelwal S, Singh T. Dalbergia sissoo Roxb.: Ethnopharmacology, phytochemistry and pharmacological activities. Journal of Drug Delivery and Therapeutics. 2021;11(3):174–182.
24. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 1935.
25. Duke JA. Handbook of Medicinal Herbs. 2nd ed. Boca Raton: CRC Press; 2002.
26. Hajare SW, Chandra S, Tandan SK, Sarma J, Lal J, Telang AG. Analgesic and antipyretic activities of Dalbergia sissoo leaves. Indian Journal of Pharmacology. 2000;32(6):357-360.
27. Islam M, Elhddad S. Phytochemical investigation and evaluation of analgesic activity of ethonolic extract of Dalbergia sissoo (Roxb.) bark. Journal of Natural Product and Plant Resources. 2012;2(6):701-704.
28. Vanshita, Bajpai M. Phytochemistry and pharmacology of Dalbergia sissoo Roxb. ex DC: a review. Journal of Pharmacy and Pharmacology. 2023;75(4):482–501. doi: 10.1093/jpp/rgac106.
29. Hossen MF, Nijhu RS, Khatun A. A phytochemical and pharmacological review on Dalbergia sissoo: a potential medicinal plant. Journal of Pharmacognosy and Phytochemistry. 2023;12(1):52–57. doi: 10.22271/phyto.2023.v12.i1a.14557.
30. Roy N, Laskar RA, Sk I, Kumari D, Ghosh T, Begum NA. A detailed study on the antioxidant activity of the stem bark of Dalbergia sissoo Roxb., an Indian medicinal plant. Food Chemistry. 2011;126(3):1115–1121.
31. Hajare SW, Chandra S, Tandan SK, Sarma J, Lal J, Telang AG. Analgesic and antipyretic activities of Dalbergia sissoo leaves. Indian Journal of Pharmacology. 2000;32(6):357–360.
32. Brijesh S, Daswani PG, Tetali P, Antia NH, Birdi TJ. Studies on Dalbergia sissoo (Roxb.) leaves: possible mechanism(s) of action in infectious diarrhoea. Indian Journal of Pharmacology. 2006;38(2):120–124.
33. Thakkar AB, Subramanian RB, Thakkar VR, Thakor P. Hydromethanolic leaves extract of Dalbergia sissoo Roxb. ex DC. induces apoptosis in lung adenocarcinoma cells. Process Biochemistry. 2023;134:250–261.
34. Dixit P, Chillara R, Khedgikar V, et al. Constituents of Dalbergia sissoo Roxb. leaves with osteogenic activity. Bioorganic & Medicinal Chemistry Letters. 2012;22(2):890–897.
35. Raheja S, Girdhar A, Kamboj A, Lather V, Pandita D. Protective effect of Dalbergia sissoo extract against amyloid-β (1–42)-induced memory impairment, oxidative stress, and neuroinflammation in rats. Turkish Journal of Pharmaceutical Sciences. 2021;18(1):104.
s