



General : Review of Santalum Album Linn: Chemical and Pharmacological Properties

Anchal Rani, Ruhani, Amanpreet Kaur, Dr. Naresh Gill

research scholar, research scholar, Astd. Proff., Principal

Rayat group of Institutions Ropar, Mohali

,Abstract -Santalum album Linn. [Family: Santalaceae] is also referred to as Srigandha (Sanskrit), Safed Chandan (Hindi), and White sandalwood (English). It grows wild and is farmed in southern Indian states. This plant has historically been used to treat inflammation, fever, and headaches. Wood oil has diuretic, stimulating, and disinfectant properties. 2.5% to 6% of sandalwood is volatile oil. Tannic acid, isovaleric aldehyde, santanone, and santalol are the primary ingredients of volatile oil. The wood of the plant was chosen and its antioxidant, analgesic, and anti-inflammatory properties assessed based on its traditional usage and chemical composition. Antioxidants and phytoconstituents have been discovered to be abundant in berries that are wild and underutilised. Thus, more research on the berries of S. album in order to determine whether they can be used as a natural.

Key words : Santalum Album Linn ,Phytoconstituents ,Indications.

1.Introduction

Indian sandalwood, a member of the sandalwood family, has the oldest and most powerful medicinal powers. Ayurvedic, Siddha, and Unani medical systems employ essential oil extracted from the sandalwood heart for the treatment and prevention of a wide range of illnesses and ailments (1).

It is 9,600 square kilometres in size and is primarily found in the Deccan region of the Indian subcontinent's deciduous forests, 8,200 of which are spread throughout the

states of Karnataka and Tamil Nadu. The region is located in India. Because of its wood and essential oils, which are utilised in the incense, medicinal, cosmetic, and fragrance sectors, it has worldwide trade (2).

In India's tropical and subtropical regions, it thrives in a variety of soil types and climates. Sandalwood oil is produced in large quantities in India for use in the pharmaceutical and perfume industries. According to the 1792 order of Tipu Sultan, the ruler of the Mysore Kingdom, this was referred to as the "Royal Tree". IUCN 2000 lists it as a vulnerable species in the wild. Countries including Australia, Indonesia, Japan, Belgium, China, Cambodia, Madagascar, Germany, Netherlands, Norway, Russia, Switzerland, and the United States are among those where it is disseminated. Small to medium-sized, semi-parasitic trees with woody branches that develop slowly are known as sandalwoods (3).

Sandalwood essential oil is an effective treatment and preventive measure for a wide range of illnesses and ailments. It is derived from the Ayurvedic, Siddha, and Unani medical systems. A small to medium-sized evergreen plant, *Albium* can grow up to 18 metres high and 2.4 metres wide. It has robust branches. The leaves are hairless and have a diameter of 1.5–8 cm or 1.63.2 cm. The peel of the plant is dark red. A solitary seed resides within the drupe-like fruit, which becomes purple when fully ripe. During the months of April through May and September through October, sandalwood fruits are picked either directly off the tree or as soon as they fall to the ground (4). East Indian Sandalwood oil is produced by steam distilling the heartwood and is widely regarded for its sweet aroma, tenacity, spicy, warm, woody undertones, stable composition, and fixative qualities. In addition to being a highly valued spice, it is also used as an expectorant, stimulant, diuretic, antiseptic, and treatment for bronchitis, gonorrhoea, urinary tract infections, and problems urinating (5). Its heartwood is extensively utilised for wood carving as well as religious and therapeutic applications. It contains 1.5–5% of a strong, distinct oil scent. Its oil was thought to contain anti-melanoma chemicals and has been utilised as a raw material for cosmetics, a major ingredient in perfumes, and an aromatherapy technique. The price of sandalwood's heartwood increased dramatically to between USD 1.000 and USD 1.500 per kg²⁵, making it a highly valuable and economical decorative wood. In the ten years between 1997 and 2007, there was even a tenfold increase in price, from 20,000 to 20,000 Rupees. Currently, the majority of this species' natural range in eastern Indonesia is thought to be gone (6). Cendana has been used in Indonesian

traditional medicine to treat a variety of conditions, including inflammation, gonorrhoea, stomach irritation, urinary tract infections, skin conditions, and chest pain. Numerous studies have been conducted worldwide on the pharmacological properties of *S. album*'s wood, root, and essential oil. Their anti-ulcer, antibacterial, antifungal, antiviral, antioxidant, antipyretic, anti-inflammatory, anticancer, anti-hyperglycemic, and anti-hyperlipidemic activities have been documented. Additionally, they have been shown to have metabolic, genitourinary, central nervous system, genotoxic, cardioprotective, insecticidal, and aromatherapy effects (7). The Hindu and Buddhist faiths, in particular, revere Indian sandalwood. Every part of human existence involves the usage of sandalwood, particularly in Indian culture and civilizations where it is necessary from birth to death. It is utilised in India to make attars that date back many centuries. Sandalwood oil and floral oils, like kewda, jasmine, and rose petals, are combined to create attar (8). Berries that have been air-dried and contain betulic acid as well as other phytoconstituents such as oleic, linoleic, palmitic, and santalbic acids. The berries are said to contain high levels of proanthocyanidins, ellagitannins, gallotannins, stilbenoids, and flavonoids. According to recent findings, berries provide significant nutritional and nutraceutical potential in addition to being a rich source of Cyanidin-3-glucoside (9). Little fragments of airborne sandal essential oil cause a reaction in the olfactory epithelium, or smell receptors, located in the roof of the nose, when someone senses the aroma. The limbic system of the brain, which controls motor functions, basic drives, emotions, and memories, is only a single nerve synapse away from here. The hypothalamus receives the impulses and uses them to control various body processes, including blood sugar regulation, growth, temperature regulation, appetite, thirst, and sexual desire. The pituitary is finally triggered, which triggers the endocrine system, which regulates all metabolic processes, emotional and sexual behaviour, digestion, and stress reactions (10). There is a long history of using sandalwood oil to treat skin issues. It nourishes all types of skin and is a fantastic moisturiser. Wounds, scars, and acne can all be effectively healed with sandalwood's astringent, anti-inflammatory, antibacterial, and pain-relieving qualities (11). There is a lot of market demand for carved representations of gods and other mythological characters. Sandalwood is used to create a vast range of items, including picture frames, combs, jewel cases, boxes, hand fans, card cases, bookmarks, and letter openers. The core of the tree is called the heartwood, and it is prized for its aroma. However, the tree's other portions, including

the bark and sapwood, are odourless. The plant has mostly been used for its sandalwood oil, which is produced by steam distilling the heartwood of the plant (12).

A vast range of wild, underutilised fruits and their products are now in high demand on the international market as significant sources of essential phytoconstituents. A number of academics recently published their findings from the phytochemical examination of a number of underutilised wild fruits. Thus, we assessed the ripened sandalwood berries' nutritional potential, antioxidant efficiency, and wide range of phytoconstituents in the current study (13).

Santalum album L. rhizome essential oil, according to phytochemical studies, includes α -santalol, β -santalol, α -santalene, β -santalene, α -santalal, β santalal, α curcumene, tricycloekasantal, and more A few pharmacological studies have shown that sandalwood oil has antiviral properties, that α - and β santalol s are neuroleptics, and that they are effective in preventing skin cancer in murine models of skin carcinogenesis (14).

For many years, Indian sandalwood has supplied 80–90% of the demand for sandal oil in the global market, with *Santalum album* having the greatest oil concentration in the genus *Santalum* (about 6%) (15).

2. Producing Regions

Native to the mountains of southern India, particularly Coorg, Chennai, and Mysore, is the plant known as *Santalum album*. At elevations of 2000–3000 feet (16), it usually happens. But the sandalwood that was naturally found in Australia, *S. spicatum*, was of lower grade than Indian sandalwood (< 90%), with a low santalol concentration (17).

As part of the Hindustan Centre of Origin of Crops and Plant Diversity, India is one of the twelve centres where cultivated plants originated. Because of its diverse physiographic and climatic conditions, India has a very rich biological diversity. India is home to roughly 4-5 percent of all known plant species worldwide. All of the world's major ecosystems are included in the remarkable diversity of biodiversity found in India, which spans 25 different biotic provinces and 10 biogeography zones (18).

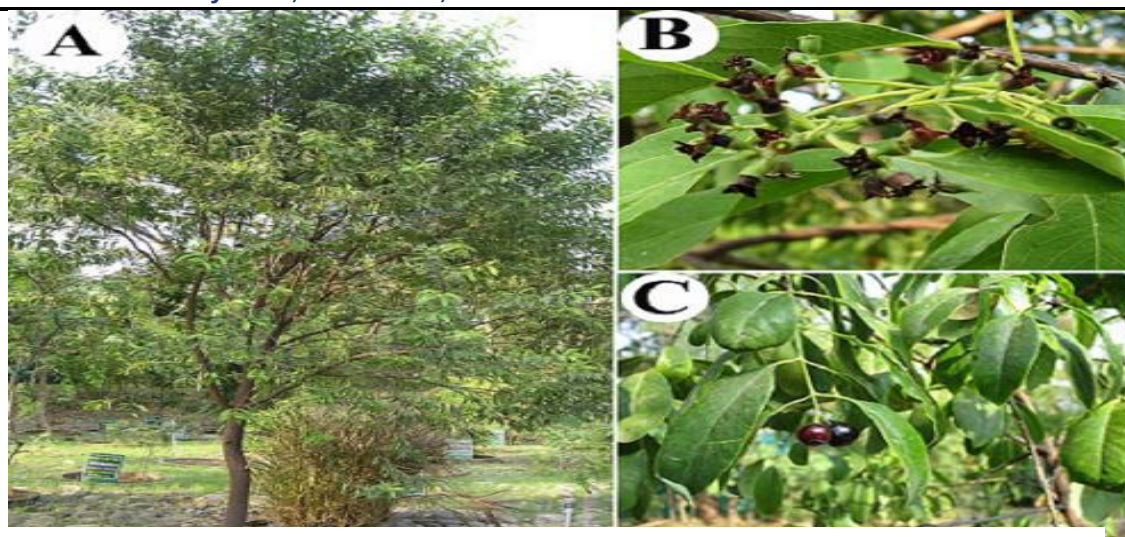


Fig1 : Santalum Album Tree

2. BOTANICAL DESCRIPTION

Evergreen in nature, sandalwood trees are indigenous to India and Indonesia and reach heights of 8 to 12 metres.

- Its girth increases by 2.5 cm.
- Leaves range in size from 3.8 to 6.3 by 1.6 to 3.2 cm.
- Leaves have an elliptic form.
- Compared to leaves, flowers are thinner and shorter.
- There is smooth bark.
- The little flowers have several short stalks . The bark is a gray-brown colour (19).

3. Utilised parts

leaves, seeds, roots, stem, and bark.

4. PHYTOCONSTITUENTS ACTIVE _____Heartwood

oil contains highly sought-after ingredients in the perfume industry, such as Santalic acid, Santalal, α and β santalol, and α and β santalene (20). Commercially available sandalwood oil contains sesquiterpene alcohols such as α - and β -santalols ($C_{15}H_{24}O$), bergamotols, and several of their stereoisomers as major constituents, while lanceol, nuciferol, bisabolol, and sesquiterpene hydrocarbons such as α - and β -santalenes ($C_{15}H_{24}$), bergamotenes, α -, β -, and γ -curcumenes, β -bisabolene, and phenylpropanoids are among the secondary constituents. Generally speaking, α -santalol is more prevalent than β -santalol. Major components of essential oils, according to Verghese and colleagues, include sesquiterpene alcohols, cis- α and cis-

β -santalol, α -transbergamotol, and epi-cis- β -santalol. Heterocyclics, hydrocarbon santene (C₉H₁₄), -santalene, β -santalene, -bergamotene, epi- β -santalene, -curcumene, β -curcumene, γ -curcumene, -bisabolene, and -bisabolol are among the minor ingredients. Other components found in the sandalwood oil include alcohol, santenol (C₉H₁₆O) and teresantalol (C₁₀H₁₆O); aldehydes, isovaleraldehyde and nor-tricycloekasantalal (C₁₁H₁₆O); ketones, l-santenone (C₉H₁₄O) and santalone (C₁₁H₁₆O); and acids, teresantalic acid (C₁₀H₁₄O), which occurs partially free and partly in relation to other substances (21). Following their extraction with petroleum ether, air-dried berries yield a viscous, greyish brown lipid that contains betulic acid, glucose, fructose, sucrose, and other phytoconstituents such as palmitic acid, oleic acid, linoleic acid, and santalbic acid. Due to the berries' high nutrient content, a large number of insect larvae attack ripened fruits, emptying their fleshy section (22)



Fig 2 : Santalum Album Linn Plant

5. MEDICINE USES AND PERFORMANCE ASPECTS

Mainly used as a cooling, sandalwood also has sedative and astringent properties that make it effective as a diuretic, expectorant, stimulant, and disinfectant in the genitourinary and bronchial tracts. Sandalwood oil is important in the perfume industry because of its strong, sweet scent. Additionally, the same is utilised as a blood purifier, memory enhancer, anti-poison, stomach and liver tonic, and heart tonic. The Ayurvedic system of medicine mentions using sandalwood for treating a number of additional conditions, including diarrhoea with bleeding internal haemorrhage

bleeding piles, vomiting, poisoning, hiccoughs, the first stage of the pox, urticaria, eye infections, and inflammation of the umbilicus (23). The oil derived from cendana finds extensive applications in the fragrance industry, cosmetics, culinary flavouring, and aromatherapy. Cendana has been used in traditional Indonesian medicine (24).

6.USE IN THEORY OR HISTORY WITH INSUFFICIENT EVIDENCE

6.1 Encourage Skin Health

It is well known that sandalwood oil can be used to treat skin issues. It nourishes and moisturises all types of skin wonderfully. Sandalwood's astringent, anti-inflammatory, antibacterial, and analgesic qualities have been effectively utilised in the treatment of wounds, scars, and acne (25).

6.2 DIY Face Packs Made With Sandalwood

Topical application of red sandalwood has many benefits. Our skin remains radiant, healthy, and clear as it is nourished. Additionally regarded as a skin-saving remedy for lifeless, dull skin is red sandalwood. In addition to these advantages, this incredible component is renowned for its capacity to tighten the skin, even out uneven skin tones, and produce skin that is firmer, brighter, and more radiant. For greasy, acne-prone skin, rosewood is a godsend. Large pores that can cause excruciating pain are treated, and excess oil is controlled (26).

6.3 Hair Wellness

Sandalwood oil is very beneficial for treating a variety of hair problems, such as dandruff and reducing hair loss. Its astringent qualities help to eliminate the scalp's excess sebum secretion. It repairs split ends and enhances the lustre and growth of the hair. When kneaded into the scalp, an amazing blend of natural balms like lavender and sesame combined with sandalwood oil helps to get rid of dandruff (27).

6.4 Calming

Aromatherapy is a safer option since sandalwood, a sedative, can be utilised in psychological and emotional treatments for mental tension, anxiety, and depression. Sandalwood oil is thought to work on the subtle emotional centres to encourage

compassion and openness while also naturally regulating anger and violence. Another urgent health concern is addiction, which requires both physical and emotional detoxification in order to be treated. The distinct fragrance of sandalwood, which is used in cosmetics and fragrances, revitalises the body and mind and promotes relaxation (28).

6.5 Coolant Impact

Sandalwood was used for its fragrant and therapeutic qualities. Most commonly, sandalwood is used as cooling. It has diuretic, expectorant, stimulant, and genitourinary tract disinfecting properties. It has both astringent and sedative properties. It is applied for memory enhancement and blood purification. Additionally, vomiting, urticaria, bleeding piles, and eye infections are treated with it (29).

6.6 Hepatoprotective properties

Through a significant increase in glutathione, superoxide dismutase, catalase, and protein levels in a dose-dependent manner and a decrease in the total weight of the liver and histopathological examinations, the hydro-alcoholic extract of *S. album* leaves demonstrated significant hepatoprotective activity against CCl₄ and paracetamol-induced hepatotoxicity (30).

6.7 Using aromas

In addition to working on the subtle emotional centres to encourage compassion and receptivity, sandalwood oil is thought to naturally control anger and violence. Treatment for addiction requires both physical and emotional cleansing; it is another urgent health concern. A person can relax and unwind thanks to sandalwood's distinctive scent, which is used in perfumery and cosmetics. It revitalises the body and mind.

6.8

Neurological Impact

Sandalwood's fragrant properties soothe a tense nerve system, balancing vyanavayu and reducing sadhaka pitta, which makes it helpful in treating depression and mental disorders.

Sandalwood oil and aqueous extract have already been shown to have sedative properties (32).

6.9 Antioxidant Function

A nutritional and nutraceutical perspective was used to examine the berries of *S. album*, with a particular emphasis on the biochemical components, such as vitamins like niacin, C, and tocopherols (vitamin E). Reactive oxygen species are fought off by a variety of extracts with diverse contents that have been demonstrated to have strong scavenging and antioxidant potentials (33).

6.10 Antimicrobial

Using *S. album* leaf extract, a low-cost, non-toxic, and environmentally friendly phytosynthesis of PdNPs was reported. TEM and XRD, respectively, were used to characterise the spherical shape and crystalline nature. The phytochemicals in the *S. album* leaf extract that bioreduce Pd ions were recognised by their functional groups in the FTIR spectra. It was observed that PdNPs exhibited efficient catalytic activity on the reduction of 4-NP to 4-AP. PdNPs made from *S. album* leaf extract had superior antibacterial activity (34).

6.11 Viral Inhibition

Antiviral properties can be found in the sandalwood oil of the *Santalum album*. A dose-dependent antiviral activity of sandalwood oil was observed, with HSV-1 being more effective than HSV-2 in inhibiting the replication of the Herpes Simplex-1 and HSV-2 viruses. The mRNA production of the influenza A/HK (H3N2) virus is interfered with by the β -santalol found in sandalwood oil, which acts as an inhibitor. The anti-HPV (Human papillomavirus) properties of sandalwood oil, specifically α and β -santalol, were found to be effective in a different study (35).

7. CONCLUSION

Santalum album is a highly recognised and frequently utilised plant in the fragrance and cosmetic industries. In addition to its many pharmacological applications in perfumes and cosmetics, sandalwood is a plant with a number of significant therapeutic properties. The oil from sandalwood has a strong, persistent scent and is a pale yellow liquid. Its applications are widespread in the fragrance, cosmetic, aromatherapy, and medicinal industries. In pharmacology, sandalwood has the

following properties: it is a diuretic, expectorant, sedative, astringent, and antiseptic in the genitourinary and bronchial segments. Jaundice and other liver illnesses are treated with the plant's wood, root, bark, and leaves. It treats nausea, vomiting, diarrhoea, jaundice, anxiety, and stomach irritation. It also functions as a blood purifier, fever reducer, liver toner, and stomach toner.

REFERENCES :

1. Shivatare, Rakesh S., and Dheeraj H. Nagore. "EXTRACTION, CHARACTERIZATION AND ANTIOXIDANT ACTIVITIES OF VARIOUS SOLVENT EXTRACTS OF SANTALUM ALBUM L. SEEDS."
2. _Sutheesh, V. K., C. M. Jijeesh, and T. P. Divya. "Evaluation of organic and inorganicpretreatments for better seed germination and seedlingvigour in Santalum album L." Plant Archives 16.1 (2016): 143-150.
- 3.Polaiah, A. C., et al. "Effect of presowing seed treatments on seed germination and seedling growth of sandalwood (Santalum album L.)." (2020).
- 4.Patil, Dharmaraj P., et al. "Development, validation and application of RP-HPLC methodfor estimation of Xymenynic acid in Santalum album_seeds extract." Journal of Pharmacognosy and Phytochemistry 8.4 (2019): 1955-1962.
5. Goswami, Nirupama Bhattacharya, and Jagatpati Tah Jagatpati Tah. "White sandal (Santalum album L.), a precious medicinal and timber yielding plant: a short review." (2018): 1048-1056.
6. Ratnaningrum, Yeni WN, and Sapto Indrioko. "Response of flowering and seed production of sandalwood (Santalum album linn., Santalaceae) to climate changes." Procedia Environmental Sciences 28 (2015): 665-675.
- 7.Puspawati, N. M., and W. S. Rita. "Topical anti-inflammatory activity of n-hexane extract of santalum album linn leaves on rat ear oedema induced by croton oil." Journal of Physics: Conference Series. Vol. 1321. No. 2. IOP Publishing, 2019.

- 8.**Sandeep, C., and T. N. Manohara. "Sandalwood in India: Historical and cultural significance of Santalum album L. as a basis for its." NeBIO 10 (2019): 235-242.
- 9.**Umdale, Suraj, et al. "Phytochemical investigation and antioxidant efficacy of wild, underutilized berries of economically important Indian Sandalwood(Santalum album L.)." Biocatalysts' and agricultural biotechnology 27 (2020): 101705.
- 10.**Goswami, Nirupama Bhattachryya, and Jagatpati Tah Jagatpati Tah. "White sandal (Santalum album L.), a precious medicinal and timber yielding plant: a short review." (2018): 1048-1056.
- 11.**Kumar, G. Ravi, et al. "Pharmaceutical importance, physico-chemical analysis and utilisation of Indian sandalwood (Santalum album Linn.) seed oil." Journal of Pharmacognosy and Phytochemistry 8.1 (2019): 2587-2592.
- 12.**Kumar, Rakesh, Nishat Anjum, and Y. C. Tripathi. "Phytochemistry and pharmacology of Santalum album L.: a review." World_Journal of Pharmaceutical Research 4.10 (2015): 1842-1876.
- 13.** Umdale, Suraj, et al. "Phytochemical investigation and antioxidant efficacy of wild, underutilized berries of economically important Indian Sandalwood (Santalum album L.)." Biocatalysts' and agricultural biotechnology 27 (2020): 101705.
- 14.**Guo, Huimin, et al. "Anti-diarrhoeal activity of methanol extract of Santalum album L. in mice and gastrointestinal effect on the contraction of isolated jejunum in rats." Journal of ethnopharmacology 154.3 (2014): 704-710.
- 15.**Sutheesh, V. K., C. M. Jijeesh, and T. P. Divya. "Evaluation of organic and inorganic pretreatments for better seed germination and seedling vigour in Santalum album L." Plant Archives 16.1 (2016): 143-150.
- 16.**Sindhu, Rakesh K., Kumar A. Upma, and Sahil Arora. "Santalum album linn: a review on morphology, phytochemistry and pharmacological aspects." International Journal of PharmTech Research 2.1 (2010): 914-919.

- 17.** George, Alex K., et al. "Progress and future research trends on Santalum album: A bibliometric and science mapping approach." *Industrial Crops and Products* 158 (2020): 112972.
- 18.** Tewari, V., et al. "Distribution, growth & yield and demand & supply of Santalum album: survey & review." *Proceedings of the National Seminar on Conservation, Improvement*. 2014.
- 19.** Aftab, Arooj, et al. "Santulum album: Medicinal and Pharmacological Properties." *Journal of Medicine and Health Research* 8.1 (2023): 9-14.
- 20.** Umdale, Suraj, et al. "Phytochemical investigation and antioxidant efficacy of wild, underutilized berries of economically important Indian Sandalwood (*Santalum album* L.)." *Biocatalysts' and agricultural biotechnology* 27 (2020): 101705.
- 21.** Pullaiah, Thammineni, et al. "Phytochemistry and Pharmacological Properties of Santalum album L." *Sandalwood: silviculture, conservation and applications* (2021): 67-96
- 22.** Harsha, PSC Sri, et al. "Cyanidin-3-glucoside, nutritionally important constituents and in vitro antioxidant activities of Santalum album L. berries." *Food research international* 50.1 (2013): 275-281.
- 23.** Sindhu, Rakesh K., Kumar A. Upma, and Sahil Arora. "Santalum album linn: a review on morphology, phytochemistry and pharmacological aspects." *International Journal of PharmTech Research* 2.1 (2010): 914-919.
- 24.** Puspawati, N. M., and W. S. Rita. "Topical anti-inflammatory activity of n-hexane extract of santalum album linn leaves on rat ear oedema induced by croton oil." *Journal of Physics: Conference Series*. Vol. 1321. No. 2. IOP Publishing, 2019.
- 25.** Kumar, G. Ravi, et al. "Pharmaceutical importance, physico-chemical analysis and utilisation of Indian sandalwood (*Santalum album* Linn.) seed oil." *Journal of Pharmacognosy and Phytochemistry* 8.1 (2019): 2587-2592.
- 26.** Nagansurkar, Shirish B., Sanjay K. Bais, and Jyoti Bagale. "A REVIEW: FACE PACK CONTAINING HERBAL PLANT SHOWING ANTI-AGING ACTIVITY."

- 27.** Aftab, Arooj, et al. "Santulum album: Medicinal and Pharmacological Properties." *Journal of Medicine and Health Research* 8.1 (2023): 9-14.
- 28.** SS, DAS, and KHAN SY. "Aromatherapy of Santalum album Linn. and its antiviral activity." *Journal of Medicinal and Aromatic Plant Sciences* 44.1-2 (2022): 12-20.
- 29.** Polaiah, A. C., et al. "Effect of presowing seed treatments on seed germination and seedling growth of sandalwood (*Santalum album* L.)." (2020).
- 30.** Kumar, Rakesh, Nishat Anjum, and Y. C. Tripathi. "Phytochemistry and pharmacology of *Santalum album* L.: a review." *World Journal of Pharmaceutical Research* 4.10 (2015): 1842-1876.
- 31.** SS, DAS, and KHAN SY. "Aromatherapy of *Santalum album* Linn. and its antiviral activity." *Journal of Medicinal and Aromatic Plant Sciences* 44.1-2 (2022): 12-20.
- 32.** Joshi, Madhusudan P., Sneha R. Satarkar, and Vedita Hegde Desai. "Comparative study of central nervous system effect of *Santalum album* Linn. paste fragrance v/s aqueous extract in Wistar albino rats." *American Journal of Phytomedicine and Clinical Therapeutics* 1.8 (2013): 661-671.
- 33.** Harsha, PSC Sri, et al. "Cyanidin-3-glucoside, nutritionally important constituents and in vitro antioxidant activities of *Santalum album* L. berries." *Food research international* 50.1 (2013): 275-281.
- 34.** Sharmila, G., et al. "Enhanced catalytic and antibacterial activities of phytosynthesized palladium nanoparticles using *Santalum album* leaf extract." *Powder technology* 320 (2017): 22-26.
- 35.** Ashrafi, Sania, et al. "Prospective Asian plants with corroborated antiviral potentials: Position standing in recent years." *Beni-Suef University Journal of Basic and Applied Sciences* 11.1 (2022): 47.