

Santalum Album L. A Sacred Religious Medicinal Plant

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Abstract

Sandalwood is a highly sacred plant. It holds great significance in India, as it is revered in Hinduism, Buddhism, and Jainism. Since ancient times, it has been utilized in Unani, Ayurvedic, and traditional rural systems of medicine. Various studies have demonstrated its efficacy in memory enhancement and its hepatoprotective, antibiotic, anti-ulcer, antimicrobial, antiviral, anti-cancer, and anti-inflammatory properties; it is also used to treat various urinary tract disorders. Additionally, it is used globally for its fragrance such as in soaps and perfumes—and in skincare applications. It is truly a highly beneficial plant.

Keyword: Santalum album L. , Hepatoprotective, Antipyretic antimicrobial Aromatherapy, Unani medicine , Ayurvedic medicine

Introduction

Sandalwood tree is found growing naturally in Dhar district. It is a plant of great medicinal importance which has been used in different parts of the world. Many tribal people and local people have been using this plant for the treatment of various diseases. Its wood is ground into powder and with this, tilak or paste is applied on the forehead. Its fragrance is very captivating and its scent is also made. It has been proved by various experiments that this is a very useful plant in various types of diseases. It also has mythological importance. It is considered very sacred in various religions, hence its wood is very valuable and is sold at a high price. It is used in Ayurveda, Siddha Unani medical system and in rural areas to cure various diseases.

Study area



Research Methodology

I gathered information about this plant by visiting several areas in the Dhar district.

I made multiple visits to the forest and collected information about the plant from local residents. Through repeated visits to the forest and its surrounding areas, I conducted a comprehensive study, paying particular attention to aspects such as its flowering and fruiting seasons, as well as its economic significance.

I examined several key research papers available on platforms such as the National Library of Medicine, PubMed, Semantic Scholar, and Google Scholar. In addition, I gathered other significant information. Additionally, I captured photographs using my mobile phone camera and conducted an in-depth investigation into this plant.

Scientific Classification

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Eudicots

Order: Santalales

Family: Santalaceae

Genus: Santalum

Species: *S. album*

Binomial name : *Santalum album* L.

Common Name: sandalwood

Arabic: Sandal abyad

Bengali: Chandan, Shwetchandan, Srikhanda,

English: Sandal, Sandal tree, Sandalwood, White Sandal, White Sandalwood

French: Santal blanc

Gujarati: Sukhada

Hindi: Chandan, Sandal

Italian: sandalo

Kannada: Bavanna, Agarugandha, Sri Gandha, Bhadrasri, Chandala

Manipuri: Chandan

Malayalam: Chandanam, chandana-mutti

Marathi: Gandhachakoda, Chandan

Oriya: Valgaka

Sanskrit: Anindita, Arishta-phalam, Bhadrasara, Chandanam, Candanah, shreekhanda

Spanish: sándalo blanco

Swedish: sandelträd

Tamil: Anukkam, Asam, Chandanam, Chandanam, Anukkam, Asam, Sandanam, Sandhanam

Telugu: Bhadrasri, Chandanamu, Tella Chandanam

Turkish: beyaz, Cinden ag, Sandal

Urdu: Sandal safaid



Santalum album L. plant



Santalum album L. Plant leaves



Santalum album L. Plant flower



Santalum album L. flower bud



Santalum album L. Plant flower and inflorescence



Santalum album fruit



Santalum album plant

Tree

Santalum album is a small tropical tree attaining a height of 4 to 20 meters and a girth of 1 to 2.4 meters. The shape of the leaves vary with six morphological types recognized widely. It may live to more than hundred years of age. The tree is variable in habit, usually upright to sprawling, and may intertwine with other species. The plant parasitises the roots of other tree species, with a haustorium adaptation on its own roots, but without major detriment to its hosts. An individual will form a non-obligate relationship with a number of other plants.

Leaves

Leaves are opposite and decussate, sometimes show whorled arrangement. The shape of leaf varies and six morphological types have been widely recognised. They are Ovate, Lanceolate, Elliptic, Linear, Big and Small.

Root

The primary root is moderately long, delicate and flexuose. Lateral roots are moderate in number, fibrous, delicate and distributed down the main root. Roots at an early stage develop nodular growth, the first sign of haustoria. However, A small number of sandal plants does exist without haustorial nodules even upto two years.

The primary root of *Santalum album* is clearly diarch, open and exarch. The secondary growth is profuse. The secondary xylem formed; lie in close proximity to that of the primary xylem. The diarch nature of the root becomes indistinct. Structure of the mature root is essentially similar to that of stem. Secondary xylem far exceeds secondary phloem in volume. Tap root system is not deep and lateral root runs almost parallel to the ground and young rootlets produce haustoria which establish connections with

neighbouring host roots for absorption of mineral salts. Not all haustoria are functional. Root contains scented oil.

Stem

Stem is initially green and tender, gradually turns brownish and becomes hard. The bark is reddish brown or dark brown and red inside. Stem is smooth in young trees, turns rough with deep vertical cracks in mature trees. Wood is hard, very close grained, oily. Sapwood is white, scentless, heartwood is yellowish to brown and strongly scented.

Heartwood Formation and Oil Content

Heartwood formation in sandal trees generally starts around 10-13 years of age, but what triggers this process has not been very well understood. Certain factors, generally relating to stress, such as gravelly dry soil, insolation, and range of elevation (500-700 m), seem to provide the right environment for the formation of heartwood, irrespective of the size of the stem after 10 years of age. The occurrence of heartwood varies. The value of heartwood is due to its oil content, and the superiority of the oil is due to the percentage of santalol.

In a tree the oil content is highest in the root, next highest in the stem at ground level, and gradually tapers off towards the tip of the stem.

Similarly, there is a gradient in oil content from the core to the periphery of the heartwood in a stem.

Depending upon their age, trees can be called young or mature, although this is an empirical classification and holds good only for a particular population. The oil content and its composition may differ at the same age:

Young trees (height less than 10 m, girth less than 50 cm, and heartwood diameter 0.5-2 cm) have heartwood with 0.2-2 percent oil content, which has 85 percent santalol, 5 percent acetate, and 5 percent santalenes.

Mature trees (height 15-20 m, girth 0.5-1 m, and heartwood diameter 10-20 cm) have heartwood with oil content of 2- 6.2 percent, which has over 90 percent santalol, 3-5 percent acetate, and 3 percent santalenes.

Flowers

Flowers are purplish brown, unscented and are borne in axillary or terminal cymose panicles. The floral organs develop in acropetal succession. The first to appear are the four perianth lobes followed by epigynous stamens, carpels and placental column. Flowers are tetra to pentamerous, rarely hexamerous and hermaphrodite. The ovary is semi-inferior and unilocular with three ovules lodged in three depressions at the base. The depressions at the base of the ovary are formed in later stages of development of flower when the embryo sac comes out of the ovule and crushes the cells at the base of the ovary to form small depressions in which the tip of the ovules and the embryo sac rest.

The placental column is straight, generally bearing three, Ovules in hexamerous flowers. However, four ovules are more frequent. The long style is traversed by a narrow canal and terminates in 3 or 4 lobed stigma.

Fruit

Fruit is a drupe, purplish when fully mature and single seeded. Shapes of fruit vary ranging from round

to oblong and sometimes show tapering ends.

Seeds

Seeds are obtained by removing the fleshy portion of the fruit. They are naked, lacking testa. The dicotyledonous embryo occupies nearly the entire length of the albuminous seed. The endosperm contains 50 to 60 percent of drying oil, protein and mineral matter. The stony endocarp, although not to be called seed coat, is referred as seed coat literally, though it is a false seed coat. Seeds show polymorphic characters, varying in size and shape.

Memory Enhancing

Santalum album has been described in Siddha medicine as possessing memory and cognitive properties. An Ayurvedic formulation is described as having the property to decrease dementia in older people. Study evaluated the effect of Santalum album in male albino mice with memory loss induced by β -amyloid protein. Results showed S. album has memory enhancing property as suggested by increased enzyme levels. (Papaiah et al., 2010)

Hepatoprotective

The hepatoprotective activity of the leaves of the sandalwood plant was examined against experimentally induced liver injury by CCl₄ and paracetamol. The oral pretreatment with the hydroalcoholic extract of the leaves of the plant showed significant hepatoprotective activity against CCl₄ and paracetamol-induced hepatotoxicity by inhibiting the activities of serum marker enzymes, lipid peroxidation, bilirubin and rise in the levels of superoxide dismutase, glutathione, catalase and protein in a dose-dependent manner. This activity was confirmed by the reduction in the total liver weight and histopathological examinations (Hegde et al 2014)

Antipyretic effect

The anti-inflammatory effect of sandalwood oil as well as HESP oil was investigated against yeast induced pyrexia in albino rat in dose of 200mg/kg using 0.2% of tween 80 as control and 100 mg/kg paracetamol as standard. A significantly high antipyretic effect observed in case of sandalwood oil and HESP

Antiulcer

The antiulcer activity of the sandalwood plant was examined against Wistar albino rats. The hydro-alcoholic extract of the stem at a dosage of 250 and 500mg/kg was administered by three in vivo models namely water-immersion restrain stress, indomethacin-induced gastric ulceration and ethanol models in Wistar albino rat. Results showed an increase in gastric protection and a significant decrease in the average number of ulcers, cumulative ulcer index and severity of ulcers

Antimicrobial activity

The antimicrobial activity of aqueous extract leaf and stem of Santalum album was performed against Escherichia coli, Staphylococcus aureus and Pseudomonas. S. album leaf extract showed inhibition to E.coli (0.8mm), Staphylococcus aureus (1.0mm) and Pseudomonas (1.4mm) while stem extract showed inhibition on E.coli (0.6mm), Staphylococcus aureus (0.4mm) and Pseudomonas (1.0mm) respectively. However leaf extract showed significantly higher inhibition when compared to stem

extract. This might be due to presence of higher amount of secondary metabolites in the aqueous leaf extract. (Kumar et.al.,2006)

Antiviral activity

Essential oils from sandalwood were screened by Koch et al. (2008) for its inhibitory effect against Herpes simplex virus type 2 (HSV-2) in-vitro on RC-37 cells using a plaque reduction assay. The inhibitory concentration (IC₅₀) was determined at 0.0015% for sandalwood oil. The results clearly showed dose-dependent effect of sandalwood oil. In order to determine the mode of the inhibitory effect, essential oils were added at different stages during the viral infection cycle. However, no inhibitory effect could be observed when the essential oils were added to the cells prior to infection with HSV-2 or after the adsorption period. These results indicate that essential oils affected HSV-2 mainly before adsorption probably by interacting with the viral envelope.

Anticancer Effects of Sandalwood Oil

The available experimental evidence suggests that sandalwood oil could function as an inhibitor of tumor initiation and promotion stages of carcinogenesis. Studies in male Swiss albino mice indicate the anticarcinogenic potential of sandalwood oil via enhancing the excretion of carcinogens. In that study, oral gavage feeding of sandalwood oil induced a time- and doseresponsive increase in the activity of glutathione-S-transferase (GST) and acid soluble sulfhydryl levels in the liver

Antiinflammatory activity

Santalols have been reported to possess a significant anti-inflammatory property, in several experimental models (Sindhu et al.,2010). Santalum album possessed anti-inflammatory and antiulcer activities as evidenced by its significant inhibition in the carrageenan induced paw edema, cotton pellet induced granuloma, as well as pylorus ligation induced ulcer. These findings could substantiate the inclusion of this plant in the effective management of inflammatory disorders like ulcer in traditional system of medicine. The in vitro antioxidant (and in vivo analgesic and antiinflammatory activities in mice were established for methanolic extracts of heartwood. (Saneja et al.,2009)

Promotes Skin Health

Sandalwood oil assumes an extraordinary part in restoring skin conditions like dryness, popping, chipping and wrinkling. Sandalwood oil helps with reestablishing the harmed skin cells, advances the skin tone and keep up with skin gleam and shiny. Going about as an astringent, clean, antimicrobial, hostile to maturing and sanitizer sandalwood oil safeguards the skin from unsafe microorganisms, infection and parasitic assaults. Applying sandalwood oil topically on the impacted skin helps in mending wounds, bruises, scars, pimples, and consumes (Moy et al.,2017.)

Aromatherapy

Sandal wood oil has soothing, relaxing, sensual and pacifying effects due to its rich and warm aroma. It is mostly used with other oils to enhance fixative ability and to provide base line. It can be used for all skin type dry, sensitive and oily. It provides restful sleep and also reduces the anxiety. It acts as a relaxant. Proof shows that sandalwood oil assists in soothing nerves, muscles and veins by reducing the

fits and compressions. Sandal wood oil has relaxing effects therefore it can be used agitated emotional states leading to headache, insomnia and restlessness

Unani medicine

Sandalwood is used by unani practitioners in their medicine because of its relaxing and cooling properties. It is utilized to cure fevers, boils, and other inflammatory diseases, as well as to balance the body's humors

1. Useful in people with Garam mizaj (hot temperament).
2. Used in zofe-meda (weakness of stomach).
3. Applied in the form of zimad (liniment) over chest in case of khafqan (Palpitation).
4. Sandal safaid and anzarut (Astragalus sarcocolla) in equal quantity is mixed with baize
5. murgh (oil extracted from egg yolk) and is applied over temples headache. Sandal powder taken with cow's milk treats gonorrhoea 10 to 30 drops of sandal oil,
6. mixed with cow's milk used thrice a day is an effective remedy for gonorrhoea.
7. Its zimad (liniments) applied over forehead relieves safravi darde sar (bilious head ache).
8. Used to relieve safravi dast (bilious diarrhea).
9. Sandal safaid and kafoor (camphor) grinded in arqegulab (rose water) is advised for
10. inhalation in cases of bilious headache.

Ayurveda

Sandal wood oil is highly valued for its antibacterial, soothing, and cooling qualities in Ayurvedic treatment. It is used to relieve the symptoms of headaches, sleeplessness, anxiety, and skin disorders including eczema, rashes, and acne. Additionally, sandal wood paste is administered topically to lessen inflammation and encourage the healing of wounds

Actions and Properties (Choudhary et al., 2021)

Kaphapittashamak: It alleviates the Kapha and Pitta components of the body.

Twagdosahara: It is useful in the treatment of skin disorders.

Durgandhara: It helps in diminishing the foul smell of sweat, wounds and mouth etc.

Varnya: It helps in enhancing the color complexion of the skin.

Medhya: It is used as a brain tonic.

Trishnanigraha: It helps in reducing excessive thirst.

Hridya: It helps in treating heart disorders.

Raktshodhak: It is used as a blood purifier.

Kaphanisharak: It helps in balancing the Kapha dosha in the body and reduces congestion.

Shleshamputihara: It helps in reducing the vitiated Kapha and helps in reducing halitosis (bad breath).

Mutrājāna: It is used as a diuretic agent.

Swedjana: It helps in inducing sweating.

Jwaraghna: It cures vitiated fever and is used as an antipyretic agent.

Daahprashama: It is used to reduce the burning sensation of the body.

Vishghna: It is used as an antivenom agent.

Angmardprashama: It is used to cure body aches.

Kamla: It is used to treat jaundice.

Mutrakriya: It is used in the treatment of painful micturition or dysuria.

Pungyameh: It is used to cure urinary tract infections.

Vastishotha: It helps in reducing the swelling in urinary bladder.

Use of sandalwood in controlling sexual urge, celibacy:

Sandalwood has been used in Hindu cultural rituals for thousands of years. Reason for this is quite intriguing. Sandalwood in small doses acts as aphrodisiac, due to its tiny sweet taste and coolant properties. But it is also very useful in controlling sexual urge and to maintain celibacy – Brahmacharya. This is the same reason, Sandalwood is used as a main ingredient in Chandanasava – a fermented Ayurvedic medicine with Sandalwood as main ingredient is used in treating Spermatorrhoea (Called as Shukra Meha in Ayurveda). Spermatorrhoea is – flow of semen along with urine.

Religious and cultural practices

Buddhism

Sandalwood is used to make prayer beads (malas) and incense sticks in Buddhist rituals. Sandalwood incense's soothing scent facilitates meditation and fosters inner serenity

Jainism

Sandalwood is utilized in Jain rites and rituals, which are similar to those of Buddhism and Hinduism. It is utilized in the creation of holy symbols and for anointing idols

Hinduism

Many Hindu rites and rituals involve the use of sandalwood paste. It is used to prepare idols and holy objects and is put as a sacred mark (tilak) on the forehead. It is said that the aroma of sandalwood in spires spirituality and tranquility

Others uses

1. **Wood:** Heartwood is yellow-brown in color, hard and durable, with an oily texture. Valued in construction and a good wood for carving. Considered rot proof. Outer part, sapwood, is unscented; white or yellow, it is used to make turnery items.
2. **Oil:** Indian sandalwood has a high santalol content (about 90%). Sandal oil is distilled from the heartwood which yields 4-10%. Sandalwood oil is used in aromatherapy and the manufacture of perfumery, soap, pharmaceuticals.
3. **Fragrance:** The heartwood is the only part of the tree used for its fragrance. Used in the production of perfume Samsara by Guerlain.
4. **Rituals / Therapies:** Sandalwood has been used in China for construction of statues and temples, and was burned in censers during religious rites; also, as aromatic medicine in the Tang Dynasty (581 AD) to treat respiratory maladies. In Egypt, used for embalming mummies, and later was burned as part of Muslim funerals. In Egypt use in ritual burning to venerate the gods. Used by Buddhists as therapy for depression, anxiety, and insomnia. Monks used it to relax the body and focus the mind.
5. **Fodder:** Trees are lopped for fodder. Foliage is palatable to grazing animals such as rabbits, sheep, goats, cattle, pigs, horses, and camels.
6. **Green manure:** Leaves make a good green manure.

Conclusion

In India, a sandalwood tilak is applied because it is believed to have a cooling effect that keeps the mind and brain cool. It exhibits hepatoprotective, antibiotic, anti-ulcer, antimicrobial, antiviral, anti-cancer, and anti-inflammatory properties. It is used to treat various ailments within the Ayurvedic and Unani systems of medicine, as well as by tribal communities in rural areas. In India, it is considered a highly sacred plant in Hinduism, Buddhism, and Jainism, and is also used in cosmetics. Its leaves are used as fodder for wild and domestic animals, and they are also used to produce green manure.

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