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# Santalum album Linn: A Review

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**Abstract:** *Santalum album Linn* belongs to the family Santalaceae and is wiedly distributed in tropical and temprate region. Plants is the most oldest known perfumery and has 2000 years of uninterrupped history. *Santalum album* L. thrives on well-drained, loamy soil. It grows also on laterite, but not waterlogged ground, and preferably on slopes of hills exposed to the sun. It requires a minimum of 20 to 25 in. of rainfall per year; more than 80 in. is harmful. Main chemical constituents are Santene, α-Santalene, β-Santalene, Teresantalol, α-Santalol, β-Santalol, Norticycloekasantalal etc. Plant is well established for its medicinal uses in various diseases like urinary tract infections including cystitis, gonorrhea, skin care (soothing for cracked, chapped and irritated skin), Antitumor activity, Anti-Helicobacter pylori induced ulcer, in bladder infections etc.
**Key Words**: *Santalum album linn.*, Santene, α-Santalol, alternative medicine, Antitumor activity.

## Introduction

In the Santalaceae (Sandalwood family) most of the plants are herbs, shrubs or trees, with simple, mostly alternate, entire leaves, or these reduced to scales. They are widely distributed in the tropics and temperate regions. A few of the members are semi-parasitic on the roots of the host plants.

The flowers are small, regular, and the 4-5 sepals sometimes petaloid. There are 4-5 stamens, opposite the perianth parts. There is 1 ovary, often inferior and embedded in the resceptacular tissue, composed of 3-4 carpels, with 1-5 ovules, but often only 1 maturing. Fruit is an achene or drupe without a seed coat. There are 26 genera in the family and about 400 spe-cres. The family in general is of little economic importance, but the sweet scented sandalwoodis used extensively in perfumes and in cabinet making. It belongs to tribe Osrideae[1,2].

### Historical Background[3]

The sandal wood is one of the most oldest known perfumery and has 2000 Years of Uninterupped history. The tree most probably indigenous to peninsular India. There are references of sandal wood in Indian mythology. Mention in Indian literature as old.

Milinda Panha (200 B.C.), Patanjali Mohabhashyaya, Dhamma pada, Vinya Pitaka, Ramayana, Mahabharta. S. Album has been grown from last 23 centuries .

| **Family** | **Santalaceae** |
|---|---|
| **Genus** | ***Santalum*:** (SAN-tal-um) |
| **Species** | ***album*** (AL-bum) |
| **Synonym** | ***Breynia album*** |
| **Vernacular Names** | |
| English | Sandal tree |
| Hindi | Safed Chandan, Chandal, Sandan |
| Bengali | Peet Chandan, ShriKhanda |

| | |
|---|---|
| Gujarati | Sukhad , Sukhet |
| Mal | Chandanam, Chandana Mutti |
| Tamil | Kulavari Sandanum, Chandanam |
| Telugu | Chandanamu |
| Oriya | Chandono |
| Sindh | Sukhed |

| | |
|---|---|
| **Category** | Trees, Parasites and Hemiparasites with sucking roots |
| **Height** | 20-30 ft. (6-9 m) |
| **Spacing** | 8-10 ft. (2.4-3 m)<br>10-12 ft. (3-3,6 m) |
| **Hardness** | USDA Zone 10a: to -1.1 ° C (30° F) |
| **Sun Exposure** | Full Sun or Sun to Partial Shade |
| Danger | N/A |
| Bloom Color | Purple |
| **Bloom Time** | Late Spring/Early Summer<br>Late Fall/Early Winter |
| **Foliage:** | Evergreen<br>Smooth-Textured |
| **Other details** | Average Water Needs; Water regularly; do not over water |
| **Soil pH requirements** | 5.6 to 6.0 (acidic)<br>7.6 to 7.8 (mildly alkaline) |

**Habitat.**[7]

*Santalum album* L. thrives on well-drained, loamy soil. It grows also on laterite, but not waterlogged ground, and preferably on slopes of hills exposed to the sun. It requires a minimum of 20 to 25 in. of rainfall per year; more than 80 in. is harmful. The finest wood, grows in the driest regions, particularly on "red or stony" ground .On rocky ground the tree often remains small, but gives the finest yield of oil. It grows most abundantly in the dry-deciduous belt along the banks of the Cauvery River, among the mountains which run through the State of Mysore from north to south. Tree's more than thirty years old may have a circumference of from 18 to 38 inches. The bark and the sapwood are odourless. The roots and heartwood contain the essential oil.

**Propagation**[7]:

In years past the sandal tree occurred mainly in the wild state, but reckless exploitation and the danger of losing the great revenue from forests induced the Mysore Government to restrict the cutting, and to propagate large numbers of trees every year (by sowing). At one time propagation of the sandal tree was considered a difficult matter, but the problem has been much simplified.

A certain amount of propagation takes place by means of birds. The blue-colored fruit of the tree is juicy and sweet and much liked by birds, which eat the outer fleshy part and drop the hard seed. Falling on suitable soil, this seed germinates, taking root and, unless destroyed by its natural enemies, grows into a tree. In past years this was the only way the sandal tree was propagated.

Today most sandal trees, at least in the State of Mysore, are propagated by sowing. The seed is placed directly into the ground, because the delicate nature of the root, which must prey on a host root, does not permit transplanting of the young trees from a nursery. The sowing is done about two weeks before the arrival of the monsoon rains, usually at the end of April. Since not all seeds germinate, five seeds are planted in a semicircle and surrounded by a number of host plants. A great enemy of the sandal tree is the common rat, which burrows into the ground for food and eats the seed. Therefore, the seed is given a protective coating of red lead paste prior to planting . The young plants grow very slowly.Foraging goats frequently attempt to feed on it and may destroy it, but the dense, thorny foliage of the surrounding host plants protects the young and tender sandal tree.

The greatest peril to the sandal tree is the so-called spike disease. This is extremely dangerous because of its contagious nature and also because no remedy has yet been found. It represents a kind of "plant consumption;" the nature of which is not fully understood.

**Fruiting**:[8]

October to December.

**Morphology of the Fruit / Seed:**

Fruit a nut or drupe, black when ripe, seed globose or ovoid.

**Seed Collection and Storage :**

Sandal fruits are collected fresh from the trees in December and are soaked in water and

remove the soft pulp. Then they are dried. The seeds are store well.

**Seed Biology**

**Pretreatment:**

Acid scarification with concentrated $H_2SO_4$ for 30 minutes with stirring and with running water, or soak the seeds in 0.05% gibberellic acid overnight.

**Nursery Technique:**

The seed beds are either sunken or raised and covered with straw which is removed when the seedlings emerge. When seedlings attain 4 to 6 leaf stage, they are transplanted in polythene bags, along with seeds of a primary host tree *Cajanus cajan.* Seed in December give 30 cms tall seedings in 4 months.

**The heart Wood[9]**

The most useful part of the sandal tree is the fragrant heartwood which usually starts after 10 years of growth. It becomes commercially useful after 30-40 years when two-year-old seedlings are treated with 1% solution of a growth retardant of different doses (1 *or* 3 ml) and different frequencies (1, 2, 3 or 4 times/year) for 3 years. After that the plants are dug up and the essential oil extracted from stems and roots. Growth retarders show a marked effect on forcing heartwood formation as means by the total oil and sandalol [santalol] content, which is much higher than in the untreated plants.

**Sandal Wood Oil**

Sandalwood oil in India is extracted from Santalum album of the Santalaceae family and is also known as East Indian sandalwood, santal, saunders and sandalwood Mysore and should not be confused with the cheap sandalwood available from Australia.

Although expensive, this oil has wonderful qualities for relieving both chest and urinary tract infections, while assisting the skin in promoting hydration and moisture and for the mind it creates a calming and harmonizing effect, while reducing tension and confusion.[10]

**Oil properties[10]**

The oil has a woody, exotic smell, subtle and lingering and the color is pale yellow to pale gold. Our essential oil contains 90% santalol - making it a very superior sandalwood oil.

**Origin of sandalwood oil[10]**

Sandalwood is an evergreen, parasitic tree that burrows its roots into other trees. It can grow up to 9 meters (30 feet) high and has a brown-gray trunk, many smooth slender branches, leathery leaves and small pink-purple flowers.

It can take thirty to sixty years for a tree to reach full maturity, when it is cut and distilled and the yellowish wood is sold in thin scrapings. It is agreed that the best sandalwood oil is from Mysore in India.

The documented use of the wood goes back 4000 years and caravans carrying this wood from India to Egypt, Greece and Rome were a familiar sight. Many temples were built from the wood and the Egyptians used the oil in embalming.

Sandalwood is much in demand as incense and has a calming effect during meditation. Swahra yoga recommends it for the union of the senses and Tantric yoga for the awakening of sexual energy.

Once Sandalwood was used for making furniture and caskets, but as the tree is nearly extinct, it is only used for the distillation of oil. Because of the threat of total extinction, this oil is now very well controlled in India - but has caused the price of this very fine oil to soar, and become one of the most expensive essential oils in the market.

**Distillation of Sandalwood oil**[7]

The distillation of sandalwood oil in India has been carried on from very ancient times by the so-called water distillation method. It consists in soaking the raw material in water in a copper vessel and heating it on an open fire. The vapors from the body of the still are conducted through a bamboo or copper pipe to receivers which are kept in cold water, the latter being renewed frequently. modern operation the raw material consists of billets and roots of sandalwood and also a quantity of chips, the latter being a mixture of both the heartwood and the sapwood. The yield of oil varies, the roots giving the highest percentage and the chips the least. The average yield from good billets and roots ranges between 4.5 to 6.25 per cent.

The wood is first of all fed to a chipping machine consisting of a rapidly rotating disc on which are mounted 6 knives radially, the wood pressed against these knives gets reduced into a coarse powder. The latter is next fed to disintegrators which will reduce the wood into a finer state of division. In some of the factories, the chipper is avoided and manual labor employed to chop the wood by means of hatchets and adzes into small-sized sticks or chips. These are then fed into disintegrators. The powder that comes from the disintegrator is carefully sieved and remixed with the object of obtaining a powder that will not "pack in" too tightly in the stills but will form a uniform porous body of material which admits of the passage of steam easily over the entire mass of powder to be distilled.

The stills, usually made of copper, rarely of iron, are provided with goosenecks to conduct the vapor of the oil and steam to tin-lined tubular condensers.

The size and shape of- the stills vary, but the standard equipment is a still holding a charge of 3/4 to 1 ton of powdered wood, the latter being generally placed on a perforated false bottom. There is usually a little space on the top of the "burden" in the still. The height of the still is about 25 per cent more than the diameter.

Distillation is usually conducted with low pressure steam, anywhere between 20 to 40 lb. High-pressure steam has been recommended for sandalwood oil distillation on the score of a slightly higher yield of the oil and a slight saving in time.

Distillation generally requires 48 to 72 hr. Each factory according to its economic condition, has its own end point of distillation. The latter is stopped when the yield of oil ceases to be economical. The distillate collects in the receivers, the crude sandalwood oil floating on the surface. This is generally skimmed off with the help of shallow ladles and then put into a separating funnel where oil and water layers are further separated. The crude oil is stored in a separate vessel and allowed to stay in this condition for some time when a little scum with suspended woody matter comes to the top. The oil is then carefully filtered.

**Physicochemical Properties**[7]

The volatile oil derived from the roots and heartwood of *Santalum album* L. is a somewhat viscous, yellowish liquid of peculiar, heavy, sweet, and very lasting odor, characteristic of East Indian sandalwood.

Gildemeister and Hoffmann [7] reported these properties for East Indian sandalwood oil:

| | |
|---|---|
| Specific Gravity at 15° | 0.973 to 0.985 |
| Optical Rotation | -16° 0' to -21° 0' in exceptional cases lower rotations have been observed |
| Refractive Index at 20° | 1.504 to 1.509 |
| Acid Number | 0.5 to 8.0 (see below) |
| Ester Number | 3.0 to 17.0 |
| Ester Number after Acetylation | Not less than 196 |
| Total Alcohol Content, Calculated as: | |
| Santalol | Not less than 90% (see below) |
| Solubility at 20° | Soluble in 3 to 5 vol. and more of 70% alcohol; in 5 to 6 vol. and more of 69% alcohol; in 6 to 7 vol. and more of 68% alcohol. |

**Characteristic of Sandal wood obtained from Various parts:**

i) Root: The root of tree contain high % of sandalwood oil of finest quality oil contains.
Sp Gravity$^{25°C}$ – 0.9645
$\alpha^{25}_{D}$ (optical rotation) - 15°
Total Alcohol contant – 95.9%

ii) Seeds: Seeds yield on expression 50-55% of dark red viscous fixed oil 60% yield by heat processing. It is drying oil and has following characterstics

Specific Gravity – 0.9356
Iodine Value- 153
Saponification value – 176
Unsaponified matter – 8.8%
The seed oil contains stearolic acid and santalblic acid.
At 220° it react with sulphur to yield a dark shaky rubber like product.

Use – Resin like colophony dammar and copal can be dissolve in oil at 180°-200° yielding an orange coloured bright. Varnish which is

a) used in manufacture of fixed oil.
b) In manufacture use of pigment enamels
c) Vulcunization properties in rubber industry.

iii) Fruit : The air dried fruit on extraction with petroleum ether yield greyish brown viscous oil. That has following characterstics

a) Saponification Value 242.6
b) Iodine Value: 123.6
c) Acid Value: 6.9

The oil contain satalbic acid palmitic acid, Oleic acid and linoelic acid, Glucose , fructose , Sucrose
Leaves : The leaves of sandalwood tree yield a pale yellow wax
M.P. 86 °
Unsaponification fractions – contain n- octacosonal, Triacontanol
Palmitone, d-10 hydroxy palmitone

**Standard and Grades of sandal wood oil[3]**

Since 1957 Goverment of India has been extending control over exports, grading Under “Agmark” is compulsory.

The standard pack of government manufactured sandalwood oil , Mysore contain tin with 11.3 kg oil. Each pack is checked for leaks and caries.

**Indian Standard**

1. Colour and Appearence : Nearly colourless to golden yellow, Visous, oily
2. Odour : Pleasant , Sweety , Woody
3. S.P. gravity$^{30^\circ}$ : 0.962-0.976
4. $\alpha$( optical rotation) : -15° to -20°
5. Esters ( Stearyl acetate) : 2.0

Free alcohol (Santalol % by wt) : 90.0

**Adulteration[7,3,11]**

Formerly, the oils of cedarwood, guaiac wood, West Indian, West Australian sandalwood, and oil of copaiba balsam and gurjun balsam for this purpose. Addition of cedarwood oil or gurjun balsam-oil increases the optical rotation, and decreases the specific gravity and solubility of the sandalwood oil. Copaiba balsam oil acts similarly, except that it usually decreases the rotation slightly.

To simulate high alcohol content synthetics aromatic isolates such as terpineol, benzyl alcohol, or_geraniol are occasionally used. They can be detected by acetylation of oil. Benzyl and geranyl acetate will betray themselves by a fruity note in the odour of the acetylized oil. The presence of terpinyl acetate can be proved by fractional saponification of the acetylized oil for 1hr.- 2 hr.

White paraffin oil has lately been observed as an adulterant of East Indian Sandalwood oil . It can be detected by the so called "Oleum Test" .The volatile oil obtained from wood of plant Eucarya spicata found in western Australia is also a substitute for sandalwood oil.

A pure synthetic product known as "Sandel" manufactured in USA has posed a natural threat to sandalwood oil

It is polycyclic alcohol $C_{16}H_{28}O$ that have same pleasant node of sandal.

**Dosage[12]:**

Infusion (hot or cold), decoction, powder (250 mg to 1 g), medicated oil **Decoction:** Boil 1 heaping tsp. wood in 1 cup water. Take 1 to 2 cups a day, a mouthful at a time.

**Tincture:** A dose is from 20 to 40 drops.

Typically, a few drops of sandalwood oil are dissolved in water, and the infected area of skin is then soaked in the solution, or the diluted oil is applied directly.

**Safety[12]:**

Some people may experience severe lung congestion.

Some people may experience mild skin irritation from topical application of sandalwood oil. No other information about the safety of this herb is available.

Use caution. Ayurvedic herbs are often taken in combination with others to neutralize the toxicity one herb with the opposing effect of other. Do not take except under the supervision of a qualified professional.

**Forms of Sandalwood Oil[10]**

Sandalwood oil can be helpful for the nervous system, for chest and urinary tract infections, for sexual problems and for skin care.

- **Burners and vaporizers**

  In vapor therapy, sandalwood oil can be used for its aphrodisiac effect, to help clear bronchitis, coughs, chest infections, asthma, insomnia, irritability, nervous tension, stress, tension, for relaxing and as an insect repellant.

- **Blended massage oil or in the bath**

  As a blended massage oil or diluted in the bath, sandalwood oil can assist with bladder infections as well as chest infections and bronchitis, coughs, dry eczema, insomnia, forming scar tissue, irritability, nervous tension, stress, tension, as an aphrodisiac and for relaxing.

- **Gargle**

  It can be effective when diluted and used as a gargle for a sore or dry throat.

- **Lotions or creams**

  When used in a lotion or cream sandalwood oil can assist with chapped, dry or inflamed skin and has wonderful moisturizing and hydrating properties, which are great for anti-ageing skincare. The toning effect is useful when fighting oily skin.

**Sandalwood oil blends well with[10]**

Although essential oils blend well with one another, Sandalwood oil blends particularly well with Bergamot, Black pepper, Geranium, Lavender, Myrrh, Rose.

**Chemical Constituents**

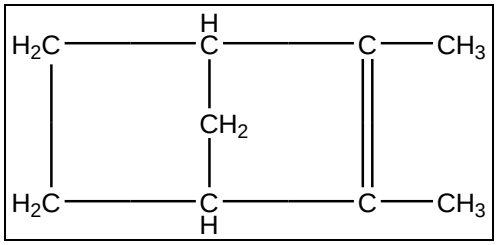
**Principal Constituents[13]**

The main constituent of sandalwood oil is santalol. This primary sesquiterpene alcohol forms more than 90 per cent of the oil is a mixture of two isomers, α -santalol and β-santalol. the former predominating. The characteristic odor and medicinal properties oil are mainly due to the santalols. The other constituents reported in sandalwood oil include the hydrocarbons santene, nor-tricycloekasantalene and α- and, β-santalenes; the alcohols santenol and teresantalol; the aldehydes nor-tricycloekasantal, *and* isovaleraldehyde; the ketones l-santenone and santalone; and the acids teresantalic acid occurring partly free and partly in ester and S-santalic acids

Variours chemical constituents of Sandal wood oil:

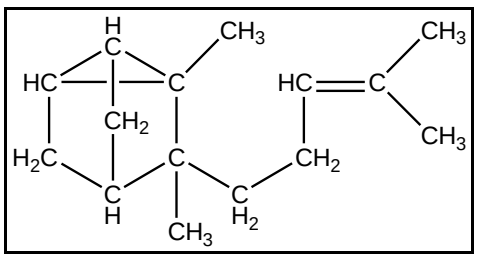
**Santene**

$C_9H_{14}$ ; Mol. Weight 122.20



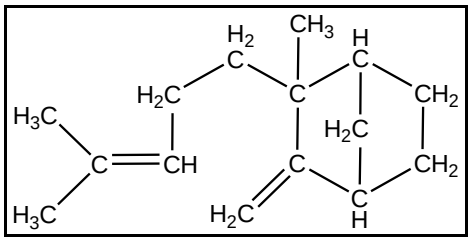
**α-Santalene**

$C_{15}H_{24}$; Mol. Weight 204.34



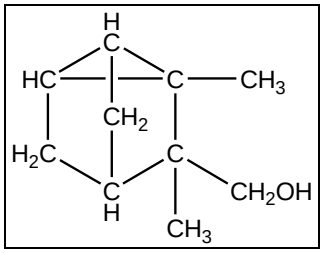
**β-Santalene**

$C_{15}H_{24}$; Mol. Weight 204.34



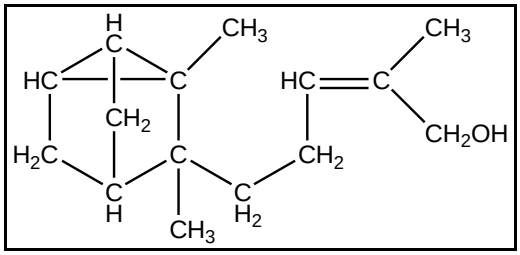
**Teresantalol**

$C_{10}H_{16}O$; Mol. Weight 152.23



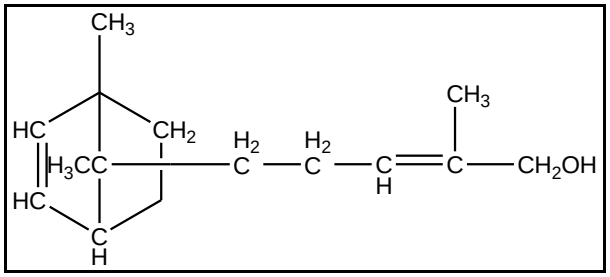
**α-Santalol**

$C_{15}H_{24}O$;Mol. Weight 220.34



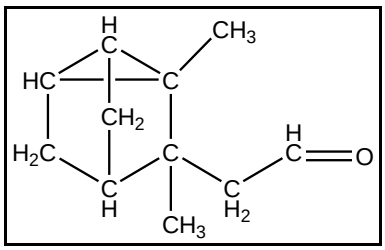
**β-Santalol**

$C_{15}H_{24}O$; Mol. Weight 220.34



**Norticycloekasantalal**

$C_{11}H_{16}O$; Mol. Weight 164.24



**Pharmacological Uses of Sandal Wood**

**1. Aromatherapy Uses[14]**

**Body:**

Sandalwood is recognized as having a pronounced effect on the genito-urinary tract and therefore is useful in urinary tract infections including cystitis (with bergamot and tea tree) and gonorrhea. Sandalwood is also a good pulmonary antiseptic and great for coughs, dry persistent ones in particular, as well as chronic bronchitis and sore throat. Good accompanying oils might include myrtle, frankincense, ravensara, thyme linalool or lemon. Sandalwood's relaxing properties mean that is particularly effective at night as it can help a cougher sleep better. Due to sandalwood's low toxicity level, this is an appropriate oil to use topically, in the bath, or as an inhalant. Sandalwood is also considered to be a digestive aid: blended with, for example, ginger, the spice oils or peppermint, it can help alleviate heartburn, nausea, diarrhea and vomiting. Lastly, but certainly not in importance, is sandalwood's role as a sexual tonic. Besides its relaxing, calming properties, sandalwood, along with jasmine, may possibly have a hormonal effect as well. It is an outstanding aphrodisiac, equally useful in cases of frigidity and impotence.

**Mind and Spirit:**

Sandalwood is calming and useful as an aid to meditation. It is excellent for the stresses of a hectic life as it helps reduce tension, confusion, fear and obsessions. It is also widely known to be an excellent aphrodisiac and anti-depressant. Sandalwood helps us cut past ties, and move through and past grief, isolationist feelings, ego-centrism, and aggression. It opens us, allowing us to receive love, warmth and understanding. Sandalwood has the ability to bring us back to ourselves, to connect with the earth, to still the mind and allow creativity and our higher consciousness to flower. Sandalwood is one of the oldest and best known of all aromatics, having been in continuous use for over 4000 years. It runs like a common thread throughout many of the world's major religions: in Buddhism, Hinduism and Islam, sandalwood forms the heart of their aromatic aspects, helping to realize and bring the divine within. It has long been considered an important meditation aid. Sandalwood powder has also been used throughout the medical systems of the world: Ayruvedic, Chinese and Tibetan. Sandalwood is also used in death rituals, especially in India. Ideally, one is immolated on a pyre of pure sandalwood and the ashes cast into the Holy Ganges, the Mother of India.

**Skincare:**

Sandalwood is good for all skin types, in particular dry and oily skin and acne. Even as it has moisturizing properties, it is a mild astringent and antiseptic. Sandalwood is also soothing for cracked, chapped and irritated skin. It is also recommended for mature and tired skin as well as stretch mark and scars.

**Subtle Energies:**

and related: Sandalwood links chakras 1 & 7, and 1, 4 & 5. It is mildly yang in character. Its body type is mesomorph. Its number is 6. Crystals are clear calcite, emerald, turquoise, and clear citrine. Elements are water, fire and air. Astrological signs are Saturn, Moon, Jupiter and Uranus.

**Perfumery:**

Sandalwood is extremely useful in high-class perfumery for its wonderful ability to blend almost any notes. It is a very popular fixative, deep and rich, yet unobtrusive, soft and sweet. Its long, lingering and subtle aroma makes it a perfect base note. Sandalwood is the utmost in complimentary notes.

**Chinese Medicine:**

Sandalwood is cooling, decongesting and astringent. It is indicated, therefore, for problems of a hot, inflammatory and catarrhal nature, most often for problems of the intestines, lungs or genito-urinary tract. Examples are diarrhoea, burning cystitis, and a harsh painful cough. Mentally, it will work best when a cooling action is needed against hot and agitated mental states. Commonly, Sandalwood is ground and used as a powder rather than an oil.

**Ayruvedic Medicine:**

Used for conditions of Pitta, heat, fire, as a cooling agent. Antifebrile, Anti-inflammatory and anti-infectious, here again Sandalwood is used ground to a paste.

**2. Antitumor activity[15]**

Three new campherenane-type and three new santalane-type sesquiterpenoids, and two aromatic glycosides together with 12 known metabolites including p-santalols , (£)-a,(3-santalals ,3-santaldiols ,a-santalenoic acid , and vanillic acid 4-o-neohesperidoside were isolated from ***Santalum album*** chips of Indian origin. The structures of the new

compounds, including absolute configurations, were elucidated by 1D- and 2D-NMR spectroscopic and chemical methods. The antitumor promoting activity of these isolates along with several neolignans previously isolated from the same source was evaluated for both in vitro Epstein-Barr virus early antigen (EBV-EA) activation and in vivo two-stage carcinogenesis assays. Among them, compound 1 exhibited a potent inhibitory effect on EBV-EA activation, and also strongly suppressed two-stage carcinogenesis on mouse skin.

**3. Infantile hyperhidrosis**

**Miliria rubra and bad body odour[16]**

The efficacy and safely of herbal baby powder containing essential oils of santalum album and olea europaea was evaluated in hyperhydrosis milirarie rubra and bad body odour. The parents were allowed to apply baby powder daily for 2 weeks and allowed to visit clinic with infant on 7 and 14$^{th}$ day of application. The study showed an improvement in above condition.

**4. Facial scrub[17]**

Herbal facial scrub was prepared using 19 ingredients out of which santalum album (1.0)gm was used for providing cooling action, astringent, red itch and inflammation.

The facial scrub is use for red acne, healing and to prevent formation of new pimples.

**5. Anti-*Helicobacter pylori* Compounds from *Santalum album*[18]**

Six new sesquiterpenes, (*Z*)-2$^{\beta}$-hydroxy-14-hydro-$^{\beta}$-santalol, (*Z*)-2α-hydroxy-albumol, 2*R*-(*Z*)-campherene-2,13-diol, (*Z*)-campherene-2$^{\beta}$,13-diol, (*Z*)-7-hydroxynuciferol, (*Z*)-1$^{\beta}$-hydroxy-2-hydrolanceol, together with five known compounds, (*Z*)-α-santalol (**7**), (*Z*)-$^{\beta}$-santalol (**8**), (*Z*)-lanceol (**9**), α-santaldiol (**10**), and $^{\beta}$-santaldiol (**11**), were isolated from *Santalum album*, by using bioassay-guided fractionation for *Helicobacter pylori*. The structures were determined by extensive NMR studies. The absolute configuration of compound **3** was determined by a modified Mosher method. The crude extracts as well as the isolated compounds showed antibacterial activity against *H. pylori*. Especially, compounds **7** and **8** have strong anti-*H. pylori* activities against a clarithromycin-resistant strain (TS281) as well as other strains.

**6. In Bladder infections[19]**

Bladder infections are a common problem for women, accounting for more than 6 million office visits each year. Men, because of the greater distance between their bladder and urethral opening, only rarely develop bladder infections.

The primary symptoms of a bladder infection are burning during urination, frequency of urination, and urgency to urinate, possibly accompanied by pain in the lower abdomen and cloudy or bloody urine. Occasionally, the infection spreads upward into the kidneys, producing symptoms such as intense back pain, high fever, chills, nausea, and diarrhoea.

Many nutritionally oriented physicians believe that regularly taking zinc supplements and decreasing sugar in the diet will help improve immunity against bladder infections. Herbs such as buchu, dandelion, goldenrod, juniper, cleaversparsley, and sandalwood may increase urine flow, which could be helpful for increasing speed of recovery from an infection that has already occurred.

**Other Uses[12]**

Sandal wood use for Acute dermatitis, Bronchitis, Cystitis , Eye diseases, Gonorrhea, Herpes Zoster Infection, Palpitation, Sunstroke, Urethritis

Vaginitis are also reported.

## Summary

Thus we can deduce that *Santalum album* is used in form of oil , massage, lotions and gargle with myriad number of uses not only in prevention of diseases but also providing calmness and soothness to human senses

Now with the latest researches , its anti tumor promoting activity has provided an edge to its importance in cancer chemotherapy where in future it can be seen as a substitute to allopathic drugs having more side effects

The tree is now on the verge of extinction due to much over exploitation through much of work has been done by the goverment to protect them by applying strict laws but still the use of new techniques and biotechnological methods like that of rapid mass propagation and in vivo in vitro micrografting are required . In addition to that good and proper storage of seeds is also an important factor considering the fact that large number of seeds fails to develop due to improper storage and poor cultivation methods.

So in a nutshell we can conclude that with proper cultivation teqniches and proper protection *Santalum album* has full potential to become an important drug in field of ayurveda not only in terms of fragrance but more pharmacological uses in near future.

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