



A Comprehensive Review on *Boswellia serrata*

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ABSTRACT

The pharmaceutical, cosmetic, and nutraceutical industries all place a high value on medicinal plants. One of these plants, *Boswellia serrata*, has several uses in both the cosmetic and medicinal industries. The Indian Olibanum tree, also known as Salai in Hindi, is a member of the Burseraceae family. Many Indian states, including Madhya Pradesh, Jharkhand, and Andhra Pradesh, among others, have it. It is a well-known herb in the pharmacopoeia of Ayurveda. Many human illnesses, including inflammation, joint pain, cough, diarrhoea, dysentery, stomach pain, Oedema, hydrocoele, toothache, and headache, among others, are treated with it in folk medical tradition. Since the beginning of time, the resin of *Boswellia* species has been utilized in medicines and as incense in religious and ceremonial rituals. In dry mountainous areas of India, Northern Africa, and the Middle East, *Boswellia serrata* (Salai/Salai guggul), a moderate to big branching tree of the family Burseraceae, thrives. Oleo gum-resin is extracted from the tree's trunk through an incision, and it is then preserved in a specially designed bamboo basket to remove the oil content and solidify the resin. The gum-resin is evaluated after processing based on its flavour, colour, shape, and size. The plant's oleo-gum resin, a complex blend of numerous therapeutically significant phytochemical components like boswellic acids, is what makes it distinctive. The primary medicinal effects of this plant include analgesic, anti-inflammatory, anti-diabetic, antibacterial, anti-oxidant, hepatoprotective, nephroprotective, and anti-cancer properties. The therapeutic and pharmacological benefits of *Boswellia serrata*, as well as its use in the folklore medical system, have been outlined in this article.

Keywords: *Boswellia serrata*, boswellic acids, anti-inflammatory, anti-diabetic, Traditional Chinese Medicine.

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INTRODUCTION

In the vast tapestry of traditional medicine, there are numerous natural remedies that have been celebrated for their therapeutic properties for centuries. One such gem hailing from the rich tradition of Ayurveda and other ancient healing systems is *Boswellia serrata*. Commonly known as Indian frankincense or simply *Boswellia*, this resinous tree holds a special place in the world of herbal medicine for its remarkable healing potential. This article delves into the history, health benefits, and modern applications of *Boswellia serrata*. Historical Roots-*Boswellia serrata* is native to the dry regions of India, Northern Africa, and the Middle East. The resin extracted from its bark has been used for thousands of years in traditional medicine systems, including Ayurveda and Traditional Chinese Medicine. Ancient texts, like Charaka Samhita and Sushruta Samhita, have documented its use in treating various ailments (1,2).

Health benefits

Anti-inflammatory properties: One of the most renowned benefits of *Boswellia serrata* is its potent anti-inflammatory effect. The resin contains compounds known as boswellic acids, which have been shown to inhibit the production of pro-inflammatory enzymes. This makes *Boswellia* a valuable natural remedy for conditions such as arthritis, osteoarthritis, and inflammatory bowel diseases (3,4).

Joint health: *Boswellia serrata* is often recommended for individuals suffering from joint pain and stiffness. Regular use of *Boswellia* supplements can help improve joint mobility and reduce discomfort, making it an attractive alternative to conventional pain medications.

Respiratory health: *Boswellia* extracts have also been studied for their positive impact on respiratory health. They may assist in managing conditions like asthma and bronchitis by reducing inflammation in the airways and promoting easier breathing.

Skin health: Topical *Boswellia* preparations, in the form of creams or ointments, are used to alleviate skin conditions such as eczema and psoriasis due to their anti-inflammatory and soothing properties.

Potential cancer benefits: Some preliminary research suggests that *Boswellia serrata* may have anti-cancer properties. Boswellic acids may inhibit the growth of cancer cells and induce apoptosis (programmed cell death) in certain types of cancer, though more studies are needed in this area.

Modern applications: In recent years, *Boswellia serrata* has gained recognition and popularity in the Western world as a natural supplement. It is commonly available in various forms, including capsules, tablets, and creams. People seeking relief from chronic inflammatory conditions often turn to *Boswellia* as a complementary or alternative treatment. It's important to note that while *Boswellia serrata* is generally considered safe when used as directed, individuals with certain medical conditions or those taking medications should consult with a healthcare professional before incorporating it into their wellness regimen (5-9).

Table 1: Vernacular names

English	Indian Frankincense Tree
Telugu	Parang, Sambrani, Anduga, Kondagugi, Tamu
Hindi	Kundur, Luban
Urdu	Kundur
Sanskrit	Ashwamuthri, Kunduru
Kannada	Chilakdhupa, Tallaki, Maddi

Table 2: Taxonomy

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Sapindales
Family	Burseraceae
Genus	<i>Boswellia</i>
Species	<i>serrata</i>

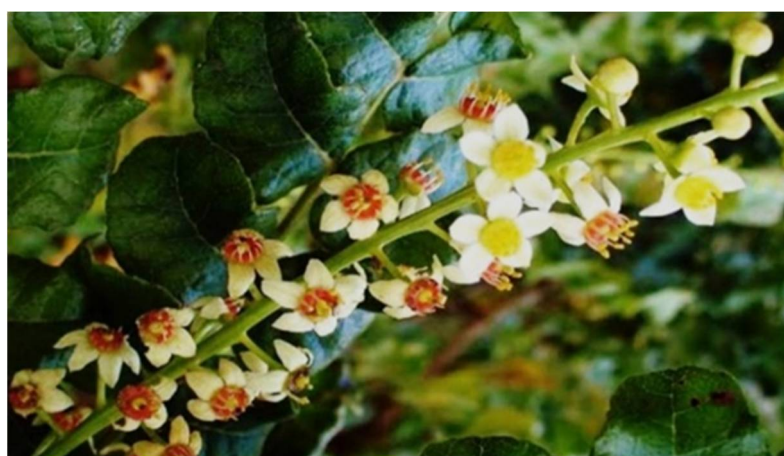


Figure 1: *Boswellia serrata* plant

Plant description

Habitat: *Boswellia serrata* is a deciduous tree that thrives in the dry and hilly regions of India, particularly in the states of Rajasthan, Madhya Pradesh, and Gujarat. It is also found in some parts of Northern Africa and the Middle East. This tree prefers arid and rocky terrain with well-draining soil. With 17 genera and 600 species widespread across all tropical climates, the Burseraceae family is well-represented in the plant kingdom. *Boswellia* is a genus with roughly 25 recognised species, the majority of which are found in Arabia, India, and the northeastern coast of Africa. Three of these species have historically been regarded as "true Frankincense" producing trees (10-12).

Morphology:

Size: *Boswellia serrata* is a medium-sized tree, typically growing to a height of 4 to 6 meters (13 to 20 feet).

Leaves: The leaves are composed of alternate, imparipinnate leaflets that are serrated along the margins. They are typically dark green and have an elliptical shape.

Flowers: The tree produces small, pale green to white flowers that are often inconspicuous.

Fruit: The fruit of *Boswellia serrata* is a drupe, which is green when young and turns red when mature. These drupes contain seeds.

Bark: The bark of the *Boswellia serrata* tree is thick and rough, with a greyish-brown to reddish-brown colour. **Resin:** The resin extracted from the bark is the most prized part of the *Boswellia serrata* tree. It is a milky-white or pale-yellow gum resin that exudes from the tree when its bark is cut or damaged.

Resin production: *Boswellia serrata* is renowned for the resin it produces, which is commonly known as frankincense. This resin is tapped by making incisions in the bark of the tree. It is then collected and allowed to harden, forming small, fragrant, and translucent gum resin tears. The resin has a distinct, earthy fragrance and has been used for centuries in incense, perfumes, and traditional medicine.

Cultural and medicinal significance: *Boswellia serrata* has deep cultural and medicinal significance, particularly in Ayurveda and other traditional healing systems. The resin obtained from this tree has been used for its anti-inflammatory and medicinal properties, making it an important component of herbal remedies for various ailments.

Conservation status: While not currently listed as endangered, *Boswellia serrata* faces threats due to habitat destruction and overharvesting for its resin. Sustainable harvesting practices are essential to ensure the continued availability of this valuable natural resource. In conclusion, *Boswellia serrata* is a resilient and culturally significant tree known for its resinous gum, frankincense, which has been cherished for its medicinal and aromatic properties for centuries. Its habitat in arid regions of India and neighbouring areas is home to a rich tradition of harvesting and utilizing this natural resource for various purposes, making it an integral part of local cultures and holistic medicine (13-16).

Extraction methods

Boswellia serrata, commonly known as Indian frankincense, is valued for its resin, which is used for its medicinal properties and in various products such as incense and perfumes. The extraction of *Boswellia serrata* resin can be done using several methods, each with its own advantages and applications (11,17). Here are some of the primary extraction methods are given in below Table 3.

Table 3: Various extraction methods of *Boswellia serrata*

S. No.	Name of the process	Procedure	Advantage	Application
1.	Traditional tapping	Traditional tapping involves making shallow incisions or cuts in the bark of the <i>Boswellia serrata</i> tree. These cuts allow the resin to ooze out naturally. The resin is then collected and allowed to harden.	This method is simple and has been used for centuries. It minimizes damage to the tree and allows for sustainable resin collection.	The resin collected through traditional tapping is typically used for incense and traditional medicine.
2.	Steam distillation	In steam distillation, the resin is first separated from the tree bark and then subjected to steam to release its essential oil components. The essential oil, which contains the aromatic compounds of the resin, is condensed and collected.	This method yields a highly concentrated essential oil with the aroma of frankincense.	The essential oil obtained through steam distillation is often used in perfumes, aromatherapy, and as a flavouring agent in some food and beverages.
3.	Solvent extraction	In solvent extraction, a solvent (typically a hydrocarbon like hexane) is used to dissolve the resin, separating it from impurities and plant material. Afterward, the solvent is evaporated, leaving behind the resin.	This method can yield a relatively pure resin extract.	Solvent-extracted <i>Boswellia serrata</i> resin is used in the production of dietary supplements, creams, and ointments for medicinal purposes.
4.	Super critical carbon dioxide (CO₂) extraction	Supercritical CO ₂ extraction involves using carbon dioxide in a supercritical state (neither liquid nor gas) to extract the resin's compounds. This method is highly efficient and selective.	Supercritical CO ₂ extraction is considered a clean and eco-friendly method that produces a high-quality resin extract without leaving behind solvent residues.	This method is often used to obtain <i>Boswellia serrata</i> resin extracts for medicinal supplements, as it preserves the bioactive compounds effectively.
5.	Cold pressing	Cold pressing is similar to traditional tapping but involves applying mechanical pressure to the resin-rich bark to extract the resin without the use of heat or solvents.	This method preserves the resin's natural properties and is considered a gentle extraction process.	Cold-pressed <i>Boswellia serrata</i> resin is used in aromatherapy, perfumery, and some natural cosmetic products.



Figure 2: *Boswellia serrata* extract

Each extraction method has its own set of advantages and is chosen based on the intended use of the *Boswellia serrata* resin extract. Whether for incense, essential oil, dietary supplements, or other applications, the method selected should align with the desired qualities and characteristics of the final product. Additionally, sustainable and responsible harvesting and extraction practices should be prioritized to protect the *Boswellia serrata* trees and their natural habitats.

Phytochemical evaluation

Phytoconstituents are the bioactive chemical compounds present in the plants. These phytoconstituents work with nutrients and fibers to form an essential part of the protection mechanism against specific diseases and stress conditions. Qualitative analysis as well as quantitative phytochemical analysis are the important application of biomedicine in pharmaceutical industries. The phytochemical analysis was very useful in identifying chemical compounds in plant material which led to their quantitative estimate and the position of the pharmacy (18-21).

Chemical constituents

Oleo gum resin of *Boswellia serrata* has numerous active chemical constituents and pharmacologically active elements such as terpenoids and oil. The content and composition may vary by species depending on age, resin quality, and geographical condition. The oleo gum contains resins (30–60%), essential oil (5–10%), and water-soluble polysaccharides (65% arabinose, galactose, and xylose). The essential oil of Salai guggal mainly contains monoterpenoids (α -pinene, cis-verbenol, trans-pinocarveol, borneol, myrcene, phallendrene, cadinene, verbenone, limonene, and a small amount of diterpenes). α -pinene (73.3%) is the major chemical constituent of monoterpenoid (16,22-26).

Pharmacological aspects

Boswellia serrata, also known as Indian frankincense, is a tree that has been traditionally used for its medicinal properties in various herbal and traditional medicine systems, particularly in Ayurveda. Its pharmacological properties are attributed to the resin it produces, which contains bioactive compounds known as boswellic acids. These compounds are responsible for many of the therapeutic effects associated with *Boswellia serrata*.

Table 4: Pharmacological applications

S. No.	Type of effect	Mechanism of action	Application
1.	Anti-inflammatory effects	Boswellic acids, especially AKBA (acetyl-11-keto- β -boswellic acid), are potent inhibitors of 5-lipoxygenase (5-LOX), an enzyme involved in the production of inflammatory leukotrienes. By inhibiting 5-LOX, <i>Boswellia serrata</i> can reduce inflammation.	This anti-inflammatory property is particularly beneficial for conditions like osteoarthritis, rheumatoid arthritis, and inflammatory bowel diseases (e.g., Crohn's disease and ulcerative colitis).
2.	Analgesic (pain-relieving) effects	<i>Boswellia serrata</i> can help alleviate pain associated with inflammation, making it useful for managing joint pain, muscle pain, and other forms of chronic pain.	It is often used as a natural alternative or complementary therapy for pain management, especially in arthritis.
3.	Anti-arthritic properties	<i>Boswellia</i> 's anti-inflammatory and anti-arthritic effects can help reduce joint swelling and improve joint function.	<i>Boswellia serrata</i> supplements are commonly used to alleviate symptoms in individuals with arthritis, promoting joint health.
4.	Immunomodulatory effects	<i>Boswellia serrata</i> may modulate the immune system, helping to balance immune responses.	This property is relevant in autoimmune conditions, where

			immune system regulation is crucial.
5.	Respiratory benefits	<i>Boswellia serrata</i> 's anti-inflammatory properties can be beneficial for respiratory conditions by reducing inflammation in the airways.	It may help manage conditions like asthma and bronchitis.
6.	Skin health	<i>Boswellia serrata</i> extracts can soothe and reduce inflammation in the skin, making them useful for managing skin conditions like eczema and psoriasis.	Creams and ointments containing <i>Boswellia serrata</i> extracts are used topically for skin health.
7.	Anticancer potential	Some studies suggest that certain compounds in <i>Boswellia serrata</i> may inhibit the growth of cancer cells and induce apoptosis (cell death) in certain types of cancer.	Research in this area is ongoing, and more studies are needed to determine the full extent of its anticancer potential.
8.	Gastrointestinal Benefits	<i>Boswellia serrata</i> extracts may help reduce inflammation in the digestive tract, potentially benefiting conditions like inflammatory bowel diseases.	It can be considered as a complementary approach to managing gastrointestinal disorders.
9.	Antioxidant properties	<i>Boswellia serrata</i> contains antioxidants that can neutralize harmful free radicals, which may contribute to various chronic diseases.	Antioxidant properties can contribute to overall health and well-being.

Anti-inflammatory activity: A study observed that the mixture of boswellic acids inhibited 25-46% paw oedema in rats, proving its anti-inflammatory property. The Boswellic acid from *B. serrata* showed significant activity of mean 35% inhibition of inflammation when tested in Papaya Latex Model (new model). Since the new model is reported to be sensitive to slowly acting, remission inducing drugs. Its mechanism of action seems to be unlike aspirin and steroidal drugs (16,27).

Anti-arthritic activity: In the anti-arthritic study on the mycobacterium adjuvant-induced poly-arthritic in rats, salai guggal showed 34% and 49% inhibition of paw swelling with 50 and 100 mg per kg-1 (p.o.) doses respectively as compared to controls (28).

Anti-diarrheal activity: The *Boswellia serrata* extract (BSE) inhibited gastrointestinal transit in croton and castor oil induced diarrhea in mice. However, intestinal motility remained unaffected in control mice by BSE (29).

Anti-cancer activity: Inhibition of tumor growth by inhibiting cell proliferation and cell growth due to the interference with biosynthesis of DNA, RNA and proteins was observed with alcoholic extract of salai guggal (AESG) for anti-carcinogenicity in mice with Ehrlich ascites carcinoma and S-180 tumour. Topical application of Boswellin with 5 nmol 12- Otetradecanoylphorbol-13-acetate (TPA) twice daily for 16 weeks to mice previously treated with dimethylbenz-anthracene caused 87- 99% inhibition in the number of tumor (16,17).

Hepatoprotective activity: Gerlach observed that alcoholic extract of salai guggal (AESG) reduced titter of SGOT, SGPT, aminotransferase and serum enzymes in galactosamine/endotoxin induced liver damage in mice showing hepato-protection effect (30,31).

Anti-depressant activity: The extract obtain from the plant is used as aroma therapy also in various tea formulations. *B. serrata* has been reported to be successful on an acute depression scale. At a dosage of 100 mg/kg, *Boswellia* has significant anti-depressant efficacy in acute stress experiments and reduces the immobility time in the experimental forced swim model. *B. serrata*, traditionally important medicinal plant, proved to be a bacteriostatic agent (32).

Hypolipidemic activity: A study proves that water soluble fraction of *B. serrata* extract showed hypolipidemic potential in rats fed on atherogenic diet by decreasing total cholesterol (38-48%) and increasing HDL (33).

Hypoglycemic activity: Herbal formulation containing *B. serrata* oleo-gum-resin as one of the ingredients has been reported to produce significant anti-diabetic activity on non-insulin dependent diabetes mellitus in streptozocin induced diabetic rat model where reduction in blood-glucose level was comparable to that of phenformin (34).

Anti-viral activity: According to the researcher, *Boswellia* species also possess having an anti-viral activity. The anti-viral activity of frankincense against CHIKV and both compounds blocked the entry of lentiviral vectors and prevented in vitro infection with CHIKV. Similarly, vesicular stomatitis virus particles and viral infections were also inhibited to the same degree, suggesting a strong anti-viral activity. Anti-viral activity of different constituents obtained from *Boswellia* species against herpes simplex type I virus and were able to reduce the number of the plaques by 100% with a minimum anti-viral concentration at 20µg/ml and

followed by acetyl-11-keto- β -BA (75% inhibition at 20 μ g/ml), β -boswellic and total alcoholic extract (50% inhibition at 40 μ g/ml), acetyl- β -boswellic and 11-keto- β -boswellic (75% inhibition at 80 μ g/ml), 3-hydroxytirucallic acid, 3-oxo-tirucallic acid, acetyl- α -BA, and total volatile oil (50% inhibition at 80 μ g/ml). On the other hand, gum, palmitic acid, and lupeol reduced the number of plaques by 25% at relatively higher concentrations. This shows that *Boswellia serrata* also exhibit anti-viral activity (35).

CONCLUSION

Boswellia serrata, with its ancient origins and modern applications, exemplifies the enduring power of natural remedies. Its anti-inflammatory, joint-supporting, and potential anti-cancer properties make it a versatile herbal ally in the realm of health and wellness. While the scientific community continues to explore its therapeutic potential, *Boswellia* remains a valuable component of holistic medicine, offering hope and relief to those seeking alternatives to conventional treatments. As we journey forward in the quest for better health, let us not forget the wisdom of our ancestors, who discovered the healing treasures hidden in the bosom of nature. Thus, this comprehensive review substantially acclaims that the traditional herb, *B. serrata* has versatile pharmacological properties. The net goal regarding the different constituents of *Boswellia serrata* is to understand the drug-drug interaction, molecular mechanism, and also strategies to improve their pharmacokinetic profile.

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