

Boswellia Sacra: A Short Review on Botany, Phytochemistry and Medicinal Benefits

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ABSTRACT:

Boswellia sacra, commonly known as the frankincense tree, is a renowned medicinal and aromatic plant native to the arid regions of the Arabian Peninsula, northeastern Africa, and parts of India. This tree is particularly valued for its resin, which contains bioactive compounds, including boswellic acids, essential oils, and polysaccharides, contributing to its therapeutic potential. *Boswellia sacra* has been traditionally used for its anti-inflammatory, analgesic, antimicrobial, anticancer, and neuroprotective properties. Recent research has confirmed the efficacy of these compounds in treating a range of conditions such as arthritis, asthma, inflammatory bowel diseases, cancer, and neurological disorders. Beyond its medicinal uses, *Boswellia sacra* plays a critical role in its native ecosystem by stabilizing soil, supporting biodiversity, and providing resources for local communities. However, overharvesting and habitat degradation pose significant threats to its survival, necessitating conservation efforts. This review highlights the ecological importance, phytochemistry, medicinal potential, and the need for sustainable harvesting practices to preserve this valuable species.

Keywords: *Boswellia sacra*, Bioactive compounds, Phytochemistry, Medicinal potential

I. INTRODUCTION:

Boswellia sacra, commonly known as frankincense, is a small tree native to the arid regions of the Arabian Peninsula, specifically Oman, Yemen, and parts of northeastern Africa, such as Somalia. This tree is renowned for its aromatic resin, which has been used for centuries in traditional medicine, religious rituals, and perfumery [1]. The resin, often referred to as frankincense, is obtained by making incisions in the bark, allowing the resin to ooze out and harden.

The tree itself grows in harsh, rocky environments and has adapted to withstand arid conditions. Its leaves are small and leathery, and it typically grows to a height of 2 to 8 meters. *Boswellia sacra* plays a significant role in various cultural practices and has been highly valued for its medicinal properties. The resin contains boswellic acids, which are thought to have anti-inflammatory, analgesic, and potential anticancer properties [2]. Today, *Boswellia sacra* remains a subject of study for its potential health benefits and therapeutic applications, making it valuable not only culturally but also scientifically.

GEOGRAPHICAL DISTRIBUTION OF BOSWELLIA SACRA

Boswellia sacra, commonly known as the frankincense tree, is native to the arid and semi-arid regions of the Arabian Peninsula, northeastern Africa, and parts of India [3]. Its ability to thrive in harsh, rocky environments makes it unique among desert floras.

- **Arabian Peninsula:** *Boswellia sacra* is predominantly found in Oman and Yemen. In Oman, it is concentrated in the Dhofar region, particularly in areas such as Wadi Dawkah, which is known for its dense frankincense tree populations.
- **Northeastern Africa:** The tree is also native to Somalia, where it grows in dry, rocky habitats. This region is one of the oldest sources of frankincense production.
- **India:** While less common, *Boswellia sacra* can also be found in the dry forests of western India, particularly in parts of Gujarat and Rajasthan.
- **Historical Trade Routes:** The historical distribution of *Boswellia sacra* was influenced by ancient trade routes. Frankincense has been traded across the Middle East, Africa, and Asia

for thousands of years, and the tree's distribution reflects areas where frankincense was historically cultivated and harvested.

BOTANY OF BOSWELLIA SACRA

Boswellia sacra, the frankincense tree, exhibits several unique morphological adaptations that enable it to survive in arid climates [4,5]. Its structure reflects resilience to harsh environmental conditions while supporting the production of its valuable resin.

Roots

- **Deep Root System:** *Boswellia sacra* has a deep, extensive root system that allows it to access water from deep underground sources, essential for survival in dry regions.
- **Adaptation to Rocky Soil:** The roots are adapted to anchor into rocky, calcareous soils typical of its native regions, providing stability and resilience to wind and erosion.

Trunk

- **Size and Form:** The tree generally has a twisted, gnarled trunk that branches low to the ground, resulting in a shrub-like appearance, especially in particularly arid areas.
- **Papery Bark:** The bark is thin and peels off in layers, likely helping to reduce water loss by decreasing surface area exposure. This characteristic papery texture gives the trunk a unique appearance.
- **Resin Canals:** The trunk contains resin canals that produce and store frankincense. When the bark is cut or incised, these canals release the resin as a defense response, which hardens upon exposure to air.

Leaves

- **Compound Structure:** The leaves are pinnate and compound, typically grouped at the ends of the branches.
- **Leaflets:** Each leaf is composed of multiple small leaflets with serrated or lobed margins, which help reduce transpiration and prevent water loss.
- **Leathery Texture:** The leaves are thick and leathery, an adaptation for minimizing water loss in hot and dry conditions.
- **Seasonal Shedding:** *Boswellia sacra* is a deciduous tree, shedding leaves during the driest periods to conserve water.

Flowers

- **Inflorescence:** The flowers of *Boswellia sacra* are small and arranged in clusters, forming at the ends of branches.
- **Flower Structure:** Each flower has five petals, typically white to pale pink, with a mildly fragrant aroma.
- **Attracting Pollinators:** The flowers attract pollinators such as bees, which assist in the tree's reproduction.

Fruits and Seeds

- **Fruit Capsule:** The fruit is a small, woody capsule containing three to five seeds.
- **Seed Dispersal:** When the capsule matures, it splits open, allowing the seeds to disperse. These seeds are relatively small and require specific environmental conditions for successful germination, which can limit natural regeneration rates.

Resin (Frankincense)

- **Production Mechanism:** The resin, also known as frankincense, is a milky-white substance produced within specialized ducts in the bark. It is exuded as a defense response when the tree bark is wounded.
- **Hardening Process:** Upon exposure to air, the resin hardens into yellowish, amber-colored "tears," which are collected for various uses.

PHYTOCHEMISTRY OF BOSWELLIA SACRA

Boswellia sacra, the frankincense tree, is rich in diverse bioactive compounds that contribute to its medicinal and aromatic properties. These compounds, particularly the unique boswellic acids found in its resin, are of great interest for their anti-inflammatory, antimicrobial, and potential anticancer effects [5,6]. The phytochemistry of *Boswellia sacra* is primarily focused on the resin, which contains various terpenoids, essential oils, and polysaccharides.

Boswellic Acids

- **Structure and Types:** Boswellic acids are pentacyclic triterpenoids unique to *Boswellia* species. The most well-studied boswellic acids include α -Boswellic Acid, β -Boswellic Acid, Acetyl- β -Boswellic Acid, 11-Keto- β -Boswellic Acid (KBA), and Acetyl-11-Keto- β -Boswellic Acid (AKBA).
- **Bioactivity:** These compounds are known for their anti-inflammatory properties, primarily by inhibiting the enzyme 5-lipoxygenase (5-

LOX), which is involved in the synthesis of pro-inflammatory leukotrienes. AKBA, in particular, has shown promise in research for its potential to inhibit cancer cell growth and modulate immune response.

Essential Oils

- **Composition:** The essential oil of *Boswellia sacra* contains a variety of monoterpenes, diterpenes, and sesquiterpenes, which contribute to its characteristic aroma. Key components include α -Pinene (Known for its anti-inflammatory and antimicrobial properties), Limonene (Often associated with antioxidant and stress-relieving effects), Myrcene (Has analgesic and anti-inflammatory properties), Sabinene (Known for its antifungal and antioxidant activity), and Incensole Acetate (Unique to frankincense, it has shown neuroactive effects and is thought to provide calming and antidepressant benefits)
- **Uses:** The essential oil derived from *Boswellia sacra* resin is used in aromatherapy, traditional medicine, and perfumes, and it contributes to the tree's therapeutic potential through both topical and inhaled applications.

Polysaccharides

- **Structure and Composition:** The resin of *Boswellia sacra* contains polysaccharides, primarily in the form of arabinogalactans, which are complex carbohydrates.
- **Bioactivity:** These polysaccharides have immunomodulatory properties, potentially stimulating immune response. They may also have prebiotic effects, promoting beneficial gut bacteria when ingested.

Terpenoids:

- **Ursane and Oleanane Derivatives:** Alongside boswellic acids, *Boswellia sacra* resin contains other triterpenoid derivatives, including ursane and oleanane. These compounds contribute additional anti-inflammatory and antioxidant properties.
- **Phenolic Compounds:** While less abundant, phenolic compounds in the resin add to its antioxidant capacity, helping to protect cells from oxidative stress.
- **Sterols:** The resin contains plant sterols such as β -sitosterol, which may help modulate cholesterol levels and provide anti-inflammatory effects.

Antioxidant Activity

- The presence of various terpenoids, phenolic compounds, and essential oils endows *Boswellia sacra* with significant antioxidant properties, helping to scavenge free radicals. This antioxidant activity supports the traditional use of frankincense in treating inflammatory and oxidative stress-related conditions.

Medicinal and Therapeutic Implications

- **Anti-inflammatory and Analgesic Effects:** The boswellic acids and essential oils in *Boswellia sacra* inhibit inflammatory enzymes and pathways, providing relief in conditions such as arthritis, asthma, and gastrointestinal inflammation.
- **Antimicrobial Properties:** Both boswellic acids and essential oils exhibit antibacterial, antifungal, and antiviral activity, which helps protect the tree from pathogens and offers therapeutic potential in treating infections.
- **Potential Anticancer Effects:** Boswellic acids, particularly AKBA, have shown promise in research studies for inhibiting tumor growth and inducing apoptosis in certain cancer cell lines.
- **Neurological Effects:** Compounds like incensole acetate have potential neuroprotective effects, with studies suggesting benefits for mental well-being, stress reduction, and possibly even neurodegenerative conditions.

MEDICINAL POTENTIAL OF BOSWELLIA SACRA

Boswellia sacra, commonly known as the frankincense tree, has been used for centuries in traditional medicine for a variety of health conditions [7-9]. Modern research has confirmed many of its therapeutic properties, particularly due to the bioactive compounds found in its resin, such as boswellic acids, essential oils, and polysaccharides. These compounds have shown promise in treating inflammatory diseases, cancer, infections, and neurological disorders.

Anti-inflammatory and Analgesic Effects

- **Mechanism:** Boswellic acids, especially acetyl-11-keto- β -boswellic acid (AKBA), inhibit 5-lipoxygenase (5-LOX), an enzyme involved in the inflammatory pathway. This reduces the production of pro-inflammatory leukotrienes, which play a role in chronic inflammation.
- **Applications:**

- Arthritis: Boswellia extracts are used in treating both rheumatoid arthritis and osteoarthritis. Studies have shown that these extracts can reduce joint pain, improve flexibility, and slow cartilage degradation.
- Inflammatory Bowel Diseases: Conditions like Crohn's disease and ulcerative colitis may benefit from Boswellia sacra's anti-inflammatory properties. Some studies suggest that Boswellia extract can be as effective as certain pharmaceutical anti-inflammatory drugs in managing symptoms of inflammatory bowel disease.

Anticancer Potential

- Mechanism: Boswellic acids, particularly AKBA, have shown the ability to induce apoptosis (programmed cell death) in cancer cells, inhibit angiogenesis (formation of new blood vessels to tumors), and reduce cancer cell proliferation.
- Applications:
 - Potential Against Specific Cancers: Boswellia extracts have shown promise in preclinical studies against certain cancers, including leukemia, breast cancer, colon cancer, and pancreatic cancer.
 - Synergistic Effects: When used alongside conventional cancer therapies, Boswellia sacra may enhance treatment efficacy and reduce side effects. However, further clinical studies are needed to confirm these benefits.

Antimicrobial Properties

- Mechanism: The essential oils and boswellic acids in Boswellia sacra have demonstrated antibacterial, antifungal, and antiviral properties, making it a natural alternative for managing infections.
- Applications:
 - Topical Applications: Frankincense oil can be applied topically to wounds to prevent bacterial infections. It may also help treat skin conditions like acne and fungal infections.
 - Respiratory Infections: The antimicrobial properties, along with the anti-inflammatory effects of frankincense, may help relieve symptoms of respiratory infections like bronchitis and asthma.

Respiratory Health

- Mechanism: The anti-inflammatory properties of boswellic acids can help reduce inflammation in the respiratory system,

making it easier to breathe and lessening symptoms of respiratory conditions.

- Applications:
 - Asthma: Studies have shown that Boswellia sacra extract can improve lung function, reduce asthma symptoms, and lower dependency on conventional asthma medications.
 - Bronchitis: Its use as a natural expectorant can aid in clearing mucus and easing the discomfort of bronchitis and other respiratory infections.

Neurological and Mental Health Benefits

- Mechanism: Incensole acetate, a compound found in Boswellia sacra resin, has neuroactive properties, which may provide calming and antidepressant effects.
- Applications:
 - Anxiety and Depression: Inhaling frankincense oil is believed to reduce stress and improve mood, potentially benefiting those with anxiety or depression.
 - Neurodegenerative Diseases: The anti-inflammatory and neuroprotective properties of Boswellia sacra may help protect neurons and improve cognitive function, though more research is needed in this area.

Digestive Health

- Mechanism: The anti-inflammatory and antimicrobial properties of Boswellia sacra can soothe the digestive tract and help manage symptoms of various digestive disorders.
- Applications:
 - Irritable Bowel Syndrome (IBS): Boswellia sacra may help relieve IBS symptoms by reducing inflammation and easing bowel movement discomfort.
 - Ulcers: Its compounds may protect the stomach lining and prevent the formation of ulcers, though more research is necessary to establish this benefit fully.

Skin Health and Anti-Aging

- Mechanism: Boswellia's essential oils and boswellic acids are known for their anti-inflammatory and antimicrobial properties, which can benefit the skin.
- Applications:
 - Wound Healing: Frankincense oil can be applied to wounds to promote faster healing and reduce the risk of infection.
 - Anti-Aging: Its antioxidant properties may protect the skin from damage caused by free

radicals, potentially helping to reduce wrinkles and promote a youthful appearance.

Immunomodulatory Effects

- Mechanism: Polysaccharides in *Boswellia sacra* resin are known to stimulate the immune system, which can help boost overall immunity.
- Applications:
 - Immune Support: *Boswellia* extracts may help strengthen the immune response, potentially aiding in the prevention of various infections and supporting general health.

II. CONCLUSION

Boswellia sacra, the frankincense tree, holds immense cultural, economic, and medicinal value, with a legacy of use that spans thousands of years. Its unique phytochemistry, particularly the presence of boswellic acids and essential oils, underpins its extensive therapeutic properties. From its anti-inflammatory and analgesic effects to its antimicrobial, anticancer, and neuroprotective potential, *Boswellia sacra* remains relevant in both traditional and modern medicine. In arid ecosystems, *Boswellia sacra* also plays a crucial ecological role, supporting biodiversity, stabilizing soil, and sustaining local communities. However, the increasing demand for frankincense and threats like overharvesting and habitat loss highlight the importance of conservation efforts to protect this species. Sustainable harvesting practices and further scientific research into its medicinal properties could help unlock more of its benefits while ensuring its preservation for future generations. In summary, *Boswellia sacra* is not only a source of valuable natural compounds but also a vital component of its native environment and a key cultural and economic resource.

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