AARM
Association for the Advancement of Restorative Medicine

Boswellia serrata

Frankincense

Indications

Musculoskeletal pain and inflammation, including bursitis, cervical spondylosis, tendonitis, osteoarthritis, and rheumatoid arthritis; and traumatic injuries, strains, sprains, and bruising.

Mechanism of Action

Many of the anti-inflammatory actions of *Boswellia* are credited to the tetra- and pentacyclic terpenoids called boswellic acids including β-boswellic acid and the triterpene acids acetyl-β-boswellic acid, 11-keto-β-boswellic acid, and acetyl-11-keto-β-boswellic acid (also known as tircuallic, lupeolic, and roburic acids). Out of these four boswellic acids, acetyl-11-keto-β-boswellic acid (AKBA) is the most potent inhibitor of 5-lipoxygenase, an enzyme responsible for inflammation.[1] *Boswellia* gum also contains the essential oils α-thujene and *p*-cymene.

Boswellia acts by many of the same mechanisms as pharmaceutical nonsteroidal anti-inflammatory drugs (NSAIDs); however, the pharmaceuticals impair glycosaminoglycan synthesis, can induce digestive ulcers, and accelerate joint damage in arthritis, whereas boswellic acids have been shown to significantly reduce glycosaminoglycan degradation.[2] Consequently, long-term use of *Boswellia* does not lead to irritation or ulceration of the stomach. Recent studies also suggest that boswellic acids exert significant anticancer, antimicrobial, and immune-potentiating effects.

Many types of proinflammatory processes are associated with an increase in leukotrienes that contributes to chemotaxis, chemokinesis, and the synthesis and release of superoxide radicals and the release of lysosomal enzymes by phagocytes. Much of the early research on the mechanism of action of *Boswellia* focused on leukotriene suppression accomplished via lipoxygenase inhibition. Numerous other anti-inflammatory mechanisms have been identified, including effects on prostaglandins, interleukins, tumor necrosis factor, and nuclear factor-κB (NF-κB), among others.[3] AKBA was credited with most of these anti-inflammatory effects; however, AKBA is poorly absorbed. Newer research suggests that alternative boswellic acids with better oral bioavailability may be as or more important.[3] Or possibly the synergism of the entire plant's constituents may be more effective than any single isolated compound.

In animal models of diabetes, histological and chemical studies show *Boswellia* species act to inhibit lymphocyte infiltration into islets, apoptosis of periinsular cells, and shrinking of islet size. It also significantly prevents the increase of inflammatory interleukin (IL)-1A, IL-1B, IL-2, and IL-6; interferon-γ and tumor necrosis factor (TNF)-α.[4] Boswellic acids suppress prostaglandin E2 synthase[5] and other inflammatory eicosanoids via cyclooxygenase and lipoxygenase inhibition.[6] Boswellic acids reduce inflammatory cytokines and exert antioxidant effects in animal models of arthritis, including significant increases of articular elastase, and they significantly reduced levels of inflammatory mediators at doses

of 100 and 200 mg/kg.[7] Various molecular investigations in animals have shown positive modulation of NF-κB/cyclooxygenase-2 pathways[8] and leukotriene and prostaglandin E2 synthesis and ratios[9]; and inhibition of TNF-α, IL-1β, and TGF-β expression and NF-κB activation.[10,11]

Evidence-Based Research

Animal studies and pilot clinical trials support the use of *Boswellia serrata* gum resin extract (BSE) in the treatment of a variety of inflammatory diseases such as inflammatory bowel disease, rheumatoid arthritis, osteoarthritis, and asthma. In 2002 the European Medicines Agency classified BSE as an "orphan drug" for the treatment of peritumoral brain edema.[3]

Because standard NSAIDs have many gastrointestinal and cardiovascular adverse effects, *Boswellia* is an important alternative offering anodyne and anti-inflammatory activities without significant side effects. *Boswellia* extracts and isolated compounds in the oleoresin (the boswellic acids) have been scientifically investigated for >50 years for their analgesic and anti-inflammatory effects. Many commercial products are standardized to contain 10–15 μg/mL AKBA.

The research is fairly extensive and tissue and pathology specific, with *Boswellia*'s anodyne and anti-inflammatory actions credited with an ability to reduce inflammatory mediators of many types. It protects various tissues including joints, connective tissue, liver, colon, and brain from pathologic changes, degeneration, and loss of function. A randomized controlled trial (RCT) reported topical application of *Boswellia* to improve psoriatic scales in 70% of subjects compared with 10% in the placebo group.[12] *Boswellia*, boswellic acids or a combination are shown to reduce inflammation and protect the joints,[7] protect the colon in from progressive pathological changes in adenomatous polyps,[8] inhibit cancer metastases in animal models of colorectal cancer,[11] protect the brain after ischemic injury, and reduce reperfusion injury.[10] It also protects the liver[13] and pancreatic islets[14] in diabetic rats and the liver from granuloma formation as a result of schistosome infections.[9] *Boswellia* may improve the leukocyte infiltration and superficial ulcers typical of ulcerative colitis. Studies in rats show *Boswellia* protects colonic mucosa cells from acetic acid induced inflammation, and molecular investigations showed *Boswellia* to prevent tissue injury via increases in lipid peroxidation and nitric oxide, and the expression of inducible nitric-oxide synthase compared with untreated control animals.[15]

Boswellia has been shown to improve pain and clinical signs in human arthritis patients. A proprietary *Boswellia* product patented in India (whole *Boswellia* extract enriched with additional AKBA) has been shown to significantly improve knee pain and symptoms in osteoarthritis patients in 30 days compared with placebo in an RCT.[16] A similar study dosed *Boswellia* or placebo for 90 days and reported that the treatment offered significant subjective improvements as assessed by pain scores and assessment questionnaires.[17] Another RCT reported all patients receiving *Boswellia* experienced a decrease in knee pain, increased knee flexion and walking distance, and decreased swelling after 8 weeks, compared with the group taking placebo.[18] A similar study gave patients 250 mg of a proprietary *Boswellia* product, and they noted improvements in osteoarthritic pain as soon as 7 days after beginning therapy.[19] Osteoarthritis investigations show *Boswellia* to reduce general inflammatory mediators as well as inhibit cartilage-degrading enzyme MMP-3[17], thus helping to protect cartilage in osteoarthritis patients.[19]

Boswellia has been shown to be a safe and effective therapy in ulcerative colitis, chronic colitis, experimental ileitis, Chron's disease, and all inflammatory bowel conditions. One RCT included patients experiencing chronic diarrhea with histologically proven collagenous colitis. Patients were randomized to receive either oral *Boswellia* 400 mg three times daily for 6 weeks or placebo. *Boswellia* was shown to

promote remission more frequently than the placebo; however, no histological changes were seen, and one patient withdrew from the study because of unspecified side effects.[20] Another RCT on colitis patients evaluated the effects of *Boswellia* at 300 mg three times a day on reported symptoms compared with sulfasalazine. Fourteen of 20 patients in the *Boswellia* group went into remission compared with 4 of 10 in the sulfasalazine group. Furthermore, 19 of the 20 patients (compared to 6 of 10 in the control group) taking *Boswellia* improved in one or more of the measured outcomes, including stool properties, histopathology, and blood markers such as hemoglobin, serum iron, calcium, phosphorus, proteins, total leukocytes, and eosinophils.[21] A similar study gave patients *Boswellia* at 350 mg three times per day for 6 weeks and reported 82% of *Boswellia*-treated patients went into remission, compared with 75% of sulfasalazine-treated patients.[22]

An RCT on asthma patients showed *Boswellia* at a dose of 300 mg three times per day improved dyspnea, rhonchi, number of asthma attacks, and spirometry readings in 70% of subjects compared with only 27% of controls receiving placebo.[23]

Safety in Pregnancy and Breastfeeding

Likely safe. Problems have not been reported.

General Safety

No toxic reactions or significant side effects to *Boswellia* have been reported, and there are no known contraindications with diseases or conditions. A review of 47 clinical trials using *Boswellia* to treat asthma, rheumatoid arthritis, Crohn's disease, osteoarthritis, and collagenous colitis reported that no serious safety issues were noted.[19,24] One study reported only minor digestive side effects.[18] A battery of biochemical parameters in serum, urine, and blood collected during an osteoarthritis clinical trial showed no toxicity or alterations of concern.[17] No drug–nutrient–herb interactions have been reported or demonstrated.

Dosage

This herb is generally considered safe at 1000–1500 mg/day.

Isolated and concentrated individual boswellic acids are generally dosed at 100 mg each day in divided doses.

Traditional Uses

Boswellia serrata is a resinous tree native to India, North Africa, and the Middle East. The gummy oleoresin exuded from injured bark is known as salai guggul that has been used in the traditional medicine of India to treat pain and inflammation, particularly arthritic conditions. *Boswellia serrata* is also referred to as Indian frankincense to differentiate it from the related frankincense species.

Additional traditional uses for *Boswellia* include pain and arthritis; diarrhea and dysentery; ulcerative colitis and Chron's disease; lung inflammation including bronchitis, asthma, chronic obstructive pulmonary diseases; and pneumonia and heart disease patients. *Boswellia* is prepared into paste, plasters, skin washes, and ointments to use topically on wounds, skin fungus, acne, boils, leprosy, to repel insects, and treat tumors.

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