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Report

## **Boswellia New Studies Show Effective Pain Relief**

By Julia blanco

Of the ten leading causes of mortality in the United States, *chronic, low-level inflammation* contributes to the pathogenesis of at least six.<sup>1-7</sup>

Despite this fact, no safe solution exists to battle chronic inflammation. Nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen are powerful inflammation fighters, but they have side effects that limit their safety for long-term use.

After much searching for safer alternatives, scientists have set their sights on the plant resin, *frankincense*, from a tree called *Boswellia serrata*. Boswellia extracts have been used for thousands of years to treat a wide range of conditions caused by inflammation.<sup>8-10</sup>

Intriguing new discoveries about *Boswellia* extracts have led to their increasingly widespread use in managing inflammatory conditions. In fact, European scientists think that Boswellia extracts perform so well that they have been labeled as drugs for reducing swelling in specific clinical settings.<sup>11,12</sup>

*Boswellia serrata* is rich in a number of compounds that have been found to reduce the inflammatory response by targeting a number of different mechanisms. These Boswellia compounds provide relief by working on different mechanisms.

The specific compound that scientists have identified as having potent pain reducing benefits is **AKBA** (3-O-acetyl-11-keto-beta-boswellic acid).<sup>11</sup>

For many adults plagued by chronic pain, the collective compounds found in the Boswellia extracts are being extensively studied and demonstrating effective pain management without side effects.

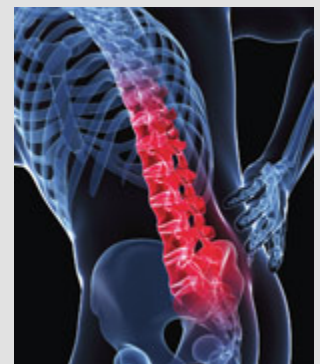


### **BOSWELLIA VERSUS NSAIDS**

It's not every day that scientists discover a natural source that fights inflammation as well as NSAIDs—much less one that exceeds them. Yet that's exactly what scientists are discovering about *Boswellia serrata*.

Importantly, Boswellia extracts achieve these benefits without the damaging side effects caused by NSAIDs.<sup>15</sup> This is because Boswellia extracts appear to have several entirely different mechanisms of action than NSAIDs.

NSAIDs prevent inflammation by inhibiting an enzyme called COX-2 (cyclooxygenase-2). The problem is that in the process, they also block COX-1, which is needed to maintain a healthy stomach lining. This is one of the primary causes of NSAID toxicity.<sup>16</sup>



Boswellia extracts work differently than NSAIDs because they inhibit *different* enzymes involved in the inflammation process. COX-2 is involved in converting arachidonic acid into an inflammatory signaling molecule known as prostaglandin E2. Instead of inhibiting COX, Boswellic acids, most prominently one called **AKBA**, work by inhibiting the enzyme 5-LOX (5-lipoxygenase), thereby reducing the biosynthesis of inflammatory signaling molecules known as leukotrienes.<sup>17</sup>

In addition to inhibiting 5-LOX, boswellic acids have been found to inhibit inflammation at a number of other points of action in the development of inflammation:

- Components of Boswellia, including a compound called incensole acetate, have been shown to regulate inflammatory responses at a very high level by inhibiting the master inflammatory regulatory complex, NF-kappaB.<sup>9</sup> Reducing NF-kappaB is an efficient means of slowing the onslaught of chronic inflammation throughout the body.
- Incensole acetate is also credited with robust neuroprotection, at least in animal models of brain trauma, and has been shown to have antidepressant, anti-anxiety, and other beneficial behavioral effects in animals.<sup>8,9</sup>
- Boswellia extracts inhibit pro-inflammatory cytokines and mediators such as tumor necrosis factor alpha (TNF-a), interleukin-1, beta (IL-1 b), and interleukin-6 (IL-6).<sup>18</sup>
- Boswellia extracts have also been demonstrated to produce a marked down-regulation of interferon-gamma (IFN-g), an activator of inflammatory T-lymphocytes.<sup>18</sup>

## Boswellia: Removing The “Flame” From Inflammation

The *Boswellia serrata* plant is a moderate-to-large branching tree that grows in high, dry habitats in India, Northern Africa, and the Middle East.<sup>10</sup> Its gummy resin is tapped from the tree by means of incisions in its bark that allow the thick, oily substance to ooze out for collection and drying.<sup>10</sup> Within that thick, oily substance are compounds that have been used for thousands of years for their anti-inflammatory, pain relieving, arthritis-fighting, and anticancer effects.<sup>13</sup>

Now, with each study that comes out, excitement is growing in the scientific community because it appears as though Boswellia could be a natural alternative to NSAIDs, the most widely used anti-inflammatory drugs. Recent research has shown that Boswellia’s anti-inflammatory actions may exceed those of the NSAIDs, having a broader spectrum of actions influencing a much wider range of inflammation-producing processes—and with far greater safety.

Boswellia resin is rich in a wide variety of biologically active compounds including **terpenes** and **boswellic acids**, which are powerful inhibitors of *pro-inflammatory signaling molecules*.<sup>10</sup> In fact, virtually all compounds isolated from the resin of Boswellia have now been determined to have anti-inflammatory properties.<sup>14</sup>

As a result, evidence is mounting for Boswellia’s ability to powerfully modify inflammation in some of the most notorious inflammatory conditions that plague older adults.

## Human Studies On Arthritis Relief

Osteoarthritis and rheumatoid arthritis can cause disabling pain in aging adults. Treatment for-both kinds of arthritis is still typically limited to NSAIDs like ibuprofen. And although more potent (and more dangerous) drugs are available for certain cases of rheumatoid arthritis, side effects limit their usefulness.<sup>19</sup>

Boswellia, on the other hand, has been safely used for thousands of years as an anti-arthritis drug—and now modern,

scientific studies have finally vindicated that use.<sup>20,21</sup>

In animal models of both experimentally induced osteo- and rheumatoid arthritis, *Boswellia* extracts have been found to reduce standard arthritis scores, paw swelling, and secretion of pro-inflammatory signaling molecules called cytokines.<sup>22</sup>

Human studies have been just as encouraging. In a double-blind, randomized, placebo-controlled trial, 30 patients with osteoarthritis of the knee received either a *Boswellia* extract or placebo. After eight weeks, the supplemented patients demonstrated superior symptom relief—including a decrease in knee pain, increase in knee flexion, and increased walking distance—and decreased frequency of knee swelling. The placebo patients experienced no such changes.<sup>20</sup>

In another study of patients with knee osteoarthritis, a *Boswellia* extract enriched in **AKBA**<sup>23</sup> was shown to produce both clinically and statistically significant improvements in pain scores and physical function scores; in some patients these results were detectable in as little as seven days after beginning supplementation!<sup>24</sup>

This study is especially encouraging because researchers determined that treatment did more than simply relieve symptoms—it *improved conditions within the ailing joints*. (The extracts achieved this effect by reducing the amounts of the joint-degrading, protein-melting enzyme matrix metalloproteinase-3.)<sup>24</sup>

Nearly identical results have been obtained using other *Boswellia* extracts rich in AKBA.<sup>23,25,26</sup>

#### WHAT YOU NEED TO KNOW

### **Boswellia Battles Chronic Inflammation**

- Chronic inflammation poses a life-shortening risk to all Americans.
- Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, have serious side effects that limit their safety over the long term.
- Extracts of *Boswellia serrata*, also called frankincense, have long been used for fighting inflammation in traditional medicine.
- *Boswellia* extracts, especially those rich in the boswellic acid known as AKBA, are now proving to inhibit inflammation at multiple points of action in the development of inflammation.
- Those properties make *Boswellia* extracts especially attractive for long-term use where NSAIDs would be inappropriate.



## **Inflammatory Bowel Diseases**



Boswellic acid's anti-inflammatory actions make it an incredibly important tool in the management of inflammatory bowel diseases such as ulcerative colitis, Crohn's disease, and collagenous colitis.

In each of these conditions, inflammation of the bowel lining is kept alive largely through excessive production of inflammatory mediators called *leukotrienes*, which are produced by the 5-LOX enzyme.<sup>27,28</sup> Since 5-LOX is potently inhibited by boswellic acids, *Boswellia* extracts are an important tool in the management of these inflammatory bowel diseases.<sup>29</sup>

In a study published in the *International Journal of Colorectal Disease*, researchers gave animals oral doses of either *Boswellia* extracts or AKBA.<sup>29</sup> Both the *Boswellia* extract and AKBA brought about a reduction in inflammatory cells sticking to blood vessels, and in the localized swelling typical of inflammatory bowel

diseases.

Another animal study showed that AKBA can decrease the number of precancerous polyps, reducing polyp formation by **49%** in the small intestine and by more than **60%** in the colon. AKBA had a still greater effect on preventing polyps from turning malignant.<sup>30</sup> In fact, polyps in the treated group showed regression towards more normal cell structures, something not seen with drug treatment.

Human studies show great benefits as well. In a study of patients with advanced ulcerative colitis, six weeks of supplementation with Boswellia gum resin extract (**350 mg** three times daily) produced significant improvements in stool properties, microscopic appearance of the bowel wall, and blood tests of inflammation.<sup>28</sup>

In fact, an impressive **82%** of the supplemented patients went into remission. These results were almost identical to the **75%** remission rate experienced by control patients that were taking the standard drug *sulfasalazine* (**1 gram** three times a day).<sup>28</sup>

A subsequent, similar study showed even better results, with a **70%** remission rate in the supplemented group and just **40%** in the drug group.<sup>27</sup>

Boswellia extracts have also induced clinical remission in patients who have collagenous colitis, a less common form of inflammatory bowel disease characterized by chronic diarrhea.<sup>31,32</sup> Patients who followed the study protocol had a **63.6%** remission rate, compared with just **26.7%** of those receiving placebo.<sup>31</sup>

## **Boswellia Tempers Cancer Promotion**

Because inflammation plays a central role in promoting cancers of virtually all kinds, inhibiting inflammation has become a key part of cancer-prevention strategies.<sup>33,34</sup> Evidence is now emerging that components of Boswellia, particularly the boswellic acids such as AKBA, can be very effective against cancers. By shutting down the master inflammation regulatory complex NF-kappaB in tumor cells, Boswellia can bring about early cell death and regression of tumors.<sup>35,36</sup>

In one animal study, when Boswellia extracts were given to mice prior to being chemically induced to develop colon cancer, the extracts significantly inhibited the formation of precancerous cell clusters.<sup>37</sup> The same study found that purified boswellic acids inhibited vital DNA synthesis in human leukemia cells in culture, preventing them from further replication.

In another study, AKBA, the most potent of the boswellic acids, rapidly induced cell death in cells derived from human meningioma, a common central nervous system tumor.<sup>38</sup>

Later studies found that when AKBA was administered to mice with implanted human colorectal cancers, it inhibited tumor growth, resulting in smaller and less aggressive cancers.<sup>39</sup> This benefit appears to be caused by AKBA's anti-inflammatory actions. Indeed, when compared with aspirin, a known nonsteroidal anti-inflammatory drug, Boswellia extracts proved superior at preventing precancerous lesions from forming in animals at risk for colon cancer.<sup>40</sup>

Studies in cells from human pancreatic and other cancers demonstrate that Boswellia extracts kill cancer cells via multiple pathways, such as restoring malignant cells' ability to die off naturally (apoptosis), and causing "cell cycle arrest," which stops reproducing cells dead in their tracks.<sup>41-44</sup>

Essential oils from Boswellia have also been found to slow the growth of human tumors implanted in mice.<sup>42,43</sup>

An exciting, yet incompletely understood property of boswellic acids, is the ability to induce "epigenetic" changes in cancer cells' chromosomes.<sup>45</sup> These changes produce physical shifts in the way various genes are expressed or suppressed,

resulting in, for example, greater expression of tumor suppressor genes.

## THE PROBLEM WITH NSAIDS

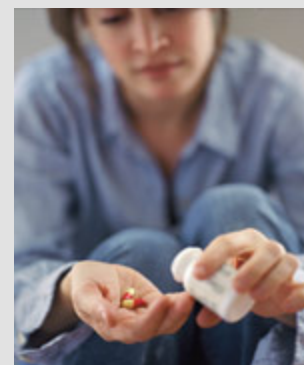
Huge numbers of Americans are in pain, judging by the popularity of over-the-counter painkillers. In a given week, **23%** of us use acetaminophen (Tylenol® and others) at least once, while **17%** use a nonsteroidal anti-inflammatory drug (NSAID), like aspirin or ibuprofen.<sup>71</sup>

Some of these drugs are clearly effective at reducing inflammation,<sup>72,73</sup> the leading cause of pain. Chronic inflammation has been implicated in diseases, including cancer, and reducing inflammation is important for long-term health.<sup>74</sup> Aspirin, of course, has been in use to prevent inflammation-related cardiovascular problems for many years, and there's evidence that moderate use of both aspirin and nonaspirin NSAIDs such as ibuprofen may be helpful in preventing certain cancers.<sup>75,76</sup>

However, despite their ability to reduce inflammation, full-dose NSAIDs cause far too many side effects for people to regularly take them as a means to boost overall health.<sup>11</sup> Gastrointestinal upset and reflux disease are two of the milder forms of NSAID side effects, but they can progress to more serious problems, such as internal bleeding and ulcers.<sup>77-87</sup>

However, you don't have to face the side effects of NSAIDs to experience their inflammation-busting actions.

For thousands of years, **frankincense** has been used to fight diseases we now recognize as inflammatory in nature. Frankincense is an extract of a tree called *Boswellia serrata*. *Boswellia serrata* extracts produce NSAID-like effects and have been used in cancer prevention, in treatment of inflammatory bowel diseases (IBD), in cardiovascular disease prevention, and in neuroprotection.<sup>8,11,88</sup>



## Boswellia Extinguishes Cardiovascular Inflammation

Atherosclerosis, or hardening of the arteries, is a complex process that leads to heart attacks, strokes, and peripheral vascular disease, as well as contributing to cognitive loss with aging.<sup>49,50</sup> Over the past decade, it has become clear that atherosclerosis, like so many other age-accelerating processes, has a major inflammatory component.<sup>51</sup> These observations make fighting inflammation a key factor in preventing and mitigating arthritis and cardiovascular disease.<sup>51,52</sup> In fact, the routine use of aspirin in some settings is an attempt to reduce some of the effects of inflammatory stimuli on blood vessels.

*Boswellia* extracts are beginning to show promise in preventing the inflammation that contributes to atherosclerosis. In rats fed a high-fat, atherosclerosis-promoting diet, supplementation with *Boswellia* extract significantly lowered total cholesterol by up to **48%**, and increased beneficial HDL-cholesterol by up to **30%**.<sup>13</sup> In the same study, liver and kidney functions returned to near-normal levels.

Basic lab studies provide insights into how *Boswellia* provides these beneficial cardiovascular anti-inflammatory effects. Potent extracts, enriched in AKBA, reduced the changes in gene expression induced by the pro-inflammatory cytokine TNF-alpha, and slowed production and activity of protein-melting matrix metalloproteinase enzymes.<sup>52</sup>

These effects are mediated by AKBA's ability to shut down NF-kappaB, the master inflammation regulatory complex.<sup>51</sup> In a mouse model of atherosclerosis, treatment with AKBA inhibited NF-kappaB, and resulted in about a **50%** reduction in the size of atherosclerotic plaques.<sup>51</sup>



Chronic inflammation also induces changes in the function of platelets, the tiny cell fragments responsible for initiating blood clotting.<sup>53</sup> Inflammatory signals trigger platelets to become increasingly sticky, causing them to adhere to vessel walls and eventually blocking blood flow to produce a heart attack or stroke. Boswellia extracts have now been shown to significantly inhibit platelet activation and subsequent clumping.<sup>54</sup>

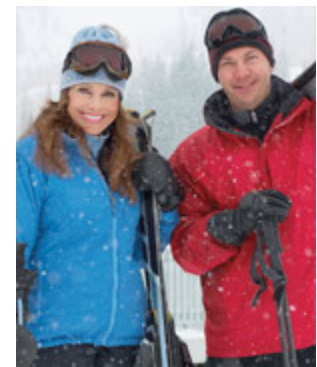
#### ANTI-METASTASIS BREAKTHROUGH

**90%** of cancer deaths result from tumor metastasis, the spreading of new tumors to distant sites in the body. Scientists have been eagerly pursuing a true anti-metastasis drug, but to date, no such drug has been found.<sup>46</sup>

As researchers are discovering more about the cause of metastasis, it's becoming clear that AKBA from Boswellia could play an important role in stopping the deadly spread of cancer.

Recent discoveries indicate that a specific receptor on the surface of tumor cells is responsible for regulating metastasis. AKBA has been found to downregulate that receptor in pancreatic cancer cells.<sup>46</sup> Researchers have also found that AKBA is able to suppress metastases to the liver, lungs, and spleen in mice implanted with human colorectal cancers.<sup>39</sup>

## Potent Neuroprotection



One of Boswellia's traditional uses is to prevent amnesia.<sup>55</sup> Now, its anti-inflammatory actions are being explored as a powerful form of neuroprotection for traumatic brain injury and stroke (both of which are aggravated by an inflammatory response following the event),<sup>56-58</sup> as well as for other, age- and inflammation-related changes in the brain.<sup>59</sup>

A component of Boswellia resin called *incensole acetate* inhibits NF-kappaB, and has now been shown to inhibit the gene expression of inflammatory mediators in an animal model of traumatic brain injury.<sup>78</sup> This effect also inhibits degenerative changes in the hippocampus, one of the brain's chief memory-processing areas. Boswellic acids have also been found to stimulate hippocampal cells to grow new, highly branching projections called **neurites**. Neurites are the tiny projections that brain cells use to contact multiple other cells to advance cognition and memory.<sup>61-63</sup>

This important study is disproving the outdated belief that brain tissue cannot regenerate—and gives a ray of hope to those currently suffering from degenerative brain disorders that are believed to be incurable.

Even hippocampal changes related to aging (which resemble a slow-motion version of acute brain injury in their cellular effects) can be attenuated in animals given Boswellia supplements.<sup>64</sup>

Animal and human studies have borne out Boswellia's memory-improving effects.

In one study, rats receiving a Boswellia supplement experienced improved memory in a maze, showing that Boswellia significantly improves spatial memory retention.<sup>65</sup> Similarly, another study found that rats with experimentally induced seizures that have seizure-related learning disorders as a result, experienced improvements in their learning ability when supplemented with Boswellia extracts.<sup>66</sup>

As an added benefit, the incensole acetate component of Boswellia has been shown to reduce behaviors typical of depression via gene expression changes in the hippocampus.<sup>67</sup> Recent work shows that these compounds can readily enter the brain from the bloodstream.<sup>12</sup>

In a human study of patients with diffuse axonal injury, a widespread and poorly understood consequence of brain trauma,<sup>68,69</sup> Boswellia supplementation produced a significant increase in cognitive abilities related to self-care after six weeks of treatment. Placebo patients experienced no such changes.<sup>70</sup>

#### BOSWELLIA EXTRACTS HELP MANAGE BRAIN TUMORS

In addition to their cancer-preventive effects, Boswellia extracts are also showing promise in management of *existing* brain tumors. Radiation treatment for such tumors typically produces brain swelling, which can be fatal.<sup>47</sup> Standard preventive treatment includes a potent steroid, *dexamethasone*, which also has a wide range of side effects.<sup>48</sup>

Studies of Boswellia extracts given at doses of **4,200 mg/day** demonstrate that reductions in brain swelling of more than **75%** occurred in **60%** of supplemented patients undergoing brain radiation therapy, but in just **26%** of control patients.<sup>48</sup>



## Summary

Your body is under constant attack by chronic inflammatory stimuli. When these break through to cause perceptible pain, you are likely to turn to NSAIDs, such as ibuprofen. But such drugs, with few exceptions, are inappropriate for chronic use to prevent inflammation and its deadly consequences.

Instead, consider supplementing with extracts of Boswellia, the source of biblical frankincense. The gummy resin has similar effects as those exerted by NSAIDs and a different mechanism of action with almost no side effects, giving it both a wider spectrum of use and a vastly safer side-effects profile.

Boswellia extracts inhibit multiple steps in the inflammation-generating cascade of events. As a result, they are showing promise in reducing risk of arthritis, cancer, inflammatory bowel diseases, cardiovascular disorders, and neurodegeneration.

Aging humans concerned about the impact of chronic inflammation and leery of long-term NSAID use may consider Boswellia extracts for broad-spectrum protection.

If you have any questions on the scientific content of this article, please call a **Life Extension**<sup>®</sup> Health Advisor at 1-866-864-3027.

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