

Chemistry and medicinal properties of frankincense

The genus *Boswellia* (family Burseraceae) consists of many species widespread throughout the world. *Boswellia serrata* (or Frankincense) is found in India, Northern Africa, and the Middle East. It is known as olibanum and *salai guggul* in Ayurvedic medicine. *Boswellia serrata* is one of the medicinal plants, which has long range of medicinal uses in pharmaceuticals, cosmetics, agriculture etc. Its bark resin, seed extract, flower extract, oil etc. have been studied, proving the existence of boswellic acid and other metabolites. *Boswellia serrata* leaf extract and fruit extract has been studied for pharmaceutical purposes. Their chemical structures and phytochemical study are helpful for the synthesis of new drugs.

Chemical properties

The resinous part of *Boswellia serrata* contains terpenes: monoterpenes (α -thujone); diterpenes (macrocyclic diterpenoids such as incensole, incensole oxide, iso-incensole oxide, a diterpene alcohol [serratol]); triterpenes (such as α - and β -amyrins); pentacyclic triterpenic acids (boswellic acids); tetracyclic triterpenic acids (tirucall-8,24-dien-21-oic acids).

Boswellic acids with the molecu-

lar formulas of $C_{32}H_{52}O_4$ are the main active component of frankincense. The four major boswellic acids (pentacyclic triterpenic acids) found in frankincense are: β -boswellic acid (BA), acetyl- β -boswellic acid (ABA), 11-keto- β -boswellic acid (KBA) and 3-O-acetyl-11-keto- β -boswellic acid (AKBA), which have been shown to be responsible for the inhibition of pro-inflammatory enzymes. Boswellic acids inhibit leukotriene biosynthesis by impairing the lipoxygenase activity. It acts as both internal and external stimulant. The gum is also prescribed in cases of jaundice, diarrhoea, dysentery, dyspepsia and haemorrhoids.

Sunpure provides Boswellic Acid (65%-85%), AKBA (10%-90%), Boswellia Essential Oil and Boswellia Complex (a high bioavailable version of Boswellia extract).

Medicinal uses of *Boswellia Serrata*

It improves blood supply to the

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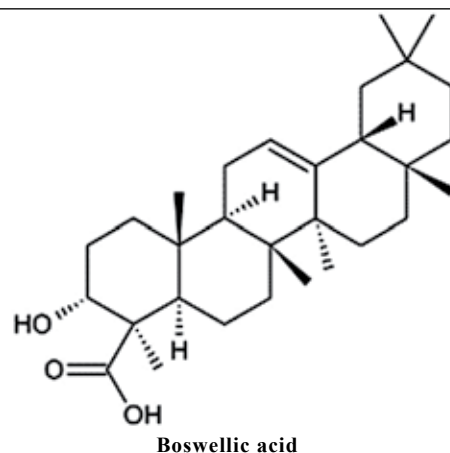
affected areas, shrinks inflamed tissue, reduces pain, and enhances repair of local blood vessels damaged by proliferating inflammation. These effects are attributed to chemical compounds known as boswellic acids, which are now used in contemporary medicine as anti-arthritis and anti-inflammatory pharmacological agents.

In inflammatory diseases

Leukotriene is a chemical produced by cells in the body which cause inflammation by promoting free radical damages, autoimmune responses, cell adhesion and migration of the inflammatory producing cells to the inflamed area. Leukotrienes cause diseases including asthma, colitis, rheumatism, arthritis and psoriasis. *Boswellia* inhibits the leukotrienes by blocking the synthesis

Key parameters of boswellia oil

Test parameters	Specification	Results
Specific gravity (at 25°C)	0.82-0.92	0.82
Refractive index (at room temperature)	NLT-1.20	1.42
Specific Optical Rotation	+5° to +30°	29.10°



of leukotrienes, which leads to the inhibition of inflammation and shrinking of sore tissue – the basic cause of pain and discomfort.

Heart disease

Atherosclerosis is the major cause of coronary heart disease. Data clearly indicates that AKBA reduces chronic inflammation through the inhibition of NF- κ B (nuclear transcription factor) system, which is a very important factor in increasing chronic inflammatory diseases.

Asthma

In a study, several patients with chronic bronchial asthma were treated with the *Boswellia serrata* preparation of 300 mg thrice daily for a six-week period. The improvement was obvious for 70% of the patients by disappearance of physical symptoms and signs such as dyspnoea (difficulty in breathing), rhonchi (hissing lung sound) and number of attacks. The data show a definite role of gum resin of *Boswellia serrata* in the treatment of bronchial asthma.

Skin

Studies have shown that the presence of *Boswellia serrata* extract reduces the redness and irritation in the skin and produces an even skin tone. In China, frankincense has been used as skin remedies for bruises and infected sores. The extracts of *Boswellia* family have shown to have a soothing effect for irritated skin and that is caused by the pentacyclic triterpene (steroid-like) structure shared in different Boswellic acid compounds. In addition, AKBA is reported to be an effective topical agent to soften facial lines and relax the skin.

In inflammatory bowel disorders

The leukotrienes play an important role in keeping inflammation active in chronic inflammatory diseases of the colon such as ulcerative colitis. Bos-

wellic acids, which are the active ingredients of the gum resin of *Boswellia* species, have been shown to be specific, non-competitive inhibitors of 5-lipoxygenase, the key enzyme of leukotrienes.

Boswellia serrata was effective in inducing the remission in about 80% of the patients with ulcerative colitis grade II and III, when applied at a level of 350 mg three times a day over period of six weeks.

Cancer

The antitumor activities of the four triterpenic acids (BA, ABA, KBA and AKBA) isolated from the gum resin of *Boswellia serrata* have been studied and it was found that these acids inhibited the synthesis of DNA, RNA and protein in human leukemia HL-60 cells in a dose dependent system. Among them, AKBA induced the most pronounced inhibitory effect on DNA, RNA and protein synthesis. Boswellic acids are effective apoptotic agents to cancer cells. The anticancer activity of AKBA is recognized by inhibitory effect on the lipoxygenases, which lead to the inhibition of cell proliferation and induction of apoptosis in tumour cells. Studies showed that AKBA also positively act on prostate cancer.

A detailed study of patients with malignant cerebral tumours who were receiving radiotherapy plus certain amount of *Boswellia* extract, showed that after the end of radiotherapy the 75% reduction of cerebral oedema was observed in 60% of the patients receiving *Boswellia* extract. It clearly showed AKBA to have strong anti-cancerous property. But *in vitro* experiments are needed.

Diabetes

The regular use of leaf and root extract for 28 days showed a decrease in blood glucose, cholesterol, triglyceride, urea and creatinine levels and enzyme actions in addition to significant hypo-

glycaemic effects. The study showed that *Boswellia* extract has anti-diabetic effects and possibly could prevent complications of diabetes in the kidneys and liver.

Antimicrobial

Among the boswellic acids, AKBA was the most active inhibitor of bacterial pathogens. A report shows that AKBA can prevent as well as reduce the *Staphylococci aureus* and *Staphylococci epidermidis* generated biofilms leading to chances of reducing 60-80% of microbial infections in the body.

Memory

Studies have shown that there is a significant increase in short-term memory and long-term memory in rats when their mother received aqueous extract of *Boswellia serrata* orally during the gestational period.

Fertility

Boswellic acids and other pentacyclic triterpenes have a chemical structure similar to steroids. In a study conducted to examine the effect of Frankincense on the reproductive system, it was shown that frankincense increased fertility in rats. In addition, the number of implantation and the number of viable foetuses also increased, which may possibly be due to the increase in sperm motility and sperm density.

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