

BOSWELLIA SERRATA ROXB. – A BIOACTIVE HERB WITH VARIOUS PHARMACOLOGICAL ACTIVITIES

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ABSTRACT

Herbal medicine has become a medicinal as well as the economic aspect of global significance. While the use of these herbal medicines has increased, there are several questions about their consistency, protection, and effectiveness in different countries. Boswellic acid (BA) is one of the active constituents obtained from plant *Boswellia serrata* (BS) family Burseraceae. The oleoresin gum of the plant is also known as Salai guggul, Indian olibanum, or Indian frankincense. *Boswellia* species comprises a variety of phytochemical components, essential oil, BA such as keto-BA, beta-BA, or acetyl keto-BA. This variety of constituents isolated from the plant using various extraction processes such as hydrodistillation, percolation, and ultraviolet-assisted extraction or solvent extraction. The active constituent has different biological activities such as antidiuretic, anticancer, anti-inflammatory, or antitumor activity. This review seeks to update information on plant BS with its medicinal uses, isolation process in the traditional or Indian system of medicine, and justify its use on modern scientific parameters.

Keywords: Natural herb, *Boswellia serrata*, Terpenic acid, Acetyl keto-boswellic acid, Keto-boswellic acid, Anti-inflammatory agent.

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INTRODUCTION

In drug research and growth, natural products are receiving expanded applications. They are chemical rich and can concurrently modulate multiple targets in a complex structure. The use of herbal medicines and phytonutrients continues to expand exponentially all over the world, with many people being exposed to such products in various national health-care settings to tackle different health problems. [1] *Boswellia serrata* (BS) extract is one of the most effective herbal drugs, which is popularly known as the sallaki, indigenous olibanum of frankincense, and luban. There are more than 25 species grown worldwide such as *Boswellia carteri*, *Boswellia sacra*, and *Boswellia papyrifera*. BS is commonly cultivated in gulf countries such as Saudi Arabia and East Africa. Indian states where it is grown widely include Orissa, Bihar, Gujarat, Rajasthan, Uttar Pradesh, and Madhya Pradesh [2].

The dry exudate from the *Boswellia* trees bark is a resin of the oleo gum. The extraction of a particular pharmacological active ingredient can be carried out using various extraction methods such as solvent extraction, hydrodistillation, and solvent extraction. This extraction requires various plant parts such as leaves, base, stem, and even a whole *Boswellia* plant. This extract can be used to cure a number of inflammatory disorders such as Crohn's disease and colitis ulcerations. Both extract and essential oil are used as antiseptic in both mouth washing and asthma with cough care [3].

The resin portion of almost all species of *Boswellia* consists mostly of boswellic acid (BA) and pentacyclic triterpene. Among all BAs, 11-keto β -BA and acetyl keto β -BA are the most potent anti-inflammatory agents that selectively inhibit leukotrienes by inhibiting 5-lipoxygenase (5-LOX) in a non-competitive, non-redox, and enzyme directed manner [4,5].

TAXONOMICAL HIERARCHY - [6].

Kingdom – *Plantae*.
 Subkingdom – *Tracheobionta*.
 Division – *Magnoliophyta*.
 Class – *Magnoliopsida*.
 Order – *Sapindales*.
 Family – *Burseraceae*.

Genus – *Boswellia*.

Species – *serrata*.

PHARMACOGNOSTICAL FEATURES

BS is medium to large size deciduous tree as shown in fig. 1 reaching up to 4–5 m like any other branching tree and having a girth of 1.0–1.5 m with a spreading flat crown with a diameter of 2.4 m (avg. 1.5). The height of the plant does not exceed 10 m and the girth does not go above 1.5–2 m [5-7]. Table 1 include the various pharmacognostical features of plant boswellia.

EXTRACTION PROCESS

Extraction constitutes the first step in separating the natural materials extracted from the raw material. The general strategies for extracting medicinal plants include maceration, infusion, percolation, digestion, decoction, hot continuous extraction (Soxhlet), aqueous alcoholic extraction by fermentation, countercurrent extraction, microwave-assisted extraction (MAE), ultrasound extraction (sonication), supercritical fluid extraction, and distillation techniques (water distillation, steam distillation, and photonic extraction [with hydrofluorocarbon solvents]). For aromatic plants, hydrowater, and steam distillation), hydrolytic maceration followed by distillation, expression, and effleurance (cold fat extraction) may be employed [7]. Some of the latest extraction methods for aromatic plants include headspace trapping, solid-phase microextraction, protoplast extraction, and microdistillation. As the plant and isolated compounds are well known for their therapeutic properties and use in Ayurveda, each of the extraction methods can be used to achieve the optimum yield of the desired compound for the intended extraction of some particular compound from the plant extract [8].

Various researchers utilized some of the above-mentioned methods for the extraction of the active compounds from *Boswellia serrata*. Some important description from their study has been enlisted in the following.

THREE-PHASE PARTITIONING (TPP)

TPP is a fast, effective, and green bioseparation process and often a one-step process to isolate and purify active compounds from complex

mixtures [9]. This method involves the concept of various techniques such as salting out, isoionic and cosolvent precipitation, and osmolyte and kosmotropic precipitation. The theory of this rapidly evolving method is to combine crude extract with solid salt mostly ammonium sulfate and organic solvent typically t-butanol to achieve three phase [10,11].

PERCOLATION

Percolation refers to the transfer and filtration of liquid by porous materials. The crude material being extracted is reduced to pieces of suitable size. If necessary, then mixed thoroughly with a portion of the specified solvent and allow to stand for 15 min [12]. The mixture is moved to a percolator an appropriate quantity of specified solvent is applied to cover entire solid mass and the mixture can percolate slowly at a rate of 1 mL/min, with 1000 g of raw material. The matter to be extracted is always covered with a layer of solvent. The residue can be pressed and the fluid obtained is mixed with the percolate and usually concentrated by distillation at low pressure [13].

ULTRASONIC-ASSISTED EXTRACTION (UAE)

Using ultrasound resulted in better separation of materials in a shorter period and at a lower temperature. The mechanical effect of ultrasound will facilitate the extraction of active plant components by the destruction of the cell walls [14]. Nowadays, UAE has been used to extract pharmaceutically active compounds such as polysaccharides, cellulose, flavonoids, saturated hydrocarbon, fatty acid, ester, and steroids from different parts of the plant. UAE is based on the transmission of mechanical waves, generated by the sequence of cycles described as the combination of high and low pressure, called compression and rarefactions [15].

SUPERCRITICAL FLUID EXTRACTION

The supercritical condition is the state in which the temperature and pressure of the substance are above the critical values where gas and liquid cannot be separated from one another [16]. The solvent in supercritical state exhibits intermediate physiochemical properties identical to liquid and gas, which improves the solvent extraction capacity [19]. Supercritical carbon dioxide is the most commonly used of the numerous supercritical fluids (ethylene, methane, nitrogen, xenon, or fluorocarbons) used for extraction, as it is non-toxic, non-flammable, non-corrosive, and easy to handle allowing supercritical activity at low pressure and near room temperature [17,18].

HYDRODISTILLATION

Distillation methods have traditionally been applied in the analysis of plant materials. Hydrodistillation represents a commonly used method of extracting essential oil from plant parts [22]. This method may be further classified into the subcategories of steam distillation, water distillation, and both. The main advantage of this method is that less processing time and higher oil yield. Heat and steam allow the plant material's cells structure to burst and breakdown, thereby releasing essential oils [21,23].

SOXHLET EXTRACTION

A Soxhlet extractor is a piece of laboratory apparatus designed in 1879 by Franz von Soxhlet. The configuration of the Soxhlet extractor consists of a round bottom flask, siphon tube, distillation path, expansion adapter, condenser, water inlet for cooling, water outlet for cooling, heat source, and thimble [24]. In this method, the powdered sample is enclosed in a porous bag or "thimble" made from a strong filter paper or cellulose, which is placed, is in the thimble chamber of the Soxhlet apparatus [20]. The extraction solvent is taken in the round bottom flask and heated using a heating source like heating mantle [25].

MACERATION

Maceration is a well-known extraction procedure where phenolic components such as tannins, coloring agents (anthocyanins), and flavor

chemicals are extracted from the various parts of the plant [11]. In the maceration process, the plant material is placed in peaces or powder, depending on convenience, in a container full of menstrum and let stand for 3 or more days, shake frequently until complete extraction of plant material. The material is then compressed and pressed to extract all of the excess oil into the resulting solid. The accumulated material is condensed by filtration or decanting. The overall maceration time depends on the type of plant to be extracted, or part of it, or the active ingredient. The most conspicuous ratio is 1:20 herb/liquid [26].

MICROWAVE-ASSISTED

MAE is a method used in the 1990s to isolate the organic substances from solid materials (microwave digestion has been used in metal analysis for many years). The approach involves simply placing the sample in specialized containers with the solvent and using microwave energy heating the solvent [27]. When collecting samples by MAE, two choices are available: Open vessel and closed vessel, and the decision is primarily influenced by the nature of the solvent used. In general, MAE uses a small quantity of solvents and it is called a "Green" system and also heating occurs in an environmentally selective manner, with even less energy loss [28,29].

STEAM DISTILLATION

Steam distillation is accomplished by passing dry steam through the plant material, volatilizing, condensing, and collecting the steam volatile compounds in the receivers. Steam distillation has been in use for many years for extracting essential oil [30]. It is a multistage continuous distillation process, where steam is used to extract the oils as a removing gas. Steam is directed through the content of the plant. The hot vapor mixture is collected and condensed to produce a liquid in which the oil and water form two distinct layers. One of these layers is essential oil, which contains oil-soluble compounds, and the other is a hydrolysate or hydrosol, which contains water-soluble components [31].

Table 2 gives a brief idea about various researches on *Boswellia* extraction process.

CHEMICAL CONSTITUENTS

Oleo gum resin of BS has numerous active chemical constituents and pharmacologically active elements such as terpenoids and oil [32,33]. 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) (BS monograph 2008). 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 [34,36].

Table 1: Pharmacognostical features of plant

S. No.	Parts	Features
1.	Leaves	Odd pinnate, length 30–45 cm long, ex-stipulate, variable in shape, crowded at branch
2.	Leaflets	8–15 in numbers, ovate or ovate-lanceolate, rounded base, almost sessile, mostly pubescent
3.	Flower	Bisexual, axillary racemes, or panicles at the top of the branches
4.	Calyx	Smaller, pubescent outside, 5–6 lobed broadly triangular-ovate
5.	Petals	5mm long oblong-ovate with the basal disk, white- pink in color
6.	Fruits	Cotyledons, trifold, drupe, 1.25 cm long trigonous obovoid type
7.	Seeds	Heart-shaped, attached to the inner angle of the compressed and multified cotyledons

Table 2: Extraction techniques with their conditions

S. No.	Technique	Solvent	Condition	Active constituent	Max. yield
1.	Three-phase partitioning	t-butanol dichloromethane	3-4 h	Acetyl keto-boswellic acid	35-40%
2.	Percolation	Ethanol Pet. ether Water Acetone Methanol	50-1000 ml solvent used 24 h	Boswellic acid	25-30%
3.	Ultrasonic assisted	Pet. ether Ethanol Methanol	50-300 ml solvent 2-3 h 20-25 kHz 150-200 W	Acetyl keto-boswellic acid	40-60%
4.	Supercritical fluid extraction	Carbon dioxide	100-250 bars 40-45°C	Boswellic acid	45-50%
5.	Soxhlet extraction	Ethanol Hydroalcohols Pet. ether Hexane Methanol	40-70°C 10-24 h	Carbohydrates Tannins Glycoside Terpenes	45-55%
6.	Hydrodistillation	Distilled water	300-500 ml 3-8 h 160°C	Essential oil	5-10%
7.	Maceration	Water Ethanol Hydroalcohols	1:1 ration 6-12 h	Boswellic acid	
8.	Microwave assisted	Water	8-10 h	Essential oils	2-5%
9.	Steam distillation	Distilled water	1 l 100°C	Boswellic acid	3-10%

Table 3: Identification test for various active constituents

S. No.	Test	Chemical used	Inference
1.	Killer-Killani test	Glacial acetic acid, ferric chloride, sulfuric acid	Reddish-brown color at the junction of two layers with bluish-green color at the top shows the presence of glycosides
2.	Salkowski's test	Chloroform, sulfuric acid	Reddish-brown band shows the presence of terpenoids
3.	Shinoda test	Ethanol, hydrochloric acid, magnesium	Reddish-pink or brown color shows the presence of flavonoids
4.	Liebermann-Burchard test	Acetic anhydride, sulfuric acid	Color change from violet to blue shows the presence of steroids
5.	Ferric chloride test	Water, ferric chloride	The appearance of the blue color shows the presence of tannins
6.	Foam test	Distilled water	Formation of stable persistent foam shows the presence of saponins
7.	Mayer's reagent test	Hydrochloric acid, potassium iodide	The formation of cream precipitate shows the presence of alkaloids

Table 4: Mechanism of action along with some formulation

S. No.	Activity	MOA	Formulations
1.	Anti-inflammatory	↓ 5-LO, ↓ 5-LOX ↓ COX-2 ↓ Pro-inflammatory cytokines ↓ TNF-α, ↓ IL-β	Tablet/herbal gel/
2.	Antimicrobial	↓ Antimicrobial peptide LL-37	Gel/cream/silver nanoparticle
3.	Anticancer	↓ NF-κB AKBA ↓ VEGFR2 Demethylation and reactivation of methylation silenced tumor suppressor genes	Solid lipid nanoparticle
4.	Improving memory	↑ GSH content	Tablet
5.	Antioxidant	Regulating the Nrf2/HO-1 pathway	Silver nanoparticles

5-LO: 5-Lipoxygenase, HLE: Human leukocyte elastase, 5-LOX: 5-Lipoxygenase, TNF-α: Tumor necrosis factor-α, (IL-β): Interleukin-1 beta, COX-2: Cyclooxygenase-2, NF-κB: Nuclear factor-kappa B, VEGFR2: Vascular endothelial growth factor receptor 2, GSH: Glutathione, Nrf-2: The nuclear factor erythroid 2 (NFE2)-related factor 2, HO-1: Heme oxygenase-1

B. serrata gum resin contains 12 different types of BA but the six major acids include the α- and β-BA, acetylated α- and β-BA, 11-keto β-BA (KBA), and 3-Acetyl keto-β-BA (AKBA) [35] which are susceptible to an inflammatory enzyme [37,38]. Chemical structure of some major terpenic acids is shown in Fig. 2.

PHYTOCHEMICAL EVALUATION

Phytoconstituents are the bioactive chemical compounds present in the plants [39,40]. 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 [41,42]. 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. There are some tests mentioned in Table 3, which help to screening the presence of active compound in the plant.

APPLICATIONS

ANTI-INFLAMMATORY

Arthritis is characterized by systemic inflammation, which can be related to pain, rigidity, and joint damage. Arthritis can be of different types which directly affect more than 1 joints such as fingers, ankles, and elbow depending on the type of arthritis. Gum resin extracts of *B. serrata* have been traditionally used in folk medicine for centuries to treat various chronic inflammatory diseases [45]. The data of numerous scientific studies support the claim that *B. serrata* possesses potent anti-inflammatory and anti-atherosclerotic activity. Su *et al.*, 2011, have reported the anti-inflammatory activity as well as the analgesic effect of BA with a combination of Myrrha [43]. Agarwal *et al.*, 2013, have prepared a herbal gel containing *Boswellia* extract for the treatment of arthritis. Some study reported that BA is as a direct 5-LO inhibitor, suppressing the synthesis of 5-LO products in common *in vitro* models [44]. Natural *Boswellia* extract compounds also exhibit anti-inflammatory properties in human peripheral mononuclear blood cells and mouse macrophages by inhibiting tumor necrosis factor-

alpha (TNF- α), interleukin-1 beta (IL-1 β), NO and mitogen-activated protein kinases, and incensole acetate, a novel anti-inflammatory

compound isolated from *Boswellia* resin inhibits nuclear factor-kappa B activation [46,47].

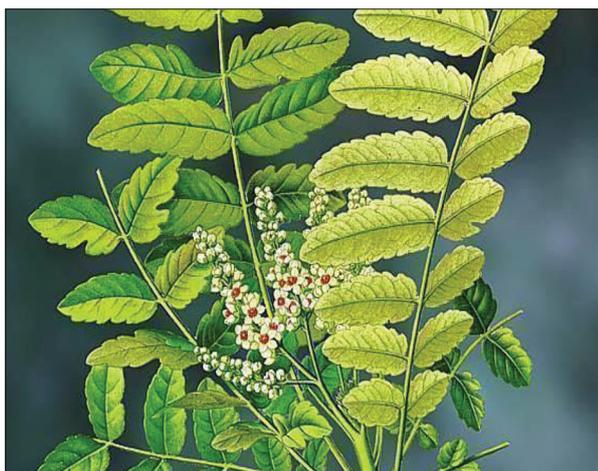


Fig. 1: *Boswellia serrata* roxbH

ANTIMICROBIAL

Various studies have reported that crude extract of *Boswellia* species contains an antimicrobial agent that stops the further growth of microbes [60]. Kora et al., 2012, to the prepared silver nanoparticle of aqueous extract of *Boswellia* which acts as an antimicrobial agent on both Gram-positive and Gram-negative bacteria [48]. Ismail et al., 2014, have reported the antimicrobial activity of frankincense on both Gram-positive and Gram-negative bacteria. Other studies also reported that the gum resin of frankincense is active against *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species, *Pseudomonas aeruginosa*, *Proteus mirabilis*, and *Bacillus subtilis* [49]. In addition to this, De Rapper et al., 2012, have reported *B. serrata* EO α -pinene (38.41%) and myrcene (15.21%), while *Commiphora myrrha* EO was characterized by a high content of furanoeudesma-1,3-diene (17.65%) followed by curzerene (12.97%), β -element (12.70%), and germacrene- β (12.15%) having both an antimicrobial and antifungal activity [50]. Vahabi et al., 2020, have reported antimicrobial activity of BS extract by disk diffusion or well plate method and broth microdilution method [51].

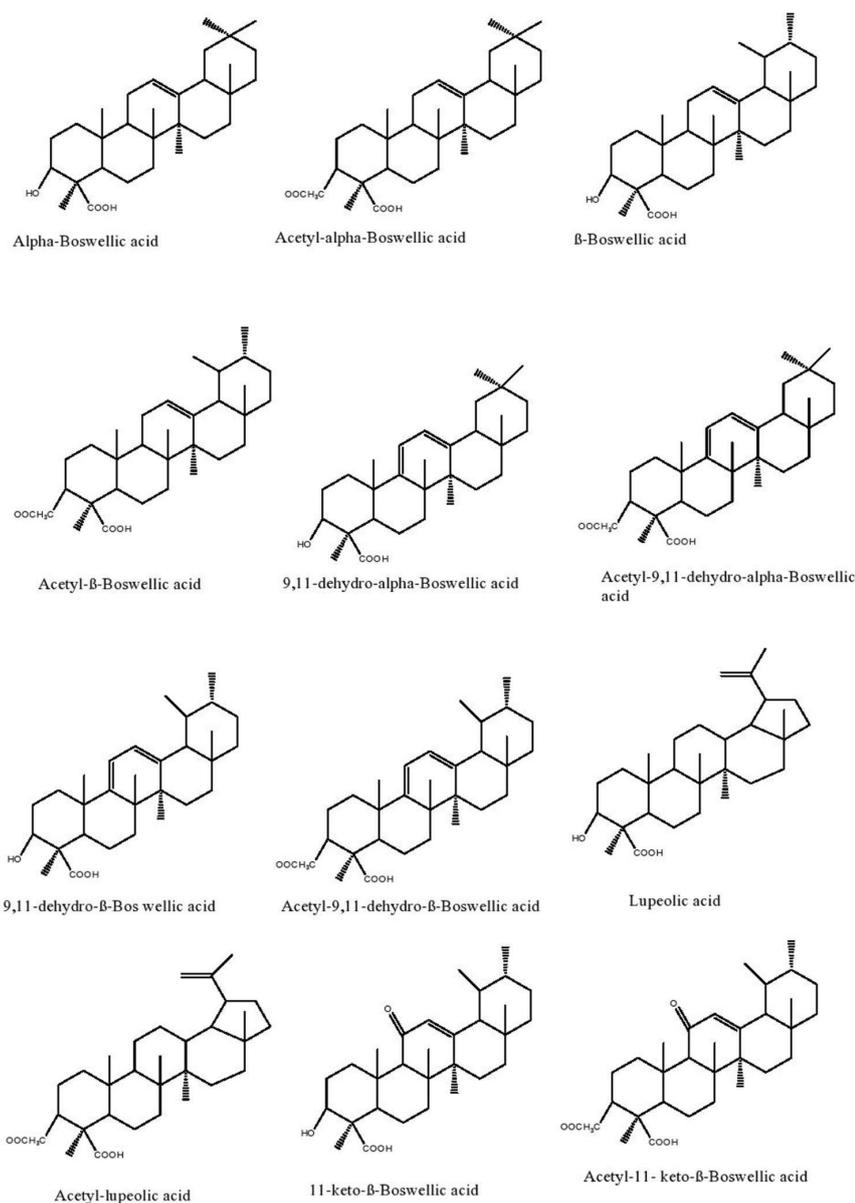


Fig. 2: Chemical structure of various terpenic acids

ANTIVIRAL

According to the researcher, *Boswellia* species also possess having an antiviral activity. Arora *et al.*, 2020, have reported the antiviral 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 antiviral activity [52]. Badria *et al.*, 2003, have also reported antiviral activity of different constituents obtained from *Boswellia* species against herpes simplex type 1 virus and were able to reduce the number of the plaques by 100% with a minimum antiviral concentration at 20 µg/ml and followed by acetyl-11-keto-β-BA (75% inhibition at 20 µg/ml), β-boswellic and total alcoholic extract (50% inhibition at 40 µg/ml), acetyl-β-boswellic and 11-keto-β-boswellic (75% inhibition at 80 µg/ml), 3-hydroxytirucallic acid, 3-oxo-tirucallic acid, acetyl-α-BA, and total volatile oil (50% inhibition at 80 µg/ml). On the other hand, gum, palmitic acid, and lupeol reduced the number of plaques by 25% at relatively higher concentrations [53]. This shows that BS also exhibit antiviral activity.

ANTICANCER AND ANTITUMOR

BA anticancer activity has been documented in many studies. Takahash *et al.*, 2012, have reported AKBA as a chemoprotective agent in colorectal cancerous cells by modulating specific micro-RNA pathways [54]. Schmiech *et al.*, 2019, have reported the correlation of boswellic and lupeolic acid contents with TNF-α, IL-1β, IL-6, IL-8, and IL-10 inhibition. They also exhibited toxicity against the human triple-negative breast cancer cell lines MDA-MB-231, MDA-MB-453, and CAL-51 *in vitro* [55]. Khan *et al.*, 2016, reported that BA significantly inhibited the ascetic and solid Ehrlich tumor model [56]. The inhibition was observed with reduced ascetic volume, solid tumor volume, and body weight when compared to that of control mice. A treatment also increased the survival of tumor-bearing mice. Vascular endothelial growth factor and TNF-α levels were decreased, whereas the IL-12 levels were increased with BA treatment at 25 mg/kg. Further, results on the decrease in the peritoneal angiogenesis and microvessel density showed the antiangiogenic potential [57,58].

ANTIDEPRESSANT 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. Prabhakar *et al.*, 2013, illustrated this at a dosage of 100 mg/kg, *Boswellia* has significant antidepressant efficacy in acute stress experiments and reduces the immobility time in the experimental forced swim model [59]. *B. serrata*, traditionally important medicinal plant, proved to be a bacteriostatic agent.

ANTI-ALZHEIMER'S ACTIVITY

Alzheimer's disease (AD) is a neurodegenerative, chronic condition. Increased oxidative stress in AD has proved to be a popular and early feature [60]. Medicinal plants with antioxidant activity have widely been used in treating a variety of human diseases. Yassin *et al.*, 2013, have reported that *Boswellia* has the potential to treat the AlCl₃-induced Alzheimer by elevation of Ach level and reduction of AchE activity in brain homogenates [61,62]. Beheshti *et al.*, 2016, have also reported that frankincense has the potential to improve dementia type of AD induced by i.c.v injection of streptozotocin in a time-dependent manner [66].

MISCELLANEOUS

Various study also have found that the boswellic acid is used in treatment of various disease mention in Table 4 including that, prepared a solid lipid nanoparticle combined with frankincense and myrrh oil which increased the antitumor efficacy in H22-bearing Kunming mice [63]. Togni *et al.*, 2014, also prepared a topical formulation for the treatment of psoriasis and eczema [64]. Taghizadeh *et al.*, 2017, were performed a study to investigate the effect of a table containing BS extract and

Melissa officinalis extract on the memory of the older adults and found that they can be beneficial on the improvement of memory [65].

SAFETY AND BIOAVAILABILITY ENHANCEMENT OF FRANKINCENSE

Based on the observations and results obtained from different research, it can be stated that the *B. serrata* given to the animals demonstrated no mortality as well as any adverse effect on animal health [67]. *Boswellia* is usually taken orally as a capsule, tablet, or decoction of its bark. The suggested dosage is based on current historical experience or studies. It is not currently known whether the appropriate dosage is for a balance between protection and effectiveness. The production of *Boswellia* products differs from one product to another and this makes standardization much more complicated. It is important to remember that most of the trials used different products manufactured by different suppliers, so clinical results could not be comparable [68,69]. In regard of the relatively low plasma and brain levels of BAs, and as a consequence of their inability to inhibit 5-LOX in whole blood, the abrogation of LTB₄ synthesis *in vivo* by frankincense extracts remains unclear. Several methods have been used to explore the potential pharmacological properties of various BAs to increase its bioavailability [70]. Some studies have endeavored to increase BAs' bioavailability using a regular meal. Furthermore, an improvement in their uptake was observed when it was administered with anionic drugs [71,72]. In addition, various approaches such as lecithin delivery process (Phytosome R); nanoparticle delivery mechanisms such as liposomes, emulsions, rigid lipid nanoparticles, nanostructured lipid carriers, micelles, and poly(lactic-co-glycolic acid) nanoparticles; and synthetic derivatization of BA have been modified to overcome this problem [73-75].

BRANDED FORMULATION CONTAINING BS

In addition to its use in religious ceremonies, olibanum has been used as an essential fixative in perfumes, soaps, creams, lotions, and detergents, with an oriental emphasis in its aroma, in leading perfume and cosmetics products [76]. A third market for olibanum was developed by the interests of pharmaceutical firms. Some of the branded formulations containing *B. serrata* available in the market are as follows [77]:

1. In 1991, Boswellin®, a Sabinsa Company registered trademark, was introduced to the US and European markets. This is available in pills or tablets, as well as in a cream of capsaicin that relieves calming discomfort. BA drugs range from 150 to 250 mgs/capsules or tablets and are taken orally 2–3 times a day. Shallaki®, contains 125 mg *B. serrata* in each capsule manufactured by Himalayan Drug Company, Makali, Bengaluru, as Licensed User of the Trade Mark owned by MMI Corporation, has excellent anti-inflammatory and analgesic properties, useful in relieving joint pains. Sixty capsule costs Rs. 75/- and the dose is 1 capsule twice daily (Batch No. F297001G). The website of the company is www.himalayahealthcare.com
2. Niltan® is a cream for external use in a 15 g container. It is a mixture of active herbal extracts (boswellin, arbutin, liquorice extract, and coriander seed oil in a cream base) developed by Dr. Reddy's Laboratories Limited, Hyderabad. It decreases the enzyme tyrosinase activity within the skin, thus reducing the development of melanin, leading to a decrease in the formation of dark skin
3. Rheumatic-X® includes, in addition to a variety of ingredients, 20 mg "Shallaki" made by Sunrise Herbals, Varanasi (U.P., India), intended for rheumatoid, gouty, osteoarthritis, and sciatic pain, two capsules twice daily or as instructed by the physician
4. Colox® is a herbal capsule that blocks COX-2 and 5-LOX reducing inflammation, joint pain, and stiffness; 901 mg natural extracts; 120 veg. capsules; zero side effects; which is suitable for Jains, vegans, and vegetarians the capsule is registered by the Vegan Society – UK
5. Frankincense® serrata an essential oil is steam obtained from a tree's gum resin by plant therapy essential oil. It has been used by native peoples as an incense, medicine, and in cosmetics for thousands of years. It is used for a blend which helps to promote clear respiration and is used in other aroma therapies.

CONCLUSION

BA has gained widespread exposure for its various health advantages which mainly tend to work through anti-inflammatory mechanism. They are also used as expectorant, antiseptic, and antineurotic drug. Alcohol extract from frankincense inhibit the growth of bacteria as well as fungi. *Boswellia* preparation like topical preparation inhibits 5-LO and prevents the formation of leukotrienes. There are various formulations which are used in the treatment of chronic disease like cancer. The net goal regarding the different constituents of BS is to understand the drug-drug interaction, molecular mechanism, and also strategies to improve their pharmacokinetic profile.

AUTHORS' CONTRIBUTIONS

All the authors have contributed to the literature review preparation, and editing of the manuscript.

CONFLICTS OF INTEREST

All authors have none to declare.

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