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A REVIEW ON:PHYTOCHEMICAL AND IN-VITRO STUDY OF BOSWELLIA SERRATA

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ABSTRACT: Boswellia serrata—from the Burseraceae family—is often called Indian frankincense and Salai guggul. The tree makes a resinous material—an "oleo-gum-resin"—which has been looked at a lot, as its make-up and power to destroy bacteria are well known. The oleo-gum-resin contains physiologically active pentacyclic triterpenoids, generally called "boswellic acids," as well as essential oils, phenolic substances, and flavonoids, all of which have different pharmacological effects. Because antimicrobial resistance is growing around the world, plants—including B. serrata—are being looked at as possible sources of natural antibacterial substances. Research into what the plant is made of has revealed that the four main, biologically active parts of B. serrata are alpha-boswellic acid, beta-boswellic acid, 11-keto-beta-boswellic acid, or KBA, and acetyl-11-keto-beta-boswellic acid, or AKBA. These substances as a whole have qualities that act on membranes and block enzymes, and so can change how microbes stay alive. Lab tests have shown that all these bioactive parts of B. serrata work against a number of disease-causing organisms, including Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Candida albicans. Further research into how it works has shown that B. serrata substances make microbes' membranes break down, stop the making of inflammatory substances like 5-lipoxygenase, and stop the growth of biofilms. This review covers the plant-chemical make-up of B. serrata and its antibacterial action and medical uses and explains how to make standard plant-based antimicrobial medicines from B. serrata.

INTRODUCTION: Scientists conduct research to find new medicinal treatments by studying medicinal plants because these plants contain chemical compounds that create multiple ways to interact with living organisms. The Burseraceae family includes Boswellia serrata, which produces a fragrant oleo-gum-resin that

Ayurvedic medicine practitioners use to treat both inflammatory conditions and infectious diseases [1]. Ancient texts explain how people used this substance to Wound healing and treat respiratory diseases and mouth infections because its antibacterial properties existed before scientists discovered modern methods for evaluating drugs. Scientists study the properties of B. serrata because drug-resistant pathogens continue to exist. Natural phytochemicals provide multiple target mechanisms that decrease resistance development whereas single-target synthetic antibiotics lead to resistance problems. The active compounds of Boswellic acids function as primary ingredients, which produce anti-inflammatory and antibacterial effects through their effects on enzyme and membrane activities. Current analytical techniques that use HPLC and GC-MS methods enable scientists to identify resin components while determining how chemical composition affects biological activity [1]. The research demonstrates that boswellic acids inhibit leukotriene synthesis because they prevent 5-lipoxygenase activity, while their antibacterial properties arise from their effects on bacterial membrane structures and metabolic processes [2-5].

DRUG PROFILE:

1.Taxonomical Classification

• Category Classification

➢ Kingdom Plantae

➢ Division Magnoliophyte

➢ Class Magnoliopsida

➢ Order Sapindales

➢ Family Burseraceae

➢ Genus Boswellia

➢ Species Boswellia serrata

2.Habitat: [2,3]

Indigenous to India Mostly found in:

The state of

➢ Madhya Pradesh

➢ Rajasthan

➢ Maharashtra

➢ Gujarat

➢ Andhra Pradesh

➢ Central and western India's arid hilly forests

3. Macroscopic Characters

❖ Tree • Medium-sized deciduous tree

• Height: 9–15 m

• Bark: thin, papery, peeling

❖ Bark[7,8,9]

• Ash-colored or greyish

• Peels in thin flakes

• Exudes resin on incision

❖ Leaves [10,11,12]

• Compound, imparipinnate

• Serrated margins

• Aromatic odor

❖ Flowers [13,14,15]

• Small, white to pinkish

• Arranged in racemes

• Aromatic in nature

❖ Fruit

• Trigonous drupe

• Three-valve

• It has fruity aroma

❖ Resin [16,17]

• Yellowish-brown tears or masses

• Aromatic odor

• Bitter, slightly pungent taste

• Resin ducts present

• Oleo resinous masses

• No organized cellular structure

• Presence of triterpenoid crystals

❖ Chemical Constituents Boswellic acid [1,3,6]

• β-Boswellic acid ($C_{30}H_{80}O_3$)

• Acetyl-β-boswellic acid ($C_{32}H_{50}O_4$)

• 11-keto-β-boswellic acid (KBA)($C_{30}H_{46}O_4$)

• Acetyl-11-keto-β-boswellic acid (AKBA)($C_{30}H_{40}O_2$)

• Essential oils (5–9%)

o α-pinene

o limonene

o myrcene

• Polysaccharides

- Galactose.
- Arabinose.
- xylose.

• Resin acids

• Gum component

❖ Pharmacological Actions [1,2,3,4,5]

• Anti-inflammatory

• Anti-arthritic

• Antimicrobial

• Antifungal

• Analgesic

• Anti-ulcer

• Immunomodulatory

• Antioxidant

• Anti-bacterial

4. Odor

• Pleasant aromatic

5. Parts used [2,6]

• Resin

• Leaves

• flowers

• bark

• fruits

A PROFILE OF PLANTS AND ETHNOMEDICINES: The Boswellia serrata tree, which grows to a medium height, sheds its leaves during wintertime and thrives in the dry and semi-arid regions of India, which include Rajasthan, Madhya Pradesh, and Maharashtra [2,4]. Oleo-gum-resin is produced by the plant by extracting its bark. Air is the substance's main active medicinal ingredient, and it solidifies upon contact. Ethnomedicinal records indicate significant use of resin formulations for the management of arthritis and dermatological infections and ulcers and inflammatory disorders. Traditional healers offered decoctions to treat respiratory ailments and applied powdered resin to wounds to eradicate bacteria. The methods show that people had a practical understanding of the properties that kill bacteria. The plant features tiny white flowers, papery bark that peels off, and imparipinnate leaves. The release of resin indicates the presence of antimicrobial terpenoids and phenolic compounds while acting as a barrier to protect against environmental stressors and microbial threats. The observed phytochemical diversity is caused by three factors: geographic location, harvesting time, and environmental conditions. These factors also affect the therapeutic value of medicinal plants. It is necessary to use reliable collection methods and botanical verification in order to ensure the reproducibility of both pharmacological and phytochemical analyses.

PHYTOCHEMICAL COMPONENTS: Pentacyclic triterpene acids, the building blocks of boswellic acids, are among the many terpenoid compounds found in Boswellia serrata resin, according to a phytochemical analysis. KBA and AKBA, as well as α- and β-boswellic acids, make up the majority of the substance [1,2,4,6]. Among all active compounds, AKBA exhibits the strongest pharmacological effects. The compounds possess hydrophobic characteristics that enable them to bond with the lipid membranes that make up microscopic organisms. The process of membrane insertion produces two effects, which include membrane permeability increase and internal cellular material leakage and ion balance disturbance. The resin contains phenolic compounds together with flavonoids. which provide protection against oxidative damage. The antibacterial action becomes more powerful because of these effects, which create oxidative damage to bacteria.[12,16,17] The researchers employ HPLC and GC-MS chromatographic techniques for sample extraction analysis because these techniques enable precise extraction measurement and chemical fingerprinting analysis. The research about structure–activity Relationships show that keto and acetyl functional groups drive biological activity because they increase molecular binding to enzyme sites. The extraction methods and phytochemical yield environmental conditions together with solvent polarity. [5,6]The research found that multiple studies showed different antibacterial effectiveness results because methanolic and ethanolic extracts contain higher boswellic acid content than aqueous preparations. Studies have shown that extracts from Boswellia serrata exhibit antibacterial activity. Boswellia serrata may destroy bacteria that are favorable for your health. Staphylococcus aureus is strongly affected. The peptidoglycan structure breaks down, which interrupts critical metabolic activities. Escherichia coli and Pseudomonas aeruginosa are two types of Gram-negative bacteria that are very sensitive because their outer lipopolysaccharide barrier prevents compounds that don't like water from getting out. Boswellic acids make membranes less flexible, which stops cells from leaking. Resin extracts hinder bacteria from finding their own quorum and forming biofilms.[2,5,6] Taking away biofilm makes bacteria more likely to respond to treatments and helps long-term diseases endure less time. Studies using electron microscopy demonstrate that treatment alters the morphology of cell walls and the arrangement of cytoplasm. These findings support the notion that B. serrata resin may be used for wound healing and infection prevention.[1,2,17.,18]

ANTIFUNGAL ACTIVITY: Studies show that Boswellia serrata extracts kill Candida albicans and other fungi in a lab setting. Boronic acids inhibit the synthesis of ergosterol, which is very important for the membranes of fungal cells. This makes the cells less stable and makes them develop more slowly. Fungal

adhesion and biofilm development affect chronic infections, and extracts may stop this effect in a dose-dependent way. After treatment, the morphology demonstrates that the hyphal development has slowed down and the cells' structure has changed.[3,6] This signifies that the fungus is no longer growing. Boswellic acids and azole antifungals operate together, which might change how effectively the medication works. Therapy is better for fungal infections of the skin, mucous membranes, and the entire body since it fights microorganisms and the consequences of inflammation [2,4,6].

ACTIVITY AGAINST MICROBES: Researchers are looking at Boswellia serrata, often known as Indian frankincense or Salai guggul, to see whether it may destroy a lot of different germs and viruses [3,4]. Boswellic acids, they are pentacyclic triterpenoids that operate in the body, are found in oleo-gum-resin. Franciscense is used to treat infections and inflammation because it keeps bad bacteria from multiplying [4]. Research shows that B. serrata extracts destroy bacteria that are both Gram-positive and Gram-negative. The resin extract inhibits infections that are bad for health, such as Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, and Listeria. monocytogenes as a natural way to kill bacteria Studies show that Gram-positive bacteria are more susceptible to Boswellia extracts because of how their cell walls are made and how easily they allow things in. Boswellic acids, such as 3-O-acetyl-11-keto-β-boswellic acid (AKBA), alter the integrity and metabolic activity of microbial cell membranes, resulting in growth suppression[1,3]. Studies on the phytochemical makeup and biological activity reveal that boswellic acids work better against bacteria. B. serrata resin essential oils are antibacterial against skin, mouth, and wound infections, supporting their dermatological and oral healthcare applications[4]. B. serrata inhibits bacteria colonization and resistance as an antibacterial and antibiofilm. It may combat antimicrobial resistance and develop plant-based drugs. Strong evidence suggests Boswellia serrata may contain antibacterial compounds with pharmacological and therapeutic utility.[5,18]

USES IN PHARMACY: - The antibacterial and anti-inflammatory properties of Boswellia serrata makes it a valuable ingredient for current phytopharmaceutical products. The researchers study standardized extracts that contain high AKBA content for developing antimicrobial products that include healing gels, periodontal treatments, and skin care products[3]. The presence of antibiofilm activity shows potential for treating infections that occur with medical devices and for managing chronic wounds. The medical benefits of boswellic acids apply to inflammatory skin conditions, which include acne, gingivitis, and dermatitis, because these acids can change inflammatory mediator levels while providing antibacterial effects. A new study is also looking at nano-encapsulation and tailored delivery methods to make boswellic acids more bioavailable.[16,18]The reason for this exists because they have poor solubility in water. The new developments

show strong potential for implementing B. serrata as a part of scientifically supported antimicrobial treatment methods. [6,5,4,18]

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