



Review Article

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THERAPEUTIC POTENTIAL OF *ONOSMA BRACTEATUM* WALL SOURCE PLANT OF GOJIHVA: A REVIEW

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ABSTRACT

The focus of this review is to comprehensively examine available information on *Onosma bracteatum* Wall, acknowledged as the species linked to Gojihva in Ayurvedic literature. The objective is to elucidate its botanical, chemical, and therapeutic characteristics, and to propose future considerations. Gojihva is a renowned medicinal herb utilized to treat various ailments in Ayurveda and other traditional systems of medicine. While the accurate identification of the Gojihva plant remains uncertain, *Onosma bracteatum* Wall is widely regarded as Gojihva in many regions due to its similar morphology and therapeutic indications. The methodology adopted for the study includes a review of literature starting from ancient Indian classics of Ayurveda to updated research articles published in journals. This detailed review meticulously examines the *Onosma bracteatum* Wall encompassing its geographical distribution, morphological attributes, chemical constituents, and therapeutic utilities. The present study not only explores the diverse aspects of the *Onosma bracteatum* Wall but also sets the stage for future research, enhancing the knowledge of its potential in medicine.

Keywords: Ayurveda, phytochemistry, medicinal plants, therapeutic applications, ethnomedicine.

INTRODUCTION

Gojihva commonly known as Gaujaban in Hindi, is a widely used plant in Ayurveda to treat fever, bronchitis, jaundice, epilepsy, kidney disease and cardiac muscle weakness.¹Gojihva has not been mentioned in the Vedas but is described in Charak Samhita, Sushruta Samhita, Ashtang Sangraha and Ashtang Hridaya in Shaak Varga. Lexicons have included Gojihva under various groups like Karviradi varga², Abhayadi varga³, Oushadi varga⁴, Guduchyadi varga⁵, Shatahvadi varga⁶ and Sharadi varga⁷. The exact identity is still unclear. Six botanical sources of Gojihva are considered among which *Onosma bracteatum* Wall and *Elephantopus scaber* Linn. are most accepted. In this review, we have considered the *Onosma bracteatum* Wall as Gojihva. Five articles related to *Onosma bracteatum* Wall were found in PubMed. It included pre-clinical trials, but no clinical trials were found. Until now, no research study has incorporated Ayurvedic principles like tridosha sidhanta, prakruti pariksha, agni, etc. Integrating these principles could offer a broader understanding of its effects on various body types, its long-term implications and mainstream usage as well. The annual demand for *Onosma bracteatum* Wall is 100-200 MT according to the National Medicinal Plants Board, Ministry of Ayush, Govt. of India. High demand and scarce sources emphasize the necessity for a conservation, cultivation, and harvest protocol which requires proper identification. Hence, a precise knowledge of *Onosma bracteatum* Wall is needed. This review aims to provide Ayurvedic references, botanical description, current research landscape and scope for further research.

The methodology encompassed a review of classical Ayurvedic texts, including the Brihatrayi (Charaka Samhita, Sushruta Samhita and Ashtanga Hridaya collective term), Laghutrayi (Bhavprakash, Madhavnidana and Sharangdhar Samhita collective term), Kashyap Samhita, and lexicons such as Raja Nighantu, Priya Nighantu, Kaiyadev Nighantu, Bhavprakash Nighantu, Abhidan Ratna Mala and reference books like the Ayurvedic Pharmacopeia of India, Wealth of India and Indian Medicinal Plants. The synonyms, rasa (taste), guna (attribute), virya (potency), vipaka (bio-transformed rasa), properties and indications were searched.

We searched multiple sources, including articles, pre-clinical trials, systematic reviews, and observational studies related to *Onosma bracteatum*. We used databases such as PubMed, Web of Science, and reputable journals. The key terms we used for the search were *Onosma bracteatum*, Gojihva, and Gaozaban. The author applied filters like full text, publication date, pre-clinical trials, clinical trials, and randomised control trials to refine the search.

The equivalent/standard English terminologies were used for Sanskrit terms from the Namaste portal. This comprehensive approach will ensure the gathering of information from both traditional Ayurvedic sources and contemporary scientific literature, providing a well-rounded understanding of *Onosma bracteatum* Wall and its potential applications.

Gojihva in Ayurvedic Texts

Gojihva, also called as Darvpatra, Kharapatra in Sanskrit, has madhura (sweet), tikta (bitter), kashaya rasa (astringent), laghu guna, sheeta virya (cold potency) and madhura vipaka (sweet bio-transformed rasa). It has grahi (absorptive), hridya (beneficial for heart/ palatable and pleasing to mind), Kaphahara (Kapha pacifying), Pittahara (Pitta pacifying) and Vatala (Vata aggravating) properties.² It is used in diseases like Vata-pittaja visarpa¹⁰, Raktapitta, kushtha, prameha, jwara, nadi, stanroga¹¹, jwara (as an ingredient of Kulathadi Sarpi)¹², nakh-dant visha in the form of lepa¹³ and Sannipataja jwara¹⁴.

Some vernacular names of Gojihva are as follows:

Language	Name
Hindi	Ratanjot Joshi, Gaujaban, Gojiya ⁸
Odia	Kharsan, Kharapatra ⁸
Kannada	Shankha Huli, Aakalanalige, Gojaba ⁸
Punjabi	Kazban ⁸
Urdu	Gaozaban ⁸
English	Vipers Bugloss
Middle east countries	Gaozaban
Arabic	Lisan-al-Thawr” or “Saql ul-Hammam

Onosma bracteatum Wall

The genus *Onosma* belongs to the family Boraginaceae, and it contains over 230 species, out of which only 12 have been reported in traditional medicines till now.¹⁵ The name *Onosma* for this genus was introduced into modern botanical nomenclature by Linnaeus, which is derived from the Latin word “osma” originated from a Greek word, “osma” which means smell.¹⁶ *Onosma bracteatum* Wall is a perennial shrub found over 3500-4500 m altitude in India and Iran. The plants of this genus are abundantly distributed in Turkey, China, Iran, Pakistan, Syria, Nepal, India and Sri Lanka besides these, Switzerland, Romania, and Anatolia⁸. In India, it is found in India’s Kali Valley, Eastern Kumaun (Uttarakhand), the region of Kashmir and Himachal Pradesh.

Taxonomical Classification

Kingdom- Plantae
Phylum- Tracheophyta
Class- Angiosperms
Order- Boraginales
Family- Boraginaceae
Sub-family- Boraginoidae
Genus- *Onosma* L.¹⁵

Morphology

The plant is a tall, perennial herbaceous shrub, reaching a height of about 40-50cm. Its stem, arising from a cluster of basal leaves, is hairy and simple, springing from a black, woody rootstock, approximately 2.5-5 cm in diameter. Several erect or ascending stems emerge from a knotty head at the rootstock.⁸

The **stem** is 30-50 cm tall, 4-6 mm diameter¹⁷, greenish-yellow, simple, and hairy with longitudinal wrinkles and fractures shortly with no distinct odour or taste.

The **leaves** are thick and have prominent veins. Radical leaves are lanceolate, 12-30 cm×1.5-3.5 cm, with entire margins and petioles¹⁷ and cauline leaves are ovate-lanceolate¹⁸. Both leaf surfaces are covered in tubercle-based, hispid hairs, appearing greenish to light yellow above and white beneath.²

The **flowers** are 5-7.5cm diameter¹⁸, deep blue, later turning purplish, trumpet-shaped, and densely covered with stiff white bristles. The **nutlets** are grey, ovoid, rough, coarsely rugose, tuberculate¹⁷ and of 4mm dimension.¹⁸

The calyx lobes in the **fruit** measure 2.5 cm and appear linear and silky. The corolla tube spans 1.3 cm in length and measures 4 mm in diameter at the mouth. It is externally covered in fine hairs and features a circle of hairs at its base internally. The anthers are situated inside the corolla tube, while the filaments are linear in shape.¹⁸

Flowering and fruiting time is August to October.

Microscopic characters

Stem: The stem exhibits a single-layered epidermis coated with a thick cuticle. Some epidermal cells elongate, forming lengthy, warty, tubercle-based unicellular hairs. The cortex differentiates into two zones: an outer 5-7 layered collenchyma and an inner 3-4 layered parenchyma, composed of thin-walled, round to oval cells. The phloem contains typical elements, lacking phloem fibers. The xylem comprises typical elements like vessels, often solitary or in small groups of 2-3, with spiral thickenings. Fibers and tracheids in the xylem have blunt tips and simple pits, and the xylem ray is indistinct. The pith consists of round, thin-walled, parenchymatous cells.

Leaf Midrib: The leaf midrib displays a single-layered epidermis with a thick cuticle and long warty, tubercle-based unicellular hairs on both surfaces. It is followed by 5-7 layers of collenchymatous cells and 3-4 layers of parenchymatous cortical cells, with the vascular bundle centrally positioned.

Lamina is isobilateral, with a single-layered epidermis on both surfaces covered by a thick cuticle and long warty, tubercle-based unicellular hairs. It comprises a two-layered palisade and an 8-10 layered spongy parenchyma, with paracytic stomata.

Powder: The powder appears greenish brown, displaying clusters of ovals to polygonal, thin-walled straight epidermal cells. It contains spiral vessels, a few entire or fragmented fibers with elongated blunt tips, long warty, tubercle-based unicellular hairs, and a small number of paracytic stomata.⁹

Phytochemical Composition

Onosma bracteatum Wall contains tannins, sugars,⁸ triterpenoids, phenolic compounds, saponins, flavonoids, mucilage¹⁹, vanillic acid, rosmarinic acid, protocatechuic acid, caffeic acid, 4-hydroxybenzoic acid, p-Hydroxybenzoic acid, pulmonarioside C, 4-O-(E)-p-coumaroyl-l-threonic acid, coumarin, umbelliferone¹, allomicrophyllone, benzoquinones, ehretiquinone²⁰, 9'-methoxyl salvanolic acid R(sun), catechin, epicatechin, rutin, onosmin A, kaempferol²¹.

Ethno-Medicinal Uses

In traditional medicine, *Onosma bracteatum* Wall is used in wound healing, stomatitis, bronchitis, asthma, respiratory diseases, lower back pain, relieving thirst, palpitations, gonorrhoea, dysuria epilepsy, rheumatoid arthritis, leprosy, heart diseases, kidney disorders, mental disorders, and as a tonic, alterative, demulcent, diuretic and spasmolytic^{1 18 22}

Current Research Landscape

Pharmacological investigations have highlighted the diverse therapeutic potential of *Onosma* species, including antioxidant, enzyme inhibitory, anti-tumour, hepatoprotective, antiviral, anti-inflammatory, and antimicrobial actions.¹⁵

Antioxidant activity

Pre-clinical studies have revealed the ethanol extract of aerial parts of *Onosma bracteatum* Wall to exhibit significant radical quenching activity in superoxide radical scavenging and lipid peroxidation assays.²¹ Ekta *et al* concluded that the ethanolic extract of *Onosma bracteatum* Wall at different concentrations using the DPPH assay method was found to be equal to the standard quercetin and ascorbic acid.²³

Analgesic activity

Imram *et al* 2018 concluded that the hydro-methanolic extract of *Onosma bracteatum* Wall possesses potent analgesic effects by inducing a significant increase in latency period in dose dose-dependent manner at all doses at 1, 2 and 3 hours post feeding respectively. The maximum effect was observed at a dose of 500mg/kg i.e. 258.9% ($p < 0.05$) at 3hrs post feeding. Diclofenac sodium (5mg/kg body weight) ran as standard and also increased the latency period continuously and the highest activity was noted at 3hr i.e. 284.5% ($p < 0.05$). Acetic acid-induced writhing test also similarly showed significant activity by *Onosma bracteatum* Wall i.e 54% ($p < 0.05$) at 500mg/kg while the standard drug Diclofenac sodium (5mg/kg body weight) showed 45.9% ($p < 0.05$) activity.²⁴

Anti-microbial activity

Yasmin *et al* concluded that *Onosma bracteatum* Wall leaf extract has moderate antibacterial activity in all four fractions (n-hexane, ethyl acetate, methanol and aqueous fractions) against the tested bacteria in comparison to the positive control. *Staphylococcus aureus* and *Pseudomonas aeruginosa* were more susceptible than *Escherichia coli*. The methanol, n-hexane, and ethyl acetate fractions demonstrated effectiveness against fungal components, whereas the aqueous fraction exhibited no antifungal activity against *Candida albicans*.²⁵ Gautam *et al* have concluded that *Onosma bracteatum* Wall is a potent antibacterial agent against respiratory tract pathogens like *Streptococcus pneumoniae*, *Haemophilus influenzae*, *P. aeruginosa*, *Staphylococcus aureus*, and *S. pyogenes*. The study was conducted by taking erythromycin as a reference drug. The activity was maximum by methanolic extract (more than petroleum ether, acetone and aqueous extract) against *S. pneumoniae* but was less active than the reference drug.²⁶

Action on SARS-CoV-2

Vegad *et al* underwent a computational and virtual screening of 11 phytochemicals including allomicrophyllone, ethretuquinones, three benzoquinones ehretiquinones B-D, Hernacorzine two naphthoquinones derivatives, Pulmonarioside C, 9'-methoxyl salvianolic acid R, and (-)-4-O-(E)- p-coumaroyl-l-threonic acid methyl ester against three main viral targets: spike, RdRp and M^{pro}. ADMET analysis and MD simulations were done and was revealed that they showed better binding affinity toward the targets than existing antiviral compounds in use.²⁷

Action on bronchial hypersensitivity

Kalpna *et al* underwent a research study to evaluate the bronchial hyper-reactivity of *Onosma bracteatum* Wall in sensitized guinea pigs. The study investigated various experimental models, including analyzing total and differential cell counts in bronchoalveolar lavage fluid (BALF), assessing histamine release from the lungs, conducting *in vitro* studies on tracheal strips, and examining histopathological changes in egg albumin-sensitized guinea pigs. When administered orally at a dose of 5mg/kg for 15 consecutive days, the ethanol extract exhibited a significant reduction in both total and differential leukocyte counts in BALF. Additionally, it effectively inhibited the release of histamine from chopped lung tissues.²⁸

Hepatoprotective and anti-mutagenic activity

Ethanol extract of *Onosma bracteatum* Wall showed significant protection against superoxide radicals and lipid peroxidation, mutagenic effects induced by 2 aminofluorine (2AF) in *Salmonella typhimurium*, CCl₄ induced liver damage. Also, a down regulation of proteins p53 and cyclin D in liver cells was found in immune-histochemical studies in male Wistar rats proving its hepatoprotective and anti-mutagenic potential.²¹

Anti-diarrhoeal activity

Chaudhary 2018 conducted a study on mice using castor oil and magnesium sulphate to induce diarrhoea and at the doses of 250mg/kg bd.wt. and 500mg/kg bd.wt, the ethanolic extract of *Onosma bracteatum* Wall showed significant anti-diarrhoeal activity.²⁹

Anti-depressant activity

Asif *et al* conducted a study that aimed to assess the effects of *Onosma bracteatum* Wall on anxiety and depression in Swiss albino mice. Administering various doses of the plant extract showed dose-dependent anxiolytic and antidepressant effects in tests like open field, elevated plus maze, force swimming, and tail suspension. Particularly at 200 mg/kg, *Onosma bracteatum* Wall exhibited significant potential similar to standard medications like diazepam and fluoxetine, suggesting its promise as a natural treatment for mental disorders.³⁰

Anti-cancerous activity

Albaqami *et al* concluded that the methanol extract of *Onosma bracteatum* Wall leaves had a cytotoxic effect on the A549 lung cancer cell line, BT549 breast cancer cell line and PC3 prostate cancer cell line and in the concentration of 1.76 microgram/ml, it reduced the lipid peroxides (MDA), in the above cell lines.³¹ Ethyl acetate fraction isolated from *Onosma bracteatum* Wall showed free radical quenching ability and strong cytotoxicity towards human osteosarcoma MG63, human neuroblastoma IMR-32, and human lung cancer A549 cells due to the presence of catechin, kaempferol, onosmin A and epicatechin.³²

DISCUSSION

Across ancient eras and professional spheres, Gojihva or *Onosma bracteatum* Wall has held a dual role, being utilized both as a culinary component and in traditional medicinal practices. Having madhura, tikta, kashaya rasa, sheeta virya, madhura vipaka, Kapha Pitta shamak properties (API), *Onosma bracteatum* Wall have been in use for respiratory diseases, rheumatoid arthritis, leprosy, heart diseases, kidney disorders, mental disorders etc.^{1,18,21}

Modern researchers have established that *Onosma bracteatum* Wall is a potent antioxidant, analgesic, anti-microbial, anti-corona virus, anti-tussive, hepatoprotective, anti-diarrhoeal, anti-depressant and anti-cancerous drug.

The analgesic activity of *Onosma bracteatum* Wall is possibly due to the presence of alkaloids, tannins, flavonoids, coumarin, and sterols, as it inhibits the synthesis of prostaglandins, hence hindering the pain pathway.²⁴ The anti-microbial activity of *Onosma bracteatum* Wall is due to the presence of alkaloids, flavonoids, glycosides, terpenes, saponins, and tannins.²⁶ The glycosides found in *Onosma bracteatum* Wall are suggested to exhibit potential anti-asthmatic effects. This action involves reducing the infiltration of inflammatory mediators such as eosinophils and neutrophils in BALF (Broncho-alveolar Lavage Fluid), inhibiting histamine release from the lungs of sensitized guinea pigs, and mitigating airway inflammation.²⁸ The combined properties of compounds within *Onosma bracteatum* Wall, including catechin, epicatechin, rutin, kaempferol, and Onosmin A, collectively demonstrate potent hepatoprotective effects. These substances exhibit antioxidant abilities, scavenging harmful reactive oxygen species (ROS) and stabilizing them. Catechin and rutin regulate inflammatory pathways and gene expressions linked to inflammation, apoptosis, and oxidative stress, while epicatechin and kaempferol possess anti-inflammatory properties by modulating pathways that suppress liver inflammation. Additionally, Onosmin A's inhibition of the

lipogenase enzyme contributes to protecting liver tissues from potential damage. These combined actions underscore the comprehensive hepatoprotective potential of *Onosma bracteatum* Wall.²¹ Anti-diarrhoeal activity is due to flavonoids present which inhibit autacoid and prostaglandin release, potentially curbing castor oil-induced motility and secretion. Furthermore, the extract's ability to alter proteins into protein tannates could contribute to its antidiarrheal activity by fortifying the intestinal mucosa, thereby decreasing secretion.²⁹ The potential mechanism of the anti-depressant effect may be due to its inhibitory action on monoamine oxidase A.³⁰⁻³² Anti-cancerous activity of *Onosma bracteatum* Wall has been found but the exact mechanism is still unknown. More studies are needed to unveil its further potential.

CONCLUSION

The exploration of Gojihva or *Onosma bracteatum* Wall showcases its intricate geographical presence, botanical characteristics, chemical constituents, and therapeutic potential. The plant is rich in various phytochemicals which are responsible for its therapeutic potential. Only pre-clinical trials are available as of now, but human trials are necessary for its mainstream usage. However, challenges persist in standardizing its use due to a lack of proper protocols for conservation, cultivation, harvesting techniques, processing as well as clinical usage. Research based on Ayurvedic principles is not available. Therefore, this comprehensive analysis offers a robust groundwork for further pharmacological and clinical research based on Ayurvedic principles, emphasizing the potential of *Onosma bracteatum* Wall as Gojihva.

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