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An Integrative Overview of *Barg-e-Gaozaban* (*Borago officinalis* Linn): Insights into its Medicinal Potential

Abstract

Borago officinalis L. (*Gaozaban*), a widely used medicinal herb in traditional healing systems, has long been recognised for its cardiotonic, mood-enhancing, demulcent, and anti-inflammatory properties. This review integrates information from authoritative classical sources of traditional medicine with contemporary scientific research gathered from standard academic databases. Traditionally, the plant has been used to manage disorders associated with melancholic imbalances, including low mood, palpitations, respiratory congestion, inflammatory conditions, and various psychological disturbances. Its phytochemical composition includes flavonoids, phenolic compounds, essential fatty acids, mucilage, volatile oils, and minerals, with recent analytical studies reporting additional novel metabolites. Experimental studies demonstrate antimicrobial, antioxidant, anti-inflammatory, hypoglycaemic, anxiolytic, and neuroprotective activities, while clinical findings highlight benefits in conditions such as cyclical mastalgia and respiratory disorders. However, the clinical evidence remains limited in scope and quality; most studies are preclinical, and human trials are few, small, and often lack rigorous controls. Notably, despite traditional use in *Amrād-i-Saudāvi* (melancholic disorders), no clinical trial has evaluated *B. officinalis* for depression, anxiety, or related psychiatric conditions. Recent evidence indicates that its bioactive constituents may support metabolic resilience and stress modulation, underscoring its relevance in both traditional and modern therapeutic contexts. The combined traditional and modern evidence underscores its potential therapeutic value, though further research is essential to standardise its use and confirm its safety. Therefore, this review concludes that while *B. officinalis* shows promise, current evidence does not support definitive clinical recommendations, especially for *Amrād-i-Saudāvi*.

Keywords: Anti-inflammatory; *Borago officinalis*; ethnomedicine; *Gaozaban*; phytochemistry; Unani medicine.

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INTRODUCTION

Borago officinalis L., known as Borage, is a member of the *Boraginaceae* family and referred to as *Lisan al-Saur* or *Qolmus* in Unani medicine. It is also called burrage, bourrache, bugloss, starflower (Baitar, 2000; Michalak et al., 2023; Nyeem et al., 2017; Pieszak et al., 2012; Shirke et al., 2024), talewort (Kabīruddīn M., 2007), beebread, and the bee plant. Recognised for its mood-enhancing properties since the 1st century A.D (Gilani et al., 2007). Dioscorides first documented it, and Arab scholars later adopted it (Khan et al., 2018). Borage is used in pharmaceuticals, industry, and as forage, with its leaves having a cucumber-like flavour and flowers used in drinks and confections. It is valued for supporting treatments for respiratory, urinary, skin, cardiovascular, and inflammatory conditions (Michalak et al., 2023). In the Unani system of medicine, *Borago officinalis*, commonly known as *Gaozaban*, is attributed with ethnomedicinal actions such as *Mufarriḥ wa Muqawwī-i-Qalb*, *Muqawwī-i-Aʿḍā' Raʾīsa wa-Ḥawās*, *Mulayyina-Ṭabīʿat* and *Muqawwī Ḥarārat Gharīz*. It is traditionally used in conditions linked to excess black bile (*Amrāḍ Sawdāwī*), such as melancholia (*Mālankhūliyā*), palpitations (*Khafaqān Sawdāwī*), meningitis (*Sarsām*), respiratory inflammation (*Barsām*), as well as psychological conditions like depression, fear, obsession, and breathlessness (Kabīruddīn, 2007). Phytochemical analysis of the plant's leaf extract has shown the presence of carbohydrates, phenols, flavonoids, phytosteroids, tannins, and volatile oils. Mucilage and gum content were quantified at 3.8% in leaves and stems, and 5.4% in inflorescences. Additionally, potassium and calcium levels were found to be 5.3% and 6.2%, respectively (Shirke et al., 2024). It is also rich in isoflavones and demonstrates therapeutic effects, including anti-inflammatory, antinociceptive, memory-enhancing, antioxidant, antidepressant, and hepatoprotective properties (Ibrahim & Alshammaa, 2023a; Michalak et al., 2023) **(Figure 1).**

Research gap and problem statement: Despite the widespread traditional use of *B. officinalis* and a growing body of pharmacological research, a critical gap exists in the literature. Most available reviews describe phytochemical constituents and traditional uses in a descriptive manner without critically appraising the strength of clinical evidence, particularly for *Amrād-i-Saudāvi* (melancholic disorders). No prior review has systematically evaluated the methodological quality of clinical studies on *B. officinalis* or explicitly identified the absence of human trials for its claimed mood-enhancing effects. Furthermore, the link

between traditional indications (e.g., melancholia, fear, obsession) and modern experimental models (e.g., anxiolytic, antidepressant) has not been critically examined.

Objectives:

Therefore, the specific objectives of this review are: (1) to systematically compile and describe the traditional uses, phytochemistry, and pharmacological evidence for *B. officinalis* as documented in classical Unani texts and modern scientific literature; (2) to critically appraise the available clinical evidence, with special attention to studies relevant to *Amrād-i-Saudāvi* (melancholic disorders); and (3) to identify evidence gaps and provide recommendations for future research, including the need for standardized clinical trials.

Main contribution:

This manuscript provides a comprehensive integration of classical knowledge from traditional medicine with contemporary scientific research on *Borago officinalis*. It summarises the plant's diverse phytochemical profile, including flavonoids, phenolic compounds, essential fatty acids, mucilage, volatile oils, and minerals, along with newly identified metabolites. The review highlights a wide range of pharmacological activities such as antimicrobial, antioxidant, anti-inflammatory, hypoglycemic, anxiolytic, neuroprotective, and mild cytotoxic effects. Clinical evidence demonstrating benefits in conditions like cyclical mastalgia, respiratory disorders, and enhanced gamma-linolenic acid levels during lactation is also discussed. By bridging traditional holistic practices with modern therapeutic applications, the manuscript underscores the potential of *B. officinalis* while emphasising the need for standardised usage and comprehensive safety guidelines.

METHODOLOGY

This manuscript presents as a narrative review to critically summarize and integrate traditional and conventional evidence regarding the therapeutic applications of *Gaozaban* (*Borago officinalis* L.) in Unani medicine with particular emphasis on its relevance in *Amrād-i-Saudāvi* and associated clinical conditions.

A comphrensive literature search involved a systematic analysis of classical Unani texts and authoritative traditional sources, particularly those describing the therapeutic actions, temperament and indications of *Borago officinalis* L in various diseases. A thorough survey of contemporary scientific literature obtained from databases such as PubMed, Scopus, Google Scholar, and ResearchGate.

The keywords used for search included “*Borago officinalis* L”, “*Gaozaban*”, "borage" OR "starflower" “traditional medicine” “melancholic disorders and *B. officinalis*” “*Amrād-i-Saudāvi*”, “Depression”, “Anxiety”, “*B. officinalis* and Pharmacological activities”, *B. officinalis* and phytochemical constituents”. Article available in English and relevant traditional literature (Urdu or Persian) available up to November 2025 were considered. Studies were included based on relevance to objectives, including publications addressing traditional uses, phytochemical constituents, pharmacological and clinical applications of *B. officinalis.*

Articles lacking sufficient methodological information, non-relevant, duplicates, and sources unrelated to therapeutic or pharmacological profile of the plant were excluded. For clinical trials, the following parameters were assessed: sample size, randomization, blinding (single/double/triple), presence of a control group (placebo or active comparator), and duration of follow-up. For preclinical studies, we noted the model used (in vitro vs. in vivo), dose ranges, and whether positive controls were included. No formal scoring system was applied due to the narrative nature of the review, but limitations are discussed in the critical analysis.

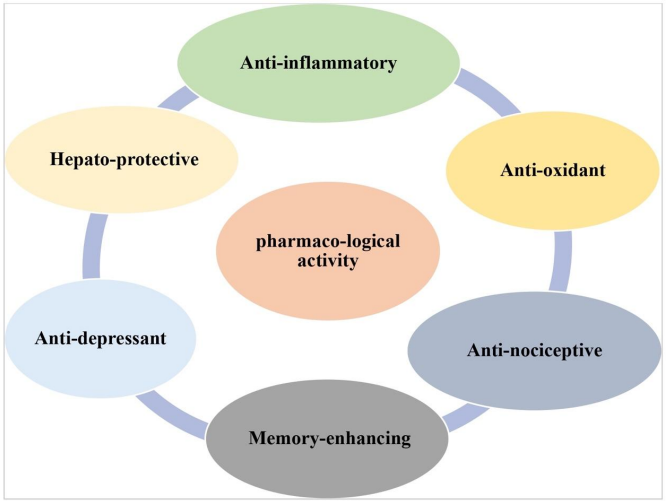

Figure 1. Pharmacological activities of *B. officinalis*

RESULTS AND DISCUSSION

Taxonomic classification of *B. officinalis*

Taxonomic classification is the scientific system of identifying, naming, and categorising organisms based on shared characteristics and evolutionary relationships, providing a structured framework to understand biodiversity and enabling clear communication among scientists worldwide. *B. officinalis*, commonly known as borage or “starflower,” is an annual herb of the family Boraginaceae. Its classification not only clarifies its botanical characteristics and phylogenetic relationships but also supports studies on its medicinal, nutritional, and ecological significance. Accurate identification of *B. officinalis* is therefore crucial for research in pharmacology, agriculture, and conservation (Ibrahim & Alshammaa, 2023b) **(Table 1).**

Table 1. Taxonomic classification of *B. Officinalis*

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Lamiales
Family	Boraginaceae
Genus	*Borago* L.
Species	*Borago officinalis* L.

Vernacular names:

Arabic: *Lisan us suar* (Ramezani et al., 2020); *Lisan al-thaur* (Kabīruddīn M, 2007; Khān MA, 2018; Rafeequddin M, 1985; Usmani MI, 2008); **Gujarati**: *Gaozaban* (Anonymus, 1987); **Urdu**: *Gauzaban*; **Hindi**: *Gaojiva*, *Gojihva*; katmanda (Anonymus, 1987; Khān MA, 2018); **English**: *Borage, Cow’s Tongue plant* (Baitar I, 2000; C. P. Khare, 2007); **Unani**: *Gaozabaan, Foghulus and Bughalas,Qolmus* (Baitar I, 2000); **Tamil**: *Kharaptra, Dharvipatara, Kozha;* **Latin**: *Bakalorom* (Khān MA, 2018); **Kannada**: *Aaklanalige, Gojaba*; **Bengali:** *Gaozaban;* **Kashmiri:** *Kazabun* (Kabīruddīn M., 2007)

Unani description of the plant

Mahiyat (Morphology)

Gaozaban in Unani medicine flourishes during the winter in regions such as Gilaan and Khurasan in Iran, where it is considered the most potent variety for medicinal use. In India, it is found in Azeemabad and various Himalayan regions at elevations around 8,000 feet, including Kashmir, Nainital, and Darjeeling. It is also cultivated as an ornamental plant in gardens (Khān MA, 2018). Ibn Sīnā regarded the varieties from Gilan and Khurasan as the original and most authentic forms of *Gaozaban*. He described the fresh leaves as thick, hairy, and pale greenish-yellow with a cucumber-like aroma. Over time, older leaves tend to darken, turning blackish and losing their fragrance. True *Gaozaban* leaves should retain their thickness and not become thin or shrivelled upon drying. The entire plant is covered with hairs and has a rough, bare texture (Baitar I, 2000; Rafeequddin M, 1985) **(Figure 2).**

Figure 2. a) Fresh leaves of *Gaozaban*; b) Dry leaves of *Gaozaban*

Miqdār (Dosage), *Muzir* (Adverse Effects), *Muṣliḥ* (Correctives), *Badal* (Substitutes), and *Mizāj* (Temperament) of *Gaozaban*:

In Unani medicine, the dosage of *Gaozaban* leaves ranges between 7 to 17.5 g (Khān MA, 2018) , 6 to 9 *Masha* (MA, 2002) , 5 to 7 g (Kabīruddīn M., 2007; Rafeequddin M, 1985) and similarly 5 to 7 *Masha* (Kabīruddīn M., 2007; Kabīruddīn M, 2007) and 7 to 17 g (Anonymus, 2007). However, it is noted that large doses of *Gaozaban* can be toxic, particularly affecting the spleen (Kabīruddīn M., 2007; Khān MA, 2018) causing Amraze Tihal (MA, 2002) and irritating the stomach (Ghanī N, 2001). To mitigate these adverse effects, certain correctives such as *Sandal Safed* (*Santalum album* Linn.), *Murrabba Hadh* (*Terminalia chebula* Retz.), and *Sumaq/Sumach* (*Rhus coriaria*) are traditionally employed. When *Gaozaban* cannot be used, substitutes include *Post Utraj* (*Citrus medica* Linn.)(Kabīruddīn M., 2007), *Abresham* (MA, 2002; Tarique NA, 2010).

The temperament of *Gaozaban* is classified as *Ḥārr* (hot) and *Raṭb* (moist) of the first degree, as described by Ibn Sīnā in *Advia Qalbiya* as Ḥārr *Raṭb* "Darja Awwal, indicating its warming and moist nature in the Unani system of medicine(Anonymus, 1987, 2007; Baitar I, 2000; Kabīruddīn M., 2007; Kabīruddīn M, 2007; Rafeequddin M, 1985).

Ethnomedicinal uses of *Barg-e-Gaozaban:*

Muqawwī-i-Aʻḍā' Raʾīsa, Mufarriḥ wa Muqawwī-i-Qalb,(Rafeequddin M, 1985)*Muqawwī Ḥarārat Gharīzī* (MA, 2002) *Mufarriḥ wa Muqawwī-i-Qalb,*(Ghanī N, 2001; Kabīruddīn M., 2007; Kabīruddīn M, 2007; MA, 2002) *Muqawwī-i-Aʻḍā' Raʾīsa wa-Ḥawās, Mulayyina-Ṭabīʻat'* and *Muqawwī Ḥarārat Gharīzī* useful in *Amrāḍ Sawdāwī,*(Kabīruddīn M, 2007; Khān MA, 2018) including *Mālankhūliyā, Khafaqān, Khafaqān Sawdāwī, Sarsām, Barsām,* depression, fear, obsession, and shortness of breath (Ghanī N, 2001).

Therapeutic uses of *Barg-e-Gaozaban* are mentioned in the classical Unani literature

The table below **(Table 2)** provides an overview of the traditional Unani uses of *Barg-e-Gaozaban* (*B. officinalis*) across a range of physiological systems. It brings together information from classical medical sources to show the breadth of its therapeutic applications. Different preparations of the plant, such as decoctions, oral remedies, topical ash, and infusions, are presented alongside their respective actions, which include benefits for respiratory and cardiovascular disorders, mental and hepatic health, immune support, urinary complaints, and skin conditions. This system-based summary offers a clear picture of the plant's long-standing role within traditional medical practice.

Table 2. Therapeutic uses of *Barg-e-Gaozaban* are mentioned in Unani Medicine

System	Form / Preparation	Traditional Use / Action
Respiratory System	*Gaozaban* (Oral)	Due to its high mucilage content, Borage acts as a demulcent herb, effectively soothing the respiratory tract and easing symptoms of bronchitis and asthma (Prajapati et al., 2003).
	Gaozaban decoction	Difficulty breathing, *Zukām* (cold), *Barsām*, pleurisy, pneumonia, and tuberculosis, as well as throat and chest pain (MA, 2002).
	Gaozaban + *Honey*	To relieve dry coughs caused by dryness in the larynx and trachea (Baitar I, 2000).
Cardiovascular System	*Gaozaban* (Oral)	Highly effective in strengthening the heart and alleviating functional palpitations (Khafaqān Sawdāwī) (Kabīruddīn M, 2007; MA, 2002). It facilitates the purgation of bile (Mirra Safrā) but also mitigates the palpitations that may follow as a secondary complication (Baitar I, 2000).
Digestive & Hepatic System	Ash of *Barg-e-Gaozaban*	Dusting powder to treat mouth ulcers promoting healing (Ghanī N, 2001). managing childhood stomatitis and strengthening loose gums. *Yarqān* (jaundice) (Anonymus, 1987; Baitar I, 2000).
Nervous System & Mental Health	*Gaozaban* Decoction + specific medicinal herbs	Meningitis (*Sarsām*), depression, fear, and obsessive thoughts (Kabīruddīn M., 2007).
	Gaozaban + Alcohol and consumed	Induces a state of inebriation(Baitar I, 2000; Kabīruddīn M., 2007; Kabīruddīn M, 2007).

System	Form / Preparation	Traditional Use / Action
	Gaozaban (Oral)	Eliminates *Khilt-e-Ṣafrā*, thereby relieving psychological symptoms such as fear, depression, and obsessive thoughts that arise from its excess. managing restlessness, melancholia, insanity, madness, and other conditions linked to a melancholic temperament (Anonymus, 1987).
Immune System & Detoxification	*Gaozaban* (Oral)	Plays a vital role in strengthening the adrenal glands, contributing to overall vitality and resilience. in moderation to maintain the body's internal balance (Baitar I, 2000).
Urinary System	*Gaozaban* (Oral)	Diuretic properties(Prajapati et al., 2003) Relieve Bladder irritation. Strangury (painful or difficult urination) (Anonymus, 1987).
Skin & Wound Care	Ash of *Barg-e-Gaozaban*	Traditionally applied topically to wounds, especially in children, to promote drying and accelerate healing (Prajapati et al., 2003) childhood stomatitis and mouth ulcers, offering relief from oral inflammation and burning sensations (Baitar I, 2000).
General Health	Freshly squeezed juice, a poultice, or an infusion.	For soothing sore and inflamed skin, it helps to encourage sweating, making it useful for relieving restlessness associated with fever (Anonymus, 1987; Prajapati et al., 2003).

Important formulations of *Gaozaban:*

The various compound formulations in Unani medicine that include *Gaozaban* are as follows: *Khameera Gaozaban, Khameera Gaozaban Ambari Jawaherwala* (Anonymus, 1987; Usmani MI, 2008), *Khameera Gaozaban Ambari Oudh Saleebwala, Khameera Abresham Saada, Khameera Abresham Hakeem Arshadwala* (Usmani MI, 2008), *Arq-e-Gaozaban* (Anonymus, 1987), *Dwaul Misk Moatadil Jwaher Wala* (Kabīruddīn M., 2007).

Ethnobotanical disruption:

B. officinalis belongs to the Boraginaceae family, which includes about 100 genera and 2,000 species, commonly found in temperate and tropical regions. It is an herbaceous, annual plant that typically grows to a height of 70 to 100 cm. It features straight, often branched stems that are hollow and covered with tough fibres. The leaves of borage are alternate, simple, and petiolate, usually bearing a rough texture due to coarse hairs that cover them. The flowers are predominantly blue; though rare white or rose-coloured varieties exist. These flowers have a distinctive five-parted calyx and corolla, divided into several segments, giving them a polypetalous appearance. A unique feature of the corolla is its tubular structure formed by the lamina parts, a trait shared with other plants in the *Boraginaceae* family, which helps distinguish borage from other species. Each flower contains five petals, with the anthers clustered near one another, and a vertical appendage at the base of the tube. The pistil has a superior ovary, which eventually transforms into a fruit containing 3 to 4 small, brownish, wrinkled nutlets. The ripe nutlets are dark brown, lack albumin, and contain a dark seed inside. (Asadi-Samani et al., 2014; Saxena NB, 2006)

Macroscopic feature of leaves:

The leaf is simple, obovate or ovate in shape, about 10-15 cm in length and 5-8cm wide with an obtuse apex and crenate margin. The surface is softly hirsute; the lateral veins anastomose towards the margin of the leaf, and the under surface shows prominent reticulation. The upper leaves are sessile or shortly stalked, with the lower ones exhibiting a decurrent petiole. The leaves have a dark green upper surface with a greyish-green lower surface due to prickly hairs. The leaves possess a cucumber-like odour and taste (Anonymous, 1987).

Habitat:

Mostly found in the Mediterranean region (Kaunitz & Manson, 2016), Europe, and northern Asia. Also reported to be planted in the Indian gardens for ornamental purposes.(Anonymous, 1987)

Period of Occurrence:

The plant occurs during November to January(Anonymous, 1987).

Procedure and time of collection:

The plant may be uprooted, washed, and dried under the shade. The dried plants may be smashed to remove the leaves (Anonymous, 1987). **Preservation and storage:** The leaf may be dried under shade or oven at 40C. the dried leaves may be stored in moisture-free air-tight containers (Anonymous, 1987).

Part Used:

Leaves (Anonymous, 1987), seeds, (Anonymous, 1987; C. Khare, 2007) flowers (C. Khare, 2007)

Identity, Purity & Strength of *Borago officinalis:*

The identity, purity, and strength of *B. officinalis* are assessed based on several key parameters. The acceptable limit for foreign matter is not more than 2%. The total ash content should not exceed 21%, while the acid-insoluble ash should remain below 6%. In terms of extractive properties, the alcohol-soluble extractives are limited to a maximum of 2%, and the water-soluble extractives should not exceed 16% (Anonymous, 2007).

Chemical Constituents of Barg-e-Gaozaban (B. officinalis)

Analysis of the fresh leaves and flowering tops of borage revealed distinct compositions of fatty acids and other bioactive compounds. The leaves were particularly rich in palmitic acid, whereas the fixed oil fraction of the flowers showed a high content of α-linolenic acid. Arachidonic acid was not detected in the leaves; however, they contained carotenoids, flavonoids, essential oils, ascorbic acid, and both chlorophyll a and b. Additional lipids identified included oleic, stearic, elaidic, linolelaidic, linoleic, lauric, and myristic acids. LC-MS/MS analysis of the borage leaf extract revealed several previously unreported metabolites, notably the secoiridoid oleuropein, along with ten other

flavonoids. The ethanolic extract was found to contain seven flavonoids **(Figure 3)**;

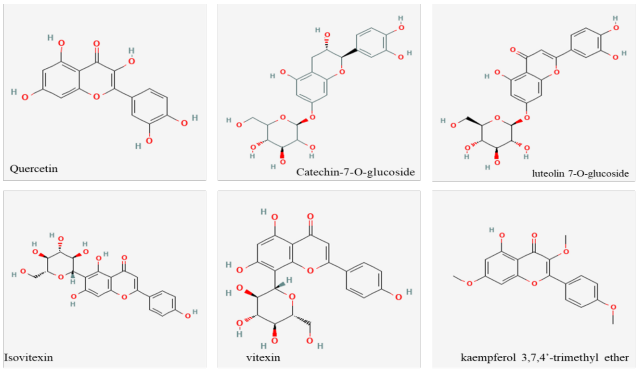

Figure 3. Molecular structures of flavonoids identified in *B. officinalis* (Source: PubChem)

such as isoquercetin, quercetin, catechin-7-O-glucoside, luteolin 7-O-glucoside, isovitexin, vitexin, and naringenin O-hexoside. Additionally, the mother liquor contained three flavonoids: kaempferol 3,7,4'-trimethyl ether, naringenin O-hexoside, and luteolin 7,3',4'-trimethyl ether (Ibrahim & Alshammaa, 2023b).

Critical analysis of chemical constituents:

While the above phytochemical profile is informative, most studies report presence/absence of compounds without quantifying bioactive concentrations or establishing structure-activity relationships. The clinical relevance of individual flavonoids (e.g., isoquercetin, luteolin glycosides) remains unknown, as no human pharmacokinetic data are available for *B. officinalis* leaf extracts. Furthermore, variability in plant sourcing, extraction methods, and analytical conditions across studies limits comparability.

Pharmacological studies

Antimicrobial activity:

- *Borage* possesses potent antimicrobial activity, which suggests its possible use in infection. the aqueous extract (AE) exhibited antibacterial potential against *Enterobacteria* and *Staphylococci* to different extents. The AE showed no bacterial inhibition against *Listeria monocytogenes*; however, some activity was recorded against *Salmonella enterica* (Miceli et al., 2014).

- **Critical note:** Minimum inhibitory concentrations (MICs) were not reported in this study, preventing comparison with standard antibiotics. The clinical significance of these in vitro findings is unknown.

Antimicrobial and antifungal:

- A study was conducted in which silver nanoparticles (AgNPs) were synthesised using an extract of *Borago officinalis* plant leaves as an environmentally friendly reducing agent. The synthesised AgNPs were subsequently evaluated for their in vitro antimicrobial and antifungal activities (Michalak et al., 2023).

- **Critical note:** This study focuses on nanoparticle synthesis, not the direct therapeutic effect of the plant extract itself. The relevance to traditional use is indirect.

Antioxidant activity:

- The seed cake extract of *B. officinalis* has high phenolic content with a significant antioxidant effect, and this extract is utilised in agricultural, cosmetic, food, and pharmaceutical applications as a natural antioxidant additive. In an earlier study, the polyphenolic-rich extract from seedcakes of *B. officinalis* possesses free radical scavenging, transition metal ion chelating, and antioxidant activities (Zemmouri et al., 2019).

- **Critical note:** These are in vitro chemical assays (DPPH, FRAP). In vivo bioavailability and clinical antioxidant effects in humans have not been demonstrated.

Anti-inflammatory activity:

- *B. officinalis* oil causes inflammation reduction by increasing the cyclic adenosine monophosphate (c-AMP) and PGE synthesis, and the presence of GLA in male rats. The GLA inhibits the release of IL-1 Beta and its production by monocytes, which in turn causes inflammation reduction. The GLA also stimulates the PG E secretion, and this factor reduces tumour necrosis factor-beta (TNF-β) production, and finally, the inflammation will be reduced (Sulaiman et al., 2020).

- **Critical note:** This study was conducted in rats. Human data are absent. The anti-inflammatory doses used in rodents may not translate to human equivalent doses.

Anxiolytic effect:

- Male Wistar rats (220-250 g) were used to test the anxiolytic-like effects of *B. officinalis* flower extract. The extract was administered intraperitoneally at doses of 50, 100, and 200 mg/kg, with behavioural testing in the Elevated Plus Maze (EPM) 30 minutes post-injection. Compared to saline controls, rats given the borage extract spent significantly more time in the open arms and had a higher percentage of entries into the open arms, while the number of entries into the closed arms remained unchanged, suggesting an anxiolytic effect without affecting general locomotor activity. The authors conclude that *B. officinalis* extract may produce anxiolytic-like effects, but the active compounds and mechanisms remain to be identified (Komaki et al., 2015).

- Critical note: This is a single animal study with intraperitoneal administration – not oral, not in humans. No clinical trial has evaluated B. officinalis for anxiety or melancholic disorders. Therefore, the traditional use in Amrād-i-Saudāvi remains unvalidated by modern clinical research.

Cytotoxic activity:

- In vitro cytotoxic effects of aqueous, ethanolic, and methanolic borage extracts were tested using MTT assay against the colon (HT-29), prostate (LNCaP), and human liver (HPG2) cancer cells. The extracts of borage flower exhibited weak cytotoxic effects on human hepatic, colon, and prostate cancer cells. However, the methanolic extract with higher polyphenolic contents has higher cytotoxic effects compared to the aqueous and ethanolic extracts. The edible parts (petioles and leaves) of cultivated and wild *B. officinalis* exhibit anticarcinogenic effects and DNA protection (Ibrahim & Alshammaa, 2023b).

- **Critical note:** In vitro cytotoxicity does not predict in vivo anticancer activity. No animal or human cancer studies exist.

Hypoglycemic activity:

- *B. officinalis* exhibited hypoglycemic properties against alloxan-induced diabetes in a rat model. The plant under study is rich in GLA and is utilised as a drug to treat different diseases like arthritis, local eczema, diabetes, heart disease, multiple sclerosis, and cyclical mastalgia (Rodríguez-Magaña et al., 2019). **Critical note:** Only one animal study; no human trials for diabetes. The claimed benefits for multiple sclerosis and heart disease are not supported by direct evidence.

Neuroprotective activities:

- A study investigated the protective effects of Borago officinalis (borage) extract on amyloid β (Aβ)-induced memory impairment in Wistar male rats. The rats were administered an intrahippocampal (IHP) injection of Aβ (25-35) and received borage extract (100 mg/kg) throughout gestation. Learning and memory were assessed using the passive avoidance and Morris water maze (MWM) tasks. The antioxidant capacity of the hippocampus was also evaluated using the FRAP assay. The results indicated that Aβ (25-35) impaired memory function, as evidenced by decreased step-through latency in the passive avoidance task and increased escape latency and travelled distance in the MWM. However, borage extract mitigated Aβ-induced memory impairment in both tasks and prevented the reduction in hippocampal antioxidant power. These findings suggest that borage may improve learning deficits and oxidative damage in the hippocampus, potentially offering a therapeutic approach to AD-induced cognitive dysfunction (Ghahremanitamadon et al., 2014).
- **Critical note:** This is a preclinical study in rats with induced pathology. No human trials exist for neuroprotection or Alzheimer's disease. Extrapolation to clinical use is premature.

Clinical trials

Effect on cyclical mastalgia:

- Cyclic mastalgia evaluates the safety and efficacy of *B. officinalis* (900 mg borage oil capsules) in the treatment of patients presenting with cyclic mastalgia. 91 subjects were included in the study. Efficacy assessments were performed based on data obtained before the start of treatment (Pretreatment), and after each menstrual cycle (Assessment 2 following 45 days of treatment; and Assessment 3 at the end of the 90-day treatment period). The VAS scores of the mean mastalgia and most severe mastalgia both showed statistically significant ($p < 0.0001$) reductions from Pretreatment to Assessment 3 (Naliato, 2015).
- **Critical appraisal:** This was an open-label study without a placebo control group. The absence of blinding introduces a high risk of bias. The sample size (n=91) is modest. Therefore, the results should be considered preliminary.

Use of borage in lactation:

- Forty nursing mothers averaging 5 weeks postpartum were randomised to receive borage seed oil capsules containing either 230 or 460 mg of gamma-linolenic acid (GLA) daily in 4 divided doses for 1 week. Half of the women in each group were considered to be atopic and had lower initial levels of arachidonic acid (AA) and dihomo-gamma-linoleic acid (DGLA) in their breastmilk. In the low-dose group of atopic mothers, GLA levels increased from 0.11% by weight to 0.16%. In the high-dose group of atopic mothers, GLA levels increased from 0.09% to 0.18%. DGLA also increased from 0.41% to 0.53% in the low-dose group and from 0.36% to 0.51% in the high-dose group. AA levels were not affected by supplementation (Vaughn, 2012).
- **Critical appraisal:** The study duration was only one week. No clinical outcomes (e.g., infant health, maternal well-being) were measured. The clinical significance of the observed changes in breastmilk fatty acid composition is unknown.

Effect on asthma:

- In one study, 52 subjects suffering from moderate persistent asthma were enrolled in a phase 2 prospective double-blind placebo-controlled clinical trial in which hydro alcoholic extract of *Borago officinalis* in the dose of 5 mL three times daily for one month was used to evaluate its effect on clinical findings, spirometry, FENO, and sputum inflammatory cells. The study results showed that borage is capable of suppressing cough, dyspnea, and airway hyper-responsiveness, and also improved the ACT score. Wheezing and Gastroesophageal reflux also improved (Mirsadraee et al., 2021).
- **Critical appraisal:** This is a positive finding from a randomized controlled trial. However, the sample size is small (n=52). Replication in larger, multi-center trials is needed before clinical recommendation.

Evidence for *Amrād-i-Saudāvi* (melancholic disorders):

- Despite the traditional use of *Gaozaban* for melancholia, depression, fear, and obsession, no clinical trial has evaluated *B. officinalis* for any psychiatric or mood disorder. The single animal study on anxiolytic effect (Komaki et al., 2015) does not constitute clinical evidence. Therefore, the traditional claim remains unsubstantiated by modern research.

Strengths, Limitations and Future Recommendations:

- The present review highlights several strengths, including the integration of traditional medicinal knowledge with modern scientific evidence, as well as substantial experimental support for the diverse pharmacological actions of *B. officinalis*, such as its antioxidant, anti-inflammatory, anxiolytic, and neuroprotective effects. However, the available data also reveal notable limitations: clinical trials remain few and often involve small sample sizes, inconsistencies exist in plant sourcing and preparation methods, and many findings rely heavily on animal studies rather than human research. Additionally, concerns regarding potential toxicity require more rigorous evaluation. To advance the therapeutic use of *Gaozaban*, future research should prioritize well-structured clinical studies, standardization of extraction and dosage protocols, detailed safety assessments, and deeper exploration of its active constituents and mechanisms. Strengthened collaboration between traditional medicine practitioners and modern researchers will further support its integration into contemporary evidence-based healthcare.
- As a narrative review, this paper does not include a meta-analysis or quantitative synthesis. Publication bias may exist; as negative results are less likely to be published. The classical Unani texts cited are historical sources and do not meet modern evidence standards. No clinical studies specifically addressing *Amrād-i-Saudāvi* were found, confirming a major evidence gap.

Specific future research recommendations:

- Randomized, double-blind, placebo-controlled trials of *B. officinalis* for mild-to-moderate depression or anxiety (to test the traditional *Amrād-i-Saudāvi* indication). Pharmacokinetic studies in humans to determine bioavailability of key flavonoids. Long-term safety studies, including hepatotoxicity and drug interaction profiles. Standardization of extracts using phytochemical fingerprinting (HPLC or LC-MS) to ensure reproducibility across studies.

Author's opinion:

- *Borago officinalis* (*Gaozaban*) appears to be a promising medicinal plant whose traditional uses are supported by emerging scientific evidence. Its wide-ranging benefits, particularly in cardiovascular, neurological, and respiratory conditions, highlight its therapeutic potential. The plant's rich phytochemical profile further strengthens its value in modern research. However, the current lack of large, well-controlled clinical studies

limits definitive conclusions about its efficacy and safety. Variations in plant preparation and concerns regarding potential toxicity also require careful attention. With standardization, rigorous testing, and improved quality control, *Gaozaban* could become a valuable complementary therapy. Overall, the plant holds strong potential, but responsible, evidence-based use is essential.

- In particular, despite traditional claims for *Amrād-i-Saudāvi*, there is currently no clinical evidence to recommend *B. officinalis* for depression, anxiety, or melancholic disorders. The plant should be considered an adjunctive, not a primary, treatment until robust clinical trials confirm its efficacy and safety for these conditions.

CONCLUSION

- *B. officinalis (Gaozaban)* emerges as a valuable medicinal plant whose traditional uses are increasingly supported by scientific evidence. Its broad therapeutic potential spanning cardiovascular, neurological, respiratory, and anti-inflammatory benefits is attributed to its diverse phytochemical constituents. While experimental studies highlight strong pharmacological promise, clinical evidence remains limited and requires further strengthening. Standardisation of plant material, dosing, and safety evaluation is essential to ensure consistent and reliable outcomes. Overall, *Gaozaban* represents a promising natural remedy that could contribute meaningfully to modern healthcare, provided future research addresses current gaps in scientific validation.
- The traditional use of *Gaozaban* for melancholic disorders (*Amrād-i-Saudāvi*) is not yet supported by clinical evidence. No human trials have evaluated its effects on depression, anxiety, or related conditions. Therefore, this specific traditional indication should be considered hypothetical until confirmed by rigorous research.

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