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## Gaozaban (*Borago officinalis* L.): A review of its phytochemical constituents and pharmacological activities

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### Abstract

Since ancient times the plant species are used for the therapeutic intervention. Due to its fewer side effects properties, hence it is preferred herbal therapies nowadays. A well-known Unani drug Gaozaban (*Borago officinalis* L.) of the family Boraginaceae described in the Unani System of Medicine with various therapeutic properties as exhilarant, expectorant, laxative, resolvent, diuretic, lithotriptic and tonic for principal organs of the body like the brain, heart and liver. Due to these properties, it is used in the treatment of Cardiac weakness, Palpitation, Anxiety, Melancholia, Schizophrenia, Catarrh, Cough, Asthma, renal calculi and healing of wounds etc. Mostly its leaves and flowers are used. Gaozaban is used as an important ingredient in many Unani compound formulations like Khamira Gaozaban, Khamira Abresham, Dawaul Misk, Mufarreh Barid, Sharbat Deenar, Arq Gaozaban etc. It is reported that it has multiple pharmacological activities such as antidepressant, anxiolytic, antioxidant, anti-diarrhoeal, antibacterial, antifungal, antiaging, anti-asthmatic, anticancer, wound healing activity and as a memory booster. These pharmacological activities are due to the presence of a number of phytochemicals such as saponin, flavonoids, tannins, anthraquinone, glycosides, phenolic compounds and gums.

The aim of this review is to update comprehensive scientific information on pharmacological activities and traditional medicinal uses of Gaozaban to provide an insight to further research on its therapeutic potential.

**Keywords:** Gaozaban, pharmacological, phytochemical, *Borago officinalis* L.

### Introduction

There are several studies which explore the benefits of different plant chemicals in many plants and their important effects on human being [1, 2]. Medicinal plants have been used for several purposes, including medicine, nutrition, flavourings, fragrances, cosmetics, charms, repellents, beverages, dyeing, smoking and other industrial applications. Plant-based formulations of drugs are used for basic health care in most of the developing countries, and around 80% of people used herbal medicine for health care [3, 4]. According to world Health Organization (WHO) report more than half of population in world mainly relies on traditional remedies [5]. Nowadays, the extracts from medicinal plants are attractive not only in the modern phyto pharmacology and phytotherapy but also for food and feed industries [2, 6]. Gaozaban (*Borago officinalis* L.) has been utilised in the Unani System of Medicine since ancient times. Mostly its leaves and flowers are used to cure a variety of conditions, including heart weakness, palpitations, anxiety, melancholia, schizophrenia, catarrh, cough, asthma, renal calculi and wound healing, due to its exhilarating, expectorant, laxative, resolvent, diuretic, lithotriptic, and tonic properties for the body's major organs, including the brain, heart and liver. Several Unani compound formulations, including Khamira Gaozaban, Khamira Abresham, Dawaul Misk, Mufarreh Barid, Sharbat Deenar, Arq Gaozaban, etc., contains Gaozaban as an important ingredient [7, 8, 9].

The leaves and seeds indicates biological activities in cancer and heart diseases prevention [2, 10] and possessed antibiotic properties [2, 11] reduces cardiovascular diseases [2, 12] and provides health-improving benefits due to their various biological activities [2, 13].

The aim of this review is to provide comprehensive and updated information regarding its botanical description and medicinal properties and therapeutic uses in Unani medicine.

**Plant Description**

The drug Gaozaban consists of dried leaves and flowers of *Borago officinalis* Linn. of the family Boraginaceae. It is an erect, spreading and hispid annual biennial plant. The plant is found mostly in Mediterranean region. Europe, Northern Asia, it is also reported to be planted in Indian gardens. The plant occurs during November to January.

**Other names**

**Arabic:** Lisan-us- Saur

**Persian:** Gaozaban

**English:** Borage, Cow's Tongue

**Gujarati:** Gaozaban

**Hindi:** Gojihva

**Urdu:** Gaozaban [14]

**Classification** [15]

**Kingdom:** Plantae

**Subkingdom:** Tracheobionta

**Superdivision:** Spermatophyta

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Subclass:** Asteridae

**Order:** Lamiales

**Family:** Boraginaceae

**Genus:** *Borago*, L.

**Species:** *Borago officinalis*, L.

**Description of leaf****Macroscopic**

The leaf is simple, obovate or ovate in shape, with an obtuse apex and crenate margin, the upper leaves are sessile or shortly stalked, while the lower ones exhibit a decurrent petiole. The leaves have a dark green upper surface with greyish green lower surface due to the prickly hairs.

**Microscopic**

The upper epidermis of lamina is covered with a thin, smooth cuticle and consists of one layer of polygonal cells with almost straight anticlinal walls. Stomata occur fairly frequently and are mainly of the anisocytic type, some are anomocytic. Covering trichomes are numerous, they are unicellular, straight having cellulose walls and tapering apices. The lumen is visible throughout the entire length, the base is somewhat swollen and may contain crystalline inclusions. Glandular trichomes consist of a unicellular stalk and a unicellular, sub-spherical head. The mid-rib has a typical dicotyledonous structure, the diameter of the central bundle increases from the apex to the base of the leaf. Large trichomes have their base surrounded by several small cells and the walls are sometimes warty. These types of trichomes are not as frequent as those with at the bulbous base. The cortex contains one or two rows of hypodermal below the upper epidermis and above lower epidermis. The endodermal sheath is consisting of a single layer of cells containing starch grains. In transverse section this layer is horse-shoe shaped. The meristele is sub-spherical in shape and well defined in transverse section. The pericycle consists of a well-defined area of collenchyma above the xylem and below the phloem. The transverse section through the petiole is similar to that of the mid-rib with an exception that cells are slightly large due to the increase in size of the total structure. Some trichomes contain crystalline deposit in their basis.

**Powder**

The powdered drug is light brown with greenish tinge, and has cucumber like odour and taste. On microscopic study it shows to contain various glandular and non-glandular unicellular trichomes, palisade and spongy mesophylls, collenchyma, and thin layer parenchymatous cells. The tracheidal vessels and vessels with annual and spiral thickenings are also seen scattered with epidermal fragments.

**Chemical constituents:** Alkaloids, Mucilage, Potassium nitrate, Calcium oxalate.

**Identity, Purity and Strength**

**Foreign Matter:** Not more than 2%

**Total Ash:** Not more than 21%

**Acid insoluble ash:** Not more than 6%

**Alcohol-soluble extractives:** Not less than 2%

**Water-soluble extractives:** Not less than 16%

**Table 1:** TLC behaviour of petroleum ether (60-80°) extract

Solvent system	Spray/reagent treatment	No. of spots	Rf value
Benzene: Chloroform (3:5)	2% Ethanol H <sub>2</sub> SO <sub>4</sub>	1	0.79

**Temperament:** Hot Moist (Har Ratab)

**Action**

Munaffis Balgham (expectorant), Mulattif (demulcent), Muharrik (stimulants), Muqawwi Qalb (cardiac tonic)

**Therapeutic Use**

Zeeq-un-Nafas (Asthma), Yarqan (Jaundice), Nazla-ozukam (coryza and catarrh) Khafaqan (palpitation)

**Dose:** 7-17 g

**Important Formulations**

Khamira Gaozaban Ambari Jawahir wala, Khamira Gaozaban Sada, Khamira Zahar Mohra, Majoon Azaraqi. Majoon Khadar, Majoon Rahul Momineen, Dyaqooza, Majoon Ushba, Mufarreh Barid, Mufarreh Sosambri, Mufarreh Barid, Mufarreh yaqooti Barid, Mufarreh Yaqooti Motadil, Sharbat Deenar, Zuroor Gaozaban, Arq Chobchini, Arq Gaozaban, Arq Juzam [14].

**Description of flower****Macroscopic**

Flowers bluish purple and turned dull brown in colour; corolla 5, gamopetalous, tubular or funnel shaped with wavy margins; stamens 5, epipetalous (filaments attached to the corolla tube at their basal ends and free above), stamen unequal in length; style bifid; characteristic pleasant odour and no taste.

**Microscopic****Corolla**

T. S. of corolla shows epidermis single layered with numerous hairs; vascular strands at regular intervals (prominent veins and veinlets running all along its length), 3 to 8 prominent vessels surrounded by a small undifferentiated cellular mass; rest of the corolla region consisting of tangentially elongated parenchyma cells.

**Style**

Style shows bifid segments, glabrous with capitate stigma and rest of the style bears aseptate long hairs of upto 1000 $\mu$  and width upto 20 $\mu$ . T. S. of style shows single layered epidermis with numerous hairs; central column of thick walled compact cells while the vascular strands run on both the sides of the column with very small 6 to 8 vessels and parenchymatous cortex.

**Pollen grains**

Pollen grains small, oval in shape with germ pores, each individual pollen grain measuring upto 20 $\mu$ .

**Powder**

Pale brown; epidermal cells in surface view; with hairs; elongated parenchyma cells; spiral vessels upto 20 $\mu$ ; pollen grains upto 20 $\mu$ ; hairs upto 1000 $\mu$  and anther walls in surface view.

**Identity, Purity and Strength**

**Foreign Matter:** Not more than 2%

**Total Ash:** Not more than 8%

**Acid insoluble ash:** Not more than 0.99%

**Alcohol-soluble extractives:** Not less than 14.44%

**Water-soluble extractives:** Not less than 56%

**Thin Layer Chromatography**

Extract 2 g of sample with 20 ml of chloroform and alcohol under reflux on a water bath for 30 min. Filter and concentrate to 5 ml and carry out the thin layer chromatography. Apply the chloroform extract on TLC plate. Develop the plate to a distance of 8.5 cm using Toluene: Ethyl acetate (5:1.5) as mobile phase. After development allow the plate to dry in air and examine under UV (366nm). It shows major spots at R<sub>f</sub> 0.95, 0.92 (Light blue), 0.78 (Reddish blue), 0.65 (Violet), 0.32 and 0.08 (Light blue). Dip the plate in vanillin-sulphuric acid reagent followed by heating at 110° for about 10 min and observe under visible light. The plate shows major spots at R<sub>f</sub> 0.95 (Dark blue), 0.78, 0.65 (Violet), 0.58 (Dark blue) and 0.08 (Green).

Apply the alcohol extract on TLC plate. Develop the plate to a distance of 8.5 cm using Toluene: Ethyl acetate (5:1.5) as mobile phase. After development allow the plate to dry in air and examine under UV (366nm). It shows major spot at R<sub>f</sub> 0.32 (Reddish blue). Dip the plate in vanillin- sulphuric acid reagent followed by heating at 110° for about 10 min and observe under visible light. The plate shows major spots at R<sub>f</sub> 0.72 (Violet), 0.64 (Greenish blue), 0.22 (Green) and 0.12 (Violet).

**Chemical Constituents:** Thesinine

**Temperament:** *Har Ratab* (Hot and Moist)

**Action**

Mufattit Hasat (Lethotriptic), Daf Humma (Antipyretic), Muqawwi (Tonic), Mudirr Baul (Diuretic) and Qabiz (Astringent)

**Therapeutic Use**

Sual-e-Yabis (Dry cough), Zeequn Nafas (Asthma), Warm-e-Lissa (Gingivitis), Qula (Stomatitis) and Khafqan (Palpitation)

**Dose:** 5-7g

**Important Formulations:** Khamira Gaozaban, Khamira Abresham, Dawaul Misk [16]

**Chemical constituents**

The leaves of borage contains following compounds: a few amount of pyrrolizidine alkaloids, licosamin, intermedin, sopinin, sopindian, yezan, colin; fatty acids including ALA (55%) and GLA (more than 4%); silicic acid (1.5%-22.0%); potassium, calcium, nitrate potassium (3%), acetic, lactic and malic acid;  $\delta$ -bornesitol, cianozhens; fresh leaves also contain mucilage hydrolysable to glucose, galactose, arabinose and alantoein up to 30%; leaves of borage in seeding stage contain 2.5-5.0 mg GLA and 5.7-9.0 mg SDA. [17, 18, 19, 20] The amount of gum and mucilage available in leave and stem is 3.8% and in inflorescence is 5.4%. The amounts of potassium and calcium are reported 5.3% and 6.2% respectively [17, 21, 22, 23] Inflorescence of borage contains mucilage, tannin, calcium, potassium and ash insoluble in acid and alkaloid but has not saponins, flavonoids and cyanogenic glycosides [23, 24, 25, 26] The flowers of borage and generally all parts of the plant contain 30% mucilage. Green parts of the plant contain nitrate potassium, resin, malate and a little amount of essence, manganese, phosphoric acid and allantoin [27, 28]. Linolenic acid and palmetic acid are collected from flowers and a high level of ALA is in mature leaves [29].

**Pharmacological Activities**

The aerial parts of *Borago officinalis L.* extract have a potential hepatoprotective effects against chronic liver injury [17, 30]. The flower methanolic extract of Gaozaban shows antioxidant and antibacterial activity together with weak anti-inflammatory and anticancer properties [2]. The crude leaves extract of *Borago officinalis L.* were investigated for its antispasmodic, bronchodilator, vasodilator and cardio depressant activities to rationalize some of the traditional uses [31]. Borage flour and its extracts have concentration-related antioxidant properties [10, 17, 32]. The extract of flower of Gaozaban shows anxiolytic Activity [33].

**Conclusion**

This review validates the therapeutic use of Gaozaban in the Unani system of medicine for different ailments as well as explores its hepatoprotective, antispasmodic, bronchodilator, vasodilator, cardio-depressant activities, anxiolytic, antioxidant, antibacterial, anti-inflammatory and anticancer properties etc. The mentioned pharmacological activities are due to the presence of different photochemical such as fatty acids, alkaloids, glycosides, saponins, flavonoids, resins, and allantoin, etc. By taking into consideration of the reported activities of Gaozaban further studies on its pharmacological aspects and the mechanism of action for drug discovery are much needed.

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**Author's Contribution**

Not available

**Conflict of Interest**

Not available

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