Phytochemical Screening and Anti-Ulcer Activity of Jasminum Grandiflorum Extract: A Comprehensive Review

Dnyaneshwar Gaikwad Rushikesh Jaybhaye Vaishnavi Halde

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Abstract

Jasminum grandiflorum Linn. (Oleaceae), commonly known as Spanish Jasmine or "Chameli," is a prominent medicinal plant in traditional systems of medicine such as Ayurveda and Siddha. While widely recognized for its dermatological and wound-healing properties, recent pharmacological investigations have highlighted its significant gastroprotective potential. This review critically evaluates the phytochemical profile and anti-ulcer activity of J. grandiflorum extracts. Phytochemical screening reveals the presence of bioactive constituents including secoiridoid glycosides (oleuropein, ligstroside), flavonoids (quercetin, kaempferol), tannins, and terpenoids. In vivo studies using models such as pylorus ligation, ethanol-induced, and aspirin-induced ulceration demonstrate that J. grandiflorum extracts significantly reduce the ulcer index, free acidity, and total acidity while enhancing mucin production and gastric pH. The mechanisms of action appear to be multifactorial, involving antioxidant defense modulation (SOD, CAT, GSH), inhibition of acid secretion, and cytoprotection via prostaglandin synthesis. This review synthesizes current evidence to support the therapeutic validation of J. grandiflorum in the management of peptic ulcers.

1. Introduction

Peptic ulcer disease (PUD) remains a global health burden, characterized by mucosal damage in the stomach or duodenum due to an imbalance between aggressive factors (acid, pepsin, *H. pylori*, NSAIDs) and defensive mechanisms (mucus bicarbonate barrier, prostaglandins, mucosal blood flow). While standard pharmacotherapies like Proton Pump Inhibitors (PPIs) and H2-receptor antagonists are effective, they are often associated with side effects such as hypergastrinemia, nutrient malabsorption, and rebound acidity upon withdrawal. Consequently, there is a growing research interest in plant-based gastroprotective agents that offer efficacy with a better safety profile.

Jasminum grandiflorum is a scrambling deciduous shrub native to the Himalayas and widely cultivated in India, Europe, and Africa. Traditionally, the plant has been utilized for ulcerative stomatitis, skin diseases, wounds, and corns. Its leaves and flowers are bitter and astringent, properties often correlated with wound healing and mucous membrane protection in ethnomedicine. This review aims to consolidate scientific findings regarding the specific anti-ulcerogenic properties of *J. grandiflorum* and the phytochemicals responsible for this activity.

Jasminum Grandiflorum Taxonomical/ Scientific Classification :

Kingdom Plantae- Plants

Subkingdom: Tracheobionts- Vascular plants

Division: Magnoliophyta- Flowering plants

Class: Magnoliopsida- Dicotyledons

Order: Scrophulariales

Family: Oleaceae- Olive family

Genus: Jasminum

Species: grandiflorum

Classical names :

Jati, Sauanasyayani, Sumama, Chetika, Hridyagandha, Malati, Rajaputrika.

Botanical Description :

A climbing shrub. The leaves are opposite, with 3 to 7 lance-shaped, entire ovate to some what elliptic in shape with acuminate mucronate apex, petiole almost lacking, imparipinnately compound, with three paired foliates ending with a single leaf at the tip. The leaflets are elongate-lanceolate, acute, 7 to 11 terminal leaflet somewhat large than laterals, narrowing at the base, ovate-lanceolate, acute or acuminate, laterals ovate, terminal one larger than laterals and often partially united with surfaces with a ciliate margin. Flowers are terminal and axillary cymes, calyx lobes long and linear, more than half as long as the corolla tubes. The fruit is a black berry, elliptic, globose berries when ripe.

2. Phytochemical Screening

The pharmacological efficacy of *J. grandiflorum* is intrinsic to its diverse chemical composition. Phytochemical screening of different plant parts (leaves, flowers, roots) has identified several classes of secondary metabolites.

2.1 Qualitative Analysis

Preliminary phytochemical screenings of ethanolic and aqueous extracts typically reveal the presence of the following major groups:

Phytoconstituent	Presence (Leaves)	Presence (Flowers)	Key Bioactive Roles
Flavonoids	+++	++	Antioxidant, Anti-inflammatory, Cytoprotective
Tannins	+++	+	Astringent, Protein precipitation (ulcer coating)
Secoiridoids	++	+	Anti-inflammatory, Bitter tonic
Alkaloids	+	-	Analgesic, Antimicrobial
Terpenoids	++	++	Wound healing, Re-epithelialization
Saponins	+	+	Mucous membrane irritation/protection (dose-dependent)
Glycosides	++	++	Diverse pharmacological effects

2.2 Major Chemical Constituents

Advanced chromatographic techniques (HPLC, GC-MS) have isolated specific compounds integral to the plant's activity:

- **Secoiridoid Glucosides:** Oleuropein, ligstroside, and demethyl-oleuropein are characteristic of the Oleaceae family. These compounds are known for potent anti-inflammatory effects.
- **Flavonoids:** Kaempferol, quercetin, and their glycosides. Quercetin is particularly noted for its ability to inhibit the release of histamine and protect gastric mucosa from oxidative stress.
- **Essential Oil Components:** Benzyl acetate, benzyl benzoate, phytol, and linalool are found in the flowers, contributing to antimicrobial and soothing properties.
- **Other:** Ursolic acid (a triterpenoid) and salicylic acid have been identified, supporting the plant's traditional use in inflammation and pain management.

3. Pharmacognostic Studies of *Jasminum grandiflorum*

Pharmacognostic evaluation forms the cornerstone for the correct identification, authentication, and quality control of medicinal plant materials. For *Jasminum grandiflorum* Linn. (Oleaceae), pharmacognostic studies have been conducted on leaves, flowers, and stems to establish diagnostic macroscopic, microscopic, and physicochemical parameters, which are essential to prevent adulteration and ensure reproducibility of pharmacological activity.

3.1 Macroscopic Characteristics

Leaves:

Leaves are opposite, imparipinnate, with 5–9 ovate to elliptic leaflets. The leaflets possess an entire margin, acute to acuminate apex, and a smooth glabrous surface. The upper surface is dark green, while the lower surface appears pale green. The leaves exhibit a characteristic bitter taste and faint aromatic odor.

Flowers:

Flowers are large, white, and highly fragrant, borne in terminal cymose inflorescences. The corolla is tubular with 5–8 lobes, and the calyx is green and campanulate. The strong fragrance is attributed to volatile oil constituents such as benzyl acetate and linalool.

Stem:

The stem is woody, cylindrical, and green to brown in color, with longitudinal striations. Younger stems are pubescent, while mature stems become glabrous.

These macroscopic features are important diagnostic markers for field identification and raw material authentication.

3.2 Microscopic Characteristics

3.2.1 Leaf Microscopy

Transverse section (T.S.) of the leaf reveals a dorsiventral structure, typical of dicotyledonous plants:

- Epidermis:

Upper and lower epidermis consist of single-layered cells covered with a thick cuticle. The lower epidermis shows a higher frequency of stomata.

- Stomata:

Paracytic (rubiaceous) type stomata are predominantly present on the abaxial surface.

- Trichomes:

Unicellular, non-glandular covering trichomes are occasionally observed, serving as an important diagnostic feature.

- Mesophyll:

Differentiated into palisade parenchyma (1–2 layers, elongated cells rich in chloroplasts) and spongy parenchyma (loosely arranged cells with intercellular spaces).

- Vascular Bundle:

Collateral and closed vascular bundles are present, surrounded by sclerenchymatous sheath providing mechanical support.

3.2.2 Powder Microscopy

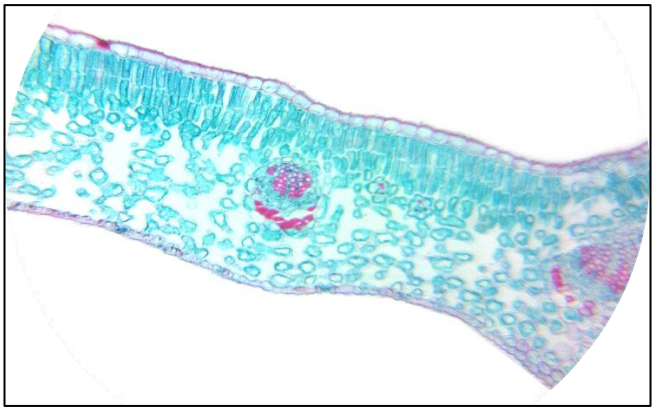
Powdered leaf material shows the presence of:

- Fragments of palisade parenchyma
- Spiral and annular xylem vessels
- Calcium oxalate crystals (prismatic type)
- Epidermal cells with paracytic stomata
- Fibers and sclereids

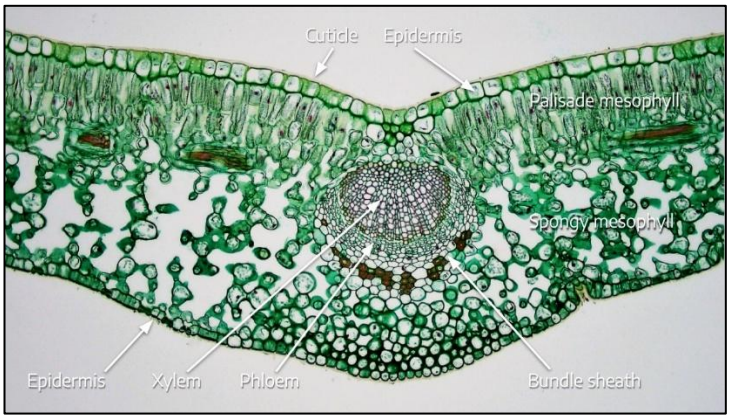
These characters serve as key identification tools in powdered crude drug analysis.

Microscopy of *Jasminum grandiflorum*

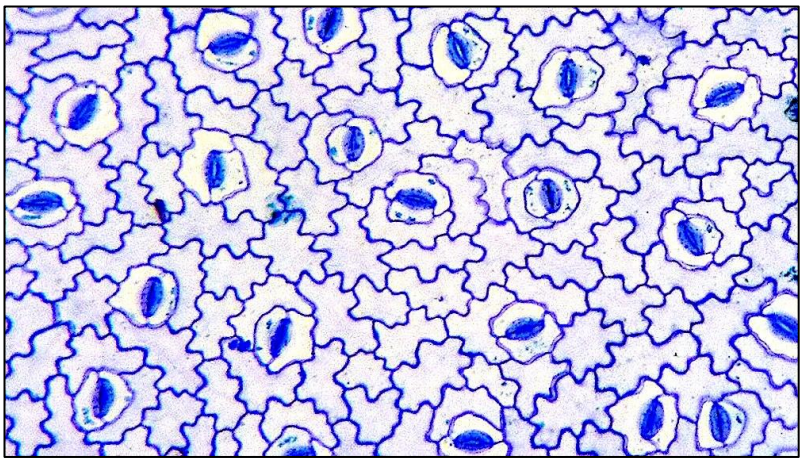
T.S. of Leaf (Dorsiventral)

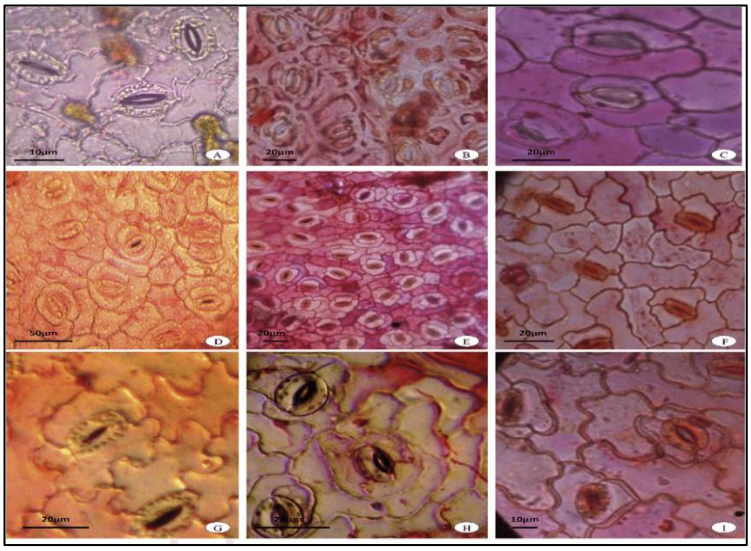


Mesophyll Region



Stomatal Type





Powder Microscopy

3.3 Physicochemical Parameters

Physicochemical constants provide quantitative standards for quality control:

Parameter	Typical Range
Total ash	7–10%
Acid-insoluble ash	<2%
Water-soluble ash	3–5%
Loss on drying	6–9%
Alcohol-soluble extractive	Higher than water-soluble extractive
Water-soluble extractive	Moderate

A higher alcohol-soluble extractive value indicates the abundance of moderately polar phytoconstituents such as flavonoids, secoiridoids, and tannins, which correlate with the observed anti-ulcer activity.

3.4 Fluorescence Analysis

Fluorescence analysis of powdered drug treated with various reagents (NaOH, HCl, H_2SO_4, iodine, ammonia) under visible light and UV light (254 nm and 366 nm) exhibits characteristic color changes. This technique is particularly useful for rapid identification and detection of adulteration.

3.5 Significance of Pharmacognostic Evaluation

The pharmacognostic profile of *Jasminum grandiflorum* establishes:

- Authenticity of the crude drug
- Purity by ruling out adulterants or substitutes
- Standardization benchmarks for herbal formulations
- Correlation between morphology, chemistry, and pharmacological activity

Given the increasing interest in *J. grandiflorum* as a gastroprotective agent, these pharmacognostic standards are essential prerequisites for its development into a standardized anti-ulcer phytopharmaceutical.

4. Mechanism of Action

The anti-ulcer activity of *J. grandiflorum* is not attributed to a single pathway but is a result of synergistic actions:

4.1 Antioxidant Activity

Oxidative stress plays a critical role in gastric ulceration. Free radicals cause lipid peroxidation, damaging the cell membranes of the gastric mucosa.

- **Enzymatic Modulation:** Studies have shown that *J. grandiflorum* significantly elevates the levels of gastric mucosal antioxidant enzymes: **Superoxide Dismutase (SOD)**, **Catalase (CAT)**, and **Glutathione (GSH)**.
- **Lipid Peroxidation:** The extract significantly inhibits lipid peroxidation (often measured by malondialdehyde or MDA levels) in gastric tissues, protecting cellular integrity.

4.2 Enhancement of Mucosal Barrier (Mucin Secretion)

The mucus-bicarbonate barrier is the stomach's primary defense against autodigestion.

- **TC:P Ratio:** Research indicates that the extract increases the Total Carbohydrate to Protein (TC:P) ratio in the gastric juice, a reliable marker for mucin activity.
- **Tannins:** The presence of tannins and flavonoids likely facilitates the precipitation of micro-proteins at the ulcer site, forming a protective pellicle (an artificial barrier) that prevents further erosion by acid and pepsin.

4.3 Anti-Secretory Activity

The significant reduction in free and total acidity suggests that *J. grandiflorum* may interfere with the biochemical pathways of acid secretion.

- **Pathway:** While specific receptor binding studies are sparse, the pattern of activity resembles that of H2-receptor antagonists. The flavonoids present (e.g., quercetin) are also known to inhibit the histidine decarboxylase enzyme, reducing histamine release which stimulates acid production.

4.4 Anti-Inflammatory and Prostaglandin Synthesis

- **Prostaglandins (PGE2):** Recent studies on related *Jasminum* species suggest that the gastroprotective effect is partly mediated by the stimulation of endogenous prostaglandins (PGE2), which improve mucosal blood flow and bicarbonate secretion.
- **COX-Pathway:** The inhibition of the pro-inflammatory COX-2 pathway (without inhibiting the protective COX-1) is a desirable property of the flavonoids found in the extract.

5. Toxicology and Safety Profile

For any herbal remedy, safety is paramount. Acute oral toxicity studies conducted according to OECD guidelines (e.g., guideline 423) have generally reported:

- **LD50:** The ethanolic extract of *J. grandiflorum* leaves and flowers was found to be safe up to doses of **2000 mg/kg to 5000 mg/kg** body weight in rats/mice.
- **Signs of Toxicity:** No significant behavioral changes, neurological toxicity, or mortality were observed at therapeutic doses.
- **Chronic Use:** While acute data is favorable, long-term chronic toxicity studies are less prevalent in the literature, representing a gap for future research.

6. Discussion

The transition of *J. grandiflorum* from a traditional wound healer to a potential anti-ulcer drug is supported by strong preclinical data. The correlation between its wound-healing properties (dermal) and anti-ulcer properties (mucosal) is logical, as both processes involve inflammation control, cell proliferation, and collagen synthesis.

The high content of **tannins** acts as an astringent, physically constricting the tissues and forming a protective layer. Meanwhile, **flavonoids** offer the systemic benefit of scavenging free radicals generated during the inflammatory response of ulceration. Compared to synthetic antacids which only neutralize acid, *J. grandiflorum* appears to offer a "mucosal restorative" approach.

However, limitations exist in the current body of evidence:

1. **Standardization:** Most studies use crude ethanolic extracts. There is a need for bioactivity-guided fractionation to pinpoint the exact molecule (e.g., is it oleuropein or a specific glycoside?) responsible for the maximum effect.

2. **Human Trials:** There is a lack of rigorous double-blind, placebo-controlled clinical trials in humans to confirm these findings.

3. **H. pylori:** Few studies have specifically targeted the antimicrobial activity of *J. grandiflorum* against *Helicobacter pylori*, the leading cause of peptic ulcers. Given the plant's known broad-spectrum antimicrobial activity, this is a promising avenue for future research.

7. Conclusion

The available scientific literature strongly supports the anti-ulcerogenic activity of *Jasminum grandiflorum*. The extract functions through a multi-target mechanism: it inhibits aggressive factors (acid, pepsin, oxidative stress) and potentiates defensive factors (mucin, antioxidant enzymes, mucosal blood flow).

- **Phytochemistry:** Rich in flavonoids, tannins, and secoiridoids.
- **Efficacy:** Comparable to standard drugs like Ranitidine in rat models.
- **Safety:** High therapeutic index with low toxicity.

Future research should focus on isolating specific bioactive markers for standardization and conducting clinical trials to develop *J. grandiflorum* as a safe, herbal alternative or adjuvant in the management of peptic ulcer disease.

Conclusion

In conclusion, *Jasminum grandiflorum* demonstrates significant potential as a natural anti-ulcer agent due to its rich phytochemical composition, including flavonoids, tannins, and secoiridoid glycosides. Experimental studies indicate that the extract exerts gastroprotective effects through multiple mechanisms such as reducing gastric acid secretion, enhancing mucosal defense, and improving antioxidant activity. These combined actions help protect the gastric mucosa and reduce ulcer formation. Additionally, the plant exhibits a high safety margin with minimal toxicity in experimental models. Therefore, *Jasminum grandiflorum* may serve as a promising herbal alternative or complementary therapy in the management of peptic ulcer disease. However, further studies, particularly well-designed clinical trials and standardization of bioactive compounds, are necessary to fully establish its therapeutic efficacy and safety in humans.