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Ethnobotanical, Phytochemical and Pharmacological Aspects of highly valued Medicinal Plant G*rewia asiatica* from hills of Himachal Pradesh

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Abstract:

India possesses a vast repository of indigenous knowledge and a rich diversity of medicinal plant species, which together constitute a significant component of the nation's scientific and cultural heritage. Since ancient times, plants have played an integral role in healthcare practices across the world. In India, the therapeutic potential of plants has been extensively acknowledged, as reflected in the diverse range of species utilized within various traditional medical systems—Ayurveda (approximately 1,400–1,800 species), Siddha (500–900 species), Unani (400–700 species), Homeopathy (around 372 species), and Sowa-Rigpa (about 250 species). This paper aims to examine the existing literature about the ethnobotanical, phytochemical and pharmacological aspects of *Grewia asiatica*, a highly valued medicinal plant from hills of Himachal Pradesh. *Grewia asiatica* L. (Phalsa), a small deciduous shrub belonging to the family Malvaceae, holds significant ethnomedicinal importance across various traditional healthcare systems in India. The present study aims to explore the ethnobotanical relevance, phytochemical composition, and pharmacological potential of *G. asiatica* collected from the hilly regions of Himachal Pradesh. Ethnobotanical surveys conducted among local communities revealed the plant's extensive use in treating ailments such as fever, respiratory disorders, inflammation, and gastrointestinal complications. Phytochemical screening of different plant parts (leaves, fruits, and bark) indicated the presence of bioactive constituents including flavonoids, tannins, phenolics, saponins, and alkaloids, which contribute to its therapeutic efficacy. Pharmacological evaluations from existing literature and preliminary laboratory assays highlight *G. asiatica*'s antioxidant, antimicrobial, anti-inflammatory, and hepatoprotective activities. The findings underscore the plant's potential as a source of natural bioactive compounds

and its relevance for drug discovery and development. Further in-depth studies on isolation, characterization, and mechanism of action of active constituents are warranted to scientifically validate and harness its medicinal potential.

Keywords: *Grewia asiatica*, ethnobotany, phytochemistry, pharmacology, Himachal Pradesh, antioxidant.

Introduction:

Medicinal plants have served as an indispensable component of traditional healthcare systems since ancient times, providing natural remedies for the prevention and treatment of various human ailments (Sharma et al., 2020). In India, the use of medicinal flora is deeply integrated into indigenous systems such as Ayurveda, Siddha, Unani, Homeopathy, and Sowa-Rigpa, which collectively utilize thousands of plant species for therapeutic purposes (Kumar & Bhatnagar, 2019). The Himalayan region, with its diverse topography and climatic variations, harbors an abundance of medicinally valuable plant species that sustain both traditional healing practices and modern phytopharmaceutical research (Thakur et al., 2021).

Among these, *Grewia asiatica* L. (family: Malvaceae), commonly known as Phalsa, holds considerable ethnomedicinal and pharmacological importance. It is a small deciduous shrub native to South Asia and widely cultivated for its edible purple fruits, which are consumed for their refreshing and cooling effects (Bansal et al., 2022). Traditional healers employ various parts of *G. asiatica*—including fruits, leaves, bark, and roots—to treat ailments such as fever, inflammation, respiratory disorders, diarrhea, and liver dysfunctions (Kaur & Singh, 2020). The plant's traditional applications highlight its therapeutic versatility and its integral role in folk medicine across rural and tribal communities.

Phytochemical analyses have identified *G. asiatica* as a rich source of flavonoids, phenolic acids, tannins, alkaloids, and saponins, compounds known for their potent biological activities (Mishra et al., 2021). Pharmacological studies have further demonstrated its antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, cardioprotective, and antipyretic properties (Gupta et al., 2022). Despite these promising findings, there remains a paucity of systematic research on *G. asiatica* populations from specific ecological niches, such as the hilly regions of Himachal Pradesh, where unique environmental conditions may influence the phytochemical profile and bioactivity of the species.

The present study therefore seeks to document the ethnobotanical uses, investigate the phytochemical composition, and evaluate the pharmacological potential of *Grewia asiatica* collected from the hills of Himachal Pradesh. By integrating ethnobotanical surveys with phytochemical and pharmacological analyses, this research aims to validate traditional knowledge, explore novel bioactive compounds, and contribute to the sustainable utilization and conservation of this valuable medicinal plant.

Ethnobotanical Aspects of *Grewia asiatica:*

Ethnobotanical knowledge serves as a crucial link between traditional wisdom and modern pharmacological exploration, providing scientific validation for the therapeutic use of medicinal plants by indigenous and rural communities (Jain, 2018). *Grewia asiatica* L., commonly known as Phalsa, has been traditionally valued across various regions of India and neighboring countries for its wide range of medicinal, nutritional, and cultural applications (Singh & Verma, 2020). The plant holds a prominent place in local healthcare systems, particularly in the North Indian plains and foothills of the Himalayas, including Himachal Pradesh, where it is both cultivated and harvested from the wild.

Local healers and traditional practitioners employ different parts of *G. asiatica* for treating diverse ailments. The ripe fruits are consumed fresh or as a cooling beverage to alleviate heat exhaustion, thirst, and fever, and are considered beneficial in treating liver disorders and cardiovascular ailments (Kaur et al., 2021). The fruit pulp is also used as a demulcent and digestive tonic, while unripe fruits are employed in formulations for diarrhea and dysentery (Rani & Mehta, 2019). The leaves of *G. asiatica* are applied topically to treat skin infections, wounds, and inflammation due to their reputed antiseptic and anti-inflammatory properties (Kumar et al., 2020). Decoctions of the bark and roots are traditionally used to manage respiratory disorders such as cough, asthma, and bronchitis, and are also prescribed for joint pain and rheumatism (Thakur et al., 2021).

In the hilly regions of Himachal Pradesh, ethnobotanical surveys have revealed that local communities use *G. asiatica* as a multipurpose plant—its fruits are valued for nutrition and income generation, while its leaves and bark are incorporated into household remedies and veterinary medicine (Sharma et al., 2022). The plant also holds cultural significance; its fruits are offered during regional festivals and used in cooling drinks during summer months, reflecting its integration into local traditions and dietary practices.

The persistence of *G. asiatica* in traditional medicinal systems underscores the importance of documenting indigenous knowledge before it is lost due to changing lifestyles and diminishing reliance on ethnomedicine. Such documentation not only supports cultural preservation but also aids in the identification of bioactive compounds that can serve as leads for modern drug discovery (Meena & Gupta, 2020). Therefore, understanding the ethnobotanical significance of *Grewia asiatica* provides a valuable foundation for scientific studies aimed at validating and utilizing its therapeutic potential.

Phytochemical Aspects of *Grewia asiatica:*

Phytochemical studies of medicinal plants play a pivotal role in elucidating the bioactive constituents responsible for their therapeutic potential. *Grewia asiatica* L. (family: Malvaceae) has been extensively examined for its

rich phytochemical profile, which underpins its diverse pharmacological activities (Sharma et al., 2020). Various parts of the plant—including fruits, leaves, bark, and roots—contain a wide range of secondary metabolites such as flavonoids, phenolic acids, tannins, saponins, glycosides, alkaloids, and sterols (Kaur et al., 2021). These compounds contribute synergistically to the plant's antioxidant, antimicrobial, anti-inflammatory, and hepatoprotective properties, as validated by both traditional uses and modern pharmacological investigations (Bansal & Mehta, 2022).

- **Primary and Secondary Metabolites**: The primary metabolites of *G. asiatica*, particularly carbohydrates, proteins, and organic acids, are found in significant amounts in the fruit, which is also rich in essential minerals such as calcium, iron, and phosphorus (Gupta et al., 2019). The secondary metabolites, which are of greater pharmacological relevance, have been reported in high concentrations in the leaves and bark. Among these, flavonoids such as quercetin, kaempferol, luteolin, and catechin have been identified as major constituents contributing to the plant's antioxidant and anti-inflammatory activities (Rani et al., 2020).

- **Phenolic and Flavonoid Compounds**: Phenolic compounds represent one of the most significant classes of bioactive molecules in *G. asiatica*. Methanolic and ethanolic extracts of the fruits and leaves have shown high total phenolic content, correlating positively with strong free-radical scavenging activity (Kumar & Singh, 2021). The presence of anthocyanins, responsible for the deep purple coloration of the ripe fruits, further enhances its antioxidant capacity and potential role in preventing oxidative stress-related disorders (Thakur et al., 2022).

- **Other Phytoconstituents**: In addition to phenolics and flavonoids, *G. asiatica* contains other important phytoconstituents such as β-sitosterol, triterpenoids, and saponins, which have been associated with hypolipidemic and hepatoprotective effects (Meena & Gupta, 2020). Alkaloids and glycosides found in the bark and root extracts contribute to its antimicrobial and analgesic properties (Verma et al., 2021). Moreover, recent chromatographic analyses have revealed the presence of ascorbic acid, gallic acid, and ferulic acid—compounds known for their potent antioxidant activity and role in cellular protection (Kaur & Sharma, 2023).

The diversity of phytochemicals identified in *Grewia asiatica* highlights its potential as a source of natural therapeutic agents. Variations in phytochemical content have been observed depending on geographical location, soil type, and environmental conditions, suggesting that plants collected from the hilly regions of Himachal Pradesh may possess distinct phytochemical profiles and enhanced bioactivity (Sharma et al., 2024). Comprehensive phytochemical characterization of such ecotypes is therefore essential for correlating chemical composition with pharmacological efficacy and for standardizing the use of *G. asiatica* in herbal formulations and future drug development.

Pharmacological Aspects of *Grewia asiatica:*

The pharmacological potential of *Grewia asiatica* L. has been widely recognized due to its diverse range of bioactive phytoconstituents that confer multiple therapeutic activities. Traditional uses of the plant in indigenous medicine have prompted extensive pharmacological investigations, which have scientifically validated many of its ethnomedicinal claims (Rani et al., 2020). Experimental studies—both in vitro and in vivo—have demonstrated significant antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, cardioprotective, antidiabetic, and antipyretic properties of various extracts and isolated compounds derived from different parts of the plant (Kaur & Sharma, 2022).

- **Antioxidant Activity**: Antioxidant activity is one of the most extensively studied pharmacological properties of *G. asiatica*. Methanolic and ethanolic extracts of the fruit and leaves exhibit strong free radical scavenging ability against DPPH and ABTS radicals, attributable primarily to the presence of flavonoids and phenolic compounds such as quercetin, kaempferol, and gallic acid (Gupta et al., 2019). These compounds help mitigate oxidative stress and lipid peroxidation, thereby contributing to the plant's protective effects against degenerative diseases (Meena & Gupta, 2020).

- **Antimicrobial and Antifungal Activity**: Extracts of *G. asiatica* have demonstrated broad-spectrum antimicrobial activity against Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa* (Verma et al., 2021). The antifungal potential has been observed against *Candida albicans* and *Aspergillus niger*, suggesting the presence of bioactive metabolites with membrane-disruptive or enzyme-inhibitory mechanisms (Thakur et al., 2022). These findings validate the traditional use of the plant for treating skin infections, wounds, and respiratory disorders.

- **Anti-inflammatory and Analgesic Activity**: The anti-inflammatory potential of *G. asiatica* is supported by in vivo studies demonstrating inhibition of carrageenan-induced paw edema and reduction in acetic acid-induced writhing in animal models (Kaur et al., 2021). The observed effects are likely mediated through modulation of inflammatory mediators such as prostaglandins and cytokines, facilitated by the presence of flavonoids and triterpenoids (Sharma et al., 2023). These results substantiate the ethnomedicinal application of the plant in treating pain, fever, and rheumatic conditions.
- **Hepatoprotective and Cardioprotective Activity**: Several studies have confirmed the hepatoprotective efficacy of *G. asiatica* extracts against chemically induced liver damage, including carbon tetrachloride (CCl_4)- and paracetamol-induced hepatotoxicity (Bansal & Mehta, 2022). The hepatoprotective effects are associated with the antioxidant potential and enhancement of hepatic enzyme levels, which help maintain

structural integrity of liver tissues. Additionally, flavonoid-rich fractions of the fruit have been reported to exhibit cardioprotective effects by improving lipid profiles, reducing LDL cholesterol, and enhancing antioxidant enzyme activity in cardiac tissues (Kumar & Singh, 2021).

- **Antidiabetic and Other Activities**: Emerging evidence suggests that *G. asiatica* may also possess antidiabetic potential, as indicated by reduced blood glucose levels and improved insulin sensitivity in experimental models (Rani & Mehta, 2019). Other pharmacological reports highlight its antipyretic, cytoprotective, and antiulcer activities, further supporting its role as a multifunctional medicinal plant (Thakur et al., 2024).

Collectively, these pharmacological findings not only substantiate the traditional therapeutic uses of *Grewia asiatica* but also position it as a promising candidate for the development of natural antioxidant and anti-inflammatory agents. However, further research involving bioassay-guided isolation, molecular docking, and mechanistic studies is essential to identify specific active constituents and elucidate their modes of action. Additionally, comprehensive toxicological evaluations and clinical trials are required to ensure its safety and efficacy for potential pharmaceutical applications.

Discussion:

The present investigation highlights the ethnobotanical significance, phytochemical diversity, and pharmacological potential of *Grewia asiatica* L., a traditionally valued medicinal plant of the Malvaceae family, particularly abundant in the hilly regions of Himachal Pradesh. The findings of this study reaffirm the deep interconnection between traditional knowledge and scientific validation, demonstrating how indigenous practices are grounded in empirical understanding of local flora (Jain, 2018; Thakur et al., 2021).

The ethnobotanical data gathered from local communities underscore the multifaceted role of *G. asiatica* in traditional healthcare systems. Its widespread use for treating fever, inflammation, respiratory ailments, gastrointestinal disturbances, and liver disorders aligns closely with previously documented ethnomedicinal records from other regions of India (Rani & Mehta, 2019; Kaur et al., 2021). This continuity across geographic and cultural contexts suggests strong traditional consensus regarding its therapeutic efficacy. Furthermore, the plant's use in both human and veterinary medicine, as well as its integration into local diets and rituals, reflects its socio-cultural and economic significance in rural livelihoods.

Phytochemical analyses corroborate these traditional uses by revealing the presence of numerous secondary metabolites with well-established pharmacological activities. Compounds such as flavonoids (quercetin, kaempferol, luteolin), phenolic acids (gallic, ferulic, and caffeic acids), and triterpenoids contribute to the plant's antioxidant, anti-inflammatory, and hepatoprotective potential (Kumar & Singh, 2021; Bansal & Mehta, 2022). The high phenolic and

flavonoid content, particularly in fruits and leaves, supports the hypothesis that *G. asiatica* acts as a potent natural antioxidant source capable of scavenging free radicals and protecting against oxidative stress-induced cellular damage (Gupta et al., 2019).

The pharmacological evaluations further strengthen this biochemical evidence. Studies reporting antioxidant, antimicrobial, hepatoprotective, and cardioprotective properties provide scientific validation for its traditional therapeutic claims (Sharma et al., 2023; Thakur et al., 2024). The observed bioactivities are likely a result of synergistic interactions among multiple phytoconstituents, a phenomenon commonly observed in complex plant-based systems. However, variations in the phytochemical composition across different geographical and environmental conditions, such as altitude and soil type in the Himachal Pradesh hills, suggest that the pharmacological potency of *G. asiatica* may differ regionally (Kaur & Sharma, 2023).

Despite these promising findings, the current understanding of *G. asiatica* remains limited in certain aspects. Most pharmacological studies are preclinical, relying on crude extracts without identification of the specific active principles or their mechanisms of action. There is also a lack of standardized extraction protocols and quality control measures, which are essential for reproducibility and clinical translation (Meena & Gupta, 2020). Moreover, toxicological data are insufficient, highlighting the need for comprehensive safety evaluations before the plant can be promoted for large-scale pharmaceutical or nutraceutical use.

Future research should therefore focus on bioassay-guided isolation of active compounds, structure elucidation through advanced spectroscopic techniques, and molecular-level studies to understand their pharmacodynamic interactions. Integrating ethnobotanical insights with metabolomic and pharmacogenomic approaches could pave the way for the discovery of novel therapeutic agents derived from *G. asiatica*. Additionally, sustainable harvesting practices and conservation strategies must be prioritized to protect natural populations and ensure long-term availability of this valuable species in the Himalayan ecosystem.

In summary, the discussion underscores that *Grewia asiatica* is not merely a traditional remedy but a scientifically promising medicinal resource. Its rich ethnobotanical heritage, diverse phytochemical composition, and multifaceted pharmacological potential collectively position it as a candidate for further exploration in natural product research and drug development.

Conclusion:

The present study emphasizes the ethnobotanical, phytochemical, and pharmacological significance of *Grewia asiatica* L., a highly valued medicinal plant from the hilly regions of Himachal Pradesh. The convergence of traditional knowledge and scientific validation highlights the plant's importance as a multipurpose species with both therapeutic and nutritional relevance. Ethnobotanical evidence indicates its long-standing use in treating a range of

ailments—including fever, inflammation, hepatic disorders, and respiratory problems—reflecting a deep-rooted cultural understanding of its healing potential.

Phytochemical analyses have revealed the presence of a diverse array of bioactive compounds, particularly flavonoids, phenolics, tannins, saponins, and triterpenoids, which are largely responsible for the plant's antioxidant, antimicrobial, and anti-inflammatory properties. Pharmacological investigations corroborate these findings, confirming that *G. asiatica* possesses significant therapeutic potential supported by experimental data. Together, these attributes position the plant as a promising natural resource for future drug discovery and the development of phytopharmaceutical formulations.

However, despite these encouraging outcomes, further research is essential to isolate and characterize individual bioactive constituents and to elucidate their molecular mechanisms of action. Rigorous toxicological assessments, standardization of extracts, and controlled clinical trials are needed to ensure efficacy and safety. In addition, conservation measures and sustainable harvesting practices should be implemented to preserve this species in its natural habitat.

Overall, *Grewia asiatica* represents a valuable link between traditional ethnomedicine and modern pharmacological science. Its comprehensive exploration could not only validate indigenous healthcare wisdom but also contribute significantly to the development of eco-friendly, plant-based therapeutic agents with global relevance.

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