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Review Article

A Review on Pharmacological and Therapeutic Potential of *Grewia Optiva* (Bhimal Tree)

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ABSTRACT

Grewia optiva (Bhimal tree) is an important multipurpose medicinal plant widely distributed in the Himalayan region and traditionally used in various indigenous healthcare systems. The plant has gained significant scientific attention due to its wide range of pharmacological properties and rich phytochemical composition. Different parts of the plant, including leaves, bark, and roots, are used in traditional medicine for treating ailments such as fever, cough, diarrhea, dysentery, skin infections, and general weakness. The growing interest in herbal medicine has encouraged researchers to scientifically validate its ethnomedicinal claims.[1] Phytochemical investigations have revealed that *Grewia optiva* contains several bioactive compounds, including flavonoids, phenolic acids, tannins, alkaloids, saponins, and glycosides. These constituents are responsible for its diverse therapeutic activities. Among them, flavonoids and phenolic compounds play a major role in antioxidant and anti-inflammatory effects, while tannins and alkaloids contribute to antimicrobial and metabolic regulatory actions.[2] Pharmacological studies have demonstrated that *Grewia optiva* exhibits multiple biological activities such as antidiabetic, antioxidant, anti-inflammatory, antimicrobial, neuroprotective, and hypolipidemic effects. The antidiabetic potential is mainly associated with the inhibition of carbohydrate-digesting enzymes and improved glucose metabolism. Its antioxidant activity helps in scavenging free radicals and reducing oxidative stress, thereby preventing cellular damage. Anti-inflammatory effects are linked to the suppression of key inflammatory mediators, while antimicrobial properties help in inhibiting the growth of pathogenic microorganisms. Neuroprotective activity is attributed to cholinesterase enzyme inhibition, which may support cognitive function.[3]

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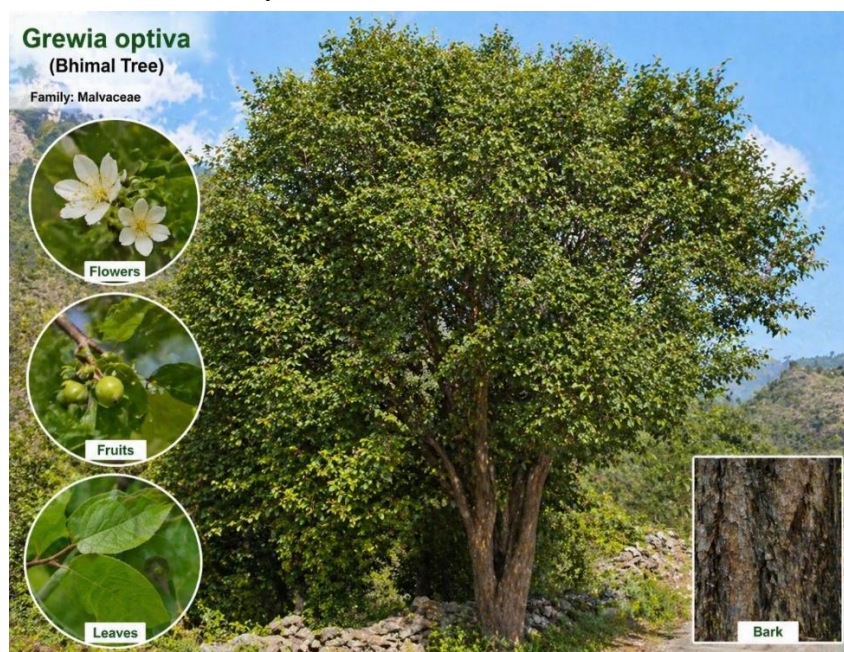
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INTRODUCTION

Medicinal plants have played a vital role in healthcare systems since ancient times, serving as a primary source of treatment for a wide range of diseases. In recent years, there has been a renewed interest in plant-based medicines due to their affordability, accessibility, and relatively fewer side effects compared to synthetic drugs. Among these, plants with potential activity against Diabetes Mellitus are receiving significant attention, as the global burden of this chronic condition continues to rise. The need for safer and more effective therapeutic alternatives has encouraged researchers to explore traditional medicinal plants and validate their uses through scientific studies.[4] *Grewia optiva*, commonly known as the Bhimal tree, is a multipurpose plant widely distributed in the Himalayan region and other parts of South Asia. Traditionally, different

parts of this plant, including leaves, bark, and fruits, have been used in folk medicine for treating various ailments such as cough, fever, wounds, and digestive disorders. In addition to its medicinal value, it also holds economic importance as a source of fodder and fiber. The ethnomedicinal relevance of *Grewia optiva* has prompted scientific investigations into its pharmacological properties.[5] Recent studies have revealed that *Grewia optiva* contains a variety of bioactive compounds, including flavonoids, phenolic compounds, tannins, and glycosides, which are known to exhibit significant biological activities. These constituents are believed to contribute to its antioxidant, anti-inflammatory, antimicrobial, and antidiabetic effects. Experimental research, particularly in animal models, has demonstrated its ability to lower blood glucose levels and improve metabolic parameters.[6]



Grewia optiva (commonly known as Bhimal tree) is an important multipurpose deciduous plant belonging to the family Malvaceae. It is widely distributed in the sub-Himalayan and Himalayan regions of India, Nepal, and adjoining countries. The plant holds significant ecological, economic,

and medicinal importance, especially in rural and mountainous communities where it contributes to livelihood through fodder, fuelwood, fiber, and traditional healthcare practices.[7] Traditionally, *Grewia optiva* has been used in various indigenous medicinal systems for the treatment of multiple

ailments. Different parts of the plant such as leaves, bark, and roots are utilized in folk remedies to manage conditions like fever, cough, diarrhea, dysentery, skin infections, and general weakness. The long-standing ethnomedicinal use of this plant reflects its therapeutic relevance and cultural importance among local populations.[8] In recent years, scientific interest in *G. optiva* has increased significantly due to its rich phytochemical composition and diverse pharmacological properties. Studies have revealed that the plant contains various bioactive compounds including flavonoids, phenolics, tannins, alkaloids, saponins, and glycosides. These constituents are primarily responsible for its antioxidant, antidiabetic, anti-inflammatory, antimicrobial, and neuroprotective activities.[9] *Grewia optiva* represents a valuable medicinal resource with strong traditional background and growing scientific evidence. Continued research is essential to fully explore its therapeutic potential and to develop safe and effective herbal formulations for modern healthcare systems.[10]

1. Botanical description and traditional use:

Grewia optiva, commonly known as Bhimal, is a medium-sized deciduous tree belonging to the family Malvaceae. It is widely distributed in the sub-Himalayan regions of India and adjoining countries such as Nepal and Pakistan. The tree typically attains a height of about 8–12 meters and is well adapted to hilly and semi-arid environmental conditions. It has a straight trunk with rough, greyish bark and simple, alternate leaves that are broadly ovate with serrated margins. The plant produces small yellow flowers arranged in clusters, followed by round, fleshy drupes as fruits.[11] In rural and traditional systems, *Grewia optiva* holds considerable importance due to its multiple uses. It is widely recognized as an important fodder tree because its

leaves are highly nutritious and are commonly used to feed cattle and goats. The wood of the tree is also utilized for fuel, agricultural implements, and small household tools, making it economically valuable for local communities.[12] Traditionally, different parts of the plant have been used in folk medicine for treating a variety of ailments. The leaves and bark are commonly employed in the management of fever, cough, skin infections, and digestive disorders. In some indigenous practices, plant extracts are also used to improve general weakness and support gastrointestinal health.[13] The long-standing ethnomedicinal applications of *Grewia optiva* suggest its therapeutic potential. These traditional claims have encouraged scientific investigations to explore its pharmacological properties, particularly its possible role in managing metabolic disorders such as Diabetes Mellitus.[14]

2. Phytochemical profile:

The pharmacological importance of *G. optiva* is attributed to its rich phytochemical composition. Major constituents include:

- Flavonoids
- Phenolic compounds
- Tannins
- Organic acids
- Lignans and glycosides

Grewia optiva is a medicinally important Himalayan plant that possesses a rich and diverse phytochemical composition, which is largely responsible for its wide range of pharmacological activities. Various studies have reported that different parts of the plant, including leaves, bark, roots, and stems, contain significant amounts of secondary metabolites such as flavonoids,



phenolic compounds, tannins, saponins, alkaloids, glycosides, and terpenoids.[15] Among these constituents, phenolic compounds and flavonoids are the most dominant and biologically active groups. These compounds are well known for their strong antioxidant potential, as they effectively neutralize free radicals and reduce oxidative stress in biological systems. Common flavonoids such as quercetin, kaempferol derivatives, and related glycosides have been identified, which contribute to anti-inflammatory, antidiabetic, and antimicrobial activities.[16] Tannins present in *G. optiva* exhibit astringent properties and are responsible for antimicrobial and wound-healing effects. Saponins contribute to membrane-stabilizing and cholesterol-lowering activities, while alkaloids are associated with various physiological effects, including analgesic and neuroprotective properties. Additionally, organic acids and lignans further enhance the plant's therapeutic profile by supporting metabolic regulation and cellular protection.[17] The synergistic interaction of these phytochemicals enhances the overall medicinal potential of the plant. Extraction studies using solvents such as methanol, ethanol, and aqueous systems have shown variation in phytochemical yield, with polar solvents generally extracting higher amounts of phenolic and flavonoid compounds.[18] Overall, the phytochemical richness of *Grewia optiva* strongly supports its traditional medicinal use and highlights its potential as a natural source for the development of novel therapeutic agents, particularly in managing oxidative stress-related disorders, diabetes, and inflammatory conditions.[19]

3. Pharmacological Activities:

Grewia optiva, commonly known as Bhimal, is a medicinally valuable plant of the Himalayan region that exhibits a broad spectrum of

pharmacological activities. These therapeutic effects are mainly attributed to its rich phytochemical composition, including flavonoids, phenolic compounds, tannins, saponins, alkaloids, and glycosides. The synergistic action of these constituents contributes to its potential in managing several diseases.[20]

4.1 Antidiabetic Activity

One of the most significant pharmacological properties of *G. optiva* is its antidiabetic effect. Experimental studies suggest that extracts of the plant help in lowering blood glucose levels by inhibiting key carbohydrate-metabolizing enzymes such as α -amylase and α -glucosidase. This delays carbohydrate digestion and glucose absorption, thereby reducing postprandial hyperglycemia. Additionally, the antioxidant compounds present in the plant protect pancreatic β -cells from oxidative stress, improving insulin secretion and glucose regulation. This dual mechanism supports its traditional use in diabetes management.[21]

4.2 Antioxidant Activity

The plant exhibits strong antioxidant potential due to its high content of phenolic and flavonoid compounds. These bioactive molecules scavenge free radicals and reactive oxygen species (ROS), thereby protecting cellular components such as lipids, proteins, and DNA from oxidative damage. This antioxidant activity plays an important role in preventing chronic diseases, including diabetes, cardiovascular disorders, aging-related conditions, and neurodegenerative diseases. Methanolic extracts generally show higher antioxidant activity compared to aqueous extracts due to better extraction of polyphenols.[22]

4.3 Anti-inflammatory Activity



G. optiva also possesses notable anti-inflammatory properties. Its extracts inhibit inflammatory mediators such as cyclooxygenase (COX) and lipoxygenase (LOX) enzymes, which are involved in the synthesis of prostaglandins and leukotrienes. The reduction in these mediators leads to decreased inflammation, swelling, and pain. The plant also modulates cytokine production, thereby suppressing inflammatory responses at the cellular level.[23]

4.4 Antimicrobial Activity

The antimicrobial potential of *G. optiva* has been demonstrated against several bacterial and fungal strains. Tannins and flavonoids present in the plant disrupt microbial cell walls, inhibit enzyme systems, and interfere with microbial metabolism. This makes the plant useful in treating infections and supporting wound healing applications.[24]

4.5 Neuroprotective Activity

The plant shows promising neuroprotective effects through inhibition of acetylcholinesterase (AChE) and butyrylcholinesterase (BChE). This leads to increased levels of acetylcholine in the brain, which is essential for memory and cognitive function. Such activity indicates potential usefulness in managing neurodegenerative disorders like Alzheimer's disease.[25]

4.6 Hypolipidemic and Hepatoprotective Activity

Preliminary studies suggest that *G. optiva* helps in reducing cholesterol and triglyceride levels, thereby improving lipid metabolism. It also exhibits hepatoprotective effects by reducing oxidative stress and enhancing liver enzyme function. Overall, *Grewia optiva* demonstrates strong pharmacological potential as a multi-target medicinal plant for the management of metabolic,

inflammatory, infectious, and neurodegenerative diseases.[26]

4. Mechanism of action:

The pharmacological effects of *Grewia optiva* are mainly driven by its rich phytochemical constituents such as flavonoids, phenolic compounds, tannins, saponins, and alkaloids. These bioactive molecules act on multiple molecular and cellular pathways, producing a broad range of therapeutic outcomes.[27] One of the primary mechanisms is **antioxidant action**, where phenolic compounds and flavonoids neutralize reactive oxygen species (ROS) and free radicals. This prevents oxidative damage to lipids, proteins, and DNA, thereby protecting cells from degeneration and supporting overall cellular health. This antioxidant defense is closely linked to its antidiabetic, neuroprotective, and cardioprotective effects.[28] In **antidiabetic activity**, *G. optiva* works by inhibiting key digestive enzymes such as α -amylase and α -glucosidase. This slows down the breakdown of complex carbohydrates into glucose, leading to reduced glucose absorption in the bloodstream. Additionally, the plant's antioxidant properties protect pancreatic β -cells from oxidative stress, thereby improving insulin secretion and glucose homeostasis.[29] The **anti-inflammatory mechanism** involves suppression of inflammatory mediators such as cyclooxygenase (COX) and lipoxygenase (LOX) enzymes. This leads to decreased production of prostaglandins and leukotrienes, which are responsible for pain, swelling, and inflammation. The modulation of cytokines such as TNF- α and IL-6 further contributes to reduced inflammatory responses.[30] For **neuroprotective effects**, bioactive compounds inhibit acetylcholinesterase (AChE) and butyrylcholinesterase (BChE), resulting in increased acetylcholine levels in the

brain. This enhances neurotransmission and supports memory and cognitive function, suggesting potential benefits in neurodegenerative diseases like Alzheimer's.[31] In **antimicrobial activity**, tannins and flavonoids disrupt microbial cell walls, inhibit enzyme systems, and interfere with protein synthesis, leading to microbial growth inhibition. Overall, *Grewia optiva* exhibits a multi-target mechanism involving antioxidant defense, enzyme inhibition, and modulation of inflammatory and metabolic pathways, making it a promising therapeutic plant for various chronic diseases.[32]

5. Recent Scientific Developments:

In recent years, *Grewia optiva* has gained increasing scientific attention due to its wide range of pharmacological potential and its role in sustainable drug discovery. Modern research has shifted from traditional ethnomedicinal use toward advanced phytochemical profiling, bioactivity evaluation, and mechanistic studies.[33]

1. Advanced Phytochemical Investigations

Recent studies have focused on detailed identification and classification of bioactive compounds present in *G. optiva*. Using modern analytical techniques such as HPLC, GC-MS, and LC-MS, researchers have confirmed the presence of flavonoids, phenolic acids, tannins, lignans, and glycosides. These compounds are strongly associated with antioxidant, antidiabetic, and anti-inflammatory effects. Current findings also emphasize the dominance of flavonoids as major therapeutic agents contributing to its medicinal value.

2. Antidiabetic and Metabolic Research

Recent pharmacological studies have validated the antidiabetic potential of *G. optiva* through in vitro

enzyme inhibition assays. The plant extracts effectively inhibit α -amylase and α -glucosidase enzymes, supporting its role in controlling postprandial blood glucose levels. Ongoing research is also exploring its effect on insulin signaling pathways and glucose uptake at the cellular level.

3. Antioxidant and Anti-inflammatory Advancements

Modern investigations have demonstrated strong free radical scavenging activity of *G. optiva*, linking it to prevention of oxidative stress-related disorders. Recent molecular studies highlight its ability to regulate inflammatory pathways by suppressing enzymes like COX and LOX, along with downregulation of pro-inflammatory cytokines. These findings support its potential use in chronic inflammatory diseases.

4. Neuroprotective and Enzyme Inhibition Studies

Recent scientific development includes cholinesterase inhibition assays, showing that *G. optiva* extracts can inhibit acetylcholinesterase and butyrylcholinesterase enzymes. This suggests its possible role in improving cognitive function and managing neurodegenerative diseases such as Alzheimer's.

5. Agro-pharmacological and Biotechnological Applications

Beyond pharmacology, recent studies have explored its role in agroforestry systems, biomass production, and soil conservation in Himalayan regions. Researchers are also investigating tissue culture and biotechnological approaches for large-scale propagation and conservation of this valuable species.

6. Therapeutic Potential:



Grewia optiva is a medicinally important Himalayan plant with significant therapeutic potential due to its rich composition of bioactive compounds such as flavonoids, phenolics, tannins, saponins, and alkaloids. These constituents contribute to its wide range of biological activities, making it a promising candidate for the management and prevention of various chronic and infectious diseases.[34] One of the major therapeutic applications of *G. optiva* is in the management of diabetes mellitus. The plant helps regulate blood glucose levels by inhibiting carbohydrate-digesting enzymes and improving insulin sensitivity. Its antioxidant properties also protect pancreatic cells from oxidative damage, supporting better glycemic control.[35] The plant also exhibits strong antioxidant and anti-aging potential, as it effectively scavenges free radicals and reduces oxidative stress. This helps in preventing cellular damage associated with aging, cardiovascular diseases, and neurodegenerative disorders.[36] In terms of anti-inflammatory and analgesic effects, *G. optiva* reduces inflammation by suppressing key mediators involved in pain and swelling. This supports its traditional use in treating fever, body pain, and inflammatory conditions.[37] Its antimicrobial activity further enhances its therapeutic importance, as extracts of the plant inhibit the growth of various bacterial and fungal pathogens. This makes it useful in treating infections and promoting wound healing.[38] Additionally, the plant shows neuroprotective potential by inhibiting cholinesterase enzymes, which may help in improving memory and cognitive function, suggesting possible application in diseases like Alzheimer's.[39] Overall, *Grewia optiva* demonstrates multi-dimensional therapeutic potential, including antidiabetic, antioxidant, anti-inflammatory, antimicrobial, and neuroprotective effects. These properties strongly support its traditional medicinal use and highlight

its importance as a natural source for future drug development and herbal formulation research.[40]

CONCLUSION

Grewia optiva (Bhimal tree) is a highly valuable medicinal and multipurpose plant native to the Himalayan region, with strong traditional, ecological, and pharmacological significance. Ethnomedicinally, it has been used for generations in rural healthcare systems to manage common ailments such as fever, cough, diarrhea, dysentery, skin infections, and general weakness. This long-standing traditional use strongly supports its therapeutic relevance and encourages scientific validation. Phytochemical investigations have confirmed that *Grewia optiva* is rich in bioactive constituents including flavonoids, phenolic compounds, tannins, saponins, alkaloids, and glycosides. These compounds are primarily responsible for its wide range of biological activities. The synergistic action of these phytochemicals contributes to its antioxidant, antidiabetic, anti-inflammatory, antimicrobial, neuroprotective, and hypolipidemic properties. Pharmacological studies have demonstrated that the plant effectively reduces oxidative stress by scavenging free radicals, thereby protecting cells from damage. Its antidiabetic activity is associated with the inhibition of carbohydrate-digesting enzymes and improved glucose metabolism. Anti-inflammatory effects are mediated through suppression of inflammatory mediators, while antimicrobial activity helps in controlling pathogenic microorganisms. Additionally, neuroprotective potential through cholinesterase inhibition suggests its usefulness in managing cognitive disorders such as Alzheimer's disease. Recent scientific developments have further highlighted its importance in drug discovery and herbal formulation research. Despite these promising findings, most studies are still in the



experimental stage, and limited clinical evidence is available. Therefore, more in-depth toxicological studies, clinical trials, and standardized extraction methods are required to fully establish its safety, efficacy, and dosage parameters. *Grewia optiva* stands as a promising medicinal plant with broad therapeutic potential and strong ethnopharmacological background. Its diverse pharmacological activities make it an important candidate for future natural drug development, supporting its integration into modern healthcare systems while also promoting its sustainable utilization and conservation.

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