



## A COMPREHENSIVE REVIEW OF MEDICINAL PROPERTIES & PHARMACOLOGICAL RESEARCH OF *GYPSOPHILA PANICULATA* LINN

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### ABSTRACT

*Gypsophila paniculata* L., commonly known as baby's breath and belonging to the *Caryophyllaceae* family, has long been utilized in traditional medicine for managing respiratory, digestive, and metabolic conditions. This review summarizes existing information on its ethnomedicinal relevance, chemical constituents, and biological activities. Phytochemical studies have identified several important compounds, including triterpene saponins (particularly gypsogenin-based derivatives), flavonoids, phenolic compounds, glycosides, and fatty acids, which are believed to contribute to its medicinal effects. Various experimental models have demonstrated notable antioxidant potential, evaluated through assays such as DPPH, FRAP, and nitric oxide scavenging, largely linked to its polyphenol content. Animal studies also suggest significant antidiabetic properties, including lowering of blood glucose levels, improvement in lipid metabolism, and reduction of oxidative stress, with effects comparable to established drugs like metformin. Furthermore, the plant has shown anti-inflammatory activity by influencing inflammatory mediators and regulating NF-κB signaling pathways. Additional studies indicate hepatoprotective and lipid-lowering effects, supporting its possible role in treating metabolic disorders. Findings from other species within the *Gypsophila* genus point to additional activities such as cytotoxic, neuroprotective, and anti-obesity effects. However, detailed toxicity studies and clinical evidence remain insufficient. Therefore, although *G. paniculata* shows promise as a source of therapeutic agents, further investigations focusing on mechanisms of action, standardization, and safety are necessary before clinical application.<sup>[1,2,3,4,5,6,7]</sup>

**KEYWORDS:** *Gypsophila paniculata*, *Caryophyllaceae*, triterpene saponins, gypsogenin, antioxidant activity, antidiabetic activity, anti-inflammatory activity, hepatoprotective effect, hypolipidemic activity, phytochemistry, medicinal plants, metabolic disorders.

### INTRODUCTION

*Gypsophila paniculata* L., widely recognized as baby's breath, is a perennial species belonging to the *Caryophyllaceae* family and is extensively cultivated for ornamental purposes. In addition to its decorative value, it has been traditionally employed in various regional healing practices. Preparations derived from its roots and aerial parts have been used to manage conditions such as respiratory disorders, digestive issues, and metabolic imbalances. In recent years, increasing scientific attention has been directed toward this plant and related *Gypsophila* species, largely due to their diverse

phytochemical profile and potential therapeutic applications.<sup>[8,9]</sup>

### ETHNOMEDICINAL AND TRADITIONAL USES

In traditional medicinal systems, *Gypsophila paniculata* and related species have been utilized for managing respiratory conditions, largely attributed to their expectorant effects. They have also been employed in the treatment of digestive disturbances, where their gastroprotective properties are considered beneficial. In certain cultural practices, different parts of the plant have been used as a gentle laxative and for promoting overall

health. Furthermore, the roots, known for their high saponin content, hold significance in traditional Chinese medicine, where they are used as supportive remedies for conditions such as rheumatic disorders and liver-related ailments.<sup>[2,3]</sup>

### PHYTOCHEMICAL COMPOSITION

Phytochemical investigations indicate that *Gypsophila paniculata* is rich in diverse bioactive constituents, with triterpene saponins—particularly gypsogenin-based compounds—being among the main components. In addition, the plant contains appreciable levels of phenolic acids, flavonoids, and other secondary metabolites that contribute to its biological activity. Analytical studies using techniques such as GC–MS have reported numerous compounds in stem extracts, including glycosides, fatty acids, and phenolic derivatives like 4-hydroxy-3-methoxystyrene, which may play a role in antioxidant mechanisms. The abundance of saponins is especially significant, as these compounds are widely associated with various pharmacological effects, and ongoing isolation studies continue to highlight their structural diversity.<sup>[3,8,9]</sup>

### ANTIOXIDANT ACTIVITY

The antioxidant capacity of medicinal plants represents a key pharmacological property. Extracts of *Gypsophila paniculata* have shown moderate to strong antioxidant activity in various *in vitro* models, including DPPH, FRAP, and nitric oxide scavenging assays. These effects are largely associated with the presence of polyphenolic compounds and flavonoids identified through HPLC–MS analysis, such as luteolin and apigenin derivatives. These constituents are known to counteract reactive oxygen species and contribute to the maintenance of cellular redox balance.<sup>[6,10]</sup>

### ANTIDIABETIC AND METABOLIC EFFECTS

Recent *in vivo* studies evaluating the ethanol extract of *Gypsophila paniculata* in streptozotocin-induced diabetic rat models have demonstrated notable effects on glucose homeostasis, oxidative balance, and lipid metabolism. Treatment with GPEE was associated with a reduction in oxidative and inflammatory biomarkers, including total oxidative status and malondialdehyde levels, alongside an enhancement of endogenous antioxidant defences. Furthermore, the extract significantly lowered fasting blood glucose and improved lipid parameters such as cholesterol and triglycerides. These effects were reported to be comparable to those of established antidiabetic drugs like metformin, indicating the potential of ethanol extract of *Gypsophila paniculata* as a supportive therapeutic agent in diabetes management.<sup>[5,6]</sup>

### ANTI-INFLAMMATORY AND IMMUNOMODULATORY EFFECTS

Inflammatory processes play a crucial role in the development and progression of various chronic metabolic and degenerative disorders. Experimental studies have shown that the ethanol extract of

*Gypsophila paniculata* possesses notable anti-inflammatory activity, evidenced by the suppression of key pro-inflammatory cytokines, including IL-1 $\beta$  and IL-18, as well as the inhibition of NF- $\kappa$ B signaling in diabetic animal models. These observations suggest that the anti-inflammatory effects of the plant may be closely associated with its antioxidant capacity, thereby supporting its potential application in the management of inflammation-related conditions.<sup>[6,11]</sup>

### HEPATOPROTECTIVE AND HYPOLIPIDEMIC ACTIVITIES

In addition to its antidiabetic activity, *Gypsophila paniculata* extract has demonstrated hepatoprotective effects in experimental models. Treatment with the ethanol extract was associated with a reduction in elevated hepatic enzyme levels, particularly AST and ALT, which are indicative of liver injury. These findings suggest a potential role for the extract in alleviating liver dysfunction commonly linked to metabolic disorders. Furthermore, the observed hypolipidemic effects in treated groups point toward an overall improvement in metabolic health, which may contribute to lowering cardiovascular risk in conditions such as diabetes.<sup>[7,12]</sup>

### OTHER PHARMACOLOGICAL ACTIVITIES IN GYPSOPHILA SPECIES

Investigations across various *Gypsophila species*, including *G. oldhamiana*, have revealed a wide range of pharmacological activities that extend beyond those specifically reported for *Gypsophila paniculata*. These activities encompass hepatoprotective, cytotoxic (potential anticancer), anti-inflammatory, neuroprotective, diuretic, and anti-obesity effects, which are attributed to diverse classes of phytochemicals such as cyclopeptides, alkaloids, and terpenoids. This diversity underscores the therapeutic potential of the genus and highlights opportunities for the discovery of novel bioactive compounds.

At the molecular level, triterpenoid saponins are believed to exert their biological effects through interactions with cell membranes, influencing membrane permeability and cellular signaling pathways. Experimental studies using crude extracts have demonstrated cytotoxic activity against macrophage cell lines, suggesting potential anticancer properties. Compounds such as gypsogenin 3-O-glucuronide derivatives have been proposed to contribute to these cytotoxic effects. Collectively, these findings indicate that members of the *Caryophyllaceae* family warrant further investigation as potential sources of anticancer agents.<sup>[9,13,14,15,16,17]</sup>

### TOXICOLOGY AND SAFETY CONSIDERATIONS

Although the pharmacological potential of *Gypsophila paniculata* and related species is increasingly recognized, detailed evaluations of their safety and toxicity remain insufficient. Traditional use may indicate a relatively broad therapeutic margin for many plant-based preparations; however, systematic studies assessing acute

and chronic toxicity, particularly at higher doses, are still lacking. Preliminary findings from related *Gypsophila* species suggest that saponin-rich extracts possess notable biological activity, underscoring the need for careful toxicological assessment and further investigation.<sup>[9,10]</sup>

### CONCLUSIONS AND FUTURE DIRECTIONS

*Gypsophila paniculata* L. remains a relatively underexplored medicinal plant with a growing body of evidence supporting its antioxidant, antidiabetic, anti-inflammatory, hepatoprotective, and metabolic regulatory properties. These pharmacological effects are largely attributed to key bioactive constituents, particularly triterpene saponins and flavonoids. Despite these promising findings, further investigations are required, including well-designed clinical trials, in-depth mechanistic studies, standardized extract characterization, and comprehensive safety evaluations to substantiate its therapeutic efficacy and facilitate its transition from traditional use to evidence-based medicine. Continued research focusing on pharmacological validation and bioactive compound isolation will be essential to fully harness the medicinal potential of *G. paniculata*.<sup>[8,9]</sup>

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