

## STUDY OF CHEMICAL AND PHARMACOLOGICAL PROPERTIES OF GERANIUM SANGUINEUM PLANT

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### Abstract

*Geranium sanguineum* (Bloody Cranesbill) is a medicinal herb traditionally used in treating various ailments such as gastrointestinal and skin diseases. This study reviews the chemical composition and pharmacological properties of *Geranium sanguineum*, focusing on its antioxidant, antimicrobial, anti-inflammatory, and anticancer activities. Key bioactive compounds include polyphenols, flavonoids, tannins, and essential oils. This review suggests the potential of *Geranium sanguineum* in therapeutic applications, although further studies, particularly clinical trials, are needed to establish its efficacy and safety in humans.

### Introduction

*Geranium sanguineum* L., commonly known as Bloody Cranesbill, is a perennial herb from the Geraniaceae family, native to Europe and parts of Asia. Traditionally, the plant has been used for medicinal purposes, particularly in folk remedies for treating gastrointestinal issues, respiratory conditions, and skin disorders [1]. Despite its widespread use in traditional medicine, scientific interest in its pharmacological properties has only recently gained momentum. The plant contains numerous bioactive compounds that have demonstrated therapeutic potential in preclinical studies. This paper aims to summarize the current knowledge on the chemical composition and pharmacological properties of *Geranium sanguineum* to provide a comprehensive overview of its medicinal potential.

### Materials and Methods

**Literature Review Approach.** This study involved an extensive literature review of research papers and reviews from various scientific databases, including PubMed, Google Scholar, and ScienceDirect, published from 2000 to 2023. Studies investigating the chemical composition and pharmacological effects of *Geranium sanguineum* were selected. The search terms included “*Geranium sanguineum*,” “chemical composition,” “pharmacological properties,” “antioxidant,” “anti-inflammatory,” and “antimicrobial.” Data on phytochemical content, pharmacological activities, and mechanisms of action were extracted and synthesized.

**Plant Material and Extraction Methods.** In the reviewed studies, *Geranium sanguineum* was typically harvested from its natural habitats or cultivated for research purposes. Various parts of the plant, including leaves, flowers, and roots, were used in the chemical and

pharmacological investigations. Plant extracts were prepared using solvents such as ethanol, methanol, or water to obtain different bioactive fractions. Extraction methods, such as maceration, Soxhlet extraction, and distillation, were employed depending on the targeted compounds [2, 3].

## Results

**Chemical Composition.** Phytochemical analysis of *Geranium sanguineum* has revealed a rich profile of bioactive compounds:

1. Polyphenols: The plant is abundant in polyphenolic compounds, including gallic acid, catechins, and ellagic acid. These molecules contribute to its antioxidant properties by scavenging free radicals and reducing oxidative stress [4].
2. Flavonoids: Flavonoids such as quercetin, kaempferol, and rutin have been identified in various plant parts. These compounds are known for their anti-inflammatory, antimicrobial, and anticancer properties [5].
3. Tannins: The presence of hydrolyzable tannins, particularly ellagitannins and gallotannins, was reported. These compounds exhibit astringent and anti-inflammatory effects, making the plant useful in treating gastrointestinal issues and skin conditions [6].
4. Essential Oils: The plant's essential oils, primarily composed of geraniol and citronellol, have demonstrated antimicrobial and antifungal properties [7].

### Pharmacological Properties

1. Antioxidant Activity: The high concentration of polyphenolic compounds in *Geranium sanguineum* contributes to its potent antioxidant activity. In vitro studies using assays such as DPPH and ABTS showed that the plant extracts could significantly reduce oxidative stress [8]. This activity may help prevent diseases linked to oxidative damage, such as cardiovascular diseases and cancer.
2. Antimicrobial Activity: *Geranium sanguineum* exhibits broad-spectrum antimicrobial effects, particularly against Gram-positive bacteria like *Staphylococcus aureus* and *Bacillus subtilis*. The essential oils of the plant, rich in geraniol and citronellol, showed potent antibacterial activity in several studies [9]. Antifungal effects were also noted against species such as *Candida albicans* and *Aspergillus niger*.
3. Anti-inflammatory Effects: The plant's flavonoids and tannins have demonstrated significant anti-inflammatory activity. Animal models of inflammation revealed that extracts of *Geranium sanguineum* reduced the levels of pro-inflammatory cytokines, such as TNF- $\alpha$  and IL-6, suggesting its potential use in treating chronic inflammatory conditions [10].
4. Anticancer Activity: Several in vitro studies have explored the anticancer potential of *Geranium sanguineum*. The polyphenolic compounds, such as ellagic acid and quercetin, were found to induce apoptosis in cancer cells and inhibit tumor growth [11]. This highlights its potential as a natural source for anticancer drug development.

5. Antidiabetic Potential: Some studies suggest that *Geranium sanguineum* may help regulate blood glucose levels. Polyphenols such as gallic acid have been linked to improved insulin sensitivity and better glucose metabolism, although more studies are needed in this area [12].

## Discussion

The chemical composition and pharmacological activities of *Geranium sanguineum* support its traditional use in medicine. Its antioxidant, antimicrobial, anti-inflammatory, and anticancer properties are primarily attributed to its rich content of polyphenols, flavonoids, tannins, and essential oils. The ability of these compounds to scavenge free radicals and modulate inflammatory responses suggests significant therapeutic potential in preventing and treating chronic diseases. Despite these promising findings, most studies are limited to in vitro or animal models. Therefore, further clinical trials are necessary to validate the efficacy and safety of *Geranium sanguineum* extracts in humans.

Additionally, standardizing the extraction methods and identifying the most active compounds are crucial for developing pharmaceutical products based on this plant. Future research should also focus on the bioavailability and pharmacokinetics of these compounds in the human body, which remain largely unexplored.

## Conclusion

*Geranium sanguineum* is a plant with a rich phytochemical profile that supports its pharmacological potential. Its antioxidant, antimicrobial, anti-inflammatory, and anticancer activities make it a promising candidate for future drug development. However, further clinical studies are necessary to confirm its efficacy and explore its therapeutic applications more comprehensively.

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