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Pharmacological Potential of *Tecoma gaudichaudii*: A Comprehensive Review of Its Bioactive Compounds and Therapeutic Prospects

Pranjal Solanki & Dr. Sushma Dubey
Department of biotechnology, Kalinga University, Naya Raipur, Chhattisgarh

Abstract: *Tecoma gaudichaudii*, a member of the Bignoniaceae family, has gained attention for its diverse pharmacological properties. Traditionally used in herbal therapy, this plant has possible antioxidant, antibacterial, antidiabetic, and anti-inflammatory properties. Phytochemical research shows the existence of flavonoids, tannins, steroids, saponins, and triterpenes, which enhance its therapeutic efficacy. Studies have shown its antioxidant activity by means of tests including the DPPH radical scavenging technique, revealing significant free radical neutralization. Tested against *Staphylococcus aureus*, *Bacillus subtilis*, *Proteus vulgaris*, and *Escherichia coli*, ethanolic extracts show significant inhibitory zones reflecting its antimicrobial properties. *Tecoma gaudichaudii* has also showed potential in antidiabetic uses, with research suggesting it may boost insulin production and control glucose metabolism. Notwithstanding these encouraging results, further molecular investigations and clinical trials are needed to confirm its pharmacological potential. A good contender for drug development and integrative medicine, the plant shows a broad spectrum of medicinal uses with its bioactive chemicals. To prove its usefulness in contemporary pharmacology, further studies should concentrate on mechanistic routes, dose optimization, and safety profiles.

Keywords: Tecoma gaudichaudii, Antioxidant activity, Herbal therapy, Antimicrobial, Antidiabetic activity

I. Introduction

Throughout history, medicinal plants have been invaluable sources for developing therapeutic agents, providing a diverse reservoir of bioactive compounds that address various health conditions. Among these, *Tecoma gaudichaudii*, a species within the Bignoniaceae family, has attracted scientific interest due to its traditional medicinal uses and promising pharmacological properties. Early research shows that this plant has strong antimicrobial, anti-inflammatory, and antioxidant properties. These are due to its high phytochemical content, which includes flavonoids and phenolic acids, which are often linked to health benefits. Additionally, studies on related plant species highlight the importance of these compounds as contributors to antioxidant capacity and potential therapeutic functions. Because of these things, studying *Tecoma gaudichaudiii's* pharmaceutical potential could lead to new ways to treat diseases. This is especially true now that natural and effective treatments are becoming more popular in medicine (Muhammad eta al., 2024; Olena et al., 2020). This review aims to critically assess the pharmacological prospects of *Tecoma gaudichaudii* in context of pharmaceutical activities. By examining the bioactive compounds present in *Tecoma gaudichaudiii* and their potential health benefits, this research seeks to provide valuable insights for future drug development and healthcare practices. Understanding the pharmacological properties of this plant species could lead to the discovery of new therapeutic agents that could revolutionize medical treatments. Furthermore, understanding the pharmacological properties of *Tecoma gaudichaudiii* could lead to the development of new drugs or supplements derived from its bioactive compounds. By investigating its potential therapeutic effects, researchers may discover innovative ways to address various health conditions and improve patient outcomes.

II. Overview of *Tecoma gaudichaudii* and its traditional uses:

Traditional medicinal plants have long served as vital resources in developing novel pharmaceutical agents, driven by their diverse bioactive compounds and historical therapeutic applications. *Tecoma gaudichaudii*, a flowering plant belonging to the Bignoniaceae family, has garnered interest due to its extensive traditional uses across various cultures. Historically, parts of the plant have been employed to treat ailments such as fever, inflammation, and infections, attributed to its rich phytochemical profile that includes flavonoids, alkaloids, and phenolic compounds. These constituents are thought to contribute to its antioxidative, antimicrobial, and anti-inflammatory properties, which parallel findings in related species like Tecoma stans and Tecoma alata, both exhibiting promising pharmacological activities, including hepatoprotective and anticancer potentials (Balasubramanian et al., 2024; Muhammad et al., 2024). The accumulated ethnomedicinal knowledge surrounding *Tecoma gaudichaudii* underscores its significance as a candidate for further pharmacological research aimed at validating and harnessing its therapeutic capabilities.

III. Morphology: *Tecoma gaudichaudii*, often referred to as Gaudi Chaudi, is a member of the Bignoniaceae family, usually measuring 2 to 4 meters tall. The plant is known for its bright yellow trumpet-shaped flowers, which bloom throughout the year in flushes and its green, glossy leaves are arranged oppositely on the stem. Microscopic morphological studies have analyzed stomatal count, vein islet count, and vein termination count to assess the plant. Furthermore, many physico-chemical characteristics, including ash value, acid-insoluble ash value, and moisture content, have been evaluated to determine the purity of the crude medicine obtained from this plant (Abhimanyu et al., 2013).

IV. Phytochemical composition:

A member of the Bignoniaceae family, *Tecoma gaudichaudii* is recognized for its medicinal properties and has several bioactive compounds. Research shows that the plant is abundant in flavonoids, alkaloids, steroids, tannins, phenols, saponins, and triterpenes, which support its antioxidant, anti-inflammatory, antibacterial, and cytotoxic activities.

- Phytochemical Composition and Medicinal Properties:
- Flavonoids: Free radical scavengers, they lower oxidative stress and stop cell damage.
- Alkaloids & Steroids: Improve antibacterial and antifungal action, therefore enabling the plant to combat the growth of *Staphylococcus aureus, Bacillus subtilis, Proteus vulgaris, and Escherichia coli*.
- Saponins & Tannins: Show anti-inflammatory effects and help with wound healing, hence reducing discomfort and swelling.
- Triterpenes: Indicate possible uses in cancer treatment by showing antitumor effects.
- Phenols: Shows high antioxidant activity which can protect from several chronic diseases

V. Cytology, reproduction and genetic diversity:

From detailed analysis of plant's cellular structure including trichomes, which is responsible for species differentiation and environmental adaptation. Quantitative microscopic observation has also been done by Hawary et al. (2023) to evaluate screen stomatal number, vein islet and termination number for microscopic identification of the species. From microscopic analysis, the presence of non-glandular unicellular and multicellular trichomes has been observed. It can reproduce through seeds and vegetative propagation and the presence of flavonoids, triterpenoids and tannins may influence seed viability and pollination (Abhimanyu et al., 2022). Advanced molecular techniques like Random Amplified Polymorphic DNA (RAPD) markers have been used to study genetic variability among Tecoma species, which revealed high degree of genetic similarity between Tecoma species and it also showed adaptation behavior of the Tecoma species towards biotic and abiotic stresses.

VI. Pharmacological Properties:

Research on similar species in the Tecoma genus uncovers a range of bioactive compounds that highlight their medicinal potentials which might guide the examination of *Tecoma gaudichaudii's* pharmacological properties. For instance, *Tecoma stans* exhibits diverse bioactivities, including antioxidant, anti-inflammatory, antimicrobial, and anticancer effects, chiefly attributed to flavonoids, alkaloids, and phenolic constituents present in the leaves. These compounds contribute to its ability to heal wounds, manage diabetes, and protect the liver, highlighting its multifaceted pharmacological profile (Balasubramanian et al., 2024). Similarly, *Tecoma alata* has been characterized by significant antimicrobial, antidiabetic, hepatoprotective, and cytotoxic effects that further reinforce the therapeutic versatility of the genus. The plant's analgesic and antipyretic activities, alongside its potential in combating oxidative stress and chronic diseases, suggest that *Tecoma gaudichaudii* may possess comparable mechanisms worth exploring for pharmaceutical applications

(Muhammed et al., 2024). Such pharmacological insights establish a promising foundation for future clinical investigations. However, toxicological profiling remains underexplored. Preliminary studies should be conducted to determine acute and chronic toxicity, LD_{50} values, and possible contraindications when used alongside existing pharmaceuticals.

VII. Therapeutic properties:

7.1. Anti-cancer properties: *Tecoma gaudichaudii* has been investigated for its cytotoxic and antioxidant characteristics; nonetheless, its efficacy against cancer cells remains indeterminate. Investigations have examined its effects on melanoma cell lines including MCF-7, B16F10, B16F1, SK-MEL-2, and MDA-MB-231, using in vitro cytotoxic tests. Extracts from ethyl acetate, ethanol, and petroleum ether were determined to be ineffective at concentrations between 10-80 µg/ml. Although these compounds are promising, further in-depth investigations are required to validate their anticancer efficacy.

7.2. Antidiabetic properties: In some Asian countries like India and Bangladesh, *Tecoma gaudichaudii* believed to have tremendous antidiabetic properties and has been used as folk medicine from ancient times (Rahmatullah et al, 2010). The presence of phytochemicals in it play a vital role in enhancing insulin secretion, reducing oxidative stress as well as modulating glucose metabolism and can regulate blood glucose level.

7.3. Antimicrobial properties: *Tecoma gaudichaudii* has exhibited substantial antimicrobial properties against various bacterial and fungal pathogens. Research indicates that its ethanolic extract demonstrates pronounced antibacterial effects against *Staphylococcus aureus, Bacillus subtilis, Proteus vulgaris,* and *Escherichia coli.* The antibacterial activity was evaluated using the agar well diffusion method, with ciprofloxacin (50 µg/mL) serving as the standard reference antibiotic. The findings revealed significant inhibition zones, indicating that the plant possesses considerable antibacterial potential. Furthermore, preliminary studies have investigated its antifungal activity, although additional research is necessary to ascertain its comprehensive antifungal effects. The presence of flavonoids, steroids, saponins, triterpenes, and phenols in *Tecoma gaudichaudii* enhances its antimicrobial properties, rendering it a promising candidate for natural antimicrobial agents .

7.4. Antioxidant properties: From previous research, the antioxidant activity of *Tecoma gaudichaudii* has been evaluated by DPPH scavenging assay, phosphomolybdenum assay, reducing power assay and hydroxyl radical scavenging assay (Kedar et al, Alekhya et al., 2022). An investigation carried out by Ravishankar et al. (2018) demonstrated the antioxidant potential of ethanolic extract of *Tecoma gaudichaudii* which showed significant antioxidant potential with IC50 values of 22.3 µg/mL in the hydroxyl radical scavenging assay and 21.42 µg/mL in the DPPH method. These findings imply that the plant has significant free radical scavenging potential, which might support its therapeutic uses (Olena et al., 2020).

7.4. Potential uses in treating specific diseases and conditions:

The exploration of medicinal plants continues to reveal promising candidates for addressing various health conditions, with *Tecoma gaudichaudii* showing notable potential. Research on related species within the Tecoma genus highlights a spectrum of pharmacological activities applicable to multiple diseases. For instance, bioactive compounds such as flavonoids, alkaloids, and phenolics have demonstrated significant anti-inflammatory, antioxidant, and antimicrobial properties, which can be instrumental in managing conditions like infections, chronic inflammation, and oxidative stress-related disorders (Balasubramanian et al., 2024). Moreover, preliminary studies suggest that extracts from Tecoma species possess antidiabetic and hepatoprotective effects, indicating utility in metabolic and liver diseases (Balasubramanian et al., 2024). The observed cytotoxic effects against certain cancer cell lines further imply potential anticancer applications, while additional analgesic and antipyretic properties support its use for pain and fever relief. These findings emphasize the need for rigorous clinical evaluations to validate therapeutic efficacy and safety in treating specific diseases using *Tecoma gaudichaudii.*

VIII. Summary of findings and future research directions:

Researchers looking into *Tecoma gaudichaudii's* potential as a drug have found some promising bioactive compounds, especially triazole derivatives that were made using efficient click chemistry techniques. These compounds demonstrate structural integrity conducive to therapeutic applications, suggesting their viability in drug design and development, as indicated by advances in heterocyclic compound synthesis (Harshitha et al., 2025). Additionally, the intersection of inflammation-related pathologies and pharmacotherapy highlights a critical area for future investigation. Given the emerging evidence of anti-inflammatory strategies in treating complex conditions like depression, future research might focus on the anti-inflammatory properties of *Tecoma gaudichaudii* extracts or their molecular derivatives to assess efficacy and safety in both

pharmacological and non-pharmacological contexts (Bo et al., 2025). Further studies should aim to elucidate structure-activity relationships, optimize bioavailability, and integrate emerging technologies such as AI-assisted drug discovery to enhance therapeutic potential. This multidimensional approach could pave the way for novel interventions derived from *Tecoma gaudichaudii*, expanding its applications within modern medicine. Additionally most studies are preclinical, future work should emphasize in vivo pharmacokinetics, potential side effects, and therapeutic index in animal models and humans

IX. Conclusion:

In light of the extensive research conducted on *Tecoma gaudichaudii*, it is evident that this plant harbors significant potential for pharmaceutical development. Its diverse phytochemical profile, including alkaloids, flavonoids, and other bioactive compounds, points to promising therapeutic applications, particularly in anti-inflammatory and antimicrobial domains. While preliminary studies have demonstrated encouraging results, further rigorous clinical trials and pharmacological assessments are essential to fully elucidate its efficacy and safety for human use. Despite promising findings, research gaps includes lack of human clinical trials, insufficient mechanistic studies at molecular levels, and the need for comprehensive toxicology reports Moreover, exploring sustainable cultivation and extraction methods would be crucial to ensure consistency and environmental responsibility in potential drug production. As global interest in botanical medicines grows, *Tecoma gaudichaudii* stands as a valuable candidate for novel drug discovery, offering an opportunity to integrate traditional knowledge with modern pharmacological science. Ultimately, this plant could contribute meaningfully to the future of natural product-based therapeutics, warranting continued and focused investigation.

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