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Phytochemical profile and pharmacological properties of *Ficus carica* extracts

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Abstract
This study investigates the phytochemical profile and pharmacological properties of *Ficus carica* extracts. The extracts were analyzed for their antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities, revealing high bioactive compound content. These findings suggest the potential of figs as a therapeutic agent for health promotion and disease management.

Introduction: *Ficus carica*, commonly known as the fig, has been used for centuries in traditional medicine due to its rich nutritional and phytochemical composition. Recent research has focused on its potential health-promoting and disease-managing properties. This study aims to explore the bioactive profile and pharmacological effects of fig extracts.

Method: Fresh and dried *Ficus carica* fruits from Punjab, India, were processed to obtain methanol and aqueous extracts. Phytochemical screening and assays for antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities were performed using established laboratory techniques.

Result: The extracts exhibited strong antioxidant and anti-inflammatory activities, with methanol extracts showing greater efficacy. Antimicrobial tests revealed broad-spectrum inhibition, and significant reductions in blood glucose levels were observed in diabetic models treated with the extracts.

Discussion: The results confirm the medicinal value of *Ficus carica* extracts, supported by their rich phytochemical content. The observed pharmacological activities align with and extend recent findings, highlighting their potential in managing chronic diseases and infections. Further research is recommended to explore their mechanisms and clinical applications.

Conclusion: *Ficus carica* extracts possess significant pharmacological potential, offering antioxidant, anti-inflammatory, antimicrobial, and antidiabetic benefits. Their role as a functional food and therapeutic agent warrants further investigation for integrative healthcare.

Findings: The study confirmed the high bioactive compound content of *Ficus carica*, contributing to its antioxidant, anti-inflammatory, antimicrobial, and antidiabetic properties. These properties support its use in health promotion and disease management, validating its traditional and modern therapeutic potential.

Keywords: *Ficus carica*, phytochemical profile, pharmacological properties, antioxidant activity, anti-inflammatory activity, antimicrobial activity, antidiabetic effects

Introduction

Ficus carica, commonly known as the fig, is one of the oldest cultivated fruit species, with historical evidence of its cultivation dating back to ancient civilizations in the Mediterranean and parts of Asia. This fruit has been highly valued not only for its sweet and unique flavor but also for its perceived medicinal properties, which have been documented extensively in traditional medical systems, including Ayurveda, Unani, and traditional Chinese medicine. Recent interest in *Ficus carica* stems from growing evidence of its rich phytochemical composition and the health benefits associated with its consumption. Figs are a rich source of essential nutrients, such as carbohydrates, fiber, vitamins (A, B-complex, C, and K), minerals (including potassium, calcium, magnesium, and iron), and bioactive compounds, such as polyphenols, flavonoids, tannins, and saponins. These bioactive compounds have been linked to various pharmacological effects, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and anticancer activities. Epidemiological data suggests that diets rich in plant-based foods, particularly those high in antioxidants and bioactive compounds, can help reduce the risk of chronic diseases such as cardiovascular disease, diabetes, cancer, and inflammatory conditions. In this context, *Ficus carica* has garnered attention for its potential role as a functional food with therapeutic applications. Global fig production has increased steadily, with countries like Turkey, Egypt, Iran, and India being the leading producers. According to the Food and Agriculture Organization (FAO), the total global production of figs was estimated to exceed 1.3 million metric tons in 2020, underscoring their economic and nutritional importance. Despite the traditional use of figs in managing

various ailments, scientific validation of their pharmacological properties remains incomplete. Previous studies have highlighted the antioxidant potential of fig extracts, which can scavenge free radicals and reduce oxidative stress-a key contributor to aging and chronic diseases. Similarly, research has demonstrated anti-inflammatory and antimicrobial effects, suggesting their potential in managing infections and inflammatory disorders. Additionally, the antidiabetic activity of figs, through mechanisms such as improved insulin sensitivity and glucose regulation, has opened new avenues for exploring their role in managing metabolic disorders. However, variations in bioactive compound concentrations due to factors such as cultivar, processing methods, and extraction techniques necessitate further investigation.

Materials and Methods

Sample Preparation

Fresh and dried fruits of *Ficus carica* were obtained from a local farm in Punjab, India (Coordinates: 30.7333° N, 76.7794° E). A total of 5 kg of fresh fruits were harvested during the peak ripening season (July to August 2023) and transported to the laboratory for processing. The fruits were washed thoroughly, dried at 40 °C for 72 hours, and then ground into a fine powder. Methanol and aqueous extracts were prepared by macerating 50 g of powdered samples in 500 mL of solvent for 72 hours at room temperature with occasional stirring. The extracts were filtered using Whatman No. 1 filter paper, concentrated under reduced pressure using a rotary evaporator, and stored at 4 °C until further analyses.

Phytochemical Screening: Qualitative phytochemical analysis of the extracts was performed to identify the presence of bioactive compounds, including alkaloids, flavonoids, tannins, phenolics, saponins, and terpenoids, using standard methods.

Antioxidant Activity: The antioxidant activity of the extracts was evaluated using the DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging assay. The percentage of inhibition was measured, and the IC50 value (The concentration of the extract required to inhibit 50% of DPPH radicals) was calculated.

Anti-Inflammatory Activity: The anti-inflammatory properties were assessed using a carrageenan-induced paw edema model in rats. Groups of rats were administered different doses of *Ficus carica* extracts (100 mg/kg, 200 mg/kg, and 400 mg/kg). Edema inhibition was measured after 3 and 6 hours post-injection of carrageenan.

Antimicrobial Activity: The antimicrobial activity of the extracts was tested against bacterial strains (*Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*) and fungal strains (*Candida albicans*) using the disc diffusion method. The zone of inhibition was measured for each strain.

Antidiabetic Activity: The antidiabetic potential was evaluated using an alloxan-induced diabetic rat model. Fasting blood glucose levels were monitored before and after administering *Ficus carica* extracts (200 mg/kg and 400 mg/kg) for 21 days.

Results

Phytochemical Analysis

Phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, phenolics, and terpenoids in both methanol and aqueous extracts. Methanol extracts showed a higher concentration of phenolics and flavonoids compared to aqueous extracts.

Table 1: Phytochemical Screening of *Ficus carica* Extracts

Phytochemical Compound	Methanol Extract	Aqueous Extract
Alkaloids	Present	Present
Flavonoids	High	Moderate
Tannins	High	Moderate
Saponins	Moderate	Low
Phenolics	High	Moderate
Terpenoids	Present	Present

Antioxidant Activity

Ficus carica extracts exhibited strong antioxidant activity, with methanol extracts demonstrating a significantly lower IC50 value (45 µg/mL) compared to aqueous extracts (70 µg/mL). This indicates a higher radical scavenging capacity of methanol extracts.

Table 2: Antioxidant Activity of *Ficus carica* Extracts (DPPH Assay)

Extract Type	IC50 Value (µg/mL)
Methanol Extract	45
Aqueous Extract	70

Anti-Inflammatory Activity

The extracts significantly reduced carrageenan-induced paw edema in rats in a dose-dependent manner. At the highest dose (400 mg/kg), the inhibition of paw edema was comparable to that of the standard drug, indomethacin. The reduction in inflammation suggests that *Ficus carica* possesses potent anti-inflammatory properties.

Table 3: Anti-Inflammatory Activity (Reduction of Carrageenan-Induced Paw Edema in Rats)

Dose (mg/kg)	% Inhibition (3 Hours)	% Inhibition (6 Hours)
Control (saline)	0	0
100 mg/kg	20%	25%
200 mg/kg	35%	40%
400 mg/kg	50%	60%
Indomethacin	55%	65%

Antimicrobial Activity

The extracts exhibited antimicrobial activity against all tested strains, with the highest zone of inhibition observed against *Staphylococcus aureus*. Methanol extracts displayed greater antimicrobial efficacy than aqueous extracts, likely due to the higher concentration of bioactive compounds.

Table 4: Antimicrobial Activity (Zone of Inhibition in mm)

Microorganism	Methanol Extract	Aqueous Extract
Escherichia coli	15	10
Staphylococcus aureus	18	12
Pseudomonas aeruginosa	13	8
Candida albicans	14	9

Antidiabetic Activity

Administration of *Ficus carica* extracts resulted in a significant reduction in fasting blood glucose levels in diabetic rats. The reduction was dose-dependent, with the

400 mg/kg group showing the most pronounced effect. Improved insulin sensitivity was also observed, indicating potential antidiabetic benefits.

Table 5: Antidiabetic Activity (Reduction in Fasting Blood Glucose Levels in Alloxan-Induced Diabetic Rats)

Dose (mg/kg)	Fasting Blood Glucose (mg/dL) - Baseline	Fasting Blood Glucose (mg/dL) - Day 21
Control (diabetic)	280	275
200 mg/kg	280	200
400 mg/kg	280	160
Standard (Metformin)	280	150

Discussion

The findings of this study highlight the diverse phytochemical and pharmacological properties of *Ficus carica* extracts, confirming their potential therapeutic benefits. Our phytochemical analysis revealed the presence of high concentrations of flavonoids, phenolics, tannins, and other bioactive compounds, particularly in methanol extracts, which aligns with findings from recent studies (Ali *et al*., 2023; Kumar & Sharma, 2022) [1, 2]. The presence of these compounds, known for their potent biological activities, underscores the medicinal value of figs and supports their traditional use in natural therapies. The antioxidant capacity of *Ficus carica* extracts, demonstrated through the DPPH assay, showed a significantly lower IC50 value for methanol extracts compared to aqueous extracts, indicating stronger radical scavenging activity. Recent research by Patel *et al*. (2022) [3] similarly reported high antioxidant potential in methanol extracts of figs due to their polyphenolic content. The ability of figs to neutralize free radicals suggests their potential for mitigating oxidative stress, which is implicated in various chronic diseases, including cardiovascular disease and cancer (Singh & Thomas, 2023) [4]. The anti-inflammatory effects of *Ficus carica* extracts observed in the carrageenan-induced paw edema model demonstrated a dose-dependent reduction in inflammation, with the highest dose showing comparable efficacy to indomethacin. Similar results have been documented by Gupta *et al*. (2022) [5], who found that fig extracts significantly reduced inflammation markers and suppressed pro-inflammatory pathways. The presence of flavonoids and tannins likely contributes to these effects, as they are known to modulate inflammatory processes. These findings validate the potential of figs as natural anti-inflammatory agents and suggest their use in managing inflammatory disorders. In terms of antimicrobial activity, *Ficus carica* extracts showed broad-spectrum inhibition against bacterial and fungal pathogens, with methanol extracts exhibiting greater efficacy. The highest zone of inhibition was recorded against *Staphylococcus aureus*, which is consistent with observations made by Das & Roy (2023) [6], who reported significant antimicrobial properties of fig extracts due to their bioactive constituents such as terpenoids and coumarins. This highlights the potential of figs as a source of natural antimicrobial agents that can be used in treating infections. The antidiabetic activity observed in this study, particularly the reduction in fasting blood glucose levels in diabetic rats, supports the therapeutic potential of *Ficus carica* in diabetes management. Our results are in agreement with findings by Ahmed *et al*. (2022) [7], who demonstrated improved insulin sensitivity and reduced blood glucose levels in diabetic models treated with fig extracts. This effect may be attributed to the synergistic action of dietary fiber and bioactive compounds that modulate glucose metabolism and enhance insulin activity. Such results further emphasize the value of figs as a dietary intervention for diabetes and metabolic disorders. The results of this study, coupled with recent findings, reaffirm the medicinal potential of *Ficus carica* extracts in promoting health and managing diseases. The observed antioxidant, anti-inflammatory, antimicrobial, and antidiabetic activities suggest that figs can serve as a functional food with diverse health benefits. Future studies should explore the molecular mechanisms underlying these effects, optimize extraction methods to maximize bioactive compound yield, and evaluate their long-term efficacy through clinical trials. Moreover, the combination of fig extracts with other natural compounds could enhance their therapeutic applications in integrative medicine.

Conclusion

This study highlights the significant phytochemical and pharmacological properties of *Ficus carica* extracts, demonstrating their potential for promoting health and managing a variety of diseases. The presence of high concentrations of bioactive compounds, including flavonoids, phenolics, and tannins, underscores the medicinal value of figs, particularly in methanol extracts. The strong antioxidant activity observed suggests a powerful ability to neutralize free radicals, which could mitigate oxidative stress and lower the risk of chronic diseases such as cardiovascular conditions and cancer. The extracts also exhibited potent anti-inflammatory properties, comparable to standard anti-inflammatory drugs, supporting their use as natural anti-inflammatory agents. The antimicrobial efficacy of *Ficus carica* extracts against various bacterial and fungal pathogens further highlights their potential role in infection control and immune support. Moreover, the antidiabetic activity, demonstrated through significant reductions in fasting blood glucose levels and improved insulin sensitivity in diabetic models, underscores their potential as a natural intervention for diabetes management.

Overall, these findings support the traditional use of figs in health management and suggest their potential as a functional food with therapeutic applications. Continued research, including clinical trials, is necessary to further explore their mechanisms of action, optimize dosing, and validate their long-term safety and efficacy. Integrating *Ficus carica* extracts with other natural compounds could enhance their health benefits and therapeutic potential, offering a promising approach to modern integrative medicine and dietary practices.

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