Research Article

Phytochemical Screening and Pharmacological Evaluation of *Pongamia pinnata* (L.) *Pierre* and *Ficus racemosa* L. Leaves Extracts for Anti-ulcer Activity

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ABSTRACT

Peptic ulcer disease is a very common gastrointestinal condition that is often made worse by oxidative stress and a persistent imbalance in the defenses of the stomach mucosa. The goal of the current study was to thoroughly assess the phytochemical profiles, in vitro antioxidant capability, and *in vivo* anti-ulcer efficacy of *Pongamia pinnata* (L.) *Pierre* and *Ficus racemosa* L. leaves in order to scientifically justify their traditional medicinal use. Petroleum ether, acetone, and methanol were used in successive solvent extractions of the dried leaves. Important secondary metabolites, such as flavonoids, alkaloids, tannins, and saponins, were detected by preliminary qualitative phytochemical screening. The 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay was used to quantify the extracts' *in vitro* antioxidant capacity. The concentration-dependent, extremely significant free radical scavenging properties of the methanolic extracts were similar to those of quercetin, the reference standard. Additionally, Wistar albino rats were used in a preclinical pharmacological evaluation for anti-ulcerogenic action utilizing an absolute ethanol-induced gastric mucosal damage model at oral dose levels of 100 mg/kg and 200 mg/kg body weight. Both medicinal plants' methanolic extracts demonstrated strong gastroprotective and antisecretory properties, dramatically lowering the ulcer index and total stomach acidity while simultaneously raising the pH of gastric juice. The synergistic cytoprotective processes and antioxidant effects of the discovered phytoconstituents, especially flavonoids, which reduce mucosal damage, are largely responsible for these significant therapeutic benefits. In summary, P. pinnata and F. racemosa extracts offer significant protection against stomach ulcers, supporting their pharmacological usefulness and incorporation into contemporary ulcer management treatment.

Keywords: Anti-ulcer activity, Antioxidant potential, *Pongamia pinnata, Ficus racemosa*, DPPH assay, Phytochemical screening, Gastroprotective.

INTRODUCTION

A major worldwide gastrointestinal problem, peptic ulcer disease (PUD) is primarily defined by the deterioration of the duodenal and stomach mucosa.[1] A physiological imbalance between aggressive luminal forces—such as excessive hydrochloric acid secretion, pepsin activity, and oxidative stress—and the endogenous mucosal defensive mechanisms is the primary cause of this condition's development.[2] Although traditional pharmacological treatments, such as histamine H2-receptor antagonists and proton pump inhibitors (PPIs), are the gold standard for reducing stomach acidity, their extended therapeutic use is often linked to specific toxicological drawbacks.[3] A horizontally integrated strategy that links long-term toxicological safety with pharmacological efficacy is needed to overcome these constraints. As a result, modern pharmaceutical research is shifting more and more toward natural products, in line with international regulatory frameworks that support the strict standardization and empirical validation of conventional phytomedicines. For long-term mucosal protection and ulcer care, botanical sources high in particular bioactive secondary metabolites present a viable and safer option.[3] within this framework, *Pongamia pinnata* (L.) Pierre (Family: Fabaceae) and *Ficus racemosa* L. (Family: Moraceae) become extremely important research topics. Both plant species have long been used in traditional medicine to treat a variety of gastrointestinal, metabolic, and inflammatory conditions. These plants' leaves are rich sources of antioxidant phytoconstituents, including flavonoids, alkaloids, saponins, and tannins, according to preliminary phytochemical analyses.[1] Thus, the goal of this work is to objectively assess and validate the medicinal potential of leaf extracts from *Pongamia pinnata* L. and *Ficus racemosa* L. The main goal is to use an ethanol-induced gastric mucosal injury model in rats to perform a thorough phytochemical screening and a rigorous pharmacological evaluation of their in vitro antioxidant ability and in vivo anti-ulcer efficacy.

MATERIALS AND METHODS

Plant material collection and authentication

Fresh leaves of *Pongamia pinnata* (L.) Pierre and *Ficus racemosa* L. were harvested in Pune, Maharashtra. Dr. B.B. Mahadik from the Department of Botany, Arts, Commerce, and Science College, Indapur, taxonomically recognized and validated the plant specimens.

Preparation of extracts

The collected leaves were shade-dried and ground into a coarse powder (mesh size 14). The powdered sample (300 g) was treated to sequential Soxhlet extraction utilizing continuous hot percolation with petroleum ether, acetone, and methanol to ensure the systematic separation of phytochemicals depending on their polarity. [8]Preliminary phytochemical screening to chemically identify the extracts,

preliminary qualitative screening was carried out on the petroleum ether, acetone, and methanolic fractions. Secondary metabolites were detected using standard known techniques.

In vitro antioxidant activity (DPPH test).

The plant extracts' free radical scavenging ability was assessed using the DPPH test. [9] Extracts and the reference standard, quercetin, were produced at varied quantities (20, 40, 60, 80, and 100 µg/ml) using methanol. The absorbance of the resulting colorimetric change was measured spectrophotometrically at 513 nm.

Experimental animals and ethical approval

Healthy Wistar albino rats of either sex, weighing between 150 and 200 g, were used for the in vivo pharmacological evaluation. The experimental methodology strictly followed the rules established by the Committee for Control and Supervision of Experiments on Animals (CPCSEA) and was previously approved by the Institutional Animal Ethics Committee (IAEC) of Vidya Niketan College of Pharmacy, Lakhewadi.

Ethanol-induced gastric ulcer model

The anti-ulcerogenic activity of the acetone and methanolic extracts was determined using an absolute ethanol-induced stomach ulcer model. After a 24-hour fast, rats were randomly allocated to one of seven groups (n=6). The test extracts (100 mg/kg and 200 mg/kg body weight) and the standard medication, ranitidine (20 mg/kg), were given orally for seven days in a row. On the eighth day, stomach lesions were caused by giving 100% ethanol (5 ml/kg) orally one hour after therapy.[12] Two hours after ulcer induction, the animals were humanely slaughtered and their stomachs removed.

Statistical analysis

All experimental data were presented as Mean ± Standard Error of the Mean (SEM). The statistical significance of the control and treated groups was determined using a One-Way Analysis of Variance (ANOVA), followed by Tukey's post-hoc test. A P-value of < 0.05 was judged statistically significant.

RESULTS AND DISCUSSION

Phytochemical screening

The initial phytochemical analysis of *Pongamia pinnata* and *Ficus racemosa* leaves revealed the presence of unique secondary metabolites across various solvent gradients. The methanolic extracts (CPME) displayed greater yield and indicated the abundance.

There are carbohydrates, proteins, alkaloids, flavonoids, steroids, tannins, and saponins. The overall Phenolic and flavonoid contents were found to be significant, with the methanolic extract having the Highest flavonoid concentration (33.02 mg/g equal to quercetin) compared to the acetone extract (29.66 mg).

Table 1: Phytochemical screening

Phytoconstituents	Petroleum Ether	Acetone (CPAE)	Methanol (CPME)
Carbohydrates	-	+	+
Proteins	-	+	+
Saponin Glycosides	+	+	+
Flavonoids	-	+	+
Tannins & Phenolics	-	+	+
Steroids	-	-	+
Alkaloids	+	+	+

(+ indicates presence, - indicates absence)

Phytoconstituents include petroleum ether, acetone (CPAE), and methanol (CPME). Carbohydrates are Negative, while proteins are positive. Saponin glycosides: + Flavonoids: + Tannins and phenols: + Steroids: + Alkaloids: + (+ indicates presence, - indicates absence).

***In vitro* antioxidant activity.**

Oxidative stress is essentially linked to the worsening of gastric mucosal injury. The free radical scavenging potential was determined using the DPPH test. Both extracts exhibited concentration-dependent radical scavenging activity. At the maximum dose of 100 µg/ml, the methanolic extract showed a considerable inhibition rate of 74.84%, comparable to the standard reference, quercetin (88.92%). (Table 2). The methanolic fraction's high flavonoid and phenolic content contributes significantly to its strong antioxidant activity.

***In vivo* anti-ulcer action**

The ethanol-induced gastric ulcer model is a rigorous approach for evaluating mucosal necrosis because ethanol directly depletes stomach mucus while increasing mucosal permeability and oxidative stress. The 100% ethanol control group (Positive Control) had significant mucosal ulcers, with a maximum ulcer index of 83.53 ± 0.17 and total acidity of 98.23 ± 0.64 mEq/L. Pre-treatment with CPME at 200 mg/kg significantly reduced ulcer damage, lowering the ulcer index to 53.11 ± 0.61 and giving 37.56% ulcer protection, comparable to the standard medication Ranitidine. CPME (200 mg/kg) effectively buffered the stomach environment, increasing pH to 3.5 ± 0.14 and lowering total acidity to 24.3 ± 0.92 mEq/L.

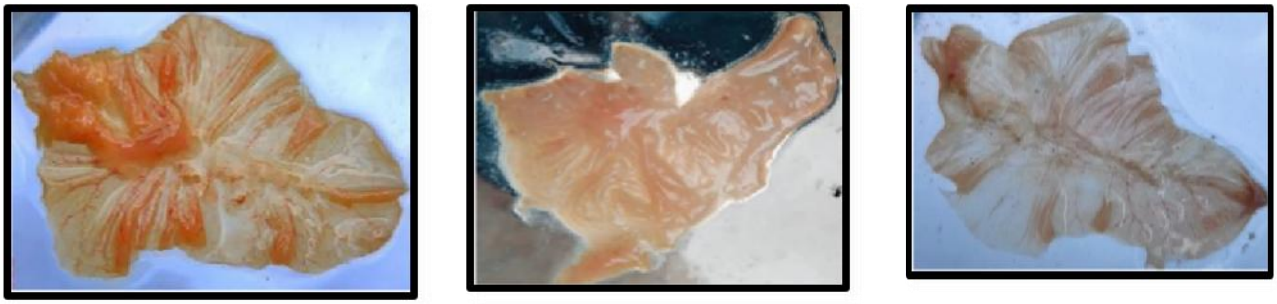
Table 2: *In vitro* antioxidant activity

Concentration (µg/ml)	Standard (Quercetin)	Acetone Extract (CPAE)	Methanol Extract (CPME)
20	44.40 ± 0.10	13.55	38.46
40	54.20 ± 0.18	24.78	51.15
60	65.56 ± 0.18	37.48	53.60
80	76.22 ± 0.17	41.88	65.81
100	88.92 ± 0.10	59.82	74.84

Table 3: *In vivo* anti-ulcer action

Treatment Groups (n=6)	Ulcer Index	Ulcer Protection (%)	Gastric pH	Total Acidity (mEq/L)
Positive Control (Ethanol)	83.53 ± 0.17	0	4.05 ± 0.07	98.23 ± 0.64
Standard (Ranitidine 20mg/kg)	51.48 ± 0.32	38.36	3.16 ± 0.06	23.83 ± 1.05
CPAE (200 mg/kg)	52.15 ± 0.44	36.41	3.40 ± 0.14	26.41 ± 0.32
CPME (200 mg/kg)	53.11 ± 0.61	37.56	3.50 ± 0.14	24.30 ± 0.92

Figure 1



PC (90 %) ethanol Ranitidine 20 mg/kg Methanol 200 mg/kg

DISCUSSION

The development of peptic ulcer disease is essentially linked to an imbalance between offensive luminal factors and defensive mucosal barriers.[1] The reduction in stomach lesions found in this study clearly suggests that the methanolic extracts of P. pinnata and F. racemosa work through two mechanisms: cytoprotective effect (increased by ROS neutralization) and strong antisecretory efficiency.[3]

Integrating this pharmacological efficacy with toxicological consequences provides a substantial benefit over traditional synthetic therapies, such as PPIs and NSAIDs, which frequently cause mucosal toxicity or disrupt fundamental acid balance after prolonged administration.[12] The radical-scavenging flavonoids work exactly to stabilize cellular membranes and inhibit lipid peroxidation cascades.[3] Standardizing such phytochemically complex yet safe botanical extracts is well aligned with evolving regulatory requirements that aim to integrate empirical knowledge with traditional medicine, paving the path for long-term, low-toxicity therapeutic modalities. Botanical extracts are completely compatible with growing regulatory compliances that strive to merge empirical data with traditional medicine, paving the door for sustainable, low-toxicity therapeutic modalities.

CONCLUSION

The current study gives strong scientific support for the traditional medicinal use of *Pongamia pinnata* (L.) Pierre and *Ficus racemosa* L. leaves in the treatment of gastrointestinal ulcers. The pharmacological analysis clearly shows that the methanolic extracts of these medicinal plants have strong, dose-dependent anti-ulcerogenic activity. This gastro protective action is mechanistically caused by a dual therapeutic profile: a strong antisecretory impact that regulates stomach acidity and a high antioxidant capacity that neutralizes mucosal oxidative damage. The abundance of bioactive secondary metabolites, particularly flavonoids, is crucial for maintaining the stomach mucosal barrier. This work demonstrates the potential of flavonoid-rich plant extracts as viable, standardized alternatives to traditional synthetic anti-ulcer treatments by bridging pharmacological efficacy and an improved toxicological safety profile Future research focusing on the isolation of specific active phytoconstituents and their evaluation in clinical settings is highly warranted to fully integrate these natural interventions into modern therapeutic regimens.

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