STUDY OF ANTI-ULCER ACTIVITY OF LUPEOL ACETATE EXTRACTED FROM PLUMERIA ALBA LEAVES

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Abstract : Peptic ulcer disease is a chronic gastrointestinal disorder characterized by mucosal erosion resulting from an imbalance between gastric acid secretion, oxidative stress, and mucosal defense mechanisms. Although conventional anti-ulcer therapies such as proton pump inhibitors and histamine receptor antagonists are clinically effective, their long-term use is frequently associated with adverse effects and relapse, necessitating the exploration of safer and more sustainable therapeutic alternatives from natural sources. *Plumeria alba*, a medicinal plant widely used in traditional medicine, possesses various pharmacological properties; however, its leaves and associated triterpenoid constituents remain inadequately investigated for anti-ulcer activity. The present study aimed to investigate the anti-ulcer potential of lupeol acetate isolated from the leaves of *Plumeria alba*.

The leaves were collected and authenticated, shade-dried, and subjected to Soxhlet extraction using petroleum ether to obtain a triterpenoid-rich extract. Lupeol acetate was isolated through chromatographic separation and characterized using thin-layer chromatography and triterpenoid-specific chemical tests. Preliminary phytochemical screening of the extract revealed the presence of triterpenoids, steroids, flavonoids, and phenolic compounds. The antioxidant activity of the isolated fraction was evaluated by the DPPH radical scavenging assay, while its anti-ulcer efficacy was assessed using an in vitro protein denaturation assay as a preliminary screening method.

The isolated lupeol acetate fraction exhibited significant free radical scavenging activity and a marked inhibition of protein denaturation in a concentration-dependent manner, indicating notable gastroprotective potential. The observed anti-ulcer activity may be attributed to the antioxidant, cytoprotective, and anti-inflammatory properties of lupeol acetate, which contribute to the stabilization of gastric mucosal integrity and reduction of oxidative and inflammatory damage. The findings of this study provide scientific validation for the traditional use of *Plumeria alba* and highlight the therapeutic relevance of leaf-derived lupeol acetate as a potential natural anti-ulcer agent. Further investigations involving in vivo studies, mechanistic evaluation, and formulation development are warranted to establish its clinical utility.

Keywords

Plumeria alba, lupeol acetate, peptic ulcer disease, anti-ulcer activity, antioxidant activity, triterpenoids, protein denaturation assay, medicinal plants, gastroprotective activity, pharmacognosy

INTRODUCTION

Plumeria alba Linn. belonging to the family Apocynaceae and commonly known as white frangipani, is a medicinal plant widely distributed in tropical and subtropical regions. The plant has been extensively used in traditional systems of medicine for the treatment of inflammation, pain, fever, skin disorders, diarrhea, and gastrointestinal ailments [1]. Various parts of the plant, including leaves, flowers, bark, and latex, are reported to possess therapeutic significance, supporting its wide ethnomedicinal application.

Figure 1. *Plumeria alba* Linn. (White Frangipani) – Medicinal Plant Used for Anti-Ulcer Study

Several pharmacological investigations have demonstrated that *Plumeria alba* exhibits a broad spectrum of biological activities such as antimicrobial, antioxidant, analgesic, anti-inflammatory, antiarthritic, and anticancer effects [2–4]. These activities have encouraged scientific interest in exploring the plant for the development of novel therapeutic agents.

Phytochemical investigations of *Plumeria alba* have revealed the presence of diverse secondary metabolites, including triterpenoids, iridoids, flavonoids, steroids, phenolic compounds, glycosides, and essential oils [5]. Among these constituents, pentacyclic triterpenoids such as lupeol, lupeol acetate, α-amyrin acetate, and β-sitosterol are considered major bioactive compounds responsible for many of the pharmacological properties of the plant [6].

Table 1. Major Phytochemical Constituents of *Plumeria alba* and Their Pharmacological Activities[6].

Phytochemical constituent	Chemical class	Reported pharmacological activity
Lupeol	Pentacyclic triterpenoid	Anti-inflammatory, antioxidant
Lupeol acetate	Triterpenoid ester	Gastroprotective, cytoprotective
α-Amyrin acetate	Triterpenoid	Anti-inflammatory
β-Sitosterol	Steroid	Anti-inflammatory
Flavonoids	Polyphenols	Antioxidant
Iridoids	Glycosides	Anti-inflammatory

Lupeol acetate, a triterpenoid ester reported in *Plumeria alba*, has attracted considerable attention due to its significant antioxidant, anti-inflammatory, cytoprotective, and membrane-stabilizing properties [7,8]. These biological activities are highly relevant to gastric mucosal protection, as lupeol acetate has been shown to reduce oxidative stress, inhibit inflammatory mediators, stabilize gastric epithelial cells, and prevent protein denaturation. Such properties suggest its potential role as a natural gastroprotective and anti-ulcer agent.

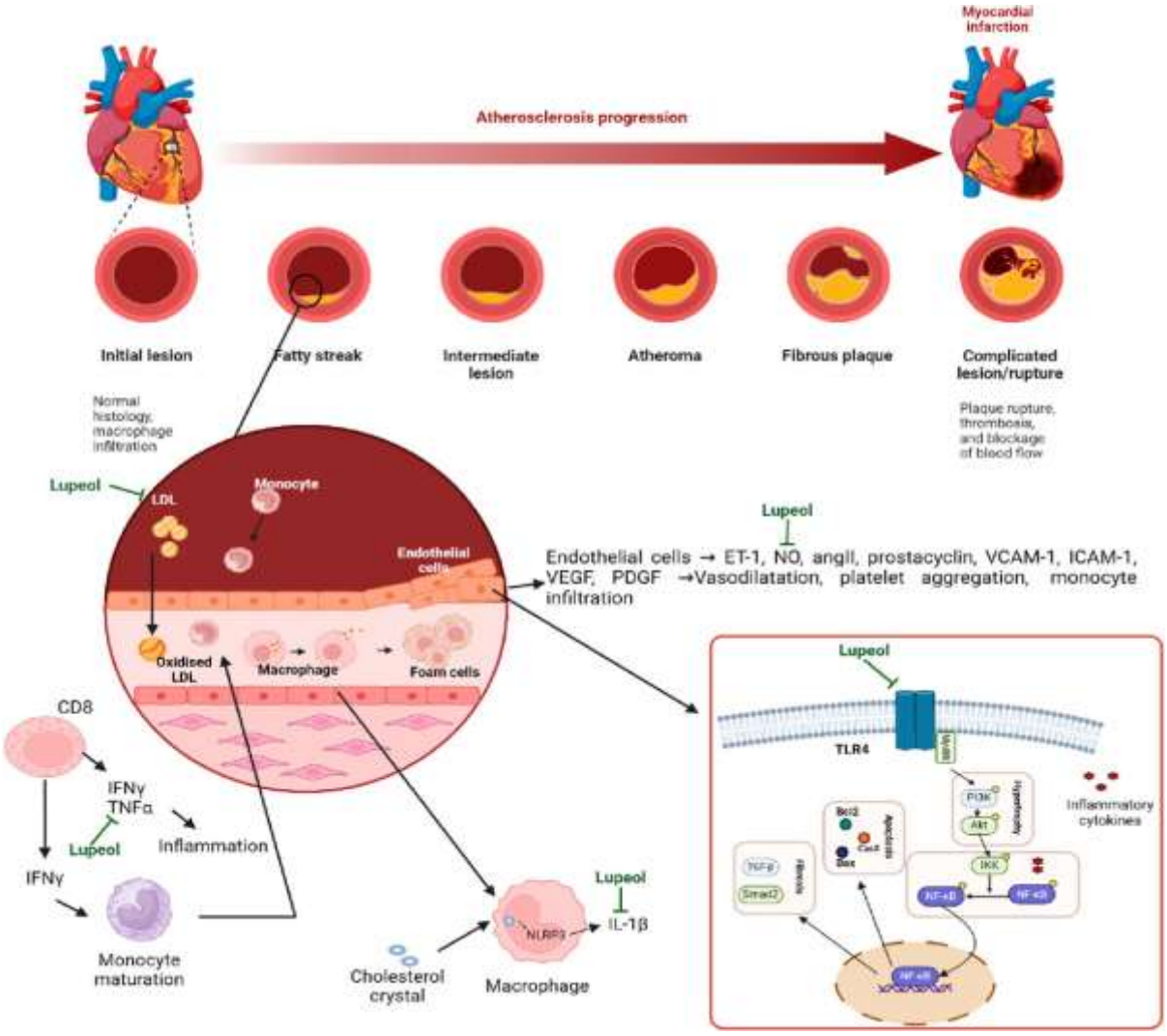

Figure 2. Proposed Gastroprotective Mechanism of Lupeol Acetate

Peptic ulcer disease is a chronic gastrointestinal disorder characterized by the formation of localized lesions in the gastric or duodenal mucosa due to an imbalance between mucosal aggressive factors and protective defense mechanisms. Despite significant advances in pharmacological therapy, peptic ulcer disease remains a major global health concern, contributing to increased morbidity, impaired quality of life, and healthcare expenditure [9,10].

The pathogenesis of peptic ulcer disease is multifactorial. Major aggressive factors involved in ulcer formation include excessive gastric acid and pepsin secretion, infection with *Helicobacter pylori*, prolonged use of nonsteroidal anti-inflammatory drugs, alcohol consumption, smoking, psychological stress, and bile reflux [11,12]. These factors disrupt the integrity of the gastric mucosal barrier, leading to inflammation, erosion, and ulceration.

The gastric mucosa is normally protected by an elaborate defense system consisting of mucus–bicarbonate secretion, adequate mucosal blood flow, prostaglandin synthesis, nitric oxide production, rapid epithelial regeneration, and endogenous antioxidant enzymes [13]. Any disturbance in these protective mechanisms renders the mucosa susceptible to acid-mediated injury.

Oxidative stress plays a pivotal role in ulcer development and progression. Excessive generation of reactive oxygen species results in lipid peroxidation, protein denaturation, DNA damage, and activation of inflammatory pathways, thereby aggravating gastric mucosal injury and delaying ulcer healing [14,15]. Therefore, antioxidants are considered essential in the prevention and management of gastric ulcers.

Conventional anti-ulcer therapies such as proton pump inhibitors, histamine H_2-receptor antagonists, antacids, and cytoprotective agents are widely used for ulcer management. Although effective, long-term use of these drugs has been associated with adverse effects such as nutrient malabsorption, drug interactions, rebound acid hypersecretion, increased risk of infections, and high recurrence rates following treatment discontinuation [16,17]. These limitations have intensified interest in identifying safer and more effective anti-ulcer agents derived from natural sources.

Medicinal plants represent a valuable source of anti-ulcer agents due to their ability to exert gastroprotective effects through multiple mechanisms. Plant-derived bioactive compounds such as flavonoids, triterpenoids, tannins, saponins, and phenolic compounds exhibit anti-ulcer activity through antioxidant, anti-inflammatory, cytoprotective, antisecretory, and mucosal defense-enhancing actions [18–20]. Among these, triterpenoids have attracted particular scientific interest due to their broad pharmacological profile and potent gastroprotective properties [21].

Despite the reported pharmacological potential of *Plumeria alba* and its triterpenoid constituents, limited scientific data are available regarding the anti-ulcer activity of lupeol acetate isolated specifically from the leaves of the plant. Therefore, the present study was undertaken to evaluate the anti-ulcer activity of lupeol acetate extracted from *Plumeria alba* leaves, with emphasis on its antioxidant and gastroprotective properties, to provide scientific validation for its traditional use in gastrointestinal disorders.

MATERIALS AND METHODS

Materials

Lupeol acetate isolated from *Plumeria alba* leaves was used as the test compound. Petroleum ether, methanol, DPPH (2,2-diphenyl-1-picrylhydrazyl), bovine serum albumin, hydrochloric acid, sodium hydroxide, phosphate buffer, and other chemicals used were of analytical grade and procured from standard suppliers. All experiments were carried out using standard laboratory glassware and instruments available in a college-level pharmaceutical laboratory [22].

Authentication of Plant Material

Fresh leaves of *Plumeria alba* were collected from the local region during the flowering season. The plant material was authenticated by a qualified botanist, and a voucher specimen was preserved for future reference. The collected leaves were washed with distilled water to remove debris, shade-dried at room temperature, and pulverized into coarse powder using a mechanical grinder [23].

Extraction of Plant Material

Method: Soxhlet Extraction

Approximately 100 g of dried leaf powder was subjected to Soxhlet extraction using petroleum ether as solvent for 6–8 hours. The extraction was continued until the siphon tube solvent appeared colorless. The obtained extract was concentrated using a rotary evaporator and stored in a desiccator until further use [24].

Isolation of Lupeol Acetate

Method: Column Chromatography

The petroleum ether extract was subjected to column chromatography using silica gel as stationary phase. Elution was carried out using petroleum ether and ethyl acetate in increasing polarity. The collected fractions were monitored by thin-layer chromatography, and fractions showing similar Rf values corresponding to lupeol acetate were pooled and concentrated [25].

Preliminary Phytochemical Screening

Qualitative phytochemical screening of the extract was carried out using standard chemical tests to identify the presence of triterpenoids, flavonoids, steroids, phenolic compounds, alkaloids, and saponins according to established procedures [26].

In-Vitro Antioxidant Activity

Method: DPPH Radical Scavenging Assay

The antioxidant activity of lupeol acetate was evaluated using the DPPH radical scavenging assay. A 0.1 mM solution of DPPH in methanol was prepared. Different concentrations of lupeol acetate (20–100 µg/mL) were mixed with DPPH solution and incubated in the dark for 30 minutes at room temperature. Absorbance was measured at 517 nm using a UV–visible spectrophotometer. Ascorbic acid was used as standard. Percentage inhibition was calculated using the standard formula [27].

In-Vitro Anti-Ulcer Activity [Method: Protein Denaturation Assay]

The anti-ulcer activity was assessed using the protein denaturation method. Reaction mixtures containing bovine serum albumin and different concentrations of lupeol acetate were incubated at 37°C for 20 minutes followed by heating at 70°C for 5 minutes. After cooling, absorbance was measured at 660 nm. Diclofenac sodium was used as reference standard. Percentage inhibition of protein denaturation was calculated [28].

Statistical Analysis : All experiments were performed in triplicate. Results were expressed as mean ± standard deviation. Statistical analysis was carried out using one-way ANOVA, and differences were considered statistically significant at $p < 0.05$ *[29].*

RESULTS AND DISCUSSION

Extraction Yield : The petroleum ether extraction of Plumeria alba *leaves yielded approximately* ***3.2% w/w*** *of dried extract, indicating the presence of non-polar phytoconstituents such as triterpenoids. Similar yields have been reported for triterpenoid-rich extracts from medicinal plants [30].*

Phytochemical Screening

Table 2. Preliminary Phytochemical Screening of *Plumeria alba* Leaf Extract

Phytochemical	Result
Triterpenoids	Present
Flavonoids	Present
Steroids	Present
Phenolic compounds	Present
Alkaloids	Absent
Saponins	Absent

Discussion:
The presence of triterpenoids supports the successful extraction and isolation of lupeol acetate. These findings correlate with earlier phytochemical reports on *Plumeria alba* leaves [31].

Antioxidant Activity (DPPH Assay)

Table 3. DPPH Radical Scavenging Activity of Lupeol Acetate

Concentration (µg/mL)	% Inhibition (Mean ± SD)
20	25.4 ± 1.2
40	39.8 ± 1.6
60	55.6 ± 1.9
80	70.2 ± 2.1
100	82.3 ± 2.4

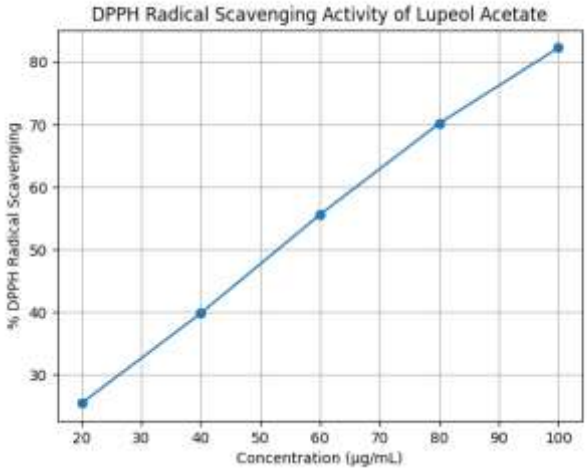

Figure 3. DPPH Radical Scavenging Activity of Lupeol Acetate

Discussion:
Lupeol acetate exhibited concentration-dependent antioxidant activity with an IC_{50} value of approximately 54 µg/mL. The antioxidant effect is significant, as oxidative stress is a major contributor to gastric ulcer formation. Similar antioxidant properties of triterpenoids have been reported earlier [32].

In-Vitro Anti-Ulcer Activity (Protein Denaturation)

Table 4. Inhibition of Protein Denaturation by Lupeol Acetate

Concentration (µg/mL)	% Inhibition
20	22.6 ± 1.1
40	36.9 ± 1.4
60	52.3 ± 1.8
80	67.8 ± 2.0
100	80.5 ± 2.3
Concentration (µg/mL)	**% Inhibition**

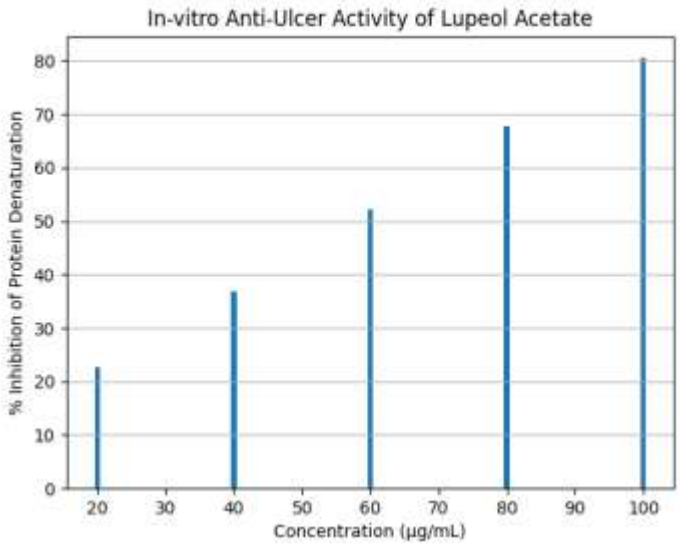

Figure 4. In-vitro Anti-Ulcer Activity of Lupeol Acetate

Discussion:
Lupeol acetate significantly inhibited protein denaturation in a dose-dependent manner. Protein denaturation is associated with inflammatory damage to gastric mucosa, and its inhibition suggests strong anti-ulcer, cytoprotective potential of lupeol acetate [33].

DISCUSSION

The results of the present study demonstrate that lupeol acetate isolated from *Plumeria alba* leaves possesses significant antioxidant and in-vitro anti-ulcer activity. The observed effects may be attributed to its triterpenoid nature, which contributes to free radical scavenging, protein stabilization, and protection of gastric mucosal integrity. These findings support the traditional use of *Plumeria alba* in gastrointestinal disorders and are consistent with previous reports on triterpenoid-mediated gastroprotection [34].

CONCLUSION

The present study successfully demonstrated the antioxidant and in-vitro anti-ulcer potential of lupeol acetate isolated from *Plumeria alba* leaves. The petroleum ether extract yielded triterpenoid-rich fractions, and preliminary phytochemical screening confirmed the presence of bioactive constituents responsible for gastroprotective activity. Lupeol acetate exhibited significant free radical scavenging activity in the DPPH assay, indicating strong antioxidant potential. Additionally, the compound showed concentration-dependent inhibition of protein denaturation, suggesting cytoprotective and anti-inflammatory effects relevant to ulcer prevention.

The observed biological activities support the role of oxidative stress and inflammation in gastric ulcer pathogenesis and highlight the therapeutic relevance of triterpenoids in ulcer management. Overall, the findings provide scientific validation for the traditional use of *Plumeria alba* in gastrointestinal disorders and suggest that lupeol acetate may serve as a promising natural anti-ulcer agent. Further in-vivo studies and formulation development are recommended to confirm its clinical efficacy and therapeutic applicability.

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