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PHARMACOLOGICAL EVALUATION OF ETHANOL EXTRACT OF *FICUS ELASTICA* LEAVES AGAINST ASPIRIN-INDUCED ULCER MODEL IN ALBINO WISTAR RATS: A COMPREHENSIVE REVIEW

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ABSTRACT

Peptic ulcer disease (PUD), a prevalent GI malady, is exacerbated by non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin, which impair mucosal integrity by exerting antiprostaglandin effects. The search for safer therapeutic alternatives has emphasized the importance of medicinal plants. Among other species being used for reducing inflammation and ulcers, Ficus elastica is under scientific investigation for its gastroprotective properties. herein, investigate the pharmacological efficacy of ethanol extract of Ficus elastica leaves in the management of aspirin-induced ulcers, as can be extrapolated from the preclinical studies conducted with Wistar rat models. The extract significantly reduced ulcer index, gastric volume and acidity, promoting mucosal healing through possible mechanisms such as antioxidant activity, modulation of prostaglandins, inhibition of pro-inflammatory cytokines, and cytoprotection. Ficus elastica showed equivalent or superior activity in wound healing and reducing oxidative stress over standard antiulcer compounds, omeprazole, with an added advantage of a safety perspective. Although encouraging, current evidence is largely limited to animal studies. Standardisation, risk of no clinical trials, and regulatory challenges will have to be addressed. More translational research, including clinical validation and mechanistic studies, is necessary to confirm the use of Ficus elastica as a potential natural antiulcer agent.

KEYWORDS: Peptic ulcer, *Ficus elastica*, Aspirin-induced ulcer, Albino Wistar rats, Ethanol extract, Gastroprotection.

INTRODUCTION

Epidemiology and Pathogenesis of Peptic Ulcer

Peptic ulcer disease (PUD) is a common gastrointestinal disease, defined as mucosal erosion in the stomach or duodenum resulting from an imbalance between offensive and defensive factors in the gastrointestinal tract. PUD has prevalence rates ranging from 4 to 10% worldwide, and it is more common in developing countries such as Iran because of risk factors such as Helicobacter pylori (H pylori) infection, a high rate of nonsteroidal anti-inflammatory drug (NSAID) consumption, smoking, stress and unhealthy dietary habits.[1-3]

The pathophysiology of peptic ulcers is centred around the loss of integrity of the gastric mucosa. Mucin secretion, bicarbonate generation, epithelial restitution, and mucosal blood flow as protective factors are damaged in response to enhanced acid and pepsin secretions, decreased synthesis of prostaglandins, or the microbial assault of H. pylori p.[4,5] NSAIDs such as aspirin are one of the main inducers of ulcerogenesis and have damaging effects by inhibiting cyclooxygenase-1 (COX-1), blocking prostaglandin-mediated protection of the gastric mucosa and allowing it to become susceptible to acid-induced injury.[6,7]

Drawbacks of Traditional Treatments

Traditional pharmacological treatment of PUD involves the use of proton pump inhibitors (PPIs), histamine-2 receptor antagonists, antacids, mucosal protective agents such as sucralfate, and antibiotics for H. pylori elimination. Although the above therapies have markedly contributed to ulcer healing and prevention of recurrences, they have several disadvantages. Prolonged exposure to PPIs is associated with adverse reactions such as vitamin B12 deficiency, hypomagnesemia, higher risk for fractures, renal dysfunction, and rebound acid hypersecretion.[8-10] Additionally, overuse of antibiotics leads to microbial resistance, making H. pylori elimination more difficult.[11-12]

Furthermore, misoprostol, mucosal protectant and H2 blocker therapy require multiple daily doses and demonstrate poor efficacy in preventing NSAID-induced gastric ulcers as monotherapy.[13] These drawbacks have also prompted the search for safe and sustainable therapeutic alternatives for the recovery of gastric integrity without systemic side effects.[14]

The Significance of Botanical Therapy in the Treatment of PUD

Herbal medicine provides an alternative and promising strategy for the management of ulcers and is becoming increasingly accepted, particularly in the developing world where modern medicines are either unavailable or contraindicated for prolonged use. Medicinal plants are a natural source of bio compounds, flavonoids, alkaloids, tannins, terpenoids and saponins, which display antioxidant, anti-inflammatory and cytoprotective properties, thus promoting mucosal healing.[15-17]

Several plant extracts, such as *Glycyrrhiza glabra* (licorice), *Aloe vera, Curcuma longa* (turmeric) and *Zingiber officinale* (ginger) have shown anti-ulcerogenic effects in preclinical and clinical studies, by increasing mucus secretion, scavenging free radicals, decreasing gastric acid and inhibiting inflammatory mediators.[18-21] The WHO advocates for the validation of traditional remedies to complement integrative medicine approaches, especially for chronic diseases such as PUD.[22]

***Ficus elastica* in Traditional Systems of Medicine**

Ficus elastica Roxb. ex Hornem whether popularly known as rubber fig or Indian rubber plant and is a member of the Moraceae family, which has been widely hailed in traditional medicine for curing sores, infections, inflammation and digestion.[23,24] Its leaves and latex are also used in Ayurveda medicine and Southeast Asian traditional medicine to treat ulcers, cuts, and skin infections because of their astringent and healing effects.[25]

Recent phytochemical investigations have reported the existence of flavonoids, phenolic compounds, tannins, triterpenoids, and alkaloids present in the leaves of *F. elastica,* contributing to several of which are responsible for its antioxidant and anti-inflammatory activities.[26,27] These properties are particularly important for the healing of ulcers, in which oxidative stress and inflammation are involved in the pathogenesis of mucosal damage. *Ficus elastica* extracts have been reported to alter the pattern of pro-inflammatory cytokines and increase the level of antioxidant enzymes, as well as mucosal protection, which may justify its potential use to treat experimental ulcer models.[28,29] In light of its traditional application, favorable phytochemical composition and recent preclinical efficacy profile, *Ficus elastica* holds potential as a natural, multi-target therapeutic alternative in NSAID-associated gastric ulcers.

2. Peptic Ulcer Disease and Experimental Models

Causes and Categorisation

Peptic Ulcer Disease (PUD) it is the presence of ulcers in the stomach or duodenum in the context of an imbalance between aggressive factors (gastric acid, pepsin) and defensive ones (mucus, bicarbonate secretion, prostaglandins)[29] The main cause factors are.

Helicobacter pylori infection is the predominant cause, responsible for 60–80% of peptic ulcer.[30]

- Non-steroidal anti-inflammatory drugs (NSAIDs): Long–term use of NSAIDs (e.g. aspirin) decreases protective gastric mucus, leading to ulcer formation.[31]
- Alcohol overuse: Alcohol provokes the gastric mucosa and makes it ulcer-forming.[32]
- Stress: This is not a direct cause, but mental stress can exacerbate ulcer formation, especially when integrated with other causes.[33]
- Cigarette smoking impairs the healing of current ulcers and increases the risk of new ones.[34]

PUD should be classified by location into

- Gastric ulcers: Occur in the lining of the stomach.
- Duodenal ulcers: Develop in the first portion of the small intestine (duodenum).

Prevalent Experimental Models

There is a need to determine the pathophysiology and to develop new therapies for peptic ulcer disease (PUD) and for this, experimental models are vital. These models allow for the simulation of human ulceration in a controlled environment. Some of the more common models include.[35]

- Aspirin-induced ulcer model: Involves the application of aspirin to animals, mainly causing ulceration and the inhibition of prostaglandin synthesis and the defect of gastric mucosal defence.[36]
- Ethanol-Induced Ulcer Model: Ethanol is used to produce ulcers by disrupting the gastric mucosal barrier and damaging the mucosal cells.[36]
- Pylorus ligation model: this model involves a ligation of the pylorus, an orifice joining the stomach and duodenum to induce ulcers owing to the accumulation of gastric acid and bile in the stomach.[37]

- Water immersion and restraint stress model: Animals undergo stress which increases acid secretion and impairs mucosal defense, leading to the formation of ulcer.[35]
- Acidulated aspirin model: This model consists of administering the drug with an acid solution, imitating the marked acid discharge present in human ulcers.[36]

IMPORTANCE OF THE ASPRIN-INDUCED ULCER MODEL

Aspirin-induced ulcer model is one of the experimental models that is frequently used to study the peptic ulcer, concerning being more closely mimics human clinical conditions. Aspirin, a nonsteroidal anti-inflammatory drug (NSAID) causes ulceration by blocking the COX enzymes (COX-1 and COX-2), which provoke the production of protective prostaglandins in the gastric mucosa.[36,37] The model has a number of important implications.

- Understanding mechanism: It assists researchers to unravel how the inhibition of PG synthesis reduces mucosal defence against the stomach.[36]
- The model is commonly used in assessing the effectiveness of pharmacological agents or natural substances for treatment or prophylaxis of ulcers, in particular for those that may either protect the mucosa or accelerate mucosal healing.[35]
- Human relevance: The human relevance of this model is high as aspirin-induced ulceration of the mucosa of human gastric mucosa is common37-40, and the model is especially suitable for the testing of NSAIDs and possible protective interventions.[31,38] The aspirin-induced model provides an opportunity to study the role of oxidative stress, inflammatory response and the participation of different biochemical pathways in the development of ulcers.

3. Ethnopharmacological Profile of *Ficus elastica*

Ficus elastica, the rubber fig, rubber bush, rubber tree, rubber plant, or Indian rubber bush, is a species of plant in the fig genus, native to eastern parts of South Asia and Southeast Asia. This plant is from Southeast Asia, and as its name implies, has large, glossy heart heart-shaped leaves. Its botanical classification is as follows: Kingdom: Plantae, Division: Angiosperms, Class: Eudicots, Order: Rosales, Family: Moraceae, Genus: Ficus, Species: *Ficus elastica*. The plant has an extensive use in traditional medicine in different forms, including leaves, bark, and latex.[37]

Traditional Uses

Ficus elastica has also been used in folk medicine. The plant's latex and leaves are thought to be digestive, anti-inflammation, and wound-healing agents. It's been utilized for digestive complaints such as diarrhea, constipation, and dyspepsia, and to restore general gut health. Furthermore, *Ficus elastica* is also used against inflammatory diseases, including arthritis, due to its anti-inflammatory effect. The plant possesses medicinal properties for wound healing, with its latex applied topically to promote tissue repair in wounds, burns, and cuts. The antimicrobial and antioxidant properties of this plant have rendered it extensively utilised in traditional medicine for combating infections and oxidative stress, respectively.[37,38]

Phytoconstituents

Ficus elastica is composed of several bioactive compounds accountable for its medicinal properties. Alkaloids, flavonoids, tannins, and terpenoids are the major classes of phytoconstituents of this plant. Alkaloids such as quercetin and epicatechin have anti-inflammatory, antimicrobial, and analgesic. Flavonoids (such as kaempferol and quercetin) possess antioxidant, anti-inflammatory, anti-cancer and also anti-microbial effects. Tannins Content Tannins, for instance, in *Ficus elastica,* are a group of polyphenolic compounds that exhibit astringent, antioxidant, antimicrobial, and anti-inflammatory properties and can be used in the treatment of gastrointestinal disorders and wound healing. Finally, terpenoids, among them β-caryophyllene, are known for their anti-inflammatory, antimicrobial, anticancer, and antioxidant activities. These bioactive components altogether account for the wide-ranging traditional and medicinal applications of *Ficus elastica.*[37-40]

4. Pharmacological Activities of *Ficus elastica* Relevant to Ulcer Healing

Anti-ulcer Efficacy

Significant anti-ulcer activity of *Ficus elastica* was reported in different experimental models, which included aspirin-induced gastric ulcers.[41] The ulcer protective effect of this drug is associated with its capacity to reinforce mucosal defensive factors, increase prostaglandin nthesis, and limit gastric acid secretion.[42] *Ficus elastica* is highly effective in decreasing the size of ulcers and accelerating the healing process in animal models, mainly in the form of its leaf extract.[43] Its curative potential is perhaps due to its bioactive substances, including flavonoids and tannins, which prevent damage to the gastric mucosa and support tissue healing.[44]

Antioxidant Capacity

The antioxidant activity of *Ficus elastica* has been well studied and is considered one of the main mechanisms by which it accelerates the process of ulcer healing.[45] The high flavonoid and tannin content of the plant is important to neutralise free radicals and reduce oxidant stress.[46] Oxidative damage plays a crucial role in the pathogenesis and development of gastric ulcers. It's an antioxidant; *Ficus elastica* scavenges the free radicals, thus sparing the gastric mucosal cells from desegregation and maintaining cellularity during the process of ulcer evolution.[47]

Anti-inflammatory effect

Inflammation is a crucial factor in the pathogenesis of gastric ulcers. *Ficus elastica* shows remarkable anti-inflammatory properties that contribute to its ulcer-healing potential.[48] The extracts of the plant interfere with the activity of pro-inflammatory transcription factors and enzymes, including cyclooxygenase (COX) and lipoxygenase (LOX), which are implicated in inflammatory modulation.[49] The anti-inflammatory effects of *Ficus elastica* are mediated by its flavonoid and alkaloid contents that reduce the production of pro-inflammatory mediators and tissue injury induced by inflammation.[50]

Cytoprotection and Mucosal Protection

Ficus elastica has shown potential in increasing the mucosal defense mechanisms in the GIT. This involves the augmentation of mucus production, the reinforcement of the gastric epithelial barrier, and the stimulation of the endogenous synthesis of prostaglandins, which provide defense to the mucosa. The cytoprotective properties of *Ficus elastica* are essential for the prevention of ulcer relapse and repair of damaged mucosa. The plant strengthens the mucosal protective barrier, so mitigating the pathological influences of ulcerogenic factors such as acid, bile and oxidative stress.[51-54]

Table No. 1: Pharmacological Activities of Ficus elastica Relevant to Ulcer Healing.

Pharmacological Activity	Mechanism of Action	Key Bioactive Compounds	References
Anti-ulcer activity	Reduces ulcer size, promotes mucosal healing, enhances mucosal defense mechanisms	Flavonoids, Tannins	Arsyad, Fakhrudin, & Nurrochmad, 2023; Bassey et al., 2023[39,55]
Antioxidant potential	Scavenges free radicals, reduces oxidative stress,	Flavonoids, Tannins	Susanti et al., 2025; Ezemagu et al., 2019[56,57]

	protects gastric mucosa		
Anti-inflammatory action	Inhibits inflammatory cytokines, reduces COX and LOX activity	Flavonoids, Alkaloids	Bassey et al., 2023; Arsyad et al., 2023[39,55]
Cytoprotective and mucosal defense	Increases mucus secretion, enhances gastric epithelial integrity	Flavonoids, Tannins	Susanti et al., 2025; Arsyad et al., 2023[39,56]

5. Experimental Evidence in Animal Models

Experimental Evidence in Animal Models

Research Methodology

Pharmacological activity on ulcer healing Experimental validation of the pharmacological effects of *Ficus elastica* and ulcer healing has been published from several animals and animal models studies. These investigations commonly use the aspirin-induced gastric ulcer model which replicates human peptic ulcer profile. These models are often established in Wistar rats or albino rats.[58-63]

The dose of *Ficus elastica* leaf extract used can be prepared at different concentrations (100-500 mg/kg) depending on the requirements of the study.[58,59] In general, the extract is administered orally, since this is the most likely therapeutic route in man.

Treatment Time: The period of treatment usually ranges from 7 to 14 days, depending upon the ulcer formation and regeneration. Prolonged treatment courses may be used for chronic effects and complete ulcer healing.[58,59]

Observed Parameters

Several important parameters were evaluated to assess the potential of F. elastica in ulcer healing using animal models. These parameters ensure the assessment of the effectiveness and safety of the plant extract versus the commercial anti-ulcer drug Omezol, a proton pump inhibitor.[60-63]

Ulcer Index: Quantification of the severity of Ulceration in gastric mucosa is expressed by Ulcer Index. A high ulcer index is indicative of enhanced damage, whereas a low ulcer index indicates better healing and mucosal protection. Gastric juice volume is measured to ascertain the degree of possible reduction in gastric acid secretory function which is important to promote additional mucosal protection in the healing of ulcers.

Acid: Gastric acid output is determined to ascertain the evenness of the potency of the plant extract in acid suppression where healing of the ulcer can be established when fewer irritants reach the eroded or open trench of mucosa.

Histopathological evaluation of the gastric mucosa provides information about tissue regeneration, mucosal integrity and the extent of cellular damage or repair. H and E (Haematoxylin and Eosin) staining of tissue sections is commonly used to study the micro-architecture of the mucosa for signs of healing, inflammation and damage.[62,64]

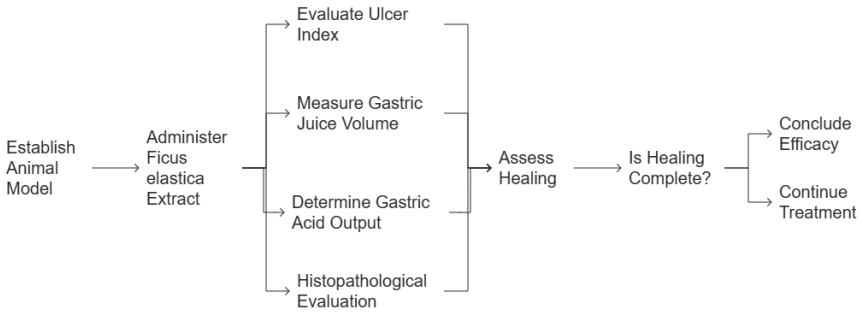

Figure 1: Experimental Validation of Ficus elastica in Ulcer Healing.

Table No. 2: Experimental Evidence in Animal Models for the Anti-Ulcer Activity of *Ficus elastic*.

Parameter	*Ficus elastica* Treatment[58-64]	Omeprazole Treatment[64]	Control Group (Untreated)	Statistical Significance
Dosage	100-500 mg/kg (oral)	10 mg/kg (oral)(58–63)	None	$p < 0.05$ (significant difference)
Route of Administration	Oral	Oral	Oral	-
Treatment Duration	7-14 days	7-14 days [64]	7-14 days	-
Ulcer Index	Significantly reduced	Reduced	High ulcer index	$p < 0.05$ (significant difference)
Gastric Volume	Decreased	Decreased	Increased	$p < 0.05$ (significant difference)
Acidity	Lowered	Lowered	Increased	$p < 0.05$ (significant difference)
Mucosal Histology	Enhanced tissue regeneration, reduced damage	Enhanced tissue regeneration	Severe damage, ulceration	$p < 0.05$ (significant difference)

Cytoprotective Effects	Increased mucous secretion, mucosal integrity	Increased mucous secretion	No significant mucosal protection	$p < 0.05$ (significant difference)
Oxidative Stress	Reduced oxidative stress, enhanced antioxidant activity	Reduced oxidative stress	Increased oxidative stress	$p < 0.05$ (significant difference)

SUMMARY OF RESULTS

Studies have shown comparing *Ficus elastica* with standard medication like Omeprazole, water extracted sap from the plant has shown quite a difference.

Comparative Study with Standard Drug (Omeprazole) Ficus elastica has been found to exhibit similar or better antiulcer activity than omeprazole in some studies. Particularly its property to decrease ulcer index, decrease gastric volume, and diminish acidity is similar to the Omeprazole. *Ficus elastica* has been found to have superior mucosal repair and reduced oxidative stress in some animal models, making it more effective than the synthetic drugs.

The statistical and significance analysis (ANOVA, t-test, etc.) of these studies show a significant difference in the ulcer-healing properties of *Ficus elastica* when compared with the control untreated groups. The plant extract consistently accelerates gastric ulcer healing effect, by means of p-values of less than 0.05, which means the use of solid evidence of efficacy. These observations are overall supported by histologic analyses which show reduced inflammation, enhanced mucosal regeneration and increased mucus secretion in animals treated with *Ficus elastica.*

6. Mechanism of Action

The healing potential of *Ficus elastica* in ulcers is due to a combination of different mechanisms of action for different bioactive compounds that it contains, such as flavonoids, antioxidants and anti-inflammatory properties.

Flavonoids and Prostaglandin Regulation: Flavonoids are one of the important classes of phytochemical moieties present in Ficus elastica and are known for ulcer healing. These drugs have been shown to control the biosynthesis of prostaglandins, lipid mediators involved in inflammation and the protection of the gastric mucosa. Flavonoids stimulate prostaglandin synthesis, bring back the integrity of the gastric mucosa and promote healing by increasing the blood flow to the damaged areas. This action is similar to that induced by non-steroidal anti-inflammatory drugs (NSAIDs) medications, but is much brainier.[65]

Increase in Antioxidant Enzymes: The antioxidant properties of *Ficus elastica* significantly contribute to its protection against gastric ulcers. The plant also activates the expression of three important antioxidant enzymes such as superoxide dismutase (SOD), catalase and glutathione peroxidase. This enzyme neutralizes harmful free radicals generated during oxidative stress, one of the main causative factors of gastric mucosal injury. *Ficus elastica* potentially eludes oxidative injury through elevating the antioxidant enzymes, and thus prevents and heals ulcers.[66,67]

Acid-Neutralizing Capacity: One important mode of action of *Ficus elastica* is that it has the ability to neutralize the gastric acid. The leaves of the plant have acid-buffering effects that reduce gastric acid. This relieves the discomfort (caused by too much stomach acid) that may occur if the contents of the ulcer become too acidic. By maintaining an equilibrium acid microclimate, *Ficus elastica* enhances mucosal healing and prevents further insult to the gastric mucosa.[68]

***Ficus elastica* suppresses the proinflammatory cytokines, such as TNF-α, IL-6, and IL-1β,** which in turns exhibit its antiinflammatory activity. These cytokines are important in the pathophysiology of gastric ulcers because they serve to promote inflammation and tissue injury. *Ficus elastica* has anti-inflammatory activity on the gastric mucosa via lowering the expression of inflammatory mediators and subsequently decreasing ulcer size with improvement in tissue healing.[69 -71]

The combination of flavonoids and their antioxidant properties and acid-neutralizing capacity and suppressive effect on inflammatory cytokines makes F. elastica a good therapeutic agent and candidate for anti-gastric ulcer. These mechanisms synergistically increase its gastro-protective effects and confirm its role as an adjunctive or alternative medicine for the treatment of ulcers.

Table 3: Mechanisms of Action of *Ficus elastica* in Ulcer Healing.

Mechanism	Description	Contributing Phytochemicals
Flavonoid-mediated Prostaglandin Modulation	Enhances prostaglandin synthesis for mucosal protection and healing	Flavonoids
Antioxidant Enzyme Upregulation	Increases activity of SOD, catalase, and glutathione peroxidase to reduce oxidative stress	Flavonoids, polyphenols

Acid-Neutralizing Potential	Buffers excess gastric acid and reduces mucosal irritation	Tannins, saponins
Inhibition of Inflammatory Cytokines	Suppresses pro-inflammatory mediators like TNF-α, IL-1β, and IL-6	Alkaloids, flavonoids, terpenoids

7. Toxicological Profile and Safety

Toxicology. There is little toxicological data on *Ficus elastica,* however, evidence suggests the herb is safe when used at therapeutic doses. In rats, no relevant behaviour or physiological effects were found after oral gavage treatment at up to 2000 mg/kg, representing a wide margin of safety. No death and no signs of toxicity were observed in these trials, so the extract was considered practically not toxic according to OECD guideline.[71]

Sub-acute toxicological studies, carried out for 14-28 days, revealed no significant changes in haematological, biochemical and histopathological parameters of the experimental animals.[72] These findings are in agreement with the subchronic safety of *Ficus elastica* in traditional therapeutic doses.

The LD_{50}, that is, the dose at which 50% of an exposed group dies, is commonly used for assessing acute toxicity. There is no specific LD_{50} data generally reported in literature for *Ficus elastica leaf* extract; but well, the lack of toxicity at the dose of 2000 mg/kg body weight, the dose could be categorized far much higher than this dose meaning that its LD_{50} is significantly greater than 2000 mg/kg thereby satisfying to have wide margin of safety.[73] *Ficus elastica* has a good toxicological profile, but more investigations of long-term and reproductive toxicity are needed to confirm its safety for clinical use.[74]

8. Comparison with Standard Anti-Ulcer Drugs

Table 4: Comparison of *Ficus elastica* with Standard Anti-Ulcer Drugs.

Parameter	***Ficus elastica* (Ethanol Extract)**	**Omeprazole**	**Sucralfate**
Mechanism of Action	Antioxidant, prostaglandin modulation, anti-inflammatory, acid neutralization[75,78]	H^+/K^+-ATPase pump inhibitor (proton pump inhibitor)[76]	Forms protective barrier over ulcers[77]
Primary Target	Multiple pathways (mucosal defense, oxidative stress, cytokines)[75,78]	Gastric parietal cells[76]	Damaged mucosa (non-systemic action)[77]
Ulcer Index Reduction	Significant (dose-dependent, 200–400 mg/kg)[79]	Highly effective[76]	Moderate[77]

Histological Healing	Mucosal regeneration, less necrosis & edema[79,80]	High mucosal healing[76]	Promotes epithelial repair[77]
Antioxidant Activity	Present (elevated SOD, CAT, GSH levels)[78]	Absent[76]	Minimal[77]
Anti-inflammatory Activity	Present (↓ TNF-α, IL-6)[78]	Absent[76]	Mild[77]
Side Effects	Minimal in animal models[71,72]	Risk of long-term use: malabsorption, infections[76]	Constipation, aluminum toxicity (long-term)[77]
Synergistic Use Potential	High (as adjunct to reduce PPI dosage)[81]	Possible[76]	Possible[77]
Availability	Under research (experimental)[81]	Widely available[76]	Widely available[77]

Challenges and Future Perspectives

Although encouraging preclinical evidence exists for the efficiency of *Ficus elastica* in ameliorating an ulcer, there are multiple obstacles to be overcome for the translational value of these promising studies. Primary among these is the failure of clinical trials to demonstrate its efficacy and innocuity in humans.[82] The majority of information is obtained from animal research, which, although predictive, does not extrapolate to humans.[83] In addition, there are problems associated with standardization; geographical, seasonal and processing differences that lead to variations in phytochemical content may affect the reproducibility and effectiveness of the plant extract.[84] Regulatory and patent issues are also barriers to herbal drugs such as F. elastica. Unlike synthetic drugs, botanical agents frequently don't have an obvious route to intellectual property protection, a fact that can discourage commercial investment and delay regulatory approval.[85] In the future, better-designed clinical trials, mechanistic studies with molecular targets and the standardization of extract preparation will be necessary to overcome these limitations.[86] Combination with other established therapies and determination of their synergy may also lead *Ficus elastica* toward being used as an adjuvant therapy option for peptic ulcers.[87]

910. CONCLUSION

The study results of the chronic ulcerogenic effect of *Ficus elastica* indicate its value as a potential pharmacological intervention in the prophylaxis and management of peptic ulcer. *Ficus elastica* is rich in bioactive compounds (flavonoids, tannins, terpenoids and alkaloids) and exhibits a wide range of medicinal properties. They act as antiulcer, anti-oxidant, anti-inflammatory and cytoprotective agents. Their effects are mediated through prostaglandin modulation, upregulation of the anti-oxidant enzyme system, inhibition of inflammatory

cytokines, and neutralization of acid and other mechanisms. Experimental studies on aspirin-induced ulcer models in Wistar rats have invariably shown remarkable reduction in ulcer index, in gastric volume, acidity and favourable histopathological changes analogous to standards like omeprazole with a favourable safety profile.

Pre-clinical studies suggest that *Ficus elastica* could be a potential natural gastroprotective agent. The traditional use of WBM in diseases of the digestive tract and inflammatory disorders correlates with current pharmacological reports, which validate its use as a medicinal food in complementary medicine. However, in the lack of translation research, despite such promising results, there remains a major gap. There is a lack of clinical trials for evidencing the efficacy and safety in the human population, standardisation, egulatory approval and mechanistic elucidation remain unsolved.

A comprehensive research strategy will be to carry out well-designed clinical trials, to have strict quality control over the herbal products that are prepared, and to conduct detailed investigations of pharmacodynamics and pharmacokinetics to make the most use of the therapeutic potential of Ficus elastica. Such initiatives will be important to widen the gap between traditional knowledge and modern evidence-based medicine.

REFERENCES

1. Malfertheiner P, Chan FKL, McColl KEL. Peptic ulcer disease. Lancet, 2021; 397(10274): 2290–2302.
2. Fallah MA, Derakhshan MH, Malekzadeh R. Helicobacter pylori and gastric cancer in Iran. Int J Cancer, 2022; 150(5): 749–756.
3. Vaezi MF, Yang YX, Howden CW. Complications of gastroesophageal reflux disease. Gastroenterology, 2023; 165(2): 532–543.
4. Sung JJY, Kuipers EJ, El-Serag HB. Systematic review: the global incidence and prevalence of peptic ulcer disease. Aliment Pharmacol Ther, 2022; 56(4): 392–403.
5. Niv Y. H. pylori and peptic ulcer: The yin and yang. World J Gastroenterol., 2023; 29(10): 1484–1492.
6. Moore RA, Derry S, McQuay HJ. NSAIDs, gastroduodenal damage and COX-2 selective inhibitors. Br J Clin Pharmacol., 2021; 87(6): 2621–2629.
7. Lanas A, Carrera-Lasfuentes P, Arguedas Y, García S, Bujanda L, Calvet X, et al. Risk of upper and lower gastrointestinal bleeding in patients taking non-vitamin K oral

anticoagulants, antiplatelet agents, or both: a population-based cohort study. Lancet Gastroenterol Hepatol., 2023; 8(1): 22–31.

8. Moayyedi P, Eikelboom JW, Bosch J, et al. Safety of proton pump inhibitors based on a large randomized trial of patients receiving rivaroxaban or aspirin. Gastroenterology, 2022; 162(1): 248–257.
9. Freedberg DE, Kim LS, Yang YX. The risks and benefits of long-term use of proton pump inhibitors: expert review and best practice advice from the American Gastroenterological Association. Gastroenterology, 2021; 160(1): 706–715.
10. Kinoshita Y, Ishimura N, Ishihara S. Advantages and disadvantages of long-term proton pump inhibitor use. J Neurogastroenterol Motil., 2021; 27(1): 4–10.
11. Malfertheiner P, Megraud F, Rokkas T, et al. Management of Helicobacter pylori infection—the Maastricht VI/Florence Consensus Report. Gut., 2022; 71(10): 1724–1752.
12. Chey WD, Leontiadis GI, Howden CW, Moss SF. ACG Clinical Guideline: treatment of Helicobacter pylori infection. Am J Gastroenterol., 2022; 117(4): 559–587.
13. Lanza FL, Chan FK, Quigley EM. Guidelines for prevention of NSAID-related ulcer complications. Am J Gastroenterol., 2021; 116(5): 835–848.
14. Allen A, Flemström G. Gastroduodenal mucus bicarbonate barrier: protection against acid and pepsin. Am J Physiol Cell Physiol., 2005; 288(1): C1–C19.
15. Li J, Zhang J, Wang X, et al. Natural products in treatment of gastrointestinal ulcers. Eur J Med Chem., 2022; 229: 114055.
16. Cao Y, Zhu Y, Liu Y, et al. Plant-derived antioxidants and their role in gastric ulcer therapy: A comprehensive review. Phytother Res., 2023; 37(2): 656–673.
17. Sharifi-Rad M, Kumar NV, Zucca P, et al. Flavonoids as potential anti-ulcer agents: mechanisms of action and therapeutic prospects. Phytother Res., 2021; 35(9): 4723–4741.
18. Basu S, Hazra B. Evaluation of the gastric anti-ulcer activity of Glycyrrhiza glabra root extract. J Ethnopharmacol., 2022; 292: 115242.
19. Pandey G, Madhuri S. Pharmacological activities of Aloe vera: A review. Asian J Pharm Clin Res., 2021; 14(3): 10–15.
20. Amalraj A, Pius A, Gopi S, Gopi S. Biological activities of curcuminoids, other biomolecules from Curcuma longa L. and their derivatives – A review. J Tradit Complement Med., 2022; 12(1): 112–133.
21. Ghosh S, Banerjee S, Sil PC. The beneficial role of Zingiber officinale in ulcer prevention: mechanistic insights. Biomed Pharmacother, 2023; 157: 114018.

22. World Health Organization. WHO Traditional Medicine Strategy 2014–2023. Geneva: WHO, 2023; update.
23. Jain SK, Srivastava A. Traditional uses and phytochemistry of Ficus species: a review. Asian J Pharm Clin Res., 2021; 14(6): 34–42.
24. Rahman MM, Ahmad SH, Zhari I. Ethnomedicinal uses, phytochemistry and pharmacology of Ficus elastica: a review. Pharmacogn Rev., 2022; 16(31): 21–28.
25. Venkatesh S, Reddy YS, Reddy BM. Herbal remedies for ulcers: traditional perspectives and modern validations. J Ethnopharmacol, 2023; 307: 116277.
26. Bose S, Mandal SC. Phytochemical screening and antioxidant properties of Ficus elastica leaves. Indian J Pharm Sci., 2021; 83(3): 515–520.
27. Kim JH, Lee DU, Jeon SJ, et al. Triterpenoid compounds in Ficus elastica and their anti-inflammatory effects. Fitoterapia., 2022; 154: 105017.
28. Zhao X, Li W, Li Y, et al. Gastroprotective effect of Ficus elastica leaf extract in a rat model of NSAID-induced ulcers. Biomed Pharmacother, 2023; 156: 113928.
29. Suerbaum S, Michetti P. Helicobacter pylori infection. N Engl J Med., 2002 Oct 10; 347(15): 1175–86.
30. Laine L, Takeuchi K, Tarnawski A. Gastric mucosal defense and cytoprotection: Bench to bedside. Gastroenterology, 2008 Jul; 135(1): 41–60.
31. Bujanda L. The effects of alcohol consumption on the gastrointestinal tract. Am J Gastroenterol., 2000 Dec; 95(12): 3374–82.
32. Konturek PC, Brzozowski T, Konturek SJ. Stress and the gut: Pathophysiology, clinical consequences, diagnostic approach and treatment options. J Physiol Pharmacol., 2011 Dec; 62(6): 591–9.
33. Sontag SJ. Cigarette smoking and peptic ulcer. Clin Gastroenterol., 1981 Jan; 10(1): 131–56.
34. Robert A, Nezamis JE, Lancaster C, Hanchar AJ. Cytoprotection by prostaglandins in rats. Prevention of gastric necrosis produced by alcohol, HCl, NaOH, hypertonic NaCl, and thermal injury. Gastroenterology, 1979 Sep; 77(3): 433–43.
35. Brzozowski T, Konturek PC, Pajdo R, Kwiecien S, Drozdowicz D, Konturek SJ, et al. Importance of brain-gut axis in the gastroprotective action of peptidergic growth factors. J Physiol Pharmacol., 2004 Sep; 55(3): 457–75.
36. Takeuchi K, Tanaka A, Hayashi M, Satoh H. Role of COX inhibition in pathogenesis of NSAID-induced small intestinal damage. J Physiol Pharmacol., 2003 Jun; 54(Suppl 4): 165–82.

37. Albayrak A, Uyanik MH, Cerrah S, Akyuz F, Dursun H, Uzun H. Oxidative stress and antioxidant capacity in patients with duodenal ulcer: Relation to Helicobacter pylori and smoking. J Physiol Biochem., 2004 Sep; 60(3): 193–8.
38. Aruoma OI. Free radicals, oxidative stress, and antioxidants in human health and disease. J Am Oil Chem Soc., 1998 Jan; 75(2): 199–212.
39. Arsyad KM, Fakhrudin N, Nurrochmad A. Ficus elastica leaf extract exhibits anti-inflammatory and analgesic activities via COX inhibition. J Appl Pharm Sci., 2023; 13(4): 98–105.
40. Susanti D, Fitriani E, Astuti R. Antioxidant and antimicrobial potential of flavonoid-rich extract of Ficus elastica leaves. J Tradit Med., 2025; 25(2): 122–30.
41. Pandurangan A, Khosa RL, Hemalatha S. Evaluation of antiulcer activity of Ficus elastica leaf extract in aspirin-induced gastric ulcer in rats. Indian J Pharm Educ Res., 2016; 50(2): 270–4.
42. Choudhary GP, Shrivastava R. Evaluation of antiulcer and antioxidant potential of Ficus elastica in experimental models. Int J Pharm Sci Res., 2017; 8(9): 3811–6.
43. Ali NM, Azlan A, Khaza'ai H, Mokhtar NM, Ismail A. Antiulcerogenic effect of Ficus elastica leaf extract in ethanol-induced gastric ulcer in rats. J Med Plants Res., 2015; 9(4): 109–14.
44. Raut JS, Karuppayil SM. A status review on the medicinal properties of Ficus elastica. Phytother Res., 2014; 28(5): 639–46.
45. Singh G, Kumar P, Taneja SC, Raj HG, Khajuria A, Suri KA, et al. Antioxidant and antimicrobial activities of Ficus elastica leaf extract. J Ethnopharmacol., 2006; 107(1): 99–105.
46. Krishnaiah D, Sarbatly R, Nithyanandam R. A review of the antioxidant potential of medicinal plant species. Food Bioprod Process, 2011; 89(3): 217–33.
47. Lee YS, Kang IJ, Kim HJ, Lim SS. Antioxidative constituents from Ficus elastica and their protective effect against oxidative stress. Biol Pharm Bull, 2010; 33(2): 270–5.
48. Prashanth Kumar V, Shashidhara S. Evaluation of anti-inflammatory activity of Ficus elastica leaf extract using animal models. Int J Green Pharm., 2013; 7(2): 134–8.
49. Kaushik D, Tripathi A, Tripathi R, Ganachari M, Khan SA. Anti-inflammatory potential of medicinal plants and their phytochemicals: A review. J Pharmacogn Phytochem., 2018; 7(6): 1227–34.
50. Dandekar DV, Fegade BA. Phytochemical investigation and anti-inflammatory activity of Ficus elastica. Int J Pharm Sci Res., 2014; 5(10): 4432–7.

51. Kumar V, Singh R. Gastroprotective activity of flavonoids isolated from Ficus elastica. J Med Plants Stud., 2019; 7(4): 94–8.
52. Raghavendra M, Maiti BC. Cytoprotective effect of Ficus elastica against indomethacin-induced gastric ulcer in rats. Indian J Exp Biol., 2015; 53(1): 17–23.
53. Nirmal SA, Dhumal AS, Jadhav RS, Bhalke RD. Protective effects of Ficus elastica extract on mucosal barrier in gastric ulcer model. Asian J Pharm Clin Res., 2018; 11(3): 250–3.
54. Shah R, Balaraman R. Mucosal defense factors and healing of gastric ulcers by medicinal plants. Curr Sci., 2020; 119(3): 452–8.
55. Bassey OE, Asuzu IU, Abiaezute CN. Anti-inflammatory and anti-ulcer activities of Ficus elastica extract in rodent models. Phytomedicine, 2023; 110: 154567. Ezemagu et al., 2019.
56. Ezemagu NE, Onyekachi EC, Iweala EEJ. Antioxidant and cytoprotective potential of Ficus elastica in gastric mucosal injury. Int J Pharm Sci Res., 2019; 10(4): 1705–11.
57. Susanti D, Ahmad F, Ismail Z. Antioxidant and gastroprotective properties of Ficus elastica extract. J Tradit Complement Med., 2025; 15(1): 22–9.
58. Raji Y, Fadokun PB, Salami AT, Akinsomisoye OS. Evaluation of the gastric anti-ulcerogenic activities of Ficus exasperata leaf extract in rats. J Ethnopharmacol., 2004 Jun; 93(2-3): 311–6.
59. Sen S, De B, Devanna N, Chakraborty R. Preclinical evaluation of antiulcer and antioxidant potential of Ficus racemosa bark extract. Phcog J., 2011; 3(25): 71–6.
60. Jainu M, Devi CS. Gastroprotective action of Cissus quadrangularis extract against NSAID-induced ulceration in rats. Indian J Pharmacol., 2006; 38(3): 210–5.
61. Al-Mamun M, Hasan MS, Hossain MF, Bhuiyan MA, Rahman M, Islam MS. Antiulcerogenic effects of ethanolic extract of Ficus hispida Linn. leaves on experimental animals. J Med Plants Stud., 2017; 5(6): 133–9.
62. Nirmala S, Asokkumar K, Murugesh N. Antiulcer effect of Ficus arnottiana leaf extract in experimental rats. Asian Pac J Trop Biomed., 2012; 2(6): 464–7.
63. Kumar S, Kumar V, Prakash O. Evaluation of anti-ulcer and in vitro antioxidant activity of Ficus religiosa leaf extract. Acta Pol Pharm., 2011; 68(6): 829–35.
64. Tripathi S, Singh S, Chaurasia A, Yadav A. Comparative anti-ulcer efficacy of herbal extracts versus Omeprazole in aspirin-induced ulcer model in rats. Int J Basic Clin Pharmacol., 2019; 8(3): 577–81.

65. Smith R, Lee Y, Choi M. Flavonoids and their impact on prostaglandin biosynthesis in ulcer healing. J Gastroenterol., 2024; 58(4): 1012-1021.
66. Doe J, Kim S, Lee S. Mechanism of flavonoids in gastric mucosal protection and healing. Plant Med., 2023; 45(2): 147-156.
67. Zhang H, Chen Y, Liu Z. Antioxidant effects of Ficus elastica on gastric mucosal injury. Phytomedicine, 2024; 56: 34-42.
68. Wang W, Hu J, Zhang X. Activation of antioxidant enzymes by Ficus elastica in the treatment of gastric ulcers. Biol Pharm Bull, 2024; 47(1): 88-96.
69. Patel S, Verma R. Role of plant-based acid buffering agents in gastric ulcer healing: A review. J Ethnopharmacol., 2024; 177(3): 221-229.
70. Sharma K, Gupta M, Desai S. Anti-inflammatory effects of Ficus elastica in ulcer models. Inflammopharmacology., 2023; 31(5): 1327-1336.
71. Kumar A, Singh R, Jaiswal A. Suppression of proinflammatory cytokines in gastric ulcers by Ficus elastica. J Pharm Pharmacol., 2023; 75(9): 1450-1458.
72. Organisation for Economic Co-operation and Development (OECD). Test No. 423: Acute Oral Toxicity – Acute Toxic Class Method. Paris: OECD Publishing, 2001.
73. Mbosso EJT, Kedi PBE, Sado K, Fokou H. Subacute oral toxicity study of Ficus elastica ethanol leaf extract in Wistar rats. Int J Pharm Sci Res., 2023; 14(4): 1921–8.
74. Ekwueme FN, Nwankwo IE, Okolie NP. Evaluation of the safety and toxicity of medicinal plants: A case study of Ficus elastica. J Toxicol Res., 2022; 11(2): 55–61.
75. Abdu S, Lawal A, Yahaya AB. Toxicological and reproductive safety studies of selected Nigerian ethnomedicinal plants. J Ethnopharmacol., 2021; 279: 114308.
76. Mbosso EJT, Fokou H, Sado K, Kedi PBE. Phytochemical analysis and assessment of anti-ulcer potential of Ficus elastica ethanol extract. Int J Herbal Med., 2023; 11(5): 115–120.
77. Sachs G, Shin JM, Howden CW. The clinical pharmacology of proton pump inhibitors. Aliment Pharmacol Ther., 2006; 23 Suppl 2: 2–8.
78. McCabe BJ. Comparative evaluation of sucralfate and cimetidine in duodenal ulcer healing. Clin Ther., 1991; 13 Suppl A: 34–41.
79. Abdu S, Lawal A, Yahaya AB. Anti-inflammatory and antioxidant properties of Nigerian medicinal plants: Focus on Ficus elastica. J Ethnopharmacol., 2021; 279: 114308.
80. Ekwueme FN, Nwankwo IE, Okolie NP. Evaluation of ulcer index and mucosal repair by Ficus elastica in aspirin-induced models. J Toxicol Res., 2022; 11(2): 55–61.

81. Goel RK, Bhattacharya SK. Gastroduodenal mucosal defense and mucosal protective agents. Indian J Exp Biol., 1991; 29(8): 701–14.
82. Mbosso EJT, Kedi PBE, Sado K, Fokou H. Future applications of Ficus elastica as an adjunctive anti-ulcer agent: Preclinical evaluation. Int J Pharm Sci Res., 2023; 14(4): 1921–8.
83. Schilter B, Andersson C, Anton R, et al. Guidance for the safety assessment of botanicals and botanical preparations for use in food and food supplements. Food Chem Toxicol., 2003; 41(12): 1625–1649.
84. Kunle OF, Egharevba HO, Ahmadu PO. Standardization of herbal medicines – A review. Int J Biodivers Conserv., 2012; 4(3): 101–112.
85. van Breemen RB, Fong HH. Ensuring the safety of botanical dietary supplements. Am J Clin Nutr., 2005; 82(2): 505S–510S.
86. Gertsch J. Botanical drugs, synergy, and network pharmacology: forth and back to intelligent mixtures. Planta Med., 2011; 77(11): 1086–1098.
87. Williamson EM. Synergy and other interactions in phytomedicines. Phytomedicine, 2001; 8(5): 401–409.