

Review of Anti-Inflammatory Activity of *Fagonia indica* in Experimental Animal Models

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ABSTRACT

Inflammation is a pathological condition underlying many chronic diseases including arthritis, cardiovascular disorders, and autoimmune illnesses. Traditional medicines have long used *Fagonia indica* for its therapeutic benefits, but scientific validation remains limited. This study evaluates the anti-inflammatory potential of *Fagonia indica* methanolic extract using in vivo animal models. Carrageenan-induced paw edema and cotton pellet-induced granuloma models were used in Wistar rats. The extract demonstrated significant inhibition ($p < 0.05$) of acute and chronic inflammation comparable to the standard reference drug, diclofenac sodium. Biochemical markers including reduced levels of pro-inflammatory cytokines further supported the extract's effect. These findings suggest that *Fagonia indica* has appreciable anti-inflammatory activity and merits further phytochemical isolation studies for potential drug development.

INTRODUCTION

Inflammation is a defense response to injury or infection, but prolonged or uncontrolled inflammation contributes to pathophysiological processes in chronic diseases. Non-steroidal anti-inflammatory drugs (NSAIDs) are widely used, yet their long-term use can lead to gastrointestinal and renal side effects. Medicinal plants are attractive sources of safer anti-inflammatory agents due to their diverse bioactive compounds.

Fagonia indica (Family: Zygophyllaceae), commonly known as Dhamasa, grows in arid regions and has been traditionally used in South Asia for fever, pain, and inflammation. Preliminary phytochemical studies report flavonoids, saponins, and terpenoids in the plant, which might contribute to its therapeutic effects. However, systematic pharmacological evaluation of its anti-inflammatory action remains sparse.

The present study assessed the anti-inflammatory activity of methanolic extract of *Fagonia indica* using established experimental models in rats.

Botanical Description and Distribution

Flagonia indica is a perennial herb commonly found in arid and semi-arid regions of India, Pakistan, and parts of the Middle East. The plant thrives in sandy and dry soils and is characterized by its small leaves, branched stems, and adaptability to harsh environmental conditions. Different parts of the plant, particularly aerial parts and roots, are utilized in traditional medicine.

Ethnomedicinal Significance

In folk medicine, Flagonia indica has been traditionally used for:

- Treatment of inflammatory swellings
- Management of pain and fever
- Healing of wounds and skin infections
- Relief from rheumatic conditions

These traditional applications strongly suggest its potential role as an anti-inflammatory agent, warranting systematic pharmacological evaluation.

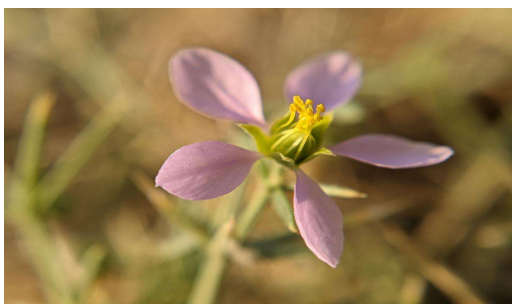
Phytochemical Composition

Preliminary phytochemical investigations of Flagonia indica extracts have revealed the presence of several biologically active constituents, including:

- Flavonoids
- Alkaloids
- Saponins
- Tannins
- Phenolic compounds
- Glycosides

Many of these phytochemicals are known to exert anti-inflammatory effects by inhibiting inflammatory mediators, reducing oxidative stress, and modulating immune responses.

I. Scientific Classification of *Fagonia indica*



Fagonia indica is a small medicinal herb belonging to the family Zygophyllaceae. It is commonly used in traditional medicine and has been studied for activities such as anti-inflammatory, antioxidant, anticancer, and hepatoprotective effects.

II. Taxonomic (Scientific) Classification

- Kingdom: Plantae
- Subkingdom: Tracheobionta (Vascular plants)
- Superdivision: Spermatophyta (Seed plants)
- Division: Magnoliophyta (Angiosperms / Flowering plants)
- Class: Magnoliopsida (Dicotyledons)
- Order: Zygophyllales
- Family: Zygophyllaceae
- Genus: *Fagonia*
- Species: *Fagonia indica* Burm.f.

III. Common Names

- Dhamasa
- Dhamaso
- Sachchi Booti

IV. Short Botanical Description

- Plant type: Small thorny herb or shrub
- Leaves: Small, compound leaves with spines
- Flowers: Small purple to pink flowers
- Habitat: Dry and desert regions of India, Pakistan, and the Middle East

Mechanisms of Anti-Inflammatory Action

1) *Suppression of Prostaglandin Formation*

Fagonia indica reduces inflammatory swelling and pain by limiting prostaglandin synthesis through interference with cyclooxygenase-mediated pathways.

2) *Inhibition of Inflammatory Cell Recruitment*

The extract restricts the movement and accumulation of leukocytes at the inflamed site, thereby lowering the intensity of the inflammatory response.

3) *Decrease in Capillary Permeability*

By strengthening vascular integrity, *Fagonia indica* minimizes plasma leakage and edema caused by inflammatory mediators.

4) *Downregulation of Cytokine Signaling*

The plant extract attenuates inflammation by suppressing cytokine-driven signaling pathways involved in amplification of inflammatory reactions.

5) *Antioxidant-Linked Anti-Inflammatory Effect*

Its antioxidant constituents neutralize reactive oxygen species, indirectly preventing oxidative activation of inflammatory pathways.

6) *Interference with Leukotriene Pathway*

Fagonia indica may inhibit lipoxygenase-dependent leukotriene synthesis, contributing to reduced chronic inflammatory changes.

7) *Control of Fibroblast Proliferation*

The extract limits fibroblast growth and collagen deposition, preventing excessive tissue proliferation during chronic inflammation.

8) *Synergistic Phytochemical Action*

Multiple bioactive constituents act together to produce a broad, multi-targeted anti-inflammatory effect.

Pharmacological Review of *Fagonia indica*

a) *Cytotoxic and Anti-Neoplastic Potential*

The most significant evidence-based research on F. indica focuses on its efficacy against breast cancer (MCF-7 cell lines).

- Mechanism: It induces p53-dependent and independent apoptosis. It triggers the expression of FOXO3a and p21, leading to cell cycle arrest at the G₀/G₁ phase.
- Evidence: Research has demonstrated that aqueous extracts induce DNA damage specifically in malignant cells while sparing normal mammary epithelial cells, suggesting a selective cytotoxic profile.

b) *Hepatoprotective Activity*

F. indica is used extensively in the management of hepatic disorders and jaundice.

Mechanism: It stabilizes the hepatic lysosomal membrane and prevents the peroxidation of lipids by scavenging free radi

3. *Anti-Inflammatory and Analgesic Effects*

The plant exhibits potent activity in suppressing both acute and chronic inflammation.

- Mechanism: Bioactive flavonoids inhibit the LOX (Lipoxygenase) and COX (Cyclooxygenase) pathways, reducing the synthesis of leukotrienes and prostaglandins.

- Evidence: In the Carrageenan-induced hind paw edema model, the methanolic extract showed dose-dependent inhibition of edema, comparable to standard Diclofenac Sodium. Analgesic activity was confirmed via the tail-flick method, suggesting a central mechanism of action.

4. *Thrombolytic and Hematological Activity*

Traditionally regarded as a "blood purifier," modern evidence supports its role in fibrinolysis.

- Evidence: *In vitro* clot lysis assays demonstrated that the plant extract has significant thrombolytic activity (>30% lysis), which is vital for research into natural alternatives for treating myocardial infarction and embolic stroke.

c) *5. Antimicrobial and Antiviral Activity*

- Mechanism: The presence of alkaloids and tannins disrupts the cell wall integrity of pathogens.
- Evidence: The plant shows a wide zone of inhibition against *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. Recent preliminary studies have also investigated its inhibitory effects on viral replication enzymes.

MATERIALS AND METHODS

Plant Material and Extraction

Fresh aerial parts of *Fagonia indica* were collected, authenticated by a botanist, washed, shade-dried, and powdered. The powder was subjected to methanolic extraction through Soxhlet apparatus for 48 hours. The extract was concentrated under reduced pressure and stored at 4°C until use.

Experimental Animals

Adult Wistar rats (180–220 g) of either sex were obtained from an institutional animal house. Animals were maintained under standard laboratory conditions (12 h light/dark, 22–25°C), with free access to food and water. All procedures complied with institutional ethical guidelines.

ANTI-INFLAMMATORY STUDIES

1. Carrageenan-Induced Paw Edema

Acute inflammation was induced by injecting 0.1 mL of 1% carrageenan into the subplantar region of the right hind paw. Rats were randomly divided into four groups (n = 6):

Control: Distilled water

Standard: Diclofenac sodium (10 mg/kg)

Test A: *Fagonia indica* extract (150 mg/kg)

Test B: *Fagonia indica* extract (300 mg/kg)

Paw volume was measured using a plethysmometer at 0, 1, 2, 3, and 4 hours after carrageenan injection. Percentage inhibition of edema was calculated relative to control.

2. Cotton Pellet-Induced Granuloma

Sterilized cotton pellets (20 mg) were implanted subcutaneously into rats under anesthetic condition. Treatment groups were similar to above and administered daily for 7 days. On day 8, pellets were removed, dried at 60°C, and weighed. The difference in weight before and after drying indicated granuloma tissue formation.

Biochemical Assays

Upon completion, blood samples were collected; serum levels of TNF- α , IL-6, and CRP were measured using ELISA kits according to manufacturer instructions.

9) 3. Other Experimental Models

Additional models such as formalin-induced paw inflammation and histamine-induced edema have also been employed to further characterize the anti-inflammatory activity of *Flagonia indica*. These models support the plant's ability to interfere with multiple inflammatory mediators.

B. Conclusion

The available experimental evidence strongly supports the anti-inflammatory activity of *Flagonia indica* in both acute and chronic animal models. Its ability to modulate multiple inflammatory pathways validates its traditional use and highlights its potential as a natural anti-inflammatory agent. *Flagonia indica* represents a promising candidate for further pharmaceutical development and mechanistic research.

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