RESEARCH PAPER

Phytochemical Evaluation and Comparative Pharmacological Profiling of Ficus racemosa and Ficus benghalensis: Analgesic, Anti-inflammatory, and Neuroprotective Perspectives

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Abstract:
The genus Ficus (Moraceae) is a rich source of bioactive secondary metabolites with potential medicinal applications. Purpose The objective of the present study is to investigate the phytochemical constituents and pharmacological importance of Ficus racemosa (Cluster Fig) and Ficus benghalensis (Banyan Tree) which are traditionally used for anti-inflammatory, analgesic and cognition enhancing activities. Methods and Materials The anti-inflammatory activity was studied by carrageenan induced paw edema model and the analgesic potential was evaluated by Eddy's Hot Plate method. A neuroprotective effect was studied in scopolamine-induced cognitive impairment by the Morris Water Maze (MWM) and Y-Maze models. Results Phytochemical screening of both species showed high concentration of flavonoids, tannins and triterpenoids. F. racemosa extracts (400 mg/kg) showed strong reduction in paw volume more than F. benghalensis in the carrageenan model. However, F. benghalensis had significant neuroprotective properties, which were demonstrated by significantly increasing the escape latency in MWM and spontaneous alternation in Y-Maze. Discussion and Conclusion The results give scientific credibility to the traditional use of these species in the treatment of inflammatory and neurological problems.

Keywords: Ficus racemosa, Ficus benghalensis, Anti-inflammatory, Analgesic, Neuroprotective, Carrageenan, Eddy's Hot Plate, Morris Water Maze.
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INTRODUCTION

Ficus, a genus in the Moraceae family, is one of the world's most important medicinal plant groups, with over 800 species of wood trees, shrubs, and vines. Ficus racemosa (also known as the Cluster Fig or Gular) and Ficus benghalensis (the Banyan Tree) are revered in the Indian Ayurvedic beneficial system and other ancient healing methods.

These plants are more than just botanical objects; they are biological factories that create a variety of secondary metabolites, such as flavonoids, tannins, alkaloids, saponins, and triterpenoids. Historically, different regions of these trees, especially the bark, leaves, and latex have been used to cure a variety of ailments, include diabetes, liver disorders, persistent inflammation, and infectious illnesses.

In today's pharmaceutical environment, the search for natural alternatives to synthetic pharmaceuticals is driven by the need to reduce the side effects associated with long-term treatment. Inflammation and pain are complex biological responses that, when unchecked, can lead to devastating chronic illnesses. Furthermore, neurodegeneration and cognitive decline pose considerable worldwide health risks. The present study was aimed to compare F. racemosa and F. benghalensis through standard animal models to support their traditional claims.

The work is concerned with three main pharmacological aspects, such as anti-inflammatory effect, analgesic power and neuroprotective efficacy. The extracts can be tested for immediate inhibition of inflammatory mediators in the carrageenan induced paw edema paradigm. The Hot Plate method of the Eddy measures the central analgesic activity, by the increase in reaction time to hot stimuli. Finally, complex behavioral models (Morris Water Maze (MWM) and Y-Maze) are used to evaluate the capacity of various Ficus species to restore memory and spatial learning in scopolamine-induced amnesic models. This structured comparison of these ancient medicinal trees is to provide scientific explanation for their multi-targeted therapeutic potential.

LITERATURE SURVEY

The present study was designed to evaluate the claims of F. racemosa and F. benghalensis in standard animal models to justify their traditional use.
The work is focused on three main pharmacological aspects, such as anti-inflammatory effect, analgesic power and neuroprotective efficacy. The extracts can be tested for immediate inhibition of inflammatory mediators in the carrageenan induced paw edema model.
The Hot Plate method of the Eddy measures the central analgesic activity, by the prolongation in reaction time to hot stimuli. Lastly, sophisticated behavioral models like Morri's water maze (MWM) and Y-Maze are employed to assess the potential of different Ficus species in restoring memory and spatial learning in scopolamine-induced amnesic models. The objective of this structured comparison of these ancient medicinal trees is to provide scientific explanation for their multi-targeted therapeutic potential.

MATERIAL AND METHODS

Plant Collection and Extraction

The bark and leaves of both Ficus species were taken from local botanical areas, certified by a taxonomist, and shade-dried to preserve the thermolabile elements. The dried material was mashed to a coarse powder. For 72 hours, an extraction was carried out utilizing a Soxhlet equipment and 70% ethanol as the solvent. The resultant extracts were concentrated under decreased pressure with a rotary evaporator and kept at 4°C for further pharmacological testing.

Phytochemical Screening

A preliminary phytochemical investigation was performed to identify the key types of secondary metabolites. Standard qualitative testing were used.
Alkaloids were tested using Dragendorff and Mayer's reagents.
Flavonoids are identified using the Shinoda test (magnesium ribbon and HCl).
Tannins were confirmed using the ferric chloride ($FeCl_3$) test.
Triterpenoids were detected utilizing the Salkowski and Libermann-Burchard assays.

Anti-inflammatory Activity (Carrageenan Model)

Wistar rats were given extracts (200, 400 mg/kg) orally 60 minutes before receiving a subplantar injection of 1% carrageenan. Paw volume was measured every hour for four hours.

Analgesic Activity (Eddy's Hot Plate)

The rats were placed on a heated plate (55°C). The analgesic response was assessed by the time it took to lick one's paw or leap.

Neuroprotective Activity (MWM & Y-Maze)

Spatial memory was assessed in the Morris Water Maze (MWM) by measuring escape latency to a hidden platform. The Y-Maze alternation behavior assessed short-term memory.

RESULTS

Phytochemical Profile

Constituent	F. racemosa	F. benghalensis
Flavonoids	+++	++
Tannins	++	+++
Alkaloids	+	+
Triterpenoids	+++	++

Anti-inflammatory Action (Carrageenan Model)

Group	Initial Vol (ml)	3h (ml)	4h (ml)	% Inhibition
Control	0.32	0.85	0.88	-
F. racemosa	0.31	0.48	0.42	52.3%

F. benghalensis	0.33	0.55	0.49	44.3%

Figure 1: Comparative Paw Edema Volume Reduction

Analgesic Effect (Eddy's Hot Plate)

Group	0 min (sec)	60 min (sec)	90 min (sec)
Control	3.5	3.8	3.6
F. racemosa	3.6	8.2	10.5
F. benghalensis	3.4	7.5	9.2

Figure 2: Increase in Reaction Time (Analgesic Potency)

Neuroprotective Evaluation

Morris Water Maze (MWM) - Escape Latency

Group	Day 1 (sec)	Day 3 (sec)	Day 5 (sec)
Amnesic (Scopolamine)	55	58	52
F. racemosa (400mg)	52	35	18
F. benghalensis (400mg)	54	30	15

Figure 3: Memory Retention and Spatial Learning in Water Maze

Y-Maze - Spontaneous Alternation

Group	% Alternation
Normal Control	75.4
Amnesic Control	38.2
F. racemosa	62.5
F. benghalensis	68.9

The pharmacological comparison of Ficus racemosa and Ficus benghalensis reveals that both species have potent therapeutic properties suitable for the treatment of a wide variety of clinical problems. In the carrageenan-induced paw edema model, F. racemosa suppressed acute inflammation more efficiently, most likely because to its high triterpene and flavonoid content.

Similarly, the Eddy's Hot Plate analgesic study showed that both extracts significantly increased pain threshold suggesting their potential as natural central analgesics. Importantly, the neuroprotective evaluation using

CONCLUSION

Morris Water Maze and Y-Maze models revealed that F. benghalensis is especially effective in cognitive recovery and spatial memory improvement in amnesic states.

These results are in agreement with ethnomedicinal use of both trees in traditional Ayurveda. F. racemosa is more suitable for treatment of inflammatory pain and F. benghalensis has more potential of neuroprotection. Future research should be directed toward identifying the specific bioactive chemicals responsible for these synergistic effects in an effort to develop standardized phytopharmaceuticals for chronic pain and neurodegenerative diseases.

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