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Original Research Article

Potential effect of ethanolic extract of *Abutilon indicum* (L.) against acetic acid induced ulcerative colitis in albino rats

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ABSTRACT

Background: Ulcerative colitis (UC) is a chronic, relapsing inflammatory disorder of the colon characterized by mucosal inflammation, ulceration, and disruption of intestinal homeostasis *Abutilon indicum* (L.), a traditionally used medicinal plant in Ayurvedic and folk medicine, has been reported to possess various pharmacological activities including anti-inflammatory, antioxidant, analgesic, and wound healing effects. However, its potential role in the management of ulcerative colitis remains inadequately explored and requires scientific validation.
Methods: Animals were treated for 11 days in different groups. Group I received normal saline, Group II received distilled water, Group III received sulfasalazine, and Groups IV & V received Abutilon indicum extract at two doses. On day 8, ulcerative colitis was induced in Groups II-V using 4% acetic acid administered rectally. On day 11, animals were anesthetized, blood samples were collected, and colon tissues were preserved for analysis (cytokine study and histopathology).
Results: The study showed that ethanolic extract of Abutilon indicum leaves has significant anti-ulcerative colitis activity against acetic acid-induced colitis. Both doses (250 mg/kg and 500 mg/kg) were effective, but 500 mg/kg showed better results. This effect was confirmed by reduced inflammatory markers (TNF-a, IL-6), decreased colon weight-length ratio, and improved histopathological findings.
Conclusions: The findings suggest that the plant possesses promising anti-colitic potential and may serve as a natural therapeutic candidate for the management of ulcerative colitis. Further studies are warranted to isolate the active constituents, elucidate the underlying molecular mechanisms, and establish its clinical efficacy and safety.

Keywords: *Abutilon indicum*, Acetic acid, Inflammatory bowel disease, Sulfasalazine, Ulcerative colitis

INTRODUCTION

Medicinal plants have been used for the prevention and treatment of diseases since ancient times and continue to play a vital role in modern healthcare.[1] According to the World Health Organization (WHO), a significant proportion of the global population relies on traditional herbal medicines for primary healthcare. Furthermore, medicinal plants serve as valuable sources for the discovery and development of novel therapeutic agents due to their efficacy, safety, and structural diversity.[2] Scientific validation through phytochemical, pharmacological, and toxicological studies has strengthened their importance in evidence-based medicine, making medicinal plants an indispensable resource in pharmaceutical research and drug development.[3]

Inflammatory bowel disease (IBD) represents a group of chronic, idiopathic inflammatory disorders of the gastrointestinal tract, primarily encompassing ulcerative

colitis and Crohn's disease.[4] Although these conditions share overlapping clinical manifestations and pathological features, they exhibit distinct morphological and histological differences.[5]

Ulcerative colitis (UC) is a chronic, relapsing-remitting inflammatory condition characterized by continuous mucosal inflammation that originates in the rectum and extends proximally through the colon. The disease predominantly affects the mucosal and submucosal layers of the intestinal wall and is associated with progressive ulceration and inflammatory damage. In most cases, the rectum is invariably involved, with disease progression occurring in a continuous pattern.[5,6]

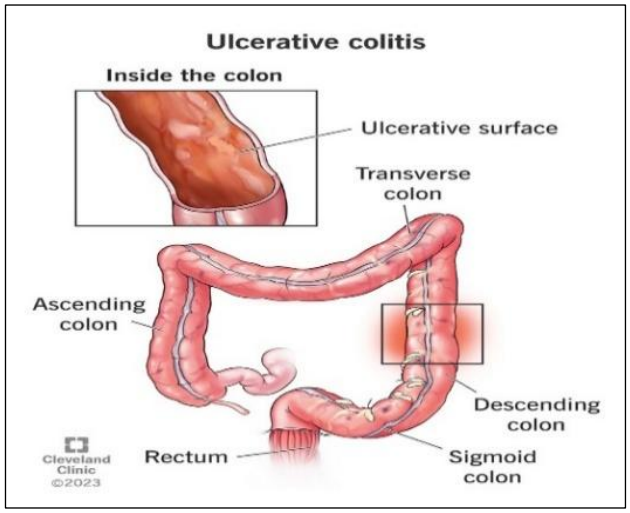

Figure 1: Ulcerative colitis.[6]

The exact aetiology of UC remains unclear; however, it is widely accepted that the condition arises due to an abnormal immune response to intestinal microbiota in genetically predisposed individuals. This dysregulated immune activity leads to recurrent episodes of gastrointestinal inflammation. Approximately 50% of patients exhibit pancolitis, whereas involvement of the terminal ileum (backwash ileitis) occurs in less than 10% of cases, typically due to ileocecal valve dysfunction.[7,8]

Epidemiological trends indicate a rising burden of IBD globally, particularly in developing nations. India reports one of the highest incidences among developing countries, with ulcerative colitis being more prevalent in the northern regions and Crohn's disease more common in southern regions. Due to the country's large population and relatively low mortality rates, the overall disease burden is expected to increase significantly in the future.[8]

Clinically, UC is characterized by symptoms such as chronic bloody diarrhea, abdominal pain, fever, weight loss, and anemia resulting from prolonged intestinal bleeding. Severe complications may include toxic megacolon, intestinal perforation, massive hemorrhage, and an increased risk of colorectal cancer.[9]

Current therapeutic strategies primarily involve the use of aminosalicylates and corticosteroids. Sulfasalazine, a commonly prescribed aminosalicylate, undergoes bacterial cleavage in the colon to release sulfapyridine and 5-aminosalicylic acid. However, its use is associated with several adverse effects, including gastrointestinal discomfort, hypersensitivity reactions, hematological abnormalities, and reversible male infertility.[10]

Corticosteroids have significantly reduced mortality rates in UC; however, their long-term use is limited by serious side effects such as hypertension, diabetes mellitus, osteoporosis, infections, and psychological disturbances. These adverse effects often lead to poor patient compliance and treatment resistance.[11]

Given these limitations, there has been a growing interest in alternative therapeutic approaches, particularly those based on natural products. Herbal medicines are increasingly recognized for their potential efficacy, reduced toxicity, and cost-effectiveness compared to synthetic drugs. Experimental models of colitis in animals have become a standard method for evaluating the therapeutic potential of plant-based compounds.[12]

Abutilon indicum (L.) Sweet (family: Malvaceae), commonly known as "Thuthi" or "country mallow," is a medicinal plant widely distributed in South Asia and extensively used in traditional Ayurvedic medicine. It possesses a wide range of pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, antidiarrheal, anticonvulsant, and wound healing properties. The plant is rich in bioactive compounds such as flavonoids, tannins, glycosides, steroids, and phenolic constituents.[13-16]

Figure 2: *Abutilon indicum* L. plant.[13]

Considering the chronic nature of ulcerative colitis, the limitations of existing therapies, and the increasing demand for safer alternatives, the present study aims to evaluate the therapeutic potential of the ethanolic extract of *Abutilon indicum* leaves in an acetic acid-induced ulcerative colitis model in albino rats.

METHODS

In the present study male Wistar Albino rats served as an experimental animal.

Drugs and chemicals

Sulfasalazine (Apollo Pharmacy), Ketamine HCl, Ethanol 99.5%, Petroleum ether was obtained from Naresh Scientific Company, Puducherry.

Study type and period

The study was in-vivo preclinical study conducted from July 2025 to December 2025.

Study place

The study was conducted in Animal House, Department of Pharmacology, Adhiparasakthi College of Pharmacy, Melmaruvathur.

Collection of plant materials

The leaves of *Abutilon indicum* L. were collected from the cultivable lands, roadsides, river banks present around Melmaruvathur- 603 319, authenticated by Dr. V. Gangadevi, M.Sc., Ph.D., Arignar Anna Government Arts College, Cheyyar. The Register number of the certificate: AAA/2025/02. The fresh leaves were collected between July 2025 to August 2025. The collected leaves were further cleaned and shade dried. The dried materials were coarsely powdered by the means of mechanical grinder and sieved using sieve No.20. The sieved powder material was used for extraction process.

Preparation of ethanolic extract of Abutilon indicum L. leaves (EEAL)

1 kg of powdered plant material was first defatted with petroleum ether and further it was subjected to continuous hot extraction method with ethanol using Soxhlet apparatus. The obtained alcoholic filtrate was evaporated using electrical water bath to obtain solid residue. The percentage yield was calculated. The obtained ethanolic extract of EEAL leaves was subjected to preliminary phytochemical studies and pharmacological studies.

Phytochemical screening[17,18]

Phytochemicals such as alkaloids, flavonoids, carbohydrates, tannins, saponins, glycosides, cardiac glycosides, phenols, steroids, terpenoids, proteins and amino acids, fats and fixed oils, gums and mucilage were analysed using specific tests.

Pharmacological activity

Experimental animals

Male Wistar Albino rats weighing 180-200 gm were procured from the “Mass Biotech”, Chengalpattu, Tamil Nadu. Animals were placed in cages at room temperature (25±2ºC), relative humidity (55±5º) and 12hr light-dark cycle was maintained with access to standard food pellet and water ad libitum. The study protocol was approved by the (IAEC)-Institutional Animal Ethical Committee. (APCP/IAEC/2025-2026/I/04, dated 26th July 2025).

Experimental design[19]

In this study, treatment was carried out for 11 days. In Group I normal saline 0.9% w/v was given for 11 days. In Group II distilled water was given for 11 days. In Group III sulfasalazine 225 mg/kg was given for 11 days. In Group IV and Group V *Abutilon indicum* L. extract of 250mg/kg and 500 mg/kg was given for 11 days respectively. On the 8th day of the study, animals in group II to group V was administrated with 2 ml of 4% acetic acid for induction of ulcerative colitis by a feeding gavage (2 mm in diameter) which was introduced to a depth of 4.5cm inside the rectum.

To prevent intra colonic solution leakage, the rats were held in the inverted Trendelenburg position during rectal installation for two mins. On the 11th day all the animals were anaesthetized under ketamine anaesthesia, blood was collected by cardiac puncture and further sacrificed using ketamine overdose.

The blood sample collected was kept at −20°C until use for cytokine determination. The colon tissues were isolated and preserved in 10% formalin for histopathological studies.

Grouping of animals

A total of 30 male Wistar Albino rats were divided into 5 groups (6 animals per group). Group I - Normal control - Normal saline 0.9% w/v p.o, Group II - Disease control- Distilled water + 4% Acetic acid 2 ml/200 gm rat on 8th day only, Group III - Std- Sulfasalazine-225 mg/kg, p.o + 4% Acetic acid 2 ml/200 gm rat on 8th day only, Group IV - EEAL (250 mg/kg, p.o) + 4% Acetic acid 2 ml/200 gm on the 8th day only, Group V - EEAL (500 mg/kg, p.o) + 4% Acetic acid 2 ml/200 gm rat on the 8th day only.

Evaluation parameters

Assessment of colon weight -to -length ratio

Rats were dissected and their colons were extirpated, opened longitudinally, and rinsed gently under running water to remove the faeces. Colons were placed on non-absorbent surface and weight-to-length ratios were assessed.

Assay of serum TNF-alfa and IL-6

Blood samples were collected in clot activator tubes and centrifuged to obtain the serum. The serum was assayed quantitatively for TNF-alpha and IL-6 by using the respective Picokine ELISA kits as instructed by the manufacturer.

Histopathological analysis

To confirm the incidence of ulcerative colitis the animals were euthanized by ketamine overdose and colons were isolated, washed, weighed and kept quickly in 10% formalin and subjected to histopathological studies using Hematoxylin and Eosin stains (H&E).

Statistical analysis

The data obtained were expressed as mean±SEM and analysed using one-way ANOVA followed by Dunnet 't' test using Graph pad prism software (version 11).

RESULTS

Extractive yield

Percentage yield of *Abutilon indicum* L. leaves extract

$$\text{Percentage yield} = \frac{\text{weight of extract obtained}}{\text{weight of crude drug taken}} \times 100$$

$$= \frac{18.72}{300} \times 100$$

$$= 6.24\%\text{w/w}$$

Phytochemical analysis

Analysed by one-way analysis of variance (ANOVA) followed by multiple comparison Dunnet 't' test. All the values are expressed as mean± SEM.

Table 1: Phytochemical analysis.

CHEMICAL TEST	Presence (+)/ Absence (-) of phytoconstituents in EEAL
Detection of alkaloids	
Dragendroff's test	(-)
Hager's test	(+)
Mayer 's test	(+)
Wagner test	(+)
Detection of carbohydrates	
Barfoed's test	(-)
Molisch's test	(+)
Selliwanoff 's test	(-)
Resorcinol's test	(-)
Detection of reducing sugars	
Bendict's test	(-)
Fehling's test	(-)
Detection of glycosides	
Borntrager's test	(-)
Modified Borntrager's test	(-)
Legal's test	(-)
Detection of cardiac glycosides	
Kellar-Killani test	(-)
Bromine water test	(-)
Balijet test	(-)
Detection of proteins and amino acids	
Biuret test	(-)
Ninhydrin test	(-)
Xanthoprotein test	(-)
Detection of flavonoids	
Alkaline reagent test	(+)
Ferric chloride test	(+)
Detection of phenolic compounds	
Iodine test	(+)
Ferric chloride test	(+)
Gelatin test	(+)
Potassium dichromate test	(-)

Continued.

CHEMICAL TEST	Presence (+)/ Absence (-) of phytoconstituents in EEAL
Detection of tannins	
Gelatin test	(+)
NaOH test	(+)
Bromine water test	(+)
Detection of saponins	
Foam test	(+)
Olive oil test	(-)
Haemolysis test	(+)
Detection of phytosterols	
Salkowski's test	(+)
Libermann Burchard test	(+)
Detection of quinones	
Alcoholic KOH test	(-)
Con. HCl test	(-)
Detection of gum and mucilage	
Alcohol test	(-)
Detection of resins	
Acetic anhydride test	(+)
Turbidity test	(-)
Detection of fixed oils and fats	
Stain test	(+)
Saponification test	(+)

Table 2: Morphological and serum analysis.

Parameters	Group-I Normal control	Group-II Disease control acetic acid 2 ml/200 g	Group- III Standard-sulfasalazine 225 mg/kg	Group-IV EEAL 250 mg/kg	Group- V EEAL 500 mg/kg
Colon weight to length ratio	0.15±0.001	0.34±0.008	0.16±0.001	0.22±0.007	0.17±0.003
TNF-α (pg/ml)	18.48±0.250	58.83±0.945	21.33±0.988	43.166±1.32	31.66±1.333
IL-6 (pg/ml)	8.71±0.411	63.53±0.693	17.22±0.561	46±1.032	23.08±0.773

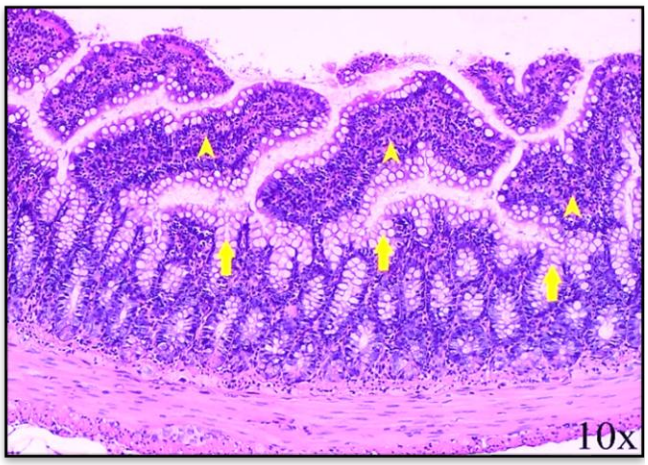

Figure 3: Normal Control group (X10 H&E)- Photomicrographs show transverse sections of adult male Wistar albino rat, normal histomorphology of colon.

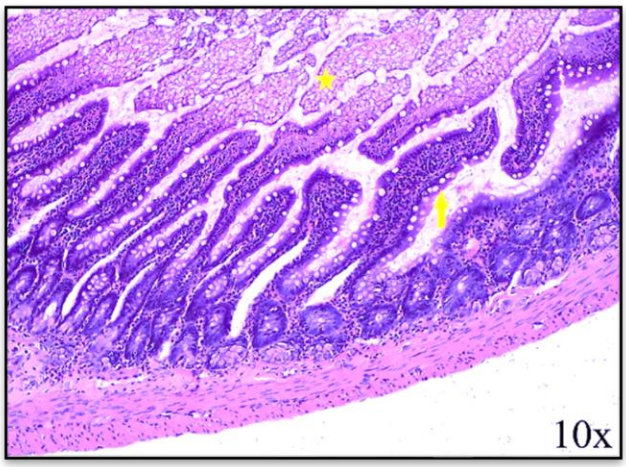

Figure 4: Disease Control group (X10 H&E)- Severe diffuse hyperplasia of goblets cells (yellow arrows) and lamina propria (yellow pointed arrows).

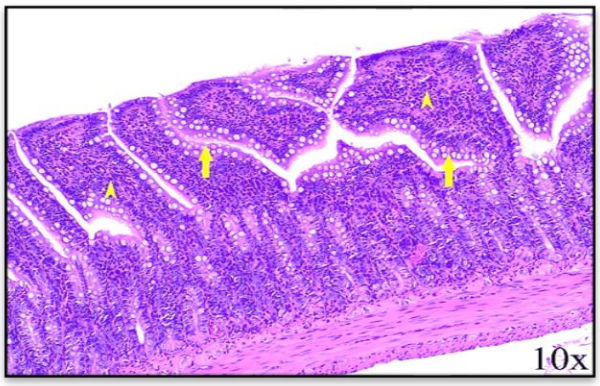

Figure 5: Standard group (X10 H&E) - Reveals normal morphology of colon compared to the normal control group with minimal hyperplasia of goblet cells (yellow arrows) and lamina propria (yellow pointed arrow) and sloughed mucosa (yellow star).

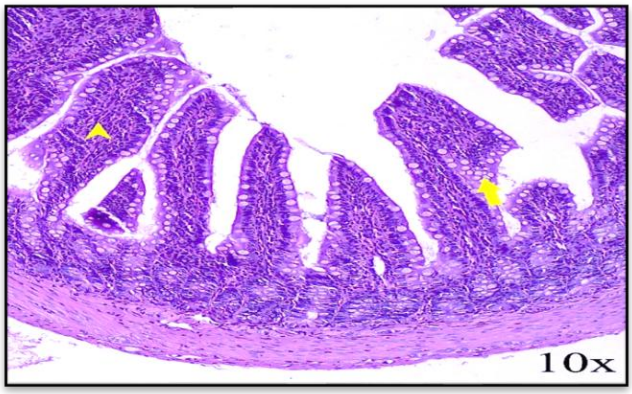

Figure 6: EEAL (250 mg/kg) group (X10 H&E) - Shows moderate diffuse hyperplasia of goblet cells (yellow arrows) and lamina propria (yellow pointed arrows).

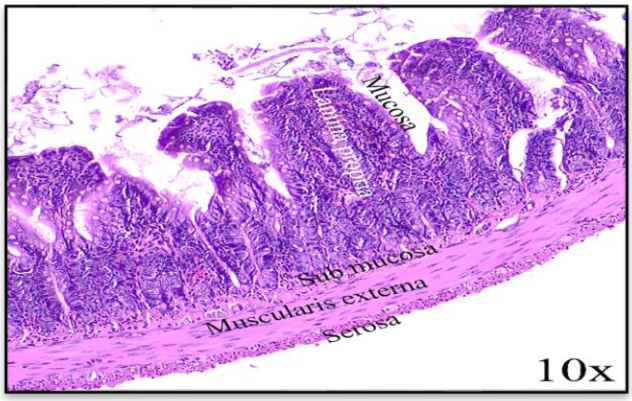

Figure 6: EEAL (500 mg/kg) group (X10 H&E) Reveals minimal hyperplasia of goblet cells (yellow arrows) and lamina propria (yellow pointed arrow) with majority of normal parenchyma of colon compared to the normal control group.

DISCUSSION

The present study demonstrated that the ethanolic extract of EEAL produced significant protection against acetic acid-induced ulcerative colitis in albino rats. Acetic acid administration markedly increased serum inflammatory cytokines (TNF-α and IL-6), increased the colon weight-to-length ratio, and produced severe histopathological alterations in the colon, confirming successful induction of acute ulcerative colitis.

A major finding of this study was the dose-dependent anti-inflammatory effect of EEAL. The disease control group showed a marked elevation of TNF-α (58.83±0.945) and IL-6 (63.53±0.693) compared with the normal group, indicating severe inflammation. Treatment with EEAL significantly reduced these cytokines, with the 500 mg/kg dose showing greater protection than the 250 mg/kg dose. This suggests that EEAL suppresses the inflammatory response associated with colonic injury.

These findings are consistent with previous studies on medicinal plants used in ulcerative colitis. Dashputre et al reported that abutilon indicum possesses significant anti-inflammatory and antioxidant activity, which may contribute to its protective effect in inflammatory disorders.[21] Similarly, Gautam et al demonstrated that flavonoid-rich plant extracts can reduce TNF-α and IL-6 levels in experimental colitis models by inhibiting inflammatory pathways.[22]

Another important observation was the reduction in colon weight-to-length ratio following EEAL treatment. Acetic acid-induced colitis causes edema, inflammatory cell infiltration, and tissue swelling, resulting in an increased colon weight-to-length ratio. The high-dose EEAL group showed a significant reduction in this parameter, approaching the effect of the standard drug sulfasalazine. Comparable findings were reported by Wirtz et al, who showed that effective anti-colitic agents significantly reduce colonic edema and tissue inflammation.[23]

Histopathological examination further supported the biochemical results. The disease control group exhibited severe diffuse hyperplasia of goblet cells and lamina propria, indicating extensive mucosal injury. In contrast, the sulfasalazine-treated group showed near-normal colonic architecture. EEAL treatment produced dose-dependent histological improvement, with the 500 mg/kg group showing only minimal hyperplasia and preservation of normal colonic parenchyma. Similar histological recovery has been reported for several plant-derived anti-inflammatory agents in acetic acid-induced colitis models (Jagtap et al).[24]

The protective effect of EEAL may be attributed to the presence of flavonoids, phenolic compounds, tannins, alkaloids, and terpenoids, which are known to possess antioxidant and anti-inflammatory properties. These phytoconstituents may reduce oxidative stress, inhibit pro-

inflammatory cytokine production, stabilize the intestinal mucosal barrier, and promote tissue repair.

Overall, the findings of the present study agree with earlier reports showing that medicinal plants rich in polyphenols and flavonoids can attenuate experimental ulcerative colitis. Although the activity of EEAL was slightly lower than that of sulfasalazine, the high dose (500 mg/kg) demonstrated substantial anti-colitic potential, supporting the traditional use of Abutilon indicum in inflammatory conditions.

CONCLUSION

In the present study, ethanolic extract of EEAL, dose of 250 mg/kg and 500 mg/kg were evaluated for anti-ulcerative colitis activity against acetic acid induced ulcerative colitis. Based on serum analysis and histopathological studies it was evident that ethanolic extract of *Abutilon indicum* L. leaves (500 mg/kg) possess significant anti-ulcerative colitis property. The decreased levels of TNF-α and IL-6 in serum and further decrease in colon weight-length ratio and histopathological studies confirmed that ethanolic extract of *Abutilon indicum* L. Leaves has anti-ulcerative colitis activity.

Among the two doses EEAL (250 mg/kg and 500 mg/kg) of test group, the EEAL 500 mg/kg was found to be more effective because there was no significant difference between the normal control (Group I) and EEAL500 mg/kg (Group V) treated group.

Further investigation on pharmacokinetics and pharmacodynamics parameter of EEAL are to be carried out in future in advance to find the lead molecule responsible for the anti-ulcerative colitis activity.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Animal Ethics Committee (Certificate no: APCP/IAEC.2025-2026/I/04)

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