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EVALUATION OF ANTI-ULCER ACTIVITY OF ETHANOLIC EXTRACT OF ABUTILON INDICUM L. ROOTS.

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Abstract:

Peptic ulcer disease (PUD) is a gastrointestinal disorder characterized by mucosal injury due to the action of gastric acid and pepsin. It most commonly affects the stomach and proximal duodenum, and is primarily caused by Helicobacter pylori *infection and prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs). Clinical symptoms include epigastric pain (especially between meals or at night), relief after food or antacids, loss of appetite, and weight loss. In some cases, ulcers may also be observed in the distal duodenum, jejunum (e.g., Zollinger-Ellison syndrome), hiatal hernia (Cameron ulcers), or ectopic gastric mucosa such as Meckel's diverticulum.*

This study was undertaken to evaluate the anti-ulcer potential of the ethanolic extract of Abutilon indicum *roots using the following experimental models:*

1. *Pylorus ligation-induced ulcer model*
2. *Ethanol-induced ulcer model*
3. *Swim stress-induced ulcer model*

The anti-ulcer activity was assessed by measuring ulcer indices and evaluating the protective effect of the extract in comparison with control groups.

The ethanolic extract of Abutilon indicum *roots showed a statistically significant reduction in ulcer index in all three experimental models. The extract demonstrated notable protective effects against ulcer formation, indicating its potential anti-ulcer activity.*

The results of the study suggest that Abutilon indicum *root extract possesses significant anti-ulcer properties and may be considered a promising natural therapeutic agent for the management of peptic ulcer disease.*

Keywords: Abutilon indicum, *Anti-ulcer activity, Pylorus ligation, Ethanol-induced ulcer, Swim stress-induced ulcer, Peptic ulcer disease*

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INTRODUCTION:

Peptic ulcer disease (PUD) is a chronic and multifactorial disorder characterized by mucosal damage in the stomach or duodenum due to an imbalance between protective and aggressive factors such as gastric acid, pepsin secretion, mucosal barrier integrity, and local blood flow. The most common etiological factors include *Helicobacter pylori* infection and prolonged use of nonsteroidal anti-inflammatory drugs (NSAIDs). Other contributing factors include emotional stress, alcohol consumption, smoking, and excessive gastric acid secretion.

Gastric erosions result from the inflammation or damage of the gastric mucosa, often induced by NSAIDs, corticosteroids, or irritant drugs. Stress-related mucosal damage is another critical factor, particularly under physiological stress conditions such as burns, trauma, or surgery. While the incidence of uncomplicated peptic ulcers has declined in developed nations, complications such as hemorrhage and perforation remain significant, especially among the elderly population due to increasing NSAID use.

The pathophysiology of peptic ulcers involves multiple mechanisms, including vagal overactivity, mast cell degranulation, decreased mucosal blood flow, increased gastric motility, and impaired prostaglandin synthesis. Free radicals and oxidative stress also contribute significantly to mucosal injury, especially in ulcers induced by ethanol, ischemia, or hemorrhagic shock. *H. pylori* is widely recognized as a major causative pathogen, triggering active inflammation and mucosal damage.

The gastrointestinal (GI) tract is composed of four primary layers: mucosa, submucosa, muscularis externa, and serosa. The stomach, the most distensible part of the GI tract, plays a vital role in digestion and acid secretion. It consists of regions such as the cardia, fundus, body, and pylorus, each contributing to the production of gastric secretions and mechanical processing of food. Acid secretion by parietal cells is tightly regulated by neural (acetylcholine), hormonal (gastrin), and paracrine (histamine) pathways. An imbalance in this regulation can lead to mucosal injury and ulcer formation.

Peptic ulcers may manifest as gastric or duodenal ulcers. Gastric ulcers are often associated with reduced mucosal protection and are commonly found along the lesser curvature of the stomach. Duodenal ulcers, on the other hand, are more frequent and typically result from increased acid secretion and impaired neutralization in the duodenum. Both types of ulcers share overlapping clinical symptoms such as epigastric pain, nausea, vomiting, and weight loss.

Complications of peptic ulcers include gastrointestinal bleeding, perforation, penetration into adjacent organs, and gastric outlet obstruction. Standard treatment approaches aim to reduce acid secretion, enhance mucosal protection, and eradicate *H. pylori*. These include proton pump inhibitors (PPIs), H2-receptor antagonists, antacids, mucosal protectants like sucralfate, and antibiotics for *H. pylori* eradication.

Despite advances in pharmacological therapy, the side effects and limitations of synthetic drugs have driven interest in herbal and alternative therapies. Medicinal plants offer a promising source of bioactive compounds with fewer side effects. *Abutilon indicum* (Indian mallow), a medicinal plant traditionally used in Ayurvedic medicine, has shown potential therapeutic effects including anti-inflammatory, antioxidant, and gastroprotective properties.

The present study was undertaken to evaluate the anti-ulcer activity of ethanolic extract of *Abutilon indicum* roots using established ulcer models: pylorus ligation-induced, ethanol-induced, and swim stress-induced ulcers in experimental animals.

OBJECTIVES OF THE STUDY

Aim:

To evaluate the anti-ulcer activity of the ethanolic extract of *Abutilon indicum* roots in Wistar albino rats.

Specific Objectives:

1. To collect and authenticate the roots of *Abutilon indicum*.
2. To carry out preliminary phytochemical screening of the ethanolic extract of *Abutilon indicum*.
3. To perform hydroalcoholic extraction of *Abutilon indicum* roots.
4. To evaluate the anti-ulcer activity of the extract using the following experimental ulcer models in Wistar albino rats:

I. Pylorus Ligation-Induced Ulcer Model

Parameters Assessed:

- Volume of gastric juice
- pH of gastric juice
- Free acidity
- Total acidity
- Ulcer index
- Percentage protection (% protection)

II. Ethanol-Induced Ulcer Model

Parameters Assessed:

- Ulcer index
- Percentage protection (% protection)

III. Swim Stress-Induced Ulcer Model

Parameters Assessed:

- Ulcer index
- Percentage protection (% protection)

5. To statistically analyze the results using one-way Analysis of Variance (ANOVA), followed by Dunnett's multiple comparison test.

METHODOLOGY:

Materials and Methods

Sources of Data:

All relevant data were collected from the following sources:

- Scientific journals and publications in Pharmacology and Pharmacognosy.
- Medicinal and Aromatic Plant Associations.
- Digital resources such as CD-ROMs and online databases.
- HELINET, PubMed, ScienceDirect, and Google Scholar.
- Library of H.K.E's MTRIPS, Kalaburagi.

Collection and Authentication of Plant Material:

The whole plant of *Abutilon indicum* was collected from the Kalaburagi region, and roots were authenticated by a qualified botanist.

Animals:

- **Species:** Wistar albino rats (both sexes)
- **Weight range:** 150–200 g
- **Source:** Mahaveer Enterprises, Hyderabad
- **Housing Conditions:** Animals were housed under standard laboratory conditions with a 12-hour light/dark cycle and free access to food and water.
- **Ethical Approval:** The study protocol was approved by the Institutional Animal Ethical Committee (IAEC) of H.K.E'S MTRIPS, Kalaburagi. (Ref. No: HKE'S/MTRIPS/IAEC/118/2021-2022), and experiments were conducted following CPCSEA guidelines.

Preparation of Ethanolic Extract:

The roots of *Abutilon indicum* were shade dried, coarsely powdered, and subjected to continuous hot extraction using 99.9% ethanol in a Soxhlet apparatus. The extract was filtered hot, concentrated under reduced pressure using a rotary evaporator, and dried. The final extract was stored in a desiccator for further use.

Experimental Design:

Wistar albino rats were divided into four groups (n=6) for each ulcer model:

- **Group I**: Vehicle control (normal saline)
- **Group II**: Standard drug – Rabeprazole (30 mg/kg, i.p.)
- **Group III**: High dose ethanolic extract of *Abutilon indicum*
- **Group IV**: Low dose ethanolic extract of *Abutilon indicum*

1. Pylorus Ligation-Induced Ulcer Model:

Rats were fasted for 24 hours. On the fifth day of drug administration, under ether anesthesia, a midline abdominal incision was made, and pyloric ligation was performed without damaging blood vessels. After 19 hours, animals were sacrificed, and the stomachs were isolated.

Parameters Studied:

- Volume of gastric juice
- pH of gastric juice
- Free acidity
- Total acidity
- Ulcer index
- % Protection

Acidity Determination:

- **Free Acidity**: Titration with 0.01 N NaOH using Topfer's reagent
- **Total Acidity**: Continuation of titration after adding phenolphthalein

Acidity Formula:

$$\text{Acidity} = \frac{\text{volume of NaOH x Normality of NaOH X 100meq/L/100gm}}{0.1}$$

Ulcer Scoring System:

Score	Observation
0	Normal stomach
0.5	Red coloration
1	Spot ulcers
1.5	Hemorrhagic streaks
2	Ulcers >3 <5
3	Ulcers >5

% Protection Formula:

$$\%\text{Protection} = [(\text{UI control} - \text{UI treated}) / \text{UI control}] \times 100$$

2. Swim Stress-Induced Ulcer Model:

After 24 hours of fasting, drugs were administered. Two hours later, rats were forced to swim for 5 hours in a cylindrical tank (45 cm height, 25 cm diameter, water level: 35 cm at 23°C). After the session, animals were sacrificed and stomachs dissected.

Parameters Studied:

- Ulcer index
- % Protection

3. Ethanol-Induced Ulcer Model:

Rats were fasted for 18 hours and placed individually in stainless steel cages. After oral administration of the respective drugs, absolute ethanol was given orally. One hour later, animals were sacrificed, stomachs isolated and opened along the greater curvature for ulcer scoring.

Parameters Studied:

- Ulcer index
- % Protection

Statistical Analysis:

- Results were expressed as **mean ± SEM**.
- Data were analyzed using **one-way ANOVA**, followed by **Dunnett's multiple comparison test**.
- A p-value < 0.05 was considered statistically significant.

RESULTS:

Anti-Ulcer Activity of Ethanolic Extract of *Abutilon indicum* Roots

1. Pylorus Ligation Induced Ulcer Model

Pylorus ligation for 19 hours led to the accumulation of gastric secretions, resulting in auto-digestion of gastric mucosa and ulcer formation in the control group. In contrast, the groups treated with ethanolic extract of *Abutilon indicum* (EEAI) and the standard drug Rabeprazole demonstrated significant protection.

The high-dose EEAI group (500 mg/kg) showed a **significant reduction in ulcer index** (4.65 ± 0.18) compared to the control group (11.85 ± 0.30), with **58.32% protection** ($P < 0.001$). The low-dose EEAI group (100 mg/kg) exhibited a moderate reduction in ulcer index (8.55 ± 0.28) with **32.12% protection**. Rabeprazole (0.30 mg/kg) showed the highest efficacy, with an ulcer index of 4.80 ± 0.42 and **79.64% protection**.

Additionally, there was a notable improvement in gastric parameters. The pH of gastric juice increased, and total acidity and acid volume decreased in the treated groups. The mucus content also significantly increased from 21.17 ± 0.81 mg in the control group to 42.82 ± 3.24 mg in the high-dose EEAI group ($P < 0.001$), indicating enhanced mucosal defense.

Table 1 summarizes the effects on gastric parameters and ulcer index. **Graph 1** illustrates the histogram comparison of ulcer index and % protection respectively.

Histopathological examination of stomach tissues corroborated the biochemical findings. The high-dose EEAI group showed reduced mucosal damage and fewer inflammatory cells compared to the control. Rabeprazole-treated tissues displayed near-normal epithelium. Low-dose EEAI-treated rats exhibited partial protection with some mucosal disruption.

Table 1: Effect of Ethanolic extracts of *Abutilon indicum* roots on Ulcer Index and their % protection in pylorus ligation induced ulceration in rats

Treatment	Dose	Total acidity	Acid volume	PH	Ulcer index	Percent protection
PL Control	-	112.1± 1.13	7.33± 0.2	2.2±0.1	11.85±0.30	-
Rabeprazole	0.30mg/kg	58.5 ± 0.84	4.73±0.33	4.9±0.16	4.80± 0.42	79.64%
EEAI(High dose)	500mg/kg	87.5± 0.22	5.02±0.01	4.02±3.33	4.65±0.18.	58.32%
EEAI(Low dose)	100mg/kg	63.3± 0.21	6.05 ± 0.1	3.32±3.05	8.55±0.28	32.12%

n = 6

Values of the mean S.E.M. of 6 rats / treatment±

Significant *P <0.05, **P<0.01 and ***P<0.001 compared with Control

Graph no. 1 : Histogram showing the effect of Ethanolic extract of *Abutilon indicum* roots on Ulcer index and %protection in Pylorus ligation induced ulceration in rats .

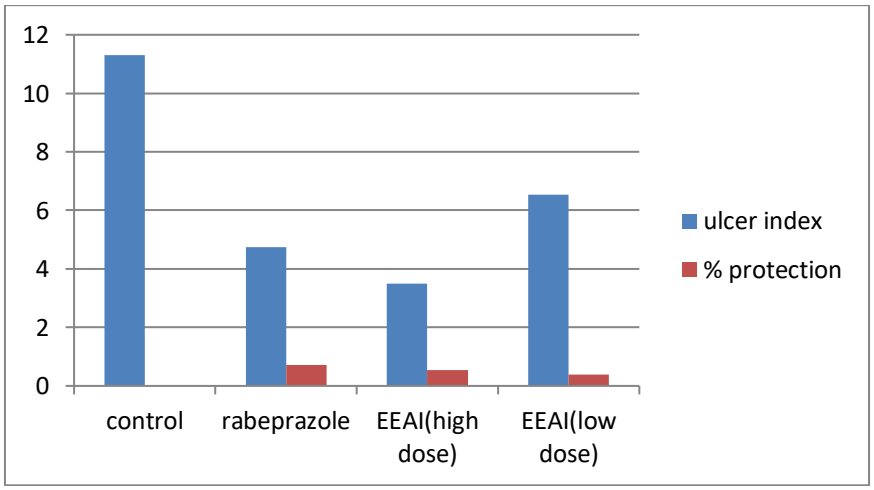


Fig no: 1 Epethilium of Stomach normal saline treated albino rats (+ve control group)

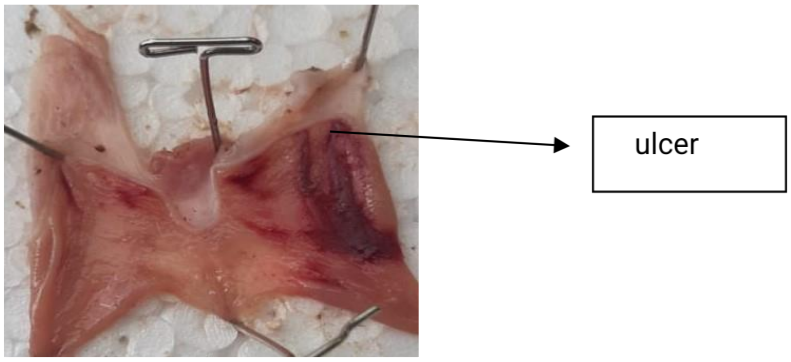


Fig: 2 Stomach epethilium of pylorus ligated rats pretreated with Rabeprazole

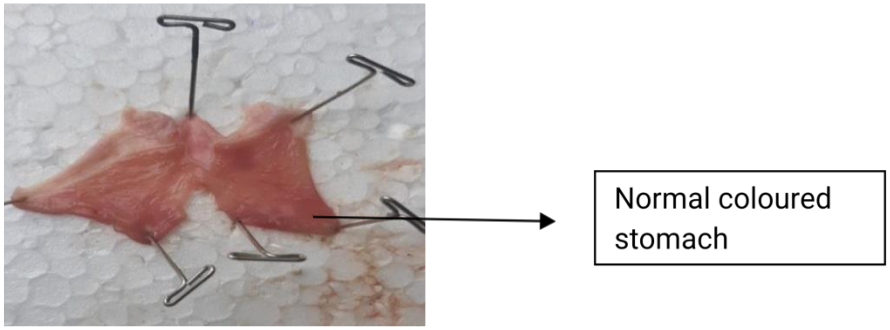


Fig No: 3 Stomach epethilium of pylorus ligated rats treated with high dose of Ethanolic extract of *Abutilon indicum* roots

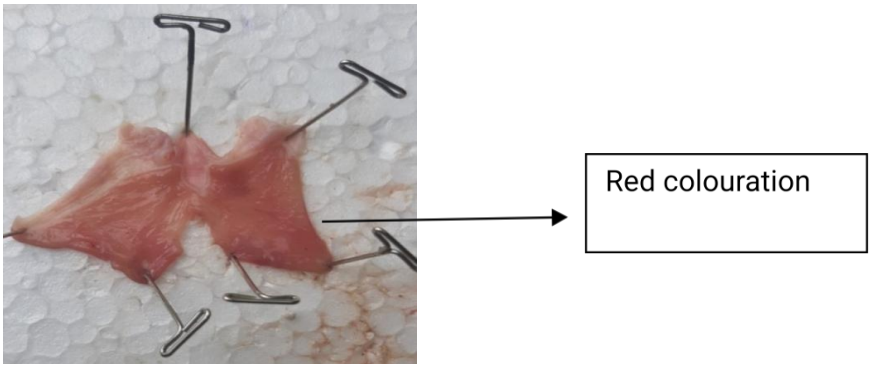
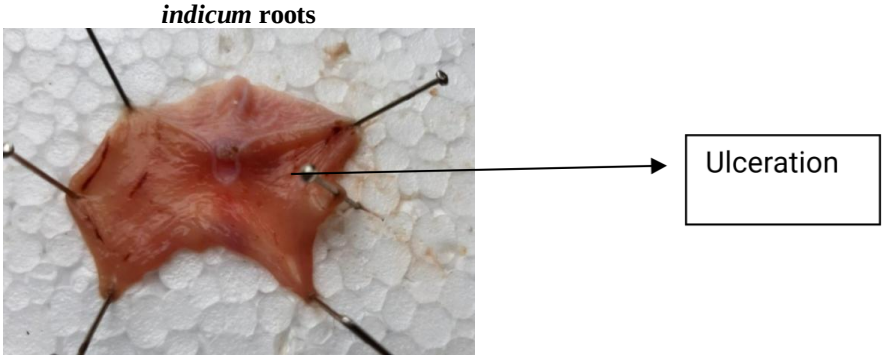


Fig no: 4 Stomach epethilium of pylorus ligated rats treated with low dose of Ethanolic extract of *Abutilon indicum* roots



2

. Ethanol-Induced Ulcer Model

Ethanol administration resulted in significant gastric mucosal damage in the control group, as evidenced by a high ulcer index of 11.3 ± 0.42. Pretreatment with EEAI offered dose-dependent protection. The **high-dose EEAI group (500 mg/kg)** significantly reduced the ulcer index to **3.49 ± 0.11**, corresponding to **68.43% protection**, while the **low-dose group (100 mg/kg)** showed an ulcer index of **6.50 ± 0.12** and **39.34% protection**. Rabeprazole again showed superior protection with an ulcer index of 4.75 ± 0.48 and **71.73% protection**.

Histopathological analysis of ethanol-treated groups supported these findings. Rabeprazole-treated rats showed normal mucosa, while the high-dose EEAI group showed minimal ulceration and inflammation. In contrast, the control and low-dose groups displayed significant epithelial disruption and inflammatory infiltration.

Table 2 presents the ulcer index and % protection in each group.

Graph no. 2 display the histogram comparisons of ulcer index and % protection in ethanol-induced ulceration.

Table no.2: Effect of Ethanolic extracts of *Abutilon indicum* roots on Ulcer Index and their % protection in Ethanol induced ulceration in rats.

s.no	Treatment	Dose	Ulcer index	%protection
1	Control	-	11.3±0.42	-
2	Rabeprazole	0.30mg/kg	4.75± 0.48	71.73%
3	EEAI(High dose)	500mg/kg	3.49 ± 0.11	68.43%
4	EEAI (Low dose)	100mg/kg	6.50± 0.12	39.34%

n = 6

Values of the mean S.E.M. of 6 rats / treatment±

Significant *P <0.05, **P<0.01 and ***P<0.001 compared with Control

Graph no. 2: Histogram showing the effect of Ethanolic extract of *Abutilon indicum* roots on Ulcer index and % protection in Ethanol induced ulceration model in rats.

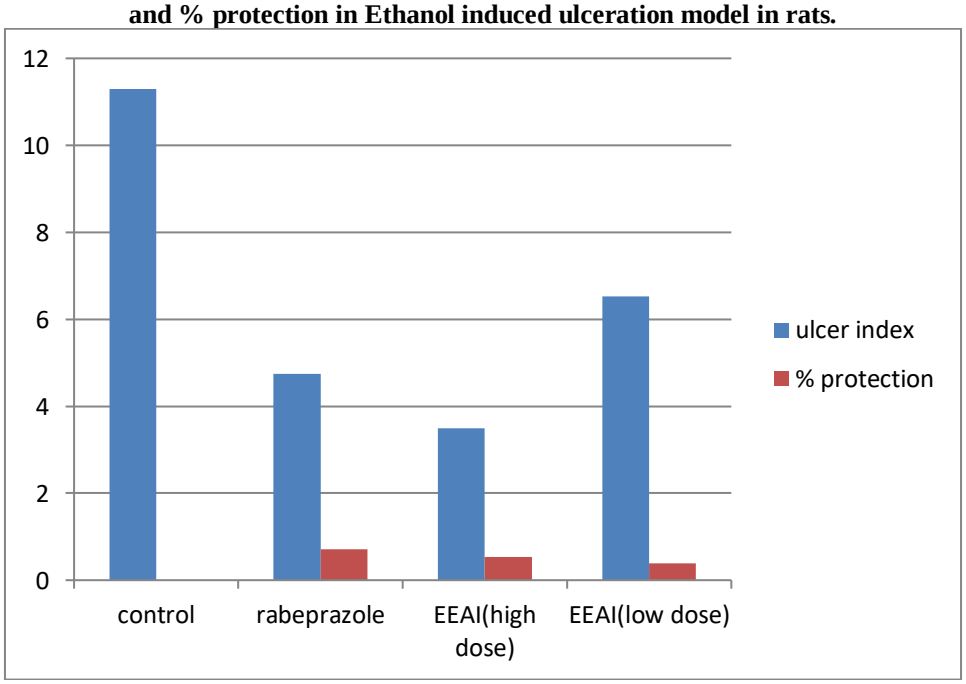


Fig No: 5 Epethilium of Stomach normal saline treated albino rats (control group)

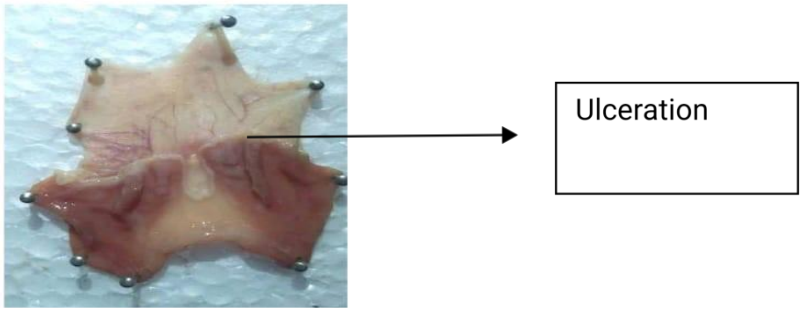


Fig No: 6 Stomach epethilium of Ethanol induced rats pretreated with Rabeprazole

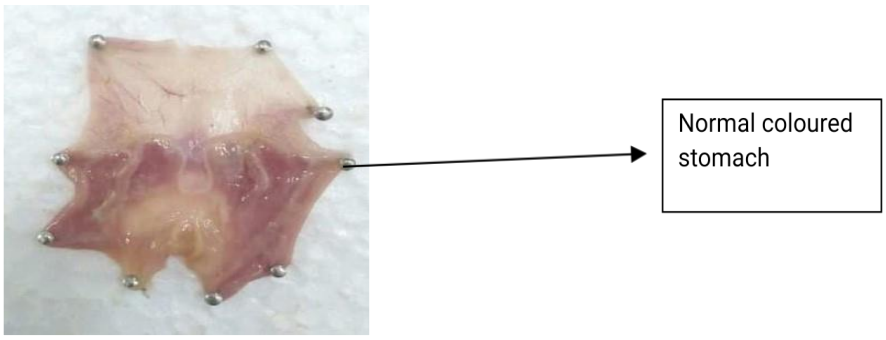


Fig No: 7 Stomach epethilium of ethanol treated with high dose of Ethanolic extract of *Abutilon indicum roots*

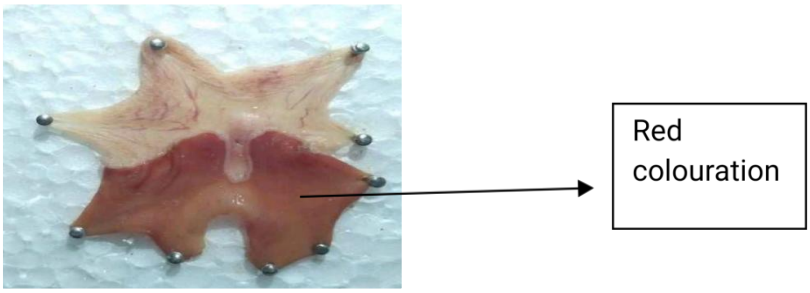
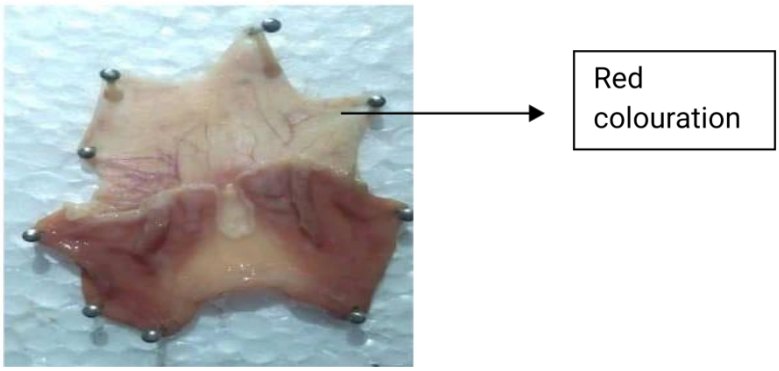


Fig No: 8 Stomach epethilium of ethanol induced rats treated with low dose of Ethanolic extract of *Abutilon indicum* roots

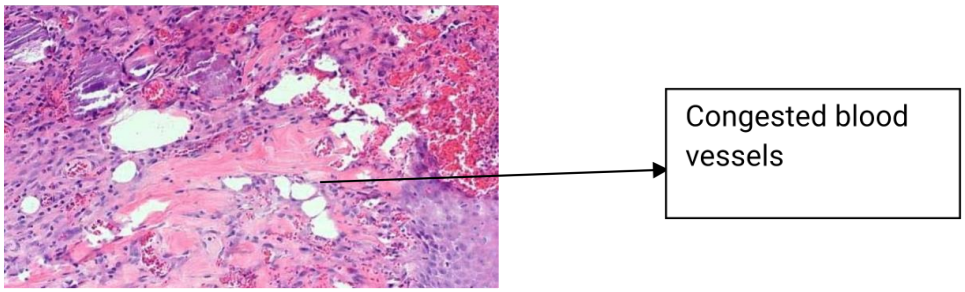


3. Histopathology Findings Summary

- **Control Groups**: Exhibited mucosal ulceration, granulation tissue formation, and congestion.
- **Standard Drug (Rabeprazole)**: Showed near-normal mucosa with reduced congestion and no visible ulceration.
- **High Dose EEAI (500 mg/kg)**: Displayed preserved mucosa with minimal ulceration and inflammatory cell infiltration.
- **Low Dose EEAI (100 mg/kg)**: Showed moderate epithelial disruption with submucosal inflammatory infiltration.

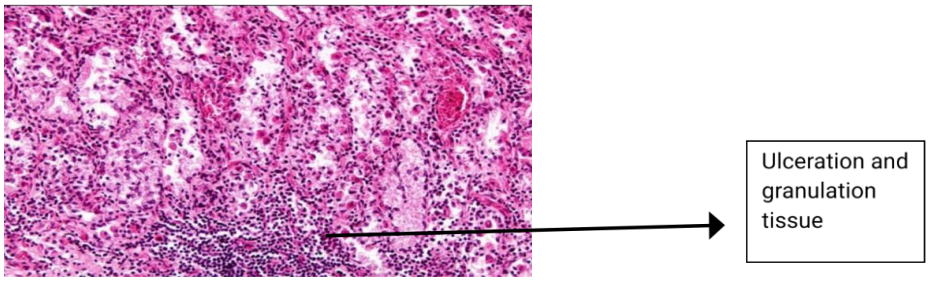
Standard group

Fig no 9: sections studied shows mucosa ,ulceration with smooth muscle and congested blood vessels.



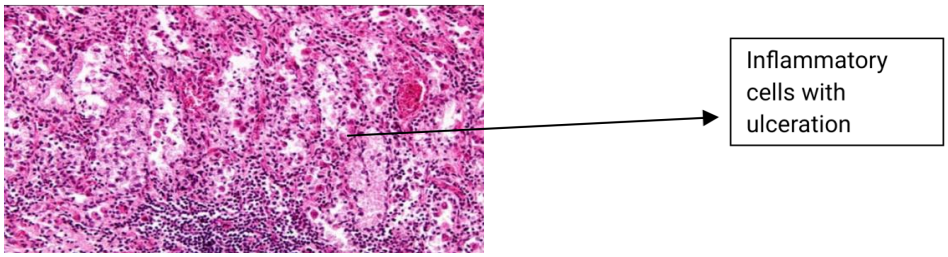
CONTROL GROUP

Fig no: 10 Sections studied shows mucosal ulceration and granulation tissue. Areas of congested seen**.**



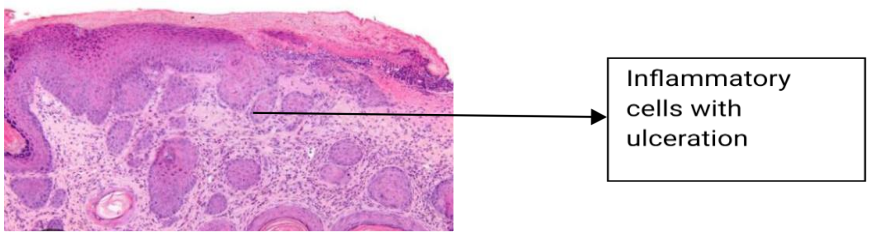
HIGH DOSE

Fig no 11: sections studied shows mucosa ,submucosa and muscularis inflammatory cells seen in muscularis 1cm ulceration seen .



LOW DOSE

Fig no: 12 :sections studied shows mucosa ,sub mucosa,inflammatory infiltration with ulceration .



DISCUSSION:

Acute Toxicity Study

The ethanolic extract of *Abutilon indicum* roots was evaluated for acute toxicity as per OECD guidelines. No mortality or behavioral abnormalities were observed in any of the animals at doses up to 10,000 mg/kg body weight, indicating a high margin of safety. Additionally, no significant changes in body weight were noted throughout the 14-day observation period, suggesting that the extract does not adversely affect metabolic or systemic health. These findings confirm the non-toxic nature of the extract and support its safe usage in therapeutic dose ranges.

Gastroprotective Activity

Peptic ulcer remains a prevalent gastrointestinal disorder worldwide, often arising from an imbalance between mucosal defensive factors (e.g., mucus, bicarbonate, prostaglandins) and aggressive factors (e.g., gastric acid, pepsin, ethanol, and stress). In the present study, three experimental ulcer models—**pylorus ligation, ethanol-induced, and swim stress-induced ulceration**—were employed to evaluate the anti-ulcer activity of the ethanolic extract of *Abutilon indicum* (EEAI).

Pylorus Ligation Induced Ulcers

Pylorus ligation in rats leads to the accumulation of gastric secretions, resulting in autodigestion of the gastric mucosa and ulcer formation. Pretreatment with EEAI significantly reduced the ulcer index in a dose-dependent manner. The extract was observed to increase the pH of gastric contents, decrease total and free acidity, and reduce gastric juice volume, suggesting antisecretory effects.

At the high dose (500 mg/kg), EEAI exhibited a **58.32% protection** against ulcers compared to **79.39% protection** offered by the standard drug Rabeprazole (0.3 mg/kg). This gastroprotective effect may be attributed to the phytoconstituents such as flavonoids, tannins, and phenolics known for their anti-secretory and cytoprotective actions. Histopathological findings further supported these results, showing reduced mucosal damage in the extract-treated groups.

Ethanol-Induced Ulcers

Ethanol is known to cause gastric lesions by disrupting the mucosal barrier, leading to inflammation, necrosis, and oxidative damage. In this model, EEAI at 500 mg/kg significantly ($P < 0.001$) reduced the ulcer index compared to the control group, offering **68.4% protection**. While slightly less than Rabeprazole (**71.39% protection**), the result is pharmacologically relevant. The protection may be attributed to the antioxidant properties of EEAI, which neutralize ethanol-induced free radicals and enhance mucosal defense mechanisms.

Swim Stress-Induced Ulcers

Stress is a key contributor to ulcerogenesis through mechanisms involving increased acid secretion, reduced mucosal blood flow, and elevated oxidative stress. In this study, rats subjected to forced swim stress developed characteristic gastric lesions. EEAI at 500 mg/kg significantly reduced the ulcer index and offered **56.4% protection**, which was **higher than the standard drug (34.33%)**. This remarkable result suggests that EEAI may exert both anti-secretory and adaptogenic (anti-stress) effects, likely mediated by the modulation of central nervous system pathways and enhanced endogenous protective factors.

Overall Interpretation

Across all three models, the ethanolic extract of *Abutilon indicum* roots demonstrated significant anti-ulcer activity. The effects were dose-dependent and closely comparable to the standard drug in ethanol- and pylorus ligation-induced models, while showing superior efficacy in stress-induced ulceration. These results support the traditional use of *Abutilon indicum* in gastrointestinal ailments and validate its potential as a natural anti-ulcer agent.

Further studies are warranted to isolate and characterize the active constituents responsible for the observed effects and to explore the exact mechanism(s) of action, including antioxidant, prostaglandin-mediated, or mucosal defense-enhancing pathways.

CONCLUSION:

The present study aimed to evaluate the anti-ulcer potential of the ethanolic extract of *Abutilon indicum* roots in Wistar albino rats using three well-established ulcer models: pylorus ligation-induced, ethanol-induced, and swim stress-induced gastric ulcers.

- Preliminary phytochemical screening of the ethanolic extract confirmed the presence of several bioactive constituents, including **alkaloids, flavonoids, tannins, terpenoids, steroids, phenols, and lipids**, which are known for their medicinal and gastroprotective properties.
- The plant is also reported to contain **mucilaginous substances**, **asparagines**, **saponins**, and essential oils composed of components such as **α-pinene, caryophyllene, farnesol, geraniol**, and **α-cineole**, which may contribute to the anti-ulcer effect.
- In all experimental models, the ethanolic extract of *Abutilon indicum* (EEAI) significantly reduced ulcer formation compared to the control group. It showed a decrease in ulcer index and increase in percentage protection, along with improvements in parameters such as **gastric pH, wall mucus content, total acidity**, and **gastric volume**.
- Among the tested doses, **500 mg/kg** of EEAI exhibited considerable **gastroprotective activity**, though it was slightly less effective than the standard drug **Rabeprazole** in pylorus ligation and ethanol-induced models. Interestingly, in the swim stress-induced model, EEAI showed **greater**

protection (56.4%) compared to the standard drug (34.33%).

- The observed gastroprotective effect is likely attributed to the membrane-stabilizing properties of the extract, primarily due to the presence of **flavonoids and other phenolic compounds**.

Based on the results, it can be concluded that the ethanolic extract of *Abutilon indicum* roots possesses **significant anti-ulcer activity**, validating its traditional use and offering potential for further development as a natural gastroprotective agent.

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