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EVALUATION OF THE ANTI-ULCER ACTIVITY OF SELECTED THREE MEDICINAL PLANTS OF SOUTH INDIA

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ABSTRACT
Peptic ulcer disease remains a major gastrointestinal disorder associated with excessive gastric acid secretion, oxidative stress, and impaired mucosal defense. Traditional medicinal plants offer a valuable source of bioactive compounds with potential gastroprotective effects. The present study investigated the anti-ulcer activity of three selected South Indian medicinal plants—*Mimosa pudica*, *Artabotrys hexapetalus*, and *Adhatoda vasica*—using experimental rat models. Methanolic, chloroform, and diethyl ether extracts of the plants were administered orally at doses of 100 and 200 mg/kg, and their effects were evaluated in aspirin-induced, alcohol-induced, and pylorus ligation-induced gastric ulcer models. Ranitidine (20 mg/kg) served as the standard reference drug. Ulcer index, percentage ulcer inhibition, gastric juice volume, acidity parameters, and pH were assessed. All three plants exhibited significant anti-ulcer activity across the tested models, with methanolic extracts demonstrating superior gastroprotective effects compared to chloroform and diethyl ether extracts. Methanolic extracts produced a marked reduction in ulcer index (approximately 60–75%), significantly decreased gastric acid secretion, and increased gastric pH in a dose-dependent manner. The observed effects were comparable to those of ranitidine. Preliminary phytochemical screening indicated the presence of flavonoids, alkaloids, tannins, saponins, and phenolic compounds, which may contribute to the cytoprotective and antisecretory actions. The findings support the traditional use of these plants in ulcer management and suggest that methanolic extracts, in particular, hold promise as natural anti-ulcer agents.
Keywords: Anti-ulcer activity, medicinal plants, *Mimosa pudica*, *Artabotrys hexapetalus*, *Adhatoda vasica*, gastric ulcer models

INTRODUCTION

Anti-cancer drug development is one of the most exciting disciplines of science, and natural product-based anti-cancer drugs are still being researched across the world. The number of tumours, their frequency, and the types of tumours vary by nation (Shu, 1998). Prostate, breast, colon, rectum, breast, cervix, uterus, liver, lung, stomach, oesophagus, kidney, urinary bladder, oral cavity, blood, and ovary are the most prevalent sites in the body where cancer is more likely to form (Bostwick and Brawer 1987). For the chemotherapeutic treatment of the aforementioned malignancies, a number of plant and derivative-based compounds are utilised. Lignans, taxanes, vinca alkaloids, stilbenes, cephalotaxanes, flavones, and camptothecins are some of the drug classes they belong to (Da Rocha et al., 2001).

Despite the fact that cancer can arise in a variety of organs with varied roles across the human body, the aetiology of cancer is fundamentally identical. When new information regarding cancer's molecular process are discovered, there's a good likelihood that more targets for therapeutic therapies in cancer's growth and

development will emerge. Cancer chemoprevention is a relatively recent method that either prevents, slows, or reverses carcinogenesis (Mehta and Pezzuto, 2002).

Various investigations have now proved that there is a substantial link between *H. pylori* infection in the stomach and cancer. According to one theory, *H. pylori* infection produces stomach inflammation, which can develop to atrophic gastritis and, eventually, gastric cancer. Furthermore, the infection of the organism is linked to stomach and peptic ulcers, as several studies have established the function of *H. pylori* in idiopathic peptic ulcer. However, the majority of infections that might cause persistent stomach inflammation are clinically undetectable (Blazer et al., 1995).

MATERIAL AND METHODS

Collection of Plant Materials: During the early winter season, the plant materials *M. pudica*, *A. hexapetalus*, and *A. vasica* were obtained from the foothills of the Western Ghats in and around Courtallum and Thaniparari Hills, Tamil Nadu, India.

Animals: For the screening, male albino rats weighing 150-200 g were procured from Madurai and kept under conventional husbandry settings (temperature 232oC, relative humidity 5510 percent, and 12 hour light dark cycle). Throughout the experiment, the animals were fed a conventional laboratory meal ad libitum.

Toxicity studies: The acute toxicity research was carried out utilising extracts from a variety of plants and followed the OECD recommendations for the acute toxic classic approach (Ecobichon, 1997). For the acute toxicity research, albino rats of both sexes were employed. The animals were fasted overnight and given just water before receiving the different extracts orally at a dosage of 300 mg/kg and being monitored for up to 14 days. If two out of every three animals died, the dosage was considered hazardous. If a single animal died, the same dosage was administered again to confirm the toxic dose. If no deaths occurred, the treatment was repeated with greater dosages of 400, 500, and 2000 mg/kg body weight. For 72 hours, the animals were monitored for hazardous signs.

Aspirin-induced gastric ulcer: In the aspirin-induced ulcer tests, 11 groups of male albino rats (100–200 g) were employed, each with 5 animals. The first group received normal saline (2 ml/kg) as a control, the second group received ranitidine (20 mg/kg) orally as a positive control, and the third to eleven groups received test extracts (100 mg/kg and 200 mg/kg) for eight days. For eight days, an aqueous preparation of aspirin (at a dosage of 200 mg/kg orally) was given to the patient. Animals were permitted to fast for 24 hours after 8 days of therapy. The animals were slaughtered on the eighth day, four hours after starting the medication treatment, and their stomachs were surgically opened to determine the ulcer index (Kunchandy et al., 1985).

Alcohol-induced gastric ulcer: Male rats were placed into 11 groups at random, each with five animals, and fasted for 24 hours with free access to water. For seven days, the animals were administered methanolic, chloroform, and diethyl ether extracts of the three plants (*M. pudica*, *A. hexapetalus*, and *A. vasica*) at doses of 100 mg/kg and 200 mg/kg, respectively, as well as Ranitidine (20 mg/kg). After an hour, each animal was given 1 ml of 80 percent ethanol orally for the next 7 days. On the seventh day, animals were slaughtered by cervical dislocation and stomachs were surgically sliced open along the larger curvature and fastened on a soft board one hour after ethanol delivery. The length of each gastric lesion was measured, and the lesion index was calculated as the sum of the total lesion length in millimetres (Kunchandy et al., 1985).

Pylorus-ligation induced gastric ulcer: For the pyloric ligation ulcer model, male albino rats weighing 150-200 g were used. The rats were separated into 11 groups, each of which included five rats. For seven days, the first group received normal saline 2 ml/kg (negative control), the second group received Ranitidine 20 mg/kg (positive control), and the third to eleventh groups received methanolic, chloroform, and diethyl ether extracts of three plants (*M. pudica*, *A. hexapetalus*, and *A. vasica*) (100 mg/kg and 200 mg/kg) by oral route. The pylorus was ligated under ether anaesthesia one hour after the previous dosage. For 4 hours, the animals were returned to the observation chamber. The animals were decapitated after 4

hours, their abdomens were surgically opened, and the stomach was isolated by suturing the lower esophageal end. The mucosal layer was cleaned with 1 mL distilled water after the stomach juice was collected. Each animal's stomach was examined for ulcers and a score was assigned. There was also a measurement of the overall volume of stomach content. The contents of the stomach were centrifuged for 10 minutes at 1000 rpm. One millilitre of the supernatant liquid was pipetted out and diluted with distilled water in a 10 millilitre batch. Using Topfer's reagent as an indicator, the solution was titrated against 0.01 N NaOH until the endpoint was reached, when the solution became orange. The amount of NaOH required was calculated based on the free acidity. The titration was maintained until the solution returned to its original pink colour (Shay et al., 1945).

The amount of NaOH necessary was calculated and assumed to be equal to the overall acidity. Acidity was calculated as follows:

$$\text{Acidity} = \frac{\text{Volume of NaOH x Normality x 100 mEq/1}}{0.1} \quad 0.1$$

Statistical analysis: For each parameter, the mean SEM values are determined. Each parameter was examined independently to determine significant intergroup differences, and one-way analysis of variance (Gennaro, 1995) was used, with individual comparisons of group mean values using Dunnet's test (Dunnet, 1964).

Group-1: Normal saline (2 ml/kg, p.o.) - solvent control
Group -2: Ranitidine (20 mg/kg, p.o.) - standard
Group -3: Methanolic extract of *M. pudica* (100 mg/kg &200 mg/kg, p.o.)
Group -4: Chloroform extract of *M. pudica* (100 mg/kg &200 mg/kg, p.o.)
Group -5: Diethyl ether extract of *M. pudica* (100 mg/kg &200 mg/kg, p.o.)
Group -6: Methanolic extract of *A. hexapetalus* (100 mg/kg &200 mg/kg, p.o.)
Group -7: Chloroform extract of *A. hexapetalus* (100 mg/kg &200 mg/kg, p.o.)
Group -8: Diethyl ether extract of *A. hexapetalus* (100 mg/kg &200 mg/kg, p.o.) Group -9: Methanolic extract of *A. vasica* (100 mg/kg &200 mg/kg, p.o.)
Group -10: Chloroform extract of *A. vasica* (100 mg/kg &200 mg/kg, p.o.)
Group -11: Diethyl ether extract of *A. vasica* (100 mg/kg &200 mg/kg, p.o.)

RESULTS

In all three models studied, all three plant extracts showed anti-ulcer efficacy (aspirin induced, alcohol induced and pylorus ligation). The methanolic extracts of the plants had a greater anti-ulcer action than other organic solvents when administered at two different doses, 100 mg/kg and 200 mg/kg. When compared to other solvents, the ulcer index in animals treated with methanolic extracts was much lower. Animals treated with methanol extracts of all three plants showed a decrease in ulcer index. The reduction in ulcer index was statistically significant and equivalent to Ranitidine (20 mg/kg), a typical medication.

Aspirin induced ulcer

Another model utilised to evaluate the effect of extracts was aspirin-induced gastrointestinal ulcers in rats. When compared to the other two extracts, the methanolic extract had exceptional ulcer-protective characteristics at 100 and 200 mg/kg. Methanolic, chloroform, and diethyl ether extracts of *M. pudica* provided 70.46 percent, 57.84 percent, and 46.46 percent ulcer prevention at 200 mg/kg, respectively. The ulcer protection was 66.15 percent, 54.76 percent, and 47.07 percent (Figure 1c) for methanolic, chloroform, and diethyl ether extracts of *A. hexapetalus* and 73.23 percent, 56.00 percent, and 49.23 percent for methanolic, chloroform, and diethyl ether extracts of *A. vasica* at 200 mg/kg, respectively; the standard drug, Ranitidine at 20 mg (Table 1: Figure 2).

Alcohol induced ulcer

The results of the alcohol-induced stomach ulceration model in rats were equivalent to the aspirin-induced ulcer in rats. When compared to the other two extracts, the methanolic extract was shown to have good ulcer-protective characteristics at 100 and 200 mg/kg. Methanolic, chloroform, and diethyl ether extracts of *M. pudica* provided 69.53 percent, 58.76 percent, and 47.38 percent ulcer protection at 200 mg/kg; methanolic, chloroform, and diethyl ether extracts of *A. hexapetalus* provided 67.07 percent, 56.61 percent,

and 48.30 percent (Figure 1d) ulcer protection at 200 mg/kg; and methanolic, chlor In the ethanol-induced ulceration paradigm, pre-treatment of rats with *M. pudica* extracts resulted in dose-dependent protection as compared to the control group (Table 18). In this model, however, the protection was statistically significant in reducing the severity of the ulcer and resulting in a substantial drop in the ulcer score. When compared to the control group, ranitidine provided considerable stomach ulcer prevention (Figure 2).

Pylorus ligation induced ulcer

The results obtained in the experimental model of Pylorus ligation induced gastric ulceration in rats. When compared to the other two extracts, the methanolic extract was found to have exceptional ulcer-protective characteristics at 100 and 200 mg/kg. When compared to the other two extracts, the methanolic extract was found to have significant ulcer-protective characteristics at 200 mg/kg. The maximum effect of ulcer protection (70.10%), (58.69%) and (46.73%) were produced at 200 mg/kg for methanolic, chloroform and diethyl ether extracts of *M. pudica*, (67.39%), (56.52%) and (48.36%) (Figure 1e)were produced at 200 mg/kg for methanolic, chloroform and diethyl ether extracts of *A. hexapetalus* and (73.91%), (57.06%) and (50.00%) were produced at 200 mg/kg for methanolic, chloroform and diethyl ether extracts of *A. vasica* and the standard drug (Ranitidine 20 mg/kg) gave 80.70% of ulcer protection (Table 2; Figure 2).

In compared to the control group, the methanolic, chloroform, and diethyl ether extracts of *M. pudica* in dosages of 200 mg/kg significantly reduced the ulcer index, stomach volume, free acidity, total acidity, and increased gastric pH. When compared to the control group, the ranitidine reference medication reduced stomach ulcers and overall acid production significantly. When compared to the other two extracts, the methanolic extract of chosen *M. pudica* considerably reduces the total volume of gastric juice, free and total acidity of gastric output, and has efficacy against gastric ulcers in rats. Ulcers and haemorrhagic streaks were present in the control animals. In contrast, there was a considerable reduction in ulcer index in animals given *M. pudica* extracts.

Preliminary phytochemical screening revealed the presence of Alkaloids, Steroids, polyphenolic constituents like flavonoids, Saponins, glycosides, tannins, gums and mucilages. Acute toxicity studies of the various extracts of the *M. pudica* did not exhibit any signs of toxicity up to 2 g/kg body weight. Since there was no mortality of the animals found at high dose. Hence 100 and 200 mg/kg dose of the extract selected for evaluation of anti-ulcer activity.

Table 1: Effect of various plant extracts on aspirin and alcohol induced gastric ulcer in rats

Treatment	Dose (mg/kg) p.o.	Aspirin		Alcohol	
		Ulcer Index	% of ulcer protection	Ulcer Index	% of ulcer protection
Control (Normal saline)	2ml/kg	□□□□□□□□□	□	□□□□□□□□□	□
Standard (Ranitidine)	20mg/kg	□□□□□□□□□□	□□□□□	□□□□□□□□□□	□□□□□
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Results are mean ± S.E.M. (n=5); statistical comparison was performed by using ANOVA coupled with student's t-test.*P<0.05, **P<0.01, ***P<0.001 were consider statistically significant when compared to control group.

Table 2: Effect of plant extracts of MP, AH and AV against pylorus ligation induced gastric ulcer in rats

Treatment	Dose (mg/kg) p.o	Volume of gastric juice (ml/4h)	PH	Free Acidity (mEq/L)	Total Acidity (mEq/L)	Ulcer Index	%Inhibition of ulcer
Control (Normal saline)	2ml/kg	□□□□□□□ □□□	□□□□□□□ □□□	□□□□□□ □□□	□□□□□□□ □□□□	□□□□□□ □□□□	–
Standard (Ranitidine)	20mg/kg	□□□□□□ □□□□	□□□□□□□ □□□□	□□□□□□□ □□□□	□□□□□□□ □□□□	□□□□□□ □□□□	80.70
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Results are mean ± S.E.M.(n =5). Statistical comparison was performed by using ANOVA coupled with student's t-test.* P<0.05, ** P<0.01,
*** P<0.001 were consider statistically significant when compared to control group.

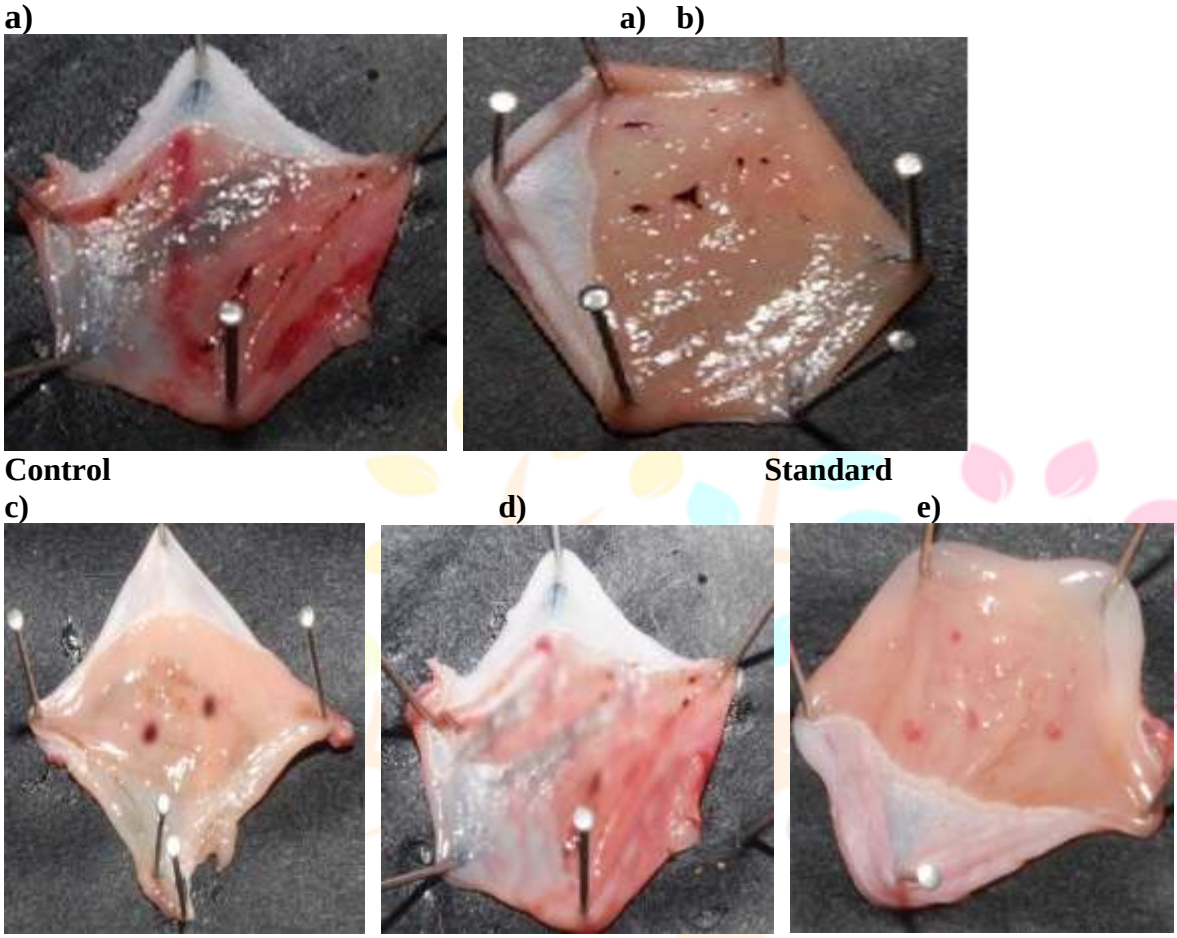
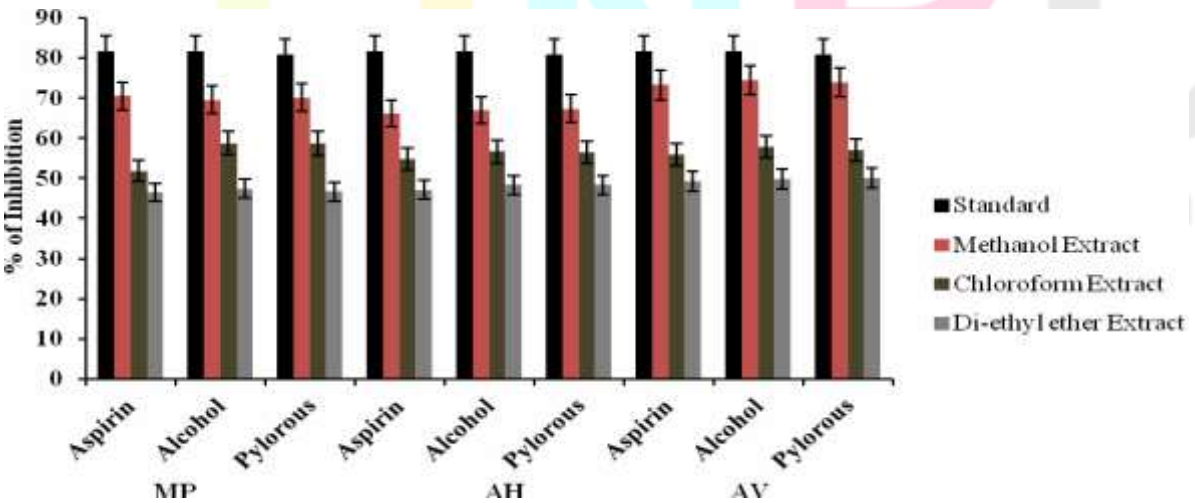


Figure 1: Effect of various extracts of *A. hexapetalus* against aspirin, alcohol and pylorus ligation induced gastric ulcer in rats **(**Ulcer in rats was induced as discussed earlier; the animals were sacrificed on 8th day and the intestine was photographed)



MP- *M. pudica* AH- *A. hexapetalus* AV- *A. vasica*

Figure 2: Effect of various extracts of *MP, AH and AV* against Anti-ulcer activity in rats

DISSCUSSION

The exact aetiology of a peptic ulcer is unknown, however it can be triggered by stress, drunkenness, long-term use of anti-inflammatory medicines, and other factors (Barocelli, 1997). However, it is thought that stomach ulcers occur as a result of an imbalance between the variables impacting and the host defence mechanisms' maintenance of mucosal integrity (Szabo et al., 1987; Piper and stiel, 1986). Excess stomach acids are produced by prostaglandin (PG), which not only promotes mucosal resilience but also reduces the aggressive variables that cause ulcers (Aly and Scand, 1987). As a result, long-term aspirin use decreases PG production, causing damage to the cells that line the mucosal layer (Rainsford, 1984). Various medicinal substances, including plant extracts, may be utilised to restore equilibrium. A variety of animal models for ulcer research are available, including asprin, alcohol, and pylorus ligation ulcer models. Stress-induced escalation in the production and/or stasis of hydrochloric acid in the stomach was discovered to be the major causal cause for gastric ulcer pyloric ligation. The amount of HCl released is also a concern since it might harm the stomach's exposed lumen (Raju, 2009). The gastric mucosa autodigestion and subsequent rupture of the gastric mucosal barrier causes pylorus ligation induced ulcers (Wagnar, 1990). Ethanol can also cause ulceration of the stomach mucosa. The ulceration is caused by the generation of superoxide and hydroperoxy radicals when ethanol is digested (Pihan et al., 1987; Jude and paul, 2009). Ethanol also causes stomach injury, which is mostly caused by blood flow stagnation (Guth et al., 1984).

Using asprin, alcohol, and pylorus ligation ulcer models, the anti-ulcer activity of the chosen plant extracts was assessed. These models are based on some of the most prevalent human causes of stomach ulcers. Many causes and processes have been linked to ulcerogenesis and gastric mucosal injury as a result of the many models used. Methanolic extracts of the chosen plants were shown to be considerably efficacious at all dosage levels in protecting stomach mucosa against aspirin, alcohol, and pylorus ligation-induced ulcers in the current investigation.

These plant extracts protect against ulceration as seen by lower lesion index values when compared to the control group, suggesting a significant cytoprotective action. The antiulcer activity of selected plant extracts in the pylorus ligation model is evident from its significant reduction in gastric volume, total acidity, free acidity, ulcer index, and increase in pH of gastric juice, as pyloric ligation is caused by the accumulation of gastric juice and meddling of blood circulation. The methanolic extracts not only prevented the formation of pylorus ulcers, but also decreased gastric volume, acid concentration, and raised pH levels in the stomach in the animals. According to this research, methanolic extracts of certain plants can reduce stomach damage caused by hostile forces.

The considerable reduction in free acidity, total acidity, number of ulcers, and ulcer index in the pylorus ligation model demonstrates A. indicum's antiulcer ability. The development of ulcers was reduced in the treated mice, which also resulted in an elevation in pH. As a result, it was hypothesised that A. indicum had the ability to mitigate the stomach damage caused by aggressive forces. The inclusion of flavonoids (quercetin), alkaloids, tannins, saponin, glycosides, and phenolic chemicals in A. indicum might explain the considerable increase in antiulcer action. Flavonoids are one of the cytoprotective materials whose anti-ulcerogenic activity has been thoroughly established. It has been hypothesised that the chemicals in the extract may speed up mucous creation, bicarbonate secretion, and prostaglandin secretion. They may also counteract the effects of reactive oxidants in the gastrointestinal lumen, causing ulcers (Sakat and Juvekar, 2009). As a result, the antiulcer action of a methanolic extract of a specific plant might be related to the flavonoids it contains. The current findings imply that a methanolic extract of a certain plant might be useful in the treatment of stomach lesions.

CONCLUSION

The anti-ulcer activity of methanolic extracts of all three herbs was comparable. In comparison to the other two extracts, the methanolic extracts showed exceptional ulcer-protective characteristics.

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