International Journal of Pharmaceutical Science Invention
ISSN (Online): 2319-6718, ISSN (Print): 2319- 670X
www.ijpsi.org Volume 13 Issue 5 ǁ Sep. –Oct, 2024 ǁ PP. 17-24

Leaves of Mimosa pudica shown to be effective in gastric ulcer an in vivo study in rat models

Bharti Rai
M Pharm, School of Pharmacy LNCT University, Bhopal M.P

Dr. Janki Prasad Rai
M Pharm, PhD, School of Pharmacy LNCT University, Bhopal M.P

ABSTRACT:
In the present look at, there was an endeavour to determine the anti-ulcer effect of methanolic, chloroform, and diethyl ether extracts of Mimosa pudica. For this one-of-a-kind ulcer brought about rat fashions were used. The ulcers have been produced by the use of aspirin, alcohol, and pyloric ligation, which brought about experimentally gastric ulcers in rats. Thus, the parameters applied to evaluate anti-ulcer interest had been loose acidity, measurement, volume of gastric secretion estimation, pH, total acidity, and ulcer index will power. The findings cited in this conversation show that the methanolic extract of Mimosa pudica leaves has caused a tremendous ($P < 0.001$) discount in the quantity of the gastric acid output and gut pH, consisting of the unfastened and total acidity, values as well as ulcer index as compared to the manipulation.

KEYWORDS*: Mimosa pudica, anti-secretary, aspirin anti-ulcer model, alcohol anti-ulcer model, pyloric ligation anti-ulcer model*

Date of Submission: 15-09-2024 Date of acceptance: 30-09-2024

I. INTRODUCTION

Gastrointestinal diseases such as peptic ulcer are among the most frequently seen clinical conditions throughout the world. Knowing the severe side effects of modern medicines such as those of arrhythmias, impotence, haematopoietic, and alterations, drugs that are locally available but with fewer side effects need to be sought after as a higher remedy for peptic ulcer. There is research and clinical reports detailing various reactive oxygen species involvement in the development and progression of a number of human ailments. Some of them include conditions like neurological diseases, various inflammatory and viral diseases, as well as autoimmune diseases. It also takes account of inflammatory gastrointestinal diseases like inflamed bowel disease and gastric ulcers [(1)]. The present study gains its importance in consideration of the fact that the lengthy-term use of synthetic anti-ulcer drugs produces a number of moderate to severe ADRs (adverse drug reactions), and hence the development of new anti-ulcer agents that can be effective without exhibiting ADR appears desirable. An investigation on the effectiveness of an extract of Mimosa pudica in three different rat models with gastric ulcers by using the methods of Pylorus ligation, alcohol, and aspirin precipitated ulcers was conducted [(2)].

Chuemue, in English known as Mimosa pudica, is of the family Fabaceae. It is a type of shrubby plant that is prostrate with straggly growth with compound leaves. It becomes sensitive to touching and the spinous types of stipules and globose pinkish flower heads are present. It is found almost in all parts of the country but regarded as a weed [(3)]. The stem and leaves of the plant have been tested, analyzing chemical composition; there is an alkaloid called mimosine in the leaves; there is mucilage; while in the roots there is tannin, including a number of flavonoids that aid in its anti-ulcer effect [(4)]. Also, this is the reason why Mimosa pudica has been used for its anti-hyperglycemic, anti-diarrhoeal, anti-convulsive, and cytotoxic effects.

Helicobacter pylori and/or nonsteroidal anti-inflammatory drugs (NSAIDs) are generic to be accountable for 80 to 90% of gastric ulcers. A response to the colonization of Helicobacter pylori bacteria is inflammation of the host, the result of which is degeneration of epithelial response and injury, commonly known as gastritis. Most commonly, this infection is associated with pan-gastritis in patients. This inhibits the somatization release from ant rum, hence increasing the gastrin secretion, which fuels the production of an increased amount of acid. Through a process of exclusion, it is understood that there are several ways in which NSAID medications cause ulceration. When exposed to gastric acid, the said drugs are equally weak in acidity. It stays in the epithelial cells and causes enhanced permeability of tissue, making cells physically damaged. The principal pathophysiology that has been proposed with the use of NSAID is the inhibition of prostaglandin production. Many NSAIDs reduce the level of the cyclooxygenase-1 enzyme, which in normal circumstances

should enhance prostaglandin formation and promote gastric bicarbonate secretion, formation of the mucus layer, increase in mucosal blood glide, and enhanced cell proliferation and repair after damage or death. NSAID medications enable the protection offered through the gastric mucosa to gastric acid and pepsin to be reduced. In sum, the physiological injury is most serious when the blood supply of the stomach is reduced and there is mild ischemic deterioration of the mucosa. Thus, regardless of the etiology, the pathophysiological mechanism of gastric ulcer formation is based on the disruption of the protective properties of the gastric mucosa [5–6].

II. MATERIAL AND METHODS

Extract Preparation for Biological testing:

In order to carry out the biological testing on the selected animal models, a weighed amount (500 g) of the defatted powder was subjected to continuous hot extraction in Soxhlet equipment with methanol, chloroform, and diethyl ether, separately. The extracts were passed through a plug of cotton in the apparatus, and then filtered through filter no. 1, which is man paper. Extra solvents were removed by passing through BUCHI's rota-evaporator (R-215). Temperature was maintained between 40 and 60 ºC till all the solvents had been separated. 18% w/w, 16% w/w, and 13% w/w of extract were finally obtained with different solvents for the initial dry material. These extracts were refrigerated at 4 ºC until used for various biological testing.

Animals and ethical consideration:

Wister albino rats weighing a hundred and fifty-200 g of both sexes were used. These were maintained at 23±2 ºC with 55±10% relative humidity. A light and dark circadian cycle of 12 hours was maintained. Feeding was done with trendy lab food, advertlibitum throughout the study. All the animals considered for the study were subjected to a health check and were recorded as healthy and normal. The experimental protocol followed was as per ArulmiguKalasalingam College of Pharmacy, Krishnankoil, India, and Institutional Animal Moral Committee (Regd No. 509/02/C/CPCSEA/2002). Guidelines of ARRIVE (Animal Research Reporting of in Vivo Experiments) have also been observed.

Toxicity studies:

Investigation of acute toxicity according to OECD (Organization for Economic Cooperation and Development) guidelines No. 423 requirements was carried out on all the Mimosa pudica extracts. The acute toxic classic method was utilized. Study become achieved on Wistar albino rats of both sec. Groups of three animals for each methanolic, chloroform, and diethyl ether extract sample were created. After overnight fasting on water only, the rats had been administered orally different extracts in a dose of 300 mg/kg. They were then monitored for 14 days. Mortality became located in a ratio of 2:1 at 300 mg/kg dosing. Further, then 250 mg/kg of the dose was tested. This was found to be safe as there was no sign of mortality. Based on this, 100 and 200 mg/kg doses of different extracts were finalized for further study of anti-ulcer pastime.

Experimental design:

Three different animal models (aspirin, alcohol, and pylorus ligation) were employed to evaluate the antiulcer activity of Mimosa pudica leaf extract.

Animal grouping:

For each of the three models, rats were randomly divided into 8 companies of six animals each. The corporations were nominated as follows:

- Neutral control organization (NC; Group I), which acquired simply normal saline (2 ml/kg).
- Positive Control Institution (PC; Group II) was handled with ranitidine (20 mg/kg).
- Test groups (TG; Groups III to VIII) each acquired methanolic, chloroform, and diethyl ether extracts of Mimosa pudica (100).

Aspirin-induced gastric ulcer:

In the aspirin-brought about ulcer experiments, 3 groups of albino rats (150–2 hundred g), with each group such as six animals, have been used. The first institution served as a management institution, the second organization as an advantageous manager, and group's three to eight served because they took a look at companies. The second and III to VIII agencies have been treated with ranitidine (20 mg/kg) and methanolic, chloroform and diethyl ether extracts of Mimosa pudica (one hundred. On same day they were then sacrificed. Immolation was carried out 4 h after oral drug administration. The belly became cut opened to calculate ulcer index by using Standard suggested technique.

Calculation of ulcer index:

$$U1= UN+US+UP+10^{-1}$$

U1 =Ulcer index
UN=Average ulcer wide variety in keeping with animal
US=Average score of severity
UP=Percentage of animals with ulcer

The ulcers severity became scored as under:

0 = Normal coloured belly
0.5 = Red shade
1 = Spot ulcers
1.5 = Haemorrhagic streaks
2 = Ulcers ≥3 but ≤5
3 = Ulcers >5.

Alcohol-induced gastric ulcer:

Selected albino rats were divided into three group son random basis. After fasting them for 24hrs. keeping their Get right of entry to to water free, Have been given Methanolic, chloroform and diethyl ether extracts Of the Mimosa pudica at a dose of one hundred and 2 hundred mg/kg separately to each groups III to VIII. Ranitidine (20 mg/kg) orally was given to group II. Ethanol 80% in a dose of 1 ml was given orally to all the study rats at a gap of 1 h of Mimosa pudica extract administration. Further, at a gap of 1 hour, cervical dislocation was performed on the study animals to immolate them. Their stomachs were separated. It was then cut along greater curvature and opened. On a soft board, the open stomach was pinned. Then each gastric lesion dimension was measured. The lesion index, a sum of the length of the entire lesion, was expressed in mm.

Pylorus-ligation brought on gastric ulcers:

Eight groups with six animals each were created with albino rats weighing 150-200 g. All the animals were fasted for 24 hours. One organization acquired regular saline 2 ml/kg (negative Manipulate); the second group received Ranitidine 20 mg/kg by oral path (positive control); and the III to VIII businesses received methanolic, chloroform, and diethyl ether extracts of Mimosa pudica (100 and 200 mg/kg separately) by oral route, 30 min prior to pyloric ligation. After a gap of 4 hours, the animals were sacrificed and their stomachs were opened. The gastric contents had been gathered. These were then centrifuged for 10 min at 1000 rpm speed. To 1 ml centrifuged supernatant, then 9 ml distilled water was added, and the resulting solution was titrated against 0.01NNaOH. Topfer's reagent was used as an indicator. At the top factor, the shade of answer is modified to orange. At this point, the amount of sodium hydroxide ate up indicated the extent of free acidity in the tissue centrifuge. Titration was further continued. The NaOH volume used for reappearance of pink color indicated the full acidity.

Acidity (mEq/100 g) became expressed as:

Acidity = (Volume of NaOH x Normality x a hundred)/0.1

Biochemical assays for antioxidant activity:

Preparation of tissue homogenates

In order to prepare tissue homogenates, the animals were immolated by giving etheranesthesia in a small dose. Stomach tissue weighing 400 mg was homogenized. EDTA0.02 M was used in an amount of 8 ml. Homogenization was done in an ice bath in a Potter-Elvehjem homogenizer. Until determination of the levels of glutathione and malondialdehyde, both supernatants as well as homogenates were stored in ice baths.

Measurement of malondialdehyde (MDA) level:

In the aspirin, alcohol, and pyloric ligation brought on gastric ulcer models, the extent of peroxidation of lipids in stomach tissue was estimated by checking MDA levels. Here is the procedure illustrated by Fotio ET. al. Changed into accompanied with mild amendment [7, 8]. To the supernatants of tissue homogenates (1 ml) from different models, 20% trichloroacetic acid (0.5 mL) along with 0.67% thiobarbituric acid (1 ml) was mixed. The resulting combination became then for 1 hour. Heated at 90◦C in a clean water bath. Finally, the supernatant was at 3000 rpm centrifuged (for 10 min.), and its absorbance was calculated at 546 nm wavelength. An ultraviolet ©spectrophotometer was used for the purpose. Through the extinction coefficient, MDA concentration was quantified with the formula below.

$OD = \varepsilon Cl$

Here, OD is the optical density measured; ε is the extinction coefficient (ε = 1.Fifty six × one hundred and five M/cm); C is MDA Awareness and l is cuvettelength. The MDA concentration was expressed in µmol per gram of tissue (11).

Measurement of reduced glutathione (GSH):

To determine GSH level in aspirin, alcohol, and pyloric ligation-prompted gastric ulcer models, 20 µL of supernatant of tissue homogenate was treated with Elman reagent (3 ml) and 0.1 Mphosphate buffer at pH 6.5 (250 ml). After standing for one hour. At the maintained temperature of the room, spectrophotometrically, the absorbance at 412 nm was captured.

GSH levels in tissue homogenates from different models were calculated by the formula:

A = ECL,

Where A is the optical absorbance, ε is the extinction coefficient (thirteen, six hundred M-1 cm-1), C is the attention in moles/litter, and l is the route period (Cm) [(9)].

Statistical analysis

Mean±SEM was calculated. Individual analysis of each considered parameter was performed to evaluate intergroup variations, if any, at the significance level. A one-way ANOVA was also done. Dennett's test was applied to check and compare the individual mean group values. The mean difference with a P value < 0.05 was recorded as significant.

III. Result and Discussion

Acute toxicity study

At a dose of 250 mg/kg of the rat's body weight or less, there was no mortality observed, indicating a lack of any acute toxicity from oral administration of Mimosa pudica extracts. Looking at this inference, a dose of 100 and 200 mg/kg of Mimosa pudica extracts was selected for evaluation of anti-ulcer pastime.

Aspirin induced ulcer

Among the three different extracts used, significantly greater ulcer protection was seen from methanolic extract, both at 100 and 200 mg/kg. Maximum percent of ulcer protection from methanolic, chloroform, and diethyl ether extracts were, respectively, 71.44%, 58.54%, and 45.86%. The reported effect was produced at 200 mg/kg. Ranitidine, the reference standard used at 20 mg/kg, produced ulcer protection of 80.75%. Table 10 summarizes the consequences received inside the experimental version of aspirin-induced gastric ulceration in rats.

Alcohol induced ulcer

The protection effect of leaf extracts of Mimosa pudica in the rats pre-treated was observed to be proportional to the dose administered when ulcers were introduced using alcohol (i.e., ethanol) in comparison to the control groups. It was found to be statistically noteworthy in controlling the severity of the ulceration as indicated by the good ulcer index and % of ulcer healing. As in the previous model, ranitidine was used as a reference, and it produced healing of 80.75%. Outcomes are summarized in Table 1 under.

Table 1. Mimosa pudica leaf extracts effects in gastric ulcers by Aspirin and Alcohol

Treatment Groups	Dose (mg/kg) p.o.	Aspirin		Alcohol	
		UI	% of UP	UI	% of UP
NC	2 ml/kg	6.43 ± 0.51	-	6.43 ± 0.51	-
PC	20	1.43 ± 0.34	80.75	1.43 ± 0.34	80.75
ME	100	4.34 ± 0.44	37.4	4.09 ± 0.32	37.17
	200	1.94 ± 0.35	71.44	1.99 ± 0.48	67.43
CE	100	4.79 ± 0.47	27.58	4.73 ± 0.45	27.19
	200	2.83 ± 0.37	58.54	2.69 ± 0.34	59.23
DEE	100	4.97 ± 0.49	24.73	4.84 ± 0.29	25.73
	200	3.49 ± 0.44	45.86	2.89 ± 0.39	46.58

UI-Ulcer Index; UP-Ulcer protection; p.o.-per os (orally); NC-neutral control; PC-positive control; ME-methanol Extract; CE-chloroform extract; DEE-diethyl ether extract

In Aspirin and Alcohol induced ulcer models, the results compiled in table 10 are mean ± S.E.M.(n = 6). ANOVA was done for comparing statistically. It was coupled with the student's't' test. The % of ulcer protection value less than 40% was found to have a probability of P< 0.05. The values of ulcer protection with values between 40 and 70% were with P<0.01, while values of ulcer protection with values greater than 70% were found to have P<0.001. These have all been taken into consideration to be statistically great when compared to neutral control groups.

Pylorus-ligation-induced ulcer:

In this model, as compared to the control institution, the Methanolic, chloroform, and diethyl ether extracts of the Mimosa pudica in doses of one hundred and two hundred mg/kg produced a substantial discount in fee of ulcer index, quantity of gastric juice, unfastened, and general acidity. Also, sufficient increase in gastric pH was observed. Ranitidine, the reference drug, was also reported to produce a significant reduction in these parameters compared to control groups (Table 2).

Table 2. Mimosa pudica extracts effect against Pylorus ligation brought on gastric ulcer

Treatment Groups	Dose (mg/kg) p.o.	Gastric juice, vol. (ml/ 4hr)	pH	Free Acidity (mEq/ L)	Total Acidity (mEq/ L)	Ulcer Index	% Inhibition of Ulcer
NC	2 ml/kg	3.83 ± 0.12	2.38 ± 0.24	27.43 ± 0.18	69.56 ± 0.30	2.68 ± 0.56	
PC	20	2.43 ± 0.06	5.34 ± 0.18	9.78 ± 0.02	21.74 ± 0.18	1.34 ± 0.24	80.75
ME	100	3.76 ± 0.26	3.27 ± 0.24	20.18 ± 0.15	50.14 ± 0.38	2.54 ± 0.34	37.43
	200	2.28 ± 0.24	4.67 ± 0.18	12.43 ± 0.06	28.62 ± 0.26	1.14 ± 0.29	71.51
CE	100	4.34 ± 0.16	3.07 ± 0.14	21.96 ± 0.18	59.48 ± 0.24	2.65 ± 0.36	29.4
	200	3.17 ± 0.24	4.38 ± 0.16	12.68 ± 0.12	34.55 ± 0.32	2.51 ± 0.44	59.48
DEE	100	3.88 ± 0.24	2.94 ± 0.34	24.53 ± 0.14	63.16 ± 0.29	2.85 ± 0.49	24.87
	200	3.78 ± 0.14	3.34 ± 0.46	16.69 ± 0.16	40.12 ± 0.34	1.87 ± 0.56	47.84

p.o.-per os (orally); NC-neutral control; PC-positive control; ME-methanol Extract; CE-chloroform extract; DEE-diethyl ether extract

In Pylorus ligation induced ulcer models, the outcomes are shown in table 11 as mean ± S.E.M.(n = 6). ANOVA was done for comparing statistically. It was coupled with the student's't' test. The % of ulcer protection value less than 40% was found to have a probability of P< 0.05. The values of ulcer protection with values between 40 and 70% were with P<0.01, while values of ulcer protection with values greater than 70% were found to have P<0.001. These were all considered to be statistically considerable as compared to neutral control groups.

The effects of the prevailing look indicate that the 200 mg/kg dose of methanolic extract of Mimosa pudica significantly constrained the total quantity of gastric juice, free and total acidity of gastric secretion, and also exhibited significant % of ulcer inhibition in rats when compared to the other two extracts. A comparative plot of the three gastric ulcers is represented in Figure 1.

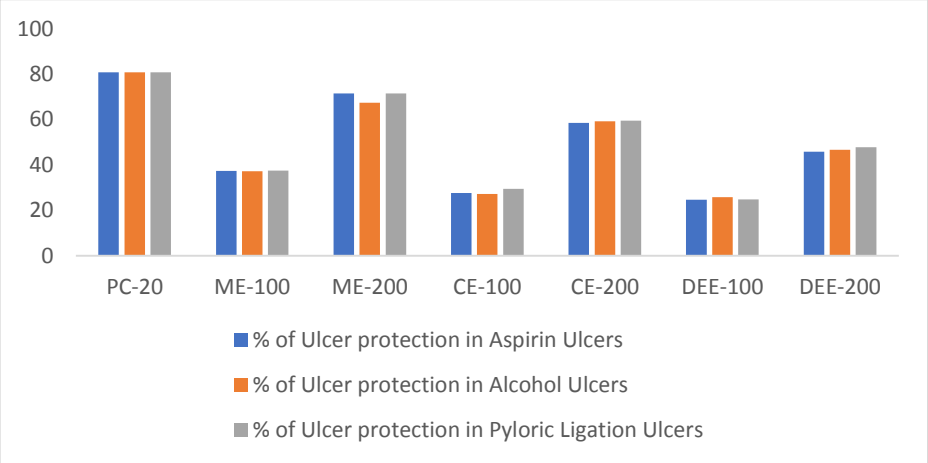

Figure 1. Comparative plot of the Mimosa pudica extract on different gastric ulcer models

Based on the above inferences, the stomach section of methanolic extract-treated groups was studied. Strips of the blood that flowed from damaged ulcerative tissue cells were observed in the control animal's groups. While animals treated with methanolic Mimosa pudica extracts showed significant ulcer index reduction ($P < 0.001$) (open stomachs shown in Figure 2).

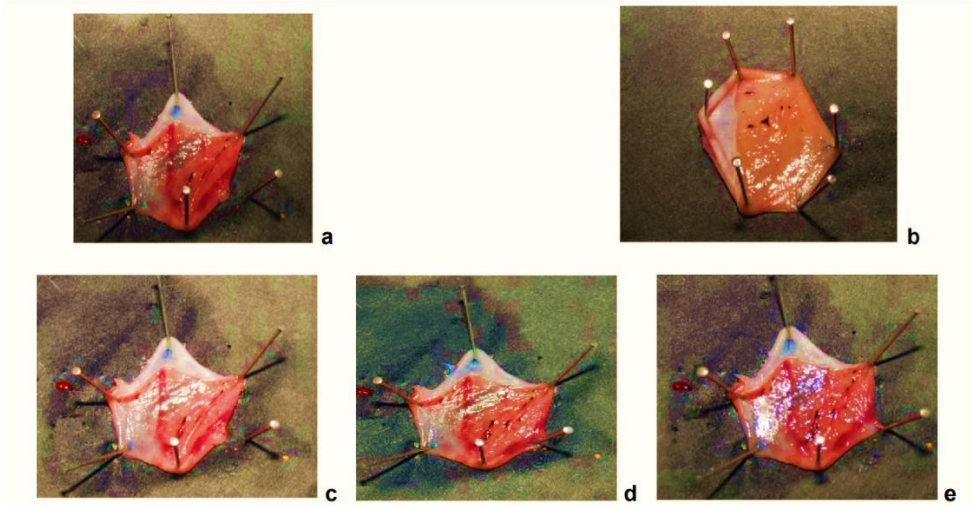

Figure 2. a, Stomach of NC; b, Stomach of PC; c, Effect of ME on aspirin gastric ulcer; d, Effect of ME on alcohol gastric ulcer; e, Effect of ME on pyloric ligation gastric ulcer

Antioxidant Effects of Mimosa pudica leaf methanolic extract on oxidative stress biomarkers

Effects of Mimosa pudica leaf methanolic extract on MDA concentration:

In general conditions during inflammations like that of ulcerative colitis, it has been reported that there is significant increase in the concentration of MDA. In the present study, elevation in MDA level was observed with $P < 0.001$, which statistically is quite significant. The values noted in different models are: aspirin (12.32 ± 0.34 µmol/g), alcohol (5.89 ± 0.14 µmol/g), and pyloric ligation (6.32 ± 0.54 µmol/g) models. The MDA level in the non-treated neutral control group of rats was 2.67±0.23 µmol/g. With a dose of two hundred mg/kg of Mimosa pudica, a significant ($P < 0.001$) decrease in MDA tissue level was observed in different models. In the aspirin (4.78±0.26 µmol/g), in the alcohol, (3.58±0.16 µmol/g), and in the pyloric ligation (2.24 ± 0.15 µmol/g), respectively. In the group of rats administered with ranitidine also, MDA levels decreased with a significant P value (i.e., $P< 0.001$) (2.87 ± 0.03 µmol/g). Data is compiled in Table 3 and represented in Figure 3.

Table 3 Mimosa pudica effect on the concentration of MDA & GSH

Animal Models	MDA µmol/g	GSH µmol/g
PC	2.87 ± 0.03	10.45 ± 0.13
Aspirin induced	4.78 ± 0.26	6.78 ± 0.16
Alcohol induced	3.58 ± 0.16	9.58 ± 0.36
Pyloric ligation induced	2.24 ± 0.15	9.24 ± 0.45

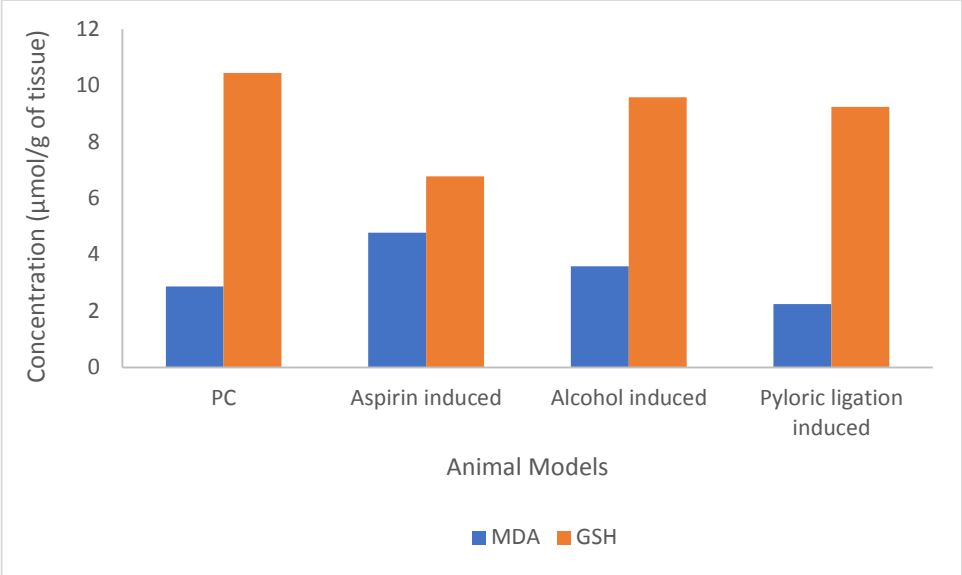

Figure 3. Effect of Mimosa pudica extract on MDA & GSH concentration

Effects of Mimosa pudica leaf methanolic extract on GSH concentration:

In general conditions during inflammations like that of ulcerative colitis, it has been reported that there is a significant decrease in the concentration of glutathione reductase enzyme. In the present study, a decline in glutathione reductase level was observed with $P < 0.001$, which statistically is quite significant. The values noted in different models are: aspirin (3.12 ± 0.23 µmol/g), alcohol (4.63 ± 0.24 µmol/g), and pyloric ligation (5.34 ± 0.24 µmol/g). The glutathione reductase level in the non-treated neutral control group of rats was 13.62±0.13 µmol/g. With a dose of 200 mg/kg of Mimosa pudica, a significant ($P < 0.001$) increase in glutathione reductase tissue level was observed in different models. In the aspirin (6.78 ± 0.16µmol/g), in the alcohol (9.58 ± 0.36µmol/g), and in the pyloric ligation (9.24 ± 0.45µmol/g), respectively. In the group of rats administered with ranitidine also, GSH levels got elevated with a significant P value (i.e., $P< 0.001$) (10.45 ± 0.13 µmol/g). Data is compiled in Table 3 and represented in Figure 3.

Irrespective of the cause, most of the stomach/gastric ulcers and sores are caused by an imbalance between the antioxidant and abrasive oxidizing agents in the gut. Thus, a situation of oxidative stress is generated that leads to this disease condition [10, 11]. It has been reported that there may be a reduction in the activity of different anti-oxidative pathways, like that of prostaglandin alone or along with potentiation of free radical formation [12]. As stated earlier, experimental ulceration by alcohol, pyloric ligation, and aspirin in study animals is the commonly used protocol. These agents cause dilation of gastric vessels, resulting in overblood flow and stagnation of WBCs, thereby elevating levels of various oxidative reactive moieties and unstable atoms [13]. Several protective antioxidant systems are reported to get activated during oxidative stress in gastric ulcers, e.g. MDA, GSH, superoxide dismutase, various catalases, etc. protect the gut lumen from lesions [14, 15]. In the presented study, MDA and GSH levels were observed before and after Mimosa pudica extract treatment as a test for oxidative biomarkers.

V. CONCLUSION

The antiulcer activity produced by the methanolic extract of Mimosa pudica in the doses of 100 and 200 mg/kg has also been found to be highly significant ($p<0.001$). Collectively, from the current results, it can eventually be inferred that the leaf extract of the plant may be used as an efficient plant medicine for curing ulcer disease. It could also be inferred from the data obtained from the available reports that the anti-ulcer activity shown by means of Mimosa pudica might be principally arising from defensive factor alteration by way of that enhancement of the gastric cytoprotection and less reasonably from the acid inhibition. The decreased mean ulcer scores have demonstrated the anti-ulcer effects of alcoholic leaf extract Mimosa pudica due to the possible association between mucosal protection, inhibition of acid secretion, and the antioxidant property of Mimosa pudica. It was seen in the preliminary phytochemical analysis as well that the aqueous extract didn't yield a much significant result, indicating its worthlessness for antiulcer testing. The methanolic extract was seen to exhibit maximum ulcer protective effect. Overall, the study has revealed the potential of the Mimosa pudica plant as an anti-ulcer candidate for therapeutic usage.

REFERENCES:

[1]. Repetto MG, Llesuy SF. Antioxidant properties of natural compounds used in popular medicine for gastric ulcers. Brazilian J Med Biol Res = Rev Bras Pesqui medicas e Biol. 2002;35(5):523–34.
[2]. E M, R. N, Ahmed SM. Antiulcer and Ulcer Healing Potential of Some Medicinal Plants: A Review. Res J Pharmacogn Phytochem. 2022;14(1):37–42.
[3]. Yemireddy P, Sidde L, Dr.C. Mohana. A brief review of Mimosa pudica. Int J Pharm Drug Anal. 2019;7(5):34–7.
[4]. Serafim C, Araruna ME, Alves Júnior E, Diniz M, Hiruma-Lima C, Batista L. A Review of the Role of Flavonoids in Peptic Ulcer (2010–2020). Molecules. 2020;25(22):5431.
[5]. Scida S, Russo M, Miraglia C, Leandro G, Franzoni L, Meschi T, et al. Relationship between Helicobacter pylori infection and GERD. Acta Biomed. 2018;89(8-S):40–3.
[6]. Kayali S, Manfredi M, Gaiani F, Bianchi L, Bizzarri B, Leandro G, et al. Helicobacter pylori, transmission routes, and recurrence of infection: state of the art. Acta Biomed. 2018;89(8-S):72–6.
[7]. Barchi A, Miraglia C, Violi A, Cambiè G, Nouvenne A, Capasso M, et al. A non-invasive method for the diagnosis of upper GI diseases. Acta Biomed. 2018;89(8-S):44–52.
[8]. Graham DY, Lu H, and Dore MP. Relative potency of proton-pump inhibitors, Helicobacter pylori therapy cure rates, and meaning of double-dose PPI. Helicobacter. 2019;24(1).
[9]. Fotio AL, Dimo T, Nguelefack TB, Dzeufiet PDD, Lemba EN, Temdie RJ, et al. Acute and chronic anti-inflammatory properties of the stem bark aqueous and methanol extracts of Sclerocarya birrea (Anacardiaceae). Inflammopharmacology. 2009;17(4):229–37.
[10]. Fotio AL, Nguepi MSD, Tonfack LB, Temdie RJG, Nguelefack TB. Acetaminophen induces liver injury and depletes glutathione in mice's brains: Prevention by Moringa oleifera extract. South African J Bot. 2020;129:317–23.
[11]. Noubissi PA, Njilifac Q, Tagne MAF, Nguepi MSD, Fondjo AF, Emégam NK, et al. Anxiolytic and anti-colitis effects of Moringa oleifera leaf-aqueous extract on acetic acid-induced colon inflammation in rats. Biomed Pharmacother. 2022;154:113652.
[12]. Pizzino G, Irrera N, Cucinotta M, Pallio G, Mannino F, Arcoraci V, et al. Oxidative Stress: Harms and Benefits for Human Health. Oxid Med Cell Longev. 2017;2017.
[13]. Al-Rejaie SS, Abuohashish HM, Al-Enazi MM, Al-Assaf AH, Parmar MY, Ahmed MM. Protective effect of naringenin on acetic acid-induced ulcerative colitis in rats. World J Gastroenterol. 2013;19(34):5633–44.
[14]. Balmus I, Ciobica A, Trifan A, Stanciu C. The implications of oxidative stress and antioxidant therapies in inflammatory bowel disease: clinical aspects and animal models. Saudi J Gastroenterol. 2016;22(1):3–17.
[15]. Khan N, Khushtar M, Rahman MA, Kaish M, and Ajmal M. Amelioration of gastric ulcer using a hydroalcoholic extract of Mangifera indica in Sprague-Dawley rats by prevention of muco-oxidative stress. Pharmacol Res - Mod Chinese Med. 2024;11:100442.
[16]. Jabbar AAJ, Mothana RA, Abdulla MA, Abdullah FO, Ahmed KAA, Hussen RR, et al. Mechanisms of anti-ulcer actions of Prangos pabularia (L.) in ethanol-induced gastric ulcer in rats. Saudi Pharm J SPJ. 2023;31(12).