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Evaluation of anti-ulcer activity of *Pluchea indica* (L) Less in various ulcer models in rats

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Abstract

Pluchea indica (L.) Less (PIL) also known as 'beluntas' is one of indigenous plant that is readily available and has been traditionally used to improve gastrointestinal disorder. In the present study, the ethanolic extract of *Pluchea indica* leaves (PIL) was investigated for its in vivo anti-ulcer activity in various experimental ulcer models; i.e 30 mg/kg indomethacin, 80% ethanol, 25% NaCl, 0.6M HCL, 0.2M NaOH and pyloric ligation model. The extract in dose of 40 and 160 mg/kg body weight had a significant anti-ulcerogenic activity against gastric ulcer induced by NaOH and indomethacin. At lower dose, the extract also significantly increased the gastric wall mucous content in pyloric ligated rats. The results were substantiated with histopathological findings. Evaluation agreed with the folkloric use of *Pluchea indica* as anti-ulcer tool.

Key words: Pluchea indica, indomethacin-induced ulcer, pyloric ligation, gastric wall mucous

Introduction

Gastric ulcer is an erosive lesion or deep wound that forms in the lining of mucosa and submucosa layer of stomach wall. Stress, smoking, nutritional deficiencies and ingestion of nonsteroidal-anti-inflammatory drugs (NSAIDs) can all increase the incidence of gastric ulcer (1). The treatment of gastric ulcer is generally based on the inhibition of gastric acid secretion by H_2-antagonists, such as omeprazole and antimuscarinics, as well as acid-independent treatment by sucralfate and bismuth (2). However, one of the major problems in the treatment of gastroduodenal ulcer is that, despite a healing rate of 80–100% after 4–8 weeks of therapy with H_2-antagonists and proton pump inhibitors, the rate of recurrence within 1 year after suspending the treatment is between 40% and 80% (3). Furthermore, most of these drugs produce several adverse reactions (4). A search for new therapeutic anti-ulcer agents is therefore essential.

Plant extracts are some of the most attractive sources of new drugs and have been shown to produce promising results in the treatment of gastric ulcers (5-6). In traditional medicine for example, several plants and herbs have been used to treat gastrointestinal disorders, including gastric ulcers (2, 7). This is an important reason to investigate anti-ulcer effect of indigenous medicinal plants with traditional use in gastric disease.

Pluchea indica (L) Less is a wild plant that grows naturally in littoral areas of many countries. In Malaysia, herbal medicine practitioners claim that the leaves of this plant are capable of treating dysentery, rheumatism, leucorrhea, bad breath and body odour, as well as boils and ulcers. The roots, on the other hand are used to treat fever, lumbago, indigestion and headache (8).

The plant has been reported to possess hypoglycaemic as well as diuretic effects (9-11). The leaves are given internally to treat lumbago (12). The root of this plant has multifarious activities. It is proven that the roots can act as anti-depression and able to induce sleep. It also possesses hepatoprotective, anti-inflammatory and anti-ulcer activity (13-15). The roots are also effective as antidote for venom poisoning.

Recently, the root extract is reported to possess antioxidant effect and also antimicrobial property (16-18). In addition, the phytochemical analyses of this plant have indicated the presence of sterols, terpenes and lignan glycosides (19-22). However, to date, there is no study has been done yet on efficacy of ethanolic leaf extract of *Pluchea indica* (L.) Less in exhibiting its gastroprotective activity. Therefore, crude ethanolic extract of *Pluchea indica (L.)* Less leaves (PIL) were assessed for their gastroprotective effect on various experimental ulcer models in the present study.

Methods

Preparation of Plant Extract

The plants were collected from a swamp area in Kuantan, Pahang with existing herbarium specimen No. KEP: 46462/68865 (FRIM herbarium). The leaves and the stem were separated. Only leaves were used in this study. The leaves were dried in an oven at 38-42 ° C for 3 days and were grounded into powdered form using a grinder mill. The powdered form of the leaves were weighed and soaked in 70% aqueous ethanol for 2 days. The solvent extract was filtered and concentrated under reduced pressure in a rotary evaporator until the solvent was completely removed. The crude extract was dried in a fume hood at room temperature for 2 day and was weighed again before being dissolved in 1% carboxymethylcellulose (CMC) into several desired dose concentration for pharmacological tests.

Ethanol (EtOH) , sodium hydroxide (NaOH), sodium chloride (NaCl), Hydrochloric acid HCl) , carboxymethylcellulose, and formalin were all purchased from Sigma Chemical Co. (St Louis, MO, USA). Drugs ie indomehacin and ranitidine were also obtained from Sigma Chemical Co. (St Louis, MO, USA).

Animals and Experimental Design

Weaned male *Sprague-Dawley* aged 5-6 weeks and weighing 150-200g was obtained from the Laboratory Animal Unit, Faculty of Medicine and Heath Sciences, Universiti Putra Malaysia with ethics approval from the Animal Ethics Committee, Universiti Putra Malaysia,(ACUC) with reference no. UPM/FPSK/PADS/BRUUH/00219. The animals were fed on standard pellet diet and water was given *ad libitum*. The animals also were maintained under standard environmentally controlled room (temperature (25 2 ° C) and light (12-h light/12-h dark cycle). The rats were randomly assigned to different control and test group.

Gastric ulcers induced by necrotizing agents (cytoprotective studies)

Cytoprotective studies were carried out according to the established method (23) with some modifications . 1 ml of necrotizing agent viz 80% (v/v) aqueous ethanol, 25% NaCl, 0.6 M HCl and 0.2 M NaOH was administered orally to induce the ulcer. SD rats of either sex weighing between 170-200 g were divided into 3 groups of 6 animals each and fasted for 24 hours with water *ad libitum* prior to experiment. The animals of group 1 were pretreated with vehicle (1% CMC) and the animals of group 2 and 3 were pretreated with PIL at 40 and 160 mg/kg respectively. 1 ml of necrotizing agent (80%, (v/v) aqueous ethanol, 25% NaCl, 0.6 M HCl and 0.2 M NaOH) was administered to all the animals of group 1 -3, 60 minutes after the respective treatments. The animals were sacrificed by cervical dislocation after one hour of necrotizing agent administration and stomach was incised along the greater curvature for determination of lesion damage. The percentage protection was calculated based on the total area lesion in treated group compared with the lesion in control group.

NSAIDs (Indomethacin)-induced ulcer

The experiments were performed according to the method of Hayden *et al* (24) with some modifications. SD rats of either sex weighing between 170-200 g were divided into 5 groups of 6 animals each and fasted for 24 hours with water *ad libitum* prior to experiment. The animal of group 1 were pretreated with vehicle (1% CMC) and the animals of group 2 was treated with standard ie ranitidine 100 mg/kg . Similarly, the animals of group 3 and 4 were pretreated with PIL at 40 and 160 mg/kg respectively. Indomethacin (30 mg/kg, p.o) was administered to all the animals of group 1-4, 60 minutes after the respective treatments. The animals were sacrificed by cervical dislocation after 6 hours of indomethacin administration and stomach was incised along the greater curvature to determine the lesion damage. The percentage protection was calculated based on the total area lesion in treated group compared with the lesion in control group.

Pyloric ligation induced ulcer

SD rats of either sex weighing 180-220 g were divided into 3 groups of 6 animals each and fasted for 48 hours and care was taken to avoid coprophagy. Control vehicle (group 1) or PIL 40 mg/kg (group 2) or PIL 160 mg/kg (group 3) were orally administered 60 minutes prior to pyloric ligation under ketamine anaesthesia. The abdomen was opened and pyloric ligation was done without causing any damage to its blood supply. The stomach was replaced carefully and the abdomen wall was closed in two layers with interrupted sutures (25).The rats were sacrificed 4 h later and the stomach were excised and opened at greater curvature, weighed and later subjected to Alcian blue method (26) for gastric wall mucus study.

Determination of gastric wall mucus content

Gastric wall mucus was determined by the Alcian blue method (26). Briefly, PIL was administered orally to 48 h fasted rats 60 min prior to induction of gastric ulcers by pyloric ligation (25). Four hours later, the animals were sacrificed and the stomach was excised and opened along the lesser curvature,

weighed and immersed in 0.1% w/v Alcian blue solution for 2 h. The excessive dye was then removed by two successive rinses in 0.25 M sucrose solution. Dye complexed with gastric wall mucus was extracted with 0.5 M $MgCl_2$ for 2 h. The blue extract was then shaken vigorously with an equal volume of diethyl ether and the resulting emulsion was centrifuged. The optical density of Alcian blue in the aqueous layer was read against a buffer blank at 580 nm using a spectrophotometer. The quantity of Alcian blue extract per gram wet stomach was then calculated from a standard curve.

Histological studies

Gastric tissue samples from each group of rats were fixed in 10% formalin for 24 hours. The formalin-fixed specimens were embedded in paraffin. The sections (5um) were cut using microtome and stained with hematoxylin and eosin. The histochemical sections were evaluated by light microscopy and histopathology changes were evaluated according to modified arbitrary scale by Al-Bekairi *et al* (27). The different histopathological indices screened were oedema, congestion, hemorrhage and necrosis.

Statistical analysis

The data for each experiment were expressed as the mean value ± S.E.M (standard error of mean) (n=6).The difference between treated and control groups were compared using the one way ANOVA and Student's t-test as appropriate and were considered as significant if P was < 0.05 or <0.01..

Results

The results of our present study are summarized in Table 1-3. After an hour, PIL at 40 and 160 mg/kg reduced the total area lesion in NaOH by 87.1& and 89.2% respectively. On the contrary, pretreatment of PIL did not show any significant reduction in total area lesion in other ulcerogen-induced ulcer models. Interestingly, PIL at 40 mg/kg reduced the ulcer lesion area by 57.7% inhibition whilst, ranitidine (positive control) reduced the ulcer scoring by 66.5%.in indomethacin-induced ulcer model. Nevertheless, at 160 mg/kg PIL did not give any significant effect in gastric lesion reduction in indomethacin-induced ulcer model (Table 1). In pyloric ligated rats, the gastric wall mucus content was significantly increased (P<0.05) from 47.173 ± 5.952 µg Alcian blue / g wet stomach in control group to 70.051 ± 4.712 µg Alcian blue / g wet stomach in PIL at 40 mg/kg. No significant enhancement of Alcian blue binding capacity was observed at higher dose of PIL (Table 2).

These results were substantiated by histopathological findings. Pretreatment with PIL was found to inhibit the oedema, congestion, hemorrhage and necrosis effects in gastric mucosa in indomethacin-induced ulcer (Table 3). Even though, there was no significant effect observed in other ulcerogen-induced ulcer except in NaOH and indomethacin, yet there were significant reduction observed in its histoptahological studies indicated that there was prominent protective effect exerted in PIL in other necrotic agents-induced ulcer. The stomach treated with low dose of PIL showed significant reduction (P<0.05) in congestion effect induced by 25% NaCl, hemorrhage effect induced by 0.6M HCL and necrosis effects induced by 80% ethanol. When induced with 0.2 M NaOH, significant difference (P<0.05) was found in hemorrhage and necrosis effect in treated rats. On the contrary, at higher dose, PIL also showed significant reduction in congestion, hemorrhage and necrosis induced by 0.2 M NaOH and in hemorrhage and necrosis effect induced by 0.6M HCl (Table 3).

see Table 1.

see Table 2.

see Table 3.

Discussion

The present study revealed that *Pluchea indica*

leaves ethanolic extract (PIL) exerted a significant protective effect against experimentally induced gastric ulcer in rats, especially ulcers induced by NaOH and indomethacin. Results on the gastric wall mucus study on pylorc ligated rats also significantly exhibited the protective effect of PIL at lower dosage. There was also an inhibition of other cytodestructive agents induced ulcers ie ethanol, sodium chloride and hydrochloric acid, although the extent of inhibition was neither marked nor statistically significant, indicating that the *Pluchea indica* leaves extract has a less prominent action on these type of ulcers.

PIL has been shown to protect gastric lesion induced by noxious chemical ie sodium hydrochloride. This agent is known as to promote oxygen fee radicals (28), reduced gastric mucosal non-protein sulfhydryl levels (29) and stimulate the formation of leukotriene C_4 (LTC_4), a lipoxygenase derived metabolite of arachidonic acid (30). Constriction of submucosal venules with subsequent stasis of blood flow in mucosal microcirculation as well as plasma leakage from the vascular bed can contribute to the widespread mucosal injury.

On the other hand, indomethacin –induced gastric damage also showed inhibition of gastric lesion by PIL extract. The mechanisms of indomethacin-induced stomach ulcers have been well documented (31). NSAIDs like indomethacin is known to induce gastric ulceration principally due to the inhibition of biosynthesis of cytoprotective PGs that are cytoprotective to gastric mucosa eg PGE_2 and PGI_2 (by inhibition of cyclo-oxygenase pathway of arachidonic acid metabolism), resulting in overproduction of leukotrienes and other products of 5-lipoxygenase pathway (32). In this model in rats, PIL at both dosages showed significant prevention in gastric lesions. Besides that, it may also cause by a reduction in the local blood flow, topical irritation and an interference with restitution and tissue repair (33,34). Furthermore, prostaglandins are responsible for mucous production and maintaining cellular integrity of the gastric mucosa (35). Thus, in this model, the results of this study suggested that the ability of PIL extract to prevent ulceration at least in part by prostaglandin biosynthesis mechanism (36). Furthermore, it also could possibly be due to 5-lipoxygenase antagonist activity, which is well supported by histopathological slides. Interestingly, Sen et al (15) has also reported on the probable similar mechanism of anti-inflammatory and anti-ulcer activity of the root extract of *P.indica* via 5-lipoxygenase pathway

The result on histopathological investigation on the gastric mucosa of the rats revealed the pretreatment with PIL reduced the NaOH induced congestion, necrosis and haemorrhage. PIL at low dosage also reduced indomethacin-induced congestion. The results are in corroboration with the anti-ulcer activity of PIL observed under the pharmacological evaluation.

Pyloric ligation-induced ulcers are probably mediated by histamine release with enhancement in acid secretion and a reduction in mucus production. Histamine plays a mediating role in the gastric secretion stimulated by gastrin, vagal excitation and cholinergic agent (37). Volume of gastric secretion is an important factor in the production of ulcer due to exposure of unprotected lumen of the stomach by the accumulating acid (25). Decrease in mucosal secretion is considered important in gastric ulceration (38). The results of the present study indicated that PIL significantly increased the mucous content at lower dosage. At higher dose, ie 160 mg/kg, PIL only showed prominent reduction of the mucous content, which was insignificant. Thus, the increased gastric wall mucous may be responsible to some extent in reducing the severity of gastric lesions in pyloric ligation model.

The leaves of *Pluchea indica* possess significant antioxidant activity as reported by Andarwulan et al (39). Therefore the anti-ulcer action of PIL maybe also by scavenging the free radicals generated in the injured mucosa. The other possible mechanisms of anti-ulcer activity of *Pluchea indica* leaves can be due to its PG synthesis, lipoxygenase inhibitory, leukotrienes antagonistic, cytoprotection anti-secretory activity or antioxidant acrivity.

The chemical constituents of *Pluchea indica* leaves

responsible for its anti-ulcer activity are not known. However, phytochemical studies on *P.indica* leaves have revealed the presence of terpenic glycosides, lignan glycosides and quinic esters (19, 20, 40). Glycosides have been shown to inhibit the gastric acid secretion and enhancement in gastric mucous content against several experimental ulcer models (41). These data suggests that glycosides present in *P.indica* leaves may be the active principles responsible, in part at least for the anti-ulcer activities shown by the tested extract.

Conclusion

The observations of the present sudy indicate that *P.indica* leaves can be a potential source for the treatment of gastric ulcer. However our results are preliminary, further studies are required to establish its exact mode of action and the active principles involved in its anti-ulcer effects.

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References

1. Belaiche J. Observational survey of NSAID-related upper gastrointestinal adverse events in Belgium. Acta Gastroenterologic Belgiam 2002; 65: 65-73
2. Bighetti AE, Antonio MA, Kohn LK, et al. Anti-ulcerogenic activities of a crude hydroalcoholic extract and coumarin isolated from Mikania laevigata Schulz Bip. Phytomedicine 2005; 12: 72-77.
3. Miller JP, Faragher EB. Relapse of duodenal ulcer: does it matter which drug is used in initial treatment. Br Med J 1986; 293: 1117-8
4. Aryphisi A, Tashiharu F, Sugimura M, et al. Recurrence during maintenance therapy with histamine H2 receptors antagonists in cases of gastric ulcer. Nihon University Journal Medical 1986; 28: 69-74.
5. Lewis DA, Hanson PJ. Anti-ulcer drugs from plant origin. Prog Med Chem 1991: 28: 201-231.
6. Borelli F, Izzo AA. The plant kingdom as a source of anti-ulcer remedies. Phythotheraphy Res 2000; 14: 581-591.
7. Gracioso JS, Hiruma-Lima CA, Souza-brito ARM. Anti-ulcerogenic effect of hydroalcoholic extract and its organic fractions of Neurolaena labata (L.) R.Br Phytomed 2002; 9: 523-529
8. Ong HC. Beluntas. In Tumbuhan liar: khasiat ubatan & kegunaan lain. Utusan Publications & Distributors Sdn. Bhd, Kuala Lumpur. 54-55. 2004
9. Peungvicha P, Temsiririrkul R, Prasain JK, et al. Hypoglycemic effect of Pluchea indica Less. Root in normal and diabetic rats. Thai J Phytopharm 1999; 6(2): 18-22
10. Pramanik KC, Bhattacharya P, Biswas R, et al. TK. Hypoglycemic and antihyperglycemic activity of leaf extract of Pluchea indica Less. Orient.Pharm. Exp. Med. 2006; 6(3):232-236
11. Pramanik KC, Biswas R, Mitra A, et al. Tissue culture of the plant Pluchea indica (L.) Less. and evaluation of diuretic potential of its leaves. Orient. Pharm. Exp. Med. 2006; 7(2),
12. Kirtikar KR, Basu BD. Indian Medicinal Plants, 2nd edition. International Book Distributors, Dehadrun, India.1344-45. 1999
13. Sen T, Nag Chaudhuri AK. Antiinflammatory evaluation of a Pluchea indica root extract. J.Ethnopharmacol. 1991; 33(1-2): 135-141
14. Sen T, Basu A, Ray RN, et al. Hepatoprotective effects of Pluchea indica (less) extract in experimental acute liver damage in rodents. Phytotherapy Res. 1992; 7(5): 352-355.
15. Sen T. Studies on the mechanism of anti-inflammatory and anti-ulcer activity of Pluchea indica - probable involvement of 5-lipooxygenase pathway. Life Sci. 1993; 52 (8):737-743
16. Alam MI, Auddy B, Gomes A. Viper venom neutralization by Indian medicinal plant (Hemidesmus indicus and Pluchea indica) root extracts. Phytotherapy Res. 1995; 10(1): 58-61.
17. Sen T, Dhara AK, Bhattacharjee S, et al. Antioxidant activity of the methanol fraction of Pluchea indica root extract. Phytotherapy Res. 2000; 16(4): 331-335.
18. Biswas R. Dasgupta A, Mitra A, et al. Isolation, purification and characterization of four pure compounds from the root extract of Pluchea indica (L) Less and the potentiality of the root extract and the pure compounds for antimicrobial activity. European Bulletin of Drug Research 2005; 13: 63-70.
19. Uchiyama T, Miyase T, Ueno A, et al. Terpenic glycosides from Pluchea indica. Phytochemistry 1989.; 28:3369-3372.
20. Uchiyama T, Miyase T, Ueno A, et al. Terpene and lignan glycosides from Pluchea indica. Phytochemistry 1991; 30(2): 655-657.
21. Chakravarty AK, Mukhopadhyay S. New thiopene derivatives from Pluchea indica. Indian J. Chem. 1994 33B; 978-980.
22. Mukhopadhyay S, Cordell GA, Ruangrungsi N, et al. Traditional Medicinal Plants of Thailand. IV. 3-(2', 3'-Diacetoxy-2'-methyl butyryl)-cuauhtehmone from Pluchea indica. J. Nat.Prod. 1983; 46: 671-674
23. Robert A, Nezamis JE, Lancaster C. Cytoprotection in rats: Prevention of gastric necrosis produced by alcohol, HCl, NaOH, hypertonic NaCl and thermal injury. Gastroenterology 1977; 77: 433-43..
24. Hayden LJ, Thomas G, West GB. Inhibitors of gastric lesions in the rats. J Pharm Pharmacol 1978; 30: 244-6.
25. Shay H, Komarow SA, Fels SS, et al. A simple method for uniform production of gastric ulcer in rats. Gatroenterol 1945; 5: 43.
26. Corne SJ, Morrisey SM, Woods RJ. A method for the quantitative estimation of gastric barrier mucus. J. Physiol 1974; 242: 116-7.
27. Al-Bekairi AM, Qureshi S, Ahmed MM, et al. A study of uric acid pretreatment for the protection of rat gastric mucosa against toxic damage. Food Chem Toxiicol 1992; 30: 525-531
28. Halliwell B. Introduction to free radicals in human disease. Saudi Med J 1991; 12: 13-19
29. Szabo S. Sulhydryl compounds may mediate gastric cytoprotection. Science 1981; 214: 201-2.
30. Hua XY, Dahlen SE, Lundberg JM, et al. Leukotrienes C4, D4. E4 cause widespread and extensive plasma extravasation in

the guinea pig. Nauyn-Schmied Arch Pharmacol 1985; 330: 136-42.
31. Fitzpatrick FA, Wynalda MA. In vivo suppression of prostaglandin biosynthesis by non-steroidal anti-inflammatory agents. Prostaglandins 1976; 12: 1037-51.
32. Singh S, Khajuria A, Taneja S, et al. The gastric ulcer protective effect of boswellic acids, a leukotriene inhibitor from Boswellia serrata, in rats. Phytomed 2008; 15: 408-15.
33. Ito S, Lacy ER. Morphology of rat gastric mucosal damage, defense and restitution in the presence of luminal ethanol. Gastroenterol 1985; 88: 250-60.
34. Taha AS, Sturrock RD, Russel RI. Mucosal erosion in long term non-steroidal anti-inflammatory drug users: predisposition to ulceration and relation to Helicobacter pylori. Gut 1995; 36: 334-6.
35. Konturek SJ, Ciezkowski M, Kwicien N, et al. Effect of omeprazole on gastrointestinal secretion, serum gastrin and gastric mucosal blood flow in dogs. Gastroenterol 1984;
36. Kiuchi F. Inhibitors of prostaglandin in biosynthesis from Ginger (Zingiber officinale). Chem Pharmaceu Bull 1982; 31(2): 298-302.
37. Glick D, Von Redlich D, Levine S, et al. Effect of adrenaline stimulation on histamine in the rat stomach. Gastroenterol 1966; 51: 18-23.
38. Goel RK, Bhattarcharya SK. Gastroduodenal mucosal defense and mucosal protective agent. Indian J Exp Biol 1991; 29: 701-714.
39. Andarwulan N, Batari R, Sandrasari DA, et al. Flavonoid content and antioxidant activity of vegetables from Indonesia. Food Chem 2010; 121: 1231-5.
40. Ohtsuki T, Yokosawa E, Koyano T, et al. Qunic acid esters from Pluchea indica with collagenase, MMP-2 and MMP-9 inhibitory activities. Phytother Res 2008; 22: 264-266.
Parmar N, Shikha P. Anti-ulcer effect of Nigella sativa linn aganist gastric ulcer in ats. Ind J Physiol Pharmacol 1998; 48: 343-351.

Treatment	Ulcerogens	Total area lesion (mm^2)	Inhibition (%)
Control vehicle (1% CMC)	Indomethacin	26.00± 6.28	-
Ranitidine 100 mg/kg		9.50± 5.74*	63.46
PIL 40 mg/kg		11.00 ± 6.81*	57.69
PIL 160 mg/kg		14.00 ± 2.52	46.15
Control vehicle (1% CMC)	EtOH	638.50± 141.44	-
PIL 40 mg/kg		529.17 ± 168.13	17.12
PIL 160 mg/kg		570.00 ±150 .03	10.73
Control vehicle (1% CMC)	NaCl	758.33± 185.93	-
PIL 40 mg/kg		682.33 ± 178.96	10.02
PIL 160 mg/kg		698.33 ± 157.27	7.91
Control vehicle (1% CMC)	NaOH	2404.16 ± 348.04	-
PIL 40 mg/kg		310.33 ± 49.42**	87.09
PIL 160 mg/kg		410.66 ± 199.72**	82.92
Control vehicle (1% CMC)	HCl	798.17 ± 75.15	-
PIL 40 mg/kg		523.00 ± 152.61	34.47
PIL 160 mg/kg		600.67± 106.34	24.7

Table 1: Effects of PIL extract against lesions induced by various ulcerogens in rats

*P< 0.05;
** P< 0.01 vs control group. Six animals were used in each group (n=6)

Treatment	Dose (mg/kg)	Gastric-wall mucus (µg Alcina blue / g wet stomach
Control 1% CMC	-	47.173 ± 5.952
PIL extract	40	70.051 ± 4.712*
PIL extract	160	53.073 ± 3.009

Table 2 : Effects of PIL on gastric wall mucus content in rats

*P<0.05 vs control group. (n=6)

Treatment (1ml/rat)	Ulcerogens	Edema	Congestion	Hemorrhage	Necrosis
Control 1% CMC	Indomethacin	1.50± 0.22	1.17± 0.31	0.00± 0.00	0.00± 0.00
Ranitidine 100 mg/kg		0.50± 0.26	0.00± 0.00	0.00± 0.00	0.00± 0.00
PIL 40 mg/kg		0.67± 0.21	0.33± 0.21*	0.00± 0.00	0.00± 0.00
PIL 160 mg/kg		1.00± 0.00	0.50± 0.22*	0.00± 0.00	0.00± 0.00
Control 1% CMC	EtOH	1.67± 0.21	1.83± 0.40	2.00± 0.37	1.17± 0.17
PIL 40 mg/kg		1.00± 0.00	1.17± 0.17	1.33± 0.33	0.17± 0.17*
PIL 160 mg/kg		1.17± 0.17	1.67± 0.21	1.67± 0.33	0.67± 0.21
Control 1 CMC	NaCl	1.50± 0.22	1.50± 0.22	2.67± 0.42	1.00± 0.37
PIL 40 mg/kg		1.00± 0.00	1.00± 0.00*	1.83± 0.40	0.67± 0.33
PIL 160 mg/kg		1.50± 0.34	1.25± 0.12	2.17± 0.31	0.83± 0.31
Control 1% CMC	NaOH	2.33± 0.21	2.17± 0.16	4.00± 0.00	4.00± 0.00
PIL 40 mg/kg		1.33± 0.42	1.45± 0.34	2.17± 0.47*	2.33± 0.33*
PIL 160 mg/kg		1.33 ±0.42	1.17 ±0.4*	1.33 ±0.42*	1.67 ±0.42*
Control 1% CMC	HCl	1.33± 0.21	1.33± 0.21	1.17± 0.16	1.33± 0.21
PIL 40 mg/kg		1.00± 0.00	1.00± 0.00	0.00± 0.00*	0.55± 0.22
PIL 160 mg/kg		0.83± 0.16	0.83± 0.16	0.00± 0.31*	0.00± 0.00*

Table 3: Effect of PIL extract on theculcerogen-induced histopathological lesions in gastric tissues of rats

Key: 0, normal; 1, little effect; 2, appreciable effect; 3, severe effect; 4, intensively severe effect.
*P<0.05 vs control group; (n=6)