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SHORT COMMUNICATION

Study of Ulcer Protective Effect of *Ipomea batatas* (L.) Dietary Tuberous Roots (Sweet Potato)

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ABSTRACT

Peptic ulcer is one of the most prevalent gastrointestinal disorder, commonly occurs in developed countries. The present work was carried out to evaluate antiulcer effect of *Ipomoea batatas* (L) dietary tuberous roots. The Ethanolic extract of *Ipomoea batatas* (EEIB) was prepared by dynamic maceration for 7 days at room temperature using 70% ethanol (V/V). The antiulcer activity was evaluated by the Pylorus Ligation (PL) and cold restraint stress (CRS) Induced Ulcer models. Male Wister rats were divided into four groups of 3 animals each for both models and received Normal saline10ml/kg, Famotidine 20 mg/kg, EEIB at 250 & 500 mg/kg respectively. After 1 h of Standard and test treatments pyloric ligation was performed and gastric pH, total acidity, free acidity, total protein, pepsin, ulcer score and ulcer index were determined. In CRS model, drugs were administered orally 30 min prior to subjecting the animals to cold stress (2°C for 3 hours), then ulcer score and ulcer index were determined. Results were mean ± SEM (n=3) and analysed using one way ANOVA followed by Dunnett test. $p < 0.05$ was considered significant when compared with the toxicant groups. In PL model EEIB significantly ($p < 0.01$) reduced the ulcer index by 55.24% and 61.45% at 250 & 500 mg/kg doses respectively. In CRS model, both the doses of EEIB significantly ($p < 0.01$) reduced ulcer index by 51.35% (250 mg/kg) and 75.68% (500 mg/kg). The *Ipomoea batatas* roots possess anti ulcer activity as evidenced by its significant inhibitory effects on PL and CRS induced ulcers.

Keywords: *Anti ulcer, Ipomoea batatas, Pylorus Ligation, Cold restraint stress, Sweet Potato*

Peptic ulcer is one of the most prevalent gastrointestinal disorder, commonly occurs in developed countries. There has been rapid progress in the understanding of pathogenesis of peptic ulcer and the drug therapy have been made possible largely by the availability of proton pump inhibitors, histamine receptor blockers and prostaglandin analogues. However, the clinical evaluation of these drugs showed development of tolerance and incidence of relapses and side effects that makes their efficacy arguable [1]. This has been rationale for the development of the new antiulcer drugs, which includes herbal drugs.

In traditional medicine, the plants and herbs are used to treat different gastrointestinal illnesses, including peptic ulcers without side effects since prehistoric times [2]. *Ipomoea batatas* (Sweet potato) were cultivated mainly for the tuber, used as vegetable, eaten boiled, baked fried or dried and ground into flour to make biscuits, bread and other pastries [3]. The leaf decoction is used as folk remedies for tumors in the mouth and throat. This is a folk remedy for asthma, bug bites, burns, catarrh, ciguatera, convalescence, diarrhea, dyslactea, fever, nausea, renosis, splenosis, stomach distress, whitlows, burning sensations, constipation, general weakness, renal calculi, and sexual stimulant [4]. The present work was carried out to evaluate antiulcer activity of Ethanolic extracts of *Ipomoea batatas* (L) dietary tuberous roots using various animal models to substantiate the traditional claims of that and its beneficial use in gastric ulcer treatment.

Table 1. Effect of *I.batatas* on pylorus ligation–induced ulcers in rats

Drug & Dose	pH	Ulcer scores	Ulcer Index (% control)	Gastric Volume	Total Acidity (mEq/L/100g)	Free acidity (mEq/L/100g)	Pepsin (µg/ml)	Total Protein (µg/ml)
Control	2.55±0.18	2.0±0.58	0.467±0.02	5.53±0.18	78.0±5.50	40.0±4.04	13.44±0.29	531.41±1.12
Famotidine (20 mg/kg)	5.02±0.13*	0.0*	0.032±0.00*(93.14%)	2.53±0.20*	35.0±1.73*	18.67±1.20*	6.18±0.22*	293.54±2.56*
EEIB (250 mg/kg)	3.77±0.32*	1.0±0.58*	0.209±0.00*(55.24%)	3.57±0.12*	58.0±0.58*	25.0±1.16*	8.92±0.38*	219.92±0.3*
EEIB (500 mg/kg)	4.94±0.08*	0.33±0.34*	0.180±0.00*(61.45%)	2.97±0.29*	43.0±1.53*	21.33±1.20*	7.31±0.21*	256.1±1.73*

Values are mean ± SEM, n = 3 in each group, *p< 0.01 when compared with toxicant control group (one-way ANOVA followed by Dunnett's test)

MATERIALS AND METHODS

Extraction of Tuberous root

The *Ipomoea batatas* (L) tuberous roots were collected from Central Market, Madurai. The plant was identified and authenticated by Dr. Baburaj, Thyagarajar College, Madurai. The roots were dried under shade for 15 days and were powdered. About 20 g of powder was mixed into 100 mL of ethanol 70% (V/V) and submitted to dynamic maceration for 7 days at room temperature. Then, the extract was filtered and concentrated under reduced pressure of 300-500 mmHg at 50-60°C [5]. The obtained semi-solid residue (6.5% w/w) was brown in colour, henceforth called Ethanolic extract of *Ipomoea batatas* (EEIB). The EEIB was subjected to qualitative test for the identification of various plant constituents [6].

Animals

Male rats of Wister strain weighing between 150-200 g were used. They were housed in standard cages at room temperature (25 ± 2°C) and relative humidity 45-55% at 12h light and dark cycle. The animals were fed with commercial pellet diet and water *ad libitum*. The study was conducted after obtaining approval of IAEC, Ultra college of Pharmacy, Madurai (UCP/IAEC/2011/059).

Pylorus ligation-induced ulcers

The overnight fasted rats were divided into four groups of 3 animals each. Group I (Ulcer control) received normal saline (10 ml/kg), Group II (standard treatment) received Famotidine (20 mg/kg), Group III and IV received EEIB 250 & 500 mg/kg respectively. After 1 h of standard and test treatments, pyloric ligation was performed as described by Shay *et al.* [7]. After 4 h of pyloric ligation, all animals were sacrificed using pentobarbitone. The abdomen was opened and oesophageal end of the stomach was tied. Then, entire stomach was removed and a small cut was made to pyloric region just above the knot [7]. The content of the stomach (gastric juice) were collected and used for estimation of free acidity, total acidity [8], pepsin content [9] and total proteins [10]. The stomach was opened along the greater curvature and washed slowly under the running tap water. The stomachs were observed under 10 × magnifications for ulcers [11]. The ulcer score and ulcer index were also determined [12,13].

Cold restraint stress-induced ulcers

Ulcer was induced by subjecting the animals to cold restraint stress (CRS). Male Wister rats were divided into four groups of 3 animals each as like PL model. Treatment drugs were administered orally 30 min prior to subjecting the animals to cold stress. The animals were placed in a restraint cage at a temperature of 2°C for 3 hours [14,15]. The animals were sacrificed after three hours; the stomach was opened along the greater curvature and washed slowly under the running tap water. The ulcer score and ulcer index were determined [12,13].

Statistical analysis

The results were expressed as a mean ± SEM of 3 animals in each group. The results were analysed statistically using one way ANOVA followed by Dunnett test. The p value < 0.05 was considered significant when compared with toxicant groups.

RESULTS

The preliminary phytochemical investigation of EEIB showed that it contains carbohydrates, glycosides, phenolic compounds, phytosterols, proteins, flavonoids and triterpenes. In the pylorus ligation–induced ulcer model, the *Ipomoea batatas* showed a significant (p < 0.01) reduction of ulcer index when compared with toxicant group (Table 1). The EEIB reduced ulcer index by 55.24% and 61.45% at 250 & 500 mg/kg doses respectively; the gastric volumes were also reduced significantly (p < 0.01). The EEIB significantly reduced (p < 0.01) the free acidity, total acidity, pepsin content, total proteins and significantly increased (p < 0.01) gastric pH of treated animals at both dose levels. In cold restraint stress model, both doses of *Ipomoea batatas* (250 & 500 mg/kg) significantly (p < 0.01) reduced ulcer index by 51.35% and 75.68% at 250 mg/kg & 500 mg/kg respectively when compared with ulcer control group (Table 2).

Table 2. Effect of *I.batatas* on cold restraint stress-induced ulcers

Drug & Dose	Ulcer scores	Ulcer Index	% Inhibition
Control	1.33 ±0.33	0.37±0.025	-
Famotidine (20 mg/kg)	0.0*	0.07±0.003**	81.08%
EEIB (250 mg/kg)	0.33±0.32*	0.18±0.016**	51.35%
EEIB (500 mg/kg)	0.0*	0.09±0.008**	75.68%

Values are mean±SEM, n = 3 in each group, *p< 0.05; **p<0.01 when compared with toxicant control group (one-way ANOVA followed by Dunnett's test)

DISCUSSION

Ipomoea batatas (EEIB), an herbal plant, is mentioned in Indian system of medicine (Ayurveda) for its remedial properties. The anti-ulcer activity of EEIB was evaluated by the Pylorus Ligation- and cold restraint stress (CRS)-Induced ulcers in rat models. The pylorus ligation-induced ulcer was used to study the effect on gastric secretion. The ligation of the pyloric end of the stomach causes accumulation of gastric acid in the stomach that produces ulcers. Agents that reduce secretion of gastric aggressive factors such as acid and pepsin (anti-secretory) and/or increase secretion of mucin (cyto-protective) are effective in reducing development of gastric ulcers in this mode [11,16]. Ulcer index is a visualized indicator used to reflect the gastric ulcer model injury or to evaluate the extent of ulcer, which is commonly used in the anti-ulcer study of pharmacodynamics [17]. The data of present study shows variable inhibitory effects of EEIB on free acidity, total acidity, gastric volume, peptic activity, ulcer score, ulcer index, total protein and an increase in the *p*H of gastric contents. These observations suggest the EEIB possibly has an antacid-like action. The agents that decrease gastric acid secretion and increase mucus secretion are effective in protecting the ulcers-induced by this method. Stress plays an important role in ulcerogenesis. The pathophysiology of stress-induced gastric ulcers is complex. Stress-induced gastric ulcers are probably mediated by histamine release with enhancement in acid secretion and reduction in mucus production [16,18]. In stress condition, there is an increase in gastrointestinal motility (GI), which causes folds in the gastrointestinal tract that comes in contact with acid secretion leading to induction of gastric ulcers. The lesions produced by these methods are located in the glandular region of the stomach [19]. The results suggest that some of the constituents present in the EEIB may have central actions, which are helpful in reducing the gastric ulcers. The reduction may be also due to local effect on gastric motility or gastric secretion. It is concluded that the ethanolic extract of *Ipomoea batatas* possess anti ulcer activity as evidenced by its significant inhibition against formation of ulcers induced by pylorus ligation and cold Restraint stress. Further investigation is required for the clear understanding of mechanism of action with chemically-identified active components.

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