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Research Article

Evaluation of Antiulcer Potential of *Bougainvillea spectabilis* Extracts on Cysteamine Hydrochloride-Induced Duodenal Ulceration in Rats

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ABSTRACT

Bougainvillea spectabilis has long been utilized for its diverse range of medicinal characteristics, including antibacterial, antiviral, hepato-protective, anti-inflammatory, antifungal, anti-diabetic, antioxidant, antifertility, antiulcer, anticancer and antiviral effects. The objective of this research was to find out how *B. spectabilis* (both ethanolic and aqueous extract) affected the development of duodenal ulcers. The investigation was conducted on a model of duodenal ulceration utilizing the chemical cysteamine hydrochloride, which has the potential to induce ulcers in conjunction with ranitidine, a conventional medicine. Then, a treatment group consisting of the plant's ethanolic and aqueous extract was compared to the chemical that causes duodenal ulcers. The ethanolic extract derived from the *B. spectabilis* plant demonstrated a strong ability to treat duodenal ulcers produced by the chemical cysteamine hydrochloride. The ethanolic extract effectively protected the duodenum and stomach regions from chemical-induced damage, as demonstrated by its superior performance compared to the conventional treatment. Both stomach as well as duodenal ulcer healing and protection against experimentally induced duodenal ulcers in rats were improved by the plant *B. spectabilis*.

Introduction

Peptic ulcer disease is a gastrointestinal illness characterized by ulcers that primarily occur in the duodenum and stomach. The morbidity rate is significantly elevated, particularly in nations with greater poverty. The duodenal ulcer is the predominant kind of peptic ulcer. Common medications used to treat this illness include antacids, proton pump inhibitors (PPIs), cytoprotective drugs, and muscarinic receptor antagonists. Several drugs fail to meet all the necessary criteria and frequently lead to adverse effects such as headache, dizziness, disturbances in male hormones, arrhythmia, and potentially interfere with drug metabolism, despite the existence of numerous treatment choices for ulcers. Thus, it is critical to keep looking for medicinal herbs that could be useful for preventing and treating stomach ulcers. [1]

The native South American plant, *Bougainvillea*, was brought to Brazil in the early 1700s. The genus was introduced to the rest of the globe by the French Navy admiral Louis Antoine de Bougainville (1729–1811), and it swiftly expanded to tropical and warm climates. [2] *Bougainvillea spectabilis*, a plant native to Brazil, is commonly utilized. This plant is classified in the family Nyctaginaceae and belongs to the genus Nyctaginaceae. The plant's remarkable capacity to thrive in various agroclimatic settings around the world has made it a preferred choice for horticulture, pharmaceuticals, agriculture, and environmental sectors in dry landscapes. There are approximately eighteen species believed to exist. The leaves of this *Bougainvillea* plant are covered in dense, hairy tufts and have a deeper hue compared to

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other *Bougainvillea* varieties. During the summer season, this plant produces vibrant red or purple bracts.

Findings from the literature review on *B. spectabilis* 's traditional usage are antibacterial,[3-5] anticancer,[6] antidiabetic,[7-9] antifertility,[10-11] antifungal,[12] analgesic & antiinflammatory,[13-14] antihyperlipidemic,[15-16] antioxidant,[17-19] antiulcer,[20] antiviral,[21] hepatoprotective,[22] and thrombolytic activities.[23]

As far as we know, the potential of *B. spectabilis* to treat ulcers in the duodenum has not been investigated. The herb's antiulcer capabilities have been specifically identified in the stomach region.[20] Due to the presence of flavonoids, which have antioxidant and antiulcer characteristics, our objective for this study was to determine whether or not ethanolic and water-based *B. spectabilis* leaf extracts could alleviate duodenal ulcers.

Material And Method

Process of Collecting and Authenticating Plant Samples

From February to march, the foliage of *B. spectabilis* was collected from the neighboring areas of M.P. Professor Mahajan, a retired botany professor at PG Government College Khargone, has authenticated the herbarium specimen of the plant, which is currently housed in the department of Pharmacognosy, Khargone.

Processing of Plant Material

Following thorough cleaning to eliminate any dirt, debris, or crystals adhering to the leaves, the recently collected foliage underwent shade-drying prior to being mechanically crushed. The fine powder was obtained after passing it through a sieve.

Chemicals and Reagents

The investigation utilized analytical grade chemicals supplied from Merck Specialties Private Limited in Mumbai, India. Sigma Aldrich Pvt. Ltd.'s Bangalore branch supplied the cysteamine hydrochloride.

Collecting the Plant Materials for Extraction

The dried and coarsely chopped leaves weighing 200 g were subjected to continuous hot percolation for a duration of 18 to 24 hours. Petroleum ether, chloroform, ethanol, and water were used in a soxhlet extractor to carry out the extraction process. The extracts unique to each solvent were subsequently weighed following the evaporation of the concentrated extracts.

Animals

The weight of the male Wistar albino rats was 140 to 200 gm. Animals were kept in standard circumstances for 15 days before the experiment, as required by rules. The CPCSEA members approved the experimental protocol during a meeting held at the Institute. Each rat was maintained at a consistent temperature of 22 ± 2°C in separate metabolic cages. The Institute ensures that the state of the animal home is approved by the CPCSEA (Registration No. 115l/PO/Re/S/08/CPCSEA).

Acute Oral Toxicity Study[24]

For this experiment, we followed the protocols outlined in OECD No. 425 and used mature Swiss albino mice ranging in weight from 20 to 25 gm. We administered five different doses of the aqueous and ethanolic extract, ranging from 500 to 2500 mg/kg body weight, to ten mice in each dose group for the acute toxicity test. Researchers closely observed the mice's behavior throughout the study using instruments such as the rota rod and actophotometer. They looked for any abnormalities or toxic manifestations, including excretion, pupil dilation, sedation, hypothermia, convulsions, hyperactivity, changes in skin or fur, and a decrease in spontaneous activity. Subsequently, the animals were monitored daily for a duration of seven days at consistent time intervals.

Experimental Design

Cysteamine hydrochloride-induced duodenal ulcers[1]

There were four separate groups of male Wistar albino rats, with each group consisting of six animals (n = 6), after a 36-hour period of fasting. The administration of cysteamine hydrochloride through orally at a dosage of 450 mg/kg led to the formation of duodenal ulcers in all groups receiving the treatment. Group I was assigned as the control and received an oral dose of cysteamine hydrochloride concentration of 450 mg/kg. Group II was assigned as the standard group and received a dosage of ranitidine at a rate of 20 mg /kg. Groups III & IV received oral administration of *B. spectabilis* extracts, i.e., aqueous as well as ethanolic, at a dose of 200 mg/kg. The stomach and duodenum were painstakingly removed from the animals after 48 hours of methodical sacrifice. The stomach and duodenum slices, which were preserved in a 10% aqueous buffered formaldehyde solution, were stained for histological evaluation. The number of ulcers was determined using this formula.

$$\text{Ulcer Index} = \text{ulcer score} + \text{Ulcer number} + \text{ulcer area} \times 10^{-1}$$

The following scores were assigned to the ulcers according to their severity:

0 = no ulcer, 1 = Erosions on the surface of the mucosa, 2 = chronic wound often accompanied by bleeding through the skin, and 3 = ulcer with a perforation or penetration.

Statistical Analysis

Mean ± SEM was used to express the results of all the estimations. After determining the statistical significance of the data using analysis of variance (one-way ANOVA), the Kruskal-Wallis test was utilized to compare data

between groups. Groups treated experimentally with either aqueous or ethanolic extracts were compared to both the control and standard groups.

Results

Any of the experimental drug groups reported no serious or fatal side effects and were administered doses between 500 and 1500 mg/kg. Aqueous and ethanolic extracts were seen to influence the behavior of selected mice at a dosage of 2000 mg/kg. Because of this, in order to conduct additional screens, we utilized a dosage of 200 mg/kg of ethanolic and aqueous extract.

Both the control and standard drugs ranitidine and the plant extract *B. spectabilis* significantly reduced the ulcer area, ulcer index, and ulcer score. The plant's ethanolic extract, administered at a dose of 200 mg/kg, exhibited a more pronounced effect on the size of the ulcer area, measuring 29.36 mm^2, and the severity of the ulcer, measuring 0.77, compared to the aqueous extract administered at the same dosage, which resulted in an ulcerated area of 47.57 mm^2 and an ulcer scoring of 1.94. (Table 1 and Fig. 1) When compared to both the standard treatment and other plant extracts, the ethanolic extract of the plant at a dosage of 200 mg/kg produced good results in terms of ulcer number and ulcer index. At a dosage of 200 mg/kg, the ethanolic extract of the plant demonstrated a protective effect and reduced gastrointestinal area injury compared to the control and standard groups. The histology results from the study indicated that both the control group and the group treated with aqueous solution had hemorrhagic ulcer areas, tissue erosion on the surfaces of the stomach and duodenum, congestion, and bleeding of the connective tissue (Figs 2 & 5). Hemorrhagic and erosion parts were partially restored in both the conventional and ethanolic groups. (Figs 3 & 4) In the gross anatomy examination, it was observed that the ethanolic and control groups had a greater number of red hemorrhagic strips compared to the standard and ethanolic groups, which had a lower number of red coloring strips. (Fig. 6)

Discussion

B. spectabilis had a substantial impact on the healing of stomach ulcers produced by cysteamine hydrochloride and duodenal ulcers. Rats' duodenal ulcers produced by cysteamine hydrochloride had histological and

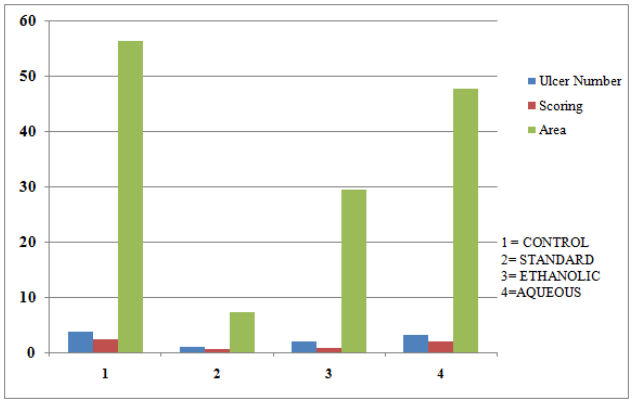

Fig. 1: Histogram of *B. spectabilis* treated groups in duodenal ulcer model

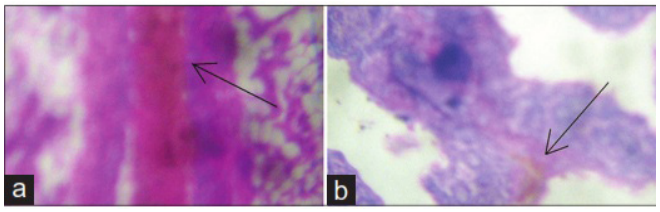

Fig. 2: (a) Duodenum of control group rats, (b) Stomach of control group rats

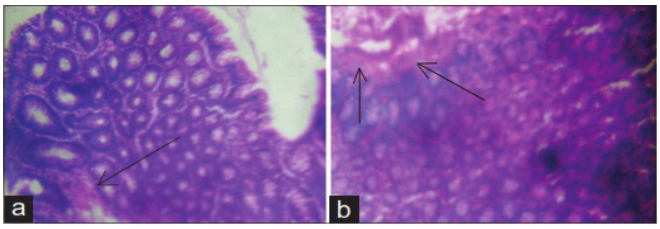

Fig. 3: (a) Duodenum of standard group rats, (b) Stomach of standard group rats

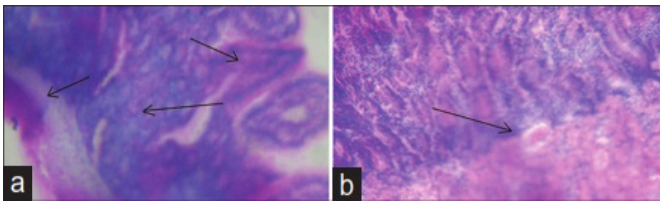

Fig. 4: (a) Duodenum of ethanolic group rats, (b) Stomach of ethanolic group rats

Table 1: Morphological index of *B. spectabilis* treated in duodenal ulcer

Group	*Treatment*	*No. of animals*	*Ulcer number*	*Ulcer scoring*	*Area (mm^2)*	*Ulcer index*
01	Control	6	3.70 ± 0.78	2.30 ± 0.30	56.36 ± 6.52	3
02	Standard	6	0.98 ± 0.32*	0.5 ± 0.12**	7.33 ± 1.43**	0
03	Ethanolic (200 mg/kg)	6	2.03 ± 0.40	0.77 ± 0.15*	29.36 ± 3.11*	1
04	Aqueous (200 mg/kg)	6	3.22 ± 0.27	1.94 ± 0.22	47.57 ± 5.06	3

*p <0.05, **p <0.01, ***p <0.001

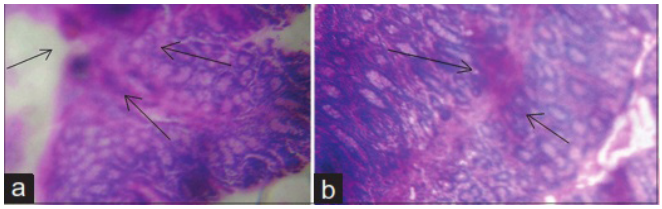

Fig. 5: (a) Duodenum of aqueous group rats, (b) Stomach of aqueous group rats

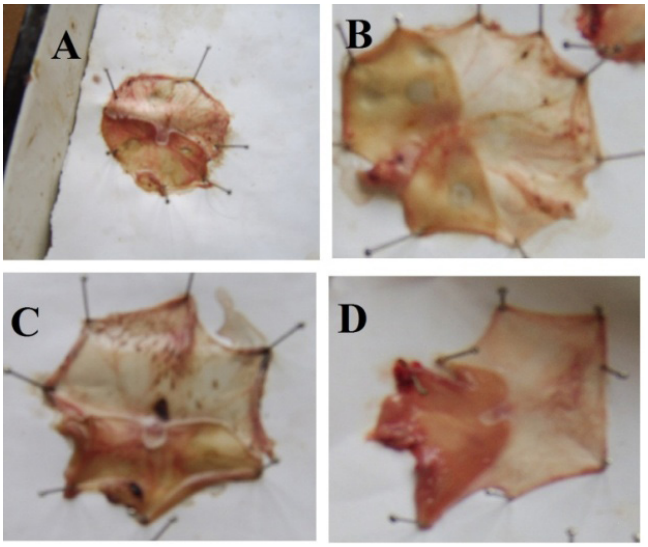

Fig. 6: (A) Stomach surface of control group, (B) Stomach surface of Standard group, (C) Stomach surface of ethanolic group, (D) Stomach surface of aqueous group

pathophysiological similarities to human duodenal ulcers. Brunner's glands in the proximal duodenum produce alkaline mucus; however, cysteamine hydrochloride inhibits its secretion while increasing the formation of stomach acid. The serum gastrin concentration increases in parallel with the delayed emptying of the stomach. The plant extracts of *B. spectabilis*, specifically the ethanolic extract, exhibited a substantial reduction in the ulcer index, ulcer score, and ulcer area. Based on the findings of the current investigation, individuals with peptic ulcers may experience advantages from ingesting an ethanolic extract derived from the *B. spectabilis* plant. The herb exhibits both anti-secretory and cytoprotective properties in the stomach, hence facilitating the healing process of duodenal and stomach ulcers.

Research has shown that the plant has antibacterial and antifungal qualities, as well as the ability to suppress the growth of *Helicobacter pylori*.[3-5, 12] This could potentially contribute to the healing of duodenal and stomach ulcers. Currently, medication is considered the most effective treatment for ulcers, particularly duodenal ulcers, as no other treatment has been found to be effective. However, the cost is prohibitive for the average individual. Therefore, natural medicines are considered the optimal solution at this juncture. Extracts derived from *B. spectabilis* exhibit a notable ability to hinder the agents responsible for ulcers and facilitate the process of healing. This may be because, in comparison to the aqueous extract, the ethanolic *B. spectabilis* extract contains more flavonoids and saponins, giving it a distinct advantage.[25] The existing research, however, fails to elucidate the specific constituents or mechanisms by which the *B. spectabilis* plant reduces the progression of duodenal ulcers. Research on gross anatomy and histology has demonstrated, to a certain degree, the efficacy of both the standard and ethanolic extracts in restoring the structure of the stomach and duodenum.

Conclusion

Based on the findings of our investigation, we concluded that the plant *B. spectabilis*' ethanolic extract may protect rats from developing duodenal ulcers brought on by cysteamine hydrochloride. However, additional studies are required to identify its active components and the specific mechanism by which it alleviates ulcers.

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