

Therapeutic effect of *Momordica balsamina* leaf extract on ethanol-induced gastric ulcer in Wistar rats

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Background: *Momordica balsamina* (*M. balsamina*) is an important medicinal plant that is used as an antibiotic, an anti-inflammatory and in the treatment of wounds. Its therapeutic properties suggest its alternative use in the treatment of various ailments and illnesses.

Methods: Gastric ulceration was induced using 80% ethanol after a pilot study was done to identify which ulcer inducing agents would induce the most ulceration with minimal mortality in one hour. Thirty Wistar rats were divided into six groups of five rats each. Group 1 (control) was pretreated with normal saline, groups 2–5 were pretreated with 100, 200, 400, 800 mg/kg of *M. balsamina* extract, respectively, while group 6 was pretreated with 100 mg/kg ranitidine 1 h prior to administration of 80% ethanol. All the rats were sacrificed 1 h after the administration of 80% ethanol by cervical dislocation and the stomach were dissected, incised, washed and examined under dissecting microscope to assess the level of ulceration. Ulcerated and total areas of each stomach were measured in mm². The mean ulcer score, ulcer index and ulcer inhibition rate were calculated for each rat.

Results: There was a significant dose-dependent decrease in the mean ulcer score of rats pretreated with *M. balsamina* compared to that of controls at $P < 0.05$, suggesting that the extract would be most effective in the prevention/treatment of ulcer at 800 mg/kg. There was a dose-dependent decrease in the ulcer index and a dose-dependent increase in the ulcer inhibition rate of rats pretreated with *M. balsamina* compared to the control at $P < 0.05$, suggesting that the extract could be as effective as ranitidine in the prevention/treatment of ulcer in Wistar rats.

Conclusions: Aqueous extract of *M. balsamina* at 800 mg/kg could be subjected to further scientific research for use in the prevention/treatment of gastric ulcers in human beings since it was proven to be effective in Wistar rats.

Keywords: Ethanol; *Momordica balsamina* (*M. balsamina*); therapeutic; ulcer; ranitidine

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Introduction

There has been a global interest in the therapeutic potential of medicinal plants with the aim of developing an alternative safe, efficacious and affordable complement with little or no side effects, which could be either in the form of a drug,

food or nutritional supplements, in the treatment and management of various diseases (1). Although “Health for all” still remains a dream and goal which humanity at large shares and strives to attain, it is now evident that modern pharmaceuticals are and will remain out of reach for a

large proportion of the human population (especially rural dwellers and people from underdeveloped countries) for the foreseeable future (2). *Momordica balsamina* (*M. balsamina*) is a plant native to the tropical regions of Africa and is commonly known as balsam apple or bitter melon (3,4). *M. balsamina* is an important medicinal plant that is used as an anti-inflammatory/wound healing agent (5,6). The Kanuri-speaking people of Borno State, Nigeria, use the leaves of *M. balsamina* as an antibiotic and in the treatment of abdominal pain. Gastric ulcer is a common gastrointestinal disorder with increased incidence due to alcohol consumption, smoking, *Helicobacter pylori*, stress and non-steroidal anti-inflammatory drugs (NSAIDs) (7). It is the most common gastrointestinal disorder with a worldwide mortality of 15 out of every 15,000 complications (8). Ranitidine is a drug used in the treatment of gastric ulcer; although it has been found to be more potent than cimetidine on the basis of inhibition of gastric acid secretion (9), it induces methemoglobinemia and results in decreased white blood cell and neutrophil counts in Wistar rats (10). Therefore, the need to provide an efficient, cost-effective and accessible alternative with fewer side effects in the management of ulcers would be further enhanced by this study if the leaves of *M. balsamina* happen to be effective in the treatment/management and prevention of ulcers.

Methods

Plant material

M. balsamina leaves were collected from Lake Alau Dam, Borno State, and were identified in the Department of Biological Sciences, University of Maiduguri, Nigeria. The leaves were air dried at room temperature and grounded into fine powder using mortar and pestle. Then 25 g of the powder was soaked in 250 mL of distilled water at 90 °C for 15 min; it was then filtered with a filter paper and refrigerated (11).

Animal husbandry

Fifty Wistar rats weighing between 180–200 g were purchased from the Animal House, Department of Biochemistry, University of Maiduguri. The rats were fed with grower mash (Vital feed, Grand Cereal Jos, Nigeria) and water ad libitum. They were kept in the animal house Department of Biochemistry, University of Maiduguri, for two weeks to acclimatize prior to the start of the experiment. A pilot test was conducted to determine which

ulcer inducing agent will induce the most ulcerations and stomach lesions upon physical examination using hand lens after one hour of administration. Twenty Wistar rats were fasted overnight and randomly divided into four groups of five rats each. The groups received 200 mg/kg of aspirin, 100 mg/kg of indomethacin, 1 mL 50% ethanol and 1 mL 80% ethanol, respectively, orogastrically and were left in elevated cages for one hour, after which they were sacrificed by cervical dislocation. The stomachs were dissected, incised along the greater curvature and washed gently in running water. It was then placed under a hand lens glass and examined for severity of ulceration. It was observed that 80% ethanol caused the greatest damage to the gastric mucosa, resulting in marked ulceration. The remaining 30 rats were randomly divided into six groups of five rats each. They were kept in elevated cages so as to prevent ceprophagy while being sustained on 8% sucrose to prevent dehydration (12). Group 1 was pretreated with normal saline, groups 2–5 were pretreated with 100, 200, 400 and 800 mg/kg of aqueous extract of *M. balsamina*, while the rats in group 6 were pretreated with 100 mg/kg ranitidine (standard ulcer drug) (13) 1 h prior to administration of 1 mL of 80% ethanol. All the rats were sacrificed one hour after the administration of 1 mL 80% ethanol by cervical dislocation and the stomach were dissected, incised along the greater curvature and washed gently in running water and examined under a dissecting microscope to assess the level of ulcerations. For each stomach, ulcerated and total areas were measured as mm².

The ulcer index (UI) for each stomach was calculated using the following formula:

$$UI = \frac{\text{Ulcerated area}}{\text{Total stomach area}} \times 100$$

The ulcer inhibition rates (UIR) for each group were calculated as:

$$UIR(\%) = \frac{UI(\text{control} - \text{pretreated})}{UI(\text{control})} \times 100$$

The total stomach area was calculated as: stomach area (mm²) = πr^2 , where $\pi = 3.14$, $r = d/2$ and d is diameter of stomach (10,14-16).

Data were expressed as mean \pm standard error of mean (SEM), they were analyzed using InStat Statistics version 3.1 (Graphpad Software, Inc. La Jolla, CA, USA). One way analysis of variance (ANOVA) was used to compare the mean differences between and within groups and a P value <0.05 was considered statistically significant.

Results

The results showed a significant increase in the degree of ulceration in rats treated with 80% ethanol as compared to that of rats treated with 200 mg/kg aspirin, 100 mg/kg indomethacin and 50% ethanol at $P < 0.05$ (Figure 1). There was a significant decrease in the mean ulcer scores of the rats pretreated with *M. balsamina* at 100 mg/kg body weight (23.00 ± 4.55), 200 mg/kg body weight (15.50 ± 8.41), 400 mg/kg body weight (15.10 ± 4.31) and 800 mg/kg body weight (10.30 ± 4.19) as compared to that of the controls (35.13 ± 4.44) at $P < 0.05$ (Table 1). There was also a significant decrease in the mean ulcer score of rats pretreated with 100 mg/kg of ranitidine (9.63 ± 3.20) as compared to that of the controls at $P < 0.05$. There was a decrease in the ulcer index in rats pretreated with 100 mg/kg of ranitidine compared to that of the controls and also in rats treated with *M. balsamina* extract at 100 mg/kg (1.68), 200 mg/kg (1.13), 400 mg/kg (1.10) and 800 mg/kg (0.75) body weight

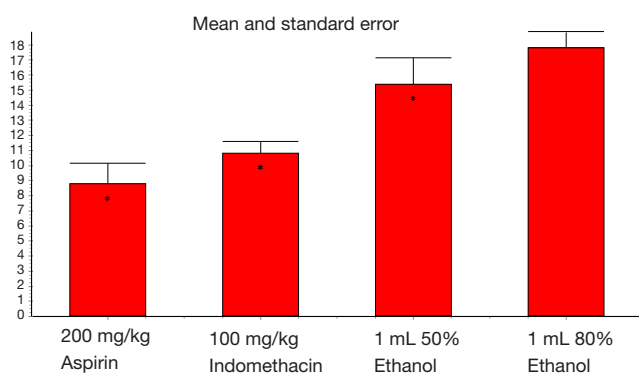


Figure 1 Degree of ulceration in the gastric mucosa of Wistar rats treated with 200 mg/kg aspirin, 100 mg/kg indomethacin, 1 mL 50% and 80% ethanol. *Indicates significant difference with 80% ethanol at $P < 0.05$.

compared to that of the controls (2.56) (Table 1). There was a dose-dependent increase in the percentage of the ulcer inhibition rate in rats pretreated with *M. balsamina* extract at 100 mg/kg (34.4%), 200 mg/kg (55.9%), 400 mg/kg (57.03%) and 800 mg/kg (70.7%) while the ulcer inhibition rate of rats pretreated with 100 mg/kg ranitidine was 72.66% (Table 1).

Discussion

The significant increase in the degree of ulceration in rats treated with 1 mL 80% ethanol compared to that of 200 mg/kg of aspirin, 100 mg/kg indomethacin and 50% ethanol showed that 80% ethanol induces severe ulceration in overnight fasted rats when compared to aspirin or indomethacin. Ethanol has been generally known to induce ulcer just like aspirin and indomethacin, which are known NSAIDs (7,8,17). In this study, it was observed that 80% ethanol results in a higher degree of ulceration than 200 mg/kg aspirin and 100 mg/kg indomethacin. The dose-dependent decrease in the mean ulcer score suggests that the aqueous extract of *M. balsamina* would be effective in the prevention/treatment of ulcers at 800 mg/kg, either through the inhibition of gastric acid secretion or through the control/inhibition of gastric bacterial activities that usually lead to severity of the gastric ulcer (4,18,19). The reported antibacterial and antimicrobial activities of *M. balsamina* and *M. charantia* show that *M. balsamina* might be used to prevent complications of gastric ulcer due to its antibacterial and antimicrobial properties. There was no significant difference between the mean ulcer score of rats pretreated with the extract at 800 mg/kg and those of rats pretreated with 100 mg/kg ranitidine, and this implies that 800 mg/kg of aqueous extract of *M. balsamina* could be used in place of ranitidine in the prevention/treatment

Table 1 Effect of aqueous extracts of *Momordica balsamina* on mean ulcer score, ulcer index and ulcer inhibition rate in the stomach of Wistar rats

Groups	Pretreatment dose	Post treatment dose	Mean ulcer score	Ulcer index	Ulcer inhibition rate (%)
1	Not pretreated	80% ethanol	35.13±4.44	2.56	–
2	MB (100 mg/kg)	80% ethanol	23.00±4.55*	1.68	34.40
3	MB (200 mg/kg)	80% ethanol	15.50±8.41*	1.13	55.90
4	MB (400 mg/kg)	80% ethanol	15.10±4.31*	1.10	57.03
5	MB (800 mg/kg)	80% ethanol	10.30±4.19*	0.75	70.70
6	Ranitidine (100 mg/kg)	80% ethanol	9.63±3.20*	0.70	72.66

Values expressed as mean ± SEM. *Showed significant difference with the control at $P < 0.05$. MB, *Momordica balsamina*; SEM, standard error of mean.

and control of gastric ulcers, since ranitidine use comes with side effects such as methemoglobinemia and decreased white blood cell and neutrophil counts (10). *M. balsamina* aqueous leaf extract will provide a cheap and readily accessible ulcer remedy with fewer side effects in the rural areas where *M. balsamina* is abundant. The dose-dependent decrease in the ulcer index and dose-dependent increase in the percentage of the ulcer inhibition rate of rats pretreated with *M. balsamina* extract suggest that the aqueous extract of *M. balsamina* at 800 mg/kg could be as effective as ranitidine (the standard drug for the prevention/treatment of ulcers) in the prevention/treatment of ulcers in Wistar rats. It is suggested that clinical trials should be conducted in humans with the view of inculcating *M. balsamina* aqueous extract in the treatment/prevention of gastric ulcers in humans.

Conclusions

Aqueous extract of *M. balsamina* at 800 mg/kg could be subjected to clinical trials for use in the prevention/treatment of gastric ulcers in humans and other mammals since its effect on the prevention of ulceration was comparable to that of ranitidine in Wistar rats. The mechanism of action of the extract could further be investigated with suggestions on the content of the extract that is responsible for the therapeutic effects.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The research was conducted in accordance with the University of Maiduguri Research and Ethical Committee Guide for the care and use of laboratory animals and it also conforms to the provisions in accordance with the Helsinki Declaration as revised in 2013, the operative procedures were supervised by a qualified Veterinarian.

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