Original Article

Gastroprotective Effect of Aqueous Extract of Unripe Musa Paradisiaca (Banana) Fruit in Rats with Experimentally Induced Gastric Lesions

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Abstract

Background: *Unripe banana fruit extract is used to relieve stomach distress in some countries. A few studies in India, China, Sudan, Nigeria and South Africa revealed protection of gastric mucosa after exposed to aggressive agent following administration of unripe banana fruit extract in experimental animals.* ***Objective:*** *To determine the protective effect of aqueous extract of unripe Musa paradisiaca (banana) fruit against ethanol induced gastric lesion in rats.* ***Materials and Methods:*** *This was a prospective experimental study carried out in the department of Pharmacology, Dhaka Medical College, Dhaka within the period from January 2015 to June 2015. Aqueous extract of unripe banana fruit was prepared accordingly. Total 24 rats were randomly divided into 4 groups of 6 in each group. Group-A served as a control group and provided with distilled water (5 ml/kg/body weight) orally by gastric tube. Aqueous extract of Musa paradisiaca was administered orally as Group-B: 0.2 mg/kg/body weight/day, Group-C: 0.4 mg/kg/body weight/day and Group-D: 0.8 mg/kg/body weight/day for 7 days. After 7 days, 1 ml absolute ethanol (a known gastric lesion inducing agent) was orally administered to all groups by gastric tube. After 30 minutes of ethanol administration, all rats were sacrificed and dissected. After separating and opening stomachs, observed lesions were examined and measured with some morphological & histological parameters. Obtained data were subjected to analysis by Student's unpaired t-test. p-value <0.05 was considered as statistically significant.* ***Results:*** *At the end of experiment, Group-A (control) showed a total of 33 gastric lesions. Group-B, Group-C and Group-D showed 22, 20 and 19 stomach lesions respectively. The difference between control group and experiment groups was statistically significant (p<0.01).* ***Conclusion:*** *The unripe banana fruit extract has dose-dependent gastroprotective effect on rats. So, it may be effective in treating peptic ulcer disease.*

Key words: Aqueous Extract, Gastroprotective, Gastric Lesion, Musa paradisiaca.
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Introduction

Peptic ulcer disease (PUD) affects four million people worldwide annually[1] and has an estimated lifetime prevalence of 5-10% in the general population[2]. Although the global prevalence of PUD has dramatically decreased in the past decades[3], the incidence of its complications has remained constant[4]. Higher peptic ulcer disease incidence has been found to be associated with male sex, smoking and chronic medical conditions[5,6]. Peptic ulcer disease has also been found to be associated with increasing age[7].

PUD mostly occurs in the duodenum and the stomach[8]. A peptic ulcer is the result of an imbalance between the aggressive and defensive factors. On one hand, too much gastric acid and pepsin can damage the gastro-duodenal mucosa and cause ulcers; on the other hand, diminished mucosal protective factors may also predispose the cause ulcer. As many as 70-90% of such ulcers are associated with the Helicobacter pylori, a spiral-shaped bacterium that lives in the acidic environment of the stomach[9]. However, as the prevalence of H. pylori infection has declined in Western countries, Gastric Ulcer has become more commonly associated with the use of the nonsteroidal anti-inflammatory drugs (NSAIDs) and the acetylsalicylic acid (ASA)[10-12].

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Helicobacter pylori predisposes to ulceration, mainly by gastric acid hypersecretion[13]. NSAIDs lead to peptic ulcer disease predominantly by compromising mucosal defenses. Other causes of peptic ulcer are smoking, steroids, alcohol consumption, psychological stress etc. Abdominal pain, classically epigastric with severity relating to meal is the main symptom of PUD[14,15]. If untreated, Haematemesis (vomiting of blood), Melaena (passage of tarry, foul-smelling stool) and rarely, gastric, or duodenal perforation. The latter is extremely painful and requires immediate surgery[16].

The current treatment of peptic ulcer is complicated and of high cost requiring minimum of two antibiotics in combination with a proton pump inhibitor, which often causes nausea, antibiotic resistance and other side effects[14,15]. So, there is a need to search for cheap alternatives having antiulcer properties with less side effects. This is the basis of study for the development of new anti-ulcer agents. Some plant derived medicines have been significantly reported to possess potent antiulcer activity[17].

Musa Paradisiaca is the most familiar of tropical fruits. From its origin in India/Malaysia, it spreads to the tropical world. Musa Paradisiaca is a monoecious herb. It grows 10-40 feet in height and has enormous broad green leaves which grow through hollow stem bearing flower and fruit. It occurs in all tropical areas native to Bangladesh, India and Myanmar. It is also distributed in New Guinea, America, Australia and tropical Africa[18].

Banana fruits consist of carbohydrates, amino acids and other nutrients. The skin of the fruit is rich in cellulose (10%) and hemicellulose. The pulp protein is rich in arginine, aspartic acid, glutamic acid, methionine and tryptophan. The phytochemicals present in it may be associated with the wound healing (anti-ulcer) and mucosal healing properties[19]. The unripe fruit of Musa paradisiaca is cheap and easily available in our country. So, unripe Musa paradisiaca (Banana) fruit extract was chosen for the study. The aim of this study was to determine the protective effect of aqueous extract of unripe Musa Paradisiaca fruit on ethanol induced gastric lesion in rats.

Materials and Methods

The study was prospective experimental study carried out in the Department of Pharmacology, Dhaka Medical College, Dhaka from January 2015 to June 2015 on total 24 rats with unripe banana fruit extract with proper ethical approval from IERB. The collected unripe banana fruits were taxonomically identified and authenticated by Bangladesh National Herbarium, Mirpur, Dhaka (DACB Accession number - 41149)). Aqueous extract of unripe banana fruits was prepared accordingly. A total of 24 rats were collected from ICDDRB, Dhaka. They were of either sex, weighing about 150-200 gm. Rats were randomly divided into 4 groups of 6 in each group. Group-A served as control group that received distilled water 5 ml/kg/bodyweight orally daily for 7 days. Group-B, Group-C and Group-D received the extract at the doses of 0.2 ml/kg/bodyweight, 0.4 ml/kg/bodyweight and 0.8 ml/kg/bodyweight respectively orally daily for 7 days. At the end of 7 days, 1 ml absolute ethanol (a known gastric lesion inducing agent) was orally administered to all groups by gastric tube. After 30 minutes of ethanol administration, all rats were sacrificed and dissected. After separating & opening stomachs, observed lesions were examined and measured with the following morphological & histological parameters.

Morphological parameters:

1. Mean lesion number per rat in each group.
2. Mean lesion length and breadth in mm for each group.
3. Mean lesion area (length x breadth) in square mm for each group.
4. Mean lesion index (sum of length of all lesions in each stomach) in mm for each group.
5. Percentage inhibition of lesion by aqueous extract of Musa paradisiaca.

Histological parameters:

The degree of gastric damage was determined histologically by microscopy of gastric lesions. Gastric damage was graded histologically as 0° damage (Normal stomach), 1° damage, 1.5° damage, 2° damage and 3° damage.

Mean and standard deviation was calculated from the obtained Data. Student's Unpaired 't' test was performed to compare between Group A & Group B, between Group A & Group C and between Group A & Group D. p-value <0.05 was considered statistically significant. Then data were presented in the forms of tables and figures.

Results

This experimental study comprises 24 rats which were randomly divided into 4 groups (group A, B, C and D) of 6 in each group. At the end of the experiment, Group-A (control) showed total 33 stomach lesions. Group-B, Group-C and Group-D showed a total of 22, 20 and 19 stomach lesions respectively (figure-1). Table-I describes the mean lesion number, mean lesion length, mean lesion breadth, mean lesion area, mean lesion index and gastric damage was maximum in group A and tends to decrease in group B, C and D. Percentage inhibition of lesion was maximum in group D and minimum in group B and more in group D than group B and group C.

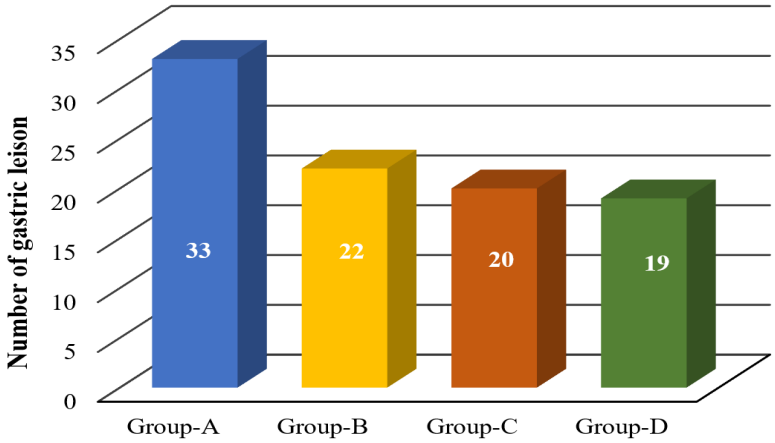

Figure-1: Bar diagrams showing the number of observed stomach lesions in four groups following administration of aqueous extract of unripe Musa Paradisiaca fruit

Table-I: Characteristics of gastric lesion among group A, B, C and D (n=24)

Variables	Group-A	Group-B	Group-C	Group-D
Mean lesions number	5.5 ± 1.04	3.66± 0.81	3.33 ± 1.21	3.16 ± 0.75
Mean lesion length	8.05 ± 2.54	2.93 ±0.69	2.55 ± 0.77	2.38 ± 0.93
Mean lesion breadth	2.61 ± 0.51	0.65±0.18	0.63 ± 0.21	0.60 ± 0.28
Mean lesion area	21.93 ± 9.97	1.87 ± 0.52	1.56 ± 0.84	1.51 ± 0.74
Mean lesion index	37.71 ± 7.47	9.17 ± 1.46	7.08 ± 1.45	6.16 ± 1.42
Degree of gastric damage	1-2	1-1.5	1-1.5	0-1.0
Percentage Inhibition of lesion	0	75.68	81.23	83.16

Table-II: Comparison of gastric lesion between Group A (Control) and Group B by t-test significance

Variables	Group-A	Group-B	p-value
Mean number of lesions (± SD)	5.5 ± 1.04	3.66± 0.81	< 0.05
Mean lesion length (± SD)	8.05 ± 2.54	2.93 ±0.69	< 0.01
Mean lesion breadth (± SD)	2.61 ± 0.51	0.65±0.18	< 0.001
Mean lesion area (± SD)	21.93 ± 9.97	1.87 ± 0.52	< 0.001
Mean lesion index (± SD)	37.71 ± 7.47	9.17 ± 1.46	< 0.001

Table-III: Comparison of gastric lesion between Group A (Control) and Group C by t-test significance

Variables	Group-A	Group-C	p-value
Mean number of lesions (± SD)	5.5 ± 1.04	3.33 ± 1.21	< 0.01
Mean lesion length (± SD)	8.05 ± 2.54	2.55 ± 0.77	< 0.001
Mean lesion breadth (± SD)	2.61 ± 0.51	0.60 ± 0.28	< 0.001
Mean lesion area (± SD)	21.93 ± 9.97	1.56 ± 0.84	< 0.001
Mean lesion index (± SD)	37.71 ± 7.47	7.08 ± 1.45	< 0.001

Table-IV: Comparison of gastric lesion between Group A (Control) and Group D by t-test significance

Variables	Group-A	Group-D	p-value
Mean number of lesions (± SD)	5.5 ± 1.04	3.16± 0.75	< 0.01
Mean lesion length (± SD)	8.05 ± 2.54	2.38 ± 0.93	< 0.001
Mean lesion breadth (± SD)	2.61 ± 0.51	0.65 ± 0.18	< 0.001
Mean lesion area (± SD)	21.93 ± 9.97	1.51 ± 0.74	< 0.001
Mean lesion index (± SD)	37.71 ± 7.47	6.61 ± 1.42	< 0.001

Student's Unpaired 't' test was performed to compare between Group A & Group B, between Group A & Group C and between Group A & Group D. Difference between Group A & Group B was significant as P value <0.05 (Table II). A statistically highly significant difference (P value <0.01) was observed between Group A & Group C and between Group A & Group D (Table III, IV).

Discussion

The present study has been undertaken to find out the gastroprotective effect of aqueous extract of *Musa paradisiaca* on ethanol induced gastric lesion in rats. For this study, 24 rats were taken and divided into 4 groups. Group A served as a control group that received distilled water 5 ml/kg BW orally daily for 7 days. Group B, Group C & Group D received the *Musa paradisiaca* fruit extract at the doses of 0.2 mg/Kg BW, 0.4 mg/Kg BW & 0.8 mg/Kg BW respectively orally daily for 7 days. At the end of 7 days, a single dose of 1 ml of absolute ethanol (5 ml/kg BW) was administered orally by gastric tube to induce gastric ulcer in each rat of each group. The dose and routes of administration was selected according to Koffuor GA, et al[20]. Absolute ethanol penetrates the gastric mucosa very quickly, which explains why a period of 30 minutes was sufficient for developing gastric lesions in rats. Lui CF, et al[21] in their study showed that oral administration of absolute ethanol (5.0 ml/kg) to fasted rats produced extensive necrosis of gastric mucosa and pretreatment with oral administration of propolis ethanol extract (PEE) could effectively and dose dependently prevent such necrosis.

To evaluate the gastroprotective effect of aqueous extract of *Musa paradisiaca*, some parameters of gastric damage such as number of lesions, lesion length, lesion breadth, lesion area, lesion index and percentage inhibition were measured at the end of the experiment. There were 33 stomach lesions in group A (control). Group B, Group C and Group D showed 22, 20 and 19 stomach lesions respectively following the administration of aqueous extract of unripe *Musa Paradisiaca* fruit in this study. Histological features of rat stomachs were also examined to confirm gastric damage and to determine extent. Aqueous extract of Musa paradisiaca 0.8 mg/kg BW>aqueous extract of Musa paradisiaca 0.4 mg/kg BW>aqueous extract of Musa paradisiaca 0.2 mg/kg BW reduced the mean lesion number, mean lesion length, mean lesion breadth, mean lesion area, mean lesion index and gastric damage caused by ethanol. Mean lesion number, mean lesion length, mean lesion breadth, mean lesion area, mean lesion index and gastric damage was maximum in group A and minimum in group D and more in group B than group C & group D. Percentage inhibition of lesion was maximum in group D and minimum in group B and more in group D than group B & group C. It showed that the aqueous extract of Musa paradisiaca protect more in 0.8 mg/kg BW dose than 0.2 mg/kg BW dose and 0.4 mg/kg BW dose. This study result was in well agreement with the result of Koffuor GA, et al.[20] study. The highest percentage inhibition of lesion occurred in group-D (pretreated with aqueous extract of *Musa paradisiaca* in 0.8 mg/kg BW dose).

So, pretreated with aqueous extract of *Musa paradisiacal* before ethanol administration prevented the ethanol induced gastric changes and decreased lesion number, lesion length, lesion breadth, lesion area and lesion index. In this study, the aqueous extract of *Musa paradisiaca* was able to deliver satisfying dose-dependent gastroprotective effects in prevention of gastric mucosal lesion induced by absolute ethanol.

Conclusion

Unripe *Musa paradisiaca* (banana) fruit extract has dose dependent gastroprotective effect on rats. Further studies are required for better understanding the gastroprotective mechanism of aqueous extract of *Musa paradisiaca* by administration of the extract in experimental animals having induced gastric lesion of a large sample comparing with positive control receiving established antiulcer drugs. However, unripe *Musa paradisiaca* fruit or fruit extract may be used as a remedy for peptic ulcer disease after ascertaining its safety.

Conflict of interest

The authors declared that they have no conflict of interest.

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