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Anti-Ulcer Activities of Methanolic Extract of *Musa Paradisiaca*

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Author's contribution

All authors designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Musa paradisiaca (plantain peel) is useful in prevention and control of numerous health problems in Ayurveda, an ancient system of medicine. The anti-ulcer activity and effects of varied dosages of its methanolic extract on gastrointestinal motility were investigated in this study. Fifteen (15) Wistar rats of 150 and 200 g were deprived of food for 24 hours; then divided into five groups (Groups I through V) of three rats each; while group I (control) received 5ml/kg of distilled water, groups II, III

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and IV received 100 mg/kg of indomethacin (ulceric), 5mg/kg of omeprazole (after inducing ulcer), and 200 mg/kg of *M. paradisiaca* respectively. After inducing ulcers with indomethacin, Group V animals were fed (orally) with 400mg/kg of extract. Oral administration of ethanol injured the mucosal lining, resulting in gastrointestinal bleeding with ulcer indexes of 13.30, 10.57, 10.62, and 9.01 in groups II to V respectively, after some time of administration of test substances. In addition, the test statistic (using ANOVA and Tukey post-hoc) on the Omeprazole and 400mg/kg extract treated groups showed a substantial protection of 8.60% and 21.27 % respectively; whereas, the Omeprazole and 400mg/kg extract treated groups had a substantial protection of 8.60% and 21.27%, respectively. Between the omeprazole, 200mg/kg and 400mg/kg of extract treated groups, there was a statistically insignificant increase (p 0.05) in gastro-protective activity. However, gastro-protective effect was statistically significant (p 0.05) at larger doses of the extract. The ulcer index decreased significantly (p 0.05) between the negative control and treatment groups, according to the findings. However, with 400mg/kg body weight of the extract, the percentage gastro-protective action was higher than in the omeprazole-treated group. We advocate using a similar extract on other platforms to back up this study's efforts.

Keywords: Ulcer; Musa paradisiaca; gastrointestinal motility; indomethacin.

1. INTRODUCTION

Plantains are one of the oldest and most widely grown fruits in west and central Africa, and their cultivation in Nigeria has become a major source of revenue for both large and small-scale farmers, particularly subsistence farmers [1].

Plantain, also known as oghede, agbagba, ayaba, and Ogadejioke in Yoruba, Hausa, and Igbo languages, is a crop belonging to the genus Musa, which is native to the tropical parts of Southeast Asia and Oceania, including Indonesia, Malaysia, Brunei, the Philippines, and Northern Australia [2]. The plant component above the ground is a fake stem (pseudostem), comprised of concentrically produced leaves, wherein the inflorescence stalk emerges.

Musa paradisiaca (plantain) is commonly used in traditional medicine in the form of Hemanta Rasa. Banana is a Spanish-Portuguese word that comes from Guinea. In India, the term "plantain" refers to a coarse banana [3]. Though the two words are often used interchangeably, banana refers to Musa Paradisiaca, the most well-known tropical fruit. It spread throughout the tropical world from its origins in India/Malaysia. It has been cultivated for Musa Paradisiaca for over 4000 years, with over 300 original variations [4].

Customarily, the plant was being used for abscess, alopecia (female), burns, cancer, cataplasm, diabetes, diarrhea, dog bites, snake bites, dysentery, dyspepsia, fracture, gangrene, hematuria, emiplegia, hemoptysis, hemorrhage, hypertension, lizard bites, marasmus, migrain, ringworm, shingles The pulp also has antiulcer, wound-healing, hair-growth-promoting, analgesic, antioxidant, and hepatoprotective properties [5]. Despite its medical use, plantain is often grown for its edible qualities. Plantain fruit, which is grown for its carbohydrate content, can be eaten as an unripe or ripe fruit [6].

The structure of a novel tetracyclic triterpine obtained from Musa Paradisiaca flowers was identified as (24R)-4-14, 24-trimethyl-5-cholesta-8,25(27)-dien-3-ol. Banana bracts, which are abundant edible remnants of banana manufacturing, have been examined as a natural colorant source [7]. The level of monomeric anthocyanin was 32.3 mg/100gm. Dephinidin, pelargonidin, peonidine, and malvidin 3-rutinoside derivatives were among the other anthocyanins studied. The presence of six other anthocyanidins, dephindin, cyanidin, petunidine, pelargonidin, peonidine, and malvidin, was discovered when anthocyanins were acid hydrolyzed [8]. Fruits consist of carbohydrates, amino acids, sugar and starch. The skin of the fruit is rich in cellulose (10 percent), hemicellulose. Arginine, aspartic acid, glutamic acid, methionine, and tryptophan were abundant in the pulp protein [9].

Musa Paradisiaca has a variety of properties that have been described in both traditional and modern scientific literatures. Antiulcer, wound healing, antioxidant, antidote for snake bite, hypoglycemia, atherogenic, and skeletal muscle augmentation are the main pharmacological properties of this herb. In rats given Aspirin, Indomethacin, Phenylbutazone, Prednisolone, Cysteamine, and guinea pigs given histamine, orally administered banana pulp powder had a strong anti-ulcerogenic effect. Banana pulp

powder enhanced mucosal thickness while simultaneously increasing thymidine levels (incorporation into mucosal DNA). When compared to control sections, banana treatment sections revealed more aggregation and severity of pink dots, according to histological investigations. Banana powder administration, according to this study, not only enhances mucosal resistance to ulcerogens, but also accelerates healing by promoting cellular proliferation [10].

Methanolic extracts of Musa Paradisiaca mature green fruit in normal and Streptozocin-treated diabetic rats using Chlorpropamide as an antidiabetic agent MEMP (100-800 mg/kg) reportedly showed a significant, dose-related (p 0.05–0.001) reduction in blood glucose level in normal and diabetic mice. In both normal and diabetic mice, chlorpropamide (250 mg/kg) caused a significant (p 0.05) drop in blood glucose concentration [11].

1.1 Aim of Study

The goal of this study was to;

i. See if a methanolic extract of *musa paradisiaca* had anti-ulcer properties in wistar rats. The study, in particular, looked at the gastroprotective effects of Omeprazole and Musa paradisiaca therapies on indomethacin and ethanol-induced ulcers in Wistar rats.
ii. Research the effects of a ripe plantain peel (Musa paradisiaca)-based diet on liver, heart, and renal enzymes in wistar rats.
iii. Determine the proximate effects of formulated feeds on gastric motility

2. MATERIALS AND METHODS

2.1 Study Location

The research was carried out in the animal house Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

2.2 Study Design

A total of fifteen wistar rats (150-200 g body weight) were deprived for 24 hours before being divided into five groups (Groups I through V) of three rats each. The following administrations were carried out in the various groups:

Group I: Normal Control (n=3) given orally distilled water (5ml/kg) body weight.
Group II: Negative control (n=3) given orally indomethacin (100mg/kg) body weight
Group III: Reference drug (n=3) given orally omeprazole (5mg/kg) body weight.
Group IV: Plant extract (n=3) given orally plantain extract (200mg/kg) body weight.
Group V: Plant extract (n=3) given orally plantain extract (400mg/kg) body weight.

2.3 *Musa Paradisiaca* Extract Preparation

In Idumebolo, Ekpoma, Edo State, about 10 kg of fresh Musa Paradisiaca sucker was collected from local gardens. To remove grime, the sucker was washed and rinsed in water. It was then dried at room temperature for 24 hours before being chopped into pieces and sun-dried at temperatures ranging from 24 to 250 degrees Celsius. After that, 200g of the pulverized sucker was immersed for 48 hours in 70% methanol. A rotary evaporator was then used to filter and concentrate the extract. The concentrated extract was then allowed to dry at room temperature. The dried product was placed in a desiccator and sealed in an airtight container. The extract was reconstituted in water and given to rats on a daily basis. The extract has a 2.61 percent yield.

2.4 Induction of Ulcer

The procedure for inducing ulcers in rats followed those of Sayanti et al. [12]. A single dose of indomethacin (30 mg/kg body weight) was given orally to the animals. Prior to causing ulcers, they were denied meals but allowed unfettered access to water for 24 hours. 4 hours following indomethacin treatment, various degrees of ulceration were expected to appear.

2.5 Ulcer Confirmation

Gastric content was collected using a Ryle or Nasogastric (NG) tube shortly after the ulcer was induced, as described by Sairam et al. [13]. Gastric aspirates (obtained content) were then centrifuged at 5000 rpm for 5 minutes in a bicarbonate-containing gastric tube. After that, the supernatant was measured and expressed in milliliters per 100 grams of body weight. Titrating with a 0.01 molar solution of sodium hydroxide (NaOH) in a calibrated cylinder using phenolphthalein indicator yielded acid output, which was expressed as Eq/6 h. The volume of gastric juice was then measured using a graduated cylinder and expressed in milliliters.

2.6 Determination of Ulcer Severity (*Musa Paradisiaca* Curative Activity)

The stomach was initially opened lengthwise, spread out, pinned, and salt-washed just before preservation, right after dissection, and then examined under a 10 magnifying glass for varying levels of mucosa lesions (Ulcer scoring). The degree of ulcer formation, as well as the number of ulcers generated per stomach, were assessed at this point. At different extremes, mucosa lesions ranging from hyperaemic to haemorrhagic to complete erosive were reported. The ulcer indices of each animal were then calculated and compared for each group using Moghaddam et al. [14] grading system as follows:

0 = typical stomach colour
0.5 = red coloration
1 = spot ulceration
1.5 = bleeding streaks
2 = ulcerations of 3 and 5 mm width
3 = ulcerations > 5 mm in dimension;
4 = perforations.

The ulcer index was calculated from the curative ratio using the relation, and the success of Musa Paradisiaca treatments was calculated from the ulcer score for each group.

Curative ratio (CR) = (LC − LMP / LC) × 100,

Where: LC = Ulcer index of animals treated solely with vitamin C,
LMP = Ulcer index of *Musa Paradisiac* treated animals

This calculation was based on the previous work of Sairam et al. [14]

2.7 Determination of Gastric Motility

WIN 55 in an IP vehicle (5 percent DMSO) prepared in physiological solution (0.9 percent NaCl) was delivered once IP (Intra-peritoneal) to suitable groups shortly before euthanasia. Animals were given oral single doses of activated charcoal suspension (5 percent charcoal and 10% acacia within deionized water) around 15 minutes before dosing, according to Camilleri et al. [15, 16]. Following that, the total distance covered by the charcoal suspension and the total intestinal length (small intestine) were measured using a tape and used to quantify the effect of IP administration on WIN 55-induced GI motility alterations using the following formula:

Percentage distance travelled = (distance travelled x 100) / Total length of small intestine

2.8 Statistical Analysis

The study's findings were expressed as Mean SEM (Standard Error of Mean), and a one-way analysis of variance (ANOVA) was used to determine the mean differences between multiple groups, with a p-value less than 0.05 (p 0.05) considered statistically significant. The turkey (post hoc) test was used to determine the source(s) of differences when a difference was discovered. All statistical procedure was performed with the graph pad prism (version 8.0) (version 8.0)

3. RESULTS

From above Table, Oral injection of indomethacin to experimental animals in groups II to V produced mucosal lesions in the rats' stomachs in form of haemorrhagic streaks with ulcer index of 11.03 ± 0.13, 9.38±0.27 and 11.00±0.83 respectively.

The gastro-protective effect of omeprazole and extract treatments at different doses on ethanol induced ulceration in wistar rats (Table 2). Here, oral administration of ethanol damaged the mucosal lining; resulting in gastrointestinal bleeding with ulcer index of 13.30 ± 0.26, 10.57±0.18, 10.62±0.31 and 9.01±1.08 in groups II to V respectively.

3.1 Effect of Ripe Plantain (*Musa paradisiaca*) Peel based Diet on Some Enzymes of the Liver, Heart and Kidney of Albino Rats

Also in this study, animals were technically assigned into two (2) dietary treatment groups and observed for body weight changes. One diet (the control) had 0% inclusion level of plantain peel while the other diet (the test diet) had 50% inclusion level of plantain peel. On the forty-second day from the commencement of the experiment, the animals were accessed for enzyme assay based on nutritional valued in administered feeds;

Compared to the control (A), the result obtained showed that there was no significant ($p < 0.05$) difference in the levels of these enzymes in the serum and studied tissues of rats fed ripe plantain peel as animal feed supplement.

Table 1. Gastroprotective Effect of Omeprazole and *Musa paradisiaca* Treatments on Indomethacin Induced, Ulceric Wistar Rats at Varying Treatments

Test	Parameters				
	Group I (Normal Control)	Group II (Neg. Control)	Group III (5mg/kg Omeprazole)	Group IV (200mg/kg)	Group IV (400mg/kg)
Ulcer Scoring	0.04±0.02[a]	23.01±1.90 [c]	11.93±1.08 [b]	10.93±1.06 [b]	9.72±0.85 [b]
Ulcer Index	0.10±0.05 [a]	11.03±0.13 [b]	9.38±0.27 [b]	11.00±0.83 [b]	9.91±0.93 [b]
Inhibition (%)	--	--	8.60	10.50	21.27

Values represent the mean ± SD for N=3. Values in the same row bearing the same letter of alphabets are not significantly different from each other (P > 0.05)

Table 2. Gastroprotective Effect of Omeprazole and *Musa paradisiaca* Treatments on Ethanol Induced, Ulceric Wistar Rats at Varying Treatments

Test	Parameters				
	Group I (Normal Control)	Group II (Neg. Control)	Group III (5mg/kg Omeprazole)	Group IV (200mg/kg)	Group IV (400mg/kg)
Ulcer Scoring	0.01±0.00[a]	29.10±4.40 [d]	16.24±2.71 [c]	15.53±1.62 [c]	9.21±1.41 [b]
Ulcer Index	0.06±0.02 [a]	13.30±0.26 [c]	10.57±0.18 [b]	10.62±0.31 [b]	9.01±1.08 [b]
Inhibition (%)	--	--	14.27	16.21	19.62

Values represent the mean ± SD for N=3. Values in the same row bearing the same letter of alphabets are not significantly different from each other (p > 0.05)

4. DISCUSSION

In orthodox medicine, the usage of conventional medications is on the decline. Medicinal herbs have demonstrated to be effective. Due to the development of live bacteria known as probiotics, which have numerous digestive benefits, fermented products of specific medicinal herbs have been recommended to generate more promising results. As a result, the current study was designed to look into the effects of a methanolic extract of plantain peel (Musa paradisiaca) on gastrointestinal function, specifically its anti-ulcer activity in wistar rats given varied doses of extract vs omeprazole. About fifteen (15) wistar rats weighing between 150 and 200 grams per kilogram of body weight were deprived for a day before being divided into five groups of three rats (Groups I through V). They were subsequently given oral doses of distilled water (5 mg/kg), indomethacin (100 mg/kg), omeprazole (5 mg/kg), plantain extract (200 mg/kg), and plantain extract (400 mg/kg) per kilogram of body weight.

Oral administration of ethanol and indomethacin induced severe stomach ulcers and haemorrhagic steaks in the experimental animals, according to the findings. Over time, the data demonstrated that these models' development of ulcers was statistically significant at p 0.05. The inhibition of the enzyme cyclooxygenase, which catalyzes the rate-limiting step in the conversion of arachidonic acid to prostaglandins, as well as the expression of histamine, gastrin, and acetylcholine receptors, which are responsible for gastric acid secretion, could be the cause of ulceration caused by these drugs (ethanol and indomethacin).

The omeprazole and 400mg/kg body weight of the extract treated groups showed substantial protection of 8.60% and 21.27%, respectively. There was no significant difference in gastro-protective activity (p 0.05) between the omeprazole group and the extract groups of 200mg/kg and 400mg/kg, respectively. However, gastro-protective effect was statistically significant (p 0.05) at larger doses of the extract.

Table 3. Proximate effects of formulated feeds on enzymatic activity

Nutrient	Group A (Control)	Group B (Exp.)	t-test (p-value)	Remark
Carbohydrate (%)	53.31±0.46	44.12±0.58	0.0210	Significant
Lipid (%)	5.13±0.41	4.57±0.36	0.1031	Insignificant
Protein (%)	23.25±0.23	15.56±0.46	0.0912	Insignificant
Fibre (%)	3.03±0.14	5.42±0.23	0.2032	Insignificant
Plantain Extract (%)	4.45±0.33	11.31±0.32	0.0021	Significant

Table 4. Proximate Effects of Formulated Feeds on Gastric Motility

Test	Parameters				
	Group I (Control)	**Group II (Neg. Control)**	**Group III (5mg/kg Omeprazole)**	**Group IV (200mg/kg)**	**Group IV (400mg/kg)**
Total Distance (cm)	4.75±0.06 [a]	3.01±0.03 [a]	4.03±0.04 [a]	5.03±0.08 [b]	5.92±0.11 [b]
Time (Hour)	15.10±2.21 [a]	14.80±1.85 [a]	16.05±3.01 [a]	18.38±3.84 [b]	18.96±4.01 [b]

Values in the same row bearing the same letter of alphabets are not significantly different from each other (p > 0.05)

The results also demonstrated that the ulcer index differed significantly (p 0.05) between the negative control and treatment groups. However, with 400mg/kg body weight of the extract, the percentage gastro-protective action was higher than in the omeprazole-treated group.

In an assessment of the effect of a ripe plantain (Musa paradisiaca) peel-based diet on enzymatic activities, extract-fed animals had significantly higher content than the others. This could be owing to the ripe plantain peel's unusually high mineral content. Other elements, on the other hand, were comparable to those in the control diet. The lack of a significant difference in the levels of these enzymes between rats fed non-extract and rats fed a control diet could simply indicate that using plantain peel as an animal feed addition does not cause noticeable harm. The proximate analysis of the prepared diets, as shown in Table 3, reveals only minor variations in carbohydrate and extract content. Experimental (technically fed) animals fed a diet with 50% plantain peel inclusion had considerably greater content (p 0.05) than control animals fed a diet with 0% plantain peel inclusion.

Again, the suppression of ulcerogenesis by Musa paradisiaxa extract can be related to two key factors: the presence of bioactive substances and the proliferation of living microorganisms (probiotics) during the fermentation process. Flavonoids, saponins, tannins, flavonoids, and phytochemical screening of unripe M are some of the compounds identified in plants that have anti-ulcer capabilities. These chemicals were discovered in paradisiaca [7]. As a result, it's possible that M. paradisiaca's ulcer-protective effect is attributable in part to their existence, and this study has confirmed the plant's use in folk medicine for the treatment of peptic ulcers. Flavonoids have also been linked to the prevention of stomach ulcers in several studies. This can happen due to an increase in neutral glycoprotein levels and prostaglandin concentrations, as well as suppression of histamine release from mast cells due to inhibition of histidine decarboxylase, which reduces H2 receptor stimulation, or secretion of prostaglandin-like substances. Saponins also lower the risk of ulcers by increasing gastric mucosa defensive factors and stopping the inflammatory process caused by aspirin induction (as evidenced by the absence of ulceration and severe haemorrhagic streaks in the gastric mucosa of experimental animals given aqueous extracts of fermented unripe Musa paradisiaca fruits).

In terms of ulcer parameters, the negative control had a significantly higher ulcer score and ulcer index (p 0.05) than the omeprazole (reference drug) and Musa paradisiaca extract groups. The results showed that giving animals omeprazole (5 mg/kg body weight) or 200 mg/kg body weight of M. paradisiaca aqueous extract before a negative control reduced ulcer formation by 8.76 percent and 7.11 percent, respectively. Ulceration was reduced by 13.51 percent when a higher dose of the extract (400mg/kg body

weight) was used. The inhibition was statistically significant (p 0.05) among these dosing groups.

5. CONCLUSION

Present study was undertaken to ascertain the effects of methanolic extracts of Musa paradisiaca fruits r on several parameters models in wistar rats. Generally, available results showed comparable antiulcer activity of omeprazole and the different doses of the extract against the different models employed in the study. Musa paradisiaca fruit extracts can thus be considered a promising candidate for testing new anti-ulcer medicines. It is suggested that more retrospective assessments of plantain peel be conducted, with literatures being extended to dates of ten years or longer (2008). Extending the benefits of plantain peels to organs such as the brain, spleen, pancreas, and thymus is also recommended to fine-tune the herb's relevance to orthodox and traditional medical practitioners.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

Also, prior to the inquiry, consent papers were given to the participants to seek their informed consent.

ETHICAL APPROVAL

The research and ethics committee of the Nnamdi Azikiwe University, Awka, Anambra State, provided ethical approval.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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