International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page: www.iscientific.org/Journal.html

Organic constituents and antiulcer activity of chloroform extract of unripe plantain (*Musa paradisiaca*) fruit peel

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Abstract

Plantain (*Musa paradisiaca*) is mainly grown for food and it is widely consumed in different forms in Nigeria. Plantain plays an important role as an African medicinal plant where. It is used against ulcer, diabetes and as antimicrobial agent etc. The present study is aimed at identification of the organic constituents of the chloroform extract of the unripe plantain peel and its antiulcer activity. Air dried unripe plantain peel was ground and batch-extracted with petroleum spirit. The residue was re-extracted with chloroform to get the chloroform extract. The organic constituent of the extract was separated by gas chromatography and identified by mass spectrometry. The crude extract was subjected to such ulcer parameters like gastric acid output, gastric mucus output and ulcer score etc. The extract contains eleven organic compounds and it is effective in control of peptic ulcer in white albino rastl. The work shows that the extract contains eleven compounds and has antiulcer activity.

Keywords: chloroform extract, antiulcer activity, ulcer parameters, organic constituents

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1. Introduction

Plantain (*Musa paradisiaca*) is an important food crop in West Africa and it also serves as medicinal herb. The unripe fruit peel is a source of antioxidant and dietary fibre [1]. The unripe fruit peel is also richer in cellulose than the inner fleshy part [2, 3, 4]. Aqueous extract of the unripe fruit peel has strong antiulcer activity on white rats and antifungal activity [5]. It is also used against diarrhea, dysentery, intestinal lessons in ulcerative colitis, diabetes, anemia, gout and hypertension [6, 7]. Earlier reported work on the antiulcer property of plantain peel was mainly on its aqueous extracts. To th ebest of our knowledge there is no reported work on antiulcer activity and the constituent organic compounds of its chloroform extract. The present study is therefore aimed at identification of individual organic constituents of the chloroform extract of the unripe fruit peel and the antiulcer activity of the chloroform extract. The work shows that the extract contains eleven compounds and has antiulcer activity.

2. Materials and methods

Unripe *Musa paradisiacal* (plantain) fruit was harvested from the Pharmacology Departmental Farm, University of Calabar (Unical) andauthenticated by the Herbarium Unit, Botany Department, Unical. The fruits were rinsed with distilled water and peeled. The peels were air dried in the open laboratory for two weeks and ground to fine particles. The ground peel (215g) was soaked in petroleum spirit ($1dm^3$) for one day and filtered. The residue was washed twice with petroleum spirit ($2 \times 100cm^3$) and finally the residue was soaked in chloroform ($1dm^3$) for 24h and filtered. The chloroform solution was distilled down over hot water bath to give a residue (14.7g) as the chloroform extract. Organic constituents of the extract were separated by gas chromatography and the individual compounds identified by mass spectrometry. The compound identification was done by comparison of their mass spectra with those of in the standard mass spectra of organic compounds from National Institute of Standard and Technology, NIST [8].

The crude drug (chloroform extract) was administered to the groups of rats by oral gavage.

Group I: Control group was fed with normal saline and animal feed.

Group II: $40mgkg^{-1}$ of body weight of aspirin was given in the morning with fasting. Animal fed and water was given in the evening.

Group III: 40mgkg^{-1} body weight of aspirin was given in the morning with fasting and 40mgkg^{-1} of extract in the evening with feed and water.

Group IV: 40mgkg^{-1} of body weight of aspirin was given in the morning with fasting and 40mgkg^{-1} of cimetidine in the evening with animal feed and water.

The body weight changes is obtained by noting the difference between the initial body weight of the rats and the weight after seven days. The difference in weight of feed kept for the rat and the weight left after twenty four hours is the food intake. The difference between the water supplied to the animal in the cage and what is left after twenty four hours is the water intake. Ulcer score and index were obtained by the method of [9]. Adherent mucus was determined by method of Tan et al [10]. The gastric juice was collected by method of Shay et al [11] and its secretion determined according to methods of Gosh and Schild [12] and Ibu et al [13]. The proteolytic activity of gastric secretion was achieved by the method of Hawk et al [14].

3. Results

3.1. Chemical composition

The gc-ms analysis of the chloroform extract of *Musa paradisiaca* is shown in table 1... The extract contains eleven organic compounds which include oleic acid (8.23%); E-9-octadecenoic acid (36.08%); mesithylene (15.08%) and 10,13-octadecdiynoic acid methyl ester (7.03%). Oleic acid is a known antiulcer agent 15 16], The remaining compounds are mainly anti-inflammatory and antimicrobial agents which may assist in ulcer management.

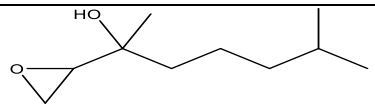
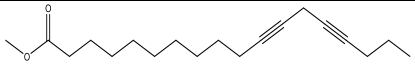
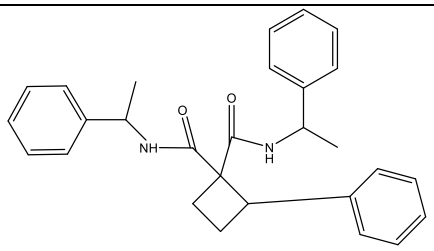
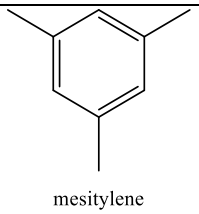
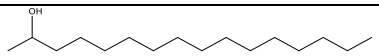
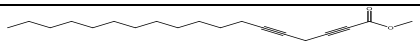
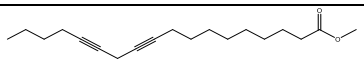
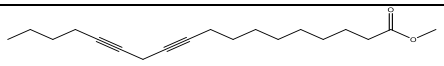
3.2. Biological activity

The observed LD_{50} is 80mgkg^{-1} of body weight.
The mean body weight change in control, 40mgkg^{-1} aspirin and aspirin with 40mgkg^{-1}of extract, 60mgkg^{-1} of extract and 60mgkg^{-1} of cimetidine were 2+0.58; 10.03 ± 2.97, 12.1± 3.49, 23.2 ±6.70 and 11.8 ±3.41 respectively. The result shows much weight loss in animals treated with the crude drug compared to the control. This is because aspirin activates an enzyme that promotes burning of fat leading to weight loss [17]. The mean food intake in control, 40mgkg^{-1} of aspirin, aspirin and 40mgkg^{-1} of extract, aspirin and 60mgkg^{-1} of extract and 60mgkg^{-1} of cimetidine were 40 ± 0.0g, 27.1 ± 2.06g, 30.6 ± 0.09, 25.9, 25.9 ± 1.09 and 27.9 ± 0.64g respectively. This shows that the mean food intake is lowered with intake of the extract [18 19]. The mean water intake in control, 40mgkg^{-1} aspirin, aspirin and 40mgkg^{-1} extract, aspirin and 60mgkg^{-1} extract and 60mgkg^{-1} extract 60mgkg^{-1} cimetidine were 18 ± 0.0, 2.7 ± 1.23, 27.6 ± 0.47, 25.2 ± 0.4 and 26. ± 0.55cm^{-3} respectively. There was an increase in water intake in the groups treated with the extract compared to the control. This is in accord the work of Malley [19] which shows that dehydration occurs early in aspirin poisoning. The mean basal gastric and output in control, 40mgkg^{-1} aspirin and 40mgkg^{-1} extract, aspirin and 60mgkg^{-1} of extract and 60mgkg^{-1} of cimetidine were 2.21 ± 0.23, 4.23 ± 0.19, 4.23 ± 0.23, 4.21 ± 0.22 cm^3 h$_{-1}$. The result shows that there was no significant difference p<0.00D for basal acid output. On administration of histamine the acid output is 4.20 ± 0.00, 4.92 ± 1.9, 4.92 ± 0.23, 4.90 ± 0.27. This shows a significant increase ($p < 0.001$) and the experimental groups. On administration of histamine, an H_2 agonist, it stimulated acid output. This is attributed to the extract enhancing the parietal cells and enabling them on secreting gastric acid.
Upon treatment with cimetidine, a hydrogen antagonist, the acid outputs were 4.20 ±0 00, 4.21 ± 0.11, 4.0 ± 0.23 and 4.0 ± 0.22 cm^3 h^{-1}. This shows a decrease in acid output. Since cimetidine, a hydrogen receptor blocker reduced acid output, it shows that histamine stimulated acid output via hydrogen receptor pathway and cimetidine reduced gastric acid output secretion by blocking hydrogen receptor on the parietal cell.

The gastric mucus output in the control, aspirin only, aspirin and 40mgkg^{-1} of extract, 60mgkg^{-1} extract, and 60mgkg^{-1} cimetidine were 0.02 ± 0.00, 0.01 ± 0.00, 0.06 ± 0.01, 0.04 ± 0.01 and 0.09 ± 0.02. The result shows increase in mucus output compared to the control and this dose dependent [20]. Increase in mucus secretion is known to suppress ulcer [20 21]. The ulcer score for control, aspirin and 40mgkg^{-1} extract, 60mgkg^{-1} extract, and 60mgkg^{-1} cimetidine were 2.0 ± 0.02, 2.0 ± 0.00, 1.0 ± 0.10, and 1.00 ± 0.0 respectively. The 60mgkg^{-1} of extract demonstrated significant protection against ulcer with ulcer score of zero and significant protection of 100% and this is in agreement with the work of Daniel and Chukwugozie, [22]. The lower dose of 40mgkg^{-1} gave ulcer protection of 50%.

The study clearly shows that the chloroform extract of unripe *Musa paradisiaca* fruit peel has strong anti-ulcer activity. Identified oleic acid, a known antiulcer agent, is partly responsible for the observed antiulcer activity. The other constituents may have contributed to the biological activity through antagonistic, addictive or synergistic effects [23]. Morah and Inuka 2021. Further work on this may lead to development of new antiulcer drug. The authors recommend the use of chloroform extract of unripe plantain peel for control and management of pectic ulcer.

Table 1: GC-MS Result of chloroform extract of *Musa paradisiaca*

S/N	RT (min)	Name of compound	RMM	% comp	Base peak	Molecular formular	Structure
1	6.870	α-Methyl-α-[4-methylpentyl]oxiran methanol	172	2.598	85	$C_{10}H_{20}O_2$	
2	7.520	11,14-octadecadiynoic acid, methyl ester	291	5.003	85	$C_{19}H_{31}O_2$	
3	7.839	1,1-cyclobutanedicarboxamide,2-phenyl-N,N'-bis(1-phenylethyl)	426	7.723	105	$C_{28}H_{30}N_2O_2$	
4	8.809	Mesitylene	120	15.884	105	C_9H_{12}	 mesitylene
5	9.203	2-hexadecanol	242	2.893	57	$C_{16}H_{34}O$	
6	9.953	2,5-octadecadiynoic acid, methyl ester	290	4.790	105	$C_{19}H_{30}O_2$	
7	11.536	10,13-octadecadiynoic acid, methyl ester	290	7.031	119	$C_{19}H_{30}O_2$	
8	12.262	10,13-octadecadiynoic acid, methyl ester	290	4.646	119	$C_{19}H_{30}O_2$	
9	35.287	Oleic acid	283	8.322	55	$C_{18}H_{35}O_2$	
10	36.076	1-heptatriacotanol	536	5.036	69	$C_{37}H_{76}O$	
11	37.627	Oleic acid	283	36.075	55	$C_{18}H_{35}O_2$	

RT=retention time, RMM=relative molecular mass, % comp=percentage composition

Conclusions

Musa paradisiaca fruit peel chloroform extract has antiulcer activity. It contains eleven organic compounds which are responsible for the biological activity.

Acknowledgement

The authors are grateful to Marcus Inyang of the Department of Pharmacology, University of Calabar, for his assistance during the laboratory work.

Conflict of interest

The authors declare no conflict of interest.

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