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Original Research Article

Sucrase Inhibitory Activities of Ethanol Extract of Unripe Peels of *Musa Paradisiaca* Linn and its Chemical Constituents

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ABSTRACT

Musa paradisiaca Linn (plantain) is a popular medicinal plant belonging to the *Musaceae* family. It is a nutritious fruit, highly eaten all over the world. The peels are the major by-product of plantain fruits, constituting about 40% of the fruits and are largely viewed to be of little or no significance and subsequently discarded, thereby constituting a threat to the environment. This study investigates the phytochemical contents and sucrase inhibitory activity of the ethanol extract from the unripe plantain peels using standard phytochemical assay procedures and Gas Chromatography-Mass Spectrometry (GC-MS) method. The result of the phytochemical screening showed the presence of flavonoids, tannins and phenols in unripe plantain peels. The total phenolics content was found to be (2870.28 ± 6.09) GAE mg/100g, total flavonoids content (2109.55 ± 10.33) GAE mg/100g, total antioxidant content (591.82 ± 5.59) GAE mg/100g, and the Ferric reducing antioxidant power (FRAP) content (964.78 ± 11.76) GAE mg/100g. The maximum % inhibition observed at 250 µg/mL for the sucrase enzyme inhibition assay was 28.30, IC_{50} > 250 µg/mL. The GC-MS analysis generated 88 peaks corresponding to the bioactive components identified by comparing their mass spectral fragmentation patterns and other parameters to the known compounds documented by the National Institute of Standards and Technology (NIST) library. This study demonstrates that the often-undervalued plantain peels have mild anti-diabetic activity. The peels could be further processed and utilized in the formulation of drugs and nutraceuticals for human and animal food.

Keywords: *Musa paradisiaca*, Sucrase, Gas chromatography-mass spectrometry, Antioxidant.

Introduction

Musa paradisiaca is an hybrid clone of *Musa acuminata* and *Musa balbisiana*.[1] *Musa paradisiaca* Linn**.**, is an important food crop in the humid forest and mid altitude agro-ecological zones of Sub-Saharan Africa and one of the major sources of carbohydrate in Asia, Oceania, Africa and Central America.[2] Plantain is called "Ogede" by the Yoruba people of southwestern, Nigeria.[3] It is also known as Jioko or Oji-Oko in Igbo language, while the Hausa people call it Agade or Ayaba. Households in Nigeria consume a variety of plantains, with the false horn variety (locally known as "Agbagba") being the most popular. In Nigeria, some parts of Africa and in many other places around the world, plantain (*Musa paradisiaca*) serves as a major staple food and is particularly desired for the variability in the stages of ripeness and in cooking methods.[4] Akinyemi *et al* [5] reported that the projected level of production of plantain in Africa is little above 50%, out of which, West Africa alone produces about 61%. Over 70 million people in Africa obtain about 25% of carbohydrate and 10% of calories by consuming plantain.[6] About 2.11 million metric tons of plantains are produced in Nigeria annually which contributes substantially to the nutrition of subtropical local populations.[7] The peels are known to constitute a threat to the society, thereby contributing to the worsening problem of environmental pollution, especially in areas where ruminants (sheep and goats) are not allowed to roam freely.[8]

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Plantain is employed in the folklore management of diseases such as ulcer, wound healing and many others due to its anti-ulcerogenic, antimicrobial, anti-urolithiatic activities, and analgesic properties.[9-10] The antidiabetic activity of the leaves, fruit peels, stems and roots have been documented using streptozotocin and alloxan induced diabetic rats.[11-13] Bisht *et al*[14] reported the antidiabetic potentials of the methanol and hydroalcoholic extract from the stem of *Musa paradisiaca*; the results revealed that the extracts efficiently inhibit both alpha amylase and alpha glucosidase enzymes *in vitro* in a dose - dependent manner. Peels are the most common by-products of fruit processing, and they have been demonstrated to be a good source of polyphenols, carotenoids, dietary fibers, and other bioactive components with a variety of health benefits.[15] Unripe (green) plantain peels have been used in a variety of applications, including soap manufacture, animal feed, and biogas production.[3] According to our conversation with a herbarium curator; the green peels of unripe plantain soaked in cold water could be utilized to treat diabetes. Hence, the goal of this study was to investigate the anti-sucrase inhibitory and antioxidant properties of unripe plantain peels *in vitro*. The phytochemicals in the plant were also characterized using GC-MS.

Materials and Methods

Sample collection and preparation

The plantains were purchased from a farmer at the Oja Bisi market in Ado-Ekiti, Ekiti State, Nigeria on April 8, 2021. The plantains bought were fresh, matured, and unripe. The plant material was authenticated at the Department of Plant Science and Biotechnology by Mr. Femi Omotayo, where a voucher specimen with identification number UHAE 2021407 was deposited. The plantain peels were separated from the plantain pulp and then weighed, after which they were allowed to drain for an hour. The drained peels were then manually sliced thinly (0.5-1.0 mm thick) into small pieces and processed using a Rico grinder (India). The peels were soaked in 2 L of ethanol for 72 hours and then filtered

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with Whatman filter paper. The ethanol extract obtained was concentrated at 50^0C using rotary evaporator and stored in a container and refrigerated pending analysis.

Phytochemical analysis of M. paradisiaca peels

Flavonoids content determination

The flavonoids content was determined using an aluminium chloride colorimetric technique based on the formation of a flavonoid-aluminium complex with a maximum absorption at 510 nm, and was carried out with minor modifications as described by Zhishen *et al*.[16] 1.0 mL of the extract (105 µg/mL) was mixed with 1.0 mL of $AlCl_3$ (5%). The mixture was allowed to stand at room temperature (25 ºC) for 5 minutes after which 2.0 mL of $NaNO_2$ (7%) was added. Afterwards, 1.0 mL of sodium hydroxide (1%) was added to the reaction mixture. The absorbance was measured at 510 nm against a blank which contained all reagents without the samples. The results were expressed in mg/100g Gallic acid equivalents (GAE).

Phenolics content determination

The assay principle is based on the reactions of phenolic groups present in the samples with Folin Ciocalteu reagent (FCR) in an alkaline medium producing a blue colour with a maximum absorption at 760 nm. About 1.0 mL of the extract (105 µg/mL) was mixed with 0.5 mL of an aqueous solution of FCR (FCR: water, 1:10 v/v). The mixture was allowed to stand at room temperature (25 ºC) for 1 hour. 1.5 mL of sodium carbonate (7.5%) was added and the reaction solution was made up to 5.0 mL with distilled water. The absorbance was read at 765 nm against a blank which contained all reagents without samples. The results were expressed in mg/100g Gallic acid equivalents (GAE).[17]

Tannins content determination

The tannin content of the sample was measured as adsorbed polyphenols in the sample solution. The phenolic contents of the supernatant as non-adsorbed polyphenols were estimated using the Folin Ciocalteu reagent (FCR) in an alkaline medium. About 1.0 mL of the extract was mixed with 0.5 mL of an aqueous solution of FCR (FCR: water, 1:10 v/v). The mixture was allowed to stand at room temperature (25 ºC) for 1 hour. After that, 1.5 mL of sodium carbonate (7.5%) was added and the reaction solution was brought up to 5.0 mL with distilled water. At 765 nm, the absorbance was measured against the blank. The total tannin content was calculated as the difference of total polyphenols and non-adsorbed polyphenols. The results were expressed in mg/100g Gallic acid equivalents (GAE).[18]

Determination of antioxidant activity by the DPPH• scavenging potential

The DPPH• assay was conducted according to the method of Govindarajan *et al.* [19]

0.15 mL of varying concentrations (50-250 µg/mL) of each extract was added to 0.1 mL of the solution of DPPH• (0.1 mM). The reaction was left in the dark for 30 minutes and afterwards, the optical density (OD) of the reaction was read at 517nm. The percentage inhibition was calculated as follow:

$$\% \text{ Inhibition} = \frac{\text{OD of blank} - \text{ODof sample}}{\text{OD of blank}} \times 100$$

Determination of hydrogen peroxide scavenging activity

Using the Ruch *et al*.[20] approach, the ability of *M. paradisiaca* plant extracts to scavenge hydrogen peroxide was determined. A solution of hydrogen peroxide containing 43 mM was prepared in phosphate buffer (1 M, pH 7.4). The different concentration of the sample (50-250 µg/mL) was added to a hydrogen peroxide solution (0.6 mL, 43 mM). Absorbance of hydrogen peroxide at 230 nm was determined after 10 minutes against a blank solution containing phosphate buffer without hydrogen peroxide. Gallic acid was used as standard. The free radical scavenging activity was determined by evaluating the % inhibition.

Determination of ferric reducing antioxidant property

1.5 mL of 0.1 M sodium phosphate buffer (pH 6.7) and 0.1 mL of 1% potassium ferricyanide were mixed with 0.5 mL of the extract solution (50-250 µg/mL). After 30 minutes of standing at room temperature (25°C), 0.1 mL of trichloroacetic acid solution (4%) was added. The mixture was prepared up to 2.5 mL and centrifuged for 5 minutes at 650×*g*. 2 mL supernatant was combined with 2 mL distilled water and 0.5 mL ferric chloride solution (0.1%). The reaction's optical density was evaluated at 700 nm, and the results were represented in milligrams per 100 grams of Gallic acid equivalents (GAE).[21]

Determination of total antioxidant capacity

The wells of the microplate were filled with 0.15 mL of each extract (50-250 µg/mL), and the reaction was initiated by adding 0.1 mL of 2,2′-azinobis-(3-ethylbenzothiazoline-6-sulphonate $ABTS^{\cdot+}$ solution (7mM ABTS prepared in 2.45 mM ammonium persulfate overnight). The absorbance of the resulting mixture was measured at 734 nm, and the antioxidant activity of each extract was expressed in mg/100g Gallic acid equivalents (GAE).[22]

Determination of sucrase inhibitory activity of M. paradisiaca peels

Inhibitory effect of sucrase was determined according to the method of Ahmed *et al*.[23] Sucrase enzyme, sucrose and different concentration of sample solutions (50-250 µg/mL), respectively were prepared using Phosphate Buffer Saline (PBS). 10 µL enzyme solution and varying concentration of samples were placed in glass test tubes and incubated at 37^oC for 10 min. Subsequently, the volume was made up to 200 µL by the addition of malate buffer (pH 6.0) and 100 µL of 60 mM sucrose. The tubes were incubated for another 30 min at 37^oC. Thereafter, about 200 µL of dinitrosalicylic (DNS) reagent was added to each tube and the reaction was stopped by heating the tubes in boiling water bath for 10 min. The absorbance of the samples were measured at 540 nm on UV-Vis spectrophotometer. Percentage inhibition of sucrase was calculated accordingly as indicated:

$$\% \text{ Inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

GC-MS Determination of phytochemical characterization

Prior to analysis, the GC-MS machine was auto tuned to perfluorotributylamine (PFTBA) using already established criteria to check the abundance of *m/z* 69, 219, 502 and other instrument optimal and sensitivity conditions. The amounts of phytochemicals in the sample were determined using GC-MS and MSD in Scan mode to guarantee that all levels of detection of the target constituents were achieved. Agilent 7820A gas chromatograph coupled with 5975C inert mass spectrometer (with triple axis detector) and an electron-impact source (Agilent Technologies) was used. The compounds were separated using HP-5 capillary column coated with 5% Phenyl Methyl Siloxane 30m length x 0.32 mm diameter x 0.25 µm film thickness) as the stationary phase (Agilent Technologies). The carrier gas was Helium used at constant flow rate of 1.4871 mL/min at an initial nominal pressure of 1.4902 psi and an average velocity of 44.22 cm/sec. About 1µL of the samples were injected in split less mode at an injection temperature of 300°C. The purge flow to the spilt vent was 15 mL/min for 0.75 minutes, for a total flow of 16.654 mL/min, with gas saver mode turned off. The oven was set at 40°C for 1 min, and then ramped at 12 °C/min to 300°C for 10 min. The run time was 32.667 min with a 5 min solvent delay. The mass spectrometer was operated in electron-impact ionization mode at 70 eV with an ion source temperature of 230°C, quadrupole temperature of 150°C and transfer line temperature of 280°C. The acquisition of ion was via Scan mode (scanning from *m/z* 45 to 550 amu at 2.0s/scan rate).[24]

Statistical Analysis

Results were expressed as the mean and standard error of the mean (SEM) of three independent determinations. GraphPad Prism software was used to analyze the data.

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Results and Discussion

Plant extraction

The result of extraction of the ethanol extract of *M. paradisiaca* peels is shown in Table 1.

From the result presented in Table 1, it is very obvious that ethanol may not be a good solvent for the peels; a non-polar solvent may be preferable because of the sticky/ gummy nature of extract. However, the pharmacological action of plantain has been attributed to its phenolic contents, [25] and the most suitable solvent for extraction has been adjudged to be polar solvents, hence our preference for ethanol.

Phytochemical screening

The phytochemical screening result is presented in Table 2.

The phytochemical analysis of extracts obtained from *M. paradisiaca* peels revealed a wide range of phytochemicals. The ethanol extract of the peel contained key phytochemical components such as flavonoid, phenol, and tannin. Alkaloid, saponin, fixed oil and protein were not detected in the peels (Table 2). Similar phytochemicals were detected in *R. mucronata, R. stylosa* and *R. apiculata*. These range of phytochemicals have been linked with various pharmacological activities.[26] Table 3 shows the results of the mean of three determinations ± SEM of flavonoids, phenolics, total antioxidant and Ferric reducing antioxidant power (FRAP). The phenol content is high in the ethanol extract of *M. paradisiaca* peels which is comparable to the phenolic levels detected in a number of medicinal plants such as *Terminalia arjuna, T. bellerica, T. chebula, and Phyllanthus emblica*.[27] The flavonoid content in *M. paradisiaca* peel extract in this study is similar to the one detected in the aqueous extract of *Rubus niveus* fruits.[28] Several phytoconstituents such as phenol, flavonoid, tannin and others, obtained from various plant sources have been reported as potent hypoglycemic agents. Some flavonoids with hypoglycemic properties may improve altered glucose and oxidative metabolisms of diabetic states. The hypoglycemic effect of some herbal extracts has been confirmed in human and animal models of type 2 diabetes mellitus.[29-30] Flavonoids have been reported to show a myriad of biological activities varying from antioxidant, anticancer, antiulcer, antivirus and antimicrobial activities.[31] Flavonoid and phenol in plants have been reported to show antioxidant, free radical scavenging abilities, anti-inflammatory and anticarcinogenic properties.[32]

Gas chromatography-mass spectrometry (GC–MS) analysis

By comparing the peak retention time, peak area (%), peak height (%), and mass spectral fragmentation patterns of the ethanol extract of *M. paradisiaca* peels to those of known compounds listed in the National Institute of Standards and Technology (NIST) library, a total of 88 peaks corresponding to the bioactive compounds were identified. However, 13 of them had greater peak areas, while the others had lower peak areas, therefore they were left out (Table 4). The structure of 13 phytocompounds identified in the ethanol extract of *M. paradisiaca* peels are presented in Table 5 as well as their retention time. The phytoconstituents in the ethanol extract of *M. paradisiaca* peels are n-Hexadecanoic acid, Phytol, Methyl8,11,14-heptadecatrienoate, 9,12,15-Octadecatrienoic acid, (Z,Z,Z)-, 1,3-bis[(2Z)-Hex-2-en-1-yloxy]-1,1 ,3,3-tetramethyldisiloxane, Pyrimidine, 2,4-diamino-5-(3-pyridylmethyl)-, Vitamin E, Campesterol, Stigmasterol, .beta-sitosterol, C(14a)-Homo-27-nor-14.beta.-gammaceran-3.alpha.-ol,9,19-Cyclolanost-24-en-3-ol, (3.beta.)-, 1,1,6-trimethyl-3-methylene-2-(3,6,9,13-tetramethyl-6-ethenye-10,14-dimethylene-pentadec-4-enyl)cyclohexane. The GC-MS spectra (Figure 1 and Table 4) of the ethanol extract of the plantain peels shows that it is majorly composed of Fatty Acids, Sterols (Cycloartenol), Tocopherol and Phytol. The structures of the identified compounds are presented in Figure 2. The fatty acids present comprise of n-hexadecanoic acid, which is also known as palmitic acid, and 9,12,15-octadecatrienoic acid (z, z, z), also known as linolenic acid. Although pyrimidine, 2,4-diamino-5-(3-pyridylmethyl) is a methyl ester but also a poly unsaturated fatty acid, as palmitic acid is saturated and linolenic acid is an unsaturated fatty acid. Phytol has a potential role in the management of insulin resistance and metabolic disorders that accompany diabetes and obesity.[33]

Table 1: Extraction of plant

Plant Material	Solvent	Weight of extract
Musa paradisiaca 2.0 Kg	Ethanol	35.9g

Table 2: Qualitative screening of phytochemicals of the ethanol extract of unripe plantain peels.

S/N	Phytochemicals	Test Results
1	Phenols	+
2	Tannins	+
3	Flavonoids	+
4	Alkaloids	-
5	Saponin	-
6	Fixed oil	-
7	Protein	-

Key: + = Present; - = Absent

Table 3: Quantitative estimation of phytochemicals present in the ethanol extract of unripe plantain peels (mg/ 100g).

Phytochemicals	(GAE mg/100g)
Total phenolics	2870. 28 ± 6.09
Total flavonoids	2109. 55 ± 10.33
Total antioxidant	591. 82 ± 5.59
FRAP	964.78 ± 11.76

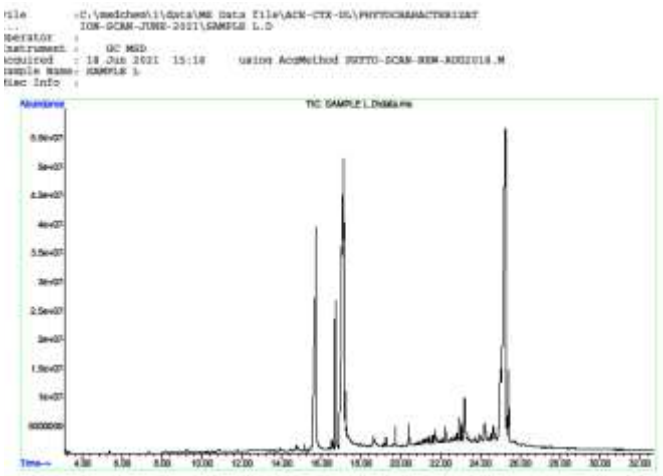

Figure 1: Phytoconstituents detected in the ethanol extract of *Musa paradisiaca* peels using Gas chromatography-Mass spectrometry.

Vitamin E supplementation has an important role in delaying the onset of the diabetic complications as well as for slowing down the progression of the complications.[34] Sterols present in the extracts of plantain peels are campesterol, stigmasterol, Beta-sitosterol and cycloartenol (Table 3). Some studies have identified sterols as key modulators of glucose metabolism. Beta-sitosterol from *Azadirachta indica* has been confirmed to be useful in the treatment of diabetes mellitus.[35] Cycloartenols which is 9,19-Cyclonost-24-en-3-0l (3β) from *Ficus krishnae* and 24-methylenecycloartanol have been discovered to have anti-diabetic effect by preventing the glucotoxicity associated with diabetes, increasing beta cell population, and restoring normal insulin release from pancreatic beta cells.[36]

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Anti-oxidant activity M. paradisiaca peels
DPPH Radical percentage inhibition
In the present study, the different concentrations of *M. paradisiaca* peels were subjected to 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) free radical scavenging analysis. The results (Figure 3) showed that the extracts with the highest concentration (250 µg/mL) had the lowest absorbance value and the highest percentage (46.57±1.63) of antioxidant resistance. The antioxidant activity is likely to originate from the bioactive compounds contained in the plantain peel extract, namely alkaloids, flavonoids, and saponins.[37]

ABTS percentage inhibition
Figure 4 shows the ABTS radical scavenging potential of the ethanol extract of the unripe plantain peels at various concentrations. From the results, it may be postulated that the extract inhibits the radical in a concentration-dependent manner with the highest percentage inhibition of (43.81 ± 0.33) at 250 µg/mL. The result of the hydrogen peroxide inhibition potential of the ethanol extract of the unripe plantain peel at various concentrations is shown in Figure 5. From the results, it may be assumed that the ethanol extract of *M. paradisiaca* inhibits in a concentration - dependent manner, with the highest percentage inhibition of 42.91±2.79 at 250 µg/mL.

Table 4: Phytochemical constituents identified in the ethanol extract of *M. paradisiaca* peels using GC-MS. CAS chemical abstract service, Sl. No. serial number

Sl. No	CAS#	Name of compound	M/W (g)	Molecular formulae	Peak area (%)
1	000057-10-3	n-Hexadecanoic acid	256.42	$C_{16}H_{32}O_2$	10.32
2	000150-86-7	Phytol	296.53	$C_{20}H_{40}O$	3.29
3	1000336-35-1	Methyl8,11,14heptadecatrienoate	278.4	$C_{18}H_{30}O_2$	21.10
4	000463-40-1	9,12,15-Octadecatrienoic acid, (Z, Z, Z)-	278.43	$C1_8H_{30}O_2$	3.89
5	1000352-73-8	1,3-bis[(2Z)-Hex-2-en-1-yloxy]-1,1 ,3,3-tetramethyldisiloxane	330.61	$C_{16}H_{34}O_3Si_2$	1.15
6	052606-04-9	Pyrimidine,2,4-diamino-5-(3-pyridylmethyl)-	201.23	$C_{10}H_{11}N_5$	1.01
7	000059-02-9	Vitamin E	430.71	$C_{29}H_{50}O_2$	2.43
8	000474-62-4	Campesterol	400.68	$C_{28}H_{48}O$	1.23
9	000083-48-7	Stigmasterol	412.69	$C_{29}H_{48}O$	1.82
10	000083-46-5	Beta-Sitosterol	414.71	$C_{29}H_{50}O$	1.55
11	024739-08-0	C(14a)-Homo-27-nor-14.beta.-gammaceran-3.alpha.-ol	428.73	$C_{30}H_{52}O$	26.72
12	000469-38-5	9,19-Cyclolanost-24-en-3-ol, (3.beta.)-	426.72	$C_{30}H_{50}O$	2.01
13	1000373-94-5	1,1,6-trimethyl-3-methylene-2-(3,6,9,13-tetramethyl-6-ethenye-10,14- dimethylene-pentadec-4-enyl)cyclohexane	452.8	$C_{33}H_{56}$	1.11

Table 5: Structures and retention time (min) of phytochemical constituents identified in the ethanol extract of *M. paradisiaca* peels using GC-MS

Sl. No	Retention time	Name of compound	Structure
1	RT-15.712	n-Hexadecanoic acid	CC[CH-]C[CH-]CCCCCCCCC(=O)O
2	RT-16.693	Phytol	CC(C)CCCC(C)CCCC(C)CCCC(=CCO)C
3	RT-17.098	Methyl8,11,14-heptadecatrienoate	CCC=CCC=CCC=CCCCCCCC(=O)OC
4	RT-17.213	9,12,15-Octadecatrienoic acid, (Z, Z, Z)-	CCC=CCC=CCC=CCCCCCCCC(=O)O
5	RT-21.706	1,3-bis[(2Z)-Hex-2-en-1-yloxy]-1,1,3,3-tetramethyldisiloxane	CCC=CCO[Si](C)(C)O[Si](C)(C)OCC=CCCC
6	RT-22.884	Pyrimidine,2,4diamino-5-(3-pyridylmethyl)-	C1=CC(=CN=C1)CC2=CN=C(N=C2N)N
7	RT-23.196	Vitamin E	CC1=C(C2=C(CCC(O2)(C)CCCC(C)CCCC(C)C)C(=C1O)C)C
8	RT-23.959	Campesterol	CC(C)C(C)CCC(C)C1CCC2C1(CCC3C2CC=C4C3(CCC(C4)O)C)C
9	RT-24.201	Stigmasterol	CCC(C=CC(C)C1CCC2C1(CCC3C2CC=C4C3(CC(C4)O)C)C)C(C)C
10	RT-24.640	Beta-Sitosterol	CCC(CCC(C)C1CCC2C1(CCC3C2CC=C4C3(CCC(C4)O)C)C)C(C)C
11	RT-25.252	C(14a)-Homo-27-nor-14.beta.-gammaceran-3.alpha.-ol	CC4(C)CCCC5(C)C3CCC1C(C)(CCC2C(C)(C)C(O)CCC12C)CC3CCC45
12	RT-25.408	9,19-Cyclolanost-24-en-3-ol, (3.beta.)-	CC(CCC=C(C)C)C1CCC2(C1(CCC34C2CCC5C3(C4)CCC(C5(C)C)O)C)C
13	RT-25.697	1,1,6-trimethyl-methylene-2-(3,6,9,13-tetramethyl-6-ethenye-10,14-dimethylene pentadec-4-enyl)cyclohexane	CC1CCC(=C)C)C1(C)C)CCC(C)C=CC(C)(CCC(C)C(=C)CCC(C)C(=C)C)C=C

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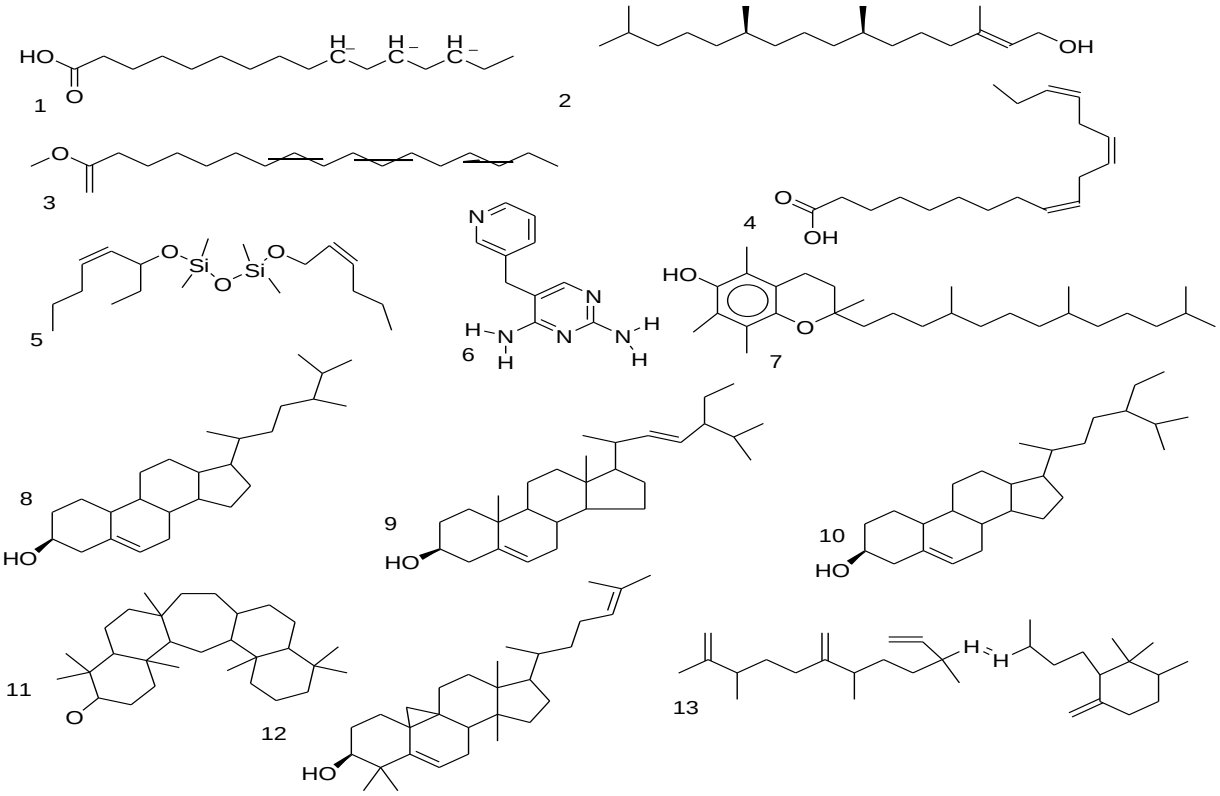

Figure 2: Structures of compounds 1-13 in Table 3. The serial number of the structures corresponds to the names of compounds in Table 3.

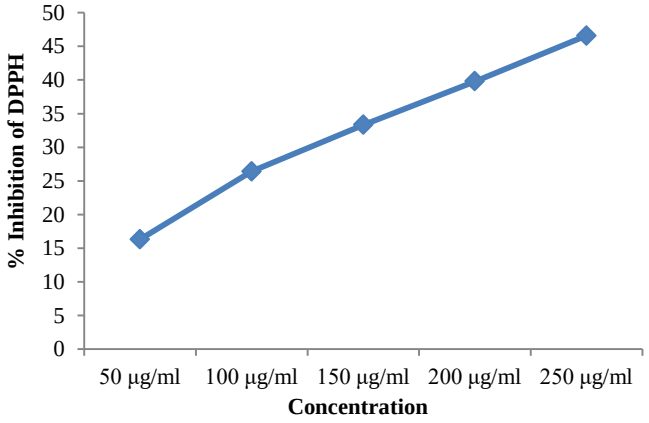

Figure 3: DPPH free radical scavenging activity of various concentrations of ethanol extract of *M. paradisiaca* peels.

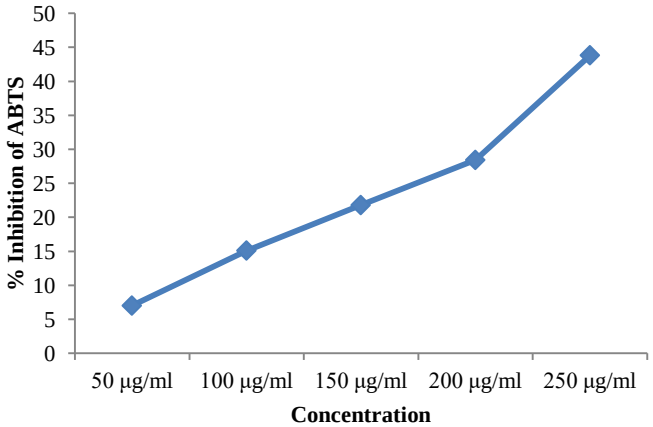

Figure 4: ABTS inhibition potentials of various concentrations of ethanol extract of *M. paradisiaca* peels.

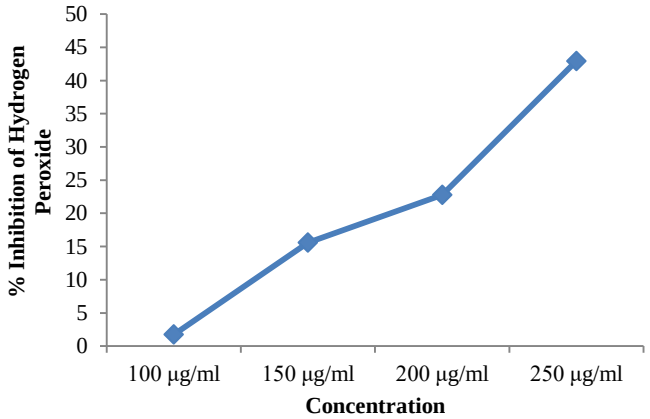

Figure 5: Hydrogen peroxide inhibition potentials of various concentrations of ethanol extract of *M. paradisiaca* peels.

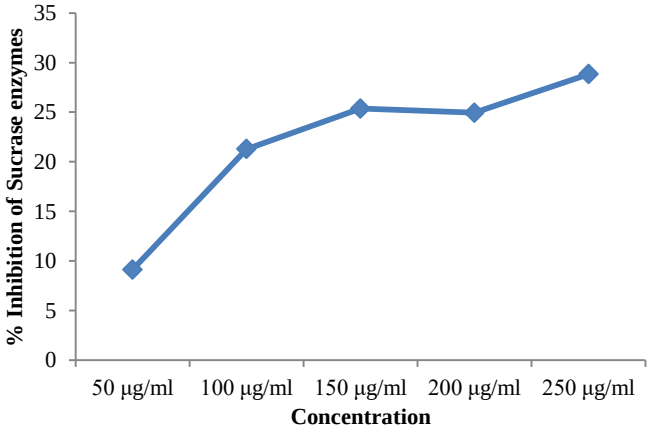

Figure 6: Sucrase inhibition properties at various concentrations of ethanol extract *of M. paradisiaca* peels.

The hydrogen peroxide inhibition was found to be low at 50 µg/mL and 100 µg/mL as the values were -3.39 and 3.33×10^{-7} respectively, which is negligible. The inhibition of sucrase by different concentrations of sample extract is presented in Figure 6. According to the result, the ethanol peel extract of 250 µg/mL showed the highest inhibitory effect against sucrase which is 28.83± 0.76%, sucrase inhibitory effect is seen to be dependent on the concentration of the extract which means a higher concentration will yield a higher effect. Sucrase inhibitors have been considered for use in treating diabetes mellitus.[38] The ethanol extract of the peels showed mild inhibitory properties against sucrase. This inhibitory property could be related to their total phenolic components. The presence of various phytochemicals such as phytol, flavonoid, saponins, etc. could be thought as the possible reasons for their sucrase inhibitory property. The sucrase inhibitory activity of hydroalcoholic extract of *A. indica* and other isolated polyphenolic compounds supposed to be due to the presence of hydrolysable tannins and flavonoids.[39] Li *et al*[38] reported the inhibitory characteristics of epicatechin and its derivatives, the compounds showed a strong inhibition towards sucrase enzymes. The result further revealed the correlation between phenolic compounds and sucrase inhibitory activities.

Conclusion

This study has revealed that unripe plantain peels are rich sources of phytochemicals and possess mild antidiabetic activity. In this regard, their disposal or disuse must abate, because they could be nutritionally studied and well processed as a good source of nutrients for animals, and even used in the formulation of drugs and cosmetic products due to their antioxidant activity. The presence of phytochemicals also demonstrates their potential to serve as nutraceuticals and a medicinally vital material in animal and human health. The results of this study demonstrated that the sucrase inhibitory activity is concentration - dependent. Hence, at a higher concentration, the sucrase inhibitory activity may be more pronounced. Further research is recommended to isolate the bioactive components of the plant.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The author hereby declares that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by her.

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