Evaluation study on Nigerian species of *Musa paradisiaca* Peels:

Phytochemical screening, Proximate analysis, Mineral Composition and Antimicrobial Activities

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Abstract:Plantain fruit is widely consumed in Africa and some other parts of the world. The peel (epicarp) which constitutes about 40% of the whole fruit weight is thought to be of little or no significance, and hence, often discarded. In view of this, the present study was carried out to investigate the presence of phytochemicals, minerals and nutrient components in ripe and unripe peels *of Musa parasidiasca*. phytochemical screening of the powdered and aqueous peel extracts showed the presence of tannins, flavonoids, terpenoids, alkaloids, glycosides and phlobatannins. The carbohydrate contents of the peels (ripe and unripe) were 42.95 and 48.18% respectively. The crude protein ranged between 6.89 to 7.18%. Ca, Mn, K, Na, Fe, Zn, N, and Cu were the detectable mineral elements in the *peals*. Sodium and Phosphorus had the highest (84.33-84.53 PPM)) and lowest (0.13-0.14 PPM) values respectively. Both peels (ripe and unripe) showed high ash content, 22.30 and 17.59% respectively. The antimicrobial activity of *M. paradisiacal* peel extracts (aqueous and ethanolic) was evaluated on selected human pathogenic microbes, and the extracts were effective against most of the bacteria and fungi. The minimum inhibitory concentration (MIC) ranged between 6.25mg/mL and 50mg/mL depending on the microorganism and type of the extract. **IGHODARO, O.M. Evaluation study on Nigerian species of *Musa paradisiaca* Peels:Phytochemical screening, proximate analysis, Mineral Composition and AntimicrobialActivities.**
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Introduction:

Musa parasidiasca belongs to the natural order, plantaginaceae which contains more than 200 species, twenty-five or thirty of which have been reported. The common plantain (Plantango major) has broad, irregular oval leaves, abruptly contracted at the base into a long broad, channelled footstalk. The fully grown blade is 1.3–2.4 meters long and about two-third as broad, usually smooth, with several parallel veins. Plantain grows more than any other plant in compacted soils, is abundant beside paths, roadside and other areas with frequent soil compaction. It is also common in grassland and as a weed among crops. It is wind pollinated and propagates primarily by seeds which are held on the long narrow spikes which rise well above the foliage. The large diversity that occurred in plantain has resulted in a variety of cultivars.

The number of plantain cultivars has been reported to vary from one country to another. Swennen (1990) observed that at least 116 plantain cultivars exist in different parts of West and Central Africa. In Nigeria alone, more than 20 cultivars have been reported, although only a few are important commercially Swennen (1990). Plantain is a major starch crop of importance in the human tropical zone of Africa, Asia, Central and South America. It is undoubtedly one of the oldest cultivated fruits in West and Central Africa. It is consumed as an energy yielding food and desert. It has been estimated that plantains and other bananas provide nearly 60 million people in Africa with more than 200 calories (food energy) per day. Fruits such as plantain are an important contribution to the diets of many low and middle class people in many African settings (Stover and Simmonds, 1987).

Materials and Methods

Preparation and Extraction of Plantain Peels

Healthy ripe and unripe plantain fruits were obtained from Gbagi market, Ibadan, Nigeria and the botanical authentication was done at the department of Botany, University of Ibadan, Nigeria. The peels (ripe and unripe) were removed by hand and cut into smaller pieces for easy drying. The dried peels were ground using a milling machine. The powdery samples were packed into screwed bottles and labeled appropriately.

The aqueous and ethanolic extracts of each peel were prepared by soaking 50 grams of each dried powdery samples in 500ml of each solvent (water and ethanol) for 48hours, during which the mixture was intermittently shaken on a shaking orbit machine. It was later filtered through Whatman No 42 filter paper. The extracts were evaporated under reduced pressure at 40^0C by a rotary evaporator; final solvent elimination was done with water bath

Phytochemical analysis

Phytochemical screening of the peels was carried out on the aqueous extract and dried powdered specimens using standard procedures as described by

Harbone (1973) Sofowara (1993) and Trease and Evans (1989

Proximate analysis

Proximate analysis was carried out by the methods of Association of Official Analytical Chemists (AOAC, 1992). Crude protein (CP) was determined by multiplying crude nitrogen by 6.25 while total carbohydrate was obtained by simple difference and energy value was calculated using Atwater factor method by multiplying the fat, protein and carbohydrate by their respective physiological fuel values of 9.0, 4.0 and 4.0 kcal/g, respectively, and taking the sum of the products (Osborne and Voogt, 1978, Eneche, 1999). The moisture content (hot air oven method), crude fat (soxhlet extraction method) were determined by the method of Pearson (1976). Mineral elements were estimated after wet oxidation of samples (2g) using concentrated Nitric acid and Perchloric acid as described by Osborne and Voogt (1978). The concentrations of the minerals in the digested sample were estimated with the Pye-Unicam Atomic Absorption Spectrum and flame Photometer

Antimicrobial sensitivity test

The organisms used for this study include Staphylococcus aureus, Bacillus subtilis, Proteus mirabilis Pseudomonas aeruginosa, Aspergillus niger, Rhizopus nigricans and Fusarisceus oxysporum. The clinical isolates were obtained from Department of Microbiology, University of Ibadan, Nigeria.

100mg/ml of each peal extract solution was used as the highest extract concentration. This was obtained by dissolving 1g of the extract in 10ml ethanol (80%.BDH). 50mg/ml, 25mg/ml, 12.5mg/ml, 6,25mg/ml, and 3.01mg/ml test solutions were subsequently prepared by serial dilution, and ethanol was used as the diluent. The culture media used were carefully handled and prepared according to the manufacturer's instruction. They were all commercial products of Oxoid Ltd Company, England. Four bacteria (Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa, Proteus mirabilis,) and three fungi (Rhizopus nigricans, Fusarium oxysporum and Aspergillus niger) were used for this assay. The antibacterial and antifungal activities of the test sample were done using the agar well diffusion method (Stoke and Ridgeway, 1980). Tetracycline disc (Himedia standard) was studied for antimicrobial activity as a positive control and ethanol used for preparing extract served as a negative control. The inhibitory zones were measured in millimeters. Negative results were regarded as zones where no inhibition was observed. The study was performed in triplicate and the mean values were presented.

Results

Phytochemical Analysis

The phytochemicals present in the ripe and unripe peels of Musa pradisiaca are shown in the table below

Table 1: Phytochemicals present in Musa paradisiacal Ripe and Unripe Peels

Phytochemicals		Ripe peels		Unripe peels
Tannins		+		+
Phlobatannins		+		+
Flavonoids		+		+
Glycosidea		+		+
Terpenoids		+		+
Alkaloids		+		+

+= Present

Proximate Analysis

The proximate analysis of Musa paradisiacal peels (ripe and unripe) showed that the peels contain varying percentage content of carbohydrate, crude protein, fat, fibre, ash and moisture. The results are shown in table 2.

Table 2: Proximate composition of Musa paradisiacal peels (ripe and unripe)

Component		% Composition		
		Ripe peels		Unripe peels
Crude protein		7.18		6.89
Carbohydrate		42.95		48.18
Crude fat		6.22		3.67
Fibre		14.31		16.20
Ash		22.30		17.59
Moisture		7.04		7.47

Mineral analysis

Musa paradisiaca peels were found to contain Calcium, Maganese, Potasium, Sodium, Iron, Zinc, Phosphorus, Nitrogen, and Copper. Both peels showed relatively high level of sodium, iron and maganese (Table 3)

Table 3: Mineral composition of Musa paradisiacal peels (PPM)

Minerals (PPM)	Na	Mn	Ca	Zn	Cu	N	K	Fe
Ripe peel	84.53	18.82	2.41	1.01	1.89	1.15	3.96	27.83
Unripe peel	84.33	12.34	2.55	1.12	1.70	1.10	3.98	42.38

Values are means of triplicate determinants

Antimicrobial Activity

Musa paradisiaca peel extracts (ethanolic) were effective against most of the bacteria and fungi isolates used for the antimicrobial screening (Tables 4,& 5).

Tabe 4: Diammeter (mm) of inhibition zones of microbial growth by ethanolic extract of Musa paradisiacal unripe peel

	Concentration of extract (mg/ml)						
Microorganisms	100.0	50.0	25.0	12.5	6.25	3.10	Standard
Pseudomonas aureginosa	8.2	5.7	4.9	2.7	1.8	Nil	14.6
Staphylococcus aureus	7.8	6.3	5.5	3.1	2.7	Nil	17.5
Proteus mirabilis	8.3	5.8	4.5	2.6	Nil	Nil	12.6
Bacillus subtilis	5.4	3.5	Nil	Nil	Nil	Nil	14.3
Aspergillus niger	4.6	3.4	2.9	1.6	0.5	Nil	11.7
Fusarisceus oxysporum	2.1	1.3	Nil	Nil	Nil	Nil	13.8
Rhizopous nigricans	3.4	0.8	Nil	Nil	Nil	Nil	12.8

Values means of triplicate determinants. Nil= no inhibition

Tabe 5: Diammeter (mm) of inhibition zones of microbial growth by aqueous extract of Musa paradisiaca ripe peel

	Concentration of extract (mg/ml)						
Microorganisms	100.0	50.0	25.0	12.5	6.25	3.10	Standard
Pseudomonas aureginosa	7.2	4.6	2.0	2.7	Nil	Nil	14.6
Staphylococcus aureus	7.7	5.3	2.2	1.1	0.4	Nil	17.5
Proteus mirabilis	6.3	3.8	3.5	2.0	Nil	Nil	12.6
Bacillus subtilis	6.4	3.1	Nil	Nil	Nil	Nil	14.3
Aspergillus niger	4.6	3.4	2.6	1.4	0.5	Nil	11.7
Fusarisceus oxysporum	2.1	0.9	Nil	Nil	Nil	Nil	13.8
Rhizopous nigricans	2.3	Nil	Nil	Nil	Nil	Nil	12.8

Values are means of triplicate determinants. Nil= no inhibition

Discussion

Documented information on the presence of some active substances in various plants, which basically serve as food and medicinal herbs abound, and are daily on the increase following continuous scientific investigations. Several works have been done to evaluate the phytochemical compositions and antimicrobial activities of different parts of diverse plants, with the aim of using these plants for the treatment of microbial infection as possible alternatives to synthetic drugs to which many infectious microorganisms have developed resistance. The objective of this study was to evaluate the phytochemical profile, proximate composition and antimicrobial sensitivity of Musa paradisiacal peels.

The bioactive compounds contained in plants are majorly responsible for their medicinal properties (Ighodaro *et al*, 2009). Flavonoids, tannins, phlobatannins, alkaloids, glycosides and terpenoids were found to be present in the ripe and unripe peels of Musa paradisiaca. These phytochemicals have been reported to exert multiple biological and pharmacological effects (antibacterial, anti-hypertensive, antidiabetic and anti-inflammatory activities (Middleton and Kandaswami, 1996). The presence of these bioactive substances in Musa paradisiaca peels therefore suggests that the peels possess valuable medicinal potential yet to be explored. Ripening which is often characterized with chemical changes appeared not to have qualitatively affected the phytochemical composition of Musa paradisiaca peels. Both peels (ripe and unripe) showed relatively high levels of sodium (84.33-84.53), iron (27.83- 42.38) and manganese (12.34-18.82) PPM (Table 3). The substantial amount of iron especially in the unripe peel of M. paradisiacal is important, as the element plays a critical role in blood formation and overall improvement of the haemopoetic system.

Sodium regulates the total amount of water in the body and also plays a role in nervous and muscular body functions. Many processes in the body, especially in the brain, nervous system, and muscles, require electrical signals for communication. The movement of sodium in and out of the cell is critical in generation of these electrical signals. Nonetheless, too much or too little sodium therefore can cause cells to malfunction, and extremes in the blood sodium levels (too much or too little) can be fatal. Increased blood sodium (hypernatremia) occurs whenever there is excess sodium in relation to water. There are numerous causes of hypernatremia, these may include kidney disease, too little water intake, and loss of water due to diarrhea. However, under normal physiological conditions, consumption of foods or food products with high sodium content may

contribute to hypernatremia. The level of sodium in M.paradisiaca peels (84.33-84.53) ppm though relatively high in respect to other minerals present in it, but not sufficient to predispose the consumers to hypernatremia when use in folklore medicine or in human/animal food formulation.

The results of the antimicrobial screening of the aqueous and ethanolic extracts of the peals against eight human pathogenic microbes, five bacteria and three fungi showed that both extracts were less effective as compared to a reference antibiotic, tetracycline. Staphylococcus aureus, Escherichia coli and Proteus mirabilis among other microbes were comparatively more inhibited by both extracts (Tables 6a &6b). These microbes are all bacteria, indicating that the extract of M.paradisiaca peels has more antibacterial than antifungal properties .The ethanolic extract exhibited higher antimicrobial activities at all concentrations compared to the aqueous extract (Tables 6a &6b). The microbes against which the extracts were effective are pathogens already implicated in the etiology and severity of human diseases. Thus, the plant extract may be useful in pharmaceutical and medical formulations. However, the possibility of further purification and formulation into antibiotics may be considered later.

These phytochemicals are bioactive and are responsible for the definite physiological effects exerted on the human body by various parts of plants (Ighodaro et al, 2009). Moreover, some of these biochemical components have been reported to exert multiple biological and pharmacological effects (antibacterial, anti-hypertensive and anti-inflammatory activities etc. (Middleton and Kandaswami, 1996). The presence of these chemicals in M.paradisiaca peels is therefore a strong indication that the peals possess valuable medicinal properties which are yet to be explored.

The mineral compositions of M.paradisiaca peels showed high levels of calcium, potassium and magnesium (1470.30mg/100g, 787.70mg/100g and 293.47mg/100g) as shown in Table 4. The calcium content is incomparably high. This result suggests that the leaves may be of great physiological significance especially in part of the world were muscle weakness, increased nervous system irritability and spontaneous action potential generation in neurons are relatively rampant. M.paradisiaca peels are also sources of sodium (47.37mg/100g), iron (26.25mg/100g). The levels of manganese (4.45mg/100g), copper (1.19mg/100g), Zinc (2.51mg/100g) and lead (0.4mg/100g) were quite low. The low content of heavy metals in the leaves is a beneficial in the light of the toxicity associated with heavy metal accumulation in the body.

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