Journal of Food Technology 6 (6): 263-266, 2008
ISSN: 1684-8462
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Chemical Composition of *Musa sapientum* (Banana) Peels

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Abstract: *Musa sapientum* peels were analysed for minerals, nutritional and anti-nutritional contents. The result of mineral content indicate the concentrations (mg g^{-1}) of potassium, calcium, sodium, iron, manganese, bromine, rubium, strontium, zirconium and niobium to be 78.10, 19.20, 24.30, 0.61, 76.20, 0.04, 0.21, 0.03, 0.02 and 0.02, respectively. The percentage concentrations of protein, crude lipid, carbohydrate and crude fibre were 0.90, 1.70, 59.00 and 31.70, respectively. The results indicate that if the peels are properly exploited and process, they could be a high-quality and cheap source of carbohydrates and minerals for livestock.

Key words: *Musa sapientum*, minerals nutrition and anti-nutritional factors, protien, carbohydrates, banana

INTRODUCTION

Musa sapientum which is commonly called banana is a herbaceous plant of the family *Musaceae*. It is known to have originated from the tropical region of Southern Asia. According to Leslie (1976), it is now cultivated throughout the tropics. Akinyosoye (1991) reported that the plant is cultivated primarily for its fruits and to a lesser extent for the production of fibre. It is also believed to be an ornamental plant.

The *Musa sapientum* grows up to a height of about 2-8 m with leaves of about 3.5 m in length. The stem which is also called pseudostem produces a single bunch of banana before dying and replaced by new pseudostem. The fruit grows in hanging cluster, with 20 fruits to a tier and 3-20 tiers to a bunch. The fruit is protected by its peel which is discarded as waste after the inner fleshy portion is eaten.

Musa sapientum fruits have been reported to prevent anaemia by stimulating the production of haemoglobin in the blood. Its role to regulate blood pressure has been associated with the high content of potassium (Akinyosoye, 1991). Banana helps in solving the problem of constipation without necessary resorting to laxatives. Wath and Brayer-Brand (1962) reported that banana can cure heart burns stress, strokes, ulcers and many other ailments. The peels have been reported to be useful in making banana charcoal, an alternative source of cooking fuel in Kampala. Kudan (1973) reported that the peels in conjunction with other substances create a liniment for reducing the acuteness of the arthritis aches and pains.

Considering the upsurge in the prizes of livestock feeds and their increasing demand, this study was conducted to provide information about the chemical composition, nutritional and anti-nutritional qualities of *Musa sapientun* peel which is often ignore and considered as waste could be domesticated for proper utilization as livestock feeds.

MATERIALS AND METHODS

Experimental: *Musa sapientum* fruits were collected along the banks of River Benue in Makurdi, Benue State, Nigeria in April, 2007. The sample was identified by Mr. Joshua Waya of the Department of Biological Sciences Benue State University, Makurdi. The peels were removed and air dried for 72 h and then oven dried at 45°C to constant weight. The sample was ground and stored in polythene container for analysis.

Determination of mineral content: About 0.1 g of ground sample was made into pellets of 19 mm diameter using 3 drops of an organic liquid binder (10% solution of styropore in toluene) and pressed afterwards using a pressure of 10 tons with a hydraulic press. Measurements performed using an annular 25 mCi ^{109}Cd as the excitation source, that emits Ag-K X-rays (22.1 keV) in which case all elements with lower characteristics excitation energies were accessible for detection in the sample, the spectra for the sample were collected for 3000 sec with the ^{109}Cd and the spectra were then evaluated using the AXIL-QXA Program (Funtua, 1999). Sodium was determined by Atomic Emission Spectrophotometer (AOAC, 1995).

Determination of Nutritional Content: The sample were analyzed for proximate composition (moisture, ash,

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organic matter, crude protein, lipids, carbohydrate and crude fibre). The moisture content of the peel was determined by oven drying to a constant weigh at 105°C. The Lipid was extracted with petroleum ether (40-60°C) using a soxhlet apparatus for 6 h. The Micro-Kjedahl procedure was adopted for the determination of protein. Carbohydrate was determined by difference (AOAC, 1995; Pearson, 1976)

Determination of Hydrogen Cyanide (HCN): About 10 g of sample was soaked in a mixture of 200 cm^3 of water and 10 cm^3 of orthophosphoric acid. The mixture was left for 12 h to release all bounded hydrocyanic acid. A drop of anti-forming (paraffin) and antibumping agents were added and the solution distilled until 150 cm^3 of the distillate was collected. About 20 cm^3 of distillate was taken into a conical flask and diluted with 40 cm^3 of water, 8.0 cm^3 of 6.0 mol dm^{-3} ammonium hydroxide (NH_4OH) and 2.0 cm^3 5% (w v^{-1}) potassium iodide (KI) solutions were added. The mixture was titrated with 0.02 mol dm^{-3} silver nitrate ($AgNO_3$) using a micro burette until a faint but permanent turbidity was obtained (1 cm^3 0.02 mol dm^{-3} $AgNO_3$ = 1.08 mg HCN) (AOAC, 1995).

Determination of phytate: About 4.0 g of sample was soaked into 100 cm^3 of 2% hydrochloric acid for 5 h and was filtered. About 25.0 cm^3 of the filtrate was taken into a conical flask and 5.0 cm^3 of 0.3% ammonium thiocyanate solution was added. The mixture was titrated with a standard solution of iron (III) chloride until a brownish-yellow colour persists for 5 min (Reddy, 1982).

Determination of oxalate content: Ground sample (1.0 g) was placed in a 250 cm^3 volumetric flask, 190 mL of distilled water and 10 mL of 6.00 MHCl was added. The mixture was warmed on a water bath at 90°C for 4 h; the digested sample was centrifuged at a speed of 2000 rpm for 5 min. The filtrate was diluted to 250 and 350 mL aliquots of the filtrates were evaporated to 25 mL and the brown precipitate was filtered off and washed. The combined solution and washing were titrated with concentrated ammonia solution until a faint yellow colouration was obtained using methyl orange as indicator. The solution was than heated to 90°C and the oxalate was precipitated with 10 mL of 5% calcium chloride solution. The solution was left overnight and than diluted to 125 mL with water after warming to 90°C and titrated against 0.05 M $KMnO_4$.

Determination of saponins: About 10 g of sample was taken into 100 cm^3 of 20% aqueous ethanol in water and m ixture agitated with a magnetic stirrer for 12 h at 55°C. The solution was filtered using Whatman No.1 filter paper and the residue was re-extracted with 200 cm^3 of 20% aqueous ethanol. The extracts were combined and reduced to about 40 cm^3 under vacuum using a rotary evaporator. The extract and 20 cm^3 diethyl ether were transferred into a 250 cm^3 separatory funnel and was shaken vigorously. The aqueous layer was discarded. The purification process was continued until a colourless aqueous extract was obtained. The pH of the aqueous solution was adjusted to about 4.5 by adding 4.0 g of sodium chloride and the solution was shaken with butanol. The butanoic extract was washed twice with 10 cm^3 of 5% sodium chloride and was evaporated to dryness in a fume cupboard, to give the saponin, which was weighed and expressed in percentage (Hudson and El-Difrawi, 1979).

RESULTS AND DISCUSSION

The result of mineral content (Table 1) shows the concentration of potassium to be highest (78.10 mg g^{-1}). The concentration (mg 100 g^{-1}) of calcium, sodium, iron and manganese were 19.20, 24.30, 0.61 and 76.20, respectively. The result agrees with Akinyoye (1991) that banana fruit has high concentration of potassium. The appreciable high content of potassium signifies that if the peel is taken, it will help in the regulation of body fluids and maintained normal blood pressure. It will also help in controlling kidney failure, heart oddities and respiratory flaw. Iron concentration was lowest, although, much lower values had been reported for the fruit (Feming, 1998). Iron carries oxygen to the cells and is necessary for the production of energy, synthesis of collagen and the proper functioning of the immune system. Its low concentration implies that banana peel will be an idyllic source of iron since, its excess is implicated in abnormal functioning of the immune system, cell growth and the heart (Feming, 1998). Manganese known to aid formation of skeletal and cartilage was also found to be high (76.20 mg 100 g^{-1}). Manganese dearth is scarce but could affect glucose tolerance, normal reproductive, skeletal and cartilage formation (Smith, 1996). The concentrations of the non-essential minerals bromine, rubidium, strontium,

Table 1: Minerals composition of *Musa sapientum* peel

Element	Concentration (mg g^{-1})
Potassium	78.10±6.58
Calcium	19.20±0.00
Sodium	24.30±0.12
Iron	0.61±0.22
Manganese	76.20±0.00
Bromine	0.04±0.00
Rubidium	0.21±0.05
Strontium	0.03±0.01
Zirconium	0.02±0.00
Niobium	0.02±0.00

zirconium and niobium were found to range between 0.21-0.02 mg 100 g^{-1}. The result implies that banana peel contained very low concentrations of the non essential minerals.

Table 2 shows the result of moisture content of the peel to be 6.7%. The value is relatively low and may perhaps be due to the time of harvest. The low value also designate that the peel can be amass for a long time without growing moldy. The ash content was found to 8.50% (Table 2). This value is analogous to other staples measured as good sources of minerals (Mirconi *et al*., 1997). The organic matter content was found to be 91.50%. Organic matter measures the nutritional value (lipids, proteins and carbohydrate) of a plant material. The high value indicates that banana peels are good sources of nutrients.

The content of protein, lipid, carbohydrates and crud fibre (Table 2) was found to be 0.9, 1.7 59 and 31.70%, respectively. The values indicate that the peel could be a good source of carbohydrates and fibre. The high fibre content also indicates that the peels could help treat constipation and improve general health and well being. The value obtained compared favorably with the recommended amount (18-32 g) per day for an average man.

The result of anti-nutrients indicate the concentrations of hydrogen cyanide to be 1.33 mg g^{-1}. Hydrogen cyanide is an extremely poisonous substance formed by the action of acids on metal cyanides. Gettle and Baine (1938) reported large dose of hydrogen cyanide can cause death within few min. While, smaller dosages may result to stiffness of the throat, chest, palpitation and muscle weakness. The result obtained falls within the threshold value (0.5-3.5 mg g^{-1}) reported as safety limit. The oxalate content of the peel was found to be 0.51 mg g^{-1} (Kumar, 1991). Oxalate consumption had been associated with kidney diseases which may result to death. It decreases the availability of essential minerals like calcium. The result obtained is low compared to 0.7 mg g^{-1} reported by Gontzea and Surtzesea (1968) for cocoyam. Phytate content was found to be 0.28 mg g^{-1}. this result is low compared to the 146-353, 206-208 mg g^{-1} reported for maize and sorghum, respectively. Saponin content was 24%. Eric (1978) observed that saponin consumption can result to paralysis of the sensory system. It is found to inhibit growth in swine and poultry; though, it increases the excretion of cholesterol in the body (Anhwange *et al*., 2006). The value obtained is relatively high compared to the 3.00% reported by Kumar (1991) as the minimum safe value for animal especially cattle.

Table 2: Proximate composition and anti-nutritional content of *Musa sapientum* peel

Parameter	Concentration
Moisture (%)	06.70±02.22
Ash (%)	08.50 ±1.52
Organic matter (%)	91.50±0.050
Protein (%)	00.90±0.250
Crude Lipid (%)	01.70±0.100
Carbohydrate (%)	59.00±1.360
Crude Fibre (%)	31.70±0.250
Hydrogen cyanide (mg/g)	01.33±0.100
Oxalate (mg g^{-1})	00.51±0.140
Phytate (mg g^{-1})	00.28 + 0.06
Saponins (mg g^{-1})	24.00±0.270

CONCLUSION

The study of the anti-nutrient content of the peel indicates generally low values except saponins. This means that if the peels are properly processed could be good source of feed for livestock.

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