# Preliminary Study on the Potassium content of Nigerian Bananas and the Methanolic Extraction, Phytochemical and Antimicrobial Studies of Oils from Banana Peels

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*Abstract*— **Banana is eaten all over the world by all sections of the population. It is known to contain potassium and it has been suggested that it could serve as a source of potassium. Recently, a valuable chemical component, a lectin, called BanLec, was isolated from banana fruit and found to possess anti-HIV-1 activity. However, the peels of banana are thrown away as rubbish and farmers are known to use them as feed for their animals. It is therefore necessary to determine the potassium content of some Nigerian bananas and to also extract the oils from their peels. The components of the extracted oils are to be determined and tested for their biological activity. The potassium content of five (5) varieties of Nigerian bananas (Dwarf Cavendish AAA GP; Lady Finger AA GP; Dwarf Chinese Double; Double Dwarf Senorata AA GP; Giant Cavendish (Williams) AAA GP and Dwarf Red AAA GP) was determined using flame photometer. The potassium content varied from 0.15 mg/g (Dwarf Red) to 1.80 mg/g (Lady Finger). Compared to the value of 358 mg per 100 g reported in the literature, these values are very low and considerable lower than the RDA of 4700 mg. The conclusion is that Nigerian bananas will not be a viable source of potassium for candidates with potassium deficiency. A report on the methanolic extract of oil from their peels is given. Two (2) of the five (5) varieties were chosen and methanolic extraction of oils from their peels was undertaken. The crude extract was subjected to phytochemical analysis, which revealed the presence of the following of steroids, saponin and terpenoids, anthraquinones and tannins. A report is also given on antimicrobial studies of the methanolic extracts, which revealed that the oils were effective against some bacteria.**

*Index Terms—Banana, Musa acuminata colla, Musa sapientum, methanolic extraction, phytochemical study, microbial study*

## I. INTRODUCTION

There are different varieties of banana in Nigeria and bananas are excellent sources of potassium, an essential mineral for maintaining normal blood pressure and heart function. It has been suggested that banana could well be a potential source of potassium for people who suffer from potassium deficiency. Potassium or lack of it has been implicated in several physiological and health issues. So it is of interest to determine the amount of potassium in banana to know if by eating banana one could acquire enough potassium required for physiological functions and activities. For example, the importance of potassium ion, $K^+$, in the $Na^+/K^+$ pump is well known; its ability to maintain normal fluid and electrolyte balance, as well as facilitating many reactions, supporting cell integrity and in assisting nerve impulse transmission and muscular contraction. Lack of or deficiency in potassium has been implicated in health issues such as muscular weakness, paralysis and confusion as well as potassium's ability to stop the heart if given into the vein; and high blood pressure is associated with low potassium and it has been suggested that high intake of potassium can prevent and correct hypertension [1-3].

An average banana has been reported to contain 467 mg of potassium and only 1 mg of sodium. A banana a day may help to prevent high blood pressure and protect against atherosclerosis. Bananas have long been recognized for their antacid effects that protect against stomach ulcers, heart burns, stress, strokes, pain relief, swelling, itching, bruising, wrinkles, sunburn, gonorrhea and many other ailments. Some of these substances in bananas help activate the cells of the stomach lining, stimulating cell proliferation which thickens the stomach mucosa and act as barrier against stomach acids while others like protease inhibitors help eliminate bacteria in the

stomach that are the primary cause of stomach ulcers [4-13]. Animal studies have shown that banana has the potential to lower cholesterol. It was suggested that the dietary fibre component in banana pulp was responsible for its cholesterol-lowering effect. The amount of dietary fibre in banana is relatively constant during banana ripening [14].

They are a good source of carotenoids, which are antioxidants and have a protective effect against chronic disease conditions. Bananas also have a high content of antioxidant phenolic compounds [15-17]. High in iron [18], bananas can stimulate the production of haemoglobin in the blood and so help in cases of anaemia [19].

Banana peels are rich in fibres and polyphenols, but their composition is dependent on the variety and maturation of the banana [20]. The peels are also rich in carbohydrates and other basic nutrients that can support yeast growth [21-23].

Although banana peels contain low quantities of lignin, they have found use in making charcoal and for the production of value-added products like ethanol, both alternative sources of energy [24, 25].

It is known that banana is a source of potassium and it has been recommended that adult humans consume 4700 milligrams (mg) or more of potassium per day, so it is necessary to determine the potassium content from this source. From the available literature, information is lacking on the potassium content of different varieties of Nigerian banana, so it important to acquire valuable information and to know which variety can provide the most source of potassium. However when banana is consumed the peels are thrown away as waste despite the fact that they are rich in carbohydrate, fibres and polyphenols and their dumping in some cases cause environmental pollution. This agricultural waste is under-utilised, though farmers use it as livestock feed. There is therefore the need to find useful applications for banana peels.

Experiments indicate that if the peels are properly exploited and processed, they could provide high-quality and cheap source of carbohydrates and minerals for livestock [26-28].

The antibacterial and antimicrobial activities, dyeing performance, and effectiveness of banana peels extract have been reported [28-31].

Recently a jacalin-related lectin, BanLec was isolated from banana fruit, *Musa acuminata*, and was found to inhibit primary and laboratory-adapted HIV-I isolates of different tropisms and subtypes. It possessed potent anti-HIV activity and was found to block HIV-I cellular entry as indicated by temperature-sensitive viral entry studies [32].

With these reports in mind it was decided to investigate efficacy of Nigerian bananas with an initial main objective of identifying and characterizing the chemical constituents of the banana peels.

## II. MATERIALS AND METHOD

The bananas, Lady Finger AA GP (*Musa acuminata colla*), Double Dwarf Senorata AA GP (*Musa acuminata colla*), Dwarf Chinese Double (*Musa acuminata colla*), Giant Cavendish (Williams) AAA GP (*Musa acuminata colla*), and Dwarf Red variety AAA GP (*Musa acuminata colla*) used in this study were obtained from the local market and their classification confirmed in the Botany Unit of the Biological Sciences department of Covenant University.

For sodium and potassium content, eighty (80) g of each of the five varieties of Nigerian banana (minus the peel) was weighed, crushed with a blender to a homogenous solution with a minimum amount of distilled water. Thereafter 100 $cm^3$ of 1 mol $dm^{-3}$ HCl (Sigma-Aldrich) was measured and added to each banana solution and placed in an electric shaker set at 200 rpm for 1 h, to ensure homogeneity and complete extraction into solution of potassium and sodium and then centrifuged at 3000 rpm for 30 min for complete separation of the solid particles from the solution. The supernatant layer was collected and stored in polyethylene bottles prior to metal analysis. The clear liquid (0.5 $cm^3$) was pipetted into a 100 $cm^3$ standard flask and made up to mark with water. This solution was then analysed for potassium and sodium using flame photometer (Jenway PFP 7). The flame photometer was calibrated with standard solutions of potassium chloride (Sigma-Aldrich).

For oil extraction from the banana peels (two varieties were chosen – *Musa acuminata colla* (Lady Finger AA GP) and *Musa sapientum*) about 300 g of the peel was chopped up and put into a thimble for exhaustive Soxhlet extraction using reagent grade methanol as solvent. The methanol was removed on a rotary evaporator to give dark brown oil with chocolate-like smell. Hexane as solvent for extraction was attempted on one banana variety to give clear yellowish oil. The amount of oil obtained from the hexane extraction was very small compared to the amount obtained with methanol as solvent. The oils obtained were stored away from light prior to analysis.

The following microorganisms were used to test the antimicrobial activity of the methanolic extract: *Bacillus spp., Pseudomonas spp., Escherichia coli, Staphylococcus aureus, Streptococcus spp., Klebsiella spp., Proteus spp. and Salmonella spp.* 1 g of the test compound was dissolved in 10 $cm^3$ of 50% DMSO. The agar well diffusion method was used and the bacteria isolates were standardised with 0.5 M MacFaland standard solution. The isolates were subcultured using nutrient agar and incubated for 24 h at 37°C. 0.3 $cm^3$ of the DMSO solution was then introduced into the bore hole to test for antimicrobial activity. Gentamycin antibiotic was the standard used for analysis. The activity index was computed by subtracting the diameter of the well from the diameter of the clearing zone divided by the diameter of the well.

## III. RESULTS AND DISCUSSION

The analysis of the results from the flame photometer indicated the potassium content as shown in Fig. 1. The highest potassium content was found in Lady Finger banana variety.

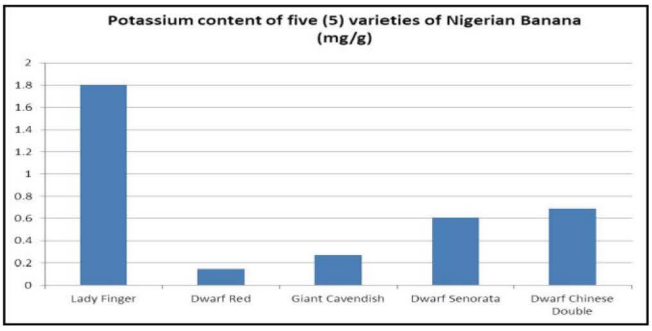


Fig. 1. Potassium content of five (5) varieties of Nigerian bananas (mg/g)

This preliminary finding shows that of the varieties, the Lady Finger variety with 1.80 mg of potassium per gram of banana had 3 times more potassium than the Dwarf Senorata and Dwarf Chinese Double varieties; 6 times more than Giant Cavendish and 12 times more than the Dwarf Red variety. These bananas are grown in different regions of Nigeria, could it then be that the nature of the soil has some influence on the potassium content of the banana?

The potassium content obtained for these varieties of Nigerian banana, when compared to an average value of 3.58 mg of potassium in 1 g of a different variety of banana [33], are significantly smaller. Lady Finger, the banana with the highest potassium content (1.8 mg/g) has about half this average value.

Qualitative phytochemical screening of the methanolic extract of the two bananas shows (TABLE I.) the presence of saponin, anthraquinones, terpenoids, steroids, tannins and trace amounts of phenols. Some of these compounds have been reported to be present in peel extracts [34].

TABLE I. PHYTOCHEMICAL SCREENING TEST FOR CRUDE METHANOLIC EXTRACT (+ PRESENT AND – = ABSENT)

| | ***Musa acuminate colla* (Lady Finger AA GP)** | ***Musa sapientum*** |
|---|---|---|
| Saponin | – | – |
| Anthraquinones | – | ++ |
| Terpenoids | ++ | ++ |
| Tannins | ++ | ++ |
| Steroids | ++ | ++ |
| Phenols | Trace | Trace |
| Flavonoids | – | – |

TABLE II. ANTIMICROBIAL TEST RESULTS ON THE CRUDE METHANOLIC EXTRACT (R = NOT RESPONSIVE)

| **Organism** | **Clearing zone (mm) Sample (0.3 $cm^3$)** | | | **Activity Index** | |
|---|---|---|---|---|---|
| | ***Musa acuminata colla*** | ***Musa sapientum*** | **Gentamycin Standard** | ***Musa acuminata colla*** | ***Musa sapientum*** |
| *Bacillus spp.* | 9.00 | 7.00 | 26.00 | 0.65 | 0.73 |
| *Staphylococcus aureus* | 12.00 | 7.00 | 25.00 | 0.52 | 0.72 |
| *Pseudomonas spp.* | 10.00 | 6.00 | 26.00 | 0.62 | 0.77 |
| *Escherichia coli* | 11.00 | 7.00 | 22.00 | 0.50 | 0.68 |
| *Streptococcus spp.* | 16.00 | 10.00 | 22.00 | 0.27 | 0.55 |
| *Klebsiella spp.* | 10.00 | 12.00 | 22.00 | 0.55 | 0.45 |
| *Proteus spp.* | 5.00 | R | 25.00 | 0.80 | – |
| *Salmonella spp.* | R | R | R | – | – |

Preliminary results of the antimicrobial tests (TABLE II.) showed that the extract was active against the test organisms used except *Salmonella spp*. *Proteus spp.* was also not responsive to *Musa sapientum*. The activity index for these extracts shown in the table it can be seen that they are effective against the bacteria shown, however not as effective as the Gentamycin standard. It is however thought that increasing the concentration of these extracts their effectiveness might be as high as that of Gentamycin standard.

## IV. CONCLUSION

The preliminary results from these experiments suggest that these bananas would not be significant sources of potassium since the highest potassium content is 1.80 mg in 1 g of banana from Lady Finger banana (*Musa acuminata colla*). The methanolic extracts were found to have antimicrobial activity against the test organisms used and we are making effort to identify the constituents of the extracts in order to identify the components that may be responsible for the antimicrobial activity.

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