Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2022; 11(2): 302-304
Received: 14-01-2022
Accepted: 21-02-2022

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Comparative study of the elemental compositions of banana (*Musa paradisiaca linn*) and plantain (*Musa × paradisiaca*) stalks cultivated in Ekpoma, Esan west local government area of Edo state

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DOI: https://doi.org/10.22271/phyto.2022.v11.i2d.14397

Abstract
The mineral compositions of banana (*Musa paradisiaca* Linn) and plantain (*Musa x paradisiaca*) stalks were investigated in this work. An atomic absorption spectrophotometer was used to examine the mineral element compositions. The mineral composition of banana and plantain stalks revealed that phosphorus concentrations were (0.550.13) mg/100g and (3.360.00) mg/100g, respectively; magnesium concentrations were (1.510.07) mg/100g and (2.220.02) mg/100g, respectively; iron concentrations were (2.000.30) mg/100g and (4.410.12) mg/100g, respectively; zinc concentrations were (1.900.01) mg/100g and (6.140.11) mg/100g. These results showed that these wastes have the potential to be good sources of mineral nutrients that can be utilized for more beneficial purposes.

Keywords: Mineral composition, Musa species, plant, stalks

Introduction

Medical researchers have discovered essential elements such as chromium, copper, iron, manganese, selenium, and zinc, and have been shown to prevent and reverse a wide range of disease and medical conditions. Many minerals are found in enzymes (protein-based molecules that speed up chemical reactions in living organisms), which act as catalysts for many of the chemical reactions that occur in the body [1]. Mineral elements also regulate and manage the normal function of human and animal organs, muscles, and tissues [1, 2].

Maintaining correct fluid balance requires sodium and potassium, Iron is crucial for delivering oxygen in the blood [3] and throughout the body [4]. Calcium is the key structural component in bones and teeth. Skin, hair, nails, teeth, bones, and all other tissues require minerals to be able to form [3]. In addition, minerals are also involved in several bodily functions, including controlling several systems within the body and in the production of energy [2].

Plantains and bananas are enormous perennial herbs that originated in Southeast Asia and belong to the genus Musa. Plantains and bananas are monocotyledonus plants, belonging to the section *Eumusa* within the genus *Musa* of the family *Musacease* in the other *Scitamineae*. Plantains (*Musa × paradisiaca*) and bananas (*Musa paradisiaca Linn*) are traditional staple foods in many countries throughout Africa, Asia, Oceania, and Central America [5]. By level of production in the world, Africa occupies a little over 50 percent out of this percentage (50%) West Africa alone produces about 61 percent [6].

Bananas (*Musa paradisiaca* Linn) can grow in a variety of soil types as long as they are at least 60 cm deep, drain well, and are not compacted. The leaves of banana plants are made up of a "stalk" (petiole) and a blade (lamina). The petiole's base stretches out to form a sheath, and the pseudostem, which is all that supports the plant, is made up of tightly packed sheaths [7]. A ripe banana fruit contains up to 22 percent carbohydrate, mostly in the form of sugar, and is high in dietary fiber, potassium, manganese, and vitamins B6 and C. Raw bananas (without the skin) are 75 percent water, 1 percent protein, and have very little fat. Plantain is a low protein food that is relatively high in carbohydrate, minerals, and vitamins. The edible fruit of plantain contains more starch than a banana and is usually cooked green, either boiled or fried. It can also be dried and ground for later use in cooking or eaten whole. In Nigeria, plantain intake has been observed in a number of food consumption surveys [8, 9].

However, despite the enormous importance of the *Musa* plant, the stalks generated after the fruits are harvested usually constitute huge waste together with the peels which in most cases are feed to animals. This study therefore focused on the evaluation of the mineral composition of the stalks to further validate and give more economic importance to these wastes.

Materials and Methods

Sample Collection and Preparation

Fresh plantain (*Musa × paradisiaca*) and banana (*Musa paradisiaca Linn*) stalks were obtained from a farm at Ekpoma, Esan West Local Government Area of Edo State. Ekpoma is located in latitude 6°45′N and longitude 6°08′E. The samples were broken into pieces and washed thoroughly under running water before air drying for two weeks. To extend the shelf life of the air dried samples, they were further dried in an oven at 105 °C for 4 hours to remove any remaining moisture before being pulverized using a Kenwood blender.

Mineral Analysis

The ground samples were first ash in a muffle furnace at 500 °C for 4 hours, then digested with 2 M HCl and made up to mark in a 100 cm^3 standard flask using deionized water. Standard curves of the various metals were prepared using analyte grade reagents of the metals of interest in the preparation of the standard solutions.

The mineral concentrations in the digests/standard solutions were analyzed using an Atomic Absorption Spectrophotometer (Model 403, Perkin-Elmer, Norwalk, CT, USA) in accordance with A.O.A.C. [10] method. All mineral concentrations were measured in mg per 100 grams of dry sample weight. Triplicate determination was done and values expressed in mean ± standard error.

Results and Discussion

Mineral element concentration in plants is heavily influenced by the amount of these elements in the soil, as well as fertilizer application rates [11]. From the analysis, plantain stalk had the highest concentrations as compared to that obtained from banana stalk for all the mineral elements concentration analyzed as shown in Figure 1 below. However, there was no statistical significant difference between the values using t-student test at 95% confidence limit.

From the result obtained, level of calcium (Ca) in banana was (2.59±0.01) mg/100g and plantain stalk (3.30±0.13) mg/100g, while level of phosphorus (P) in banana was (0.55±0.13) mg/100g and plantain stalk was (3.36±0.00) mg/100g. The adult body has roughly 1,200 g of calcium, with the skeleton accounting for nearly all of it, and skeleton growth necessitates a positive calcium balance until peak bone mass is reached [12]. For a 70 kg man, the dietary requirement for calcium is 800 mg [12]. Although many healthy adults ingesting up to 2,500 mg of calcium per day have shown no detrimental effects, high calcium intakes can cause constipation and put up to half of otherwise healthy hypercalciuric males at risk of urinary stone development [12]. Intestinal absorption of iron, zinc, and other important minerals may be hampered by a high calcium intake [13]. In both sexes, excessive calcium consumption can cause hypercalciuria, hypercalcemia, and worsening of renal function [14].

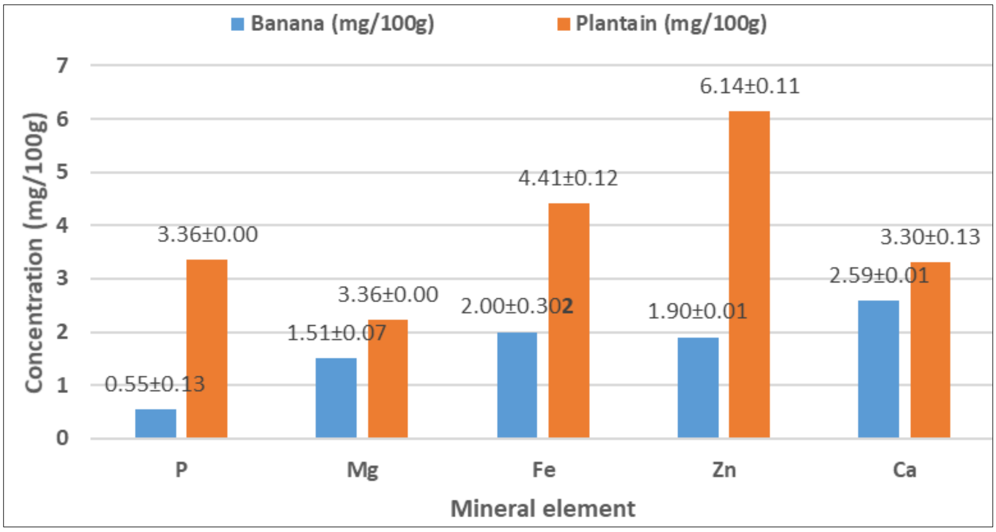

Fig 1: Mineral element concentrations in the stalks samples analysed.

The magnesium (Mg) concentrations in banana and plantain stalk were (1.51±0.07) and (2.22±0.02) mg/100g respectively. Mg improve blood sugar control by increasing cells' response to insulin, a hormone that regulates blood sugar levels. In fact, magnesium-rich diets have been associated with up to a 14% reduced risk of diabetes [15, 16]. Mg is required for a variety of processes, including energy generation, oxidative phosphorylation, and glycolysis. It also aids in the active transport of calcium and potassium ions across cell membranes, which is necessary for nerve conduction, muscle contraction, and normal heart rhythm [17].

Iron (Fe) is involved in a variety of biological processes and has a unique role in the metabolic process [18]. The Fe concentration of (4.41±0.12) mg/100g obtained for the plantain stalk was higher than the value (2.00±0.31) mg/100g recorded for banana. The function of iron in the organism is obviously linked to hemoglobin and oxygen transmission from the lungs to tissue cells [19]. Human Fe insufficiency is the most common nutritional deficit [20]. Fe is a vital element for both humans and animals, and it is a component of hemoglobin. It aids in the oxidation of carbs, proteins, and fats, which helps to manage body weight, which is a key factor in diabetes [21].

The zinc (Zn) concentrations were (1.90±0.01) mg/100g and (6.14±0.11) mg/100g for banana and plantain stalks respectively. By stabilizing the molecular structure of cellular components and membrane structures, Zn aids in the maintenance of cell and organ integrity [22]. Zn is used for treatment and prevention of zinc deficiency and its consequences, including stunted growth and acute diarrhea in children, and slow wound healing. It's also used to strengthen the immune system, treat the common cold and recurring ear infections, and prevent infections in the lower respiratory tract.

Conclusion
Plantain stalks had higher concentration of the mineral elements than banana stalks. Both stalks had concentrations of mineral elements that present them as good sources for the analyzed elements. Therefore, these wastes have the potential to be good sources of mineral nutrients for animal feed production, and their use for this reason should be encouraged, as it will also help to reduce waste in the environment.

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