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Full Length Research paper

Plantain (Musa Paradisiaca) waste flour's proximate and mineral composition: A possible source of nutrients for animal feed formulation

Rodríguez* and Ramírez

University of Carabobo, Carabobo, Venezuela

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In the tropics, plantain fruit is a staple food and a significant source of energy. While the bracts, fruit stalk, and leaf are left on the farm as waste, the fruit's peel is thrown away as waste once the edible portion is consumed, endangering the environment, particularly in areas where it is often consumed. In several nations, these waste materials have been contemplated for use as organic fertilizer. The purpose of this study was to ascertain the mineral and proximate composition of plantain (Musa paradisiaca) waste flour as potential sources of nutrients for animal feed formulation. The atomic absorption spectrophotometric method and standard AOAC analysis techniques were used to ascertain the proximate and mineral composition of plantain wastes (bract, ripe peel, fruit stem, and leaf). 9.39 to 9.53g of moisture, 1.87 to 19.37g of crude protein, 0.73 to 1.83g of crude fat, 8.10 to 15.50g of crude fiber, and 54.00 to 68.00g of carbohydrates per 100g sample were all present in the trash. Iron (10.50–14.00 mg), calcium (120.00–150.00 mg), and phosphorus (110.00–180.00 mg) are all abundant in plantain bracts per 100g sample. Because plantain wastes are rich in protein, fiber, and vital minerals, they can be used as a source of nutrients when making animal feed. Since the waste would have been an annoyance to the environment, this will have the twin benefits of being used as animal feed and a proper plantain waste management (waste reduction) approach.

Key words: Proximate and mineral composition, Animal feeds, Plantain waste management.

INTRODUCTION

One of the most significant tropical plant crops is the plantain. It is a member of the genus Musa and the family Musaceae. Musa paradisiaca is a tropical plant native to India that is also called "plantain" in English, "Ogede agbagba" in Yoruba, "Ayaba" in Hausa, and "Ogadejioke" in Igbo. With a lifespan of roughly 15 years (Philips, 1982), the plant has long, overlapping leaf stalks and a 1.22–6.10 m high stem (Oladiji et al., 2010). Each individual plantain in the cluster, which grows in clusters, is slightly longer than a banana fruit and has a diameter of around 1 inch. Eight to twelve months after planting, or roughly two and a half to four months after shooting, are needed for plantain fruit to be ready for harvest (Swennen, 1990a).

Because of its high fiber content, plantains can reduce cholesterol, ease constipation, and prevent colon cancer. In addition, its high potassium content has been shown to help reduce muscle cramps and elevated blood pressure (Ng and Fong, 2000). The plant's leaves, root, fruit stem, bract, and fruit have all been utilized for household and therapeutic reasons. The leaves serve as an arbortifacient, the fruit is eaten, and the leaf juice is applied to cuts, wounds, and insect bites. Its sap is used to treat epilepsy, hysteria, dysentery, and diarrhea. Anaemia and venereal disorders are treated with a cold infusion of the root. Furthermore, the fruit has purportedly been used as a diuretic, aphrodisiac, and antiscorbutic (Gill, 1992). 100g of plantain that was edible included 67.30g of moisture, 0.4g of crude fat, 31.15g of carbohydrates, 0.95 mg of potassium, 35.1 mg of sodium, 71.5 mg of calcium, 28 mg of phosphorus, 2.4 mg of iron, and produced 116 kcal of energy, according to Adeniji et al. (2006). According to Osma et al. (2007), plantain peels are by-products of the plantain processing industry and are typically disposed of in rivers, landfills, or unregulated areas. After the fruit's fleshy inside is consumed, the peel is thrown away as waste, endangering the ecosystem, particularly in areas where eating it is widespread. According to Omole et al. (2008), snails may be able to replace corn starch in their diet with the peel, but bracts, fruit stalks, and leaves are occasionally discarded on farms. After being chopped, fermented, and dried, leaves, pseudostems, fruit stalks, and peels produce a meal that is marginally more nutrient-dense than alfalfa press-cake. In Somalia, these waste products have been contemplated for use as organic fertilizer. Pigs fed pseudostems in Malaya are less likely than those fed other diets to develop liver and kidney parasites.

This study was carried out to ascertain the proximate and mineral composition of Musa paradisiaca wastes (bracts, fruit stalk, leaf, and peel) flour for potential use as livestock feeds due to the need for waste management, the rise in the prices of livestock feeds, and their growing demand.

MATERIALS AND METHODS

Plantain Wastes Sample Preparation

Plantain bracts, fruit stalks, and leaves were gathered at a plantation in Ilesa, Osun State, Nigeria, while ripe plantain fruit was bought in Oje market in Ibadan, Oyo State. After removing the peel, bract, fruit stem, and leaves, they were cleaned with distilled water, allowed to sun-dry for 168 hours, and then oven-dried at 1050C until their weight remained constant. After being ground and run through a 0.1 mm mesh screen, the samples were kept in a polythene container until they were required for analysis.

Chemicals and Reagents

All the chemicals and reagents used in this study were of analytical grade and were products of British drug House Laboratory, England.

Proximate Composition

The Association of Official Analytical Chemists' established methods of analysis were used to evaluate the samples' proximate nutritional makeup (AOAC, 1995).

The samples' moisture content was ascertained using the Gallenkamp air oven method at 1050C. The micro-Kjeldahl technique was used to evaluate the samples' crude protein content. Petroleum ether was used as the extracting solvent in the Soxhlet extraction procedure to assess the crude lipid content. A muffle furnace heated at 5500C for four hours to achieve a consistent weight of ash was used to measure the amount of ash present. The Saura-Calixto et al. (1983) method was used to calculate crude fiber. The difference was used to determine the carbohydrate content.

Mineral analysis

By digesting the sample ash with nitric acid and perchloric acid, potassium and sodium were measured using a Jenway digital flame photometer/spectronic 20 (Bonire et al., 1990).

The vanado-molybdate colorimetric method was used to determine phosphorus (Ologhobo and Fetuga, 1983). Using a Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk), calcium, magnesium, and iron were measured spectrophotometrically (Essien et al., 1992). The absorption of these minerals was compared to the absorption of standards.

Statistical analysis

All determinations were carried out in triplicates. Descriptive statistics, analysis of variance (ANOVA) and Duncan Multiple Range Test were used to interprete the results obtained, and the level of significance was set at $p \leq 0.05$.

RESULTS

Table 1 displays the findings of the plantain wastes' proximate nutritional composition. Plantain wastes had a very low residual moisture content (less than 10g/100g sample). The moisture content of the fruit stem, ripe peel, and bracts was substantially lower than that of the leaf ($p<0.05$), although it was not significantly different from one another ($p>0.05$). The waste products' protein contents varied greatly from one another, with the highest protein level found in leaves and the lowest in bracts and fruit stalks. While there was no significant difference in the crude lipid content of bracts and leaves, there was a significant difference ($p<0.05$) between ripe peel and fruit stem. Every sample had a notably varying ash value, with the leaf having the lowest value and the mature peel and fruit stem having the highest. The waste items' crude fiber content varied significantly from one another, with the highest value found in fruit stalks, followed by ripe peel, bracts, and leaves ($p<0.05$). The sugar the peel had the highest concentration, while the leaf had the lowest ($p<0.05$).

Table 2 displays the mineral makeup of plantain wastes. All of the mineral values for each sample varied significantly from one another. The leaf sample had the highest levels of calcium and phosphorus ($p<0.05$), ripe peel had the highest levels of sodium, and bract had the highest levels of potassium, magnesium, and iron.

Table 1. Proximate composition (Dry Matter, DM) of plantain wastes flour (g/100g)

Sample	Bract	Ripe peel	Fruit stalk	Leaf	Mean
Moisture	9.5^{b}±0.1	9.5^{b}±0.2	9.5^{b}±0.1	9.4^{a}±0.3	9.4±0.3
Protein	11.5^{c}±0.2	2.3^{b}±0.6	1.9^{a}±06	19.4^{d}±0.3	8.7±0.5
Crude lipid	1.8^{c} ±0.1	0.9^{b}±0.1	0.7^{a}± 0.6	1.8^{c}±0.6	1.3±0.5
Ash	7.8^{b}±0.6	8.9^{c}±0.6	9.1^{d}±0.6	7.2^{a}±0.1	8.2±0.8
Crude Fibre	8.5^{b}±0.1	10.4^{c}±0.6	15.5^{d}±0.1	8.1^{a}±0.2	10.6±3.1
Carbohydrates	60.9^{b} ±0.5	68.0^{d}±0.3	63.3^{c}±0.2	54.6^{a}±0.3	61.7±5.1

All data were mean ± standard deviation of triplicate determinations
Means within the same column with the same subscripts were not significantly different (Duncan's test)

Table 2. Mineral composition (Dry Matter, DM) of plantain wastes flour (mg/100g)

Sample	**Na**	**K**	**Ca**	**Mg**	**P**	**Fe**
Bract	280.0^{b}±0.0	40.0±0.0	135.0±0.0	18.0^{d}±0.0	151.7^{c}±2.9	14.0^{c}±0.0
Ripe peel	315.0^{c}±12.0	35.0±0.0	120.0±0.0	14.5^{b}±0.0	145.0^{b}±0.0	12.3^{b}±0.3
Fruit stalk	253.3^{a}±5.8	30.0±0.0	125.0±0.0	15.3^{c}±0.3	110.0^{a}±0.0	12.1^{b}±0.1
Leaf	280.0^{b}±23.2	35.0±3.7	150.0±0.0	12.3^{a}±0.3	180.0^{d}±0.0	10.5^{a}±0.0

All data were mean ± standard deviation of triplicate determinations
Means within the same column with the same subscripts were not significantly different (Duncan's test)

DISCUSSION

The samples' moisture content (Table 1) was much higher than the value documented in the literature (5.43%, USDA, 2009). The freshness and shelf life of foods and processed goods are indicated by their moisture content; high moisture content makes food items more susceptible to microbial spoiling and short shelf life, which can cause degradation (Adepoju and Onasanya, 2008). In comparison to other plant protein sources, the crude protein content of the leaf and bract samples was comparatively high. They surpass those of cocoyam leaves (Adepoju et al., 2006), amaranthus, and shea butter fruit pulp (Adepoju and Ketiku, 2003). When compared to other commonly consumed staple roots, tubers, and fruits, the protein content of plantain ripe peel and fruit stalk powder was low (Aurand, 1987; USDA, 2009), significantly lower than that of leaf and bract samples ($p<0.05$), but higher than that of fluted pumpkin pod and pulp (Essien et al., 1992). Protein's primary role in nutrition is to provide an appropriate supply of necessary amino acids, making it a necessary part of both animal and human diets for survival.

The samples of plantain wastes had extremely low crude fat content, and they might not be a suitable source of fat-soluble vitamins or be able to make a substantial contribution to the calorie content of the feeds made from the wastes. The fat content of the plantain fruit was highest in the bract and lowest in the stalk. Their low fat content will prolong the flour's shelf life by decreasing the likelihood of rancidity. Comparatively speaking, the samples' ash level was larger than that of other studies on plantain peels (Adeyi and Oladayo, 2010) and agricultural hulls (Adebowale and Bayer, 2002). The high ash readings were a sign that the wastes contained a lot of minerals, particularly macrominerals. The fruit stalk and plantain leaf had the greatest and lowest ash values, respectively. The crude fiber content of the plantain wastes was significantly higher than that of plant products such fruit pulp (4.3g/100g, Adepoju and Adeniji, 2012) and ube (Dacryodes edulis) (2.1g/100g, Adepoju and Adeniji, 2008). The increase could be explained by the plantain waste's high total dietary fiber content, particularly in the peel (Haslinda et al., 2009). Crude fiber content was highest in the plantain fruit stalk, followed by mature peel, and lowest in the leaf. A high fiber diet has been shown to promote the removal of possible mutagens, steroids, and xenobotics by binding or absorbing to the fiber components and facilitating digestion. As a result, these wastes will have positive health effects for fish and cattle farms. The samples had a high carbohydrate content and might provide the animals with a strong source of energy. Carbohydrate content was highest in the peel and lowest in the leaf.

The samples had low levels of iron and magnesium but high levels of calcium, phosphorus, potassium, and sodium (Table 2). The leaf had the most calcium and phosphorus content, the peel had the highest sodium level, and the bract had the highest potassium, magnesium, and iron content. Iron, phosphorus, and calcium can all be found in good amounts in the feces. Strong bones and teeth, growth, blood coagulation, heart function, and cell metabolism all depend heavily on calcium and phosphorus (Roth and Townsend, 2003; Rolfe et al., 2009). Potassium is a crucial basic ingredient for making soap and neutralizing soil (Adeolu and Enesi, 2013). The wastes had a greater iron content than fresh and roasted Dacryodes edulis fruit (7.0 mg and 3.0 mg/100 mg, respectively, Adepoju and Adeniji, 2008) and dried guinea corn leaf extracts (1.2–2.1 mg/100g, Adepoju, 2007). Because it is abundant in macrominerals, it can also be used to make baby food and instant flours for convalescence, as these human groups need high mineral levels for growth and healing.

CONCLUSION

The plantain wastes can be used as raw materials or as ingredients in animal feed because they were high in ash, crude fiber, and carbs. If accessible, the leaf and bract samples' high crude protein content could be used as a source of protein for animal feed. The wastes can be a good supply of calcium, phosphorus, and iron because of their high concentrations. Plantain wastes have the potential to be excellent sources of nutrients for animal feed production, and their use for this reason should be promoted as it will also lessen the environmental threat posed by plantain waste.

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