



Journal of **Plant Sciences**

ISSN 1816-4951



Academic
Journals Inc.

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Comparative Study on the Nutritional Values of FHIA-21 (Tetraploid Hybrid) and Apem (Triploid French Plantain) in Ghana

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Abstract: The nutritional composition of the green stages of fruits of a FHIA hybrid (FHIA-21) and local Apem were determined in Ghana. Fresh fruits were harvested from the plantain orchard of the Crops Research Institute in Kumasi, Ghana. The standard AOAC methods were used to determine the moisture, crude protein, ash, crude fibre, potassium, iron, calcium, carbohydrate, sodium and crude fat. Pulp colour was measured with a Chromatometer (Minolta). The results showed that the nutritional composition of the hybrids were similar to that of the local Apem. The hybrids however had higher fat content (1.94%) than the local (0.22%). Apem had lower water content (53%) than the hybrids (60%). The hybrids were slightly soft due to the high moisture content. The potassium content was also higher in the hybrids (1060 mg/100 g dry weight) than the local (760 mg/100 g dry weight). The local on the other hand contain more iron (1.06 mg/100 g dry weight) than the hybrids (0.45%/100 g dry weight). The peel and pulp colours of the hybrids and the local were similar. FHIA-21 and Apem all had bright orange pulp colour which was indicative of the presence of provitamins and carotenoids. The high potassium level in the hybrid may be an advantage over the local for use as a therapy. FHIA-21 could be described as a high energy yielding carbohydrate compared to Apem.

Key words: Plantain, FHIA-21, apem, nutritional value, musa

Introduction

Banana, cooking banana and plantain (*Musa* spp. AAA, AAB and ABB groups) are major starchy staples of considerable importance in the tropics. They are consumed both as energy-yielding food and as dessert, providing more than 200 calories (food energy) a day (Stover and Simmonds, 1987). Plantains are known to be a great source of calcium, vitamins A, B1, B2, B3, B6, C and minerals such as potassium and phosphorous.

Ripe mashed banana is an excellent food for babies after the six month exclusive breast feeding. This advantage is due to the easy digestibility and the mineral and vitamin content. For elderly people, the fruit can be consumed in large quantities without being fattening or causing digestive disturbances (<http://www.turbana.com/index.htm>, Accessed August 14, 2003).

Plantain is known to be low in sodium (Chandler, 1995). It contains very little fat and no cholesterol; therefore it is useful in managing patients with high blood pressure and heart disease. They are free from substances that give rise to uric acid therefore, they are ideal for patients with gout or arthritis. Due to the low sodium and protein content, plantain is used in special diets for kidney disease sufferers. The capacity of the plantain to neutralize free hydrochloric acid suggests its use in peptic ulcer therapy (<http://www.turbana.com/index.htm>, Accessed August 14, 2003).

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A fully ripe plantain mixed with milk powder is especially recommended for ulcer patients. For patients with gastritis and gastro-enteritis, banana is one of the first foods to be introduced after nausea and vomiting are brought under control. The low lipid/high palatability combination is ideal for the diet of obese people (<http://www.turbana.com/index.htm>, Accessed August 14, 2003). The plantain plant has also some medical properties. The leaves can be pounded and applied to the wound to suppress bleeding.

They are also very important sources of rural income (Ortiz and Vuylsteke, 1996). They are attractive to farmers due to their low labour requirement for production compared with cassava, maize, rice and yam (Marriott and Lancaster, 1983).

In Ghana, plantain contributes about 13.1% of the Agricultural Gross Domestic Product (AGDP) and its per capita annual consumption of 96.4 kg per head (Lescot, 2000) is higher than other starchy staples except cassava. It is of great socio-economic and nutritional significance and generates considerable employment. Annual production in the country is about 1.8 metric tonnes for plantain (AAB subgroup) of which only 0.5 tonnes is exported (Lescot, 1999) and 7.9 metric tonnes for banana of which 3.4 metric tonnes is exported (Lescot, 2000).

Despite the high value of plantain and banana, growing pest and disease pressures have affected production, the most notable being the fungal disease Black Sigatoka (*Mycosphaerella fijiensis*) (IITA, 1992; Stover and Simmonds, 1987; Swennen, 1990). Yield losses due to the disease are highly significant ranging from 20 to 50%. Under very severe conditions yield losses may be as high as 80% (Hemeng and Banful, 1994). Unfortunately all the landraces in Ghana are susceptible to the Black Sigatoka disease. In view of this, new hybrids were introduced in 1994 to supplement the landraces. The tetraploid hybrids are high yielding and disease tolerant, however their nutritional composition was not determined. It was therefore necessary to evaluate the hybrids alongside the landraces. This study was to compare the nutritional composition of the hybrid with a local land race.

Materials and Methods

Fruits were harvested from the plantain orchard of the Crops Research Institute in Kumasi, Ghana in 2004. Harvesting was done at physiologically matured stages of the fruits and taken to the laboratory for analysis.

Physiochemical Analysis

Moisture, crude fat, ash, crude protein and crude fibre contents were determined on Official Methods of Analysis (AOAC, 1990). All the minerals (i.e. Sodium, Potassium, Iron, Phosphorus and calcium) were determined using atomic absorption spectrophotometer after acid digestion of the sample.

Colour Determination

The pulps were sliced into thin slices of 5 mm thickness and placed on a petri dish. The colour was determined using the Chromameter (Model Cr-200 Minolta Camera Co. Ltd, Japan) on the L*, a* and b* scale colour notation. The sensor of the Chromameter was placed on the sliced pulp and the colour measured at three randomly selected positions and the mean calculated. The Chromameter was calibrated using a standard white tile [L* = 100.01; a* = -0.01; b* = -0.02]. The "L" coordinate is a measure of lightness (white-black and ranges from no reflection L = 0 to perfect diffuse reflection L = 100), the "a" scale ranges from negative value for green to positive values for red and the "b" scale ranges from negative values for blue to positive values for yellow.

Results and Discussion

The nutritional values of FHIA-21 (hybrid plantain) and Apem (French plantain) plantain were compared (Table 1). Moisture level was appreciably high in FHIA-21 (60%) compared to Apem (53.1%). This could be attributed to the banana characteristic in the FHIA 21 hybrid. This shows that Apem had higher dry matter than the tetraploid. Water content is known to have influence on general energy and nutrient density. The low water content in plantain is reported to have an influence on general energy and nutrient density (Gowen, 1995). The low water content has greater energy content. The high pulp to peel ratio in all cultivars (1.23 for Apem and 1.36 for FHIA-21) indicated that there was more edible portion per unit weight. In FHIA-03, Cuerno, Bluggoe cultivars, pulp to peel ratios of 0.98, 1.70 and 1.33, respectively were observed (Dadzie, 1993). However the thin peels of the cultivars could predispose the fruits to mechanical damage. Their transportation over long distances would require care especially in Ghana where the roads are not very good.

Fat content was higher in the hybrid (1.94%) compared to Apem (local cultivar) 0.22%. This could be an added advantage of the hybrid over the local Apem. There was no difference in the ash contents of FHIA-21 and Apem. The ash contents were 1.02 and 1.0%, respectively. Iron level was lower in the hybrid compared to the local plantain. However, potassium was higher in the hybrid plantain and lowest in the local Apem. It is reported that plantains are rich in vitamin B6 and the combination of the vitamin B6 and potassium makes it nature's brain food, since these two substances are essential for proper brain function (<http://www.turbana.com/index.htm>, Accessed August 14, 2003). The sodium levels are low while potassium levels are high; however, the high potassium provides a protective effect against excessive sodium intake (Meneely and Batterbee, 1976). The high potassium level in the hybrid may be an added advantage of the hybrid over the local for use as a therapy. As regards iron, plantain is poor source (0.5 mg/100 g) however, unlike other foods; the iron provided by plantain is 100% utilizable by human body.

Calcium and phosphorous on the other hand are vital for bone. The calcium contain was slightly higher in Apem compared to FHIA 21. The soft nature of the hybrid makes it easy to cook and for mastication when prepared as slice compared to the local (Dzomeku *et al.*, 2004).

The results of the study showed that the nutritional composition of the hybrid related very well with the findings of Chandler (1995). FHIA-21 could be described as a high energy yielding carbohydrate compared to Apem. The fat content of the hybrid was higher than that of the local Apem signifying higher calorific value. The nutritional composition of the hybrid matches that of the local. The hybrid could be recommended as a good starchy staple for consumers of plantain.

Table 1: Nutritional composition of Apem and FHIA 21 (Composition (per 100 g dry weights))

Parameter	Variety	
	Apem	FHIA 21
Moisture (%)	53.10±0.02	60.62±0.49
Fat (%)	0.22±0.06	1.94±0.55
Ash (%)	1.00±0.03	1.02±0.14
Crude fibre (%)	1.04±0.04	1.02±0.05
Crude protein (%)	2.19±0.05	2.08±0.03
Carbohydrate (%)	42.50±0.05	41.52±0.03
Pulp to peel ratio	1.23±0.04	1.36±0.06
Potassium (mg)	760.00±0.02	1060.00±0.002
Calcium (mg)	13.20±0.02	11.20±0.01
Iron (mg)	1.06±0.03	0.45±0.05
Sodium (mg)	45.30±0.04	49.50±0.02

Table 2: Peel and pulp colour of FHIA-21 (hybrid) and Apem (local French plantain)

Peel colour	Apem	FHIA-21
L	54.3±0.21	63.9±0.15
a*	-18.4±0.15	-17.4±0.16
b*	38.2±0.27	35.6±0.24
Pulp colour		
L	103.7±0.06	100.36±0.21
a*	0.09±0.00	0.11±0.00
b*	23.0±0.03	27.0±0.01

The peel and pulp colour of banana, cooking banana and plantain were assessed as they serve as major criteria used by consumers, growers and research workers to determine whether a fruit is ripe or unripe. In Ghana, most consumers tend to associate the colour of the pulp to maturity. If the colour of the pulp of plantains were orange/yellow or light orange then the fruit was matured, if on the other hand it was white it indicates that the fruit was immature. In general all the cultivars studied had green peel colour (at matured unripe stage) as indicated by the “L”, “a”, “b” values (Table 2). Like plantains the pulp colour of FHIA-21 was light or bright orange comparable to the pulp colour of triploid French plantain (Table 2). The orange colour of the pulp is an indicative of the rich provitamins and carotenoids (Gowen, 1995). The results for the peel and pulp colours of the cultivars studied were similar to the results of (Dadzie, 1993). There was no difference between the peel and pulp colour of the hybrids and the landrace.

Conclusions

The study has revealed that FHIA-21 was high energy yielding carbohydrate compared to Apem. The fat content of the hybrid was higher than that of the local Apem signifying higher calorific value. The nutritional composition of the hybrid matches that of the local. However the hybrid was softer than Apem. This could be attributed to the genetic make-up of the hybrid, which is cross between plantain and banana.

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