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EVALUATION OF BUNCH CHARACTERISTICS AND FLOUR YIELD POTENTIAL IN BLACK SIGATOKA RESISTANT PLANTAIN AND BANANA HYBRIDS

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ABSTRACT

Post harvest evaluation is an important criterion in the screening of plantain and banana hybrids. Processing is a means of adding value to fruits, while extending shelf life and facilitating transportation. This study aimed at determining genetic differences among p' ntain and banana hybrids for flour yield to facilitate adoption and industrialisation. Eleven *Musa* hybrids, with resistance to black Sigatoka disease were used in this study. Flour was obtained by milling dried pulps, and flour yield was expressed as percentage of the bunch weight. Significant differences in flour yield were observed across the genotypes. Among the hybrids, highest flour yield (16.5%) was obtained in 548-9, while 25273-1 had the lowest (10.3%). Flour yield did not differ significantly ($p>0.05$) between Obono l'Ewai (18.5%) and two of the hybrids, 548-9 (16.5%) and 25502-S4 (16.4%). However, there was a significant difference ($p<0.05$) in flour yield between Obino l'Ewai and all other hybrids. Clone 548-9 differed significantly ($p<0.05$) from 25291-S41, 25273-1 and SH 3362 in flour yield. The moisture content of the flour was averaged 8%. This study revealed that there is a potential for adoption of black Sigatoka resistant *Musa* hybrids based on high yield at harvest and flour yield potential. Plantain and banana hybrids may therefore constitute important source of flour for baking industry.

KEYWORDS: Hybrids, Black Sigatoka resistant, adoption, flour yield, utilisation.

INTRODUCTION

Plantain and banana (*Musa* spp.) are major staple food throughout the tropics and are used for many delicacies. They are high yielding crops, which form an integral component of the farming systems in tropical Africa (Wilson, 1983; Swennen, 1990b). The overriding constraints to plantain and banana production are decreasing soil fertility, yield decline syndrome, pest (weevils and nematodes), and most importantly, the widespread leaf spot disease called black Sigatoka (IITA, 1992; Stover and Simmonds, 1987). The International Institute of Tropical Agriculture (IITA) has bred many cultivars of *Musa* hybrids, which combine high yield with disease resistance. Tetraploid plantain hybrids produce heavier bunches than their parents (Vuylsteke *et al.* 1997). However, the introgression of genes of bananas may alter fruit quality characteristics in the hybrids, which may in turn affect consumers' acceptability and processing qualities.

Plantain and banana, like most agricultural crops, are perishable in nature. Their shelf life is often reduced as a result of poor handling during harvesting and transportation (Chukwu, 1996). Consequently, the market value of harvested fruits decreases rapidly from the time of harvest to the time of marketing and utilisation. Rahman (1963) and Edelmiro *et al.* (1977) investigated an economical method for the production of flour from entire plantains, including the peel, and preparation of green banana flour, respectively. Processing of fresh fruits into flour that has high starch content (Crowther, 1979) could provide raw materials for the preparation of s veral dishes. Flour is an important raw material in the baking industry. It has a longer shelf life because of reduced moisture content, and it is a means of adding value to plantain and banana fruits. Commercial production of plantain flour is required to meet the industrial need (Ogazi and Jones, 1982). In most developing countries, green plantains and cooking banana are consumed as a major part of the meal. The predominant methods of preparation include boiling, roasting, and frying, while in West Africa, banana beverage is a common delicacy. The diversity of culinary methods of *Musa* fruit processing depends largely on the texture and composition of the fruit (Dadzie, 1995). The objective of this study was to determine whether genetic differences exist among the new *Musa* hybrids for flour yield, and to provide information for increased utilisation of plantain and banana flour in the baking industry.

MATERIALS AND METHODS

Eleven *Musa* genotypes consisting of plantain and banana hybrids and landraces with proven agronomic qualities were used for this study. These included 548-9, 1658-4, 7152-2, 7152 OP 15, 25273-1, 25291-S41, 25502-S4, A5-SPS 548-9, SH 3362, and two African plantain landraces, Agbagba and Onino l"Ewai. Bunches were harvested at matured (green) stage and weighed. Flour was produced from bunches using the method described by Adeniji (1998). Bunches were first de-handed and individual fruits de-fingered from the hands into a bowl containing water. Fruits were washed to remove dirt and chemical residue and latex, which exuded from the cut surface of the crown. The fruits were peeled manually with the aid of stainless kitchen knife and kept in a bowl containing water, and they were allowed to remain in water until the peeling process is complete. The pulps were sliced longitudinally to about 15 mm thickness to enhance dehydration. Sliced fruits were dried in Forced-Air Sanyo Gallenkamp Moisture Extraction Oven at 60°C for about 48 hours. Milling was carried out using a Retch Muhle, 2850 RPM Hammer Mill. The moisture content of the flour was determined using the procedures described by AOAC (1990). Data analysis was performed using a Statistical Analysis Systems, SAS (1996).

RESULTS AND DISCUSSION

Flour was produced from a selection of *Musa* hybrids, using green unripe fruits, where almost all the carbohydrate is in the form of starch. Processing yields are presented in Table 1, with Obino l"Ewai having the highest flour yield. Significant differences ($p<0.05$) in flour yield were observed between Obino l"Ewai and all the hybrids, except 548-9 (16.5%) and 25502-S4 (16.4%). Hybrid 548-9 is a progeny of Obino l'Ewai, suggesting that higher flour yield in this hybrid could be

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attributed to heterosis and partly as a result of black Sigatoka resistance trait in the hybrid. The average moisture content of the flour was 8%. This is in consonance with the report of Rahman (1963) and Crowther (1979). Edelmiro *et al.* (1977) and Ogazi and Jones (1990) reported that 10% moisture c ntent in flour is ideal for good keeping quality. Rahman (1963), Edelmiro *et al.* (1977) and Crowther (1979) had earlier reported higher percentage flour yields in *Musa* species, using different drying equipment and techniques. Flour yield is a function of pulp to peel ratio, and aggregate fruit weight, among other factors. The pulp to peel ratios for 25273-1, 7152-2, and 25291-S41 are much lower compared to other genotypes. Pulp to peel ratios in 548-9 was significantly different ($p<0.05$) from some of the other genotypes, and this may have contributed to higher flour yield in this genotype. Expectedly, a high positive correlation ($p<0.1$) was found between bunch weight and flour weight, and also between the aggregate fruit weight and flour weight. Pulp weight also had a high correlation ($p<0.1$) with flour weight.

Processing of improved *Musa* hybrids into flour could provide a substitute to some of the imported farinaceous products being consumed in Nigeria. This may contribute to marketing stability and encourage the farmers to increase the production of plantain and banana flour. Rahman (1963) reported that plantain and banana flours are produced in commercial quantities in many countries of the world, especially in Brazil. T..ese flours are known and used for many centuries in the tropical plantain producing areas of the world.

The demand for bakery products in Nigeria is increasing (Ogazi and Vaidya, 1983). Most of these products are made from imported wheat flour, but Ogazi (1996) found that plantain flour could be substituted for wheat flour to produce good quality bread, cake and biscuit. Adeniji and Empere (2001) reported on the preparation of cake using 100% cooking banana (Cardaba and Bluggoe) flour, and the cake was acceptable to consumers. Ogazi (1991) conducted a study on the profitability of plantain flour production, where the top of the range of returns was estimated at 64%. The current price of wheat flour in a local market in Port Harcourt, Nigeria is ₦3,000 per 50kg (i.e. ₦60 per kg). This is against ₦400 to ₦500 per kg of plantain flour in the same market. Despite this sharp difference in price, it is interesting to note that there is high demand for plantain flour, particularly among diabetic patients and the obese people. Plantain has a low glycaemic index, which enables for gradual release of sugar into the blood, thereby preventing sharp accumulation in the blood stream (Davidson *et al.* (1975). The carbohydrate in plantain and banana is easily digestible. In this study, most of the hybrids investigated had a higher percentage of flour yield compared to traditional plantains. This advantage should be fully harnessed through the conversion of green plantains, especially wind-damaged plants, and rejected fruit to flour for traditional dishes and for the baking.

CONCLUSION

Processing of new *Musa* hybrids to determine whether genetic differences exist in flour yield and to enhance the utilisation of plantain and banana was investigated. This study demonstrated that new *Musa* hybrids could be substituted for or complement to plantain landraces in flour production. Although the shelf life of the resultant flour was not carried out in this study, the average moisture content of the flour could justify good keeping quality. Flour from new *Musa* hybrids could constitute suitable raw material for the baking industry. Improved cultivation of new plantain and banana is therefore recommended to provide adequate raw material for the baking industry, and as a means of foreign exchange earning for Nigeria.

Table 1: Flour yield potential for a selection of *Musa* clones

Genotype	Bunch Traits (kg plant^{-1})[a]								
	Bwt	Afwt	Pedwt	Pewt	Puwt	Pu:Pe	PuDwt	Flowt	Floyld (%)
Plantain Hybrid									
548-9	12.7	11.8	0.7	5.1	6.9	1.3	2.2	2.1	16.5
1658-4	10.6	9.8	0.7	4.52	5.2	1.1	1.7	1.7	16.0
7152-2	9.8	8.8	1.4	4.6	4.2	0.9	1.4	1.4	14.3
7152-2-OP15	7.0	6.0	0.9	2.0	3.0	1.5	1.0	1.0	14.3
25273-1	5.8	4.8	1.1	2.6	2.2	2.0	0.6	0.6	10.3
25291-S41	7.7	6.8	0.9	3.6	3.4	0.9	1.0	1.0	12.9
25502-S4	14.6	12.4	2.4	5.4	7.0	1.3	2.4	2.4	16.4
A5-SPS 548-9	7.7	6.7	1.0	3.4	3.5	1.0	1.1	1.1	14.3
Banana Hybrid									
SH 3362	11.4	10.2	1.15	4.3	6.2	1.4	1.3	1.3	11.4
Plantain Landrace									
Obino l'Ewai	8.1	7.5	0.52	3.2	4.2	1.3	1.6	1.5	18.5
Agbagba	5.8	5.0	0.53	2.3	2.9	1.3	1.0	1.0	17.2
LSD(0.05)	**4.35**	**4.23**	**0.31**	**1.87**	**2.51**	**0.23**	**0.81**	**0.77**	**2.28**

[a]Bwt = Bunch weight (Kg), Afwt = Aggregate fruit weight (Kg), Pedwt = Peduncle weight (Kg), Pewt = Peel weight (Kg), Puwt = Pulp weight (Kg), Pu:Pe = Pulp to peel ratios (Dimensionless quantity), PuDwt = Pulp dry weight (Kg), Flowt = Flour weight (Kg), Floyld = Flour yield (% of bunch weight).

Table 2: Correlation among bunch traits in relation to flour yield in *Musa* spp. fruit

	Bunch Traits[a]					
	Bwt	Afwt	Pedwt	Pewt	Puwt	Flowt
Bwt	0.9933***		0.5073**	0.9593***	0.9758***	0.9401***
Afwt			0.4255*	0.9624***	0.9833***	0.9468***
Pedwt				0.4651**	0.3682*	0.3494*
Pewt					0.9151***	0.8921***
Puwt						0.9422***
Flowt						

[a]Bwt = Bunch weight (Kg), Afwt = Aggregate fruit weight (Kg), Pedwt = Peduncle weight (Kg), Pewt = Peel weight (Kg), Puwt = Pulp weight (Kg), Pu:Pe = Pulp to peel ratios (Dimensionless quantity), PuDwt = Pulp dry weight (Kg), Flowt = Flour weight (Kg).
*, ** and *** indicate that correlation coefficients are significantly different at the 5%, 1% and 0.1% probability levels, respectively.

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