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VALIDATING CULTURAL, AGRO-ECOLOGICAL, POST-HARVEST AND AGRO-PROCESSING TECHNOLOGIES FOR MAKING DASHEEN (*COLOCASIA ESCULENTA* (L.) SCHOTT VAR. *ESCULENTA*) CHIPS IN DOMINICA.

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ABSTRACT: Dasheen (*Colocasia esculenta* (L.) Schott var. *esculenta*) is an important staple and export crop in Dominica and other Caribbean Countries. Though CARDI's research has expanded the fresh produce trade from within the Caribbean to markets in the United States and Europe, dasheen is slowly loosing appeal in its fresh form. Rice and other similar commodities which are easy to store and prepare, are becoming more attractive purchases. In addition, dasheen as perishable is coming under increasing export pressure due to stringent international trade regulations. Preparation can also be difficult because of peeling and scratching allergies. The dasheen industry is therefore forced to diversify its product portfolio, in order to expand production and increase farmer earnings. In so doing the industry has decided to move away from the holistic risk and uncertainty of fresh produce market. Value added products (dasheen chips) provide a suitable alternative. Dasheen chip production was however constrained by acridity problems and despite workshops on post-harvest treatments and agro-processing aspects of dasheen, sustainable production of the highly nutritional dasheen chip remains constrained, by a lack of understanding as to how cultivars, agro-ecological zones and time of harvest affect corm acridity. Experiments addressing the above, examined corm acridity, of the "Common", "White" and "Purple" cultivars, when harvested between four and nine months. Corms were produced in Grand Bay (mean annual rainfall 2400mm) on soils characterized as plastic sticky clay loams without a silica pan, and in Wet Area (mean annual rainfall 5300mm) on soils characterized as sandy clay loams. Results showed that, when harvesting in Grand Bay for processing into dasheen chips, the "Common" and "Pink" dasheen should be harvested in seven months and the "White" dasheen in eight months. In Wet Area, the "Common", "White" and "Pink" dasheen can all be harvested in eight months].

Key words: *Colocasia esculenta* (L.) Schott var. esculenta; cultivars, time to harvest, ecological zones, acridity.

INTRODUCTION

Though CARDI's research programmes have expanded the dasheen fresh produce trade during the 1990's (CARDI Dominica Annual Reports 1990, 1993, 1999, 2001, 2003), production, exports and revenues earned have stabilized over the past 5 to 10 years (Dominica Export Import Agency, 2001). This may be due to dasheen loosing its appeal as a fresh commodity, as storage and preparation (peeling and scratching allergies), make rice and noodles, easy to store and prepare imported staples, a more attractive purchase. Influences such as technology, improved communications including television and international travel, have made significant impact on

food choices causing local foods to be displaced by fast foods. The stakeholders in the dasheen production and marketing systems recognize that diversifying the product portfolio, improving the commodity appeal, and directing the industry towards the microwave and e-commerce society, thus moving away from the holistic risk and uncertainties of fresh produce export market, which are now further complicated by the rigorous hemispheric trade regulations, is an important step to boost production and increase farmer earnings.

The industry must therefore move towards "value added products" in order to remove the post-harvest and preparation issues stated above. One of the areas which can be exploited is the processing of dasheen into chips.

Dasheen chips were manufactured by La Robe Creole Plantation Ltd. and Bannis Farms in the 1990's. La Robe Creole Plantation Ltd. used the "common" dasheen, at different stages of maturity. However complaints of acridity (itching) caused by calcium oxalate crystals which form insoluble needles or raphides, that puncture the skin causing irritation either singly or in combination with a proteolytic enzyme (Bradbury and Nixon, 1998) persisted and production was stopped. *Bannis Farms* selected the "purple" petiole dasheen and then blanched the peeled corm before deep-frying. Bannis Farms were partially successful in eradicating the acridity problem. Bannis Farms indicated that they were unable to standardize the process and that could have been the cause for the acridity still being present. Bannis Farms also indicated that the "Purple" petiole cultivar was not in abundance, when compared to the "common" and "white" dasheen and that they would be interested in trying the other cultivars using the same process. When the both processors were asked, if they had considered the possible effects that the different cultivars, corm age and origin, could have on acridity, they indicated that they had not.

The IICA workshop held in October 2002 introduced and demonstrated to agro-processors and farmers new technologies for processing dasheen into chips. When validated, the agro-processors found the process long and tedious, and acridity was still not eradicated. Discussions were subsequently held between the agro-processors and CARDI in an attempt to review the process of converting dasheen into chips. It was felt that since little could be done to the industrial process at the time, a detailed examination of the raw material going into the process would be beneficial.

Since dasheen acridity is known to be affected by cultivar (Afoakwa et al., 2003, Bayer, 2003) and may also be affected by other factors such as corm age and agro-ecological zones from which the corms originate (Robin, 1993; IICA, 2002; Sandra Timothy, personal communication) and information on the local cultivars was unknown, priority was given to examination of the above in collaboration with the agro-processors.

MATERIALS and METHODS

The experiment was conducted on the Grand Bay Agricultural Station and on a farm in Penrice. The Penrice area is characterized as having deep allophanic clay soils. These soils can be water logged and drainage may be limited by a hardpan. Average annual rainfall is about 5000 to 6000 mm and mean annual temperature is approximately 20°C. Altitude is approximately 900m (Lang, 1967; Barker 1981). The Grand Bay Agricultural Station has young soils, which are characterized as having a plastic, sticky clay without a silica pan. Average annual rainfall is about 2,400 mm, with a marked dry season from January to April. Mean annual temperature is approximately 27°C. Altitude is approximately 235m (Lang, 1967; Barker 1981). The area has been under continuous cultivation.

The experiment was a 3 {Common (C), White (W) and Purple petiole (P) dasheen} **x** 5 {five harvest dates 4, 5, 6, 7 and 8 months)} factorial design; the treatment combinations were as follows: C4, C5, C6, C7 and C8; W4, W5, W6, W7 and W8; P4, P5, P6, P7 and P8. The area was brushed to remove the heavy weed growth then sprayed with paraquat (2.5L per hectare). Holes spaced 60cm to 75cm apart, 15cm to 20cm wide and 20cmto 25cm deep were prepared with a fork. Planting materials used were collected from two different locations. The Common and White dasheen were obtained from Penrice and the Purple petiole from the Roseau Valley. All plants were cut to a petiole length of about 30cm and corms were cut back to about 5cm from where they joined the base of the petiole. The plants were then treated in a solution of bleach (100ml of bleach to 2.2L of water) for 15 minutes. Staggered monthly plantings began in August 2002 ended in December 2002. Manual weeding was carried out when necessary and fertilizer was applied at 2 and 8 weeks after planting at a rate of 57g per plant, in a circular band, approximately 15cm to 20cm away from the base of the petiole. Moulding was done after the second fertilizer application (Robin, 1993).
At harvest, a randomized sample of corms, of the various age ranges, was taken from each cultivar and delivered to both agro-processors.

Acridity testing

A scoring test using a Hedonic Scale was used. An example of the scoring sheet used for the test on the dasheen chips is shown below.

Assessors' name ..... (Optional) Date .....

Rating	Sample C5GL	W7PB	P6GB	C8GL	W5PB
	Acridity	Acridity	Acridity	Acridity	Acridity
Very Strong = 4					
Strong = 3					
Moderate = 2					
Slight = 1					
Absent = 0					

All samples were identified by code. The code CSGL (as seen on the questionnaire), indicated the common dasheen (C), harvest at five (5) months, grown in Grand Bay (G) and processed by La Robe Creole Plantation Ltd (L). The samples were presented in a randomized layout. Samples were sized to enable the assessor to get the full taste.

The consumer panel of assessors comprised twenty randomly selected persons at whom the product would be targeted. Assessors worked in an area free from distractions, and were not allowed to interact with each other. They were supplied with drinking water to wash their mouths after tasting each sample.

RESULTS

Acridity analysis

Table 1 shows that corm age had no significant difference on chip acridity scores. However eight-month-old corms produced the least acrid chips.

Table 1. The effect of corm age on dasheen chip acridity.

Age (months)	Mean Score
4	1.286
5	1.389
6	1.389
7	1.156
8	1.072
d.f	218
S.E.D.	0.205
Fpr	0.147

Table 2 shows that, there were no significant differences between the chip acridity scores of the three cultivars. However the common produced the least acrid chips.

Table 2. Cultivar effects on dasheen chip acridity.

Dasheen (Cultivar)	Mean Score
Common	1.176
Pink	1.338
White	1.201
d.f	218
S.E.D.	0.1464
Fpr	0.594

Table 3 shows that, though not significant, chips manufactured from corms produced in Grand Bay were less acrid than those manufactured from corms produced in Penrice

Table 3. The effects of location on dasheen chip acridity.

Location	Mean Score
Grand Bay	1.147
Penrice	1.303
d.f	218
S.E.D.	0.131
Fpr	0.106

Table 4 shows that, the common dasheen, harvested at 4 (0.842) and 8 months (0.852) and white dasheen harvested at 7 months (0.850) produced the least acrid chips ($p<0.05$).

Table 4. The effect of corm age and cultivar interaction on dasheen chip acridity.

Age (months)	Dasheen cultivars		
	Common	Pink	White
4	0.842	1.463	1.424
5	1.723	1.449	1.079
6	1.299	1.207	1.650
7	1.166	1.434	0.850
8	0.852	1.282	1.007
d.f	218		
S.E.D.	0.349		
Fpr age Cultivar	0.034		

Table 5 shows that, there were no significant differences between chip acridity scores due to location and corm age interaction. However 7 and 8 old corms from Grand Bay and 8 months old corms from Penrice produced the least acrid chips.

Table 5. The effects of corm age and location interaction on dasheen chip acridity.

Age (months)	Location	
	Grand Bay	Penrice
4	1.156	1.359
5	1.291	1.445
6	1.163	1.515
7	1.074	1.202
8	1.085	1.064
d.f	218	
S.E.D.	0.291	
Fpr Age.Location	0.779	

Chip acridity score shown in Table 6, for cultivar and location interactions, shows that in Grand Bay corms of the white dasheen produced the least acrid chips, whereas in Penrice corms of the common dasheen produced the least acrid chips.

Table 6. The effect of cultivar and location interactions on dasheen chip acridity.

Age (months)	Location	
	Grand Bay	Penrice
Common	1.291	1.112
Pink	1.129	1.456
White	1.061	1.280
d.f	218	
S.E.D.	0.221	
Fpr Cultivar.Location	0.268	

Table 7 shows that there were no significant differences between dasheen chip acridity scores obtained for interactions between corm age, cultivar and location. However, in Grand Bay and Penrice, the white dasheen harvested at 5 months and the common dasheen harvested at 8 months, produced the least acrid chips.

Table 7. The effects of corm age, cultivar and location interactions, on dasheen chip acridity.

Age (months)	Dasheen	Mean Score	
		Grand Bay	Penrice
4	Common	1.161	0.663
	Pink	1.072	1.682
	White	1.242	1.526
5	Common	1.733	1.717
	Pink	1.614	1.357
	White	0.618	1.338
Age (months)	Dasheen	Mean Score	
6	Common	1.256	1.324
	Pink	0.768	1.454
	White	1.519	1.723
7	Common	1.049	1.232
	Pink	1.154	1.591
	White	1.006	0.762
8	Common	1.248	0.630
	Pink	1.160	1.350
	White	0.884	1.077
d.f		218	
S.E.D.		0.502	
Fpr Age.Location		0.654	

Though not significant, Table 8 shows that chips produced using the La Robe Creole method were the least acrid.

Table 8. The effects of the different agro-processes on dasheen chip acridity.

Process	Mean Score	S.E.M	d.f	FPr
La Robe Creole	1.113	0.100	247	0.14
Bannis	1.317	0.94		

DISCUSSIONS AND RECOMMENDATIONS

Overall 8-month-old corms produced the least acrid chips, so the agro-processors will have to indicate to producers, where cultivars are unknown, that 8-month-old corms are best for processing. Where cultivars can be identified, the Common dasheen should be harvested at 8 months, the pink at 8 months and the white at 7 months.

If the farmer grows the corm in a particular location such as Grand Bay (lower rainfall area), he should advise that in Grand Bay and locations with similar AEZ's, the Common and Purple dasheen should be harvested in 7 months and the White in 8 months. For Penrice and locations with similar AEZ's , the Common, White and Pink dasheen can all be harvested in eight months.

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