Discovery of three genotypes of *Dioscorea trifida* grown in Venezuelan Amazons, with quite low-amylose Starch: I. Physical attributes and proximate composition of the tubers and characterization of its waxy starches.

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INTRODUCTION

Yam *Dioscorea trifida*, is an economical and cultural important crop for indigenous from Amazon region of South America. These crops could be a potential supply of starch that would be good source for different industries. Although several studies, including starches physicochemical and functional properties, have been reported of yam crops, such as *D. alata, D. cayenensis, D. esculenta D. rotundata;* information pertaining to the starch of *D.trifida* would appear to be less-readily available. Moreover, is very little known about their composition and its starch type. Indeed, the total amylose content of different genotypes of the genus *Dioscorea* being reported in literature by different researchers (Farhat et al.1999 and Gebre–Mariam and Schmidt, 1998 cited by Moorthy, 2002) varies from 13.0 to 29.7 %. Some reports (Bou Rached et al., 2006) indicates an amylose content of 34.72 and 43.33 % and for starches isolated from white and purple *Dioscorea* trifida genotypes respectively, however, non literature reports have been pointed out for *Dioscorea* trifida waxy starch. From the two starchy components, the amylose content is often considered as one of the main factors controlling and contributing to the end product quality. This linear component of starch varies considerably among different starches and genetic modifications have been carried out to obtain amylose content varying from 0 to 75%. Consequently, in this study were characterized the physical attributes and proximate composition of the tubers, and were also isolated, purified and characterized the starches from three genotypes of *Dioscorea trifida,* cultured at the Amazons of Venezuela by the indigenous community "*Piaroa*".

MATERIALS AND METHODS

Materials

Two independent batches, at two time periods: (2005 and 2009), of three different *Dioscorea trifida* tubers **genotypes** (cv.) were gathered from crops of the "*Piaroa*" community of Puerto Ayacucho, edo. Amazonas, Venezuela.

Sample preparation:

Fresh root samples: Tubers were cleaned and rinsed with a large amount of tap water, and manually dried for later morphological description, and starch isolation. The moisture content of the cleaned and peeled edible portion was immediately evaluated, the rest of the fresh peeled root samples were frozen to later composition analysis.

Starch isolation: Starches of *Dioscorea trifida* cultivars were obtained from three different batches of the tubers by using the method described by Perez, et al., 1993.

Methods

Fresh root samples

The tubers were analyzed for their physical attributes: morphology, size and weight, color and external appearance, and the whole external and transversal section of the tubers were photographed . All of the three of tubers genotypes were also analyzed for their proximate composition (AACC; 2003). Dietary fiber [total (TDF), soluble (SDF) and insoluble (IDF)] (AOAC, 1990), Total carbohydrate was calculated on dry basis by subtracting the contents of protein, fat, fiber and ash from 100% basis. The mineral profile was also determined by using Atomic Absorption Spectrophotometer AOAC, 1990.

Starch isolated and purified

The starches were analyzed for moisture, ash, crude protein (N x 6.25) fatty material, and total sugar (AACC 2003 and Smith, 1967), in order to perform the degree of purity, also were determined the damage starch, density, pH, titrable acidity, color and morph metric characteristics (AACC, 2003, Smith, 1967, Perez, et al., 2003). The amylose content was evaluated by colorimetric and calorimetric methods (Mac Grance, 1998, and Mestres et al, 1996). The starches physicochemical properties ;such as, swelling power, solubility ,dispersed volume fraction, gelatinization profile by DSC, gel clarity and pasting properties by RVA (AACC; 2003).

RESULTADOS Y DISCUSION

There are noticeable differences in the morphology, whole external appearance of the three tubers, and also in the color, forms and sizes (Figure 1). Table 2, summarizes the proximate composition of the edible portion of the three tubers genotypes. The moisture content of the *Dioscorea trifida* genotypes varied from 69.39 ± 0.34 to a 75.28 ± 0.35 %, the protein content varied, being higher at the white genotype (6.79 % ± 0.02), than those found for the purple and black ones (4.72 % ± 0.05 and 4.87 % ± 0.54 8 respectively).

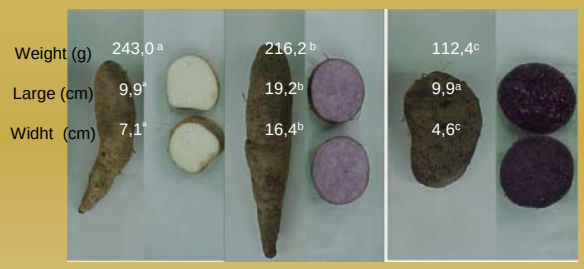

Figure 1. External and internal appearance and dimensions of the of three genotypes *Dioscorea trifida* Yams .

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Table 1. Proximate composition and mineral profile of three genotypes of *Dioscorea trifida yams*.

Parameters	White	Purple	Black
Moisture (%)	69.39 ± 0.34[a]	72.65 ± 0.04 [b]	75.28 ± 0.35 [c]
Crude protein (%)	6.79 ± 0.02[b]	4.72 ± 0.05[a]	4.87 ± 0.54[a]
Fatty material (%)	0.30 ± 0.02[b]	0.28 ± 0.11b[b]	0.03 ± 0.01[a]
Ash (%)	3.37 ± 0.22[b]	3.15 ± 0.03[b]	1.89 ± 0.13[a]
Total CHO (%)	89.54	91.58	93.21
Starch (%)	64 ± 0.12[b]	58 ± 0.03[a]	63 ± 0.03[b]
T. D.F. (%)	4.34± 0.00 [b]	3.44± 0.00[a]	12.65± 0.00 [c]
S.D.F (%)	0.39± 0.20 [a]	0.99± 05[b]	1.29± 0.40 [c]
I.D.F. (%)	3.95± 0.02[b]	2.45± 0.35[a]	11.36± 0.12[c]
Phosphorus (%)	0.10± 0.00 [c]	0.12± 0.00 [b]	0.05± 0.00[a]
Potassium (%)	1.19± 0.00 [b]	1.35± 0.00 [c]	0.83± 0.00[a]
Calcium (%)	0.04± 0.00 [b]	0.04± 0.00 [b]	0.04± 0.00 [b]
Magnesium (%)	0.05± 0.00 [b]	0.04± 0.00 [b]	0.05± 0.00 [b]
Cupper (ppm)	11.94± 0.00[c]	6.65± 0.00[a]	8.97± 0.00[b]
Zinc (ppm)	13,93± 0.00[b]	6.24± 0.00[a]	17.94± 0.00[c]

Results are means of three determinations. Means with different letters in the same column within the same genotypes differs significantly ($p < 0.05$).

As can be seen at Table 2, the purity degrees were quite high and the damage starch quite low, corroborating that the isolation method was simple, efficient and well performed. There are no statistical significant differences between the three starches, in regards to the acidity, pH and density. The starches isolated have a high white index. From the amylose contents data, can be for sure postulate, that the three genotypes are waxy starch. The clarity of the starch gels was very variable (from 22.4 to 62.7%). Also these waxy starches have substantially differences at the solubility and swelling power, when comparing them to non waxy starches from other genotypes. The starches from the three genotypes also exhibit a quite stable viscosity during the holding stage at 90 °C, a high breakdown, a similar consistency and a low setback upon cooling down.

Table 2. Properties of the waxy starches isolated from three genotypes of *Dioscorea trifida*.

Parameters		White	Purple	Black
Purity degree		99.78[a]	99.79[a]	99.79[a]
Amylose Content (%) Calorimetric		1,44 - 2,24	0,00 - 3,78	1,11 - 2,31
Amylose Content (%) Colorimetric		9.6±0.00[a]	12.7±0.00[c]	11.0±0.00[b]
Damage starch		2.95± 0.01[b]	0.41± 0.00[a]	0.41± 0.00[a]
pH		6.31± 0.11[a]	6.36± 0.03[a]	6.32 ± 0.12[a]
Titratable acidity (meqv/g)		$4x10^{-4}$±0.0[a]	$3x10^{-4}$±0.0[a]	$4x10^{-4}$±0.0[a]
Density (w/v)		1.49± 0.20[a]	1.38± 0.22[a]	1.46± 0.02[a]
Color	**L**	95.06	96.68	94.03
	a	1.11	0.57	1.52
	b	3.68	1.86	2.56
	White Index	93.73	96.15	93.32
DSC-Gelatinization profile	**Onset (°C)**	71.4-73.4	69.1-71.0	72.8-72.3
	End set(°C)	81.4- 83.6-	79.8-81.9	83.4-81.9
	ΔH (J g^{-1})	22.2-23.9	22.2-24.6	24.9-24.6
RVA-Pasting properties	**Pasting Temp. (°C)**	75.4-75.7	73.4-75.1	78.4-75.7
	Peak Viscosity	3,444 -4,102	3,869 -3,983	3,612-3,796
	Breakdown (cP)	2,013 -2,474	2,582 -2,376	1,680 -2,383
	Consistency cP)	98 -356	34 -367	172 -367
	Setback (cP)	-1,934 -- -2,375	-2,349 -- -2,342	-2,089 -- -2,311
Gel clarity		50.8-55.6	48.3-79.2	24.3-62.1

Results are means of three determinations. Means with different letters in the same column within the same genotypes differs significantly ($p < 0.05$).

CONCLUSION

Results reveal noticeable differences in the tuber morphology, whole external appearance of the genotypes, and also in the color, forms and sizes. Despite in literature there are not report for waxy *Dioscorea trifida* starch, the data reveal that these starches are waxy type with a high variability in its amylose content (varying from 0.0 to 3.78%).

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